May 20, 2019 - Subsea Wells Source Control Workshop Report

28 June 2019

As a preamble event to the Spillcon international oil spill conference held in Perth, Western Australia on May 20th 2019, Australia's National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and the Australian Petroleum Production and Exploration Association (APPEA) hosted a one-day workshop to assess the current state of the industry's subsea well Source Control Preparedness and Response planning efforts, specifically addressing the delivery and installation of a Capping Stack.

Subject matter experts from offshore oil and gas companies, product and service providers, and regulators from various international jurisdictions, presented a series of topics on the various aspects and necessary work planning to implement a subsea well source control response. The workshop was attended by delegates from all parts of the subsea well control industry to discuss global subsea well response equipment stockpiles, interface and connection variables, fluid dynamics modelling, logistics arrangements, regulatory requirements, and current best-practice in planning for a subsea well source control response.

Figure 1: NOPSEMA and APPEA hosting Subsea Well Source Control Workshop

The purpose of this report is to provide a synopsis of the information presented throughout the workshop and provide feedback to questions that were raised and recorded on the day.

In addition, incorporating and building on the outputs from the workshop, NOPSEMA is sponsoring the development of a Subsea Well Source Control Planning Tool in the form of a Response Time Model (RTM). This RTM will establish a globally consistent guideline for capping equipment delivery and installation by defining discrete and detailed tasks in a planning tool presented in a MS Project format. The use of the tool is intended to provide a common platform for identifying required tasks and estimating timeframes for implementing a Capping Stack deployment, which will assist in identifying where improvements in pre-incident planning can have positive affects to overall timeframes.

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1. Workshop Background and Agenda

NOPSEMA, APPEA and the International Offshore Production Regulators (IOPER) hosted the workshop during Spillcon. Held every three years, Spillcon is the Asia Pacific oil spill conference portion of the tri-conference circuit with the European Interspill and the American International Oil Spill conference (IOSC). Australia's key government and industry agencies, the Australian Institute of Petroleum (AIP), Australian Marine Oil Spill Centre (AMOSC), the Australian Maritime Safety Authority (AMSA) and NOPSEMA organized and sponsored the 2019 Spillcon event.

Building on a succession of global source control programs, this workshop focused on the preparedness activities that should be addressed to ensure an Operator is adequately prepared for a Loss of Well Control (LOWC) event. Preparedness involves having the right equipment and sufficient numbers of experienced and trained people available, as well as having a clear set of response plans in place that have been physically tested in practice drills and exercises.

It was one of the most well attended source control workshops with regards to the number of operators and regulators in attendance, creating a collaborative and cooperative atmosphere between governmental regulatory offices, well control specialists, oil spill and recovery specialists, and industry E&P organizations. The workshop was attended by 122 participants comprising:

- Drilling & Completions Managers and Engineers from multiple international operators,
- Emergency and Oil Spill Response professionals from several Oil Spill Response Organizations,
- International Well Containment Equipment suppliers and Well Control Specialist organizations,
- Global Source Control Consortium Coordinators,
- Multiple employees from various local, regional and international Offshore Oil & Gas Regulators,
- Industry Subject Matter Experts in the area of source control, and
- Representatives from the International Association of Oil & Gas Producers (IOGP), Source Control Sub-Committee.

The workshop began with a brief history of the steps the industry has taken in response to the 2009 Montara and the 2010 Deepwater Horizon/Macondo well control incidents. It described how the industry developed various equipment packages to provide an Operator with the tools to respond to a similar incident, how the industry organized and supported the formation of multiple emergency response consortiums for various world regions, and detailed the industry's continued focus on source control response issues leading to the recent release of the IOGP Report 594: Source Control Emergency Response Planning Guide for Subsea Wells; outlining the industry recommended content of a Source Control Emergency Response Plan (SCERP).

Ten speakers presented various topics during the day, highlighting:

- Developments in equipment and installation analysis tools,
- Pre-drilling preparedness tasks,
- The importance of obtaining and maintaining qualified personnel,
- The importance of preparing for an incident by establishing a specific management command centre site complete with office and accommodation space for the incident management team and support team, and
- The significant issue of timely logistics and deployment capability in vessel availability and air transport.

Several general questions were pre-prepared and presented during the day as the various speakers began and/or ended their presentations. Answers were collected via an online audience participation tool. Additionally, questions and comments relating to presentations topics were collated throughout the day to allow subject matter experts the opportunity to address these areas post-workshop as part of this report.

Questions raised for each speaker are addressed within each section of this report. Note that individual audience questions are recorded exactly as submitted anonymously to the specific presenter during the workshop - they were taken verbatim from delegates via the online recording tool Mentimeter. The answers are presented exactly as submitted by the specific presenter and have not been modified. There were some audience questions that were deemed as inappropriate and are not included. Please note also that the responses are from the presenter and do not necessarily represent the views of the workshop facilitators or any other workshop participant.

The workshop concluded with a panel session where attendees were given the opportunity to ask questions and conduct discussions. The panel members mainly consisted of the individual presenting speakers, representing total aggregate experience of over 265 years in various segments of the subsea and offshore oil & gas business sector.

Mitch Guinn, Sr. Subsea Advisor for Oil Spill Response, Ltd., collected the data resulting from the workshop and prepared this report jointly with Andrew Best, Environmental Specialist - Spill Risk for NOPSEMA. Mitch has over 30 years of experience in subsea drilling and completions, and was a part of the Macondo subsea team planning the intervention activities, writing the BOP intervention procedures and developing the initial design of the Capping Stack, and was involved in the designs of most of the Capping Stacks that followed after Macondo. Mitch is also listed on the patent for the ExxonMobil-sponsored Marine Well Containment Corporation (MWCC) and was involved in developing many of the equipment specifications. Andrew has over 20 years of experience in the oil and gas industry with focus on pollution control systems, emergency management systems, and incident and oil spill response. Mitch and Andrew will be subsequently developing the Subsea Well Source Control Planning Tool (RTM) with review and collaboration from several of the workshop participants and several operators to ensure alignment with the industry.

2. Workshop Report

2.1. Setting the Stage

Figure 2: Opening address

The workshop was opened by Wendy Kennedy, Chief Executive – Offshore Petroleum Regulator for Environment & Decommissioning (OPRED) and Chair of the International Petroleum Offshore Environmental Regulators (IOPER) – (shown seated above in Figure 2), welcoming all attendees, highlighting the future challenges of the oil and gas industry, and requesting open and straightforward communication and participation. Cameron Grebe, Head of Environment Division, National Offshore Petroleum Safety & Environmental Management Authority (NOPSEMA) – (shown standing above), then followed with remarks stressing the priority initiative regarding source control including preparation and actual response.

Brian Starkey, Chair of the APPEA Oil Spill Preparedness and Response Working Group, then emphasized the need for this workshop to include the cross-section of experienced industry professionals that were present and asked for continued collaboration between the attendees to ensure this event was fruitful.

A group of Subject Matter Experts (SMEs) were invited to present 10 sessions and to sit in a panel open for questions from and discussions with the workshop attendees. Robert Limb, CEO of Oil Spill Response, Ltd., moderated the workshop presentations and the ensuing panel discussion.

The speakers:

- Andy Myers - Oil Spill Response Limited, SWIS Engineering Manager
- Chris Carstens – IOGP Wells Expert Source Control Subcommittee, Chairman
- Brett Morry – Trendsetter Engineering, Global Technical Director
- Thomas Selbekk – Add Energy Group, Well Control and Blowout Support, Vice President
- Andy Cuthbert - Boots & Coots - Halliburton, Global Engineering and Technology Manager
- Guy Fox - Boots & Coots, Well Control & Prevention Services, Senior Product Manager
- Brett Phillips (in place of Luke Pirie) – Oceaneering, Technical Solutions Manager, Australasia
- Chris LeCompte – Wild Well Control, WellCONTAINED, General Manager
- Derrick O'Keefe (in place of Jeremy Dunster) – NOPSEMA, Head of Division – Safety & Integrity
- David Pulk - Global Trade and Transport Solutions Inc., Managing Director

Figure 3: Speakers (including Mitch Guinn, Workshop Report author) on Panel Session

3. Past, Present, Future

NOTE from Author and NOPSEMA: Please accept that the Workshop Report Author and NOPSEMA have diligently worked to the best of our ability to present the highlights of the speaker presentations without bias. Any omission or clarification is undertaken for the purpose of highlighting the most important aspects of each speaker's presentation and presenting factual information only.

3.1. SPEAKER 1 – Andy Myers – Industry Global Response Capability and Plans

Andy Myers presented an historical view of the steps the industry has taken since 2009/2010 and the two major well control incidents that occurred during that time – Montara & Deepwater Horizon/Macondo. Beginning with organizing to determine the causes of the incidents and investigate the means to prevent and/or respond to similar incidents in a more efficient manner, the major oil and gas operators at the time gathered forces and collaborated to design, build, store and maintain the equipment they felt would be required in the event of a similar incident anywhere in the world. Andy clearly stated three critical facts:

- No one response company can do it all,
- Operators have built and stored sufficient equipment to address the worldwide risks as they are understood today, and
- People and their skill sets are the most critical assets in responding to an incident.

There were several industry initiatives that originated post-Macondo/Montara - some to address specific national and geographical boundary issues. The US Gulf of Mexico (USGOM) became the focal point for the Marine Well Containment Corporation (MWCC) and the Helix Well Containment Group (HWCG) and are essentially limited to the USGOM. All offshore Operators have the capability to belong to more than one capping and containment organization and many choose to do so.

The following diagram shows the path the members of the International Oil & Gas Producers (IOGP) took to develop the ability to efficiently respond to an offshore well source control incident.

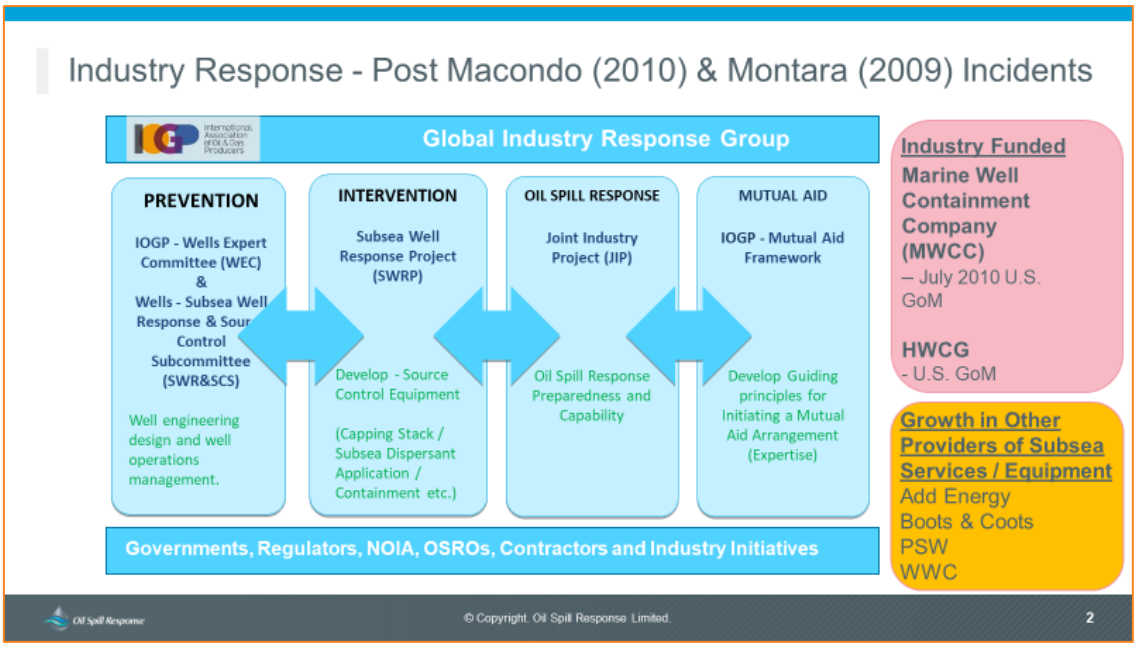


Figure 4: Global work-streams following Montara/Macondo incidents

The Global Industry Response Group (GIRG) established the Wells Expert Committee (WEC) which then formed the Subsea Well Response Project (SWRP). The Subsea Well Intervention Services (SWIS) group within Oil Spill Response, Ltd. (OSRL), was selected by the SWRP industry working group (Figure 4) to provide equipment for international use outside the USGOM. Operators joined the various response organizations based on the regions in which they were operating at the time.

Upon delivery of the required equipment systems, the industry then decided upon the worldwide storage locations intended to cover what they felt were the most active exploration areas at that time and the areas in which they expected future developments may occur.

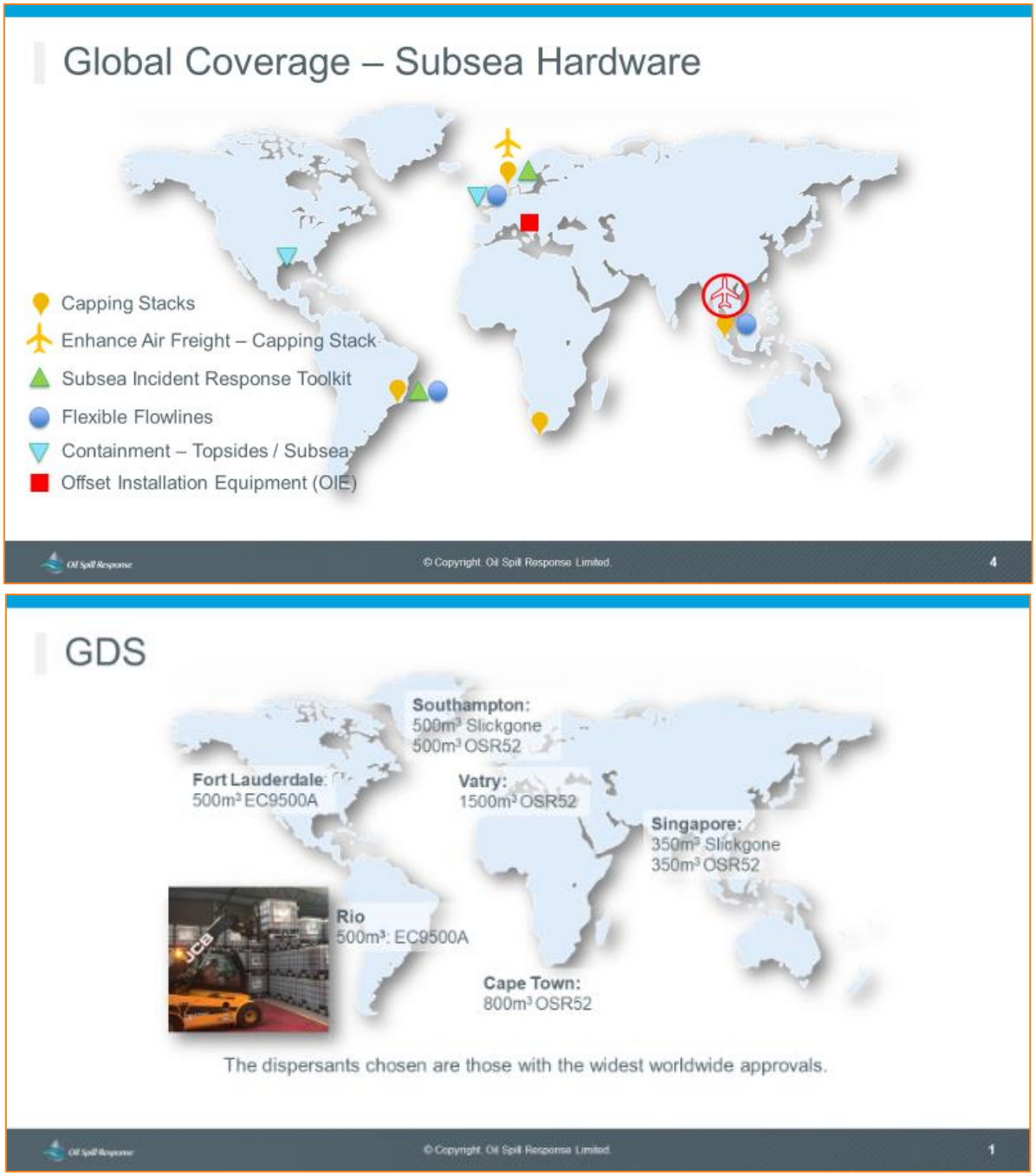


Figure 5: SWRP subsea response equipment locations

The industry developed some basic operating rules for mobilizing and deploying the equipment being stored. Procedures were developed, published and stored with OSRL for storage, maintenance, mobilization and deployment of the equipment as the equipment was delivered to the selected locations (Figure 6).

Procedures, drawings and all manufacturing records and certifications were stored with OSRL/SWIS and are currently maintained within a SWIS member-accessible website. The SWRP Master Response Guidelines (Figure 6) was an initial attempt for the industry to record the steps they felt were necessary to prepare for an offshore well source control incident. This document was a valuable reference during the development of IOGP Report 594.

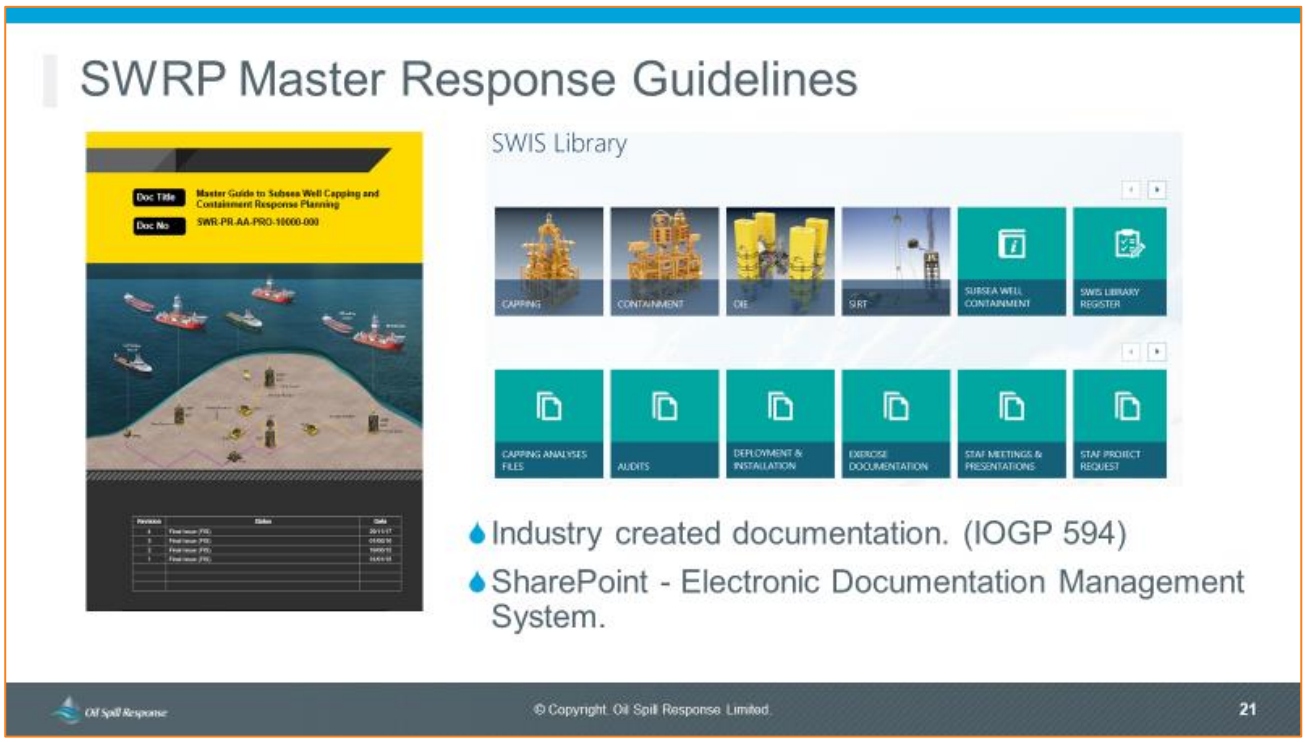
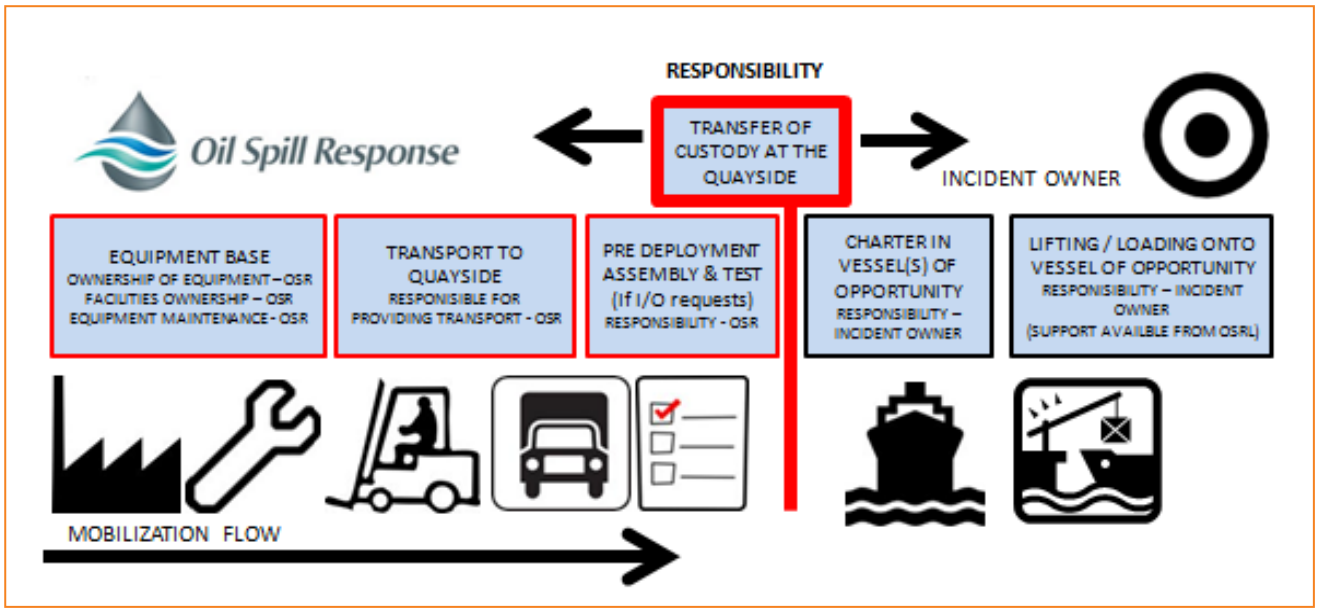


Figure 6: SWRP Master Response Guidelines

Regarding mobilization and deployment, it was the opinion of the industry group at that time that each individual operator possessed the experience and knowledge, and was ultimately responsible for making its own arrangements, for mobilization and deployment at the incident site.

The diagrams below (Figure 7) depict the steps for mobilization of the stored equipment from any of the agreed upon storage locations, for any operator who shared ownership of the equipment. OSRL's original remit, limited due to liability risk as determined by the original members who formed it, was to just store and maintain the equipment, allowing the operator members to conduct their operations beginning with offloading at the dock or airport.

Mobilization by sea freight



Mobilization by air freight

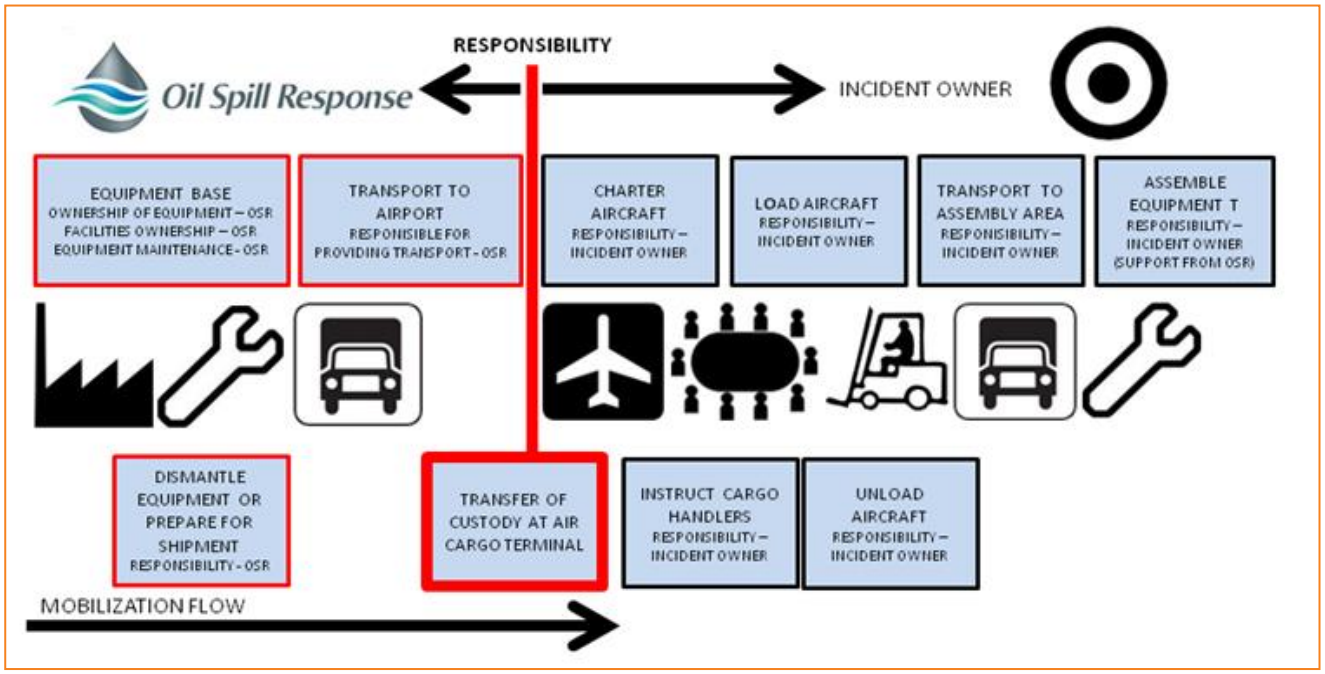


Figure 7: Mobilisation responsibilities

Andy also acknowledged that additional equipment has been built by several operators and service organizations to meet specific industry needs and expand on the global equipment capability.

3.1.1. Workshop feedback and questions – with answers from Andy Myers

- What is next for OSRL?

The focus of OSRL Subsea Well Intervention Service (SWIS) is to continue to work with our subscribers and industry to promote collaboration and consistency in the quality of response preparedness. The intention is to work initially on a regional basis to promote consistent comprehensive response strategies and joint subscriber exercises. OSRL will continue to promote training for subscribers and industry.

The industry supports the fact that no one company can provide all the necessary expertise or resources to develop a comprehensive response plan or to provide an effective response (particularly for scenarios of sustained duration). OSRL will continue to develop our Global Subsea Response Network building closer relationships with recognized subsea expertise companies, logistics providers, etc. OSRL intends to act as a facilitator to enable our subscribers access as far as practicable to a turn-key comprehensive response capability. Mutual aid will be a key principle.

From a hardware perspective we continue to see good investment from our subscribers and are working to increase the pressure rating of our Singapore capping stack from 10K to 15KPSI. We will also be introducing enhanced airfreight capability for the Singapore capping stack in 2019. We will continue to challenge the premise of the equipment inventory to address gaps in the well owner responsibility of supply and resources.

- Why can't OSRL provide end-to-end solution to the industry?

No one company can provide a true end-to-end solution. No other hardware and source control expertise companies has the capacity to offer a comprehensive service. For example, to charter installation vessels for offshore deployment of the equipment in a response requires financial standing / indemnity provision beyond the hardware and source control companies capabilities.

However, OSRL can help to facilitate an end-to-end solution via a contractual framework that ensures as far as practicable a turn-key solution for our subscribers.

Industry funded consortiums such as OSRL have the added benefit of being owned / funded directly by our subscribers so the principle of industry collaboration is fundamental to our existence.

With the development of our SWIS Mutual Aid Framework Agreement (MAFA), at no additional cost to our subscribers, in the unlikely event of an incident the well incident owner can request mutual aid from other subscriber companies.

- How can OSRL provide project management services for logistics planning and engineering?

OSRL regularly provide subscribers support with development of logistics planning and engineering requirements. If 3rd party support is required, this is provided to subscribers at cost.

OSRL is keen to promote collaboration between the necessary expertise/companies that will be required to develop comprehensive response plans and an effective response. Please refer to previous responses.

- Is there benefit in having capping stack on standby locally?

This approach is [*generally*] not supported by industry as capping stacks have been strategically located globally to meet the main vessel markets where the likely installation vessel of opportunity will be sourced. This is the reason the OSRL capping stacks are stored fully assembled at storage locations with direct quayside access. As part of subscription to the SWIS service subscribers have access to the SEA Response software which has been jointly developed by Clarksons (vessel chartering specialists). This allows OSRL / SWIS subscribers to track the necessary offshore vessels for the specific response mission plans.

- What is the status of the OIE adapter for the 10k Singapore stack?

The associated adaptor mandrel is currently on order. This interface issue will be closed in 2019.

- Is there a water depth limit for the capping stack?

The current specified certified (DNV technology certificate) limitation of the OSRL capping stacks is 3000m. However, as per other hardware providers with operational controls the equipment could potentially be used at greater depths. The main limitation on water depth capability of the BOP based capping stacks relates to the subsea accumulator capacities. The valve based stacks which allow manual actuation via ROV alleviate this issue. OSRL are currently working contractual mechanisms to provide cover for wells greater than 3000m (10,000ft) to 12,500ft in-line with other hardware providers. This concern will be addressed shortly.

- How accessible is the OSRL CS in Brazil for incidents outside Brazilian waters?

Mobilisation of the Brazil based OSRL capping stack outside of Brazilian waters has been successfully exercised comprehensively on behalf of our subscribers.

- Why can't OSRL offer a one stop shop with installation support also?

Please refer to previous response.

- How many times have the capping stacks been deployed?

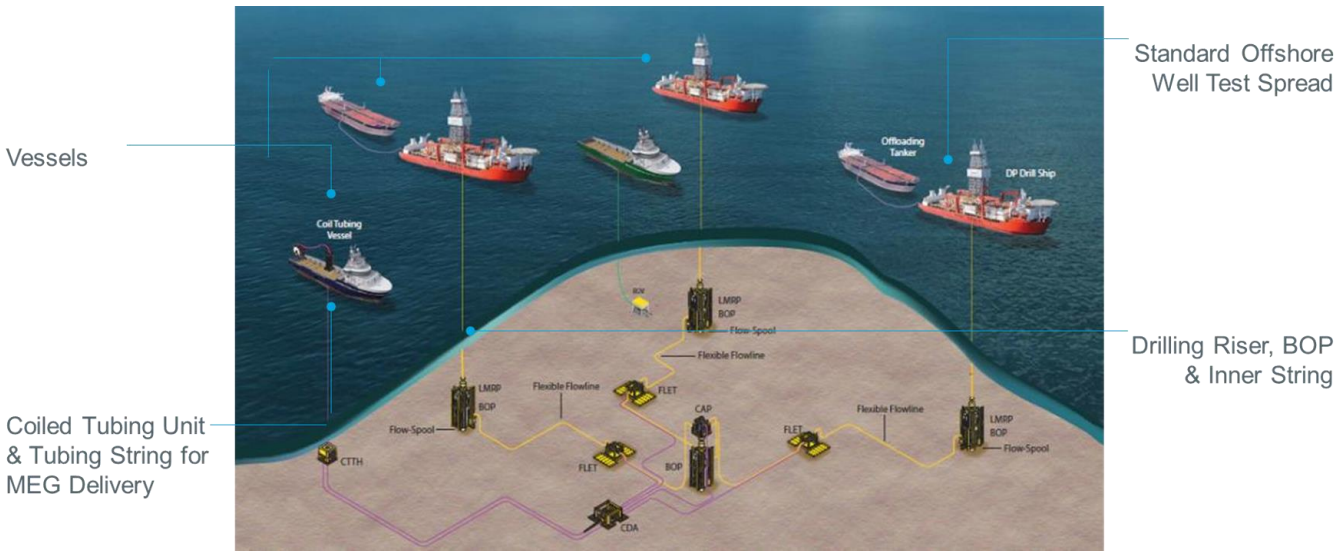
The MWCC capping stack (OEM Trendsetter – of similar design to the OSRL capping stacks) was successfully wet tested in the Gulf of Mexico. The OSRL capping stacks have never been subsea. The TRL level of capping stack technology is considered to be sufficiently field tested due to utilization in previous incident responses.

- What is being developed for a platform blowout where access is not possible?

There have been smaller capping stack designs for use on platforms where well spacing prohibits the larger designs. However, that has been done by Operators specifically for their own use. No requests have been made from the industry to OSRL or the capping stack providers to develop smaller designs.

- Explain the Containment System components…..one question about risers/conduits to surface with emergency disconnects.

Think of the containment system as a temporary pilot subsea production system. All technology is field proven - FLETs, flow spools, riser bases, etc. The well incident owner can configure the equipment as required. All connections / systems are standard subsea design. The containment system is part of the fully integrated system offered to industry through OSRL (Capping & SIRT / OIE, etc.)



In general (excluding pre-defined well owner supplied equipment such as mudmats, etc.), OSRL provide all the subsea equipment for the containment system. OSRL also provide the surface pumps & coolers and the marine offloading hoses. OSRL would be happy to discuss further details as required.

- Can the OSRL CS be air-freighted in only one AN124 in its entirety? – Briefly explain the capping stack air freight scenario.

The main component of the 15K PSI capping stack located at the Norway base in Tananger can be airfreighted in its assembled configuration (without breaking pressure integrity) thus limiting reconfiguration in country. Ancillaries will need to be moved separately but are easily transportable in B-747F or other airframe types. Membership entitlement of the SWIS service provides access to two out of the four capping stacks. So it is possible to mobilise / prioritise ancillary items from a secondary base (along with spares). For Australia it could be possible to mobilise chokes or transportation skids from Singapore to stage these items (even potentially sea-fastening) in advance of the capping stack arriving to address the critical path in a response. Mobilisation sub-options such as this should be considered in a comprehensive response plan.

- On flowbacks and OIE, what interfaces should be identified by the operator regarding additional equipment needs and additional personnel to be prepared – i.e., anchors for OIE, installation personnel, OIE operations personnel, etc.

As part of the delivery of the SWRP (Subsea Well Response Project) JIP a suite of subsea source control planning documentation was created (which in part was utilized in the development of the over-arching IOGP 594 guidance). This documentation is available to subscribers of the service clearly defining the well owner supplied equipment / resource requirements and the premise for the original project basis. OSRL continue to work with our subscribers to test through exercises the premise of the SWRP project and address gaps when highlighted.

- Which Australian airports can Antonov AN124 utilize?

Refer to the Logistics presentation by David Pulk later in the workshop.

- Has CFD analysis been performed on OIE landing a capping stack?

Yes extensive engineering has been completed as part of the original project.

- What is preventing better alignment between operator and regulators expectations on LOWC preparedness?

Industry has recognized the need for improved guidance on what should be considered in a quality response plan, hence the development of IOGP 594. This guidance should help to promote consistency in subsea source control response plans which will help alignment between operator and regulator expectations. NOPSEMA is also sponsoring, as announced at the workshop, the development of a comprehensive response time model tool that will help to maintain consistency regarding response time estimates.

- What challenges does OSRL see for the industry and regulators to improve SC response planning and readiness in Australia?

OSRL has supported positive initiatives between industry (local operators) in Australia. For example in the week prior to SpillCON *[many companies and service providers]* collaborated on a response preparedness workshop for the North West Shelf. So the message is that industry is working together and will continue this approach moving forward. OSRL are happy to facilitate and support as required by industry / our subscribers.

- What in your opinion is the biggest challenge to source control?

In an event (particularly if significant) the greatest challenge will likely be available resources personnel / vessels, etc (particularly in remote regions). Hence the importance of mutual aid (SWIS MAFA) and software developments such as SEA Response.

In "peacetime" the greatest challenge is managing / addressing misinformation:

- Capabilities of each of the available equipment varies. The equipment available globally through different providers has different capabilities and applications. There are valid applications for all available equipment, and each must be selected based on the merits and needs of the specific wells and reservoir characteristics, and selected to minimise uncertainties that could arise in a deployment.
- Full bore capping stacks can accommodate more flow than a reduced bore device which impacts the landing capability. In a plume the weight of the capping stack is important as the heavier the stack the more stable it is in the flow and the greater the resistance to uplift forces. Marginal safety factors in supporting landing analyses should be questioned. Full bore 18 ¾ inch equipment requires far less CFD analyses justification to confirm capability. The risk with CFD analyses and other detailed modelling of this kind is if the quality of the input data is poor the results can be questionable.
- Messages about the importance of mobilizing equipment to the incident location in hours does not address the real issue in a response. Every incident has specifics, but at the same time a quality developed response strategy / plan has more value and likelihood to support an effective response. There are various mission plans that need to be undertaken to understand the incident specifics and the incident site will likely need intervention prior to a suitable window for a capping stack to be run. This will take time. Response should be by planned / tested / controlled procedure not a race.

The focus of the industry, as highlighted by the issue of IOGP 594, is a shift from hardware (which is readily available globally through multiple subscribers) to true preparedness planning and exercising / testing those plans.

OSRL are ideally positioned to facilitate the Global Subsea Response Network on behalf of industry / our subscribers and to support exercises, etc.

- Cost for OSRL seems high compared to all others especially as not turnkey? Is there a way all companies with SWIS type of equipment can come together to harmonize response for all?

OSRL SWIS operates on a different business model to other providers. The premise of the service is similar to an insurance based approach. In an event of a mobilization the equipment transfers into ownership of the well incident owner (after a pre-determined period of time). This was a key lesson from previous incidents. There are no charges for the SWIS equipment in the event of a mobilization. Standing financial security (for which there are various options that this can be provided – including a surety bond approach) is required during the term of the subscription which can be recovered in the event of a mobilization and the equipment cannot be returned to replace the equipment for the other subscribers. So the premise to the question of cost is actually how an operating company perceives risk and how the operating company understands the extent of financial exposure in the unlikely event of a mobilization.

It is worth highlighting also that the major component of the fee for subscription to the SWIS service is repayment of the loans associated with the equipment. The loans are close to maturity. There will then be a reduction in associated cost for subscription.

As per previous responses, any claim by any provider that they offer a turn-key solution is not founded on a sound basis and should be challenged.

3.2. SPEAKER 2 – Chris Carstens – Developing Industry Standardisation in Preparedness Planning

Chris Carstens continued the morning with a detailed explanation of the information included in the recently released IOGP Report 594: Source Control Emergency Response Planning Guide for Subsea Wells. As he explained, the purpose of the report was to:

- Fill an industry knowledge gap where a vast amount of information has been accrued but not concisely disseminated to the wider industry in recent years,
- Inform both technical and non-technical stakeholders as to what is meant by source control and present a holistic picture of what is involved,
- Provide an overview of the technical activities that should be considered when designing a well and preparing a response plan, and
- Establish a common workflow and guidelines for industry participants to work from in preparing for a response to a loss of well control incident.

Chris explained that the participants who developed the report were members of the Subsea Wells Source Control Subcommittee that supports the IOGP Well Expert Committee (WEC), which was formed as a recommendation of the IOGP GIRG Report (see Figure 4). Established in June 2011, the Wells Expert Committee has become the global voice of Operators and a relevant and effective technical authority on the prevention and mitigation of high consequence well control events. Figure 8 shows the governance structure of the Wells Expert Committee over the work-streams identified.

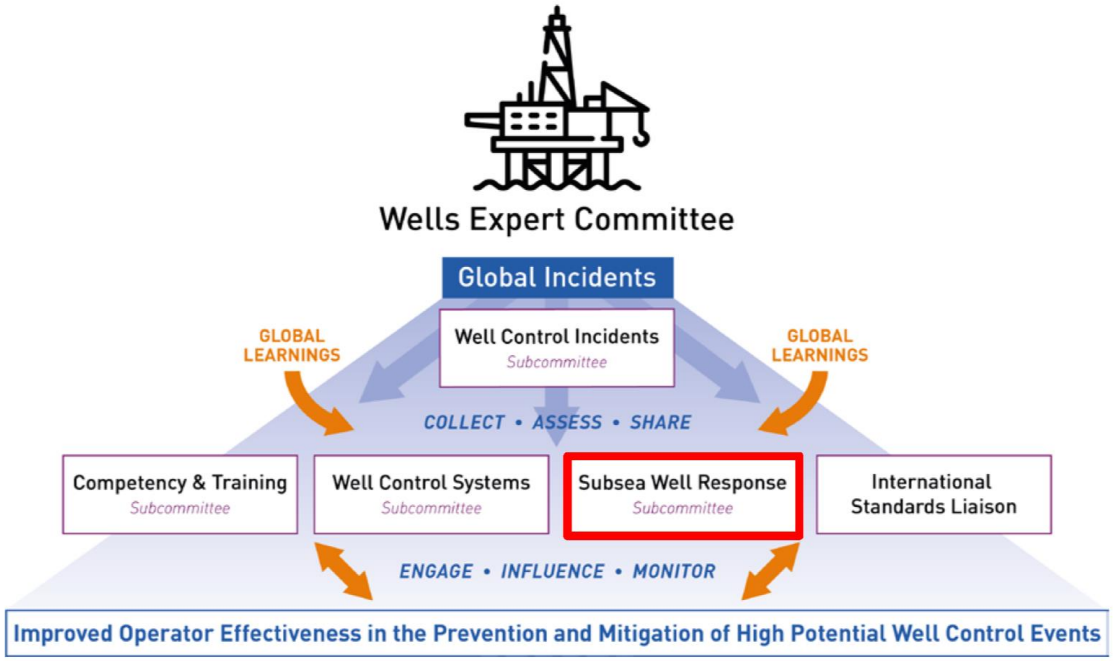


Figure 8: IOGP Wells Expert Committee governance and work-streams

The committee is made up of Subject Matter Experts from the following companies: Anadarko, BP, Chevron, Equinor, Shell, ExxonMobil, Kosmos Energy, Petrobras, Total and Oil Spill Response Ltd. They represented a variety of technical disciplines and skillsets and considered surface, subsurface, Metocean, and other considerations in developing this guide. They all acknowledged that different regions will have different capabilities.

In reviewing the content and structure of Report 594, Chris described how much the industry has focused on prevention, but also on response in an efficient manner should an incident occur. Acknowledging that the risks of a blowout can never be reduced to nil, proactive prevention activities have resulted in:

- Greater awareness that the risks are real and the consequences are grave
- More rigorous crew training and certification
- Various crew competency Process Safety programs by Operators and Rig Contractors
- Stronger regulatory requirements for Well Control Systems
- Remote drilling monitoring centres
- Advancing monitoring technology for kick detection

The key message of IOGP's Report 594 is that the industry has evolved from a "Relief Well Response" to a "Cap and Stop the Well Flow Response". The report outlines best practice planning for capping and containment response operations for a subsea well, and contains six key sections:

- Forward – Introduces the report and describes the difference between Capping and Containment
- Part 1: Overview of Source Control Emergency Response – describes response organisational structures and key task groups
- Part 2: Engineering Activities to Support Response Planning – describes engineering, design and preparation activities that should be considered before drilling commences
- Part 3: Capping Stack Planning and Installation – discusses how to choose and deploy the right capping stack solution
- Part 4: logistics planning – considers mobilisation and logistics requirements
- Appendix – contains and overview of containment, response task groups detailed descriptions, capping stack resources available to industry, an overview of capping stack installation process, example drawings, and Response Plan Checklists

Each section describes the pre-drilling planning tasks that should occur to support a subsea well response. Hard copies of the Report 594 were distributed to the Workshop attendees (Figure 9).

Figure 9: IOGP Source Control Emergency Response Planning Guide for Subsea Wells

Chris presented an overview of the contents of each of the sections, to aid the operator in establishing an appropriate and fit-for-purpose Source Control Emergency Response Plan. The pre-drilling planning functions are critical to the success of a subsea well intervention program, and have been described succinctly in the Report 594.

As an example, Chris presented the response task groups that must be planned and prepared, which are subsets of the recommended organizational chart shown below (Figure 10):

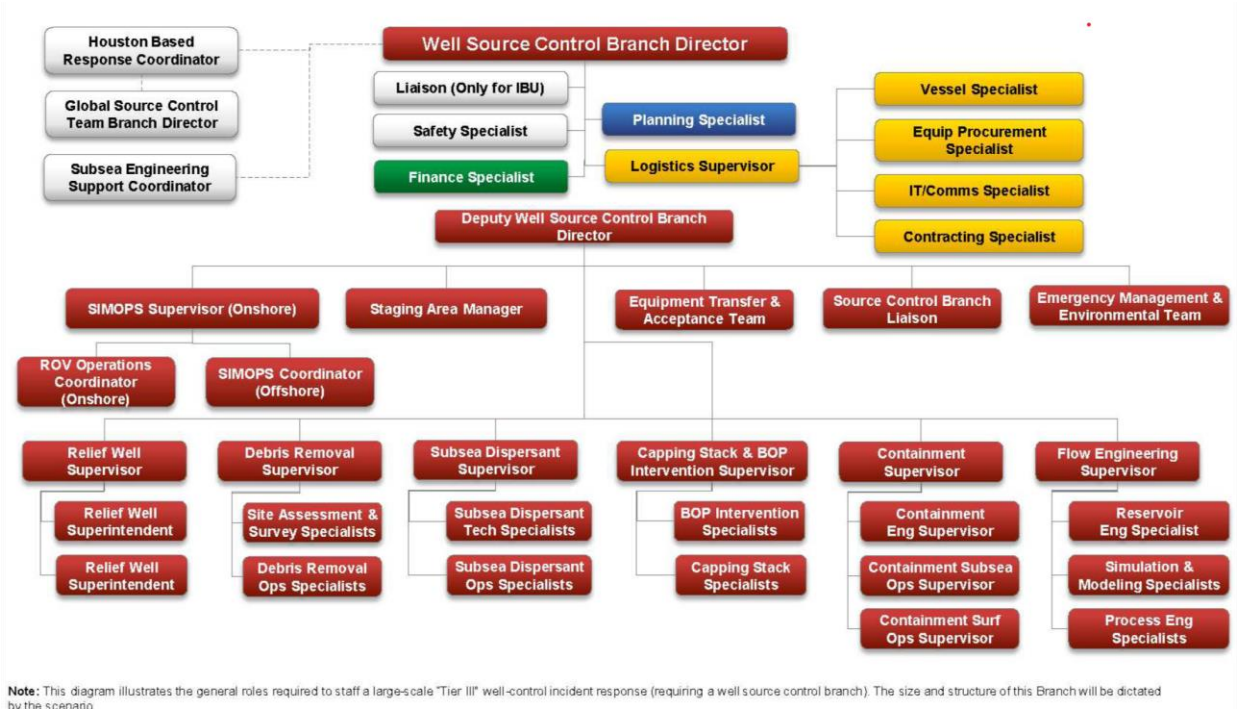


Figure 10: Subsea Well Source Control Response Organisational Chart

Chris described in his slides the five main tasks for which an operator should be prepared in a source control emergency, with a 6th task as an option if conditions warrant:

- Site Survey
- BOP Intervention
- Debris Removal
- Subsea Dispersant Injection
- Capping
- and finally, Containment

The remaining portions of the presentation guided the audience through the engineering and technical preparedness planning that is required to develop the activities to efficiently and effectively complete the above tasks, including the engineering calculations, capping stack selection, capping stack landing analysis and the multitude of logistics options.

Finally, Chris summarized in the following slide (Figure 11) the state of capping stack systems available worldwide from various sources.

State of the Industry Snapshot

The IOGP Report 594 – *Provides a snapshot for the state of the industry's ability to respond*

Figure 11: Global equipment overview

3.2.1. Workshop feedback and questions – with answers from Chris Carstens

- How much effort do you think we spend on prevention versus response preparation?

For Chevron response I would say 90/10 for prevention/response. Which I think arguably is about right. Chevron has implemented our WellSafe (internal regulator), DSC (remote well control monitoring center) internal Chevron Well Control Training, a "super 53" Well Control Systems Standard along with a number of smaller initiatives for control and containment of our high risk, high consequence wells. Of course I think we should do more in response but we do require all wells all BU's to have a Well Source Control Response Plan which gets exercised against. We regularly carryout 2-3 major exercises / workshops per year around the world.

- Do you think the industry can endorse a "No Incident" policy?

Policy or goal? We declare "zero is obtainable" for fatalities I don't see why not for well control events. We need to advance technology for closed loop, MPD, automatic shut-in, in situ closure devices, and other technologies to shut-in the well before loss of containment.

- What are the main gaps in source control preparedness and response that you see globally?

Lack of funding for training and drills, lack of industry sharing and working together on drills and exercises. Different levels of alignment between Operators on "readiness".

- What training is being considered for Report 594?

This is an area that the IOGP Subsea Well Response Committee should address this year and next. I would like to see an industry (something like PetroSkills) offer a course based upon the content of Report 594.

3.3. SPEAKER 3 – Brett Morry – Capping Stack Deployment Simulation Phase 1

Brett Morry began his presentation outlining the various parts of a source control plan. Brett described the activities involved in a source control response and specifically, the capping operation, using the following slide (Figure 12). Using video simulations, he presented descriptions of the activities involved in each of the missions required to undertake Capping Operations (lower boxes).

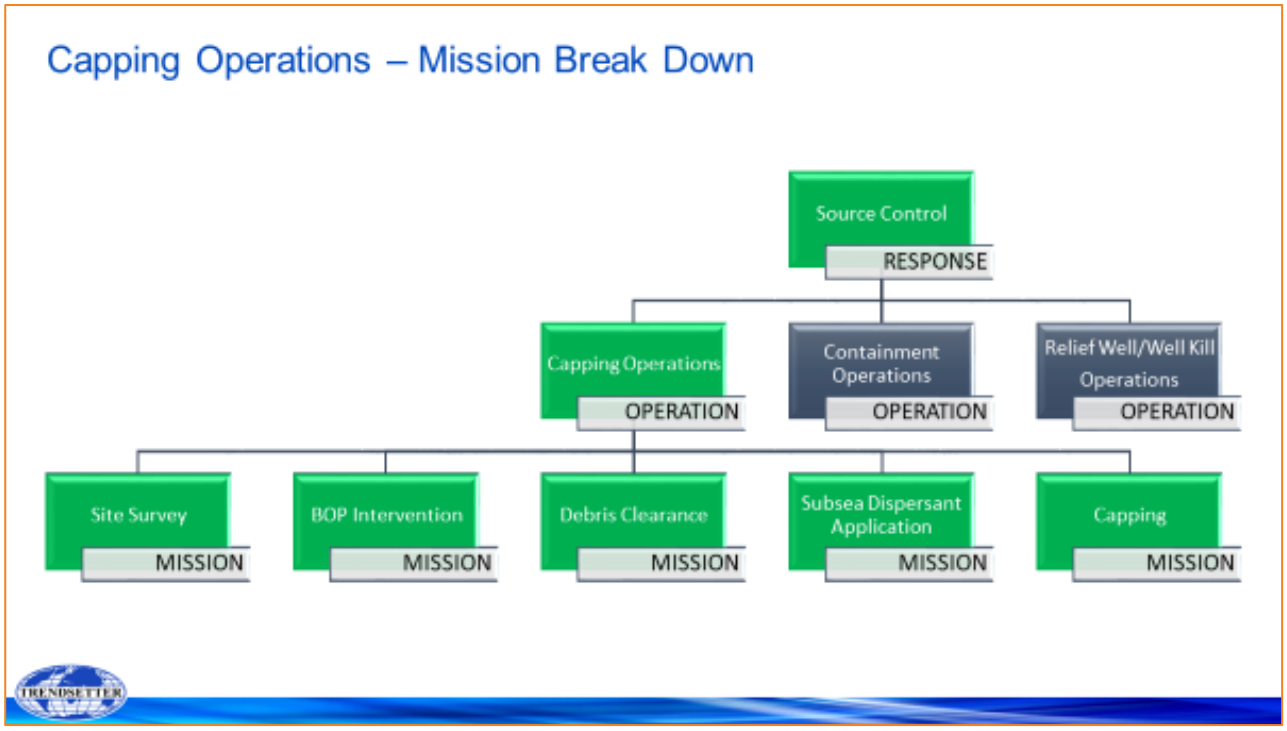


Figure 12: Capping operations and missions

He described the purpose, and provided video simulations of each of the missions:

- Site Survey
- BOP Intervention
- Debris Clearance
- Subsea Dispersant Injection
- Capping Operations

Brett presented an overview of various equipment providers. He remarked that in the post-Macondo world a new market emerged to provide global offshore drilling operators with services to ensure that they are compliant with regulatory requirements dealing with subsea blowouts, and that they are prepared to respond to the blowouts. The initial regulatory guidance/requirements focused solely on equipment availability. This need has been addressed by several consortiums, organizations and companies for the Australian market. For this region, these are:

- Australian Marine Oil Spill Center (AMOSC)
- Oil Spill Response Limited (OSRL)
- Wild Well Control, Inc. (WWCI)
- Boots & Coots (B&C)

Recognising that Andy Myers had presented previously on the equipment provided through the SWRP and OSRL, and that AMOSC equipment was to be presented in a later presentation, Brett's presentation provided an overview of the Capping Stack and intervention equipment provided by Wild Well Control and Boots & Coots, describing the equipment, storage locations, and capabilities.

Brett presented WellCONTAINED as the organization from Wild Well Control. WellCONTAINED provides member companies access to subsea capping stacks as well as technical planning, advanced engineering, and response training. The response equipment comprises four modules:

- Debris removal
- Subsea dispersant application
- Subsea Hydraulic Power Unit (HPU)
- Subsea capping stack

Brett gave a detailed description of the equipment that makes up these packages.

Brett presented Haliburton/ Boots & Coots as providing member companies with access to a Global Rapid Intervention Package (including subsea capping stack) as well as technical planning, advanced engineering, and response training. The Global Rapid Intervention Package (GRIP) is comprised of the following five modules:

- Debris removal
- Subsea dispersant application
- Subsea Hydraulic Power Unit (HPU)
- Subsea capping stack -RapidCap
- Top Hat

Brett gave a detailed description of the equipment that makes up these packages.

3.4. Capping Stack Deployment Simulation Phase 2

Brett then gave phase II of his presentation, focusing on the inputs required to develop a Response Time Model (RTM). The goals of the presentation were to provide an oversight into the structure and content of a Source Control Response Time Model, educate the attendees on the typical missions required to prepare a failed BOP to accept a Capping Stack, and in coordination with attendees identify potential GAPs or areas of improvement.

A simulated (fictitious) scenario was provided to which the workshop evaluated the response timelines for a Capping Stack deployment.

Group discussions were encouraged to discuss pre-spud planning. This included the following questions:

- Does your company currently have a Source Control Emergency Response Plan (SCERP) for this region? The SCERP is a document which provides an operator with 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
- What pre-engineering has been done prior to spud? Has the Worst Case discharge modelling included Blowout Load Cases, Plume Modelling, Relief Well Dynamic Kill plans, & RW Locations identified?

- What infrastructure exists in this region to support a response? - Deepwater Ports, Airports, Available vessels and ROV's. What facilities exist at the port? How much water available alongside? What's the load bearing capacity of the docks? What cranes exist? Are they at the port or brought in from elsewhere?
- What facilities exist at identified Airports? Do they have the necessary equipment to handle a 747 or Antonov? What about overland routing to the Port of Mobilization? Are there any route restrictions?

The presentation then provided video simulations of the fictitious scenario. It guided attendees through the initial response and notification requirements, and the task force mobilisations. The following discussion points were presented:

- Do you have sufficient work force for 24 hr operations?
- Do you have mutual aid agreements for additional support?
- Do you have a viable SCERP with up to date contact details and pre-identified assets? - People / Equipment / Layout
- Have you notified and began mobilization of response personnel and equipment assets?

Two immediate priorities were identified:

1 - Perform a Site Survey:

- Have you sourced the Site Survey Vessel? What are the minimum requirements?
- Have you identified and sourced the necessary equipment to perform the task?
- Where you able to source the majority, if not all, of the necessary equipment locally?

2 - Notify Capping Stack & Intervention Equipment Providers of need to mobilize equipment:

- Where are the available capping stacks and additional intervention equipment coming from and how would you transport them to location? Would you marine freight it in from its storage location? Would you air freight it in from its storage location? Would you truck it overland from its storage location?

An approved operational survey plan would need to be written and utilized on location to ensure all necessary data is gathered and disseminated for assessment and planning. Specific areas of interest would be seafloor condition and composition, indications of broaching, BOP status, condition of onboard accumulation, Wellhead & BOP structural integrity (*Inclination, damage, leaks, etc.),* debris which would need to be removed to facilitate intervention & capping (*access to BOP intervention panel, access to BOP hub/mandrel), w*ell flow data (*rate, composition, behaviour, etc.).*

Brett raised the following points for vessel and ROV selection:

- What are the minimum requirements for a BOP Intervention? What options are available and how long would it take to conduct an intervention?
- If the vessel you had selected for the site survey was equipped with a BOP Intervention skid, could you have immediately attempted to shut the failed BOP? If not, what's the potential impact on your RTM waiting for a suitable vessel and intervention hardware?

- What additional equipment is required to function the subsea BOP with an ROV and where can it be sourced? Hydraulic fluid - Can you use Sea Water to attempt to function the rams closed?

Having reviewed the site survey mission, we now know what debris we have to contend with. Knowing what we know, what tools would you propose to perform the work required?

- What are the minimum vessel requirements?
- What are the minimum ROV requirements?
- What options are available and how long would it take to source?

What if the LMRP and riser was still attached?

- How would this impact our schedule?
- What additional resource would we need in that eventuality?
- Why would we want to wet store as opposed to recovering to surface during the response?

Brett then raised the issues associated with dispersant deployment:

- How long will it take to get approval to use dispersants?
- What are the minimum Vessel & ROV requirements? What options are available and how long would it take to source?
- What equipment is available from the AMOSC SFRT and is it needed to conduct dispersant application? What's available from other Capping Stack providers?
- What is missing from AMOSC SFRT kit and needs to be provided by Company? - Coil Tubing, Surface Pump Units, Storage Tanks, Dispersant Resupply.
- How much dispersant is available for subsea use? How long before we run out of local dispersant stockpile amounts? What is the plan for replenishment? Where is the rest of it coming from? Via what method of transport? How long would it take to consume the stockpile? Who do you approach to start backfilling available supply with new product?

The Capping Stack will be mobilized either dockside or for aerial transport based on the requirements you provided to your supplier. Your overall response time model will depend heavily on the method of transport selected. These issues should have been pre-planned and included in your companies RTM for Capping Stack deployment:

- Which Capping Stack have you nominated for your operation, have you confirmed the correct configuration, and how is it being transported? Is it coming to site directly from the Capping Stacks port of mobilization via sea freight? Can you improve on this with Air Freight?
- If Airfreight, how many planes do you need to source? What's a realistic time for the plane to be available to pick up the Capping Stack?
- What are the vessel requirements and where's the installation vessel coming from?
- What's a realistic time for the Capping Stack vessel to be on site ready to deploy a Capping Stack?

3.5. Design: Capping Stack

Brett described a brief history of well blowouts and subsequent capping operations, and highlighted that capping stacks are not a recent invention – they have existed since some of the first blowouts on land. Subsea wells on the other hand, presented an entire new set of design requirements that had to be addressed "under fire" during an actual incident (Figure 13).

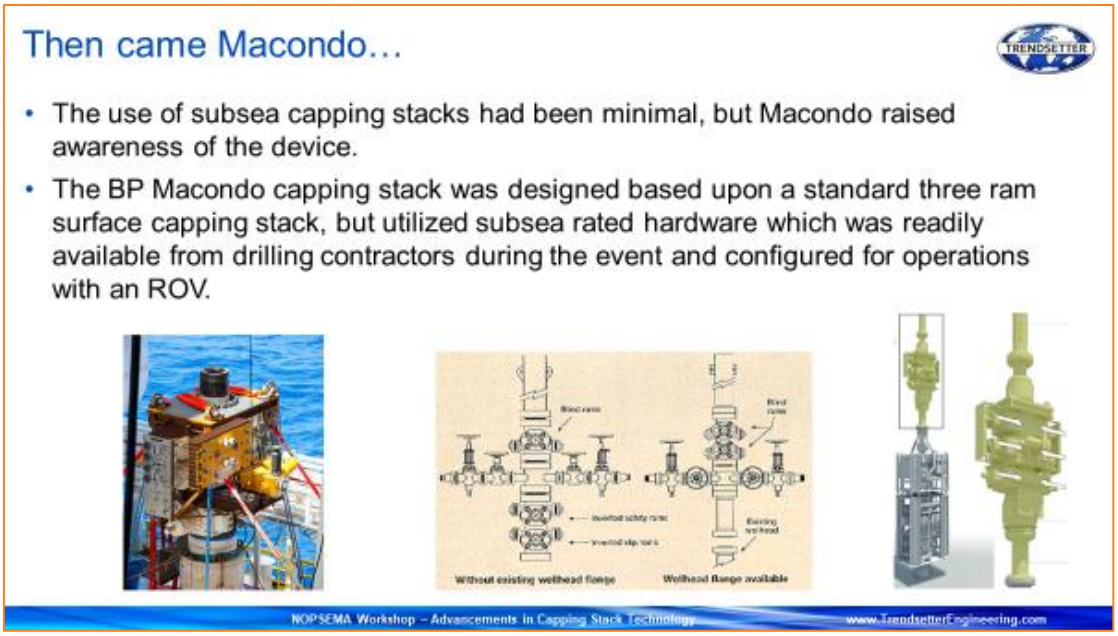


Figure 13: The original subsea Capping Stack

Brett mentioned the capping stack at Macondo and those designed by the SWRP industry team (refer to Figure 3 for details) for a potential future incident were all ram-based to give as much tolerance to unknown flow rates and other abnormal well conditions as possible (Figure 14).

Figure 14: Post-Macondo Capping Stack design

Brett stated his opinion that the original capping stack designs were also driven by drillers who insisted that the opening of the capping stack allow full bore access to the wellbore through the BOP, if present. The prevailing idea at the time was that kill operations could potentially proceed through the capping stack and everyone had significant concerns regarding the uplifting forces, the potential of equipment/tooling/material protruding from the wellbore and other landing issues that warranted utilizing as large a bore as practical (Figure 15).

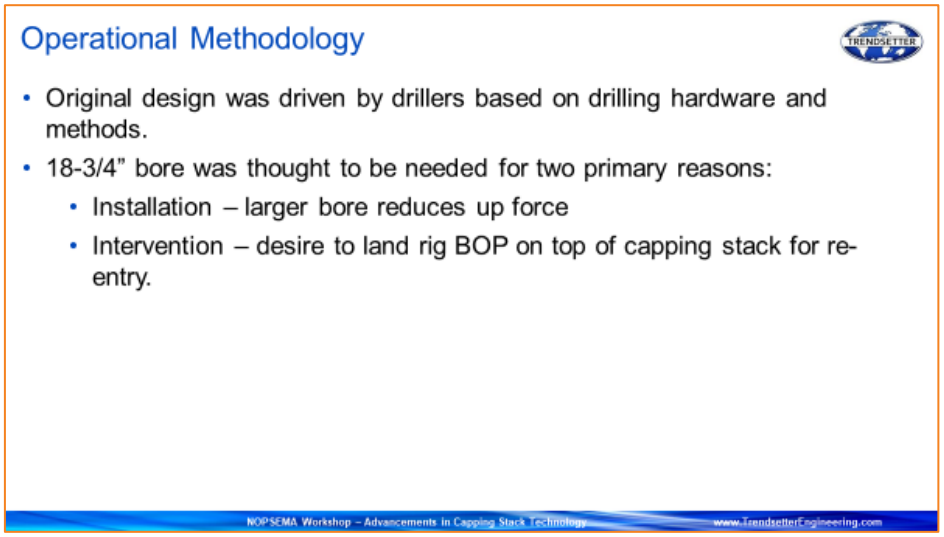


Figure 15: Original design philosophy

The immediate goal of landing, connecting and stopping the flow of hydrocarbons to the sea influenced all the design decisions made regarding the original and future capping stack designs. To be clear, those design influences remain to this day even though, in many cases, obstructions at the point of connection or other downhole obstructions may prohibit simple re-entry through the wellbore and it appears that in cases of lesser flow rates, uplift forces may not be as significant and alternative valve-based capping stacks may be a suitable alternative.

After the dust settled from Macondo and the initial requirements for Capping Stack availability were met, the industry's focus shifted to planning and preparedness including understanding more about the operational needs and refining the technical requirements for a capping stack. Several technical and operational issues were highlighted and a shift in response methodology was also recognized. Brett explained that there are issues to consider regarding the well design structural strength that must be examined, especially on older wells or in adverse soil conditions: i.e. the wellhead loads exerted from a primary BOP, Capping Stack, and a re-entry BOP. Regardless, the industry is and must be prepared for worse case scenarios with the current fleet of response equipment. In practical terms, during an actual incident an operator should always consider minimizing uncertainties and reduce risks to try to ensure success on the first attempt to stop the flow. Modifying the design capabilities of any of this type equipment and/or not taking the time to assess the original well design and its current state may present unnecessary risk. Thorough assessment is required for any Capping Stack design modification.

Capping Stack design proceeded to be defined for many possible scenarios. Initial capping stacks were based on BOP Ram technology, with some later variations including valve technology. Brett presented a brief evaluation of the characteristics of valve-based capping stacks for audience edification (Figure 16).

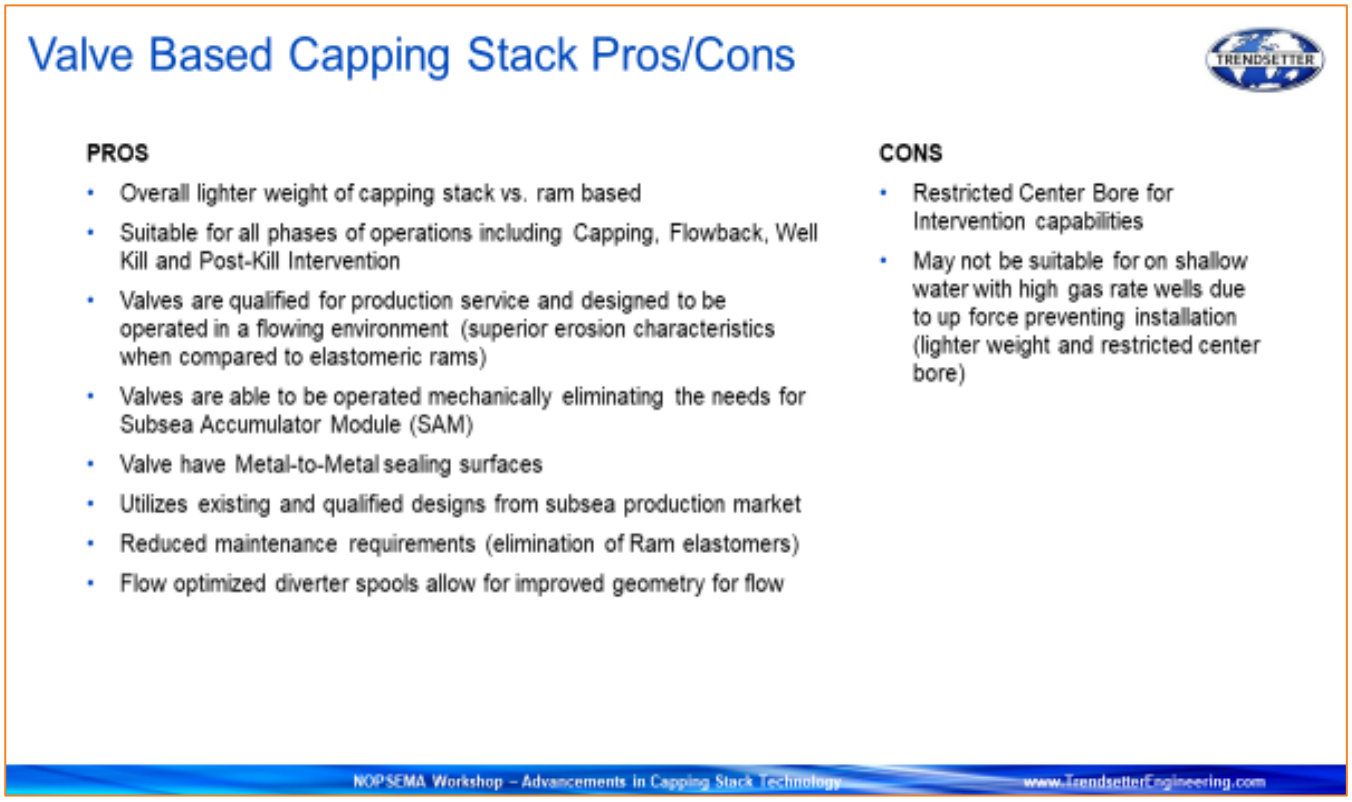


Figure 16: Valve-based Capping Stack designs

Brett presented information on other advancements, such as the Mudline Closure Device (Figure 17).

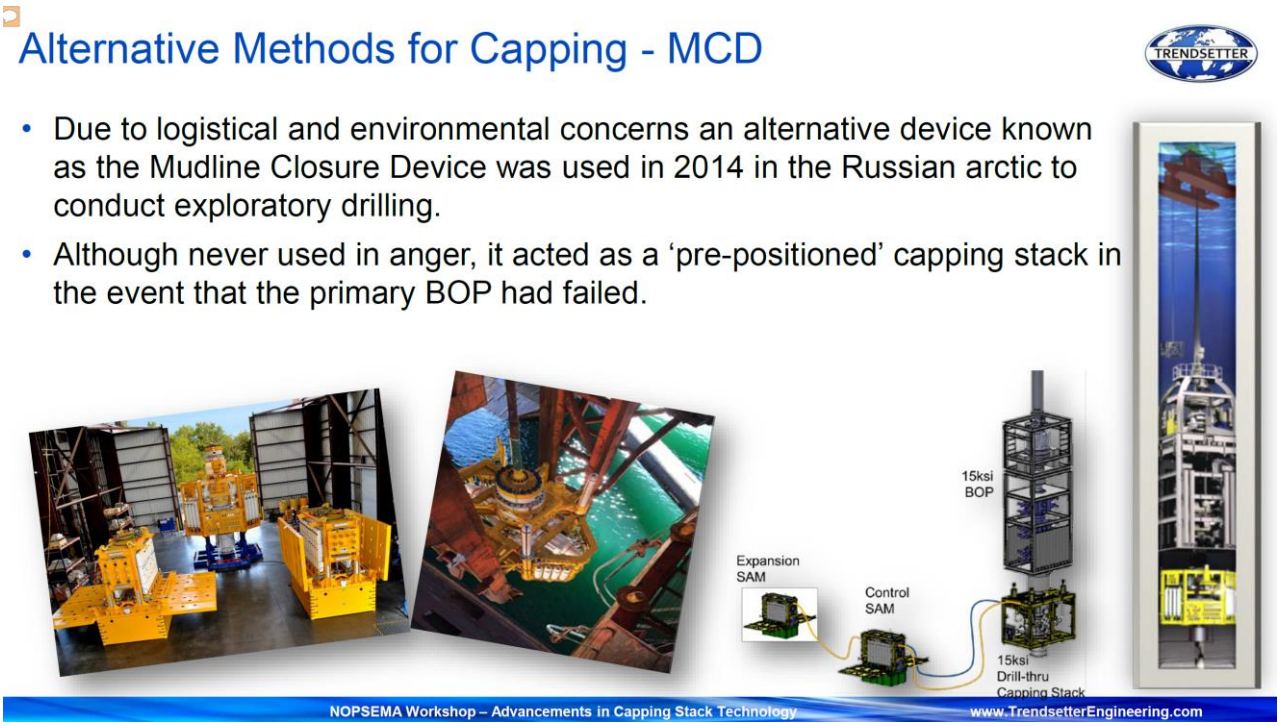


Figure 17: Mudline Closure Device

Brett presenting a summary of the current supply of capping stacks, with some pertinent technical information and when the particular stacks were introduced to the industry (Figure 18). Most of the capping stacks belong to consortiums that require paid membership fees to gain access when it's needed.

Figure 18: Post-Macondo Capping Stacks

Brett then scoped the future, stating the focus must shift to all aspects of the response, not just equipment. This should include:

- Emergency response planning and services
- Training and eLearning
- Drills and exercises
- Actual response support

3.6. Additional Speaker 4 – Thomas Selbekk – Exercise and Training

Brett introduced Thomas Selbekk of Add Energy and they both discussed the modelling and analysis programs Add Energy uses to simulate pressure response curves while simulating well shut-in operations. Thomas introduced the simulator Add Energy use to train personnel in capping stack response, Olga-Well-Kill, which has been designed for planning and evaluation of dynamic kill and well intervention options, used on 70+ live blowout and well control incidents, and has been central in the preparation of more than 1400+ blowout contingency plans. Available features include:

- Dynamic kill simulations
- Top kill simulations
- Kick tolerance and circulations
- Bullheading simulations
- Crossflow potentials

- Shallow gas analysis
- Versatile graphical presenter

Thomas talked about the challenges and lessons learned from Source Control Exercises:

- Spill drills tie up a lot of resources and are often costly.
- Engineers are often busy and don't want to be at the drills
- Plan to make it a valuable and successful event. All participants must be engaged
- In large drills it's difficult to keep all groups and participants updated. Operational status and data must be shared continuously

Solution-place large screens in all Incidence Command Center showing ROV feeds of the SC operation:

- Allows continuous visualization of the well status and current operation
- It mimics real-world events
- Engages participants

The VROV simulator has been designed as an interactive ROV simulator that can visualize a subsea capping operation. The OLGA-WELL-KILL multiphase simulator models fluid behaviour during a blowout and source control operation. Given a blowout scenario, the physics from OLGA-WELL-KILL can be programmed into VROV. The result is an interactive training tool that can mimic a real-world incident and significantly enhance source-control exercises.

Implementation during Source Control Drills, the VROV can be run in pre-scripted or fully interactive mode. A continuous feed of the subsea operations can be shown in multiple views e.g. bird-eye view and ROV view. OLGA-WELL-KILL is used to calculate what the ROV panel should display during the different operations. Temperature and pressure inside stack is read by the participants during the soft shut in and compared to the modelled PRC plot:

- Using soft shut in procedures based on a well bore schematic and predicted reservoir properties, a soft shut in dive plan is created to perform a shut in of the selected Capping Stack using the ROV Simulator
- Using the Capping Stack operating manual, the dive plan follows the correct procedures to operate each component
- HOLD periods are in place after each step to monitor reservoir performance via the chemical injection panels
- The OLGA Well Kill software establishes the predicted reservoir pressure response curves
- The cross sectional profile of the Capping Stack flow paths, and the sequence to shut in the Stack contribute to calculating the pressure response curves
- The ROV shut in sequence in the procedure matches the predicted pressure response curve defined by the soft shut in analysis
- HOLD points allow the bore pressures to stabilize between steps
- As the sequence to shut in the stack is performed, the gauges react accordingly depending on the configuration of the center bore and side outlets
- Digital read outs add a higher level of resolution, mimicking the response from a digital pressure gauge

Thomas then demonstrated some of the simulation graphics used in this training simulator.

3.6.1. Workshop feedback and questions – with answers from Brett Morry

- How small can capping stacks get?

To date, Trendsetter have built two Capping stacks that are in the 40T range. One was a bespoke application for a TLP type response, while the other was designed specifically for air freight ability.

- Is there any thoughts regarding framed self-supporting capping stacks to avoid overloading the BOP and well infrastructure?

Not at this point. Given the variability in wellhead heights and soil strengths, designing a structure to accommodate load bearing for a range of situations and connection points would probably prove problematic.

- With regards to sourcing vessels for source control response – how do you see Safety Cases impacting on response operations?

No comment. We do not interact with NOPSEMA regarding Safety Cases.

- Can you elaborate rigging up one vessel for multiple response operations?

The more capable a vessel is (i.e. deck space and capacity, crane capacity, down line length, ROV capability, etc) the more source control missions that vessel could accomplish. A high spec vessel could conceivably perform all source control missions if suitably equipped.

- Top hat deployment and coiled tubing deployment requires open water fatigue analyses. Is this part of TEI's preparatory documentation?

No. Coil tubing providers are in a position to provide this analysis. Coil Tubing is not part of the hardware TEI have been called upon to provide.

- Is Trendsetter involved in improving or expediting vessel Safety Case requirements and approvals in Australia?

No, see above. We do not interact with NOPSEMA regarding Safety Cases.

- Are there guidelines for flowrate limitations for all the different capping stacks?

Flowrate limitations are specific to the individual capping stacks and their design. Each Capping Stack comes with a design flow rate. Theses flow rate design requirements are in a range of 100,000 barrels per day to 330,000 barrels per day. Maximum flow rates for capping stacks are heavily dependent on flow path design, water depth and GOR.

- Can you list the resource issues that represent gaps the industry needs to address?

Hardware availability is no longer the issue it once was. Focus now needs to shift towards education and training.

- How well do you think Australia is prepared to deal with a source control incident?

The recent NOPSEMA workshop is evidence of the focus source control is receiving in Australia. Operators are taking a proactive stance with regards to training. Australia has always enjoyed a prominent position in Source Control preparedness.

- How reliable do you think the current state of submitted RTMs are from operators?

We have zero exposure to the RTM's submitted by operators to the regulators and therefore cannot comment.

- With regards to just-in-time manufacturing of dispersant in AU – Ardox is not on the approved list anymore so isn't considered in response by many.

Noted. Should it be though? Refer to NOPSEMA guidelines on dispersant approval process.

- How prepared do you think Australia is for a major LOWC event? What are the gaps, if any?

Australia have been very proactive when it comes to establishing hardware locally via AMOSC, and all the operators have agreements in place with Capping Stack providers. Ongoing source control exercises are held periodically amongst all operators. Any gaps that remain should be identified and addressed during well ops preplanning in a comprehensive Source Control Emergency Response Plan.

- Exercises tend to be sequential – this didn't work so now we move on to the next step. Is there enough emphasis on AAR's to review why it turned out like that, as a means of guiding future actions?

Trendsetter are involved in the facilitation of an exercise, but to date have not been party to any AAR's, so therefor cannot pass comment. This has been the purview of the operator's emergency response teams. We would welcome the opportunity to be more engaged post exercise.

- To what extent do you think regulators are affected by claims from source control OEM's on RTM which may not have considered all logistics issues?

Trendsetter is not in a position to comment on this as we have no exposure to this topic.

- Is there a response plan toolkit available that supports Report 594?

Trendsetter do not know the answer. The report does a good job of identifying recommending engineering best practices to support SCERP Planning however, and there are companies providing planning services that cover the content of Report 594.

- What are the major resource issues that you would consider as a gap that industry needs to close?

Response Hardware is no longer the issue. Education and training should now be the prime target, with a focus on preplanning engineering and asset identification.

- Based on your experience from other parts of the world, how well do you think the Australia is prepared to deal with a source control event?

As mentioned above, Australia has been very proactive in this space and is a leader in source control preparedness and training.

3.6.2. **Audience questions** – with answers from Thomas Selbekk

- Where do we get details of VROV and OLGA, how do we best utilize it in exercises?

VROV as part of a Source Control exercise is coordinated by Trendsetter Engineering and Add Energy. The logic for the capping stack operation is created by Brett Morry with Trendsetter and visualized by company GRI under Trendsetters direction. The pressure response curves are created by Add Energy using the transient, multiphase software OLGA-WELL-KILL powered by OLGA, and the PVT simulator PVTSim

created by Calsep. These tools are best utilized in source control exercises when drilling engineers, subsea engineers and reservoir engineers work hand in hand to facilitate a safe shut in of a Capping Stack via a high-fidelity simulation.

3.7. SPEAKER 5 – Andy Cuthbert – Key technical parameters for Capping Stack evaluation

Andy presented the erosion modelling, factory acceptance test, and operational and maintenance tests of Capping Stacks as defined by API RP 17W (Figure 19).

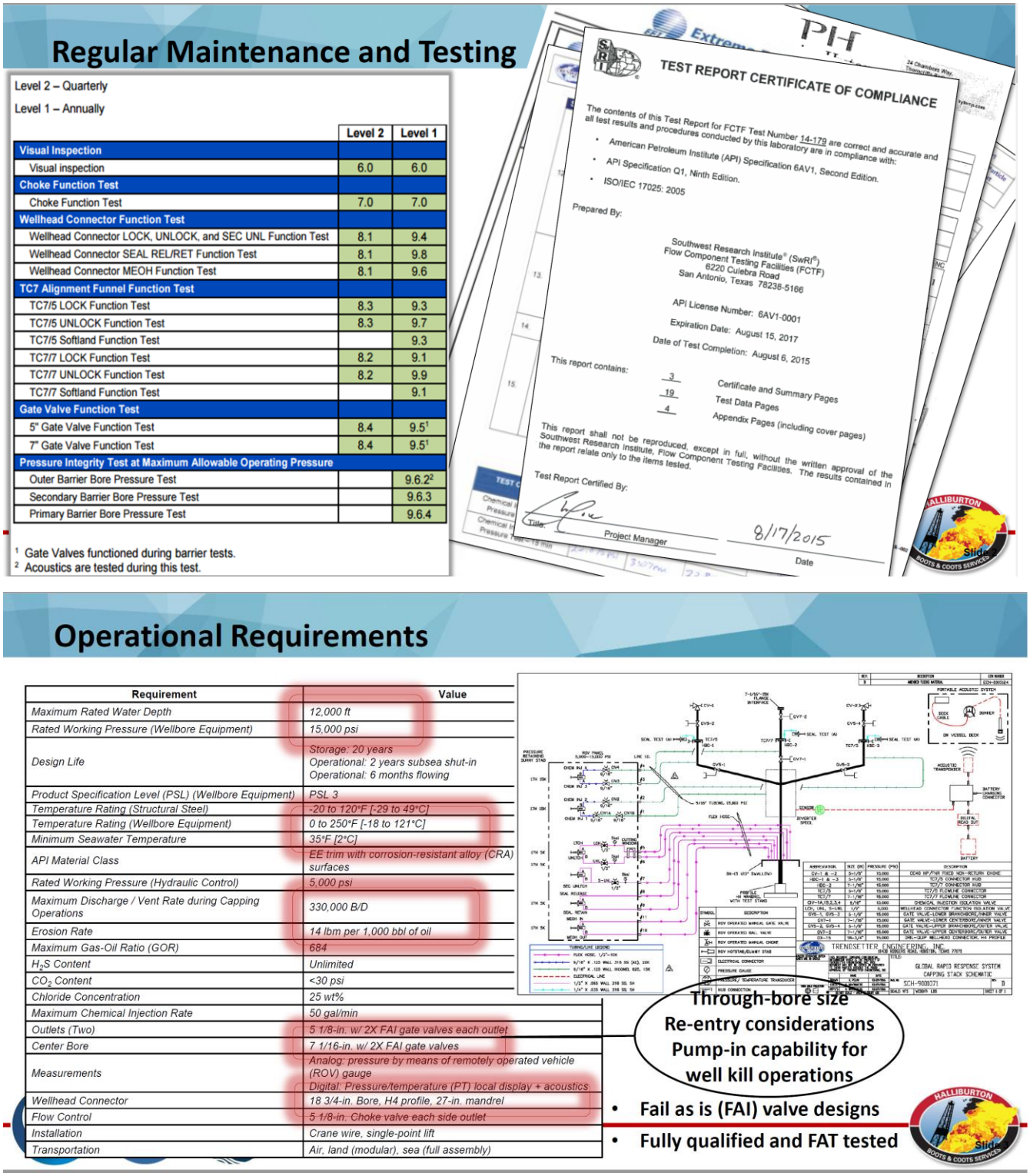


Figure 19: Capping Stack operational, maintenance and testing requirements

Andy then elaborated on the operational requirements required for consideration when evaluating Capping Stacks (Figure 20).

Operational Requirements

energy API

API RP 17W
Recommended Practice for Subsea Capping Stacks

Category	Design Standard
Pressure Containing Equipment exposed to bore fluids	API 6A, PSL 3
Subsea piping systems	ASME B31.8
Hydraulic Control and Chemical Injection Circuits	ASME B31.3 • Chapter II is applied for pressures up to ASME B16.5 class 2500. • Chapter IX is applied for higher pressures
Pressure Containing Steel Welding	ASME Section IX, B31.8 and API 6A, as applicable
Structural Steel Components	API 17D or API RP 2A, as deemed applicable by Trendsetter
Structural Steel Welding and inspection	AWS D1.1 or other industry standard as deemed applicable by Trendsetter
Lifting Points / Equipment for Offshore Lifts	API 17D or DNV 2.7-3, as deemed applicable by Trendsetter
Subsea Connectors	API 6A and API 17D, PSL 3
Cathodic protection systems	DNV RP-B401
Hot Stabs and Receptacles	API 17H and API 6A
Other ROV Interfaces	API 17H as deemed appropriate by Trendsetter

Operational Requirements

- Flowing temperature, pressure rating, flow rate, and fluid type rating and water depth rating, which affect stack specifications and deployment method(s).
- Pressure and temperature monitoring sensors.
- Choke size and specification (important for cap and contain methods or contingency).
- Closing method: mechanical, hydraulic, or both types of equipment required to enable alternate or contingent actuation possibilities without having to recover the stack.
- Nitrogen and hydraulic fluid according to well and location requirements. Pre-charging pump or subsea accumulator bottles (SAM) mobilised as air freight.
- Mobilisation: Modularity of design and ability to mobilize expediently from point of location (land, air, or sea freight).

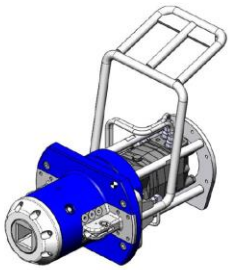


Figure 20: Capping Stack operational requirements

He then discussed the clash analysis requirements when undertaking Capping Stack feasibility assessments (Figure 21).

Clash Analysis of Capping Stack

NORSOK D-010

An outline plan for capping and containment in a blowing subsea well should be in place to demonstrate mobilization and installation of capping equipment within a reasonable timeframe.

The plan should:

a) *evaluate the feasibility of capping a blowout scenario at the given water depth;*
b) *identify all connections and possible interfaces from wellhead to flexible joint;*
c) *identify all connections and possible interfaces from XT to interface to workover equipment;*
d) *include an overview of equipment requirements and availability to allow installation of a capping stack, including an adapter to enable connection of the capping stack;*
e) *consider additional well load cases resulting from a capping operation*

Clash Analysis of Capping Stack

Rig Operator Provided Data Sets for BOP clash analysis

Mandrel

- Drawing or spec sheet which identifies:
  - Type (API Hub, H4, HC, etc.)
  - OD (16", 27", 30", etc.)
  - Length / Available Swallow (48", 52", 58")
  - Seal Prep (AX, VX, etc.)
  - Bending Capacity
  - Pressure Rating (10K, 15k, etc.)

Structure/Frame

- GA Drawing(s) of the BOP detailing the following information:
  - All structure directly surrounding Mandrel OD from base of mandrel/bottom of connector swallow (Plates, Guidance frame, Inverted Funnel, etc.)
  - This is to confirm that the existing capping stack connector will physical fit inside the structure and engage the mandrel seal
- This is to confirm the capping stacks will not have physical clashes with guide posts, padeyes, framework, panels, etc. which may protrude above the interface equipment.

Figure 21: Clash analysis requirements

Andy stated that the uplift forces caused by hydrocarbons exiting the well bore during landing can vary considerably and should be calculated carefully to ensure stability of the capping stack during landout on a mandrel. He pointed out that API RP 17W also states that modelling should be used to "optimize or modify stack designs and installation procedures (Figure 22), and has been the basis of Capping Stack design since the Macondo incident where modelling and analysis were considered by the industry when designing the original and subsequent capping stacks that are currently stored and maintained by the industry.

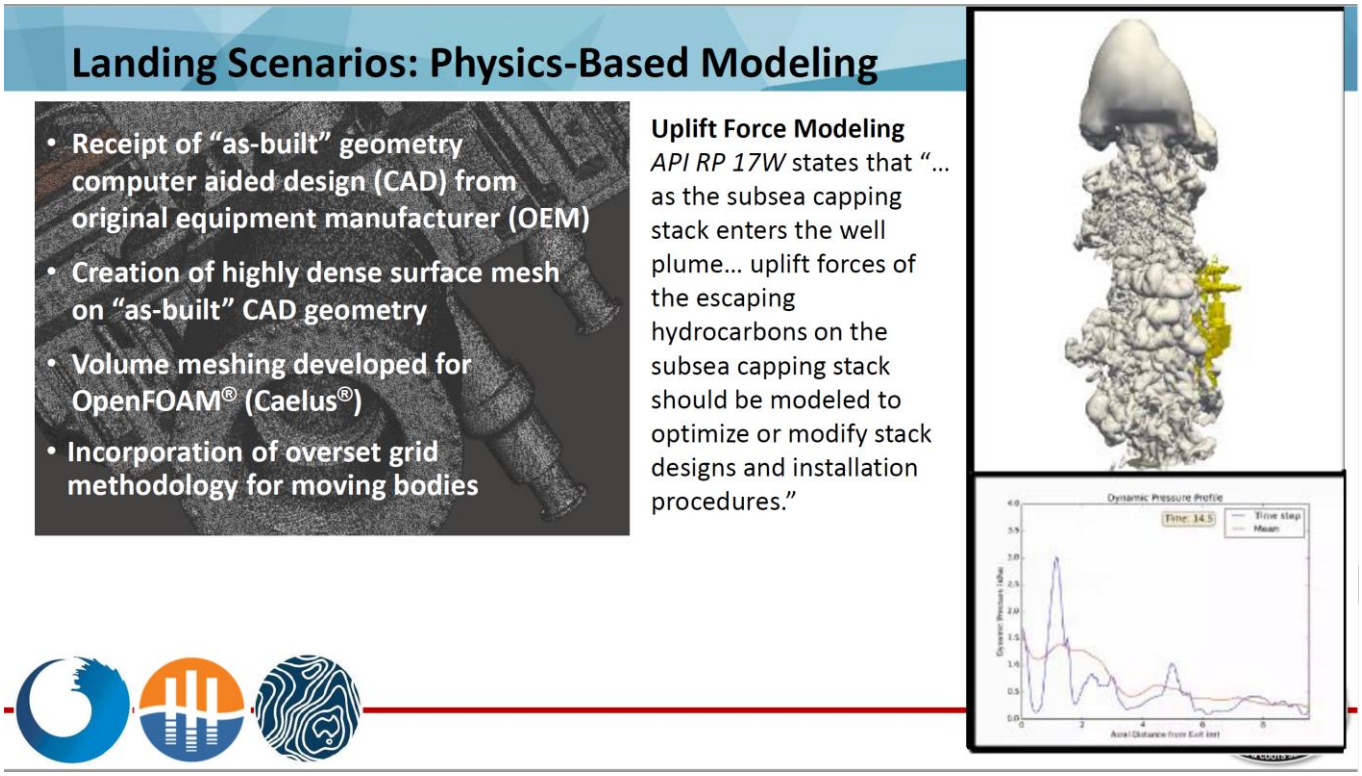


Figure 22: Uplift force modelling requirements

Andy presented a specific case study performed to determine the uplift forces from a simulated well incident. He emphasized that "worst case" conditions should be modelled to confirm the uplift forces that could be present during an incident. Andy presented the analysis that resulted in a 40T maximum uplift force (Figure 23). He applied this case study to the applicability of the lighter Capping Stacks that were now available through the use of smaller through bore sizes and valve technology. Andy introduced Boots & Coots new version of a capping stack and presented slides showing the testing they had performed to prove their design. Highlighting the lower weight and the ability to air freight on a readily available Boeing 747 airplane, he explained how their GRIP system may offer some operators an option to consider, noting also the requirement to load the stack in the side and not the nose of a Boeing 747 requires specific lifting and handling equipment.

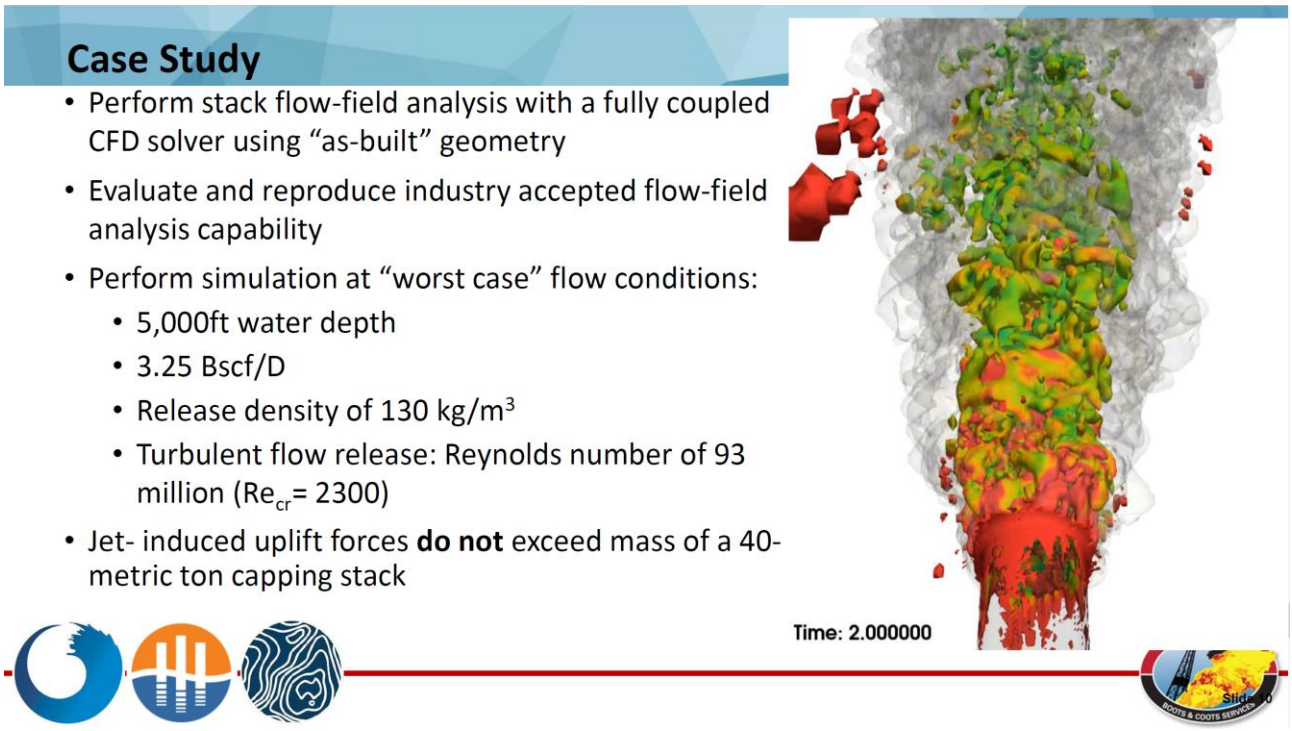


Figure 23: Case study for flow-field analysis

Andy concluded with the following slide (Figure 24), which lists recommendation of the critical areas of capping stack designs that should be performed in the preparedness stages prior to drilling.

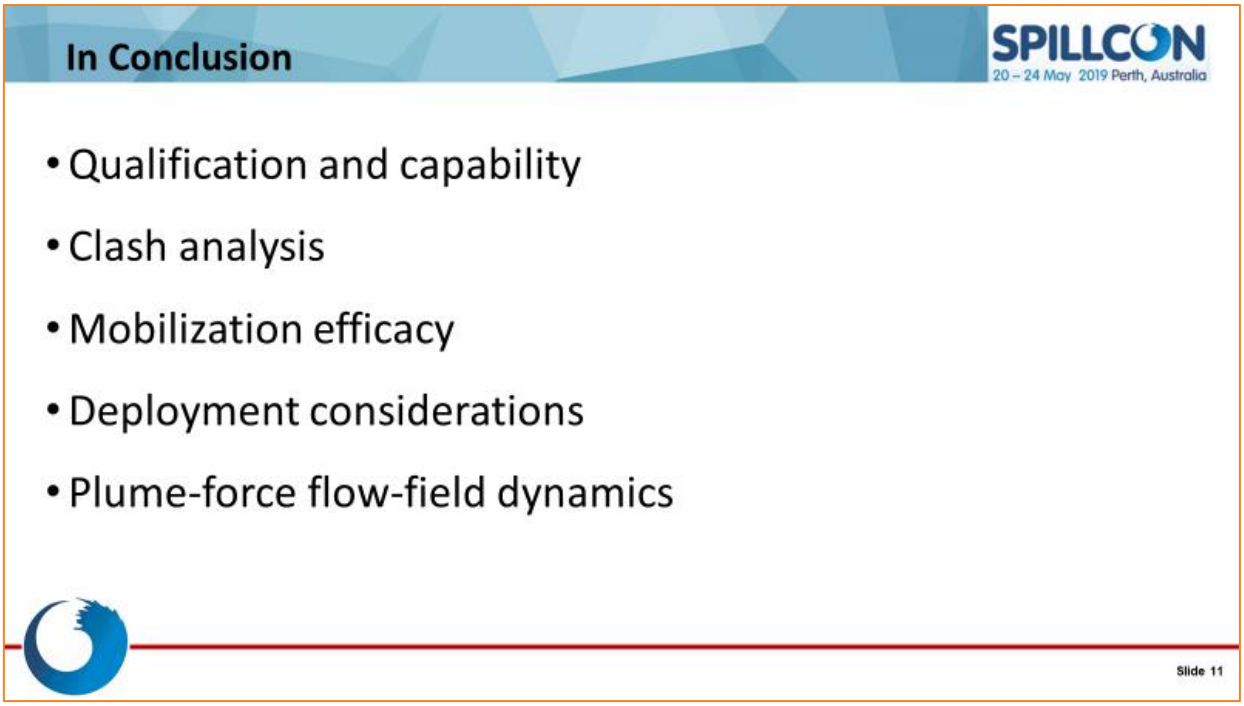


Figure 24: Summery of technical evaluations required for Capping Stack

3.7.1. Workshop feedback and questions – with answers from Andy Cuthbert

- Is your capping stack a viable option on high rate gas wells in Australia?

Yes, absolutely. We have modeled high GOR in shallow water and verified that the RapidCap is viable. We would recommend that a plume force analysis is undertaken, however, as each scenario is different.

- What is the backup plan if reassembly and testing on site damages components?

Although one can never rule out damage to equipment, applicable to any capping stack, we have never suffered damage in any instance during reassembly and testing from the deployment configuration. Because the main components involved are off-the-shelf items, replacements can be accessed very quickly.

- Since exploration wells have very uncertain reservoir properties, how big an impact will this make on CFD analysis for deployment and shut-in procedures?

Correct, reservoir properties will affect the structure of the plume flowfield, it is essential for accurate modeling to have as precise conditions as possible. Given that the flowfield is dependent on the reservoir characteristics, the actual deployment manoeuvre will change case by case. Shut in procedures will depend on well integrity, as long as the well can be shut in the procedure will remain the same, if not then containment is the only other recourse.

- Are you stating that since you've shown that your 40t capping stack can accommodate a 3.25Bcf/day plume during deployment and landing? Then what is the reason for further analysis?

That is entirely at the discretion of the operator. A "worst case discharge" with a high gas rate in shallow water is the worst combination, but each well is different and each scenario, metocean conditions, vessel type, etc will influence deployment and plume characteristics.

- Are you stating that the larger capping stacks are no longer needed?

No, that's not what I'm stating.

- What qualification tests and 3rd party certification was done to support 12,000fwd rating?

I'd have to refer you to the OEM, Trendsetter Engineering Inc. for these details, but they are unlikely to be issued unless you have become a subscriber.

- Does Boots & Coots have an offset installation solution (in shallow water) for your capping stack?

Yes we do, we are currently refining the methodology, and will be conducting a drill in early August to test the procedure.

- Can you provide feedback on valve closure times for your capping stack?

The center valves close with 90 turns. The torque tool used spins at approximately 45 rpm, therefore the most time used to close these valves is approximately two minutes.

- Why hasn't the industry properly embraced accuracy in plume force flow field analysis?

The early analyses provided a convenient "centering force" theory, which was readily accepted by the industry as it "solved" some important issues. However, the fidelity to which the analysis is now being done reveals a spectrum of aspects that should be considered, but the industry doesn't know what it doesn't know, only by educating industry experts and revealing what is involved and at stake, will a higher resolution analysis become accepted as industry standard.

- Since a lot of calculations are not completely infallible, what happens when flow rates cause spinning, or wobbling, or can't land?

Plume force velocity and density combinations, coupled with effects of exit geometry, the fluid/ solid interfaces and GOR, create highly turbulent conditions, resulting in vortices within the plume and result in the overall force flowfield. To wit, the stack will always be prone to movement about the 6 degrees of freedom. Add vessel movement (hull geometry in the given metocean conditions), crane movement on the vessel, spring force in the deployment cable, it soon becomes a complex multi body equation, but intuitively the stack will always "wobble". It is the prediction of the wobble within the plume flowfield that can be modelled to give the stakeholders an insight into what is happening, guide the ROV pilot and vessel captain to ensure that the reaction is anticipated to avoid overreaction or overcompensation. Using actual subsea examples and subsequent customer input, all our analyses have proven that the cap will land, simply put, gravity over uplift forces.

3.8. SPEAKER 6 – Brett Phillips – Subsea First Response & Dispersants

Brett began his talk describing the Australian offshore industry's Subsea First Response Toolkit (SFRT). The slides are included here to accurately list the equipment contained within the kit and to clarify what equipment is not included in the kit stored with Oceaneering.

The SFRT is stored at Oceaneering's Jandakot facility and is maintained and tested on a regular basis. Dedicated scopes of work have been prepared for all maintenance activities and operations activities and records are maintained and available for inspection.

The SFRT contains equipment that may be needed to perform several of the mission plans referred to in IOGP Report 594. Slides showing the various components used in each mission were presented and are shown below as separate figures – Debris Cleaning (Figure 25), Subsea Dispersant Injection (Figure 26), and BOP Intervention (Figure 27). Brett advised that an offshore deployment plan should be developed for each mission.

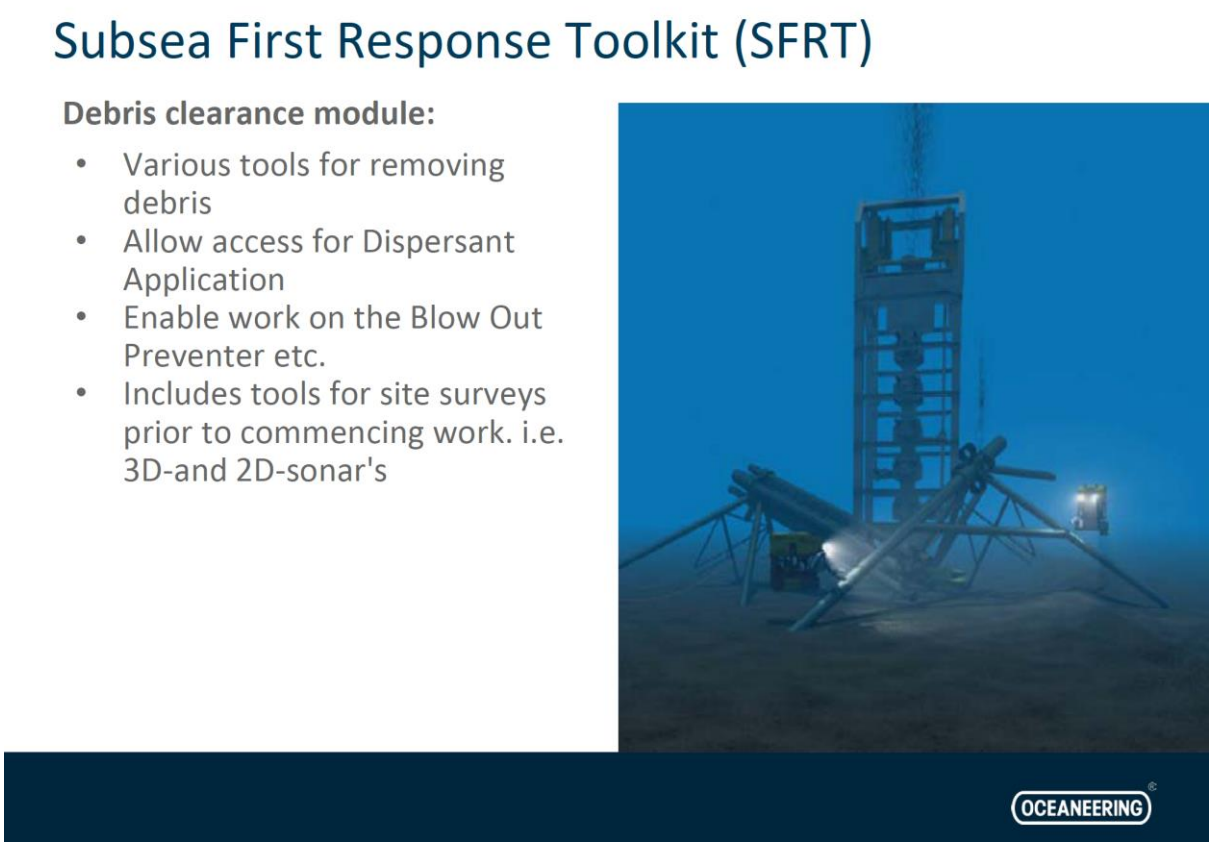


Figure 25: Debris clearance equipment

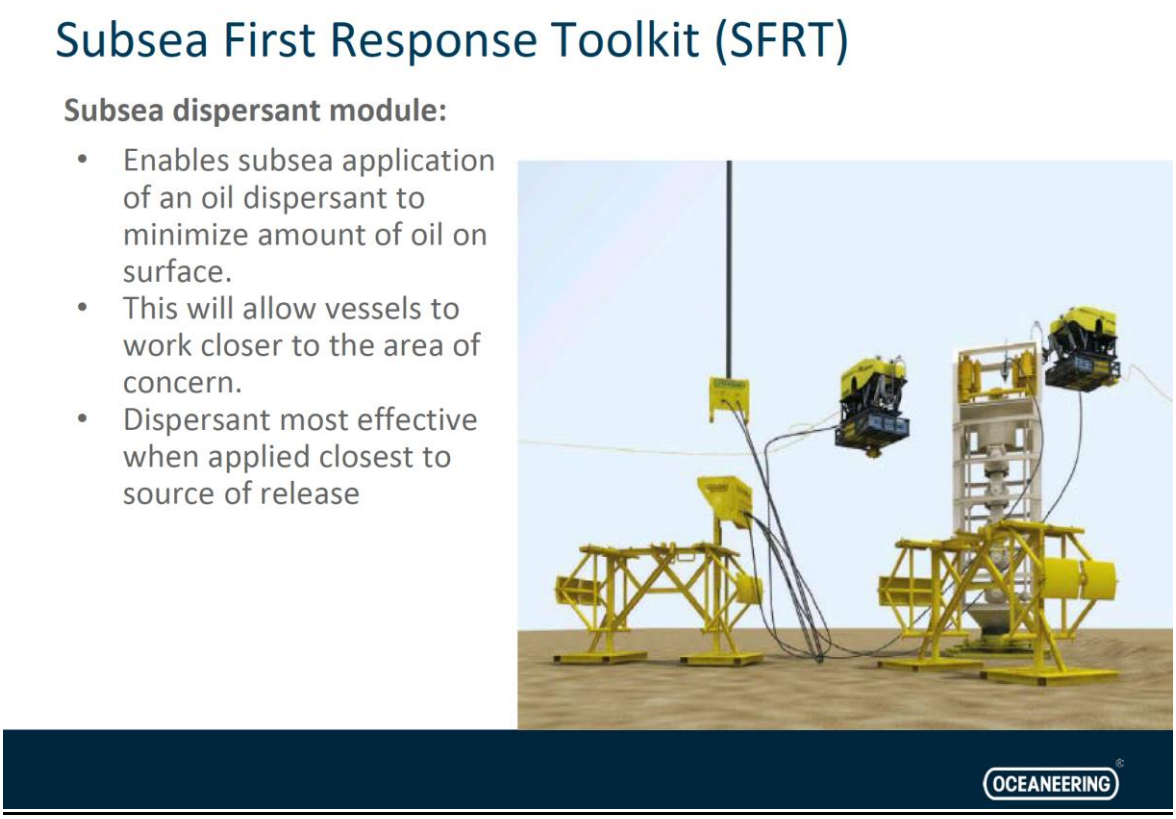


Figure 26: Subsea dispersant equipment

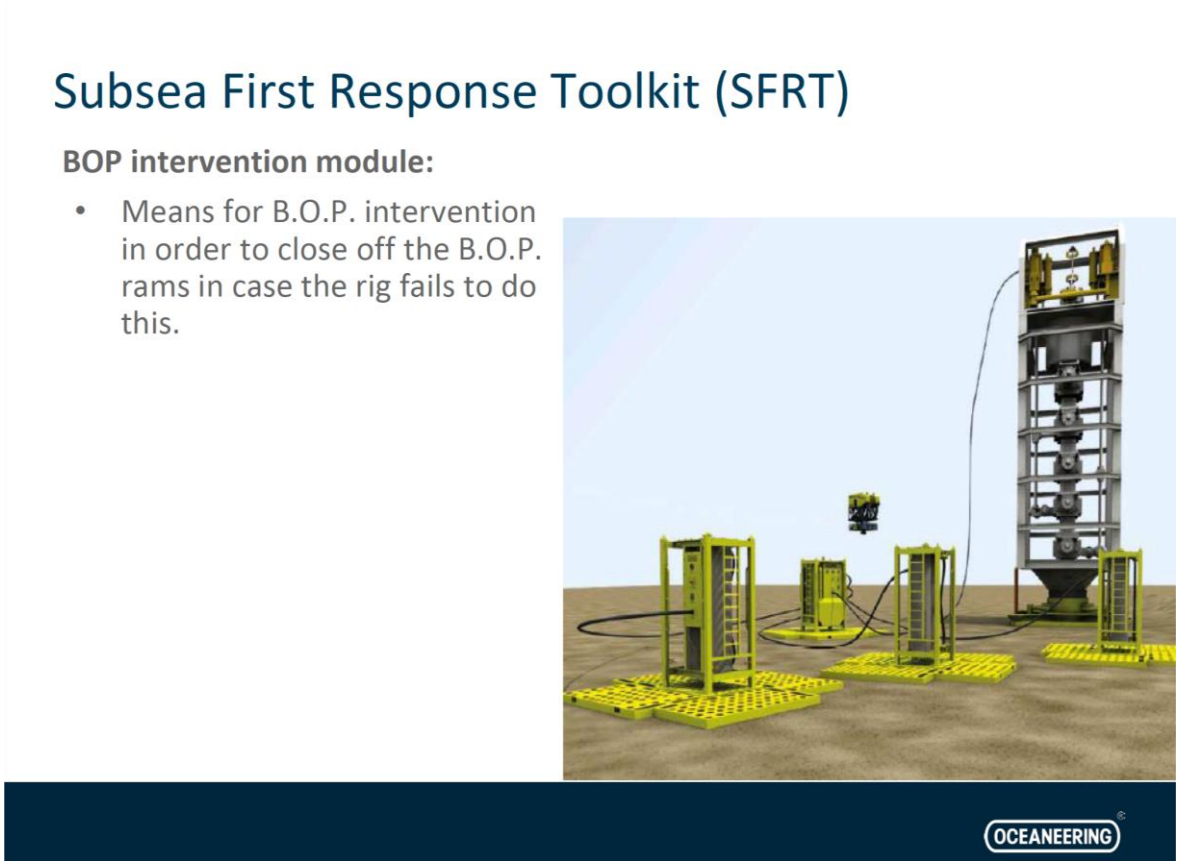


Figure 27: BOP intervention equipment

Brett continued with several slides indentifying additional considerations regarding several of the missions during an incident. He did not review the issues regarding approval processes required to use dispersants, since that subject is covered within IOGP Report 594 and has been well documented including explinations in NOPSEMA Information Papers. His slides highlighted the need for sourcing not only the dispersant chemical(s) but the containers, storage tanks and delivery system required, and the transportation arrangements needed to maintain a suitable supply during an incident (Figure 28).

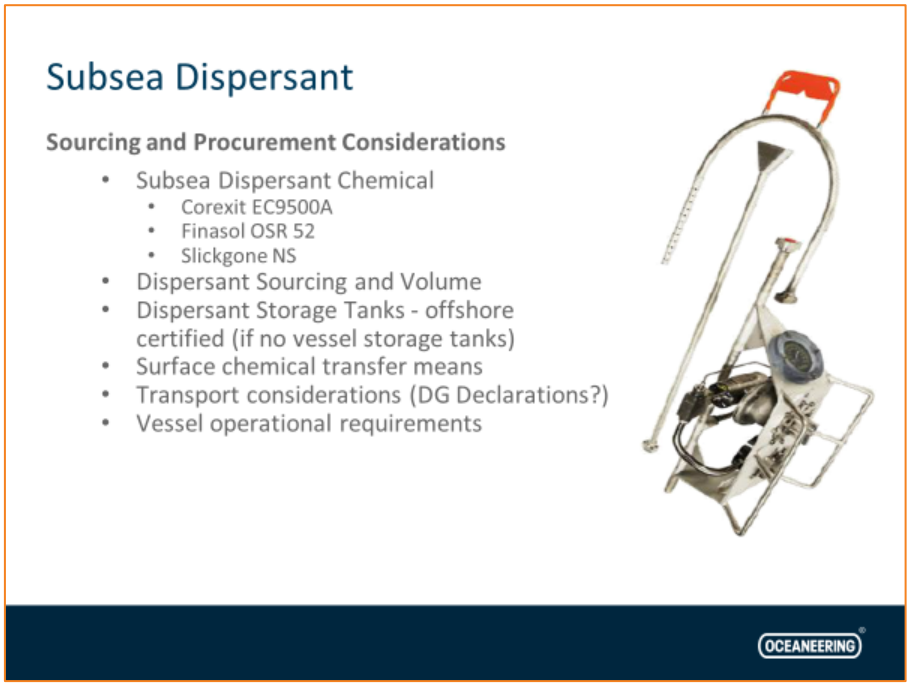


Figure 28: Additional equipment and supplies for dispersant operations

Brett described some of the issues to consider surrounding delivery of the dispersant from the work vessel to a subsea wellhead (Figure 29).

Figure 29: Dispersant delivery considerations

Brett described the additional issues to consider when planning a BOP Intervention mission (Figure 30).

Figure 30: BOP intervention considerations

In addition to explaining the equipment included within the SFRT, Brett highlighted the equipment that is not contained within the kit and must be supplied by the operator or from a 3rd party selected by the operator (Figure 31).

Figure 31: What's not in the kit

Due to the design nature of this type of equipment, several of the equipment items included in the SFRT are typically improved on a regular basis regarding design capability or handling ability and should be investigated by all operators occasionally as plans are reviewed to ensure the latest and most capable equipment is available, especially regarding dispersant delivery systems and pipe or metal cutting/shearing devices.

One of Brett's last slides (Figure 32) was a reminder that each operator is responsible for investigating the requirements for specific interfaces and potential debris removal needs in preparedness phases of a drilling campaign.

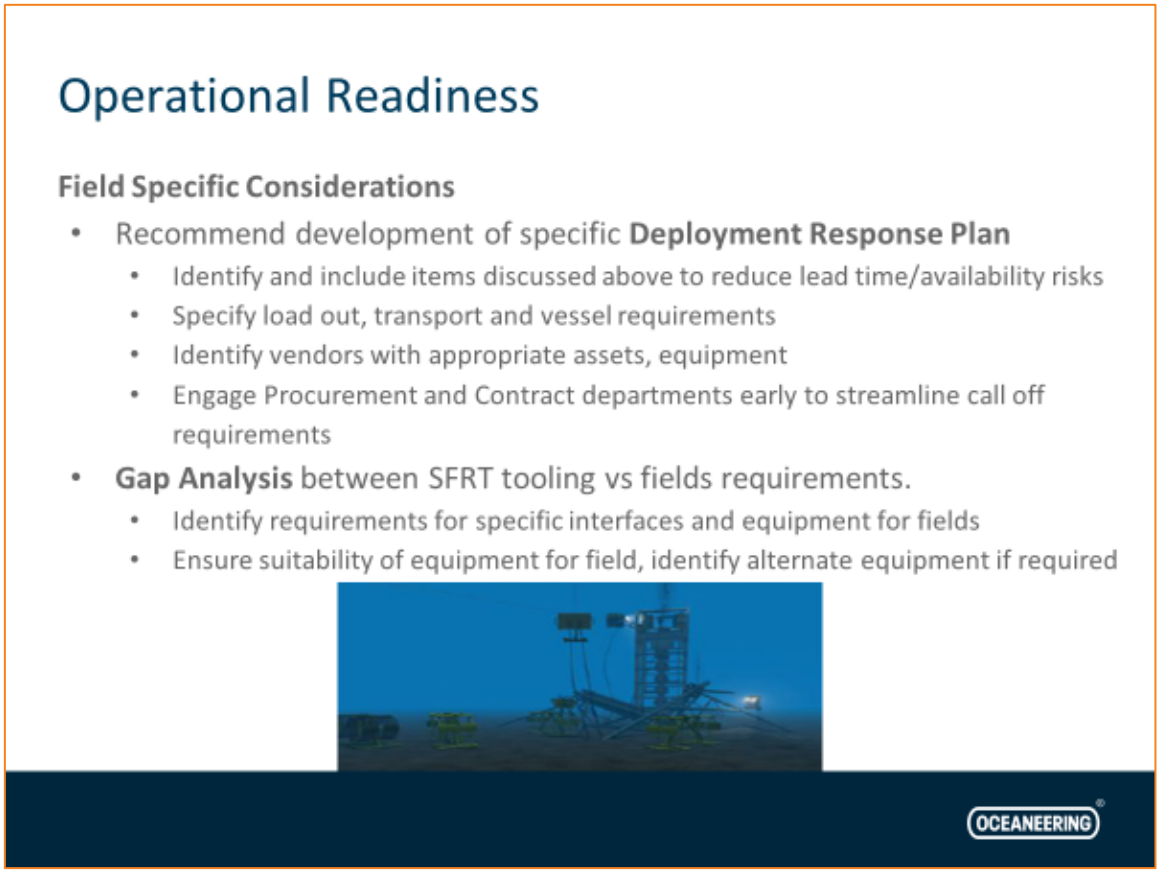
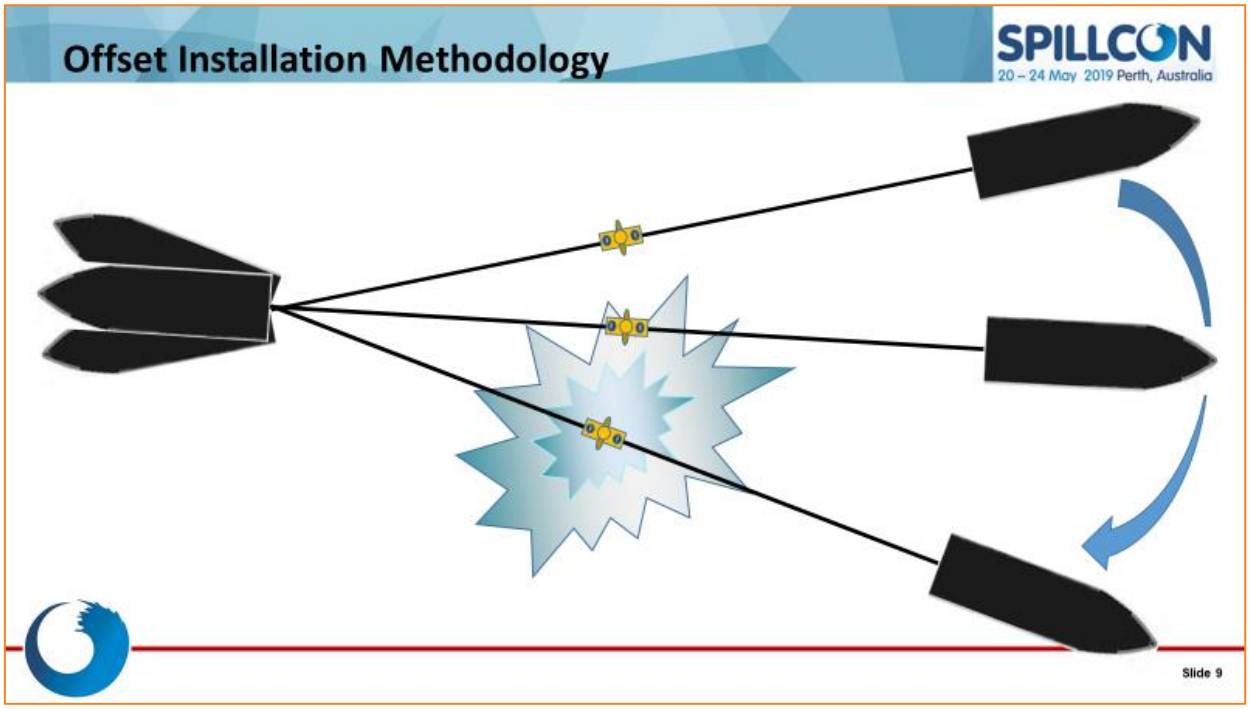


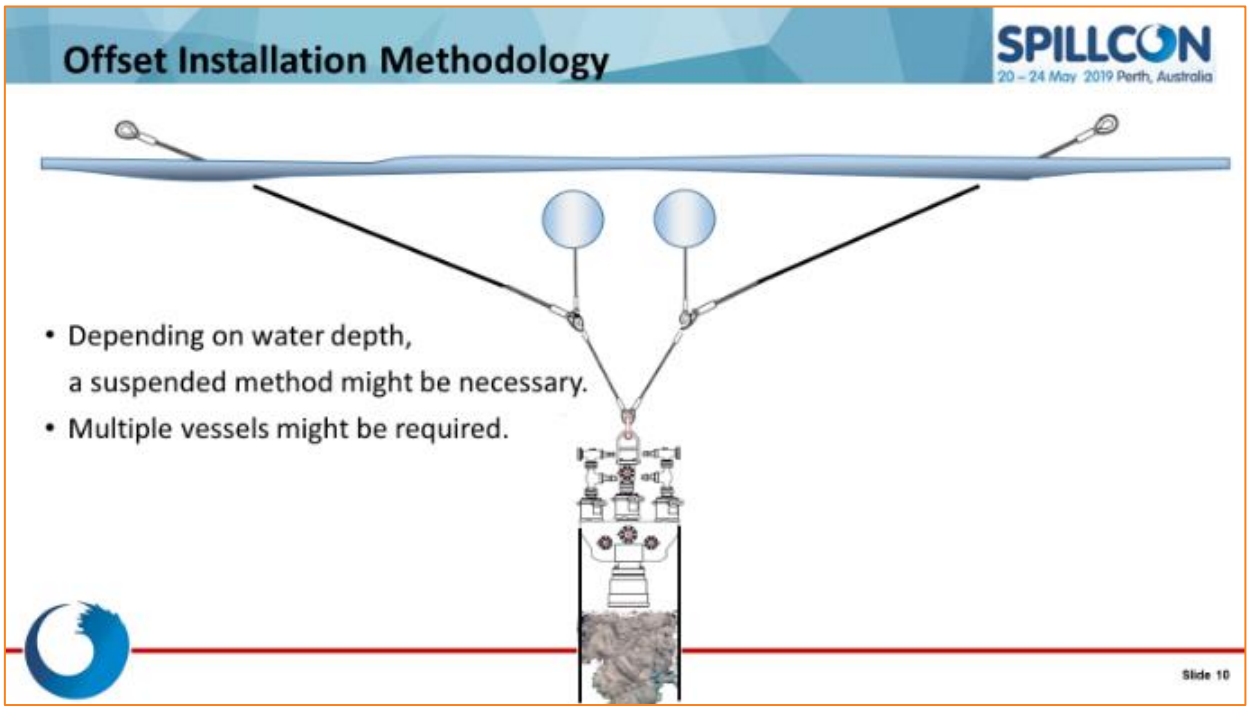
Figure 32: Operational readiness in preparedness activities

There were no audience questions for Brett Phillips.

3.9. SPEAKER 7 – Guy Fox – Landing & Shut In

Guy described an alternative installation method for shallow water incidents where vertical access to the well bore isn't available (Figure 33). Guy discussed the process to approach a well in shallow water and variations on the Offset Installation strategy.





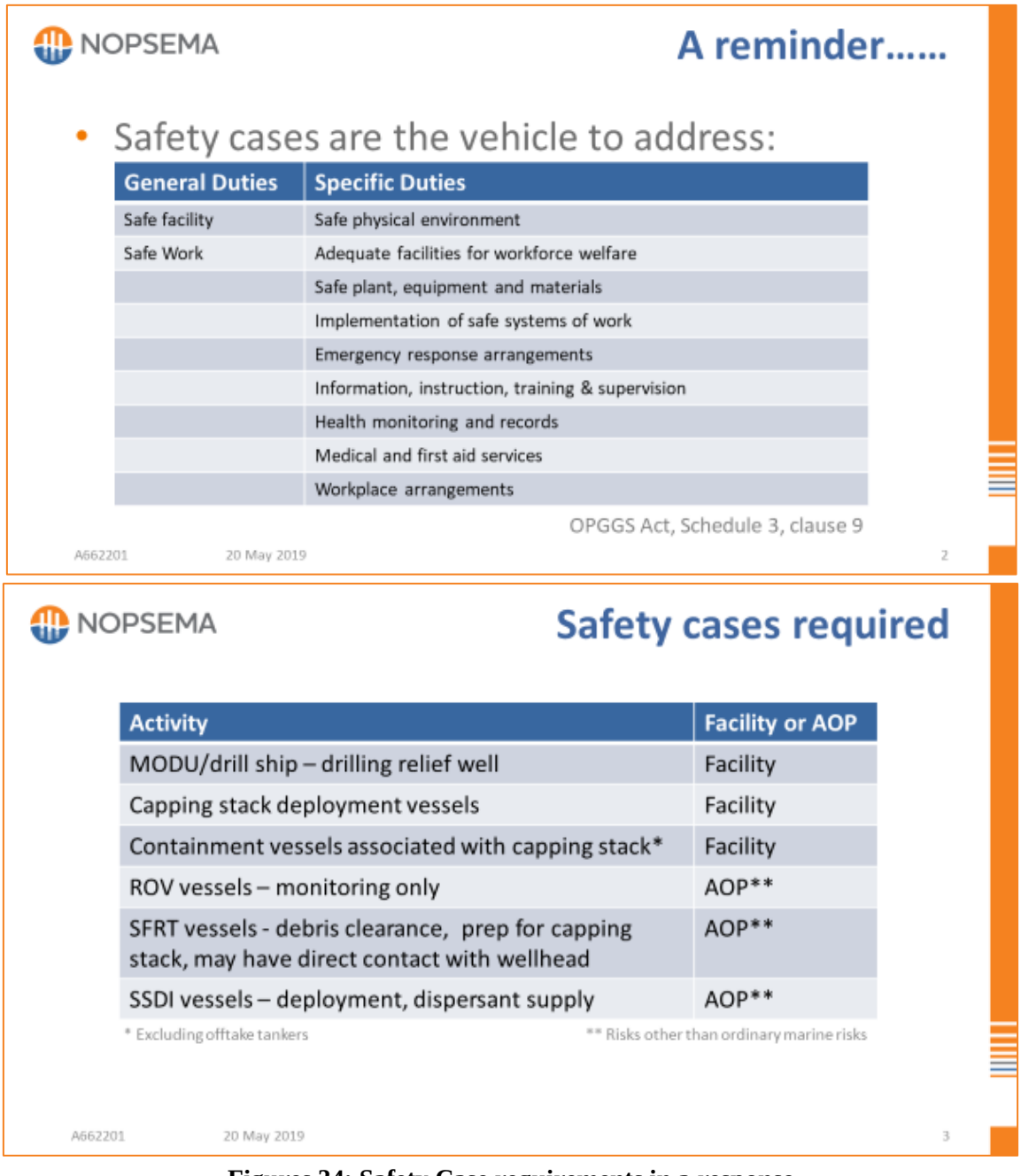
Figures 33: Alternative offset installation method

There were no audience questions for Guy Fox.

4. Logistics, Safety Cases and Transportation

4.1. SPEAKER 8 – Derrick O'Keeffe – Vessel Safety Case Regulatory Requirements

Derrick's presentation provided an overview of the Safety Case requirements and approval process within NOPSEMA. He defined what the Safety Case was designed to address and what activities required 'Facility' or 'Associated Offshore Place' Safety Cases (Figure 34), and stressed that all "out of the ordinary" operations require a separate Safety Case for any vessel operating with Australian waters. He further highlighted that this included all operations during a source control incident.



Figures 34: Safety Case requirements in a response

Using the following slide (Figure 35), Derrick described the Safety Case approval process and explained how the timeline for approvals can stretch from weeks to months if not submitted properly and without prior engagement with NOPSEMA to ensure everyone understands the process. Derek raised the issue that delays can be avoided with sufficient preparedness and planning. Without such planning, unnecessary delays would not be consistent with ALARP principles.

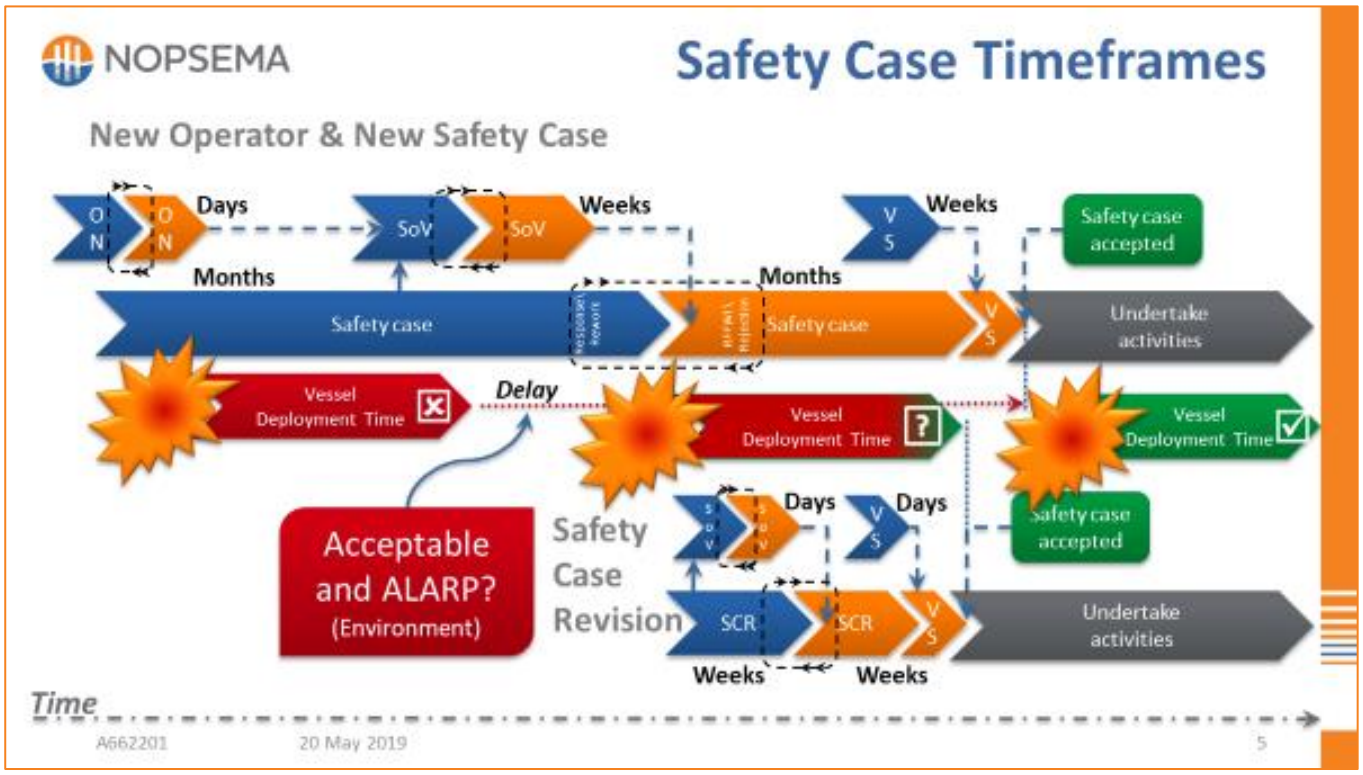


Figure 35: Timing for a Safety Case revision impacts timing of the response

Derrick presented two examples of Safety Case approval processes in the Montara response. The first involved the approval of fire response deluge vessels, which through on-demand planning resulted in a significant timeframe for the Safety Case assessment process, and subsequent abandonment of that aspect of the response. The second example related to the Safety Case assessment and approval of the Relief Well MODU, which was completed in relatively quick time due to thorough preparedness of the MODU for safety case assessment; the decision to approve the Safety Case occurred days before the MODU was operationally ready to begin drilling.

Derrick concluded his presentation with listing some of the key factors affecting the Safety Case approval process (Figure 36), and stressed that operators should look towards collaborative solutions for Safety Case preparedness in order to be suitably prepared for a response.

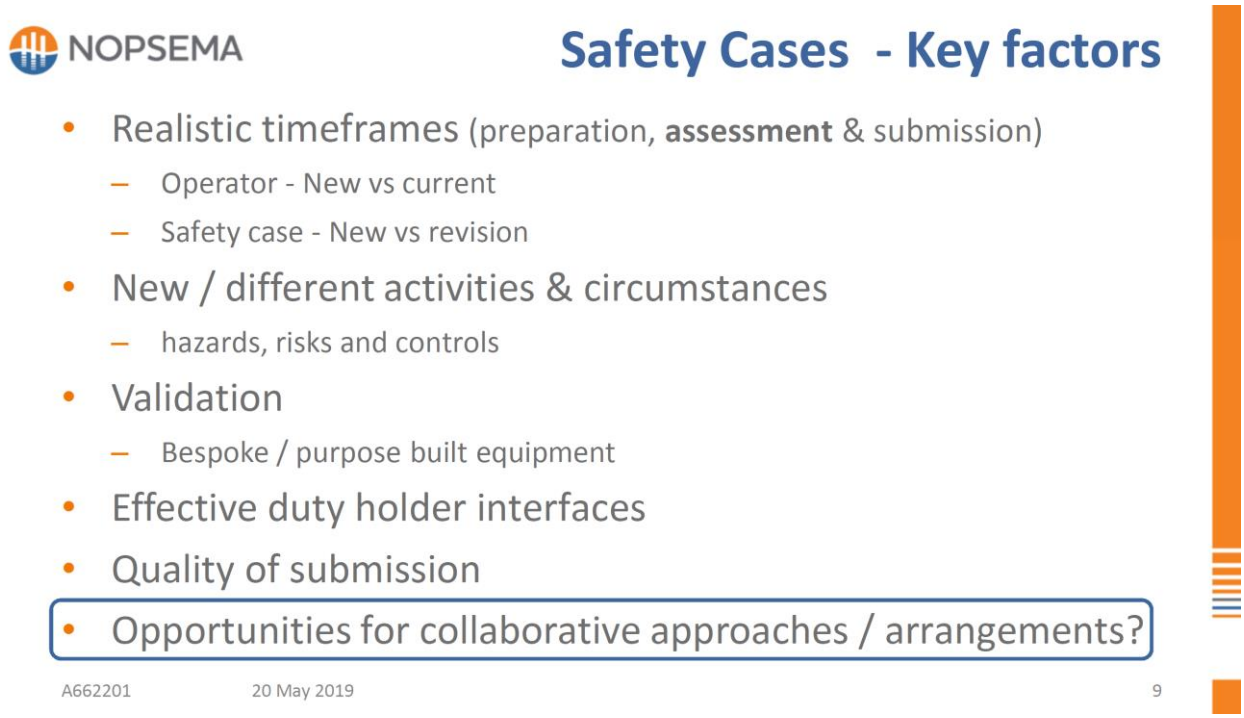


Figure 36: Safety Case key factors

4.1.1. Workshop feedback and questions – with answers from Derrick O'Keeffe

- 1/ What can we do to improve timelines for Safety Case Approvals for response vessel?

Work with vessel operators to develop base safety case revisions for response activities and submit them for assessment prior to undertaking activities.

Well written, structured, and internally reviewed safety cases usually take less time to assess.

- 2/ Can you address if NOPSEMA is amenable to becoming more engaged upfront in the process of approving vessels? IF so, then how?

There is no impediment in submitting a safety case for potential response activities at any time, i.e. titleholders/production facility operators could collaborate with vessel operators to develop safety case revisions covering response activities and submit them for assessment prior to undertaking any activities. This could form the basis for a more rapid safety case revision assessment for a specific scenario.

- 3/ Would NOPSEMA consider a prequalification check list or specification that operators could use to pre-qualify the vessels listed in their SCERP?

No, this is a matter for the operators to consider for the activities they are contemplating undertaking and in what and circumstances. NOPSEMA guidance Vessel facilities subject to external hydrocarbon hazards, N-04300-GN1733 in particular provides specific guidance relevant to spill response activities.

Operators should not be considering prequalification checklists for vessels undertaking response activities. The Safety Case is required as a mechanism to provide a safe working environment and help keep personnel safe while undertaking the response. Safety cannot and will not be compromised. Any deviation from the Safety Case Revision and acceptance process could result in unnecessary safety incidents, which

would further compound what would already be a "bad day". No prudent operator should ever find themselves in that position.

- 4/ Can a base case be prepared in advance for specific incident response operations; i.e., a subsea dispersant application vessel or a capping stack installation vessel?

Yes, a safety case could be prepared and submitted for assessment. Depending on the operational boundaries the case covers, this may mean an activity specific safety case revision would not be required.

- 5/ Can the process of reviewing a Safety Case be simplified by having more detailed guidelines in advance – perhaps a template?

As noted above NOPSEMA has already published guidance that would be particularly pertinent noting it forms part of an extensive suite of safety case guidance. Arguably the requirements in the Part 2, Division 1 of the OPGGS(Safety) Regulations provides a template for a safety case given the 12 pages of content requirements.

- 6/ Can quarantine requirements be shortened or eliminated in some cases?

This is a matter for AQIS and/or other agencies, departments

- 7/ During an incident, are there any Safety Case requirements that can be waived?

No, although there is provisions for some exemptions as covered in the NOPSEMA Exemptions Policy - N-05000-PL0157

- 8/ Is there any difference in SC requirements for "peacetime" versus "wartime"?

No, a case for post incident response activities still has the same requirements, the context has just changed. Possibly the risk to personnel has increased as you have an uncontrolled situation. Safety will be number 1 priority and we won't allow a reduction of standard in 'wartime' to expedite a response, particularly if this is going to expose people to heightened risk.

- 9/ For an incident, can NOPSEMA prioritize the approval process in any way?

In the event of an incident NOPSEMA would appropriately resource and prioritize assessment of associated submissions. NOPSEMA will be committed to rapid timeframes, but that may not improve the SC approval timelines if the SC is not prepared well. Pre-planning will achieve timeframes much shorter than NOPSEMA could otherwise. Priority would be given to the incident over other workloads e.g. 7 day and extended working hour operations.

- 10/ Is there a NOPSEMA database listing types of vessels with accepted VSSC & expiration dates?

No, however NOPSEMA is working on having the operator register indicate if there is a safety case in force for a facility.

- 11/ Do NOPSEMA and NOPSA regularly communicate? If so, how?

Assuming the question refers to NOPTA (NOPSA was NOPSEMA's predecessor), NOPSEMA and NOPTA do communicate on a regular basis on matters of mutual interest.

- 12/ Why not have a "Mission Safety Case" which covers the deployment of all of the "Yellow Kit" which is known? The SCE for the vessel can be identified and then when the vessel is chosen, its capabilities are checked versus safety case.

See points 1, 2 and 4 above. You could prepare parts of a safety case regarding the activities and specific tools and equipment, however a significant proportion of the risk controls will still belong to the vessel facility, so you could work collaboratively with other operators and with potential response deployment vessel operators to prepare 'Mission Safety Cases' with as much available information as possible prior to undertaking a drilling campaign. These Mission Safety Case (templates) could be used for multiple drilling campaigns and multiple operators.

You could identify the range of vessels that comply with specification requirements for response activities, and working either collaboratively with other like operators and vessel operators or independently, create a Safety Case revision for the response activities and a suitable vessel, and submit it for assessment prior to undertaking the activity. In the event of an incident requiring the response activities, modify the draft Safety Case with specific vessels chosen to undertake the activity. In reality, for the heavy lift heave compensated requirements there are limited vessels, and most response activities can be well defined in preplanning to enable preparation, submission and assessment of a Safety Case revision prior to undertaking the activity.

4.2. SPEAKER 9 – David Pulk – Transport and Deployment Logistics

David began his presentation by highlighting the areas of current offshore development by the major operators with regards to potential use of a capping stack (Figure 37), and where the Capping Stacks may be coming from (Figure 39).

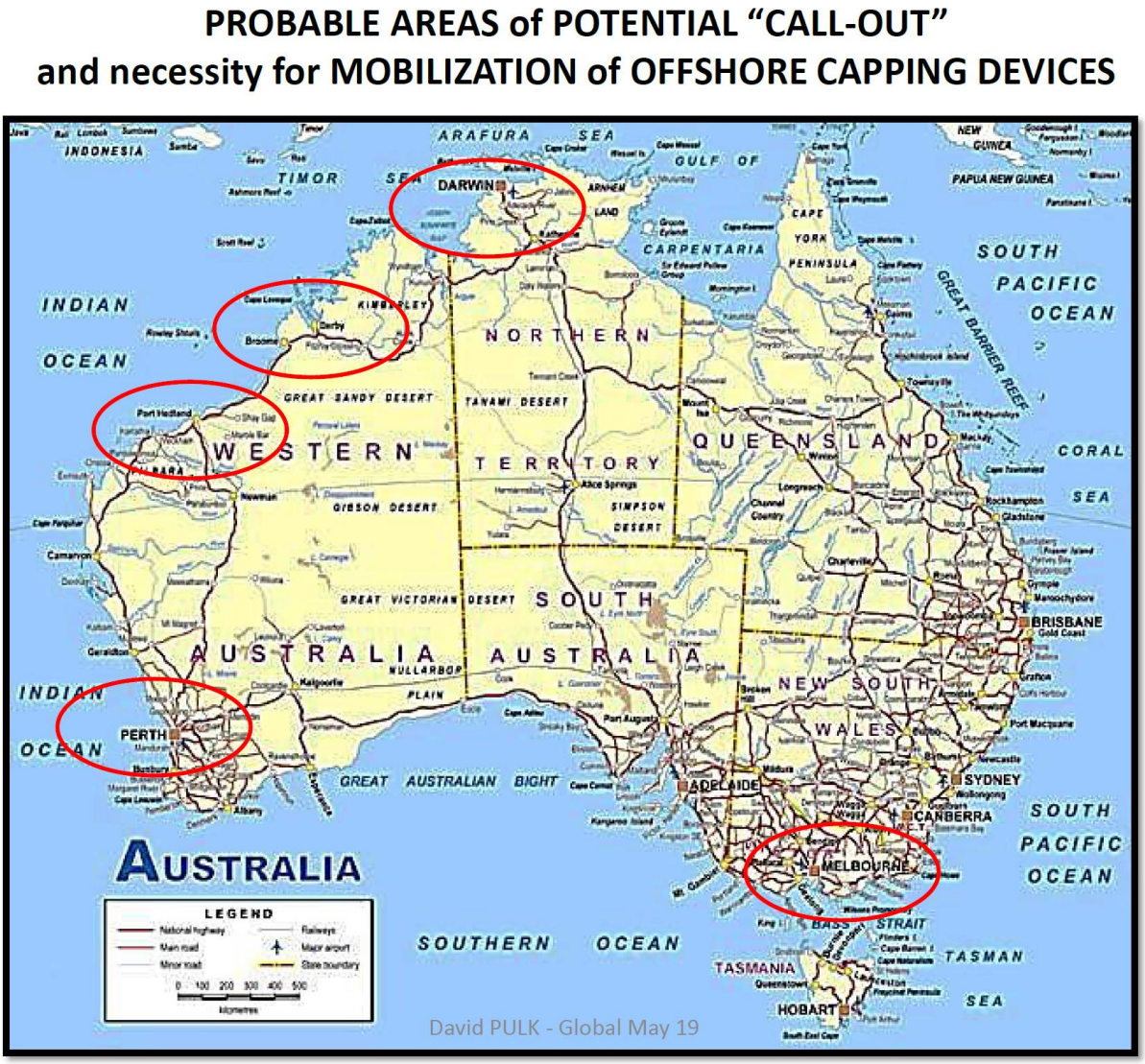


Figure 37: Areas potentially requiring Capping Stack delivery in Australia

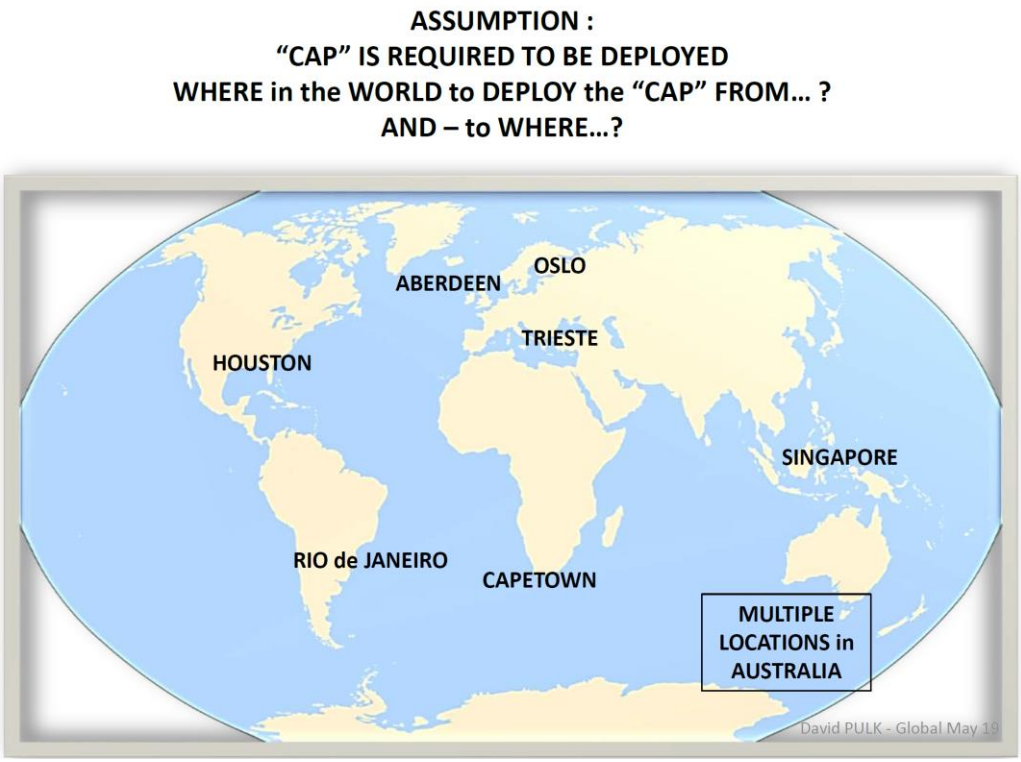


Figure 38: Potential origins of capping Stacks

He noted the evaluation required for suitable destination airports (Figure 38).

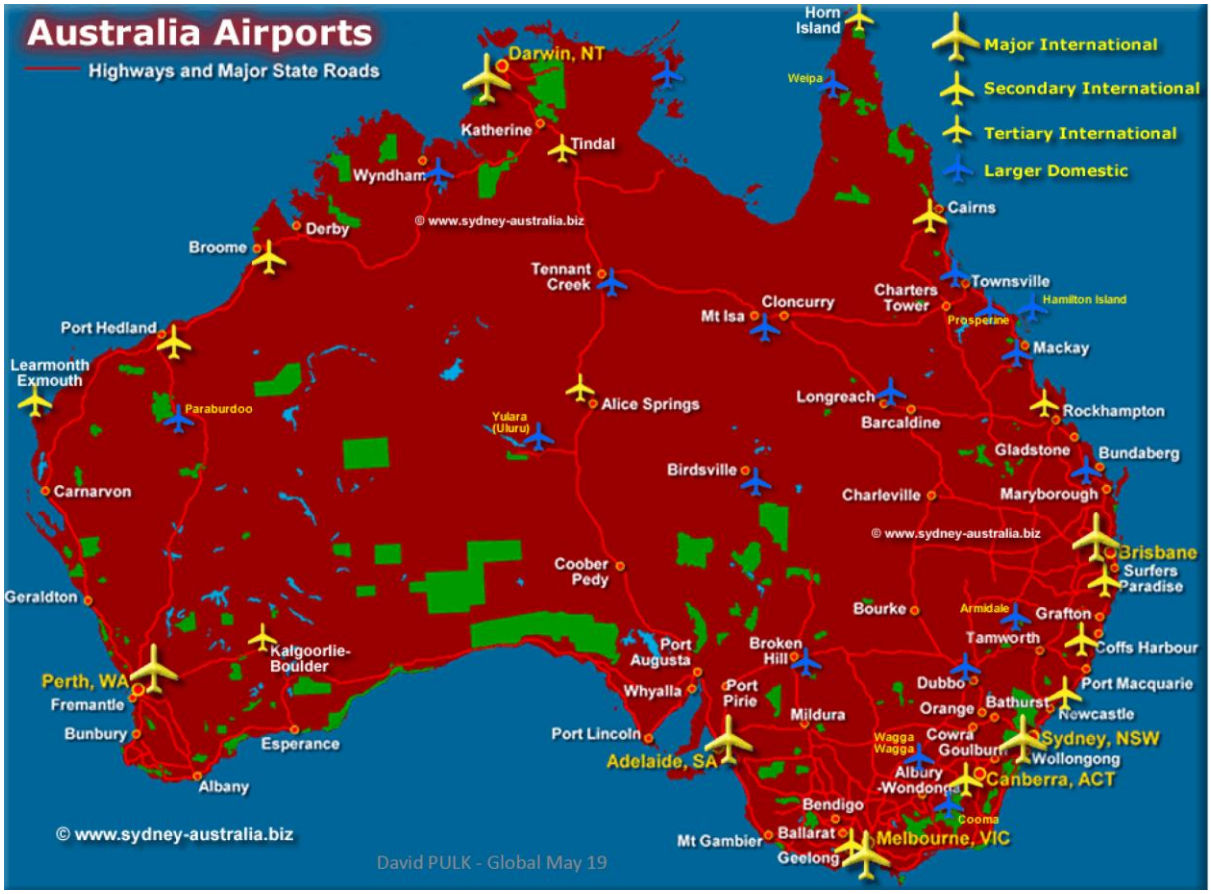


Figure 39: Possible destination airports

He described the areas of concern after landing at an appropriate airport (Figure 40).

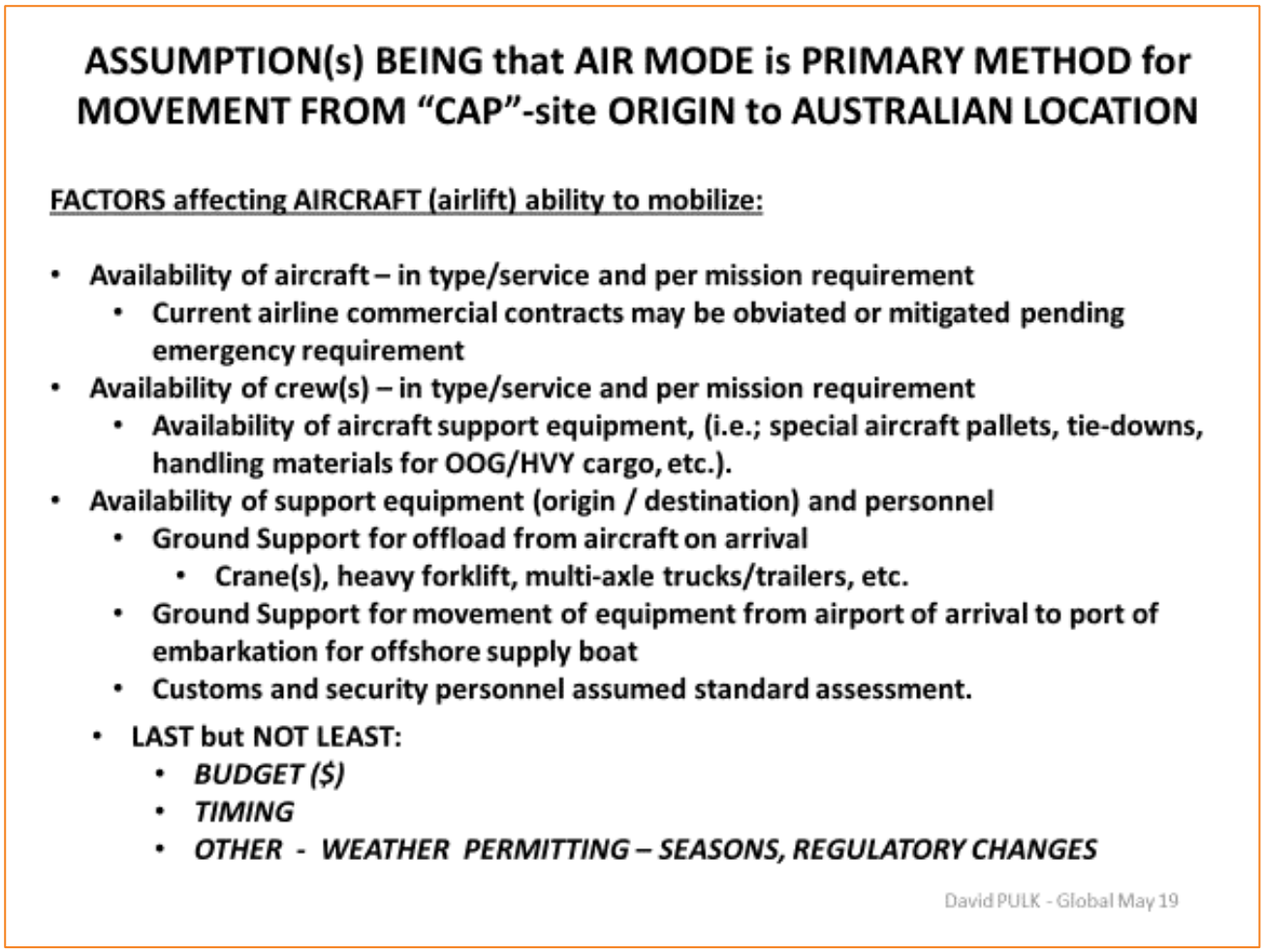
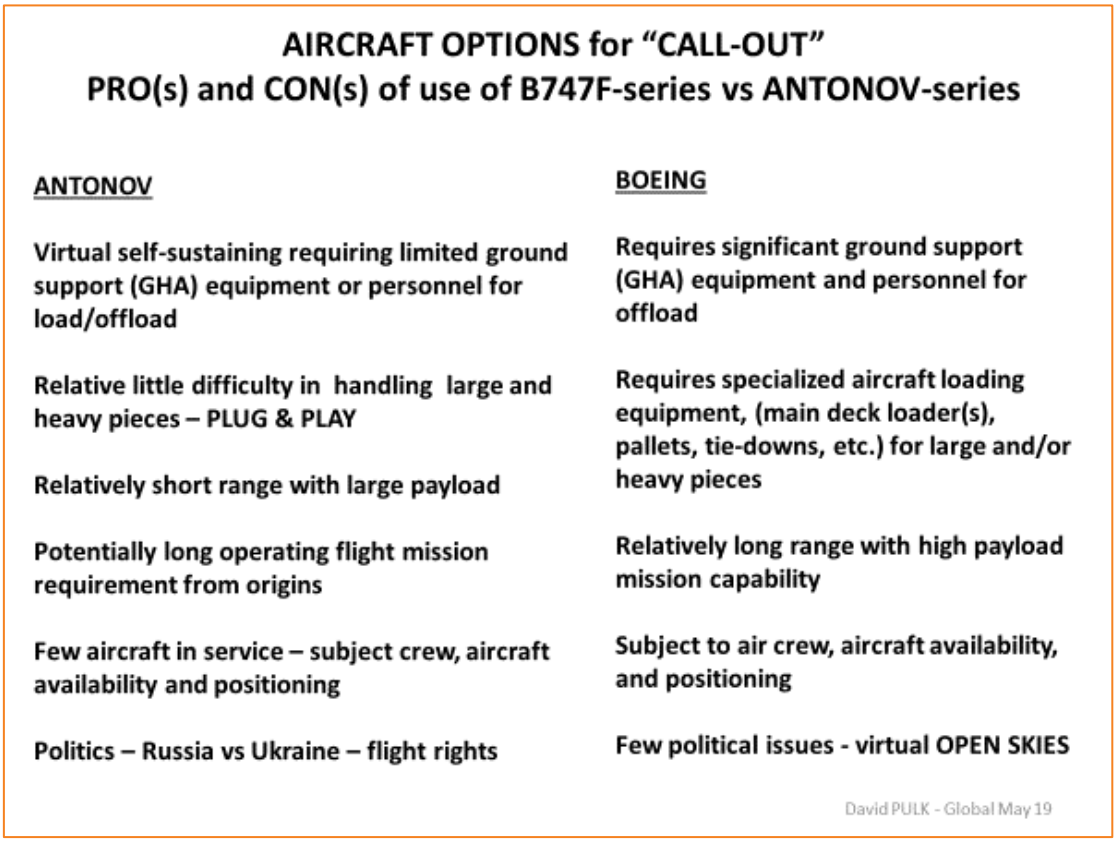
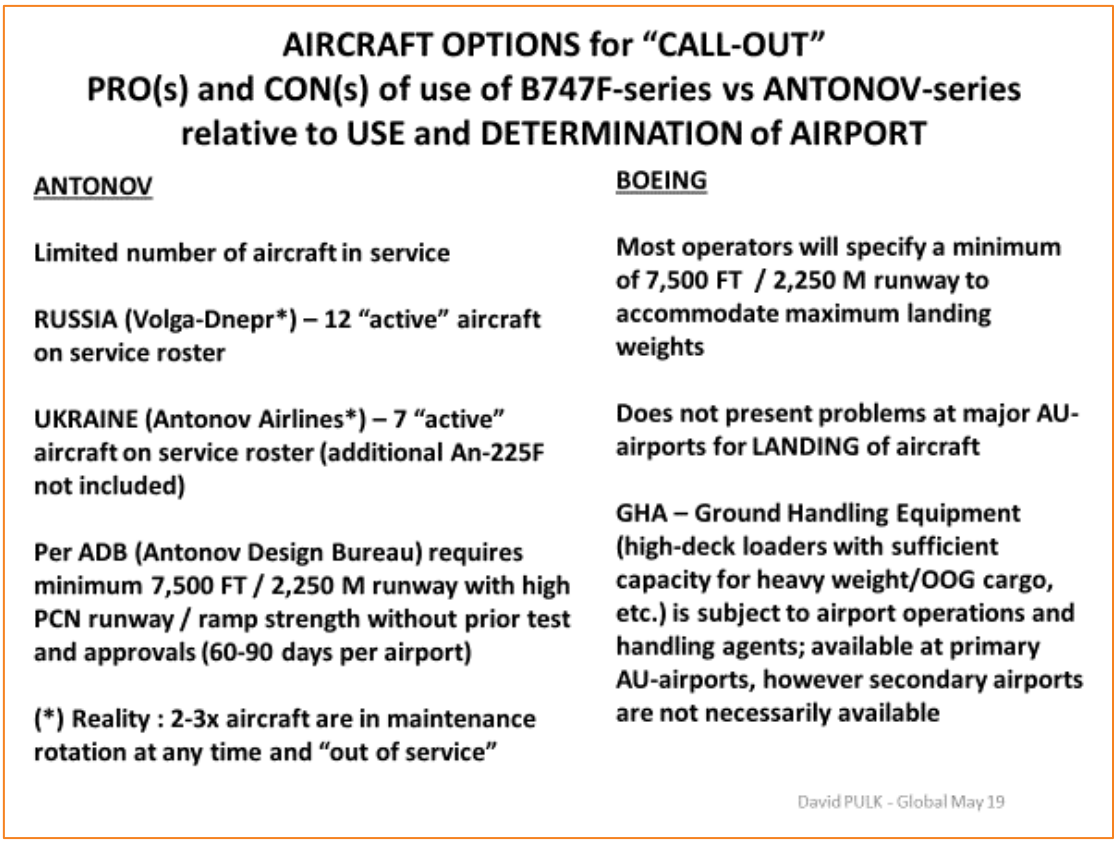


Figure 40: Factors affecting aircraft ability to mobilise

David examined the airframe differences and explained the comparisons of the Boeing 747F versus the Antonov AN-124 (Figure 41) – two of the highest rated cargo planes in popular use for transporting large heavy equipment.





Figures 41: Aircraft comparisons

David summarised the different considerations in evaluating the aircraft (Figure 42).

POINTS to CONSIDER IN EVALUATING AIRCRAFT and/or OPERATORS
THEY MAY "LOOK" the SAME – however, THEY ARE DIFFERENT
SO – WHAT's the DIFFERENCE?

The type certificate and basic ANTONOV-124F aircraft is a 1970s design of Antonov Design Bureau (ADB) of Kiev, Ukraine, first built and delivered in the mid-1980s, and later modified in the early 1990s from military-to-civilian use and designated AN-124-100F. The aircraft TYPE has been manufactured in Kiev (ADB), Ukraine and Ulyanovsk, Russia under license to CJSC-AviaStar-SP.

The "newest" aircraft is now 25+ years old, and there are no new aircraft currently in production, however there have been upgrades to the current fleet and further in progress. Current aircraft operators are Russian – Volga-Dnepr Airlines, Ukrainian – Antonov Airlines, UAE - Maximus Airlines – singular aircraft managed by ADB agreement.

The Russian military operates a number of AN-124-100F and/or AN-124F aircraft, and in 2014/15 time frame re-absorbed the aircraft from 224 F.U.S.A. into the Russian Air Force.

Currently, there are existing restrictions placed on either/both Russian/Ukrainian operators – as to revenue-based flights, over-flights, use of airspace, etc. Eg. A USA-D.O.T. (Dept. of Transportation) imposed ruling, may also affect other countries who may have restrictive policies as to "open skies" determination and regulatory issues for filing prior to operating.

David PULK - Global May 19

Figure 42: Aircraft – what's the difference?

He cautioned on making assumptions on generic capabilities. Not all aircraft are the same (Figure 43).

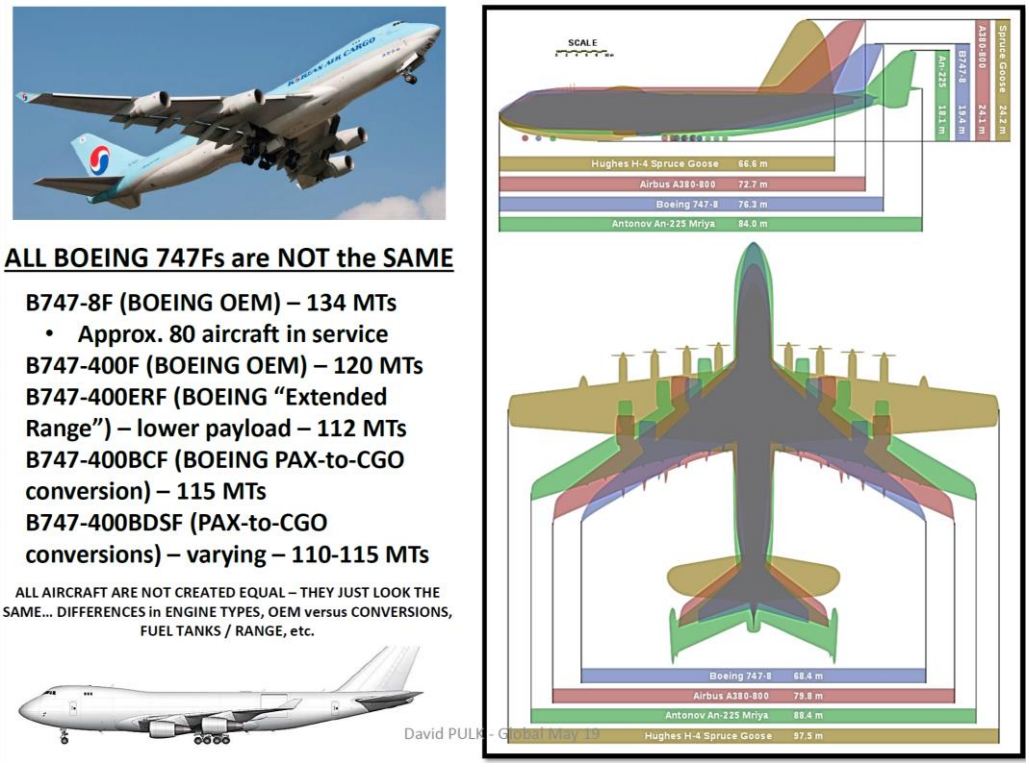


Figure 43: Differences in 747Fs

Finally, David offered some suggestions for improving any timeline involving air freight and crossing international borders (Figure 44).

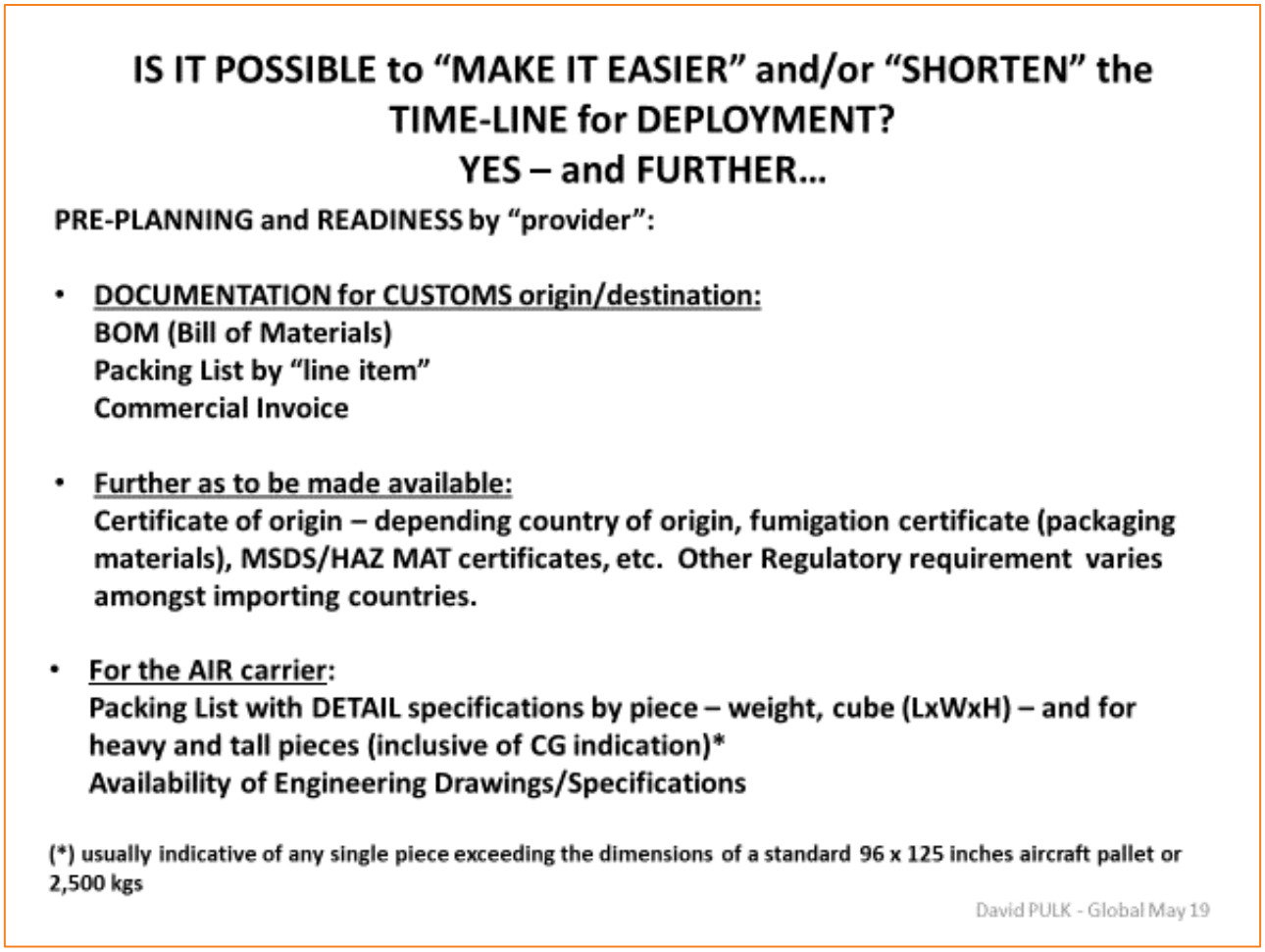


Figure 44: Improved timelines for aviation transport

There were no audience questions for David Pulk.

5. Response Ready Personnel and Incident Site Location

5.1. SPEAKER 10 – Chris LeCompte – Response-ready Personnel Arrangements & Procedures

Chris began his presentation describing the challenges involved in assembling an incident response team. He emphasized that the various roles of incident response team members require tasks that are usually outside normal work scopes while the stress levels are also highly elevated. He highlighted that the normal daily operations would probably continue in some fashion which tends to increase the stress levels even more. Chris pointed out that an operator will find that only with proper planning and exercises can anyone be expected to react safely and efficiently to a source control incident.

Creating a high-level incident command organizational chart, he noted the considerations for preparing appropriate numbers of personnel (Figure 45).

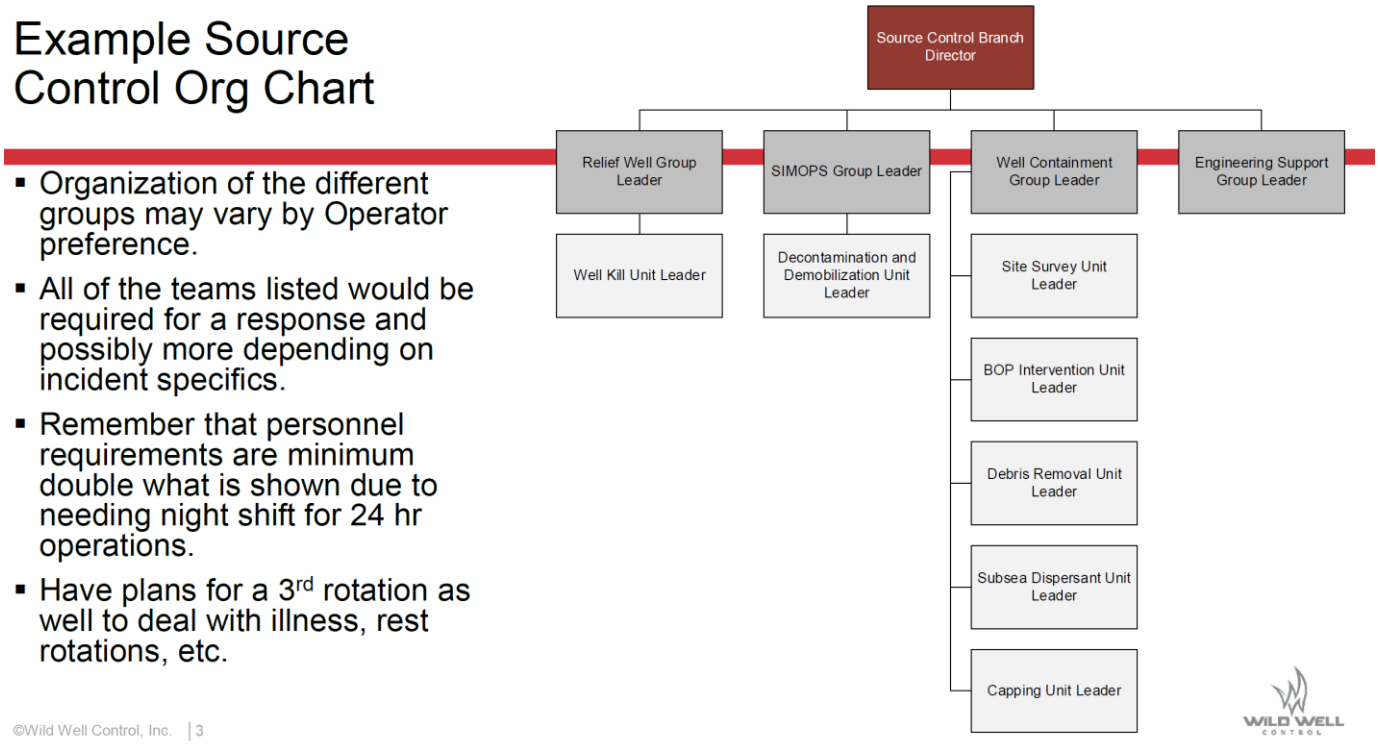


Figure 45: Considerations for personnel numbers

He offered some additional recommendations regarding office space, communication setup, as well as housing and catering (Figure 46).

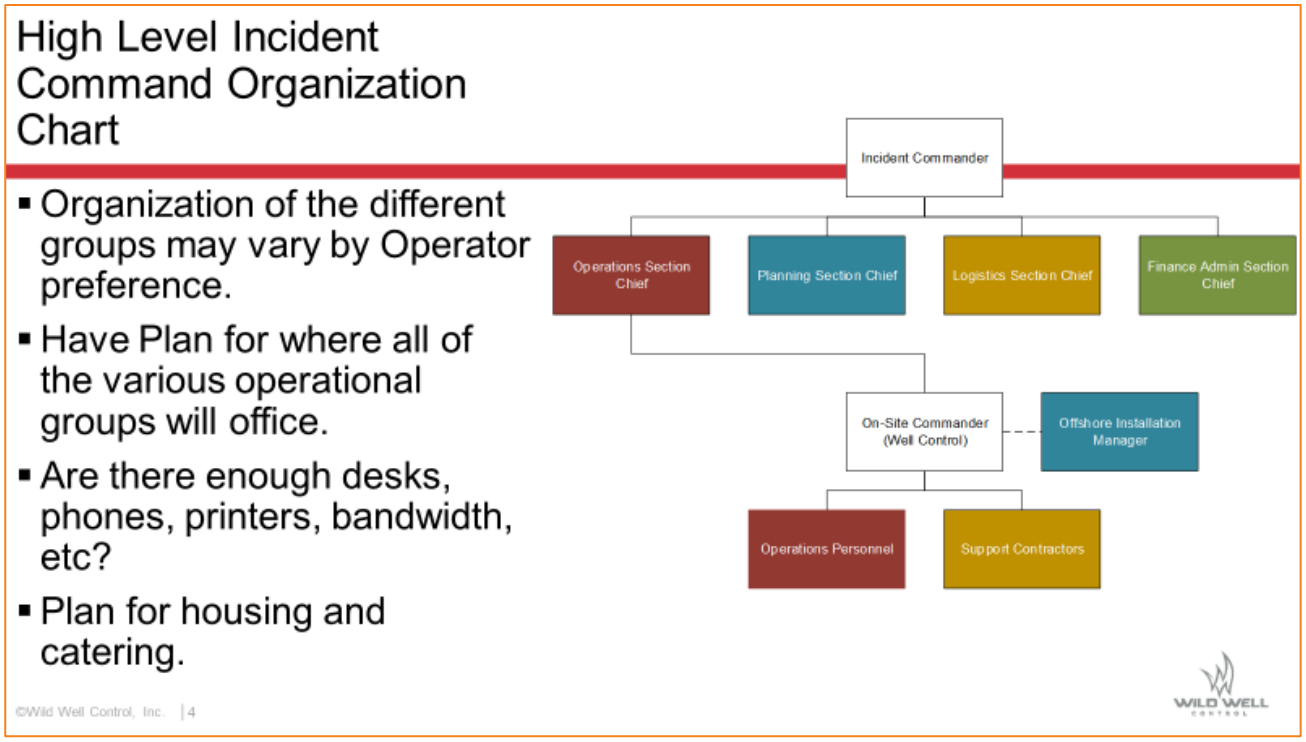


Figure 46: Additional considerations

Chris noted that there is more positions and personnel to consider for support of the Source Control Team, which should be addressed in preparing for an incident (Figure 47).

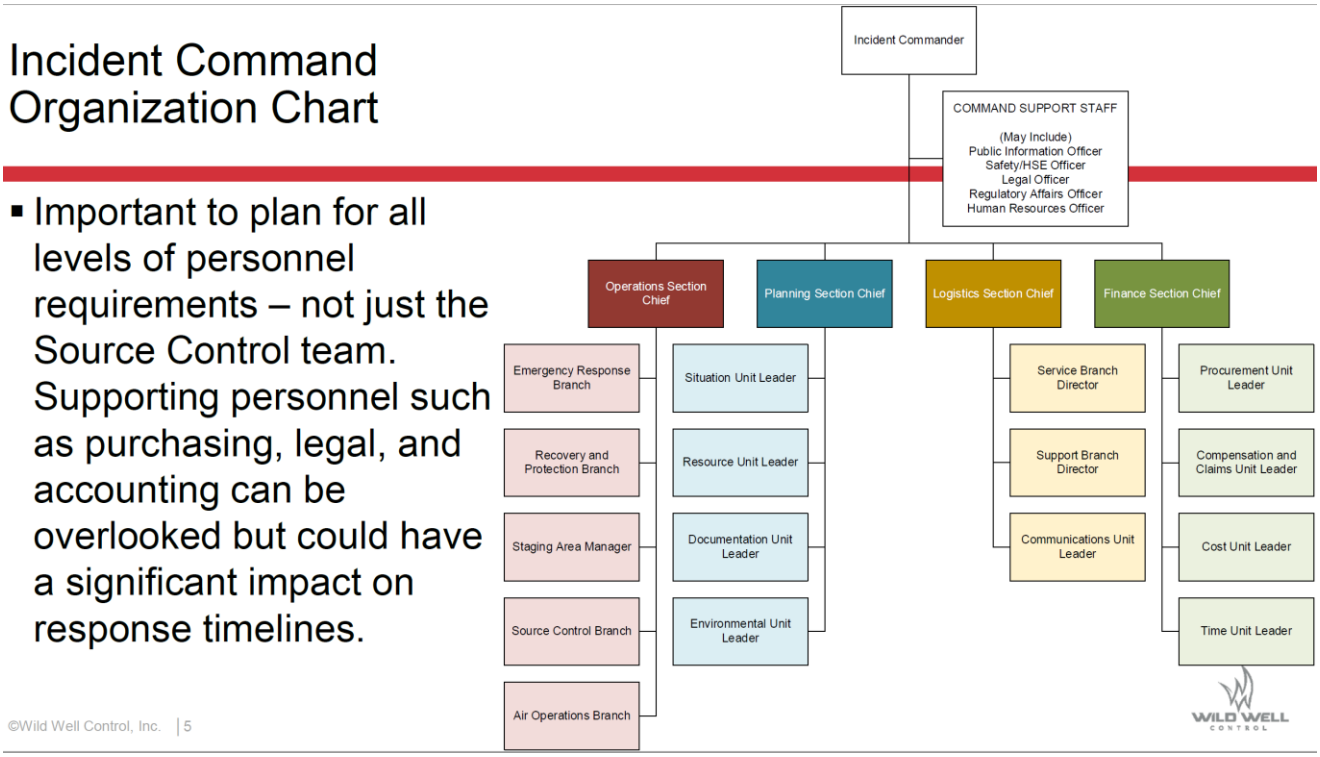


Figure 47: Support positions

Chris highlighted the need to plan and prepare prior to undertaking drilling campaigns (Figure 48).

Planning for Personnel Needs

- Put together Organization Charts for Response Scenarios (Small, Medium, Large).
- Identify personnel from within the Company to fill the required roles. Remember to account for night shift and a minimum of 1 alternative.
- Identify any open gaps in staffing.
- Establish plans to fill the gaps:
  - Company personnel from another region
  - 3rd Party Contractors
  - Consortium Models, i.e. Mutual Aid

 6

WILD WELL CONTROL

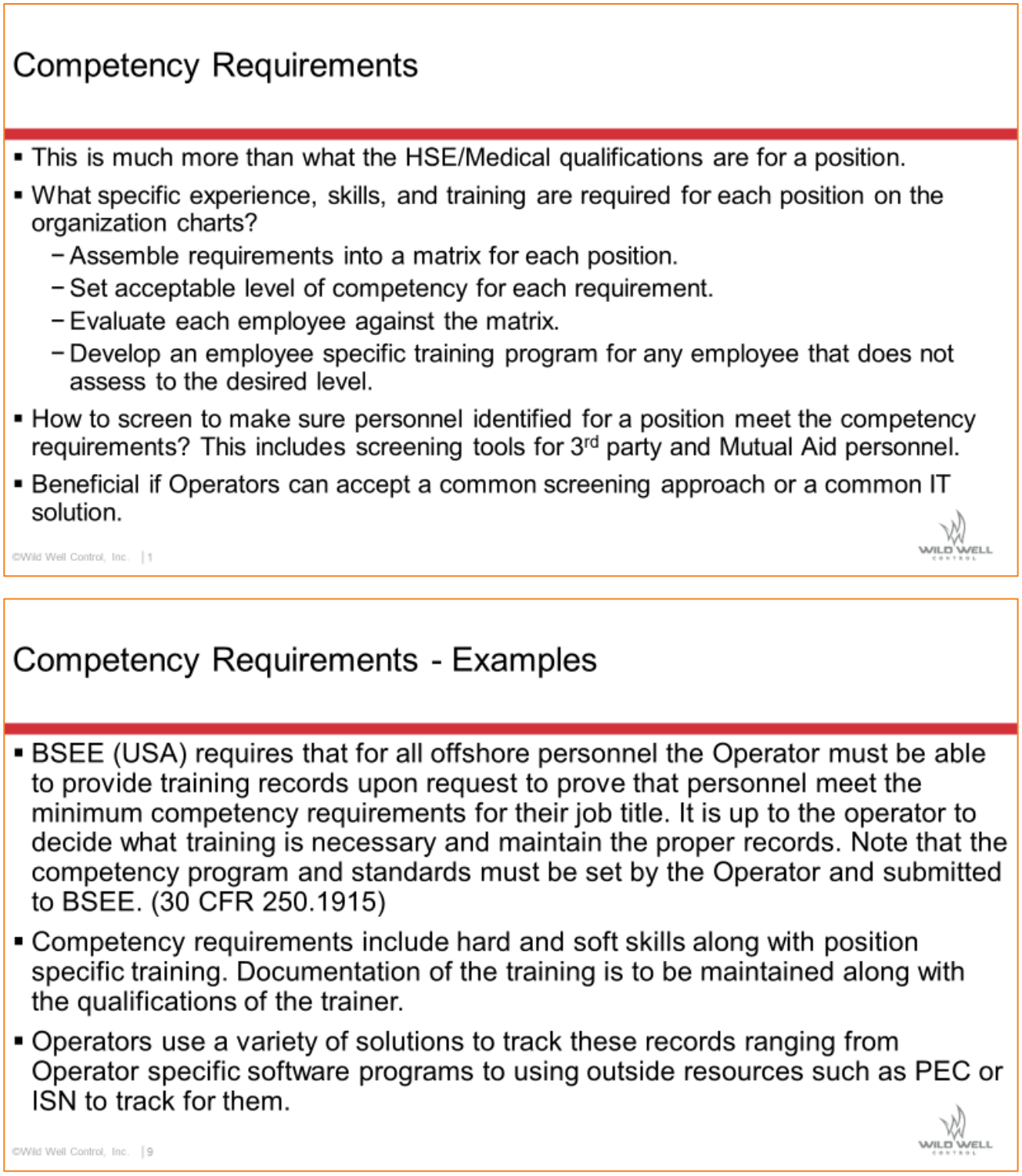
- Once roles within the organization are identified, train all company personnel on the assigned positions.
- Establish position specific checklists identifying responsibilities and tasks for the first 24-48 hours.
- Hold drills and exercises to train and practice.
- At a minimum, review plans yearly to make sure they are up to date with any organizational and personnel changes.
- Contact all of the 3rd parties identified in plans periodically to check contact information and update as necessary.

 7

WILD WELL CONTROL

Figure 48: Planning and preparation needs prior to undertaking drilling campaigns

Regarding competency requirements, Chris presented some industry recommendations and guidelines from other governmental organizations (Figure 49).



Figures 49: Competency considerations

Chris reiterated that Mutual Aid is a very popular subject, even among major operators, since a prudent operator would not knowingly attempt to prepare for or respond to a major source control incident without enlisting guidance from another experienced operator or organization. The following slide (Figure 50) highlighted the major points that should be addressed in a mutual aid agreement. Chris recommended that they should be resolved prior to undertaking drilling operations.

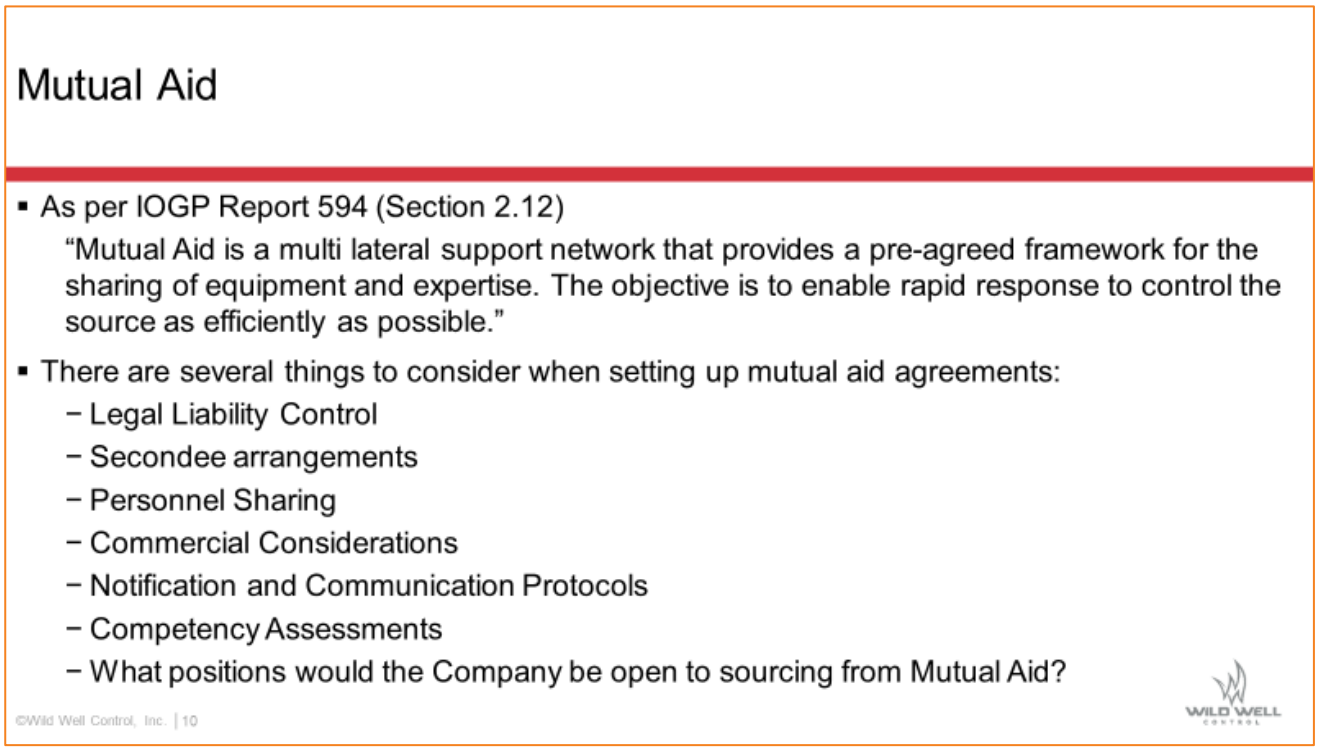


Figure 50: Mutual aid considerations

Finally, Chris highlighted personnel training as one of the most important areas of concern. He emphasized that how and when to train personnel and how and when to conduct exercises will always be critical decisions; training and exercise plans should be an integral part of source control preparedness activities. He summarised the following recommendations when preparing personnel for a response (Figure 51).

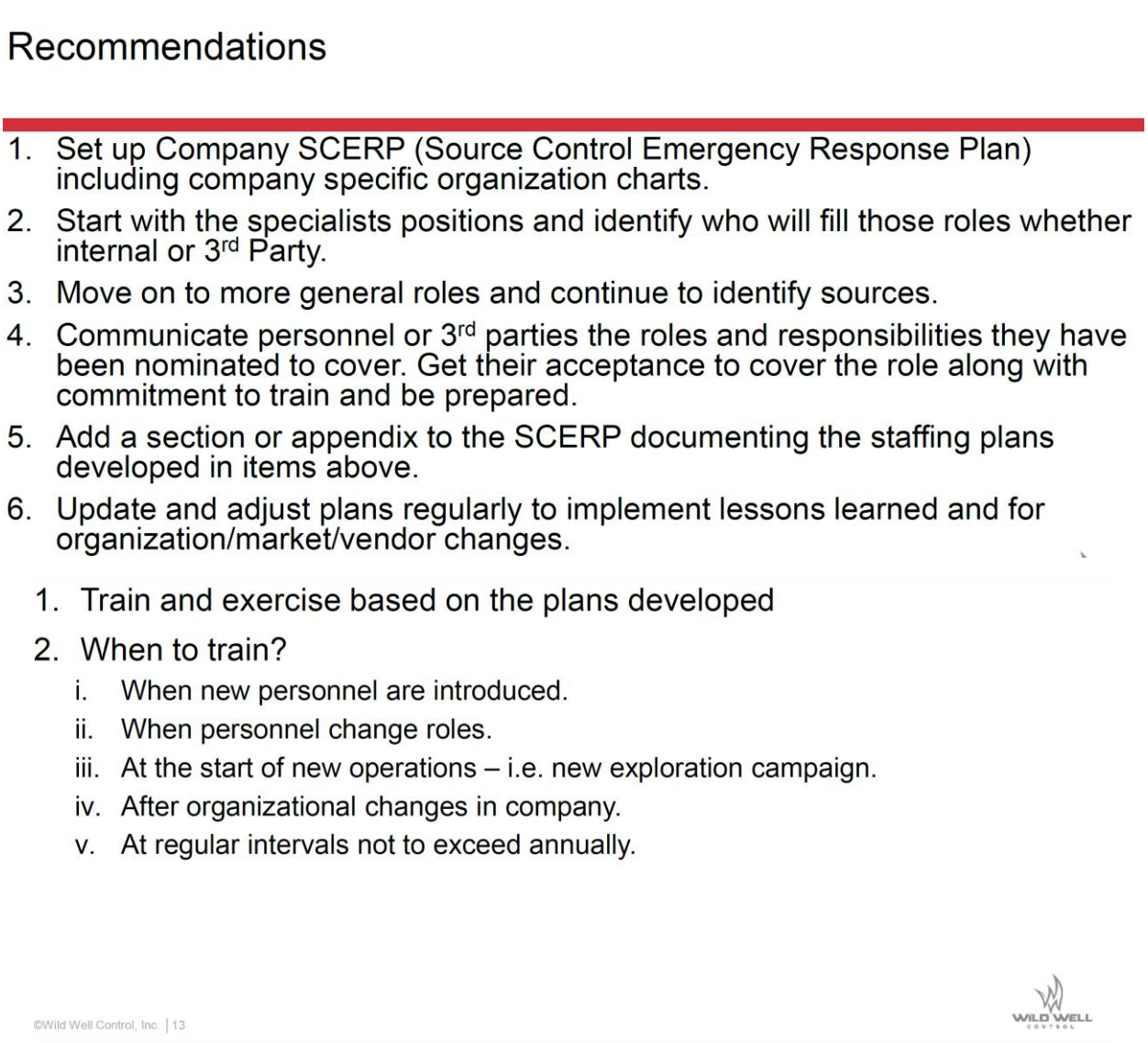


Figure 51: Training recommendations

5.1.1. Workshop feedback and questions – with answers from Chris LeCompte

- How large is the pool of personnel from WWC?

We have approximately 105 active operational personnel within Wild Well Control. I think it is safe to assume that we can dedicate up to 70 people from that pool to support a single incident response if needed. The attached employee experience sheet can provide further detail on the areas of expertise (engineering, well control operations, subsea, and special services) and skill levels of the personnel Wild Well can provide.

6. Review of audience input and participation via the online Mentimeter survey tool

At the beginning of the workshop, the audience was given a link with which they could download an online audience participation and survey tool. As each speaker presented and specific slides were shown, the audience was asked to use the survey tool to answer questions or grade/rate statements to establish the importance and priority of actions and aspects. The audience was also asked for specific questions addressed to each speaker. The questions addressed to individual speakers are shown in the previous sections describing the various presentations. General questions, including those subjects of demographics and audience experience levels are included below. Some of the actual slides are shown, with a brief summary of the slide where appropriate. In several instances, the answers were summarized for clarity.

Audience participation levels were generally reflective of the proportion of personnel roles, knowledge and skillsets in the workshop with regards to the nature of question being asked. Where audience participation was extremely low, the questions were discarded.

Question – What do you think we need to achieve in this workshop to make it a success?

This question was answered by 52% of the audience, with the following priorities:

- Better or common understanding of activities involved in preparedness and response
- Collaboration among operators and regulators
- Common and consistent approach to preparedness
- Mutual Aid agreements
- Understanding of any gaps in equipment and logistics complexity

Question – Which best describes your role in oil & gas?

Audience participation was high but the percentage was undeterminable since the participants were free to list themselves in multiple categories:

- 55% considered their background as drillers or subsea engineers
- 56% considered themselves involved in Emergency/Oil Spill Response, Health & Safety roles
- 16% registered themselves as Regulators
- 12% registered as Logistics, Engineering, or Equipment providers

Question – How familiar are you with the planning recommendations of IOGP Report 594?

Audience participation was 60% on this question.

The respondents ranked their familiarity with Report 594 at 4.9 on a scale of one to ten.

Question – What do you think are the biggest challenges for timely response to a loss of well control?

Audience participation was 38% for this question. The answers submitted as they were listed by the survey tool have been summarized for clarity:

- Vessel availability, deployment vessel not reliably available
- Real time data and knowledge of well condition – missing simulation experience
- Detailed planning and preparation to start of project or pre-spud
- People, training and knowledge of processes and timely access to resources.
- Time and money in the project assigned to planning and preparedness, $$$$ no one want to spend upfront.

- Many companies now employ all contractors so people move regularly, skill pool declines as people leave the industry
- Safety Case process, operators not properly preparing Safety Cases, Safety Case and access to competent personnel
- Regulatory document preparation and approvals
- Operators thinking it will never happen again, industry head in sand attitude
- Logistics – availability of vessels/ aircraft and personnel – regulatory approvals, the sheer complexity of the logistics operation
- Logistics and regulatory approvals – Can the use of drill-thru capping stacks be extended and become the new norm for offshore activities?
- It's not about the hardware, money should be better spent on prevention
- Lack of training and practice
- Lack of awareness and openness of industry to share lessons learned from exercises

Question – How do you rate your knowledge and expertise in subsea well source control response techniques?

The audience registered an average rating of 5.6 on scale of one to ten. However, it should be noted that there was a large number of the audience in the middle range of 5.6, then the rating declined but spiked for a smaller number at the high end. This is consistent with the few in the audience that considered themselves Subject Matter Experts, but the majority of the audience understands that there is more everyone can learn.

Question – How often do you work in subsea well control or response issues?

Audience participation was 29% for this question.

- 9% exclusively
- 37% often
- 26% sometimes
- 26% rarely
- 3% never

Question – How regularly does your company perform exercises to test real-time availability and deployment of vessels, aircraft, equipment and personnel?

Audience participation was 56%.

The results showed that 70% of the respondents stated that their company performs these tests at least annually or before every separate campaign.

Question – How thorough is your company preparedness for OIE deployment?

Audience participation was 40% for this question.

- 10% stated that OIE wasn't needed due to deep water operations
- 29% stated that studies show a potential need but plans were not in place
- 25% stated that contracts were in place with provider, but little logistics planning had been performed
- 23% stated that contracts, logistics and deployment plans were in place
- 13% stated that all contracts and plans were in place and had been tested

Question – What level of planning does your company do to on-board vessels suitable for your Capping Stack deployment?

Audience participation was 40% for this question.

- 26% stated that they performed technical evaluations and tracking, identification and contracts in place
- 10% stated that they have contracts and Safety Case Approvals in place
- 6% stated that they have identified vessels and maintain Safety Case Templates
- 32% stated that they perform only general tracking of vessels

Question – Please rate on a scale from 0-5 your priority items to work on to improve pre-planning for SRT and CS deployment.

Audience participation was 72% for this question.

The following items were all ranked between 3 up to 3.4 on a scale of 0-5.

- Supply arrangements for all required equipment
- Incident owner responsibilities and procedures for mobilization of equipment
- Pre-planned Logistics Transport Plans
- Pre-project validation of load-out equipment requirements and sourcing
- Securing mission specific vessels

Question – Rate the value of preplanning procedures for the CS interface scenarios?

Audience participation was 23% for this question.

On a scale of one to ten, the audience ranked the following scenarios between 5.6 up to 6.6, indicating that all four scenarios should be treated as pertinent options for an operator to include in pre-planning activities:

- Riser connected to LMRP, bent and on BOP and sea floor
- Riser parted from BOP at the flex joint, with possible BOP and Well Head off vertical
- Riser cut or disconnected above the LMRP, with the LMRP still connected to the BOP
- Disconnected LMRP with the upper connector mandrel accessible for latching

Question – What parts of a subsea dispersant program does your company prepare with pre-activity?

Audience participation was 43% for this question.

The answers showed that 30% of the respondents included all parts listed in their plans and that 60% of the respondents had identified the required dispersant supply sources. The remaining categories below were listed by 9 up to 18 of the respondents as significant parts of their preparedness programs:

- Dispersant tanks/containers
- Dispersant vessel deck plans
- Dispersant transfer/injection pumps
- Pipes/Çoiled tubing
- Dispersant vessel Safety Case approvals

Question – Where should we put effort to improve preparedness and timeliness for flow back if pore pressures exceed well design?

Audience participation was 64% for this question.

The answers submitted as they were listed by the survey tool have been summarized for clarity:

- Change well design, Advanced modelling, Planning and equipment design to ensure pore pressure not exceeded, Well design itself, Well design and implementation regulations and requirements
- Advanced reservoir and geomechanic and well control modelling and simulations, Thorough well control contingency planning / DWOP
- Stop minimizing risk
- Managed pressure drilling, Well design and kick detection, Design limits in WOMP
- Logistics
- Contingency planning
- Minimizing flow while still maintaining pressures below design
- Relief well plans that are robust
- Closer collaboration between well design and emergency response measures
- Risk assessments
- Consider preparing for a flowback

The following slide (Figure 52) was responded to by 52% of the attendees –

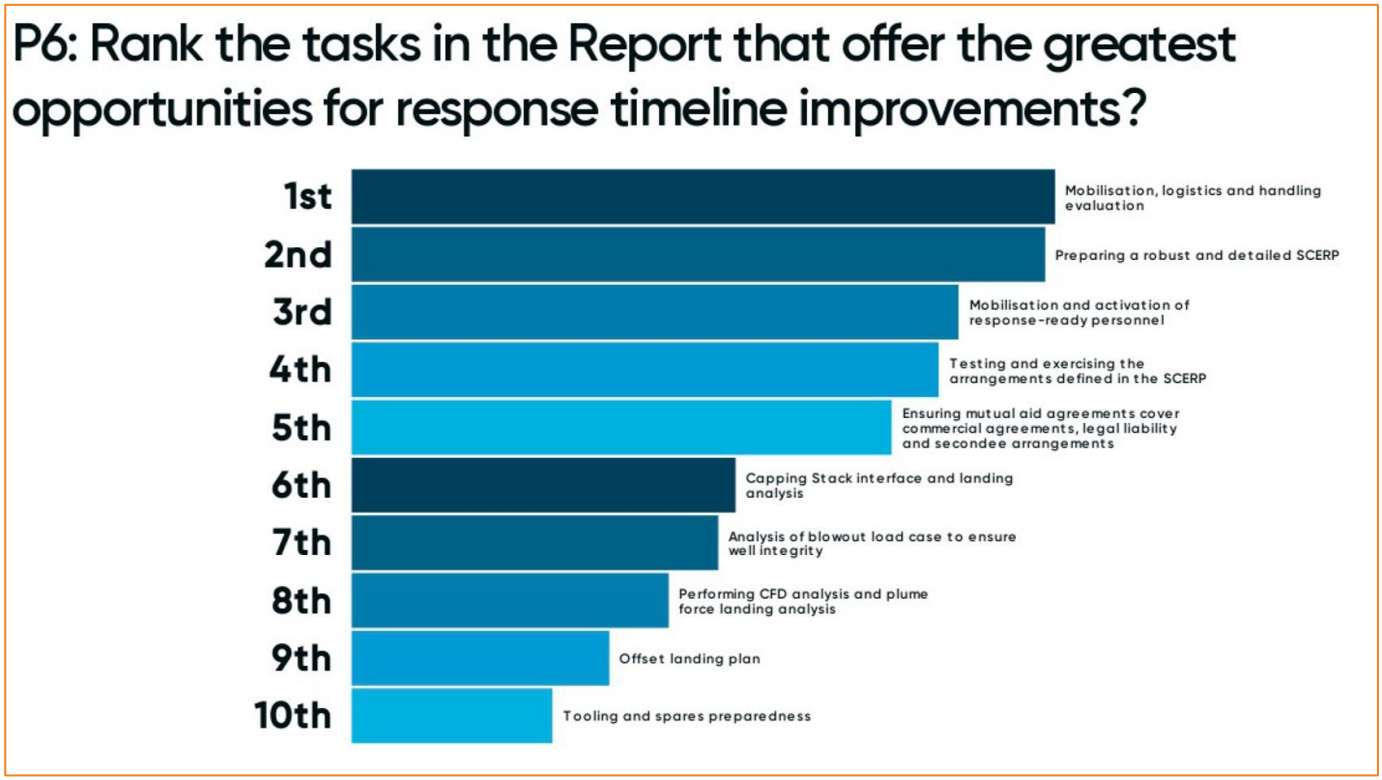


Figure 52: Rank the importance of tasks in Report 594

It is evident that the majority of respondents believe that mobilization, logistics and handling are extremely critical issues – and that written documentation (SCERPs) and formal testing and exercising are also critical to support a safe and effective response timeline.

The audience particpation for the following slide (Figure 53) was 68% -

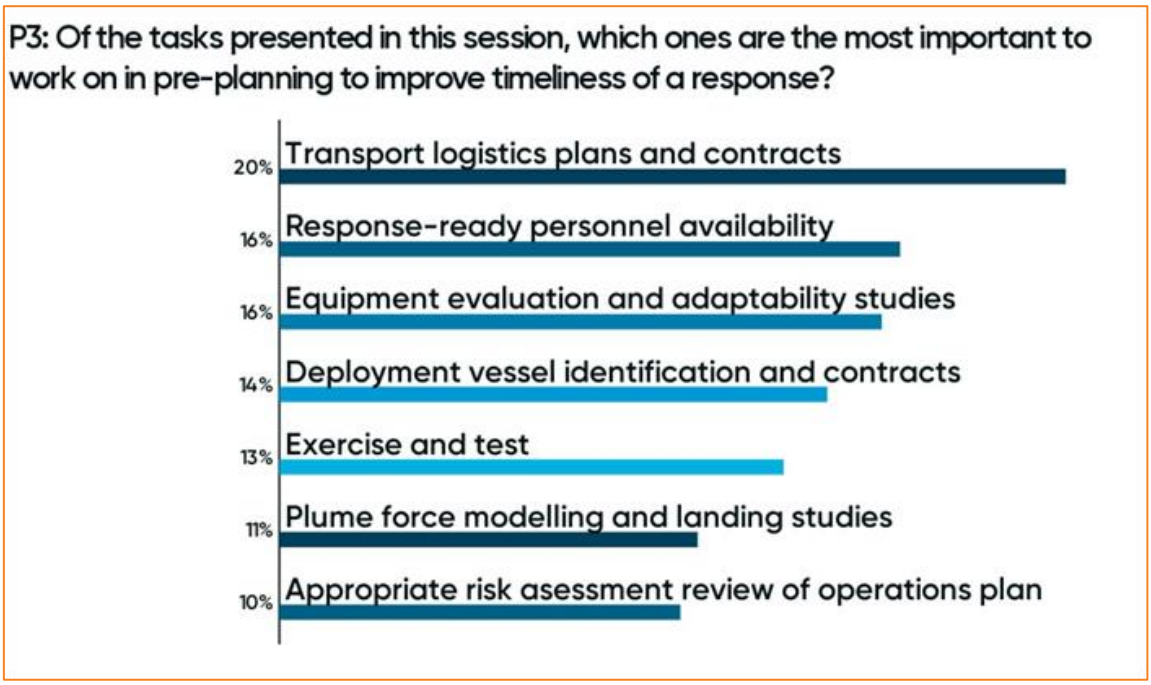


Figure 53: Most important pre-planning tasks

In summary, logistics plans, response-ready personnel, deployment vessel identification, and exercises and tests were the most critical preparedness activites for an operator to consider. Plume force modelling and risk assessments are also critical activities but are considered as sequential after the preparedness activites listed have been performed.

The audience was asked where is the biggest benefit to prepare critical path personnel for a well control incident. Responses were received from 29% of the attendees. The information in the slide is summarized below:

15% - Defining all required personnel titles

15% - Identifying providers of personnel

13% - Identifying locations and mobilization plans for personnel

3% - Preparing permit requirements of internationally supplied personnel

6% - Establishing Notification, Mobilization and Authorization Form Templates

10% - Conducting drills and exercises for the deployment of personnel

6% - Establishing Communication Plans with potential personnel providers

9% - Establishing legal arrangements for on-boarding personnel

24% - All the above

With 24% of the respondents listing “All” of the categories in the slide as being the biggest benefit, the slide clearly depicted the critical nature of identifying and obtaining sufficient response-ready personnel. Several of the speakers have highlighted the issues regarding identifying and training response-ready personnel and it is also emphasized in the newly released IOPG Report 594.

7. Workshop Results - General State of Industry Preparedness

From the opening of the workshop and the discussions about the industry's steps to recover from the Deepwater Horizon/Macondo and Montara incidents, it was evident that a concerted effort has been made and is still being driven by the industry to be fully prepared for the next well control incident. This has resulted in the evolution of preparedness activities from a "Relief Well Response" to a "Cap and Stop the Well Flow Response", as stated earlier within IOGP Report 594.

The main goals of this workshop were met, with recognition of three main points:

a. Responding to an emergency subsea well source control incident involves much more than delivering a capping stack

b. The industry currently has in place the equipment and the logistics/delivery systems required to respond to a subsea well source control incident anywhere in the world. It is the responsibility of each Operator to ensure robust and effective Logistics Plans are in place.

c. Preparedness involves having the right equipment and sufficient numbers of experienced and trained people available, as well as having a clear set of response plans in place that have been physically tested in practice drills and exercises

Reinforcing the goals of this workshop, there were several clearly identifiable statements to the audience:

1. From all the presentations, it was clear that the industry is fully aware that although prevention is high on the priority list, incidents can still happen and all Operators and governmental regulators should ensure that everyone involved is fully prepared to deal with a catastrophic incident.
2. To be prepared for the next incident, the industry has built and is maintaining a suite of equipment– capping stacks, containment systems and shallow water installation systems (see Speakers 1 to 4 for more details) - and has placed this equipment in strategic locations around the world.
3. Capping stacks are not new to the industry. Capping stack designs were and continue to be focused on being prepared for as many variables and "unknown factors" as possible in confronting a subsea well control incident. The industry has selected equipment and developed response plans that give them the best chance for success because with the next major catastrophic well control event, the only certainty is that the event will be different than the last one.
4. In recent years, additional capping and containment system designs have been developed to meet specific design requirements and/or specific regional/operator preferences and may continue to be modified to address specific design and/or installation challenges. Overall though, there has not been an "evolution" of capping stack designs; the original design basis developed after the Deepwater Horizon/Macondo incident is still the industry's preferred solution, with recent modifications making lighter stacks available for smaller and well understood flow and GOR wells.
5. Overall the industry has the capability to deliver, in a timely manner, all the necessary capping and containment equipment systems to any area of the world in which it operates. Availability to specific equipment systems for an Operator is predicated on joining one or more response organizations who stores and maintains the equipment.
6. The critical need for training of personnel and retention of experienced personnel to be response-ready has been noted by several of the speakers (see Speaker 9 for more details). This will continue to be a major focus area as demographics constantly change.

Finally, there has been no globally consistent approach to developing a response timeline that addresses all the personnel, equipment and vessel requirements for a subsea well source control incident response. There are finite steps that need to be identified, planned for, and practiced to ensure proper execution during an incident.

To complement the results of this workshop, NOPSEMA is sponsoring the development of a detailed list of those steps as a Subsea Wells Source Control Planning Tool in the form of a generic Response Time Model (RTM). After it has been developed in draft form, it will be reviewed by industry and calibrated and released as a useable tool so that all interested parties may examine proposed response timeline estimates for any region in the world. Combined with the recommendations from IOGP Report 594, this tool when properly used by the industry will help all parties ensure we are all sufficiently prepared for an offshore well source control incident.

Lastly, if there are any questions or comments regarding this report, please direct them to Andrew Best with NOPSEMA and/or Mitch Guinn with Oil Spill Response USA.