LEARNING, INNOVATING, COLLABORATING:

DELIVERING THE NEXT GENERATION OF WELL INTERVENTION CAPABILITIES

1.0 Abstract

The international oil and gas industry is continuing to develop innovative technologies that enhance its ability to operate safely in different conditions around the world. In the unlikely event of an incident, the industry must be prepared to respond and minimise the impact to people, local communities and the environment.

Through the Subsea Well Response Project, nine leading oil and gas companies have worked together to develop new capping and dispersant equipment that can enhance international subsea well incident response capabilities. The Subsea Well Response Project is now collaborating with Oil Spill Response Limited, so that companies across the industry have an opportunity to benefit from this new intervention system, which includes four capping stacks and hardware for the subsea application of dispersant. Oil Spill Response Limited will own, maintain and store the equipment across four international locations, with the first equipment ready for use from the end January 2013.

The Subsea Well Response Project presents the findings from almost two years of study and collaboration across the industry. This paper outlines the capabilities of the new equipment and its contribution to enhancing well incident intervention capability around the world.

2.0 An unprecedented challenge

Recent well control incidents have put the spotlight firmly on the subsea oil and gas industry and expectations are high for it to be able to respond effectively in the unlikely event of an incident. As part of its role in securing an energy supply for the future, industry is discovering oil and gas in ever more challenging environments. At the same time, the environmental agenda has risen in prominence for companies, regulators and the general public. Consequently, companies must not only be able to drill safely in challenging scenarios, they must also demonstrate that they can do so in an environmentally responsible manner.

Developing and deploying internationally-applicable equipment represents a further technical and logistical challenge. The geological contexts in which oil and gas are found vary greatly in type of fluid, reservoir size, water depth and location. Day-to-day changes in weather and ocean conditions (such as wind and wave intensity) can affect the suitability and effectiveness of any offshore incident response system. The distance between where equipment is stored and where it may be needed must also be considered in estimating response times.

Faced with these numerous considerations, an effective response would be enhanced with effective industry cooperation.

3.0 Industry collaboration

3.1 The Subsea Well Response Project (SWRP)

To meet this challenge, nine major oil and gas companies have come together to enhance the industry's capacity to respond to subsea well incidents.

The Subsea Well Response Project is a not-for-profit initiative comprising experts from, and resourced by, BG Group, BP, Chevron, ConocoPhillips, ExxonMobil, Petrobras, Shell, Statoil and Total. It was launched in May 2011 on the recommendation of the International Association of Oil & Gas Producers (OGP) as part of a package of measures to enhance well incident prevention, intervention and response across the industry. Prevention is covered by the OGP's Wells Expert Committee. Response is covered by a Joint Industry Project with IPIECA, addressing various surface response options and issues.

SWRP was set up to focus on well incident intervention and aimed to enhance international capabilities by:

1) designing a capping toolbox to allow subsea wells to be shut in;
2) designing hardware for the subsea injection of dispersant;
3) evaluating potential approaches for deployment of equipment;
4) assessing the need for, and feasibility of a containment system in the event that a capping operation cannot immediately control a flowing well.

3.2 Cross-industry collaboration

The nine companies behind SWRP have been working closely with the wider industry to share expertise across all aspects of well safety and to secure regulatory support for their activities.

Preventing incidents altogether will always remain the industry's primary aim. The development of robust well designs and operations procedures, proper inspection and maintenance of equipment, solid safety and management systems, and competence and safety-first behaviours among personnel is the surest way to prevent well control incidents from occurring. These practices are a vital part of everyday activities across the industry and are subject to constant review and improvement. The OGP's Wells Expert Committee (WEC) is specifically focused on helping the industry prevent incidents. SWRP has been working closely with WEC throughout the research and planning process.

The IPIECA-led Joint industry Project on oil spill response aims to better understand the environmental effects of well incidents and response methods. Its team is looking into the merits of dispersant use and controlled in situ burning, and developing improved oil spill modelling. Again, SWRP has worked closely with this team in planning its own equipment, including subsea dispersant capabilities.

Cooperation is not limited to the commercial offshore oil and gas industry. Whilst planning the intervention system, SWRP sought input from industry experts and regulators in order to meet and surpass current and future regulatory requirements on subsea well incident response capability.

This extensive collaboration has been vital in planning new well intervention equipment. It is also important to make this equipment available for inclusion in incident response preparations and for the industry to use in the unlikely event of an incident.

4.0 Subsea well intervention system

SWRP's technical experts have spent almost two years undertaking collaborative studies into subsea well incident intervention requirements. This covers a variety of potential incident scenarios and geographic variations in weather, ocean and oil conditions.

They identified a set of intervention equipment that can enhance the industry's capabilities to respond to a subsea well incident in a variety of conditions around the world. SWRP is now collaborating with Oil Spill Response Ltd (OSRL) to develop this system and make it available to the industry.

The intervention system includes four capping stack toolboxes and two hardware kits for the subsea application of dispersant at a well head. OSRL owns the systems contracted Trendsetter Engineering to construct the capping stack toolboxes and Oceaneering to develop the subsea dispersant hardware kits.

The first equipment is due to be completed by the end of 2012. It will be ready for transportation from vendor sites by sea and/or air in the event of a subsea well incident. During 2013, the equipment will be moved to four strategic storage locations – in Norway, Singapore, South Africa and Brazil – to further enhance international deployment and intervention readiness. These locations have been selected for international reach, strong transport links (by sea and/or air), to reduce logistical challenges and to further enhance international readiness.

Effective incident response can depend upon the timely transportation and deployment of equipment at the incident site. All components of the intervention system are designed to be transportable via sea or air-freight carriers by minimising size and weight and optimising modularity. This allows the equipment to be transportable around the globe and delivered to a nominated point for onward transportation and deployment by the operator responding to an incident.

4.1 Compatible capping system

The four capping stack toolboxes are designed and optimised to operate in a variety of conditions around the world where wells are being drilled, or might be drilled, with subsea blowout preventers. As this could involve a variety of different circumstances, SWRP's equipment is designed to be adaptable and easily reconfigurable to address the majority of scenarios in which incidents might arise.

The equipment includes four capping stack toolboxes – two 18 3/4" bore capping stacks developed to handle pressure up to 15kpsi and two 7 1/16" bore capping stacks designed for pressure up to 10kpsi. All four stacks are designed from one common core structure giving greater component compatibility and flexibility to handle a variety of scenarios. They have common pipework, valves, chokes and spools all rated to 15kpsi. The key difference is the use of 7 1⁄16" 10k gate valves for the 10k stacks and 18 3/4 " 15k rams for the 15k stacks.

The capping stacks are designed to allow for inspection by the incident operator's remotely operated vehicles (ROVs), which would also be used to aid with installation, hook-up, tie-in, commissioning, start-up, maintenance, repair, and intervention of the subsea equipment.

The capping stacks include a number of important features:

- Designed to handle pressure up to 15kpsi
- Designed for subsea wells in water depths up to 3000m
- Rated for temperatures up to 150^{o}C
- Capability to lower and connect the capping stack in a slanting position
- Diverter spool is cladded with 4 outlets – reducing corrosion, erosion and providing system redundancy
- Subsea chokes (x4) are subsea retrievable (and re-installable) by ROVs
- Subsea accumulators are subsea rechargeable and can be deployed disassembled or fully assembled, depending on the incident scenario
- International certification body Det Norske Veritas (DNV) will assess the capping stacks for a DNV Certificate of Fitness for Service

4.2 Hardware kits and subsea dispersant application

The intervention system includes hardware to support the capping process and apply subsea dispersant.

The kits include debris clearing equipment with cutting, grappling and dragging tools to gain access to the blowout preventer where necessary. In the unlikely event that the rig does not close off the BOP, emergency BOP intervention tools can be used by the responding operator. This allows the existing BOP to be 'manually' shut-in, using ROVs assisted by hydraulics hardware on the seabed.

The kits also include dispersant wands and associated manifolds for the subsea application of dispersant at a wellhead. This creates safer surface working conditions by reducing the concentration of volatile organic compounds at the surface. Subsea dispersant aids oil dispersion, which in turn aids the bio-degradation of the oil by naturally-occurring micro-organisms. This can help minimise stranded oil on the shoreline.

IPIECA is currently leading plans for a global stockpile and supply chain of subsea dispersant. OSRL plans to provide global dispersant stockpiles (this will be separate from the intervention system subscription).

5.0 Enhancing intervention capabilities across the industry

SWRP has planned a set of subsea well intervention equipment that has the technical capability and versatility for use in the majority of anticipated subsea well incidents around the world.

SWRP's aim was not only to identify appropriate equipment, but to help enhance the international offshore oil and gas industry's intervention response capabilities. That means making this equipment available, if needed, to oil and gas companies around the world to help control the flow from a deepwater well, in the unlikely event of an incident. SWRP is collaborating with Oil Spill Response Ltd (OSRL) to realise this objective.

OSRL is the largest international industry-owned co-operative and global provider of oil spill response and preparedness services. This includes not only rapid response to oil spills in different

parts of the world, but also the provision of training, consultancy and other support services to help reduce the impact of an oil spill. OSRL's members account for a significant proportion of global oil production.

Companies across the industry now have the opportunity to access the equipment through membership of OSRL and a supplementary agreement. This is an important milestone for international well incident intervention capabilities but as hydrocarbon exploration and drilling technologies evolve, the industry will continue to innovate.

The Subsea Well Response Project and its collaboration with Oil Spill Response Ltd is another important example of the industry working together to enhance intervention capabilities around the world. While we hope this intervention equipment will never be needed, it is critical for the industry to be prepared.

6.0 Contact

To find out more or gain access to the intervention system, please contact: subseaservices@oilspillresponse.com or visit the following websites; www.oilspillresponse.com & www.subseawellresponse.com.

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