

Subsea Intervention

(Output from ITF Technology Challenge Workshop (Theme Day), Houston, USA)

Collaborative Approach to Technology Investment

The Industry Technology Facilitator (ITF) is a not for profit organisation owned by, and with access to funds from major oil and gas operating and service companies that comprise its membership. ITF has an impressive track record in delivering finance to help develop new initiatives for oil and gas technologies from early stage joint industry projects (JIPs) through to field trials and commercialisation. Since 1999, ITF has supported over **150** projects worth in excess of **£45 million** in funding. ITF's key objectives are to identify technology needs, foster innovation and facilitate the development and implementation of new technologies.

A fundamental element of ITF's role as an internationally recognised champion for facilitating research, development and deployment of technology innovation within the upstream oil and gas industry is to engage with key industry sources. ITF uses a proven process, working in collaborative participation with both its Members and industry to identify technology needs and potential solutions.

The ITF process, illustrated below as a step-by-step course of actions, endeavours to bridge the gap between the industry's large global players and development community with the ultimate aim of implementing new technology solutions:

- STEP 1** - Understand and Identify Technology Needs
- STEP 2** - Engage the Development Community / Invite Proposals
- STEP 3** - Evaluate Proposal Submissions
- STEP 4** - Secure Funding
- STEP 5** - Assist the Launch of JIPs
- STEP 6** - Facilitate the Implementation of Technologies

ITF has contractual confidentiality arrangements with all its Members and will enter into a parallel agreement with all developers submitting proposal applications. Proposals will be submitted to our Members only for the purpose for which they are provided, i.e. assessment for funding support and implementation.

Proposals submitted under this Technology Challenge Programme will be reviewed for financial sponsorship by **all ITF Members** therefore this is an excellent opportunity to gain access to a global audience in seeking support for your technology. The focus of all ITF Technology Challenges is to identify technologies which bring clear benefits to sponsors but which require assistance in **research, development, and / or field trial**.

For details of ITF's full Portfolio of Members, please visit our Website - www.oil-itf.com

Background to the Technology Challenge

Subsea Intervention, whether for construction, maintenance and production enhancement is now the only viable option for many field developments, and for the first time, Inspection, Repair and Maintenance (IRM) has overtaken construction as the number one subsea expenditure for upstream production. Improving and extending efficiency and capability of intervention can therefore play a significant part in the lifecycle cost of subsea production. Innovative technology has an increasingly pivotal role in delivering these performance improvements.

Specialist intervention technologies will continue to open up new opportunities for Subsea Well Intervention.

In line with the industry's increasing focus on Subsea Intervention, this Call for Proposals is the collective output of an ITF 'Subsea Intervention' Technology Challenge. This was the first ever ITF 'Technology Challenge' held in Houston in October 2009, aimed at tackling the technology issues surrounding the area of Subsea Intervention.

By bringing together a number of the industry's major operator and service companies, this technology challenge discussed a number of the issues facing the industry with a view to stimulating innovative technology solutions to have a significant impact in the area of subsea intervention.

The Technology Challenge included an intensive, facilitated workshop which brought together experts from ITF membership, operators, service companies, small and medium-sized enterprises, and research and academia. This wide variety of attendees discussed the challenges faced within the area of 'Subsea Intervention, the output of which has formed the basis of this Call for Proposals.

Programme Timeline

Each ITF Technology Challenge follows a nine month timeline from Technology Challenge Workshop to completion. The following list of tasks describes the key milestones and their associated date:

Programme Start / Technology Challenge Workshop	October 2009
Call for Proposals Issued	February 2010
<i>Deadline for Receipt of Proposals</i>	<i>March 2010</i>
Publish to Members for Review	April 2010
Member Review and Voting	May 2010
Technical Clarification Meeting	June 2010
Members finalise commitment to sponsor	Sept 2010
Program Complete	Sep 2010

Open Invitation to Global Technology Developers

This document aims to stimulate *high quality* proposals from global development expertise which meet the specific requirements for deployment within the area of 'Subsea Intervention'. ITF and its Members will jointly assess all submitted proposals and our Members will potentially fund those proposals of greatest interest.

ITF and its Members will not prescribe specific technology solutions, but instead use the output gathered from the Technology Challenge Workshop to stimulate innovative proposals that offer potential solutions to identified needs. Key technology drivers, as identified by ITF Members, are the desire to produce fields in a more cost effective and efficient manner.

This is an open invitation to any organisation seeking sponsorship for innovative technologies in the oil and gas industry to submit proposals for research, development, and / or field trial in the following areas, associated with the identified needs of the 'Subsea Intervention' technology challenge.

This invitation also welcomes proposals from consortia of organisations where the relevant expertise of each organisation has a valuable input into providing the overall most innovative and best practical solution.

Subsea Power
AUV Mission
Cost Effective Light Well Intervention (LWIV)
Downhole Diagnostic Tools
HPHT Technology
Better Artificial Lift

The list of detailed technology challenges are identified within each area that are of explicit interest to ITF Members in the 'Specific Technology Requirements' below. This information highlights key elements required but allows for innovation and flexibility in interpreting the most appropriate technical solutions.

The method for submitting a proposal is described later in this document but you can also learn how to submit a proposal by going to our website www.oil-itf.com

Specific Technology Requirements

(Any submitted proposal **must** address one or more of the following identified requirements)

SUBSEA POWER

Background:

As the number of subsea wells and equipment positioned on the seafloor continues to increase, future field developments will demand steadily higher power from long distance transmission and distribution systems. This will lead to a demand for reliable and maintainable subsea high voltage equipment without a power connection to the surface.

Requirements:

- Subsea Power Generation (10 kW – 60 MW)
 - Separation, pumping, compression (2-60 MW)
 - Seabed Drilling (2-60 MW)
 - Long distance transmission and distribution system (6.6-35 kV) (Grid Stability)
 - Improved reliability of electrical penetrators enabling subsea installation, hookup and commissioning. A move towards wet-mate connectors would be advantageous.
 - Power Supply – portable / residing at wellhead
 - Switchgear/Circuit Breakers/ Transformers/ Variable Speed Drives (VSDs) – The ability to distribute power to multiple consumers.
- Reduction in size and weight of components e.g. power umbilicals, transformers etc.
- Ability to interface with Inspection, Repair and Maintenance (IRM) vessels
- Wireless power technology would offer a step change providing data from places in the wellbore which are out of reach of cables.
- Local Power Generation (Capacity 1-12MW)
 - Form-factor – fuel cells (small), nuclear (large)
 - Long life batteries
 - Fuel cells
 - Umbilical-less - through the pipeline (0-50 mls)?
 - Uninterruptable power supply (UPS) – backup, start-up, shut-down

* *Please note that some of the requirements listed are similar to those posted in our 2009 Subsea Long Tiebacks Call. Some of the proposals within this call did not fully meet the criteria listed.*

AUV Mission

Background:

Global expenditure on autonomous underwater vehicles (AUVs) is expected to be about £1.42 billion over the next decade. It is therefore essential to match advances in AUV technology to applications in Subsea technology. Initially looking at simple diagnostic inspection the challenge is to move interventions on to full AUV intervention.

Requirements:

- AUV Mission - Docking station/power sources - Long life batteries / Fuel cells
- Low cost surveys/inspections
- Back up data gathering
- Tethering – AUV positioning and location

Considerations:

- AUV technology factored into new field facility specification and design
- Increased AUV reliability – reduction in NPT, easier maintenance
- Potential for arctic operations

COST EFFECTIVE LIGHT WELL INTERVENTION (LWIV)

Background:

Efficient, cost effective LWIV can help increase the economic benefit of all subsea fields. Key to this efficiency is the intervention vessel utilised in the operation. Existing LWIV technology is capable of performing most types of well interventions at costs lower than rig however, the majority of these systems require a dedicated vessels and handling systems to deploy the technology which makes the intervention more expensive than it might otherwise have been if a vessel of opportunity could have been used.

Requirements:

Development of smaller and lighter intervention equipment (with simpler handling equipment) in order facilitate the use of lower cost vessels of opportunity.

Considerations:

- Evaluation of decoupling technology from the vessel platform - seafloor/surface decoupling without adverse effect on operating envelope
- Riser Design Methods
 - Lightweight
 - Buoyancy assisted
 - Spoolable
 - Floating – left in place
 - Utilisation of modular systems
- Coiled Tubing - Issue re handling returns (other than down a flowline)
 - Total depth of well (WD + TVD/MD) makes coiled tubing and wire-

through-water interventions challenging.

- Portable handling equipment - can be moved from vessel to vessel
- High rate pumping capability in deepwater (>3500 ft)
- LWI's performed at water depths greater than \approx 1500m.
- Standardization of LWI equipment.
- Development of HPHT systems.
 - Development of 15,000 psi rated intervention systems

Considerations:

- LWI's performed at water depths greater than \approx 1500m.
- Development of 15,000 psi rated intervention systems
- Standardization of LWI equipment.

DOWNHOLE DIAGNOSTIC TOOLS

Background:

Hydrocarbons are recovered from underground reservoirs using wellbores drilled into the formation bearing the hydrocarbons. The construction and subsequent use of a well for recovering hydrocarbons typically involves the deployment of a variety of tools into a wellbore. Conventionally, the effective operation of these tools while in the wellbore may require some form of control.

Certain conveyances such as wirelines can provide a relatively fast rate of data transfer between the surface and a downhole tool. Thus, such devices may be operated from the surface. However, downhole tools used in connection with conveyance devices such as drill pipe, coiled tubing, slick-lines and drop tools may have inadequate access to communication uplinks and downlinks. Thus, surface personnel may have limited operational control over such tools.

Requirements:

- Development of a downhole autonomous tool to perform a well health check

Considerations:

- Non invasive procedures
- Time based through well/field life
- Predictive maintenance
- Time dependent degradation
- Well Integrity

HPHT TECHNOLOGY

Background:

The conditions of HPHT — which can be defined, in deepwater, as temperatures above 400°F (149°C) and pressures above 10,000 psi (689 bar) — call for the use of new insulating materials, as those currently in use today have maximum operating temperatures of about 250°F (120°C).

Over the last 10 to 15 years a number of HPHT fields have been discovered and brought into production. This has led to both the extension of existing practices and the development of specific new technology and solutions to enhance reservoir production.

One of these developments has been the application of Coiled Tubing (CT) as an intervention technique. HPHT CT intervention can be defined as work in wells with over 10,000 psi bottomhole pressure and over 300°F bottomhole temperature (BHT) or wells where the pressure gradient is over 0.8 psi/ft and BHT 300°F. The UK Central North Sea has many fields that meet this definition.

Requirements/Challenges

Some challenges that the industry is facing when designing equipment are:

- Develop ESPs for high-pressure environment (accelerate production from tight reservoirs).
- Develop ESPs for deep wells (20,000' BML).
- BOP/Riser weight
- Making the wells slimmer (i.e. Well Head (WH)) to reduce the size of the BOPs

Considerations:

- High pressures in deepwater raise issues around the possibility or appropriateness of using a smaller pipe diameter. This would help to counter the need for greater pipe wall thickness to handle pressures that could be as high as 15,000 psi (1,033 bar), and possibly even the need for 20,000 psi rated systems.
- Imposed bending moment from BOP and landing string
- Riser tension (incl. hysteresis) at greater depth
- Rig motion pattern
- Time used for drilling, completion and intervention/workover (heavy)
- Use of strain gauges on subsea equipment to monitor fatigue
- Evaluation of Christmas Tree (XT) designs (i.e. vertical XT) where the tubing hanger will be positioned within the wellhead instead of the XT as this will eliminate the direct need for the BOP to be positioned on top of the XT—thus lesser bending moments.
- Use of open water workover systems (LRP/EDP) instead of heavy workover systems (BOP/landing string) for light workover operations (i.e. WL & CT). These systems are sized according to the production tubing and can therefore be made lighter.

- * *As HPHT development has been described as the 'greatest technological and regulatory challenge to the oil and gas industry today'. ITF intend to run this area as a Technology Challenge in August 2010.*

BETTER ARTIFICIAL LIFT

Background:

Artificial-lift technology has been around for many years. Throughout the last decade, both operating companies and manufacturers have made considerable effort toward understanding the science behind artificial-lift systems and their performance. However there remains scope for improvement, particularly in reliability, ease of deployment and effectiveness.

As artificial-lift systems continue to evolve, and their operational uses expand this call seeks proposals from technology developers to develop or field trial truly innovative new approaches to artificial lift. Some suggestions include:

Requirements:

- Development of a higher reliability artificial lift for subsea which is more compact with higher power (HP).
- Wire-line deployed Electro-submersible pumps
- Combined deep-set safety valve and pump

Considerations:

- Greater efficiency at Gas Volume Fraction (GVF)
- Emphasis on higher recovery rate and reliability
- New technologies aimed at providing artificial lift in gas wells
- Deployable from vessels other than MODUs.

Process for Submitting a Proposal

1. Register Interest with ITF

Register your interest as early as possible by sending an email to Ryan McPherson at r.mcpherson@oil-itf.com

2. Visit the ITF Website - www.oil-itf.com

On the ITF Home page, click on the "How to Submit a Proposal" button or follow [this link](#) to access all the information required to submit a proposal.

3. Read the 'Project Application Guidance' Document

This document is available to view or download from the 'ITF Downloads' / 'Proposal Submission' section of the ITF Website. Reading this document prior to submitting a proposal is essential. If you require further clarification or are unsure if your proposal is suitable for submission, please call ITF (ITF Contact Information appears later).

4. Download and Complete the 'Project Application Form'

This form is available to download from the 'ITF Downloads' / 'Proposal Submission' section of the ITF Website.

5. Download and Complete the 'Project Presentation Template'

This template is available to download from the 'ITF Downloads' / 'Proposal Submission' section of the ITF Website.

6. Email the Completed 'Project Application Form' and 'Project Presentation Template' to ITF

Email the Completed 'Project Application Form' in Microsoft Word format (not PDF) and the 'Project Presentation Template' in Microsoft PowerPoint format (not PDF) to Ryan McPherson at r.mcpherson@oil-itf.com by **no later than 15th March 2010**. Proposals received after this date may not be processed.

Qualifying Technologies

In order to qualify for potential sponsorship, technologies submitted in response to this Call for Proposals must:

- be applicable to at least one of the identified requirements
- be novel or innovative
- demonstrate a clear business case for support
- have a clear and demonstrable path to commercialisation and implementation
- be capable of being developed by the proposer(s)

Note: Proposals submitted to any other ITF Call in the past nine months or any previously unsuccessful applications should not be resubmitted without first consulting ITF (contact information provided later in this document).

Qualifying Organisations

Proposals are invited from any organisation including SME's, academia, research institutions, large organisations, consortiums or alliances. Proposals may be submitted by a national or international organisation, and equal opportunities will be extended to all proposers. Please keep in mind however that should your proposal be taken forward, you will be required to participate in meetings and make presentations to interested parties in the UK and in the English language (teleconference and video conference are acceptable).

ITF Contact Information

If you would like to discuss any matters related to this call or any other issue related to ITF, please contact any of the following people:

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