ITF Call for Proposals

Focus: Technology for HPHT Production

Improved Solutions Sought for Oil & Gas Production in Extreme Environments

Aims

This is an open invitation to any organisation from any sector seeking funding for innovative technologies in the oil and gas industry to submit high quality proposals for research, development and / or field trial of potential solutions that will help in High Pressure, High Temperature (HPHT) issues associated with oil and gas production.

HPHT specific areas of interest:

- Alternatives to Alloy Steels (liners/coatings)
- Develop and Demonstrate Reliable Downhole Permanent Monitoring Systems
- Extend the Reliability of Downhole Chemical Injection Systems
- Extending Well Life in HPHT Fields Suffering from Depletion Driven Compaction
- Extend Capabilities and Alternatives to Elastomer Technology
- In the area of MWD/LWD and Wireline: Increase Sensor (Electronics) Reliability, Robustness and Temperature/Pressure Rating
- Improving Drill Steering Capability in HPHT Fields

Justification

ITF members, major operating and service companies in the oil and gas sector, met recently at an international ITF Technology Challenge Workshop (TCW) and explicitly identified the current shared challenges they are facing across the industry in the area of high pressure, high temperature oil and gas production.

Who Should Respond

The invitation is open, to all relevant industry sectors and all credible entities from small and medium sized enterprises, to academic and research institutions, to large industry players alike.

Benefits of Participation

- Funding: Up to 100% funding for any stage of the research, development and demonstration cycle.
- IP Protection: A proven confidential, collaborative and standard contractual process
- Exposure and validated applications for your scientific and technological expertise
- Access to the key global players in the oil and gas sector

How to Participate

Your contact points and outline method for submitting a proposal are provided in this document but you can immediately learn how to submit a proposal by going to our website http://www.oil-itf.com/index/submit-a-proposal

Alternatively you can ring us and talk to one of our analysts about your idea, +44 (0)1224 222410.

Key Words and Potential Technology Areas

High Pressure; extreme high pressure; ultra high pressures; high temperature; extreme high temperature; ultra high temperatures; alloy steels; liners and coatings; downhole; chemical injection, nanotechnology; depletion driven compaction; well life; HPHT fields; elastomer technology; measurement while drilling (MWD); logging while drilling (LWD); wireline; sensor reliability; sensor robustness; permanent monitoring systems, steering capability; temperature rating; pressure rating; wellbore strengthening; directional drilling; barrier qualification; line bursts; safety valves; scale build up; integrity systems; horizontal wells, deepwater wells, shale gas, reservoir characterisation; reservoir robots; internal hydraulics; fibre optics, dogleg capability; continuous monitoring; harsh environment connection systems.

(NB. The above list is not necessarily exhaustive).

Readers who are not familiar with the industry may find using some of the above terminology on a variety of internet search engines which would lead to some useful initial descriptions of the industry and associated techniques.

HPHT Production Challenges

The search for hydrocarbons has pushed the Oil and Gas industry to drill for oil in even harsher environments at high pressures and high temperatures (HPHT). These environments are generally called HPHT environments and are generally described on the pressure and temperature scales as shown in the table below.

	Pressure			Temperature	
	Kpsi	bar	Kg / mm^2	°C	°F
High	10-15	689 - 1034	7–10.5	150-180	200-350
Extreme	15–20	1034 - 1379	10.5–14	180-204	350-400
Ultra	20–30	1379 – 2068	14 - 21	204-260	400-500

These HPHT environments cause a variety of problems throughout the production cycle, from downhole to topsides causing equipment failure and breakdown resulting in lost production time. These failures are often cause seals and elastomers to fail, motors to not work efficiently and causes sensors and associated electronics to fail as well. If we can solve these problems, drilling and production in these environments would improve drastically, enable the industry to operate in harsher environments, and maximise production opportunities.

The prime areas of concern have been identified by ITF members as follows:

- Alternatives to Alloy Steels (liners/coatings)
- Develop and Demonstrate Reliable Downhole Permanent Monitoring Systems
- Extend the Reliability of Downhole Chemical Injection Systems
- Extending Well Life in HPHT Fields Suffering from Depletion Driven Compaction
- Extend Capabilities and Alternatives to Elastomer Technology
- In the area of MWD/LWD and Wireline: Increase Sensor (Electronics) Reliability, Robustness and Temperature/Pressure Rating
- Improving Drill Steering Capability in HPHT Fields

Alternatives to Alloy Steels (Liners/Coatings)

Alloy steels are made up of a variety of elements in total amounts of between 1 – 50% by weight accompanied with steel to improve its mechanical properties. They are generally referred to as low alloy steels. Alloy steels improve the property of steels with regard to strength, hardness, toughness and improved resistance to wear and tear. These properties are usually achieved by treating the metal with heat.

When these compounds are exposed to HPHT, failures occur as a variety of these compounds are designed for specific conditions. The failures are generally classified as failures due to stress cracking and corrosion. Thus developing alloys for a variety of applications is difficult and expensive as existing technologies are condition and location specific. When failures occur the compounds have to be reengineered which causes a long lead time. The goal would be the development of materials that would withstand these temperatures and pressures, throughout the life of the field improving upon existing technologies.

The Challenges

- Improved alternative materials (ferrous/non ferrous compounds). Possible materials could be composites, ceramics or carbon fibre that are HPHT resistant throughout field life. These materials should be able to withstand HPHT perceived limits through field life conditions.
- Improved barrier systems that will protect assets in the HPHT environment which could be clad or bonded coatings to existing infrastructure to protect against corrosion and stress cracking. The systems should be designed for use throughout the life of the well. Scavengers as well as nanotechnology could be used as well.

Develop and Demonstrate Reliable Downhole Permanent Monitoring Systems

Suitable processes for the collecting and storing state data in HPHT environments requires constant, evaluation and monitoring of a variety of processes. Access to the right data, supplied to the right people, at the right time will lead to improved decision making in HPHT wells. Current systems offer a variety of benefits but performance may be affected as a result of changes in the well during the field life and systems will have to

be repaired or replaced. The goal would be to develop permanent monitoring systems downhole through the life of the well that can operate at Temperature and Pressure rating 20,000psi and 400°F (approx 204°C) respectively.

The Challenges

- Monitoring systems that provide continuous data throughout the life of the well with minimal power requirements
- Innovative technologies using fibre optics, acoustic technology as well as improved electronics to monitor downhole activities throughout the life of the well at HPHT ratings provided above
- Innovative Cable/Cable less (Wireless) downhole solutions at HPHT
- Improved electronic component and connector design to deal with harsh temperatures and pressures downhole
- The use of RFID technology for downhole monitoring at HPHT as well as the possible use of 'reservoir robots' to provide data for continuous monitoring

Extend the Reliability of Downhole Chemical Injection Systems

Downhole Chemical Injection systems are designed for the introduction of polymers or surfactants in the well to improve oil flow in a well during production. They are often used late in the life of the field. A variety of the systems used today provide a variety of benefits but operators require systems with high integrity that can be installed during the construction of the well and would last during the life of the well. The goal will be developing high integrity chemical injection systems with back-ups and fail safe systems that are reliable and redundant over the life and HPHT conditions of the well.

The Challenges

- Operators require systems that are functional over the life of the well at HPHT with production/safety protection ensuring choice of when and what to inject during production operations

- Chemical injection systems that will aid in barrier qualification with robust internal systems protecting against line bursts as well as optimum injection positions
- Downhole chemical injection systems that will aid in the protection of downhole safety valves
- Develop and demonstrate tools with high integrity and functionality that can be installed when the well is constructed and activated in mid-late life of the well from the surface
- The use of nanotechnology to prevent the build up of scale on systems, a proactive approach rather than a reactive approach

Extending Well Life in HPHT Fields Suffering from Depletion Driven Compaction

Reservoir rocks are subjected to a variety of stresses and strains throughout the life of a producing field. This greatly affects aspects of field development and production. Operators have to plan for; depletion, wellbore stability and integrity and in some cases subsidence and overburden deformation. Geomechanical engineers have to study these mechanisms to provide solutions to reservoir compaction. Depletion can cause compaction of reservoir sands, transferring strains to casing and equipment and in some cases damage casing or equipment. The goal is to improve the understanding of weaknesses of existing wells constructed in the reservoir and the immediate overburden at HPHT.

The Challenges

- Develop and demonstrate the most robust well construction mitigation approach at HPHT
- Improved enabling technologies to improve well design and construction for HPHT fields thus extending field life
- Improved performance from casings, cement performance packers and under-reaming, thereby providing resistance to shear stress and buckling

- Improved materials or combination of materials that are resistant to these changes throughout the life of the field experiencing depletion driven compaction

- Develop and demonstrate improved multifunctional geo-mechanical modelling and well construction technologies

Extend Capabilities and Alternatives to Elastomer Technology

Elastomers generally can be described as a thermoplastic or thermoset which has the ability to undergo deformation under the influence of a force and regain its original shape once the force has been removed. Elastomers are used widely in the Oil and Gas industry for a variety of tools and equipment throughout the production cycle. The main issues faced when using them relates to maintaining their mechanical properties over and extended temperature range at low and high pressures. There is a need for particular focus on their mechanical strength with high compliance (resilience). Due to the chemical composition of some elastomers they react with some fluids downhole causing failures, they also get impregnated with gases during oil and gas production as well. Operators require elastomeric or alternative sealing mechanisms they can trust and that will not fail at HPHT, are resistant to stress and have a variety of applications.

The Challenges

- Development of elastomers for specific use in a variety of applications such as downhole applications versus well head versus downstream applications with reliability and robustness at HPHT

- Development of elastomers that can be permanently installed at high temperatures over the life of a tool or sets of tools

- The development of smart materials that are resistant to HPHT and can be permanently installed such as; metals/ceramics, composites(plastics) as well as nanotechnology to modify elastomer performance

- Development of elastomer life cycle prediction software to aid the selection dilemma faced with material selection that will extend knowledge of theory of life/endurance predictions

MWD/LWD and Wireline: Increase Sensor Reliability, Robustness and Temperature/Pressure Rating

Measurement While Drilling (MWD) is a system developed to perform drilling related measurements downhole and transmit information to the surface while drilling a well. MWD tools are conveyed downhole as part of bottom hole assembly (BHA). The tools are either contained inside a drill collar (sonde type) or are built into the collars themselves. Logging While Drilling (LWD) is a technique of conveying well logging tools into the well borehole downhole as part of the BHA. Wireline usually refers to a cabling technology used by operators to lower equipment or measurement devices into the well for the purposes of reservoir evaluation and well intervention. LWD tools work with its Measurement While Drilling (MWD) system to transmit partial or complete measurement results to the surface providing real time data.

These tools operate in conventional wells but in HPHT environments, the tools fail or breakdown during the course of the drilling operations these breakdowns cause lost time and cost operators money. Operators need tools that are reliable and robust for longer time frames in a variety of wells at these temperatures and pressures to enable improved reservoir characterisations resulting in smarter completions.

The Challenges

- Reliable tool components that can withstand HPHT at for longer periods of time in long, hot horizontal lateral wells
- Tools that provide reliable and robust data from HPHT deepwater wells such as; shale gas, images of the formation, provide elemental spectroscopy, pressure and temperature data, identify fluids and fluid flow and provide data for tubing and casing inspection

Improving Drill Steering Capability in HPHT Fields

Steering is a challenging aspect of drilling operations and is especially difficult to achieve directional drilling at high temperatures. Current technologies are not suitable and operators struggle to maximise production in HPHT fields. Motors are limited by

elastomers, reservoir simulation is quite challenging as well as dealing with mechanical and hydraulic issues. Drilling fluids in these environments create some problems as well as their performance is affected in these environments.

Operators require improved field development options. As a result operators will be able to directional drill wells and reduce well counts thus reducing capital and operating expenses. Optimised well placement will result as reservoir contact increases as well. Technologies should maximise existing technologies and wherever possible should be retrofitted with minimal pressure losses.

The Challenges

- To develop directional drilling capabilities at 220°C (430°F)/ 20,000 psi with 3°/100 dog leg capability capable of running 12 – 14 day run life at 220°C.
- Develop low toxicity oil based muds for use at 220C/20,000psi up to 19ppg

ITF's Role & Approach

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 **£50 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 Theme will be reviewed for financial sponsorship by **all ITF Members** therefore this is an excellent opportunity to gain a global audience in seeking support for your technology. The focus of all ITF themes 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

Technology Challenge Timeline

The ITF Technology Challenge follows a staged timeline from the initial workshop through to launch of successful projects. The following list of tasks describes the key milestones and their associated date:

- Programme Start: Technology Challenge Workshop — Aug 2010
- Call for Proposals Issued — Oct 2010
- ***Deadline for Receipt of Proposals*** — ***10 Dec 2010***
- Publish to Members for Review — Jan 2011
- Member Review and Voting — Feb 2011
- Technical Clarification Meeting — Mar 2011
- Members finalise commitment to sponsor — Apr 2011

Process for Submitting a Proposal

1. **Register Interest with ITF**

   Register your interest as early as possible by sending an email to Mark Anju at m.anju@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 (Contact Information below).

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 Mark Anju at m.anju@oil-itf.com by **no later than 10 December 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

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:

Technology challenge manager and primary contact point for this Call:

Mark Anju - ITF Technology Analyst

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