

Focus: Subsea Technologies

Aims

This is an open invitation to any organisation, from any sector, seeking partners and 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 dealing with issues relating to subsea technologies.

Specific areas of interest:

- Subsea Power
- Flow Assurance
- Subsea Separation
- Temperature Management
- Pipeline Integrity Management / Cost Reduction
- Low Cost Intervention
- Specific Australian Regional Challenges
- Other

Justification

ITF members, major operating and service companies in the oil and gas sector, met at two international ITF Technology Challenge Workshops (TCW) in Perth, Australia and London and explicitly identified the current shared challenges they are facing across the industry in the area of 'subsea technologies'.

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.

Keywords and Potential Technology Areas

Subsea power, flow assurance, subsea separation, temperature management, pipeline integrity management, cost reduction, low cost intervention, renewable power sources, hydrate detection, wax, direct electrical heating, power distribution, heat, solids, pipeline, corrosion, microbial induced corrosion, produced water, sand, environmental standards, glycol, cold flow, BTEX, NORM, water shut-off, high temperature, heavy oils, water cleaning, discharge, methane, scale, heavy metals, intervention, chemical dosing, CO₂, H₂S, fouling, choke, coatings, metocean, CRA, composite materials, integrity, hydrotesting, inspection methods, pipelaying, repair, measurement, subsea connectors, subsea test flow loop, chemical injection, HPHT, multiphase pump, equipment retrofit, vibration monitoring, condition monitoring, fibre optics, MEG.

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

Subsea Technology Challenges

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

- Subsea Power
- Flow Assurance
- Subsea Separation
- Temperature Management
- Pipeline Integrity Management / Cost Reduction
- Low Cost Intervention
- Specific Australian Regional Challenges
- Other

Subsea Power

Cost effective high voltage power is required for remote subsea locations. Reliability and level of power is an issue e.g. lost power on unmanned facility. Energy source reliability, maturity and availability of supply are issues if using renewable energy sources. Those that give constant supply, e.g. water current, would be advantageous.

The Challenges

- Re-use of thermal power generated subsea
- Electric power transmission (100MW) over long distances (>300km). Specifically the focus is on subsea DC (direct current).
- Subsea generation and power transformation
- Methods for installation of cables in deep water (1500m+)
- Reliable high voltage wet connectors
- Long distance distribution. Currently >200km is uneconomical
- Wind, wave, current generation
- Compression powered by deepwater marine renewable energy sources
- Local geothermal sub-sea power generation (60°C)

Flow Assurance

Affordable, reliable and robust flow assurance is required for remote deepwater service which will in turn increase production, profitability and viability. This is currently problematical due a number of reasons; limited water concentration, limited design options, having a limited toolset available to assess the problem, no

remediation, limited hydrate detection technology and insufficient information on blockage formation.

The Challenges

- Improved internal pipeline coatings for hydrate plug prevention
- Subsea well stream cooler and liquid separation as a non-glycol flow assurance
- Direct electrical heating over long distance for hydrate and wax management, and heating of subsea components such as manifolds, spools, jumpers etc
- Alternative pipeline active heating systems - e.g. trace heating, pipe in pipe
- Hydrate subsea management of cold flow
- Hydrate plug detection, location and better understanding of characteristics and behaviour
- Holistic modelling at conceptual stage to get integrated reservoir and process flow assurance modelling. Perhaps integrate existing software packages to give 'what if' concept development
- Long distance chemical injection
- Solids transport and deposition in pipelines and risers
- Risk based flow assurance design toolkit - to mitigate corrosion, wax and scale
- Better corrosion modelling for pipelines
- Better understanding of microbial induced corrosion

(the last 2 points may also apply to Pipeline Integrity Management / Cost Reduction)

Subsea Separation

Sufficiently effective subsea separation is necessary to allow the disposal of produced water. Guaranteed performance is required over whole life of field to meet the large range of operational and design pressures encountered. Environmental and water quality standards must be met with approval from regulators (e.g. consideration and treatment of issues such as oil in water, benzene toluene ethylbenzene, and xylene-volatile aromatic compounds (BTEX), temperature, NORM (naturally occurring radioactive material), scale, solids and heavy metals). Chemical dosing and intervention and maintenance should be taken into consideration. New unit designs must be compact with dimensions compatible with subsea deployment and its instrumentation must provide online / real time measurement with reliability, accuracy as well as utilising telemetry. Marinisation of existing technologies is a possibility to provide, for example, downhole water separation and water shut-off capabilities.

The Challenges

- Water and heavy oil separation, cleaning and discharge techniques
- Control of separation quality, e.g. providing accurate measurement of hydrocarbon 5ppm in disposed water
- Establish produced water subsea dischargeable standards for deepwater developments.
- Meeting and monitoring a produced water specification for reservoir injection
- Subsea solid separation and disposal, including clean sand disposal to sea
- H₂S and CO₂ separation and subsea sequestration
- Internals to prevent foaming in subsea vertical gas line separators
- Subsea compressor reliability with ease of intervention, reliability, remote control monitoring, condition monitoring and ease of maintenance
- Subsea High Integrity Pressure Protection System (HIPPS) - lower cost options, reduced complexity and testing requirements
- Measurement and control of gas quality for subsea gas scrubber
- Subsea fast responding control valve
- Qualified rigs and subsea production equipment for HPHT
- Larger electrical motors for pumping applications, e.g. 6 MW
- Gas tolerant liquid pumps
- Pumps for higher shut-in pressures and deeper waters

- Vibration and condition monitoring of subsea rotating plant, pipelines, flexible and structures – detection of low energy vibrations and spectral monitoring on electric submersible pumps (ESPs)
- Improved and more reliable pump performance. Multiphase pump efficiency over a wide operating range with tolerance to sand and solids. Booster pumps with flexible internals to cover changing Gas Volume Fraction (GVF) during life of field. High DP (5MW+), high power requirements
- Large compressor for field installation. E.g. a liquid tolerant centrifugal compressor
- The ability to qualify the operational strategy in order to operate subsea compressor systems without recycling
- Control of separated fluids quality in compact equipment

Temperature Management

Effective temperature management of production fluids is required. For example the transfer of heat energy from upstream produced fluid to downstream produced fluid. In addition, the control of production fluid temperature out of the heat exchanger must be considered. Other related temperature management issues to consider are; marine fouling, corrosion due to seawater, the insulating property of coatings, as well as having an appropriate choke design to accommodate a variety of operating envelopes. Metocean conditions are of particular importance in regions such as Australia.

The Challenges

- Novel heating and cooling solutions
- Develop a smarter model for subsea cooling applications e.g. using finite element methods
- Effective lateral buckling control methods which are reliable and cost effective
- Corrosion prevention methods which enable the avoidance of CRA (corrosion resistant alloy) pipe (this point may also apply to Pipeline Integrity Management / Cost Reduction)
- Alternative composite materials to combat corrosion at high temperatures. For clarity, High temperature is 150-180°C (200-350°F), Extreme temperature is 180-204°C (350-400°F) and Ultra temperature is 204-260°C (400-500°F)

Pipeline Integrity Management / Cost Reduction

The main issue is to increase pipeline integrity whilst reducing the cost and closing any technology gaps. An aim would be to save 20% of the pipeline installation cost, however there is currently a lack of collaboration between operators and contractors due, perhaps, to conservatism in design or 'gold plating'. The length and size of pipelines, particularly in Australia, is a problem as are CO₂, H₂S and high temperature flow assurance issues. There is a cost and schedule impact of hydrotesting long pipelines, so there is an opportunity for alternative inspection and testing methods to be developed to improve integrity monitoring. Data access is difficult when the pipelines are not piggable, are buried or inaccessible, or there is a lack of appropriate instrument technology available.

The Challenges

- Deepwater pipeline protection from trawling gear, heavy impact and drag
- Cathodic protection of rock dumped pipelines
- Low cost gas flowlines for deepwater e.g. using carbon steel or composite materials
- Low cost pipeline stabilisation and tie-backs
- Reliable pipeline subsea oil and gas leak detection
- Alternative and more cost effective pipelaying methods, such as automated pipeline barges, coiled tubing, reel-lay tow bundles and spiral pipe
- Repair systems for internally corroded hydrocarbon pipelines
- External verification methods for whole pipeline integrity
- New filler or repair systems e.g. sock technology, perhaps looking to the water industry for ideas
- Alternative measurement techniques using technology such as acoustics, infra-red, nuclear, electromagnetics, signal analysis and seismic along length of pipe

Low Cost Intervention

Low cost subsea intervention and monitoring is required along with the production of stranded reserves. At the moment there is a perceived disconnect between users and suppliers, a lack of cooperation between users and a lack of standardisation from suppliers and OEM's (original equipment manufacturers). It is important to find a standard re-useable design that fits all requirements as deployment and recovery is required from a wide range of vessels and weather conditions.

The Challenges

- Methods for standardisation of subsea equipment and interfaces to reduce maintenance time
- Modularisation to allow flexible capacity and low cost intervention
- Diagnostics and intervention enhancement
- Expansion to services currently offered from vessels, for example top hole/intermediate hole drilling and well cleanups, to speed up response and mobilisation.
- Re-usable subsea facilities
- 'All-electric' - eliminating the use of hydraulics. Electric trees, ROV's (remotely operated vehicles) and workover systems with low power consumption
- Low cost, wet tree and small accumulation production systems

Specific Australian Regional Challenges

Although the following challenges are not unique to Australia, they were agreed to become the priority focus areas for the Australian Region. If overcome, they provide opportunities for step change reductions in development CAPEX/OPEX and/or improved recovery (rate/ultimate) in this region. However, presented solutions may also have an application in other regions.

The Challenges

- General (Oil and Gas)
 - Reduce Installed cost of Rigid Pipelines
 - Improve viability of remote/deepwater marginal fields
 - Reduce Drilling, Completion and Workover Costs
 - Avoid need for surface piercing structures, e.g. floaters
- GAS - Characterised by Long Tie backs > 50 km in deepwater
 - Cold Flow or Heat and Insulate
 - Avoid hydrate risk

- Minimise or eliminate mono ethylene glycol (MEG)
 - Avoid wax risk
- Remote Power
 - Enables Subsea Processing, e.g. Heating, Boosting, Compression, leading to..
 - ...Increased rate of recovery and/or ultimate recovery
- Subsea produced water separation & disposal direct to ocean
 - Reduce or avoid hydrate risk
 - Minimise or eliminate MEG
 - Eliminate need for Water Injection Well
- Manage corrosion in Carbon Steel Pipelines (formation water)
 - Avoid CRA materials
 - Increase life of Carbon Steel Pipelines
- OIL - Characterised by Subsea Production Systems tied back to floating production, storage and offloading vessel (FPSOs)
 - Subsea produced water separation & disposal direct to ocean
 - Reduce flowline diameters and costs (transport oil and gas only)
 - Reduce or avoid hydrate risk
 - Minimise or eliminate MEG

Other

Other issues identified at the Perth and London workshops are:

The Challenges

- Subsea test flow loop- a simulated sea-bed flow loop (e.g. 6 x 2km) to test flow assurance strategies on live hydrocarbons at real scale. So called 'industry funded fantasy island'
- Subsea sour service - risk management
- Reduced cost retrofit of sensor equipment, trees, manifold, longer life Emergency Shut Down Valve and more reliable sand monitors
- Subsea wet-mateable fibre optic technology
- Clamp connector that can be closed and seal with angular misalignment
- Mud mat foundation for a template production manifold that can resist erosion from drilling and environmental loads

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 around **170** projects and secured approximately **£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 dates.

Note: If there is significant interest in a proposal, ITF has a mechanism for fast tracking projects.

- Programme Start: Technology Challenge Workshop June 2011
- Call for Proposals Issued 11 Aug 2011
- ***Deadline for Receipt of Proposals*** ***6 Oct 2011***
- Publish to Members for Review Oct 2011
- Member Review and Voting Nov 2011
- Technical Clarification Meeting Dec 2011
- Members finalise commitment to sponsor Mar 2012

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 6 October 2011**. 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 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

Email: m.anju@oil-itf.com

Tel: +44(0)1224 222420

Other members of team available for your support:

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For more information on ITF please visit the ITF Website - www.oil-itf.com