



Call for Expressions of Interest

Development of Tight Gas Reserves

- Accessing a Vast Global Resource -

UK operating oil companies have identified key business needs within the area of **Development of Tight Gas Reserves** and, through ITF, they would like to promote development of collaborative, world-class solutions to these needs.

This call for Expressions of Interest is the first step in identifying consortia to undertake funded research & development work in this area.

1. About the Proposed Programme

This Programme is based primarily on subsurface issues and a key feature of it is that it should stimulate innovative solutions with the potential for major impact on our understanding of tight gas reservoirs and our ability to economically recover the gas. Input is encouraged from across the R&D community and, where appropriate, drawing on expertise from non-oil technology sectors. It is envisaged that within the overall Programme, there will be a number of inter-related projects undertaken by different R&D consortia.

The operators have identified five areas where technology advances are sought,

- Saturation Modelling & Measurement
- Pore Networks Understanding
- Sweet Spot Identification
- Impact of Geomechanics
- Well Stimulation/Fracking

On the following pages are given the key business needs, as defined by the operators. The format used is intended to encourage innovative solutions and researchers are asked to address as many of the issues as they feel appropriate.

It is expected that the Programme will be up to three years in duration and will produce clear, tangible outputs. Consideration of routes to implementation should form part of each submission. In addition, significant deliverables will be expected throughout each project.

2. About ITF

ITF is a not-for-profit organisation owned and supported by major oil operating and service companies. It is the vehicle through which these companies fund joint industry projects that meet the technology needs of the upstream oil and gas industry. ITF has the remit to facilitate the development of new, high impact technologies that will increase hydrocarbon recovery from mature basins and frontier exploration areas. Further information about ITF can be found at www.oil-itf.com.

One of ITF's principal activities is to identify technology needs through consultation with its member companies and then work with the R&D community to develop proposals for innovative solutions to these needs.

3. Call for Proposal Dates

Deadline for Expressions of Interest	4 June 2007
Request for Presentation of Full Proposal	July 2007
Deadline for Presentation of Full Proposal	September 2007
Sanction / Start Date	End 2007

4. Key Business Needs

With the increased focus on security of hydrocarbon supplies, more effort is being devoted to maximising recovery of existing hydrocarbon reserves, both in the NW Europe and in other basins around the world. This has brought into focus the economic production of gas from unconventional sources (primarily tight gas, coal bed methane, and gas hydrate). Very large volumes of gas are known to exist in each of these 'reservoirs' but it is on Tight Gas that this call is focused.

There are varying definitions of what constitutes a tight gas reservoir, some more formal than others because of local tax breaks, but a figure of an average permeability of less than 0.1 mD ($1 \times 10^{-16} \text{ m}^2$) is good to work to. Globally many 100's of TCF (trillion cubic feet, 1 cubic foot = 0.0283 cubic metres) of gas are known to exist in this type of reservoir.

The economic recovery of gas from tight reservoirs will depend on a number of factors which together will determine whether the financial threshold of the licence-holding E&P company is reached. This will differ from company to company. It is acknowledged that access (drilling and completion) and recovery costs often dominate these calculations but it is known that much development work is currently underway to address these.

Therefore it is the purpose of this Call for Proposals to focus on subsurface-based issues which will help **maximise the understanding of tight gas reservoirs and the ability to economically recover the gas.**

5. Issues Identified by the Operators – The Call

It is recognised that key to this improved understanding and ability to recover the gas will be better characterisation of the tight gas rocks, understanding the mineralogy and the distribution of water & gas in the pores and managing the great uncertainties which inevitably exist.

Researchers are invited to propose solutions which address these issues. Below are some of the specific points identified by the operating companies which should be considered,

Saturation Modelling & Measurement

The operating companies' main interest is in the effective gas in place – the mobile gas element – although most measurements focus on the total gas in place. The challenge is to develop more effective modelling and measurement technologies/methodologies which will ultimately provide this information.

- What are we actually measuring and is it correct? Do the existing methods and equations hold for low porosity/permeability reservoirs? How do we account for the trapped irreducible water?
- Saturation modelling
 - how do we better model saturation?
 - are we measuring the real saturation? How do we reduce the uncertainty around this parameter?
 - in calculating the gas in place (GIP), how do we calculate connected GIP & recoverable gas? How do we measure the degree of connectivity?
- Does NMR work in low perm settings? (it is the calibration that poses a difficulty)
 - Is a new equation required?
- Reservoir behaviour – how vulnerable is it to fluid invasion in the near-wellbore?
- Anisotropy – how to handle effectively? Currently we are steered by the worst behaviour
- Rel perm issues & modification:
 - how do we prevent damage?
 - we study ductiles in the reservoir – what is their provenance?
 - what is the percentage of ductiles? What are the effects on compaction behaviour as the field depletes? How does the geo-dynamic behaviour respond in reaction to production?
- Large transition zones – how will they behave, especially in terms of capillary pressure
- What can the matrix give you, in terms of a measurement of effective hydrocarbons in place?

Pore Network Understanding

- What is the connected vs. isolated pore distribution
- Looking at cleaned core is not representative of real reservoir conditions. How do we measure and visualise the pore network in the 'wet' state (fluid present)?
 - is there relevant expertise in other sectors which could be applied in this context (e.g. the medical sector – is 'live' rock similar to 'live' tissue)?
- How can we better simulate laboratory measurements & calibrations?

- There is an interest amongst operators in the creation of a digital database of pore network images based on a wide a range of rock types
- Quality downhole measurements would greatly add to the industry's understanding in this area – what is now possible? Are there new sensor technologies available – e.g. electro-acoustic measurements?

Sweet Spot Identification (macro-scale)

Because of the heterogeneity of the subsurface, within low permeability reservoirs there will be areas of higher permeability/connectivity – 'sweet spots'. Identification of these on a macro scale is of great importance in accessing these reserves, through optimum well and perforation placement. The focus of this part is to better understand how to identify these sweet spots within the formation.

- By understanding the burial curve can we predict where the sweet spots may be?
- Can we push the limits of seismic to allow identification of the characteristics of in-field properties of sweet spots (permeability as well as porosity)?
- If boreholes already exist in the formation, are there downhole techniques or measurements which would assist?
- A number of the issues outlined above are already being addressed by the geophysical community; however is there anything uniquely required for a tight gas reservoir context?
- Can we look at connectivity between wells – what is the most efficient methodology to use for interference test data? What is the pertinence of conventional interpretation (analytical tools) when sweet spots are geometrically (structurally) complex? Is it necessary to use complex reservoir models for such short term tests (single phase flows)?

Impact of Geomechanics

Recently there has been an increased focus on the impact of geomechanics on development, operating costs and recovery factors in 'normal' reservoirs. At very low permeabilities, the effect of stress is likely to have an even more significant impact. We need to be quantifying the properties of tight rock types under reservoir stress conditions.

- Can geomechanical modelling be extended to tight gas environments? In particular can we consider,
 - permeability & pressure distribution in relation to production
 - the impact on fractures – reduction in permeability over time/effects caused by fines migration
 - initial & longer term reservoir performance relating to stress regimes
 - the effects of compaction on permeability, both positive & negative
- Measurement of m&n cementation & saturation values. More realistic values (rock properties database) to plug into fracture simulators

Well Stimulation/Fracking

It is recognised that well stimulation/fracing are well established techniques with much experience residing within the service company sector. However the operators are interested in proposals which can extend these technologies.

- there has not been a systematic collation of the application of treatments and their success/failure for different pore networks, rock properties and stress regimes. A catalogue/information sharing proposal covering this would be of interest to operators.
- Can fracs be extended to many times their current length – super fracs?
- Can we improve and tailor induced fractures for offshore tight gas environments?
- What makes a single-stage frac as effective as a multi-stage one?
- How can we improve transferability of designs from one reservoir to another?

As a general point ***if software is to be proposed as a deliverable it must be capable of being integrated with existing industry standard software platforms.***

6. Expression of Interest - Issues to be Addressed

Using the attached form, the Expression of Interest should detail the innovation proposed. In addition, it should address some or all of the following questions plus any other information considered relevant. Proposers are requested to limit submissions to the three A4 pages provided.

- i. How does the proposed contribution fit with the overall theme of this Call?
- ii. What collaborations have been established, or will be established, to fulfil delivery of the proposed contribution?
- iii. What are the track records of researchers in this or related areas, such as technology transfer between industrial sectors?
- iv. What is the proposed route to delivery/implementation of outputs?
- v. Does the submission contain confidential information? If so, you can complete the Confidentiality Agreement available on www.oil-itf.com/downloadarea/index.htm.
- vi. What steps have been taken to protect/exploit intellectual property arising?

7. Next Steps

Expressions of Interest should be submitted to Duncan Anderson, ITF Subsurface Technology Manager. Contact details are given below.

After the 4 June closing date, a panel of experts will review the submissions. These will be judged on their relevance to the overall Programme and to the issues detailed on previous pages, the track record of the researchers in developing practical, innovative solutions and the potential impact of outputs from the proposal on the understanding and development of tight gas reserves around the world.

Following this review, successful consortia will be invited to present more comprehensive proposals according to the timetable summarised on page 2.

8. ITF Contacts

If you would like to discuss any matters related to this programme or any other issue related to ITF, please contact either Duncan Anderson or Colin Sanderson.

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