



Technical Session 2

ETI CCS MMV Project Overview



Dr Graham Brown

Divisional Director Oil & Gas, Sonardyne International Ltd.

...our vision is to facilitate safe, secure, economical and environmentally sound operations upon and within the worlds oceans and seas...

...we aim to achieve this by continuously building on our position as a leading independent global provider of trusted marine technology solutions...

...our values are clear: business integrity; a strong customer focus; a passion for engineering excellence and innovation; meticulous attention to quality; and a strong commitment to our employees and the community.



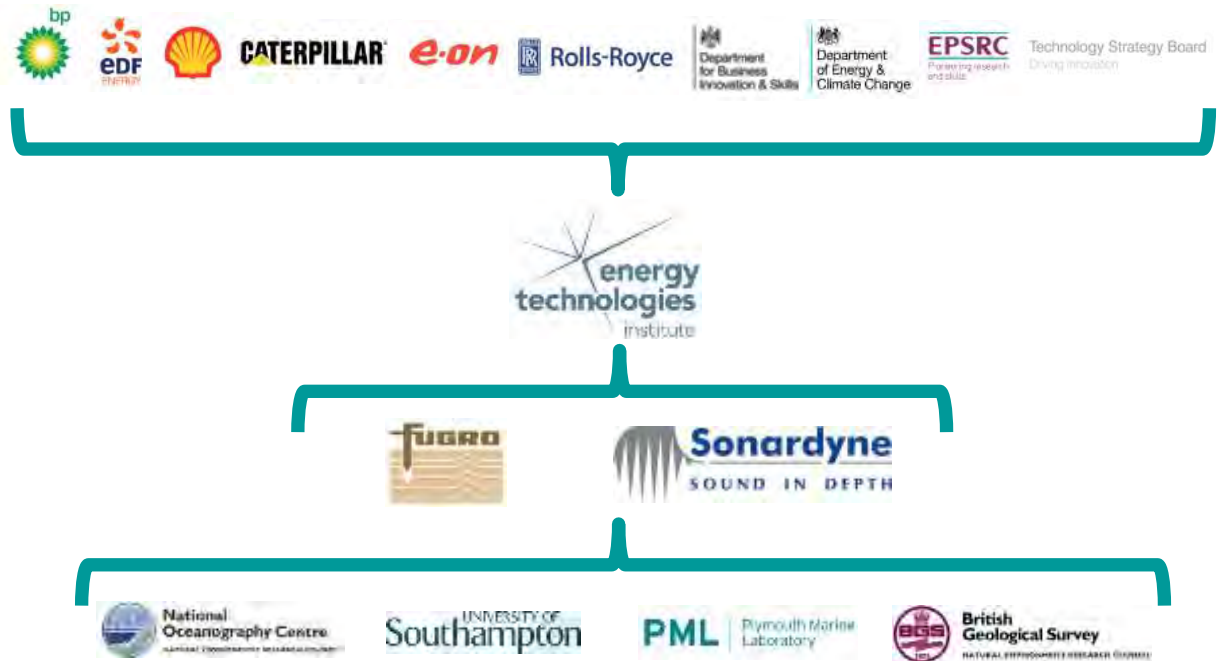
“The purpose of the Project is to develop and demonstrate a cost-effective MMV system for ongoing environmental assessment of emissions in the marine and shallow subsurface environment in order that operators involved in the injection of carbon dioxide into the subsurface can meet the legislative requirements for such activities.”

The Players

CCS MMV Project

The ETI is a public-private partnership between global energy and engineering companies and the UK Government.

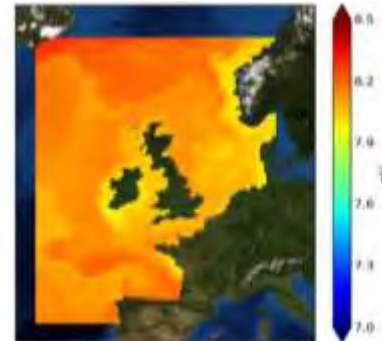
Their role is to act as a conduit between academia, industry and the government to accelerate the development of low carbon technologies.



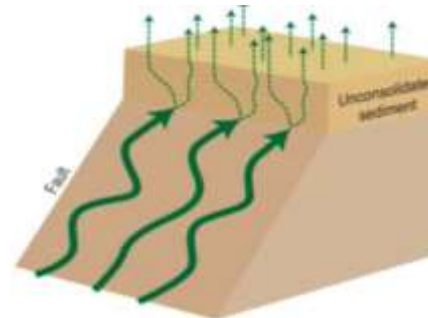
Sonardyne engineers have worked with scientists to understand the problem:

- pH variations on a Sea scale across the seasons
- How much might leak out of a reservoir
- How the leak may appear at the seabed
- Tidal mixing processes and how a leak signature would disperse
- How gas and chemical plumes would form and disperse

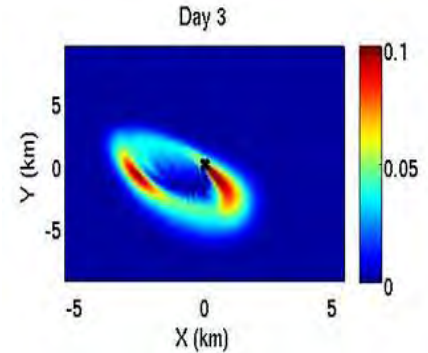
Once we understand the problem we can design a system!



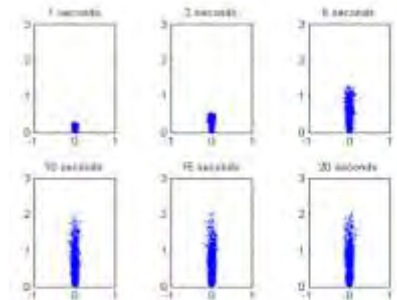
PML | Plymouth Marine Laboratory



BGS British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL



National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL



UNIVERSITY OF
Southampton

Types of Leak

Mechanical vs Geological



Leakages

'Mechanical'

'Geological'

High DP

Low DP

Fracture

Pinhole

Seal washout

'Seep'

Flux rate (0.1 – 1000) litres/min
bubble size >= 10 mm

Flux rate (0.1 – 1000) litres/min
bubble size < 10 mm

Orders of magnitude approach...

NOC/PML modelling

10Te & 100Te per day :100m scale model & 50km extent

Category	Tonnes / hour	Tonnes / year
1	100	1,000,000
2	10	100,000
3	1	10,000
4	0.1	1,000
5	0.01	100
6	0.001	10
7	0.0001	1

'0.01% store inventory'
 smallest store 10MTe =1000Te/year

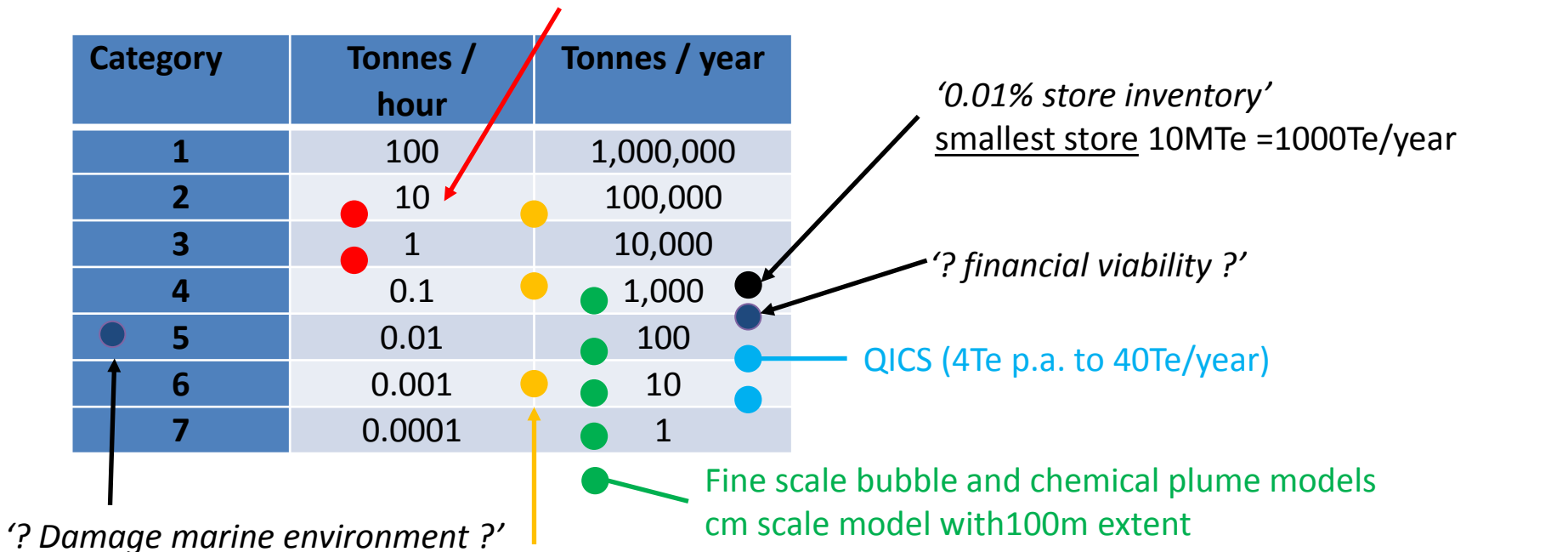
'? financial viability ?'

QICS (4Te p.a. to 40Te/year)

Fine scale bubble and chemical plume models
 cm scale model with100m extent

'? Damage marine environment ?'

Fine scale high pressure cases



CONOP – Concept of Opera

Risk based areal coverage

ASV
Subsea to surface
Comms gateway

AMT
Point chemical
At risk locations
Comms to surface

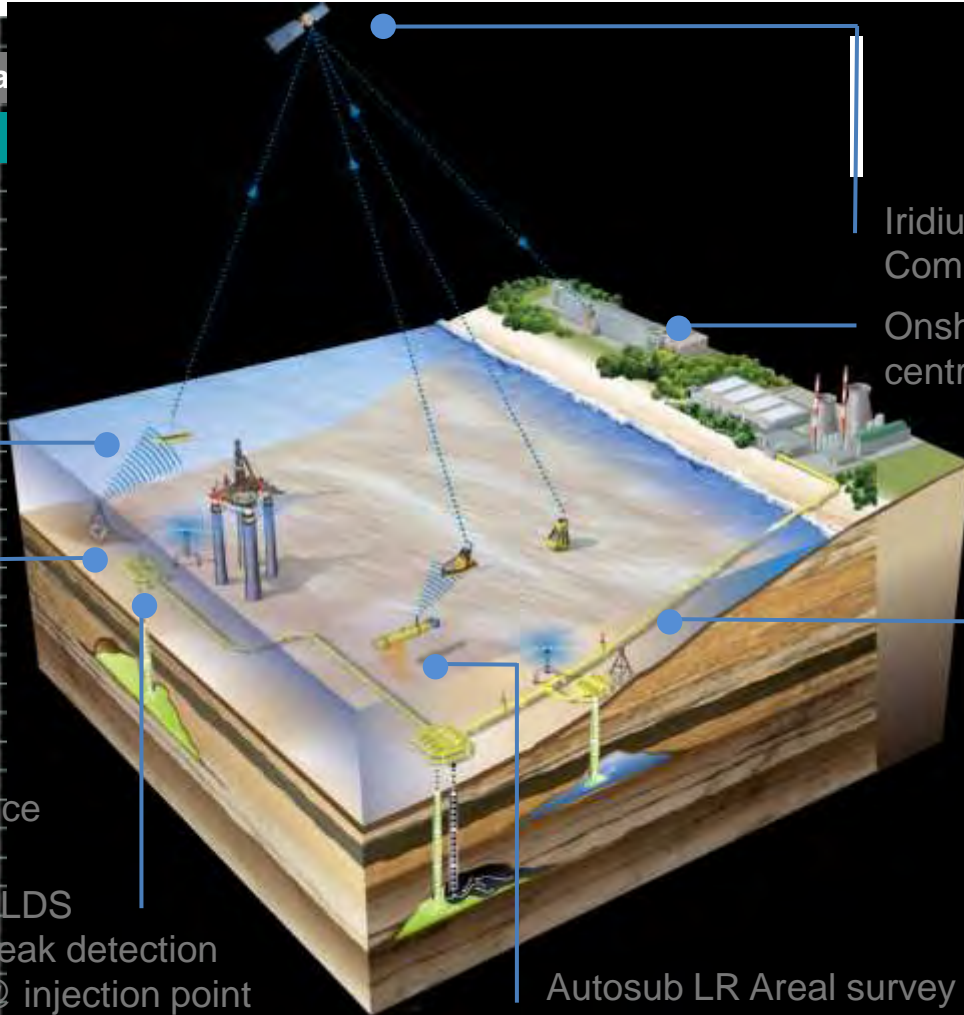
ALDS
Leak detection
@ injection point

Autosub LR Areal survey

Iridium Surface to Shore
Comms

Onshore monitoring
centre

CO2 source
& pipeline





The Autosub Long Range AUV (or ALR) is a new type of AUV. Although a third the weight of the Autosub3 and the Autosub6000 AUVs it will be able to travel 6000km.

The key to achieving this performance is efficient propulsion at slow speed and by keeping tight control of the power used by the AUV sensors and control systems. In particular the wide area side scan sonar and chemical sensing.



Key challenges are autonomy in decision making for target recognition, obstacle avoidance and data storage / compression



NOC is one of only two organisations representing the UK in the Wendy Schmidt Ocean Health XPRIZE, which is offering a total prize fund of (US)\$2million for the development of accurate and affordable ocean pH sensors to improve our understanding of ocean acidification.

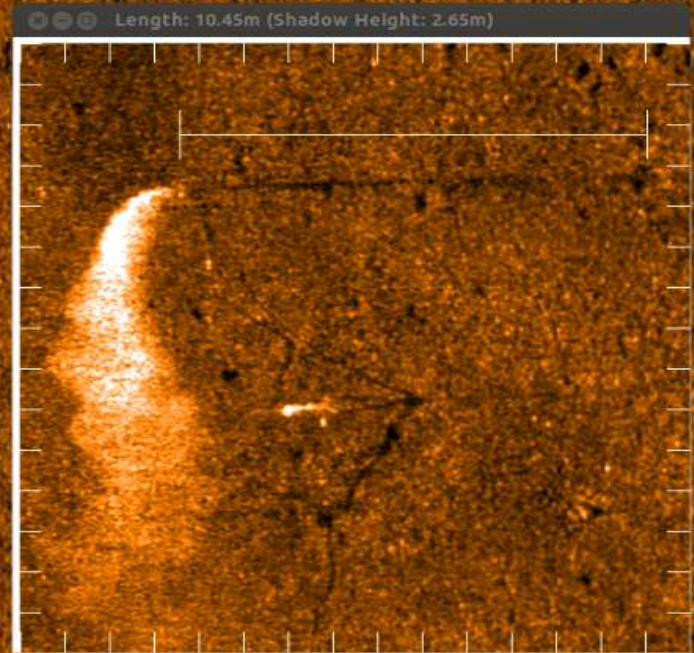
Very small in size, it is based on a microfluidic design, which requires very small volumes of seawater to generate a reading. It is also being designed as an autonomous system able to operate on a number of oceanographic platforms – AUVs & Landers



Technologies

Solstice - Low power wide area coverage leak detection

“10 l/min CO₂
gas leak, 2.65m
tall plume from
seabed”





“That signal is the diver’s bubble trail”

“We must be able to use that to detect leaks”



Key Requirements for Leak Detection

- Early detection of small leaks
 - Minimise clean-up costs
 - Prevent larger spills
- Capable of oil and gas detection
- Automated detection and classification
- Rapid response time
- Localisation
- **Very low false alarm rate**

Applications

- Drilling Phase
 - Medium term duration – 3 to 6 months
 - Standalone operation
- Production Phase
 - Long term (>5 years)
 - Connected to control/monitoring system
- Post abandonment/capping
 - Medium term duration
 - Minimal infrastructure

Automated Leak Detection Sonar (ALDS) Key Technology Features

360°
COVER

24/7 .2
OPERATION

70W
POWER

- 4000m depth rating as standard
- Grade 5 Titanium pressure housing
- Ethernet command & data transfer
- SISS Level 3 instrument
- 84kg in air, 330mm diameter and 550mm tall
- PC processing topside
- Automated detection and alarms



Thunderhorse Gulf of Mexico



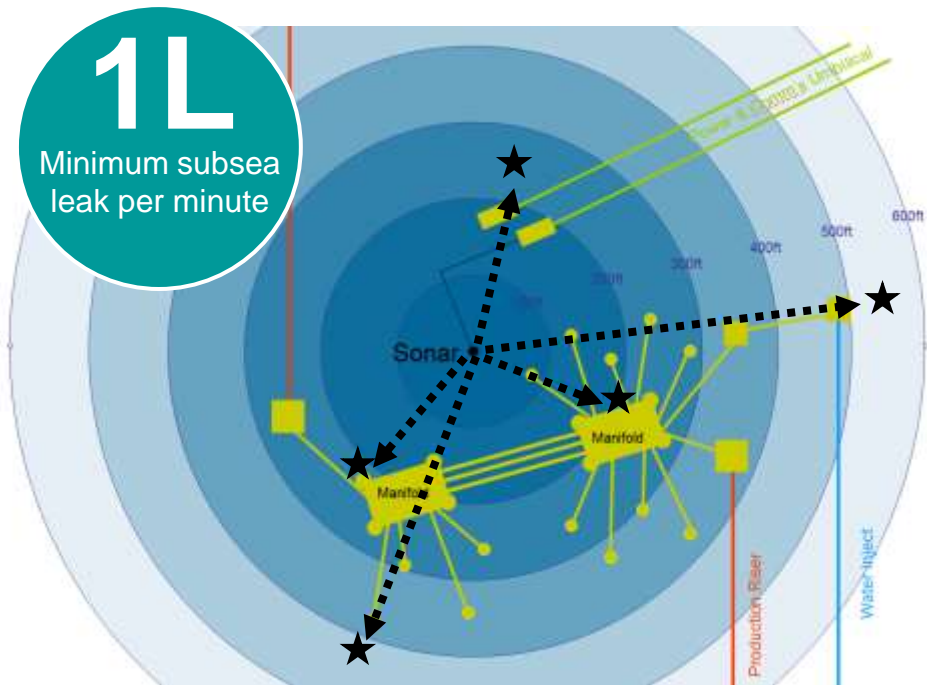
- 8km tieback via existing subsea link
- Power and comms via ROV connection to UTH
- Data processing in rig control room

2012 Oil Leak Trials
2013 Gas Leak Trials
2015 Installation



1L

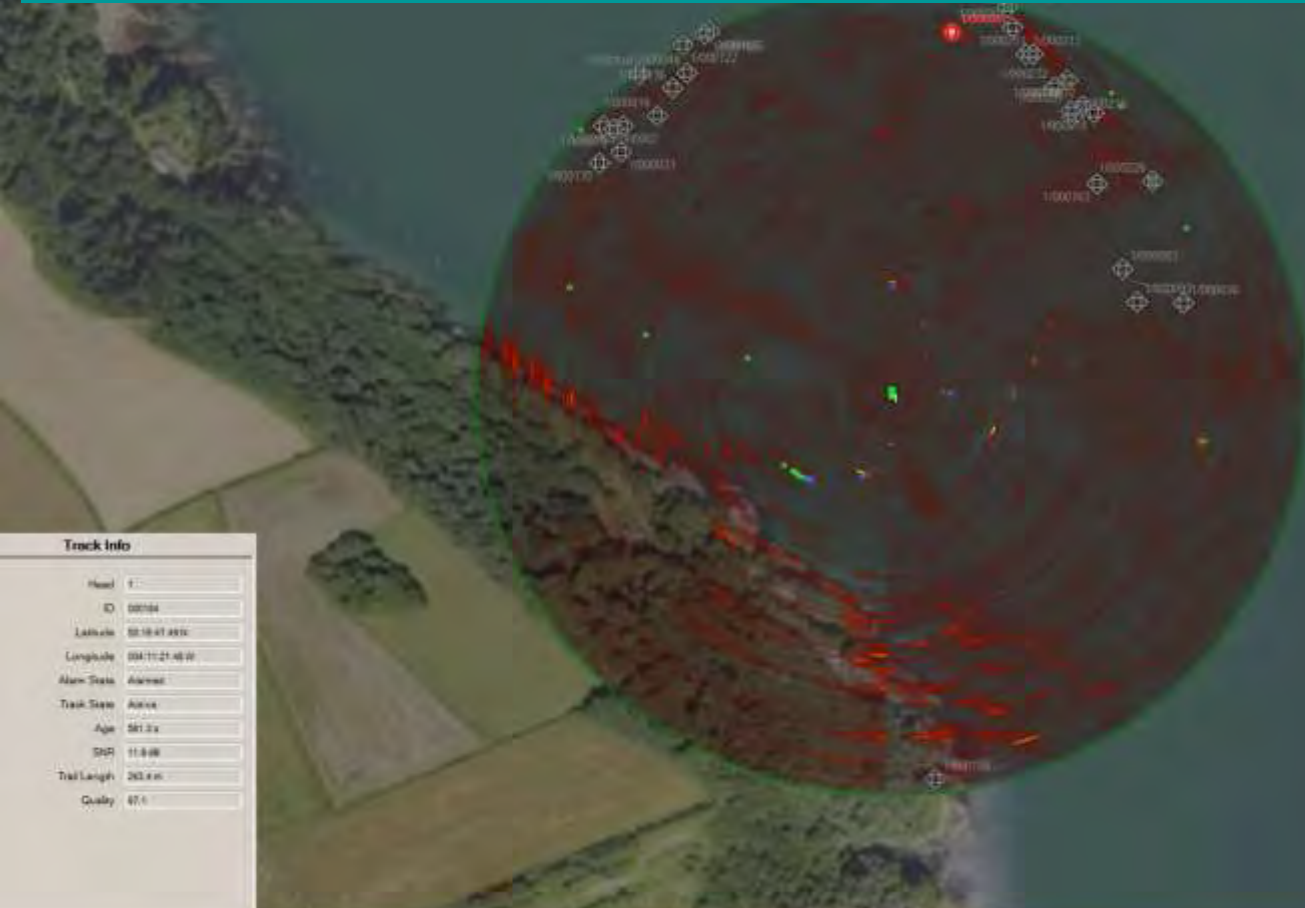
Minimum subsea leak per minute



- Leak 'target' deployed in and around structures – 170 m range
- 'Clear Vector' tests up to 670 m range
- **ALL** leaks detected and localised



Detecting gas in water



Alarm

Head: **1** Track: **184**

Alarm Lat: 50°19'47.49" N Alarm Long: 004°11'21'52" W

Reference Trigger Live

Info More Acknowledge

Track Info

Head	1
ID	000004
Latitude	50°19'47.49" N
Longitude	004°11'21'48" W
Alarm State	Alarmed
Track State	Active
Age	581.3s
SNR	11.8 dB
Trail Length	263.6 km
Quality	67.0

Replay from Sonar: **1**

Select Record: **04/02/2014-14190**

Continue Playback

Start Cycle: 15382

This Cycle: 15382

End Cycle: 15734

- Home
- Grid
- Alarm
- Map
- Layers
- Search
- Settings
- Help
- Close
- Power

Deep and Shallow Water Tests

No false alarms during operation

High volume, ultra long range coverage from a single point

Always on

Early warning – ability to detect small leaks and intervene quickly

Battery operation and subsea processing options



Dead oil (2012)
50-100 bpd
@ 450 m range
2000m depth

CO₂ (2014)
2 litre/minute
@ 850 m range
10 m depth

'Live' oil (2013)
1.5 bpd
@ 670 m range
2000 m depth

Gas (2013)
1 litre/min at 1 bar
DP
@ 670 m range
2000 m depth



Any questions?