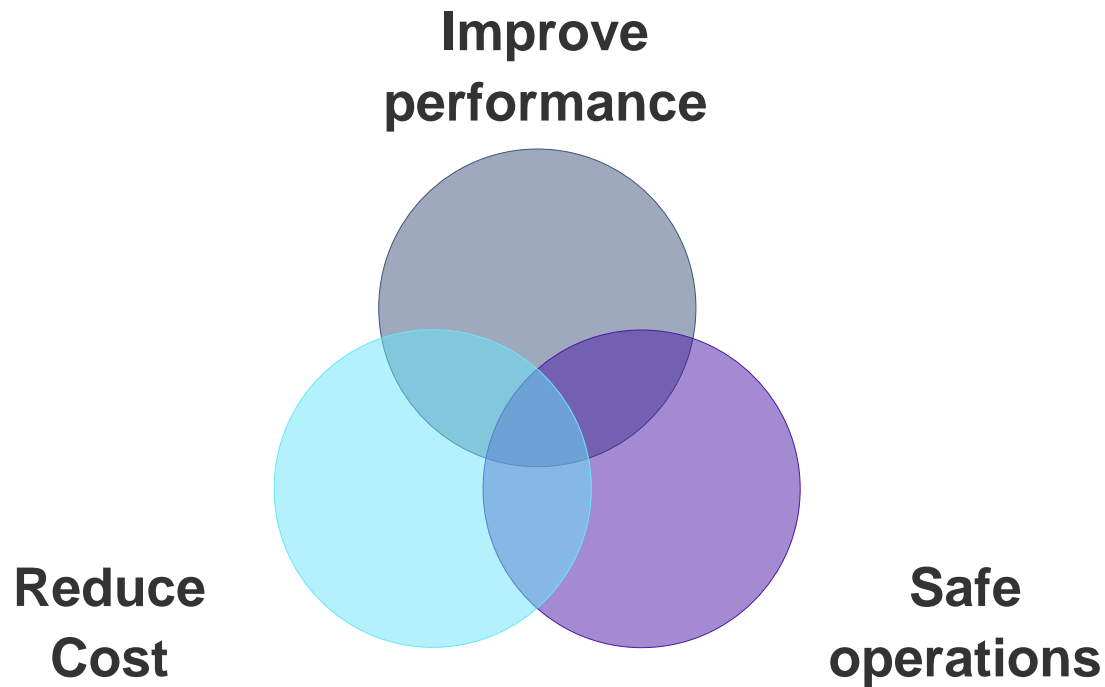




# Integrated Environmental Monitoring Statoil research project

# The purpose of environmental monitoring

Environmental monitoring as an integrated part of our operations



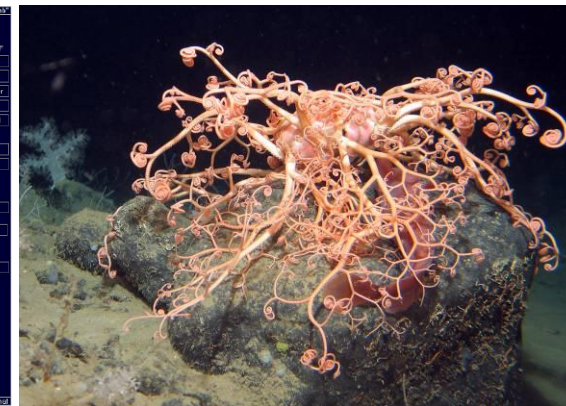
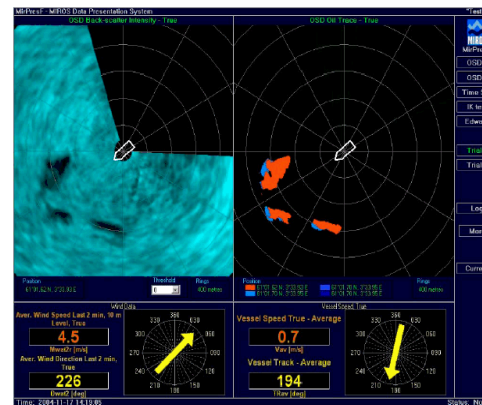
- Early warning
- Verify predicted risks and impact
- Documentation of area of exposure and impact

# Current practice - monitoring regimes

To be carried out by independent 3<sup>rd</sup> party

Point samples of selected physical/chemical and biological parameters

- Sediments
- Water column
- Soil
- Ground water
- Remote sensing
- Follow-up after spills
- Visual surveys



# Current practice - challenges

- Flexibility
  - Monitoring must be suited to the actual habitat
  - Physical sampling may harm sensitive habitats
- Response time of point sampling
  - Significant time lag between impact occurrence and detection
- Cost-effectiveness
  - Can be improved through integration in design and operations
- Automatic detection
  - Gas leakages and acute discharges



# Paradigm shift



From “expeditionary”  
offline sampling



To continuous environmental  
monitoring

**Licence to operate**  
demonstrating  
**prudent operations in sensitive areas**

# Integrated Environmental Monitoring

## Asset control room



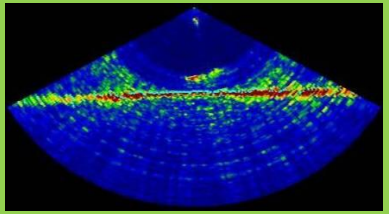
## Central support functions



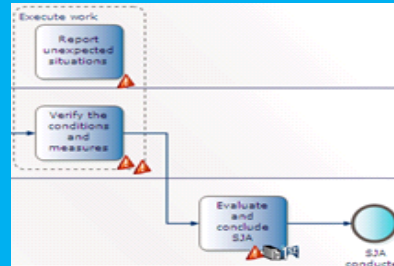
## Emergency response



## Domain experts



## Information & work processes



## External organisations



## Sensors & sensor platforms

### Existing sensors & sources



### Stationary ocean observatory



### Mobile



# IEM Work Packages

## Work Package 0, Particular sensor technologies

- Sensor technologies of particular importance for Statoil operations

Ongoing

## Work Package 1, Environmental data capture

- Focus area **1**, sensor technology
- Focus area **2**, communications infrastructure

ITT  
Q1-2011

## Work Package 2, Environmental monitoring in daily operations

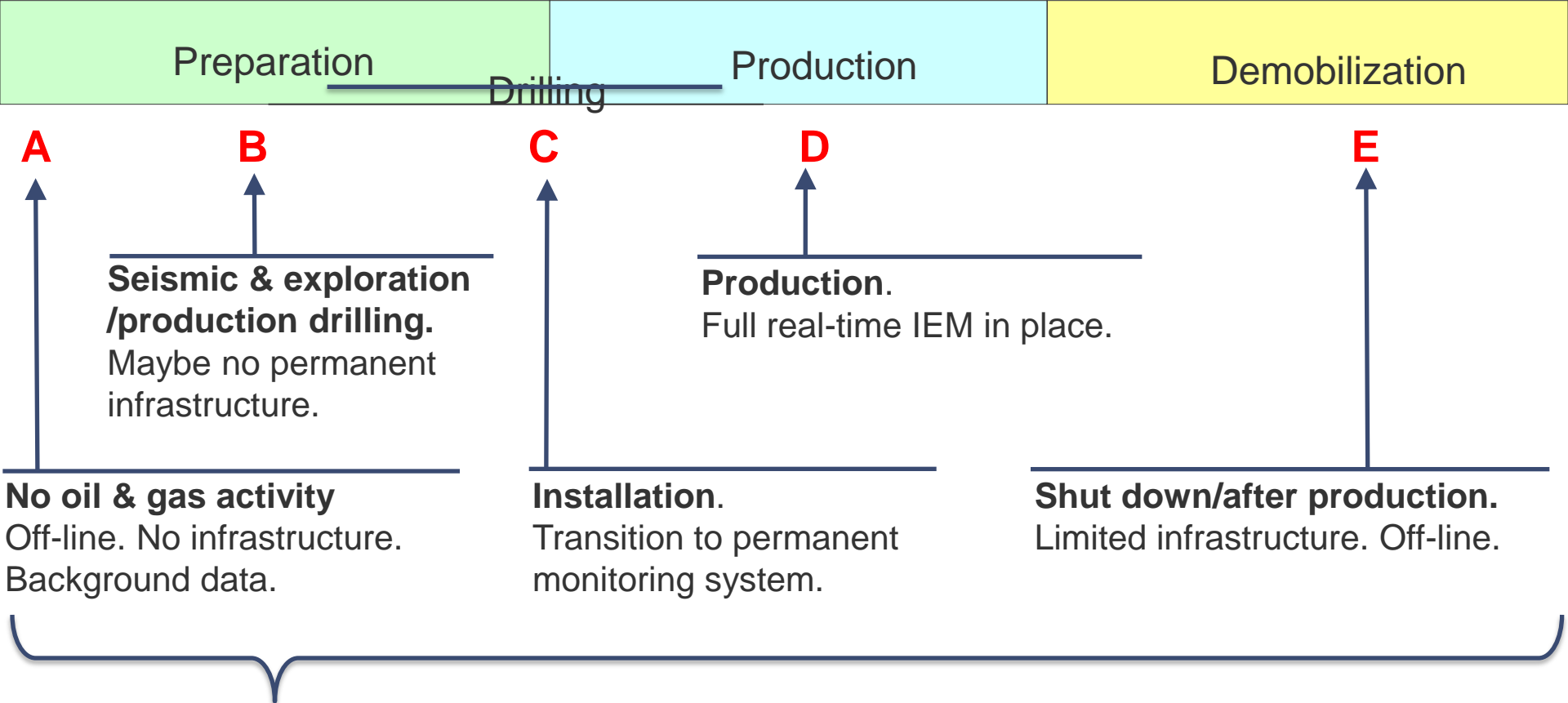
- Focus area **3**, data access, and management
- Focus area **4**, Information workspaces, collaboration and work practices
- Focus area **5**, Analytics

## Work Package 3, Extended analytics

- Focus area **5**, Environmental data analysis, complex analytics and correlations; algorithms, on-line dispersion and risk models
- Not part of Work Package 1 ITT. Internal pre-work with separate ITT

ITT  
Later

# Scenarios



### 3 infrastructure situations

1. Area with no infrastructure
2. Field with limited power supply and data communication (typically old fields)
3. Field with subsea power supply and fibre optic communication (typically new fields)

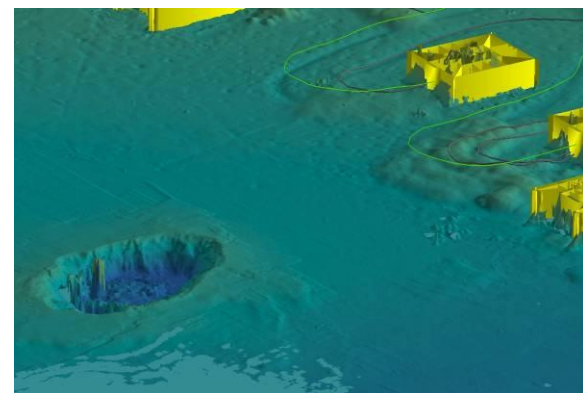
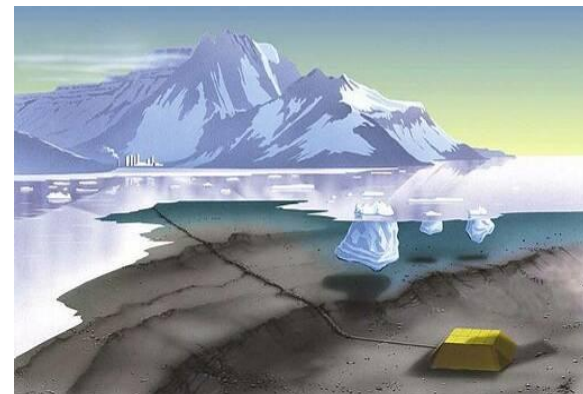
# Business case examples

## Monitoring in challenging areas

- Areas covered with ice
- Areas with activities restrictions parts of the year
  - Longer activity windows
- Sensitive areas
  - Morvin: Surveillance of corals with respect to drill cuttings
  - Coastal areas e.g. Nordland VII
  - Calcareous algae Peregrino
  - Full life cycle approach to environmental monitoring

## Condition monitoring

- Production leaks (subsea and surface) and technical condition
- Verify containment of injected fluids (produced water, drill cuttings, CO<sub>2</sub>)

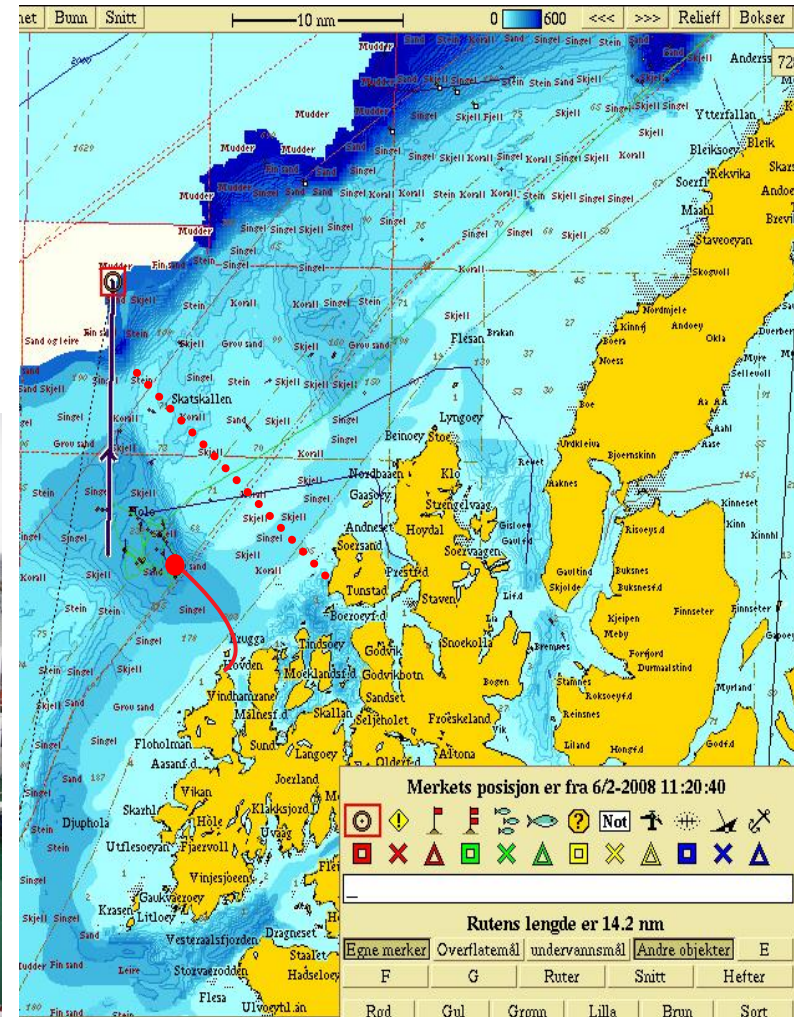
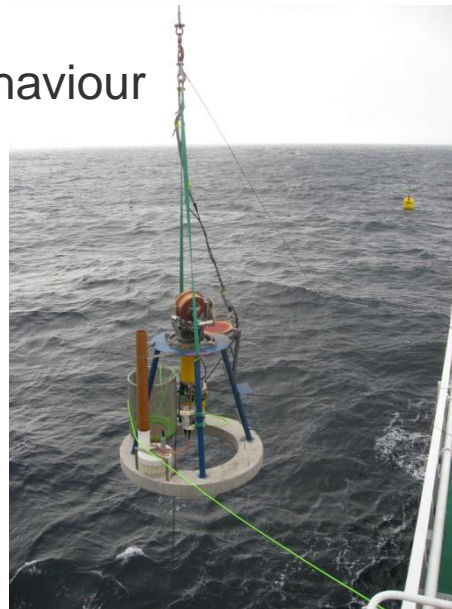
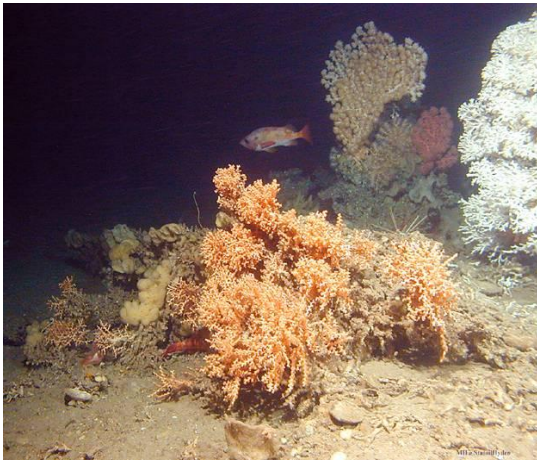


# Ocean observatory in an area with no petroleum activity

## Nordland VII, Norway

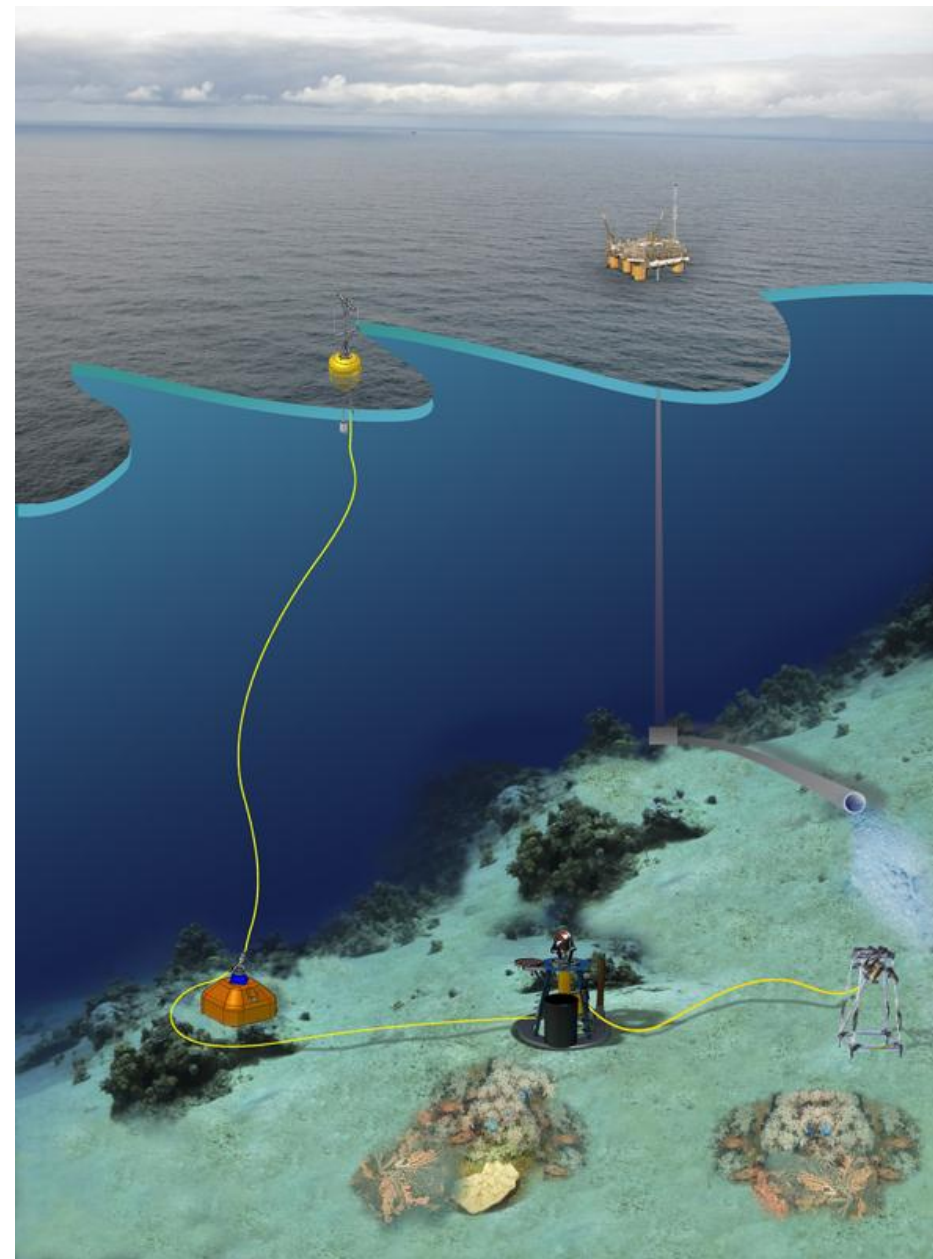
Purpose is to increase knowledge of:

- Biological fluxes
- Coral behaviour
- Sensors
- Food dependent behaviour



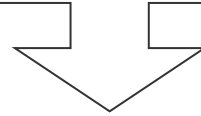
# Morvin, Norway

- Located in the Norwegian sea
- Area with cold water coral structures
- On-line monitoring before, during and after drilling
  - Physical/chemical data
  - Visual monitoring
- Real time monitoring proved no harm to the coral structure

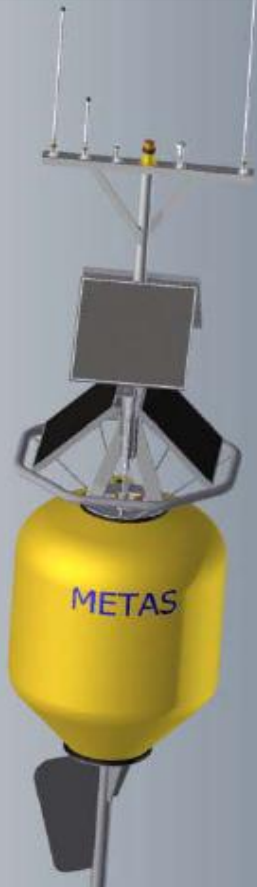


# Peregrino, Brasil

- Turbidity
- Light intensity
- Particle concentration, composition and movements



- Continuous monitoring of particle fluxes
- Mapping of cuttings dispersion
- Calibration of existing model
- Better definition of area of influence
- Visual observations of the habitat over time



## Communication buoy

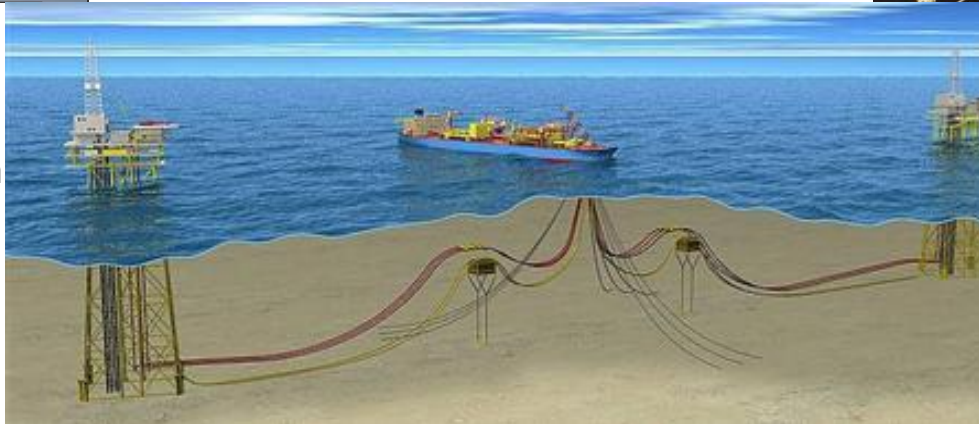
Diameter: 1,2 m

Length: 7,5 m

Height above surface: 4,2 m

Weight: 460 kg

Surface buoy equipped with flashing navigation warning light and AIS system.



## Lander

Submerged instrument frame

Dimensions

Circular frame Ø: 2,5 m

Height: 2,5 m

Weight: 2,5 tons

# What do we want to measure? (examples)

<b>Sensor/Parameter</b>	<b>Parameter</b>	<b>Data type</b>	<b>Location specific</b>
Echo sounders	Biological activity (presence of fish, sea mammals and corals etc), gas bubbles, particles in the water columns	Echogram, large data files that needs expert interpretation	Range
Camera with light	Visual observation	Video and/or still pictures	Range
Recording Doppler Current Profiler, RDCP or equivalent	Current speed and direction Temperature Conductivity Pressure Oxygen Turbidity Fluorescence	Time series, vector data Point data	Point source
Sediment trap		Samples to be analysed in the laboratory	Point source
Hydrophone	Biological activity	Echogram, large data files that needs expert interpretation	Range
Hydrocarbon sniffers	Presence of hydrocarbons	Point data	Point source