



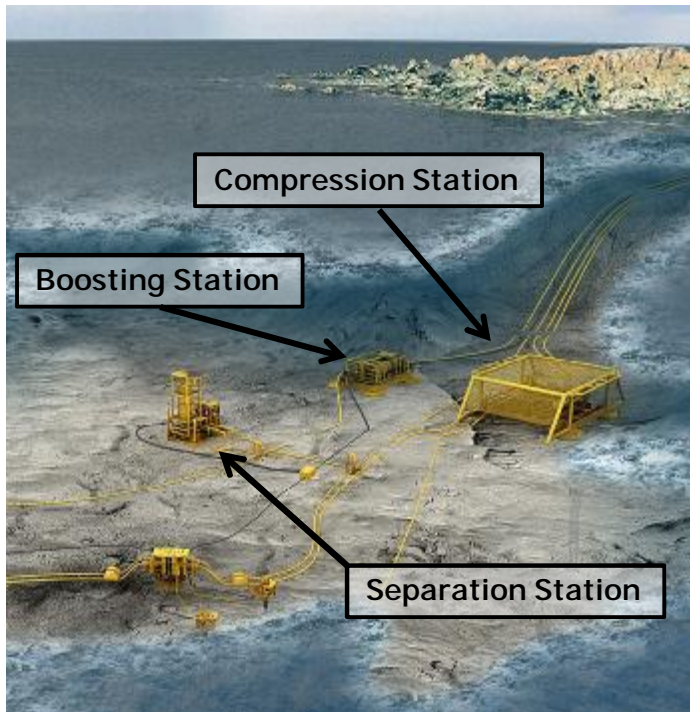
Subsea Processing & Boosting

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Subsea Processing



- Largest contributor to Increased Recovery
- Enabler for difficult production regimes:
 - Long distance tie-back's
 - Low pressure reservoirs
 - Arctic Developments – long distance, under ice
 - Cost efficient handling of increased water production
- Enabler for next generation Subsea Developments (Less Topside – More Subsea)

Subsea Processing = Separation, Boosting, Compression and Power Transmission

FMC is focusing on the IOR Opportunity

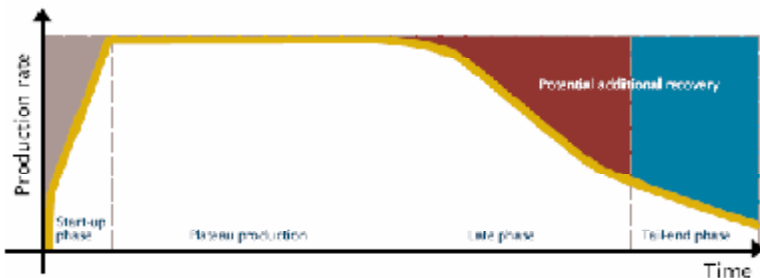
IOR Drivers

- Increased demand for oil
- Need for increased production from existing fields
- Extended life-time for existing fields
- OPEX reduction on existing production
- Increased environmental friendliness

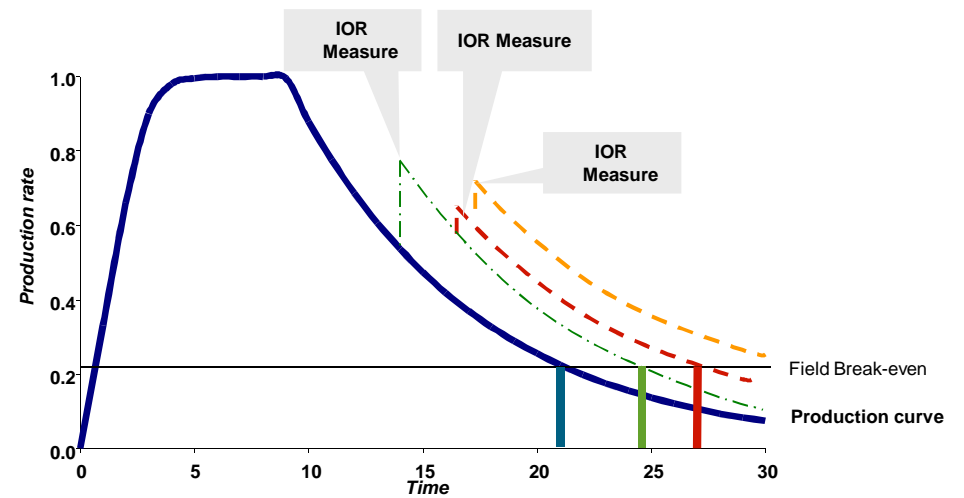


Subsea IOR: Great untapped Potential

Increased Oil Recovery defined as the application of technology that can improve recovery beyond what is expected with current plans and methods



IOR Implementation

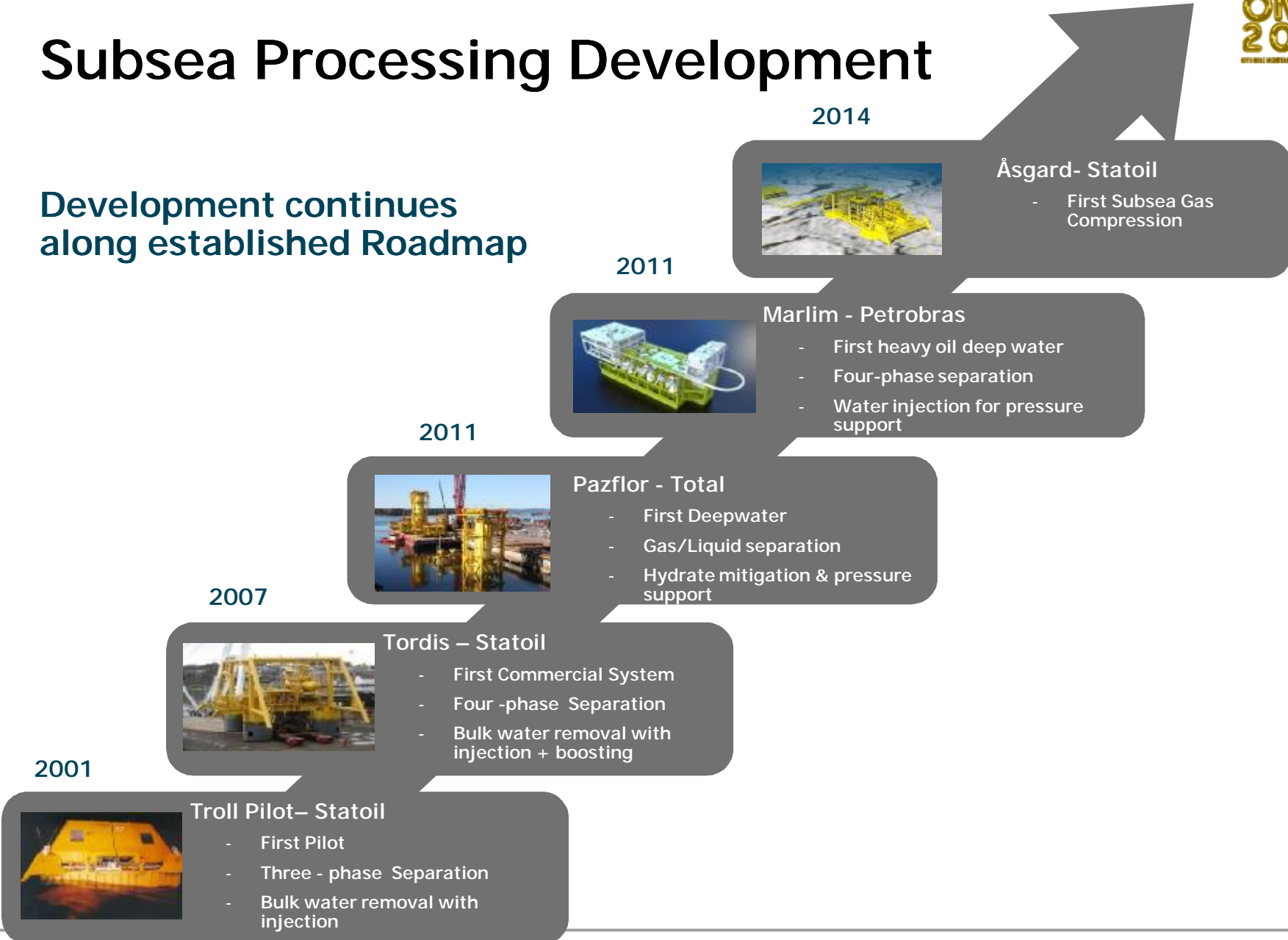


- Complements continuous production optimization
 - Optimized uptime and production
- Implementation of measures to shift production curve upwards to increase recovery
- Combination of technologies and services

Subsea Processing Development

OMC
2011
OFFSHORE MARKET CONFERENCE

Development continues along established Roadmap



Subsea Processing

Enhancing brownfield oil recovery and enabling greenfield development

- **Brownfield challenges:**
 - Declining oil & gas production
 - Increasing water production
 - Constrained topside facilities

- **Greenfield challenges:**
 - Heavy oil
 - Low reservoir pressure
 - Hydrate formation

- **Subsea processing solutions:**
 - Gas/oil/water
 - Gas/Liquid
 - Sand separation
 - Boosting
 - Gas compression



Why Subsea Processing

- Increased recovery
- Accelerate production
- Reduced Capital Expenditure
- Makes it possible to:
 - connect satellite fields to existing infrastructure
 - exploit fields that are normally inaccessible
 - exploit costly infrastructure fully throughout the systems operational period
 - depressurize system as a hydrate strategy
- Influence on the environment will decrease
- Reduces water disposal to sea
- Enhances flow management



What influence selection of separation technology?

- Drivers for subsea processing station
 - System considerations, not only component considerations
 - Flexibility over the life of field, need to cover changes in conditions and uncertainties
 - Robust and reliable systems
- Fluid properties
 - Density, viscosity, mixed viscosity, inversion point etc at operational conditions, asphaltenes, creation of foam, emulsions etc.
- Production profile
 - Water cut (WC), gas volume fraction (GVF) as function of time
 - Pressure, temperature profile as function of time
- Sand production
 - During "normal" conditions and "worst case" conditions (e.g. screen failure)
- Field layout
 - Field layout of wells/drilling centers/existing infrastructure
 - Sizes of pipelines
 - Location of processing station compared to wells

Some operational issues

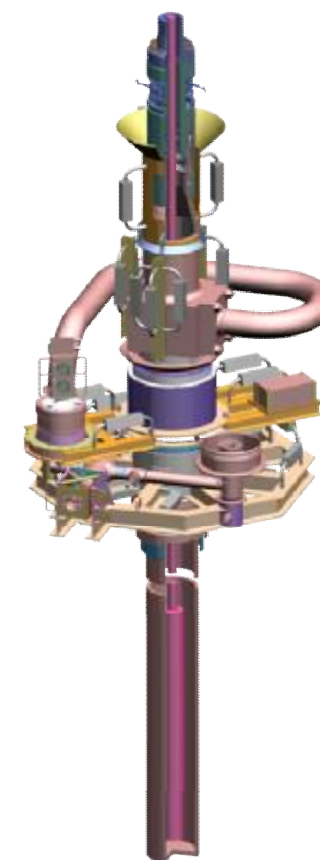
- Condition change during the field life
 - ➔ Flexible and robust system
- Operate outside the design conditions
 - ➔ Fail safe systems and training of personnel
- Failure of equipment due to operational errors
 - ➔ Fail safe and protection of equipment, e.g. CPM
- Failure of equipment due to mechanical failure
 - ➔ Robust design and testing

Future Solutions

Moving from bulk gravity separation

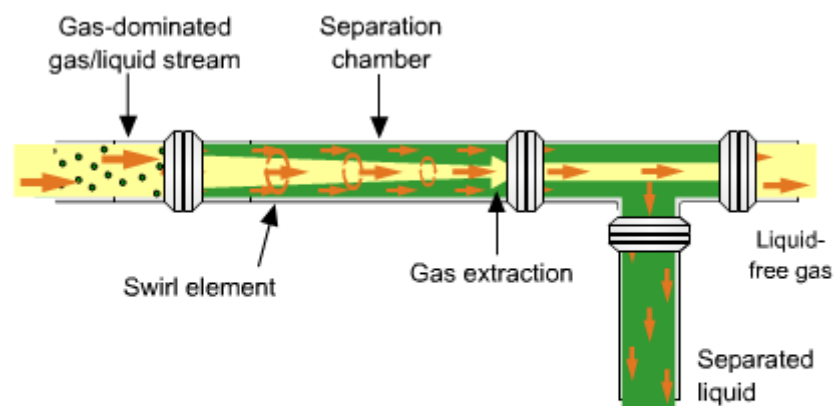


.....to slimmer and more compact solutions.....



.....to inline, ultra-compact solutions

- Proven topside technology
- Ongoing qualification for subsea use



Questions on Subsea Processing

- Do oil companies know what is out there?
- Is the full potential recognized?
- What can we do to increase awareness?
- What will it take to make this a common used technology?
- Economic models demonstrate the benefits, but the risk is considered to high?
- What can we do to reduce risk and increase the confidence?
- Why wait until the added value is less?

The Vision



Thank You!