FACTS

SINTEF Petroleum Research

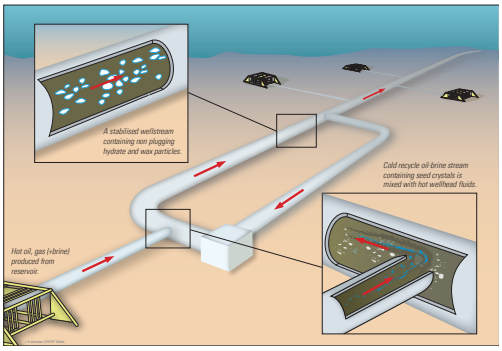
# SATURN Cold Flow

April 2010

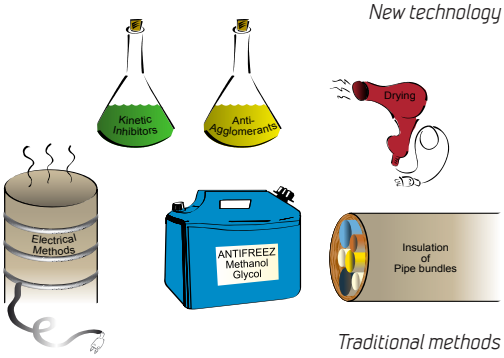
The overall objective for the SATURN Cold Flow project is to demonstrate an innovative and ground-breaking technology solution which allows:

- subsea field developments based on ultra-long cold multiphase, wellstream transport in uninsulated pipelines,
- with no heating requirements and no chemical additives, and with,
- very simplified subsea equipment and control procedures.

The goal is achieved through a novel recirculation scheme for seed particles of gas hydrates and wax. These act as nucleators and growth controllers for further precipitation phenomena and eliminate deposits and plugs. The end result of the process is an easily flowable slurry with inert particles suspended in the liquid phase.




*New technology*




*Traditional methods*

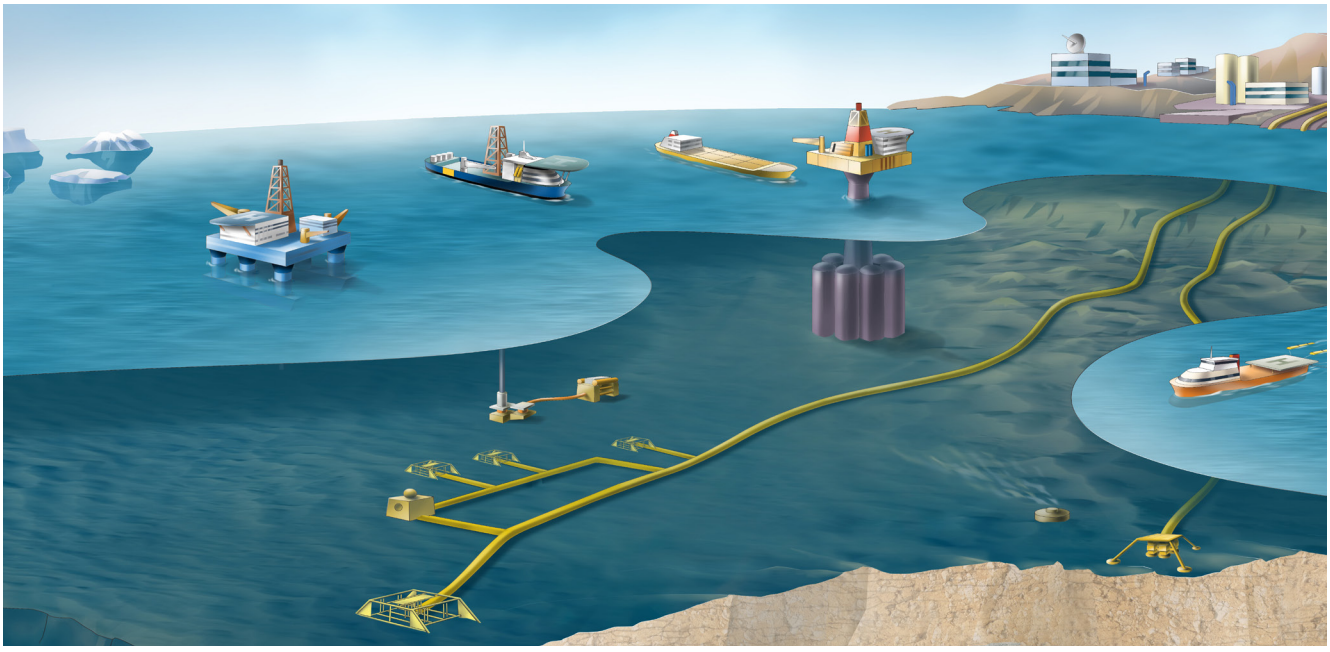
## Cold Flow benefits

**Reduced CAPEX**

- Significantly lower cost tie-backs
- Eliminates high cost passive and active insulation/heating solutions
- Long tie-backs to shallow water host
- Eliminate deepwater surface-piercing structures
- Produce directly from subsea to shore

**Reduced OPEX**

- Eliminates or reduces need for chemical injection
- Eliminates MEG regeneration needs
- Less need for platform personnel
- Improved production
- Removes hydrate / wax blockage risk
- Simpler operation, steady operation, low maintenance

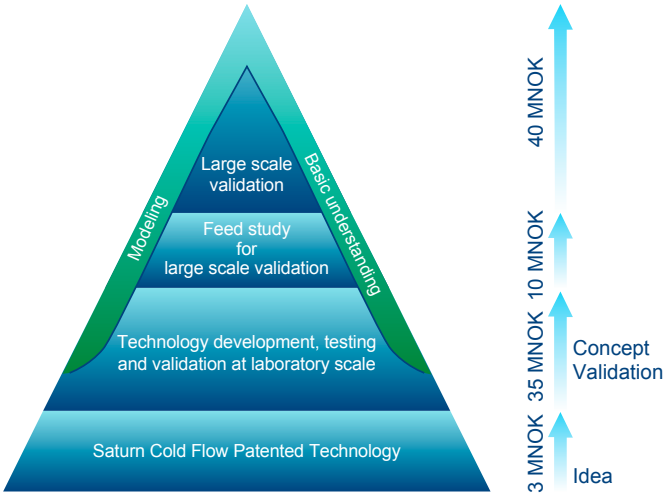


## Background

The SINTEF Multiphase Flow laboratory has been involved in several large multiphase research programs since its establishment in 1982. The multiphase flow simulator OLGA has been developed based on large-scale two-phase flow experiments at SINTEF.

In the late 1990s, SINTEF developed a concept to address hydrate problems in pipelines by creating inert hydrate particles which are easily transportable and which will not deposit or agglomerate under real flow conditions. This patented concept has since 2003 been subject to extensive testing in a laboratory programme focussed on real oil systems.

The project has now entered a demonstration phase, where the goal is to bring qualification of Cold Flow technology to the position where the technology is ready for either a field trial or a first commercial application.




### Improved HSE

- Lower numbers of offshore personnel – reduced risk
- Removes blockage risk and potential personnel risk
- Reduced handling of harmful chemicals
- Zero emission of harmful chemicals to sea (methanol, glycols, LDHI etc.)
- Reduced energy input for heating pipelines
- Reduced $CO_2$ emission

### Value Creation

- Increased asset value
- Enabling technology, increasing the number of viable projects
- Enabling technology for ultra-long tie-backs
- Extended tail-end production, recovery rate

## Project possibilities

The Cold Flow technology may be developed further along different lines, in sub-projects of varying size and cost. These include:

- Cold Flow basic principles (small-scale detailed laboratory testing, modelling)
- Cold Flow wax protection
- Cold Flow hydrate production and transport
- Cold Flow gas drying
- Cold Flow large-scale testing and qualification
- Cold Flow field planning and testing

All these project possibilities will be located in the upper part of the pyramid shown above, based upon the strong Cold Flow technology foundation.

*Wax deposits pigged out after an experiment without SATURN Cold Flow.*

*Pig with **no wax deposits** after an experiment with SATURN Cold Flow.*

SINTEF

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