Oil Companies must spend 50% of their research investments in Norway. 1978-1982

Gas and liquids flow in the same pipe.

- Stratified flow: gas flows on top and liquids on the bottom.
- Slug flow: large liquid slugs cause production problems.

An apparently simple concept has been shown to be extremely complex.

Norwegian Technical Highschool Co-operation

Competence development

Technology development

Industry

Ministry of Petroleum & Energy

Ministry of Petroleum & Energy

1986

www.sintef.no

Foresight

Arve Johnsen of Statoil was willing to spend 500 million kroner on research into multi-phase flow.

Approach

- Use multiphase flowlines
- Save vast amounts of money!
- Requires knowledge!

Pressure drop and liquid holdup in a pipeline must be accurately calculated for optimum design and stable operation!

Two-phase test-loop built by Esso in 1982
- SINTEF took over in 1983
- The test-loop was an example of successful co-operation, in which a number of companies have performed large projects over more than 20 years:
  - Esso, Conoco, Mobil, Norsk Hydro, Petro Canada, Saga, Statoil, Texaco, Agip, Elf, Total...

Two-phase test-loop (now the Multiphase flow laboratory)

- Fullscale industrial facility,
- World’s largest flow laboratory.

Significance of a reliable flow simulator

- Large cost savings (investments, Opex),
- Safer operation of oil and gas fields,
- Better understanding of multiphase flow,
- Allows the development of “uneconomic” prospects.

The OLGA flow simulator is developed
- Close co-operation between IFE and SINTEF,
- Long development programme over many years.

www.sintef.com

Technology for a better society

This affects our common future!

What is multi-phase flow?

- Two-phase
- Three-phase
- Multi-phase

Technology agreements

1982

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This affects our common future!
Multiphase flow simulators were a prerequisite for field development.

The requirement for new technology is being developed now!

The realities in today's oil & gas production.

Underwater installations

Up to 90% water production

Multiphase transport in longer pipelines

1998 2002 2005 -

Old & marginal fields

Progressively more complicated systems are investigated.

Sand production

Hydrate problems

Scale problems

To-day's tools:- 1D

The future's tools:- 3D

The solution:- transport hydrates as a powder.

Large savings on investment costs

No chemicals

More stable production

Requirement for more detailed and accurate simulators.

The challenges for the industry, now and in the future -
- The need for increased recovery,
- Lower profit margins on marginal and old fields,
- Increased focus on environmental issues.

Advanced technology is needed!

Large requirement for reliable simulators!

- Smaller margins increase the need for accuracy,
- The demand for more detailed simulation continues to grow,
- 1D - today's simulators,
- 3D - the simulator of the future.

Windows into a complex world!

Ormen Lange - a gigantic subsea multiphase flow project.
- Only sea-bottom templates, no platform or production ship,
- 2 x 30" multiphase production pipelines, 125 km long,
- Difficult route along the Storegga avalanche site.

Snøhvit - gas from the North
- Only sea-bottom templates, no platform or production ship,
- The world's longest multiphase pipeline to date, 160 km,
- Will be used for CO2 deposition,
- Icebergs pose a real problem.

Hydrates
- Form from natural gas and water at high pressure,
- Snow-like crystal structure, stable at high temperature,
- Can block pipelines,
- Very expensive to avoid,
- Very expensive to remove (if possible!).

ColdFlow
- SINTEF patent under development,
- Uses hydrates as a resource, not a problem!
- Enormous financial savings,
- Enormous environmental benefits,
- Increased safety.

Research challenges now and in the future
- Water increases the complexity dramatically,
- Hydrates in the flow - immature technology,
- Sand in the flow - very immature technology.

Large, target-oriented and joint efforts will increase the chances of success - history has shown this already!

1100 m 345 m 300 m

The technology of the future - is being developed now!

The significance of multiphase flow technology for Troll
- The processing plant could be built onshore,
- Multiphase transport for 63 km to shore (Kollsnes),
- In total kr 30,000,000,000 saved from capital expenditure and operating costs.

OLGA® – a success story
- OLGA® has 90% of the world market,
- It is a industry standard across the whole world,
- E.g. Conoco has made savings of several billion NOK from their research investments on OLGA®.

Scandpower
Petroleum Technology
commercialises and further develops OLGA.

OLGA 2000

Increased complexity

The technology of the future

OLGA®

OLGA ut i verden

OLGA 2000

TROLL

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