

# SINTEF – Large Scale 3-Phase Test Facility

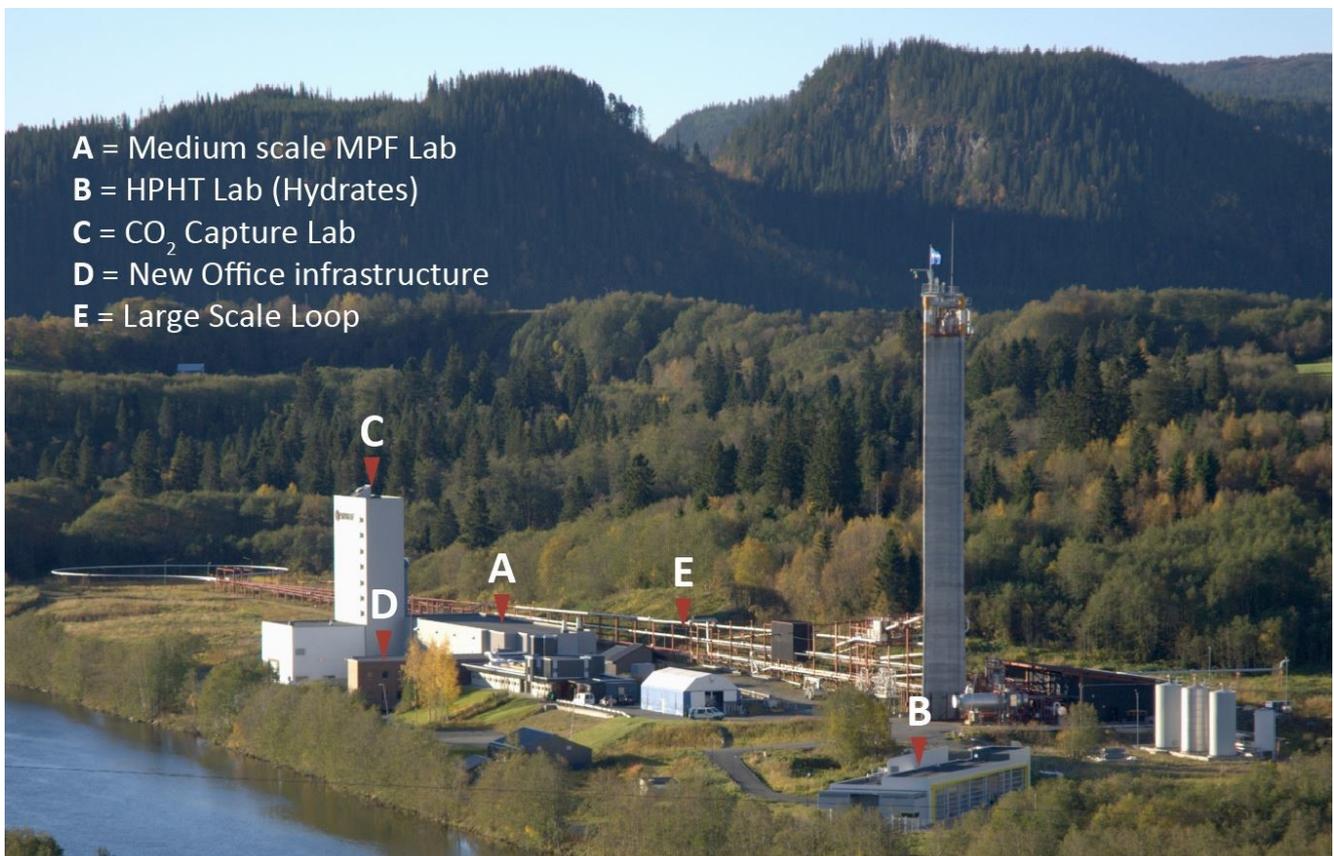
## THE EXTENDED TILLER FACILITY

SINTEF Multiphase Flow Laboratory consists of a medium-scale multiphase flow laboratory (A), an HPHT laboratory (B), a CO<sub>2</sub> capture laboratory (C), and an office building (D). Along with the three-phase high pressure large scale flow loop (E) this test facility is a foundation for continued development of subsea oil and gas production technologies.

SINTEF has established a truly unique subsea field development test laboratory which will be able to actively simulate flow assurance challenges for complex three-phase flows in a variety of pipe sizes and configurations. Well streams with compositions, rates, pressures and temperatures covering a wide industry-realistic range will be provided, as well as pipes, instrumentation and equipment to allow studies of all major Flow Assurance challenges.



*Gas hydrates are one of the most important Flow Assurance challenges which depends on the chemistry of the system.  
Photo: Geir Mogen*





### THE LARGE SCALE LOOP

The large scale loop is an industrial scale three-phase flow facility with EX control. The main features are a 500m long pipe rack and a 60 m high riser tower. A typical loop configuration has a total length of 850 m.

### THE MEDIUM SCALE LOOP

The medium scale loop is located indoor in a 60 m long laboratory hall. By using SF<sub>6</sub> as the gas phase, gas densities equal to that of methane at 88 bar can be reached. This facility allows the study of multiphase flow in much greater detail than what is possible in large scale. For example: oil droplets, gas entrainment into oil and droplet entrainment into

the gas phase, may be studied in this facility. A 11 m<sup>3</sup> separator provides long retention times so that less easily separable fluids, such as viscous oils can be used.

### THE SMALL SCALE REAL CRUDE LOOP

The use of actual hydrocarbons breaks an important barrier enabling studies of complex chemistry-dependent phenomena. SINTEF's Small Scale Real Crude laboratory allows work on high-pressure high-temperature (HPHT) fluids. The test loop consists of a 50m long 1in pipe which can be pressurized up to 100bar, and temperature-controlled room from -10°C to +50°C. In addition, high-pressure wheel-shaped flow loops are available up to 1000 bar.

		Max operating pressure bara	Minimum pressure bara	Temperature range (typical) °C	Line sizes Rectangular Sizes	Horizontal line length m	Inclinations deg	Vertical line length m
Large Scale Loop	Three-phase flow loop	90	5	10 to 50 (30)	8" (4" and 12")	50 - 800	0, 0.5, 1,90	55
Medium Scale Loop	Three phase flow loop + solids (sand)	10	atm.	5 to 50 (20)	2.5", 3", 4"	50	-4 to 4	35
Small Scale Loop	Three-phase flow loop + solids (hydrates. etc.)	100	atm.	-10 to 50 (4)	1" and 2"	~50 m	0 to 90	2 (flex. conf.)
Wheel Flow Loop	Three-phase flow loop + solids (hydrates. etc.)	1000	atm.	-10 to 80 (4)	2" and 5"	6.3 m (circular)	NA (vertical mounting)	NA (vertical mounting)

		Flow rate, gas Am <sup>3</sup> /h	Flow rate, oil m <sup>3</sup> /h	Flow rate, water m <sup>3</sup> /h	Oil	Water	Gas
Large Scale Loop	Three-phase flow loop	1500	480	200	Refined oil, crude oil (no precipitates)	Fresh water/brine pH>10	Nitrogen (any inert gas)
Medium Scale Loop	Three phase flow loop + solids (sand)	160	80	120	Exxol D80 (any non-flammable HC)	Fresh water	Sulphur hexafluorid (any inert gas), air
Small Scale Loop	Three-phase flow loop + solids (hydrates. etc.)	3	5	5	Any crude or model oil	Any water chemistry	Any (excl. H <sub>2</sub> S)
Wheel Flow Loop	Three-phase flow loop + solids (hydrates. etc.)	36	36	36	Any crude or model oil	Any water chemistry	Any (excl. H <sub>2</sub> S)



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