

# The Lyre loop

## A dedicated Flow Assurance facility at IFP Energies nouvelles-Lyon

The Lyre loop is dedicated to the study of Flow Assurance issues under conditions as close as possible to those in the field, with live oils, exact flow pressures and cold temperatures, and flow in multiphase conditions.

For a long time, IFP Energies nouvelles' teams have acquired extensive know-how in Flow Assurance issues on the Lyre loop, on such varied topics as:

- formation and transportation of natural gas hydrates in both gas-dominant and crude-oil-dominant systems;
- deposition of wax;
- shutdown and restart of flow under conditions of hydrate formation and wax gelification;
- efficiency evaluation of chemicals such as anti-agglomerants, anti-emulsifiers, hydrate inhibitors, drag reducing agents;
- evaluation of procedures, sensors, equipment.

The Lyre loop is used to add to our understanding of physical phenomena, to develop modeling and technological tools, and to improve operational field procedures. Work done on the Lyre loop is



supported by experimental laboratory facilities dedicated to fluid characterization and to thermodynamics, and by fluid flow simulation. It benefits from the high quality of IFP Energies nouvelles' scientific environment.

The Lyre loop is a high-tech tool to assess the risk of hydrate or wax formation under real conditions. Because representative field conditions are reproduced and reliably monitored, shutdown and restart procedures can be fine-tuned before they are applied in the field.

### Operating conditions

The Lyre loop is 140 meter long. Its inside diameter is 2 inches (5 cm). It is fully temperature-controlled from 50°C down to 0°C (122°F– 32°F) and operates at pressures up to 100 bar (1450 psi).

### Instrumentation

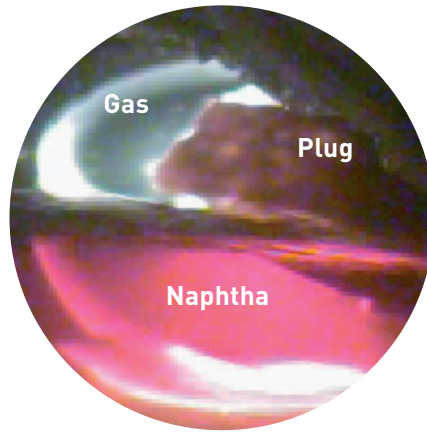
It is fully instrumented to measure pressure drops, temperatures, and flow rates, with vortex or Coriolis flowmeters for the gas and liquid phases. Gas balances are performed during hydrate formation thanks to pressure and temperature monitoring of the gas reserve tanks.

It also includes specific equipment such as an embedded camera, gamma-ray densitometers, and a FBRM (Focused Beam Reflectance Measurement) particle size analyzer. Its instrumentation is regularly upgraded.

Various flow regimes - single liquid or gas flow, stratified, slug, annular flow - can be managed by accurate control of the flowrate of each phase.

### Specific loop sections

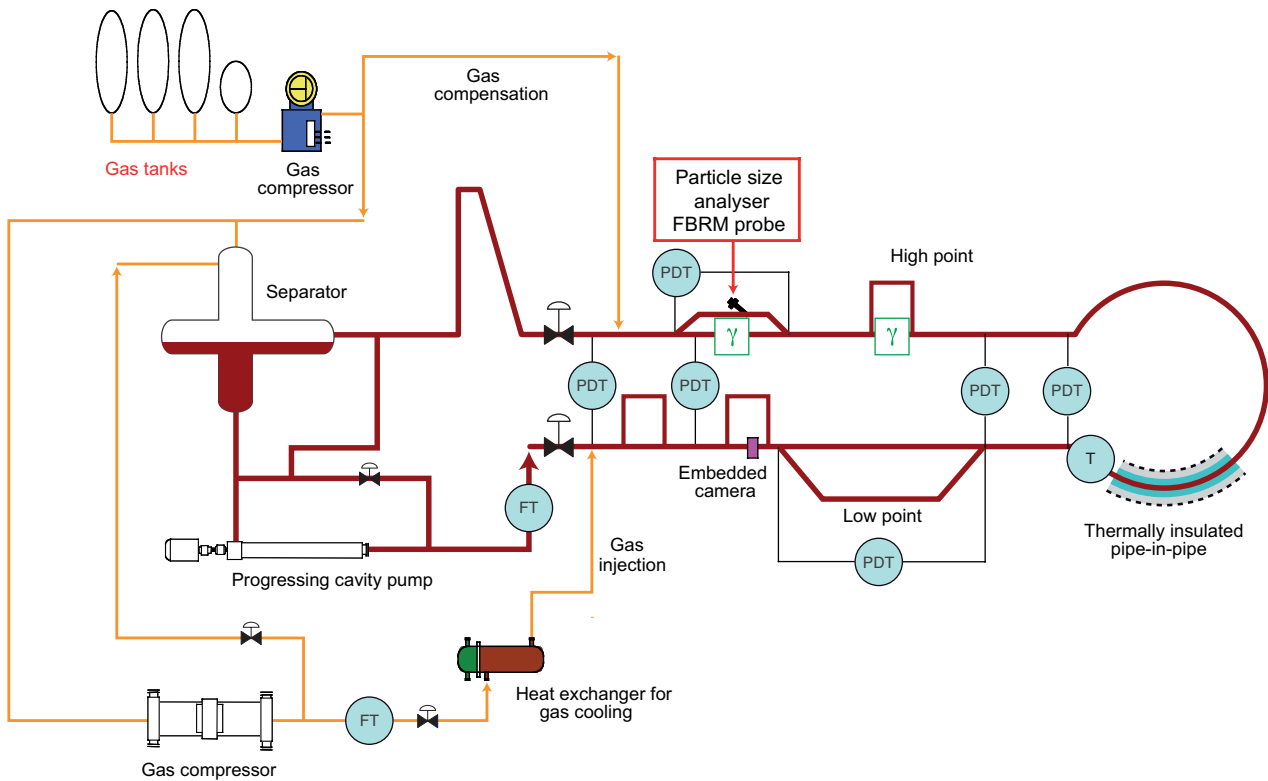
- a low point, constituted by a 22-meter-long section descending gradually to a level of 1.10 m below



Hydrate plug inside a gas/naphtha flow showed by the embedded camera.

the loop level, then ascending back to its original level, and **three high-point sections**. These sections can be independently included in the flow in order to create geometrical singularities along the flow line;

- a wax deposition section constituted by a 7-meter-long sub-cooled section. The temperatures of the flowing fluid and of the pipe wall are monitored, as is the pressure drop. A 1-meter spool piece can be retrieved so that the deposit can be observed, sampled and analyzed.



FT: Flow-rate transmitter  
 T: Temperature probe  
 PDT: Differential pressure transmitter  
 FBRM probe: "Focused Beam Reflectance Measurement" probe  
 γ: Gamma-ray densitometer

*The information contained in this document is not contractual*

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