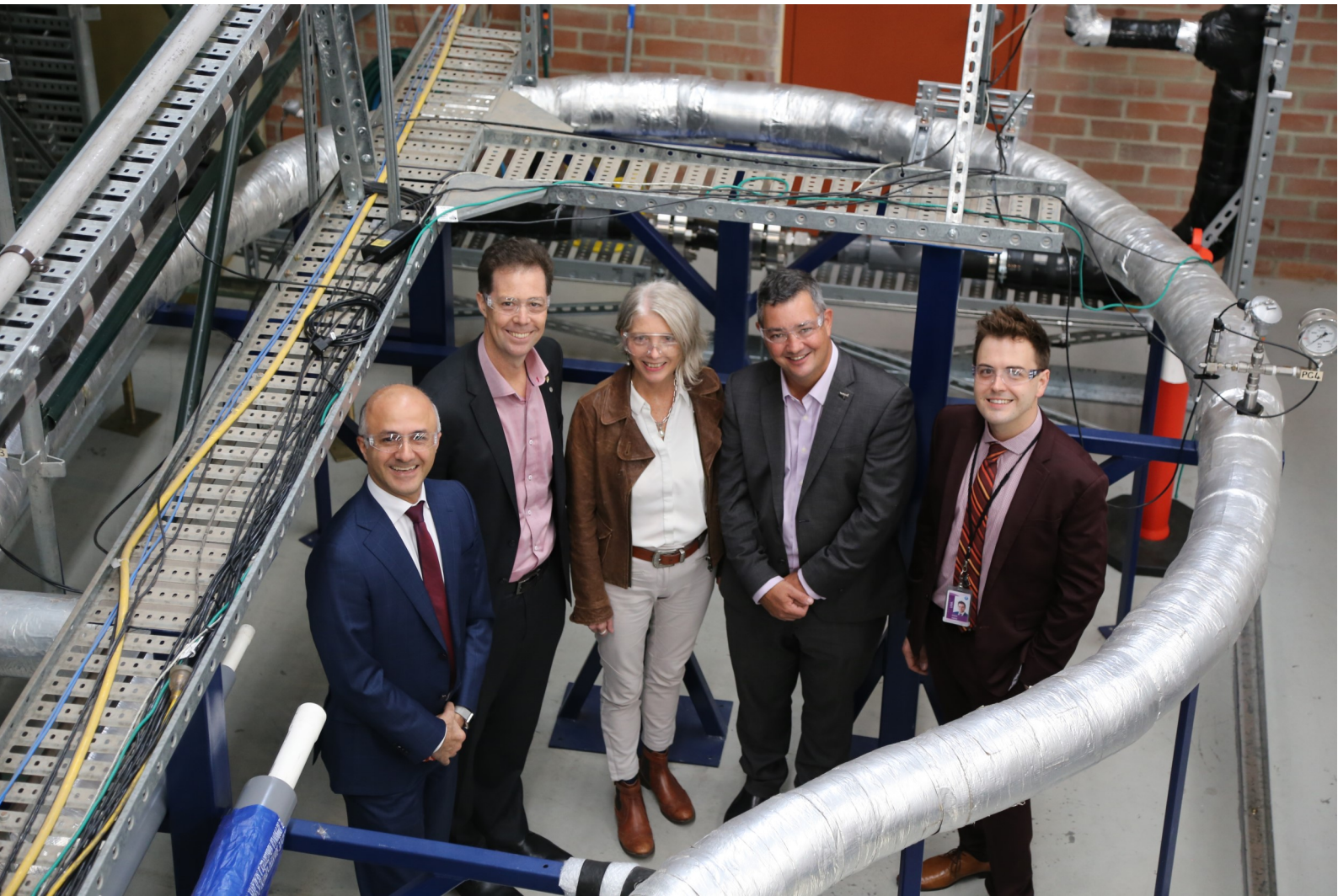


Virtuoso Hydrate Blockage Model



World's First Online Hydrate Blockage Prediction Model for Gas Dominated Systems

Gas Hydrates:

Natural gas hydrates present a major challenge in multiphase subsea pipelines due to the blockages and production loss they can cause.

Currently most oil and gas developments operate on a complete hydrate avoidance philosophy due to the considerable cost impact of a single hydrate blockage remediation, production deferment and the associated reputational impact of possible missed nominations. In gas condensate systems this often means considerable overdosing of production critical hydrate inhibitors such as MonoEthylene Glycol (MEG).

This highly conservative approach is the present industry standard as there currently are few commercial software packages for design to quantitatively analyse hydrate blockage probability and none in online applications.



Virtuoso Hydrate Blockage Model Project:

Wood's online operational production management digital twin "Virtuoso" is used to manage over 10% of the world's gas production and over 30% of the world's LNG. In collaboration with National Energy Resources Australia (NERA), University of Western Australia (UWA) and with support from operators such as Chevron and Woodside, Wood has taken up this challenging project to integrate a mechanistic hydrate model developed by UWA into Wood's Virtuoso™ software package. This will allow operators for the first time ever to quantitatively calculate the operational risk of a hydrate blockage in their assets in real time based on live operating data.

The online estimation capabilities provided by implementing this research into Virtuoso allow optimisation of chemical injection quantities necessary to prevent hydrate formation in natural gas pipelines.



Project Objectives:

- Integrate UWA's hydrate research from CSIRO's HyJump flow loop into Wood's online monitoring software package Virtuoso™
- Benchmark integrated model with flow loop data and upscale for real field data
- Predict hydrate formation/blockage using online model and compare with experimental results

Why Wood?

- Completed numerous hydrate-related projects worldwide
- Flexible, industry standard online production management package
- Actively involved in hydrate-related Joint Industry Projects (JIPs)
- World renowned consultants & in-house hydrate experts
- Close collaboration with specialist & independent labs

Integrated model:

An integrated model has been built by combining Wood's "Virtuoso" transient multiphase flow solver with the hydrate kinetics model from UWA. The Virtuoso pipeline model solves one-dimensional momentum, mass and energy equations for each discretised segment of the pipeline and further predict the multi phase fluid flow regime along with phase distribution and shear stress between the fluid layers and the wall.

The UWA hydrate model estimates the mass transfer between fluid and hydrate phases and hydrate deposition rate which will then be used by Virtuoso to determine the impact on pressure drop.

The Integrated Virtuoso Hydrate Blockage model is designed to support oil and gas field developments in both Design and Operations phases.

Operational benefits:

- Hydrate blockage prediction and lookahead
- Predict optimum MEG injection rates
- Surveillance & trouble shooting/restriction identification
- Financial optimisation based on MEG injection rates, risk level & production
- Live production envelope prediction

Design benefits:

- CAPEX optimisation through:
 - Dedicated MEG distribution system vs umbilical
 - MEG vs insulate & blowdown
 - Topsides/receiving facility equipment sizing optimisation
- OPEX optimisation for the field life based on production profile
- Specification of operable production envelope
- Dashboard with key hydrate drivers as output:
 - Water and gas volume
 - Thermodynamics, etc.



Impact on the industry:

Allowing operators to reduce uncertainty margins associated with chemical addition could reduce OPEX costs by more than \$10 million per year per project.

It will also allow significant improvements in design of new systems or tiebacks as it allows a risk-based approach to hydrate blockage avoidance. This could allow project CAPEX savings as high as ~ \$500 million in some cases.

Timeline:

The first commercial product is expected to be available before October 2020.



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