TOTAL
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OFFSHORE THERMAL TESTING OF AN ELECTRICALLY TRACE HEATED PIPE-IN-PIPE

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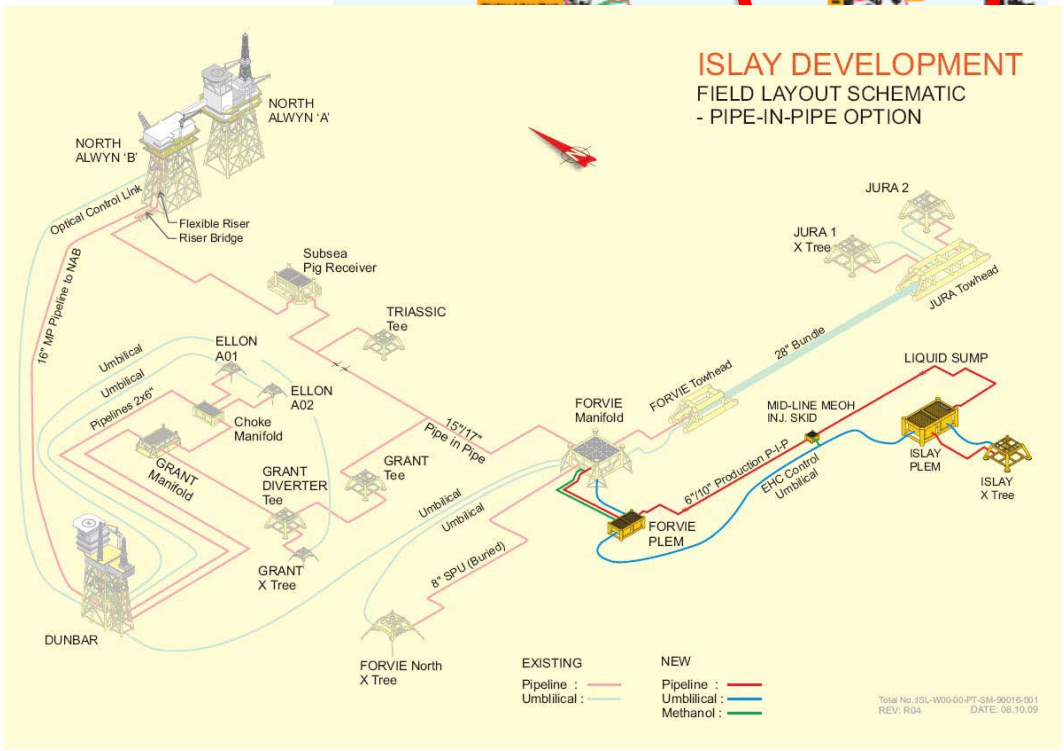
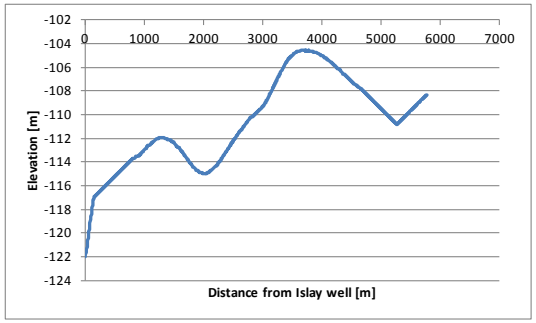
MCE Deepwater Development, 24/03/2015

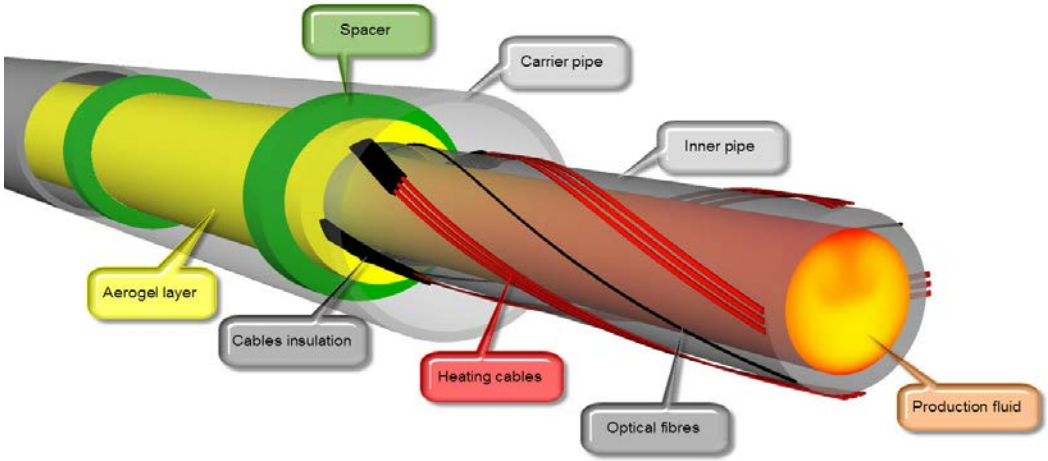
ISLAY FIELD DEVELOPMENT : DESCRIPTION

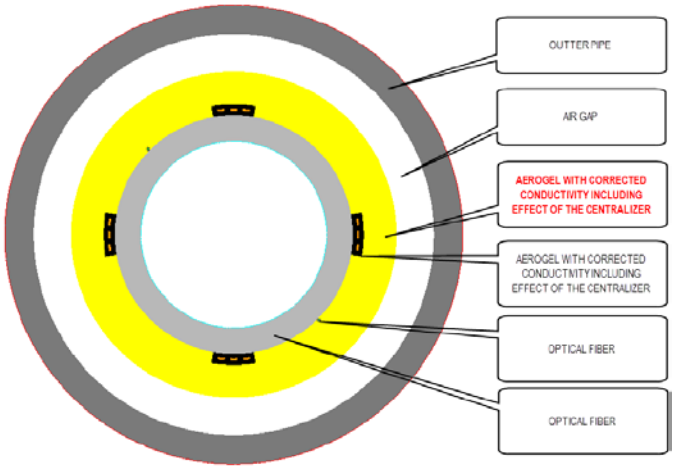
- Offshore Shetlands - South of Alwyn at the end of a complex pipeline network
- 122m WD
- 6km single well tie-back
- 6” ID
- $U_{ID}(20^oC) = 0.9\ W/m^2.K$
- Gas Field
- High Temperature (120 °C)
- Challenging Bathymetry





ISLAY ETH PIP DESIGN ARCHITECTURE





- Cable rated 2kV Designed for 30W/m
- 300% (warm up) redundancy
- Two x fibre optic cables
- All electrical components have been qualified
- High thermal insulation & power efficiency (180 kW)

FULL SCALE OFFSHORE TESTS

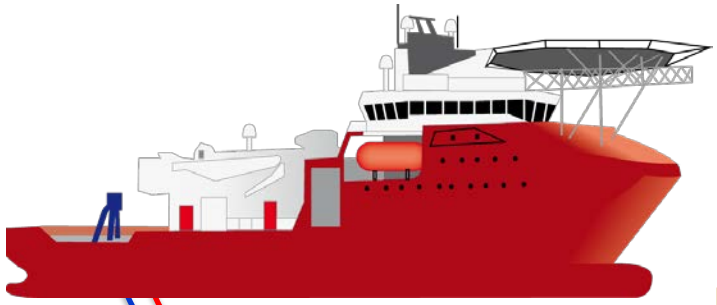
- Commissioning test, April 2012
  - Few damages (connection system)
- Thermal test, September 2012
  - Design performances confirmed
- Thermal test, June 2014
  - Design performances confirmed

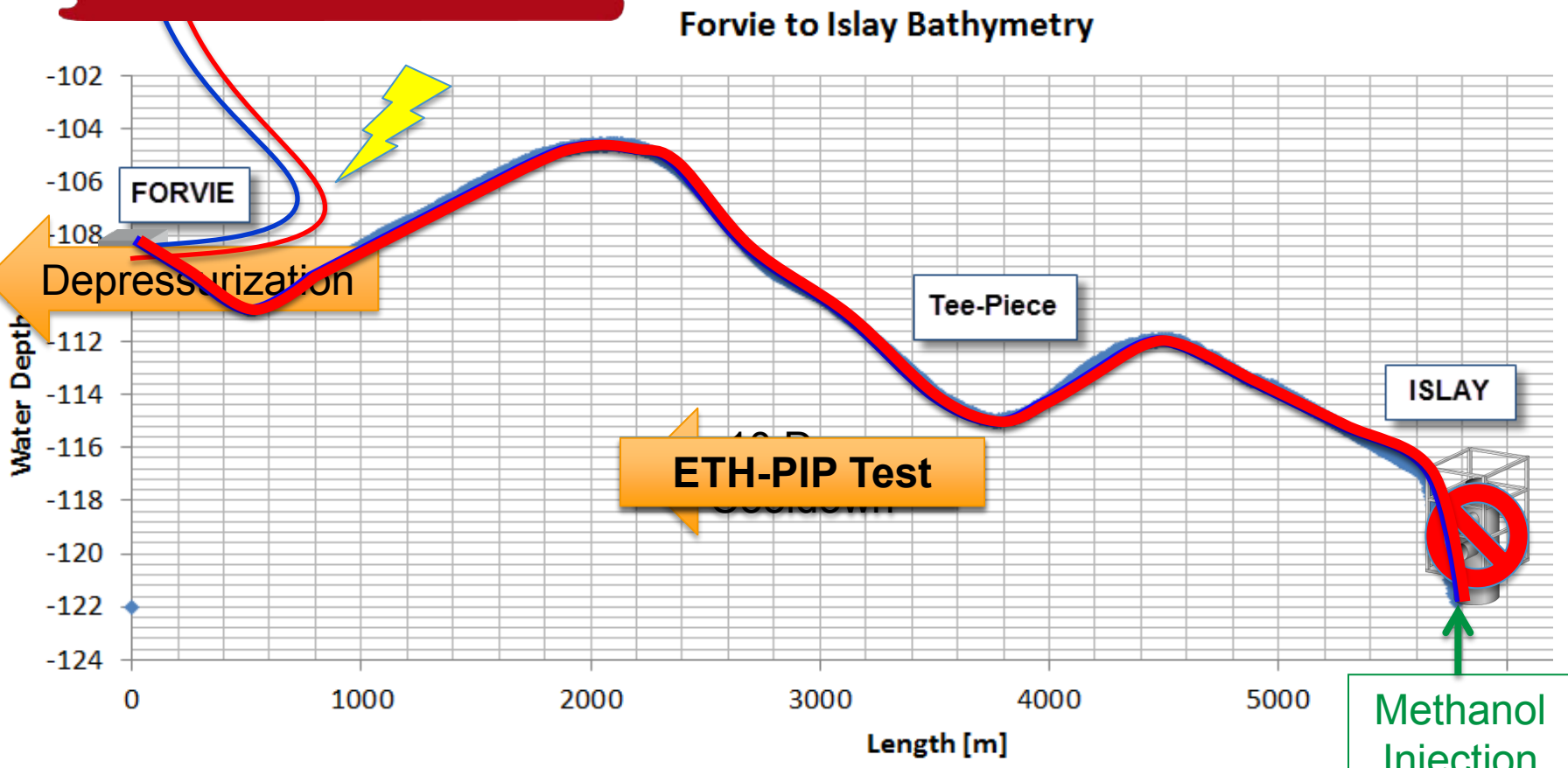
Flow assurance modelling using an electrical trace heated Pipe in Pipe: From qualification to offshore testing
Decrin M-K., Nebell F., Naurois H., Parenteau T., 2013
Offshore Technology Conference, OTC 24060

Field deployment of the world's first electrically trace heated Pipe in Pipe
Fisher R.C., Hall S., Cam J-F., Delaporte D., 2012
Offshore Technology Conference, OTC 23108

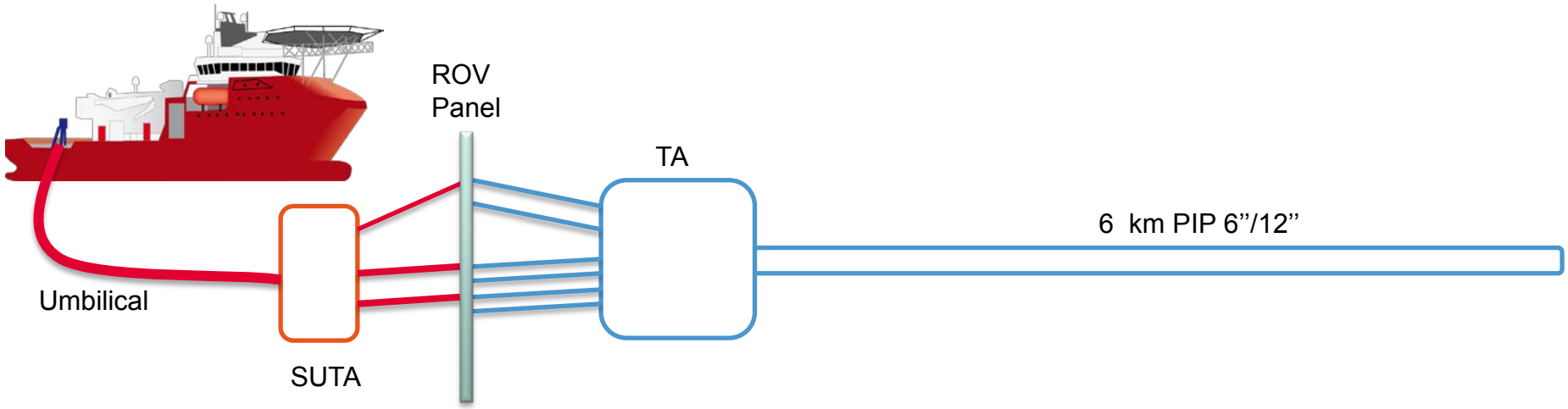
Evaluation qualification of electrically heat trace Pipe in Pipe for a SS flowline and selection for an application on a subsea field in the UK, Islay
De Herve N., Delaporte D., Hellingoe M., Hughes G., 2011
Offshore Technology Conference, OTC 21396

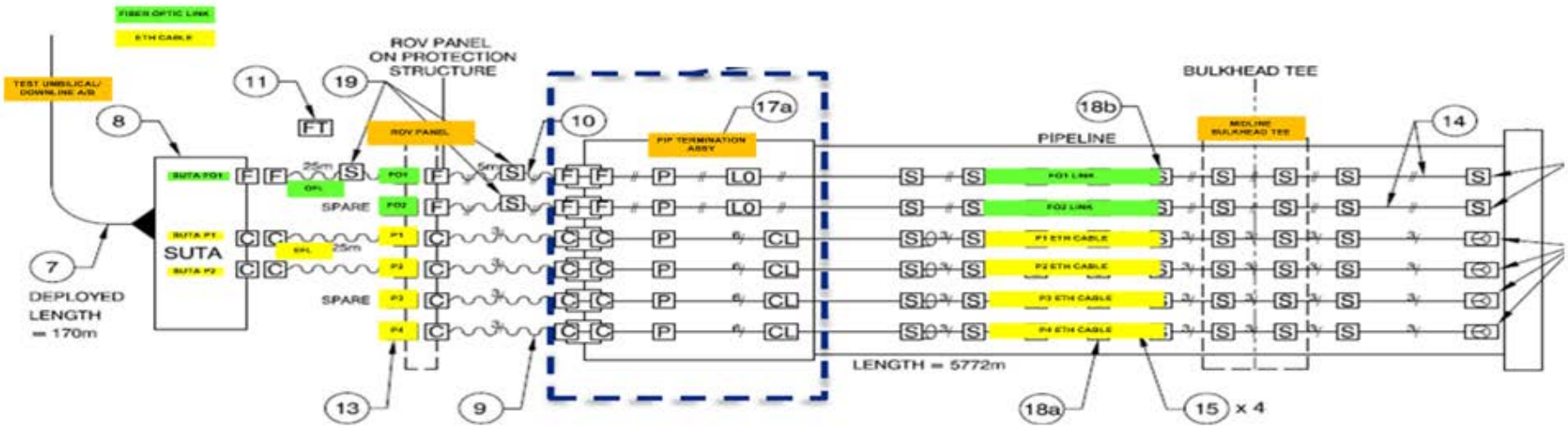
PROCEDURE – ISLAY PIPELINE SHUTDOWN





DEPLOYMENT AND SUBSEA ARCHITECTURE





OFFSHORE DEPLOYMENT

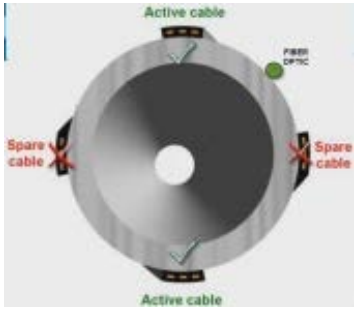
THERMAL TEST PROCEDURE

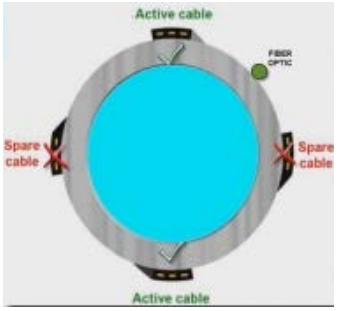
- **RAMP-UP** : The power in each cable is brought to its maximum power gradually
- **WARM-UP** : Continuous temperature increase inside the flowline using a constant high power in each cables (about 15 Watt per cable and per meter of ETH-PIP)
- **MAINTAIN** : The flowline temperature is maintained by supplying a constant low power in each cable.
- **COOLDOWN** : Temperature inside the flowline is reduced by stopping all power feed to the ETH-PIP.

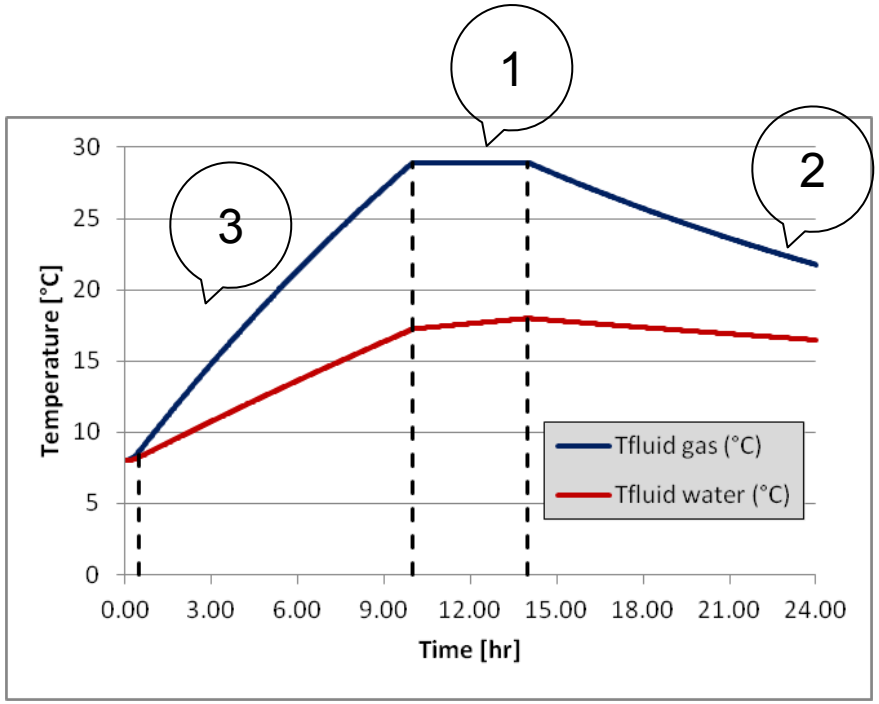
$$\rho Cp \frac{\partial T}{\partial t} + \nabla.(k \nabla T) + s = 0$$

$$T(t) = T_\infty + (T_0 - T_\infty) e^{\frac{-h}{\rho c_p}\frac{A_s}{V}t}$$

$$U = \frac{q}{\pi D \Delta T}$$

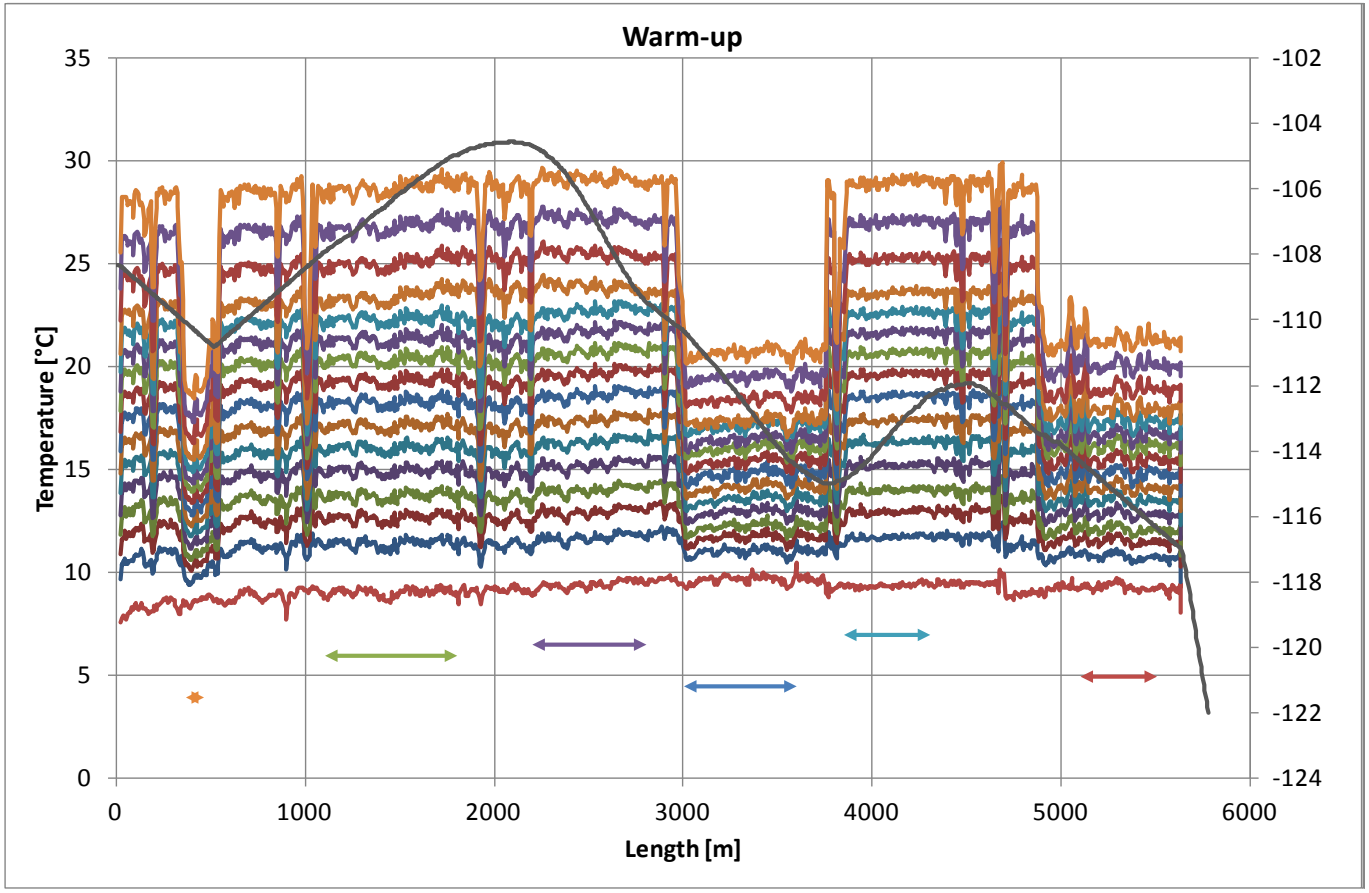


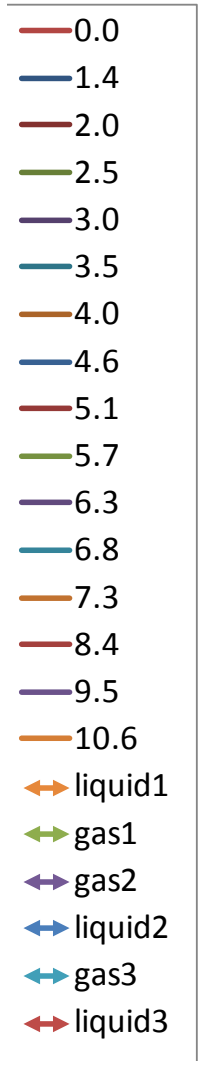




TEMPERATURE PROFILE

- Temperature evolution during warm-up phase
- Sections selection



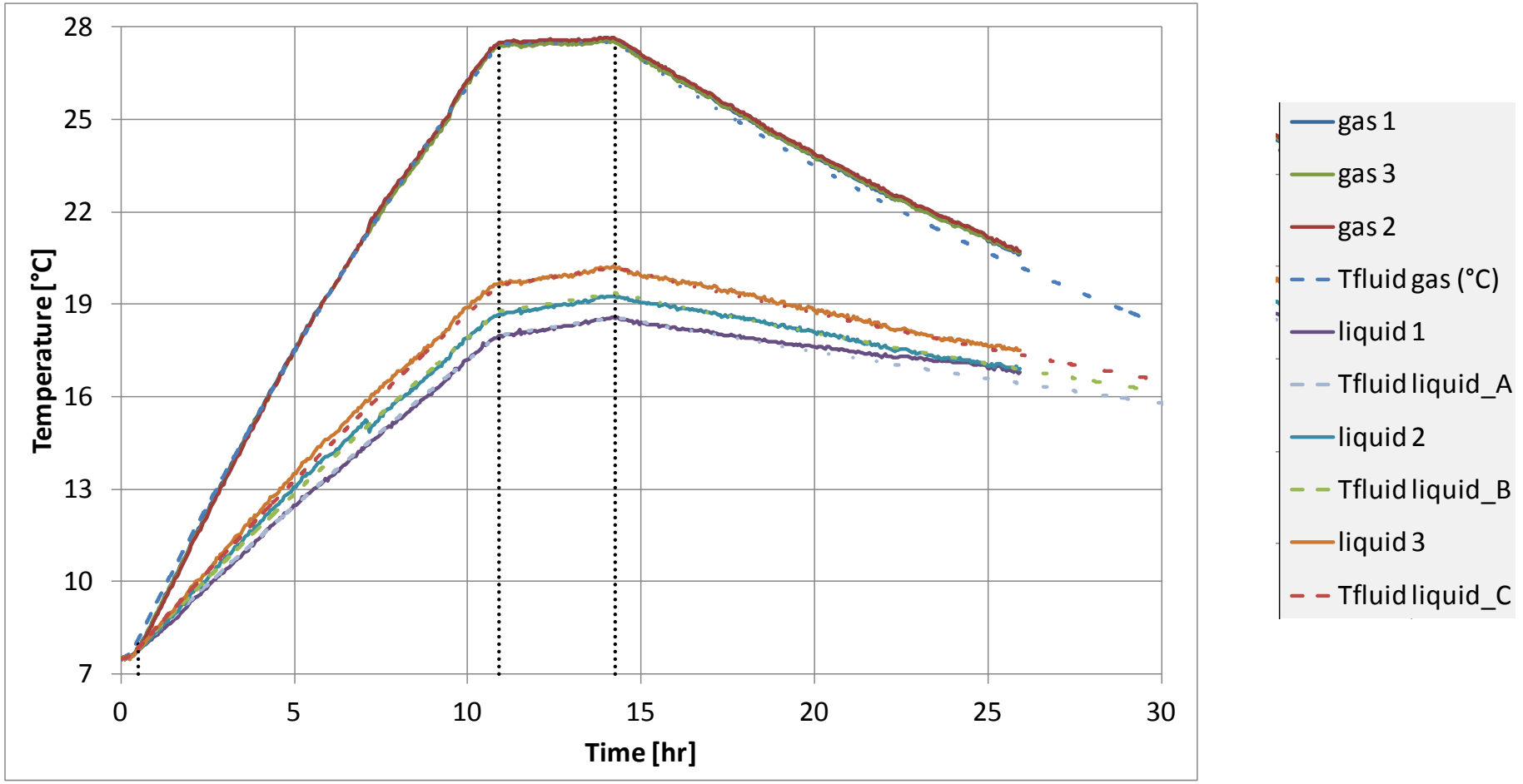


TOTAL

FLUIDS INVENTORY

fluids	gas	0.8	1921
	water	998	4180
	methanol	796	2480
liquid	**% methanol**	**ρ [kg/m3]**	**Cp [J/kg/K]**
A	55%	887	3245
B	75%	846	2905
C	95%	806	2565

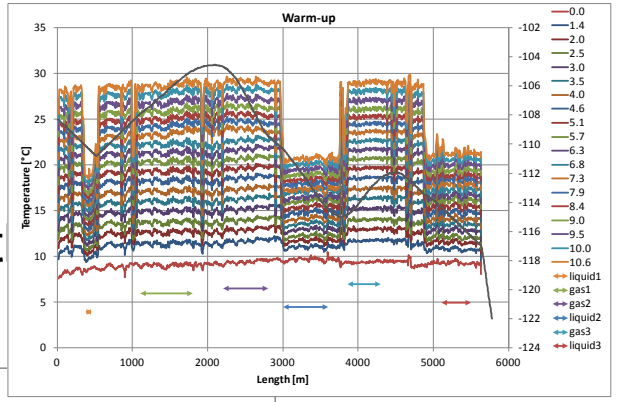
- Fluids characterization from temperature evolution

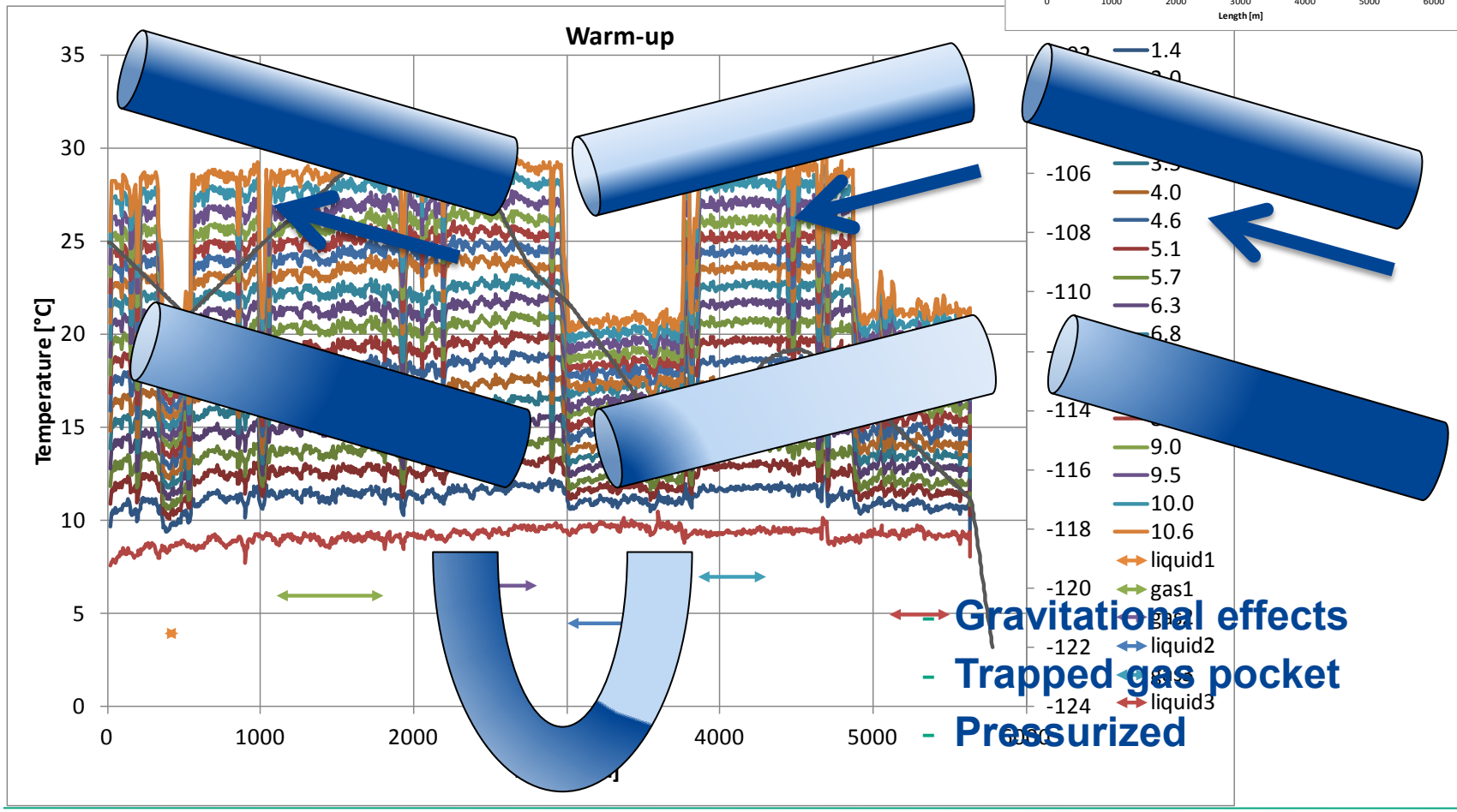


TOTAL

FLUIDS INVENTORY

- Good estimation of the injected amount of met
- Asymmetry of liquid pocket





CONCLUSION (TESTS)

- Challenging tests but successful!!!
  - Part of Alwyn Area Summer Shutdown offshore campaigns
- Equipment running well
  - Harsh connection
  - Partial loss of redundancy
- Flow assurance monitoring
  - Insulation performances
  - Liquid hold-up

- The tests have shown that the Islay Electrical Trace Heating is a robust system that has maintained its thermal performance over time and is now ready to be deployed elsewhere in the Total Group.

CONCLUSIONS (TECHNOLOGY)

- ETH PIP as a power-efficient alternative to DEH
- High qualification level allowing to consider this technology for new development
- Good involvement of Technip & Subsea 7
- Correct level of competition between two or more contractors
- Recommended technology to other operators!!!


(သင့်ကို) ကျေးဇူးတင်ပါတယ
gracias
Terima Kasih
Thank you
谢 谢
Cám ơn
شكراً
спасибо
Obrigado
grazie
Merci
Tusen takk
ขอบคุณมาก

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