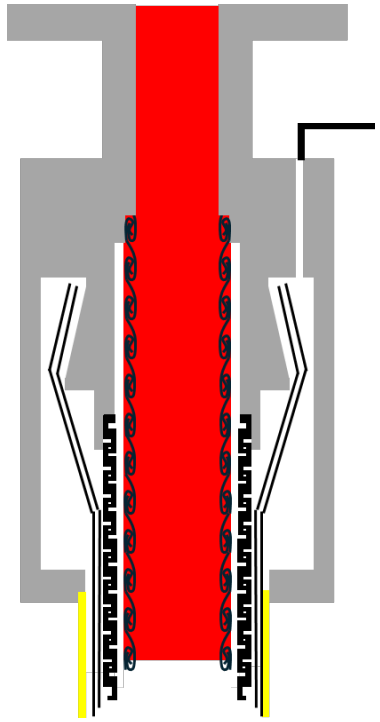
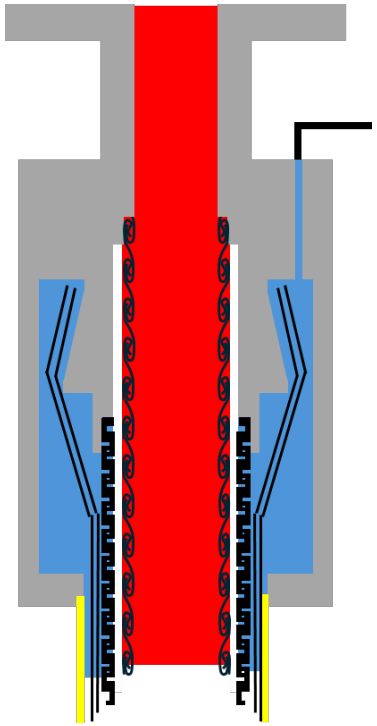
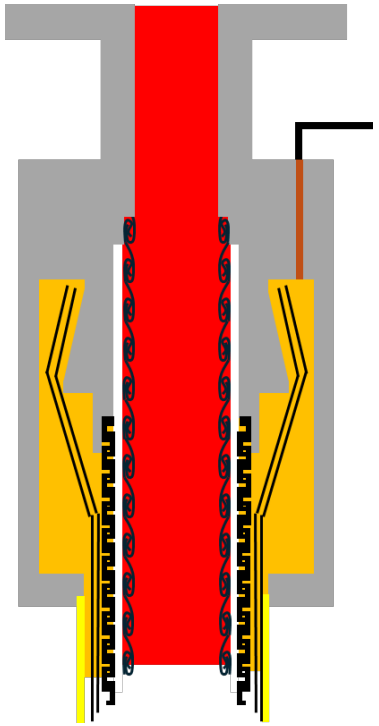
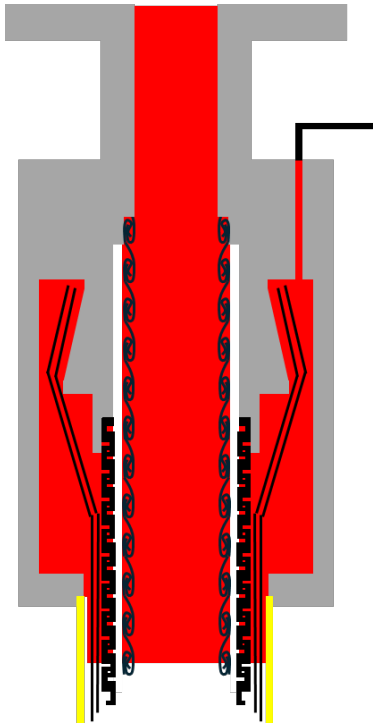
Improving flexible pipe integrity management through annulus vent gas monitoring

Seminar on flexible pipes, integrity management and aging, 26.11.25

Topics

01	Why monitor annulus vent gas
02	Monitoring system requirements
03	Alarms and actions
04	Short- and long-term data evaluation
05	Remote annulus volume testing

Why monitor annulus vent gas

Normal	Annulus flooding	Restriction in vent path	Loss of containment
			
	Outer sheath wear		Loss of EF sealing

Monitoring system requirements

- Key components
  - Pressure transmitter
  - Actuated valves
  - Reference volume or cylinder
  - Logic solver

10 of installed

- Monitoring parameters
  - Annulus pressure
  - Ventilated volume

- Calculated parameters
  - Vent flowrate
  - Free volume estimation

11 of installed

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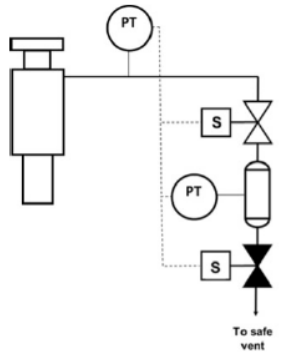
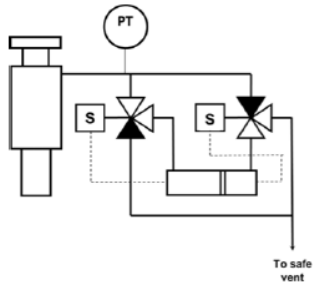
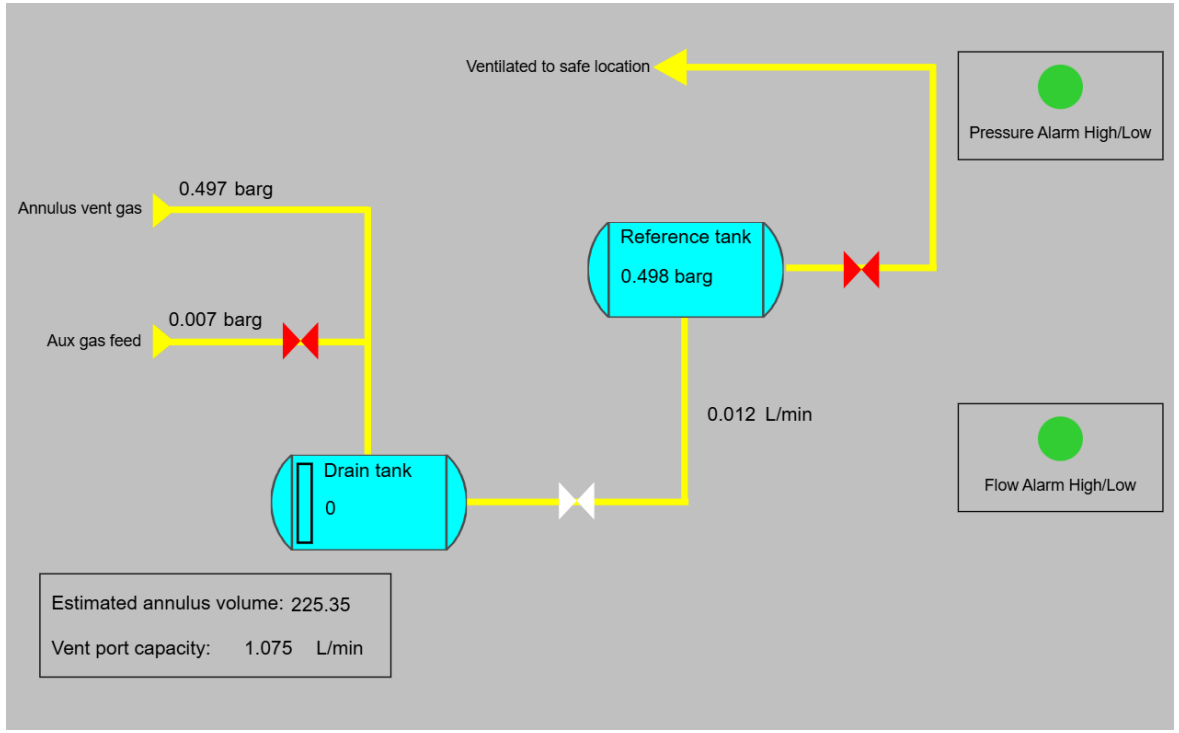
No	Main components	Setup	Monitoring parameters	Limitations
6		• A reference volume is used as a flowmeter. • Actuated valves are operated to fill and empty a reference volume. • Time between each cycle is used to calculate vent flow rate. • Total vented volume is obtained by counting number of cycles.	• Annulus pressure • Vent flowrate • Vented volume • Free annulus volume can be estimated.	• Limited vent flow capacity due to cycle time. • Inaccurate instantaneous vent flow rate measurement for pipes with low permeation (accurate vent flow can be determined by long term trending of vented volume).
7		• A double acting piston which contains two reference volumes is used as a flowmeter. • The actuated valves are controlled when the reference volumes are filled and venting pressure is reached. End switches and springs may be one option. • Time between each cycle is used to calculate vent flow rate. • Total vented volume is obtained by counting number of cycles.	• Annulus pressure • Vent flow rate • Vented volume • Free annulus volume can be estimated.	• Same as 6. • Dynamic seal requires maintenance.

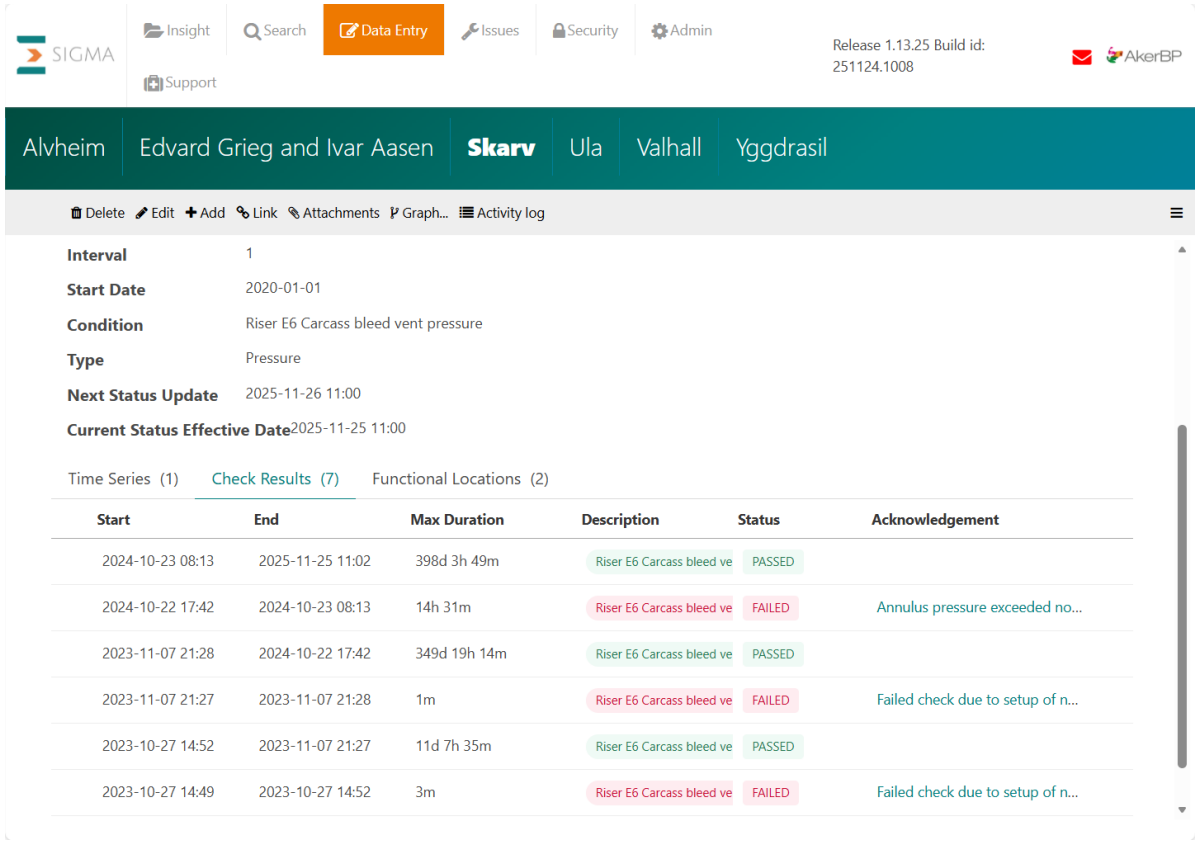
Alarms and actions

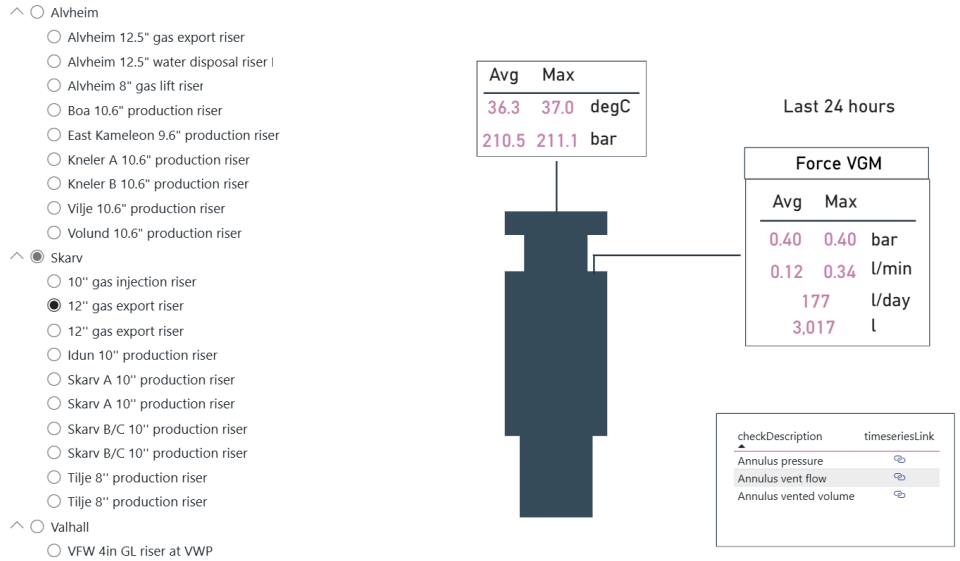


	Low pressure	Normal pressure	High pressure
Low flow	Outer sheath damage	Restriction in end fitting	Restriction in vent system
Normal flow	System fault	Normal condtion	
High flow		Loss of containment	

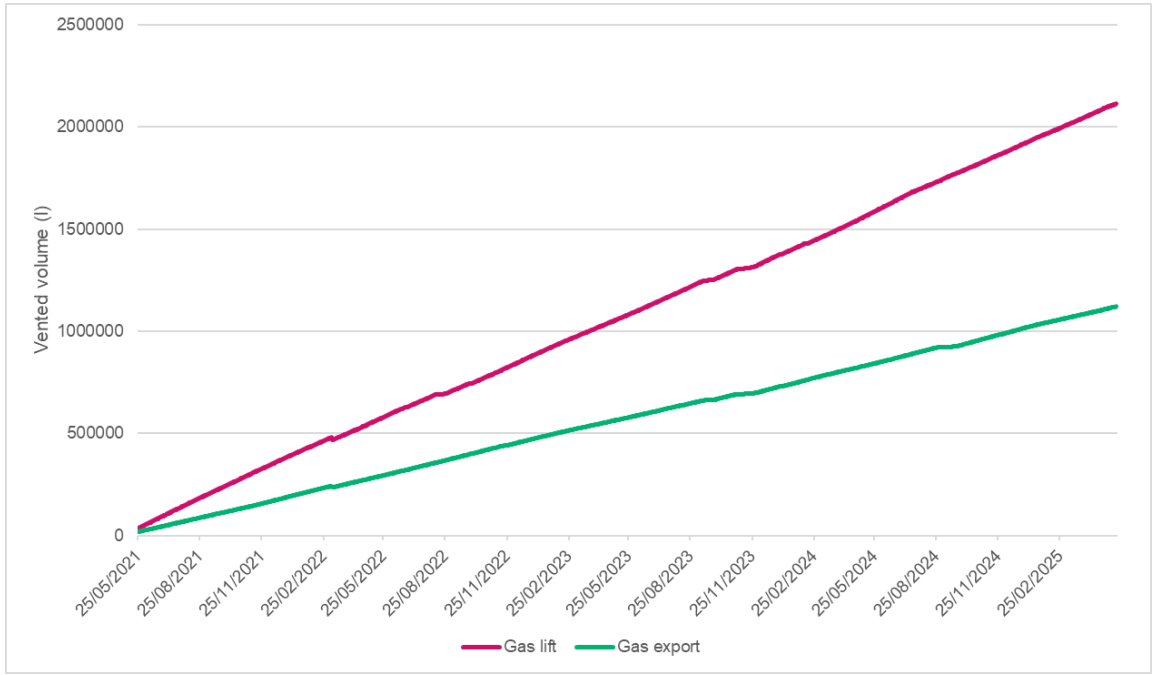
Action required
Critical

Short-term data evaluation





Long-term data evaluation

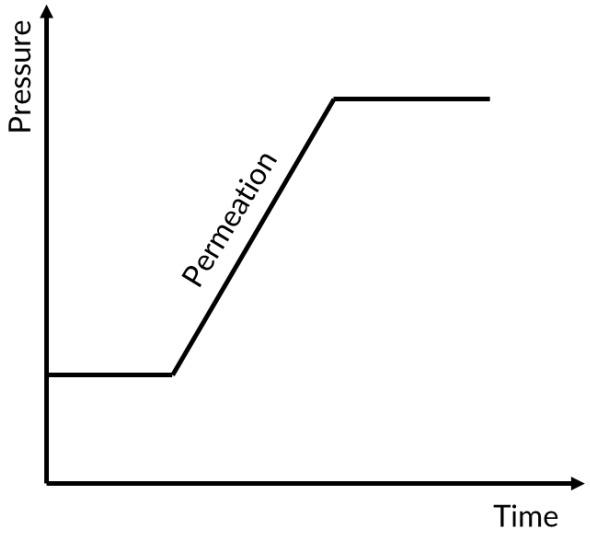


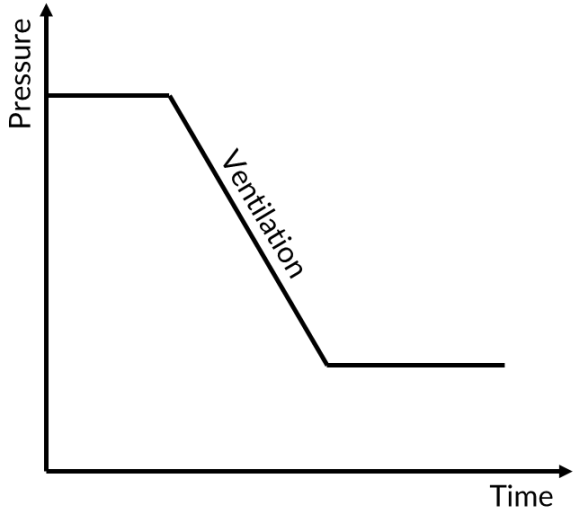
Remote annulus volume testing

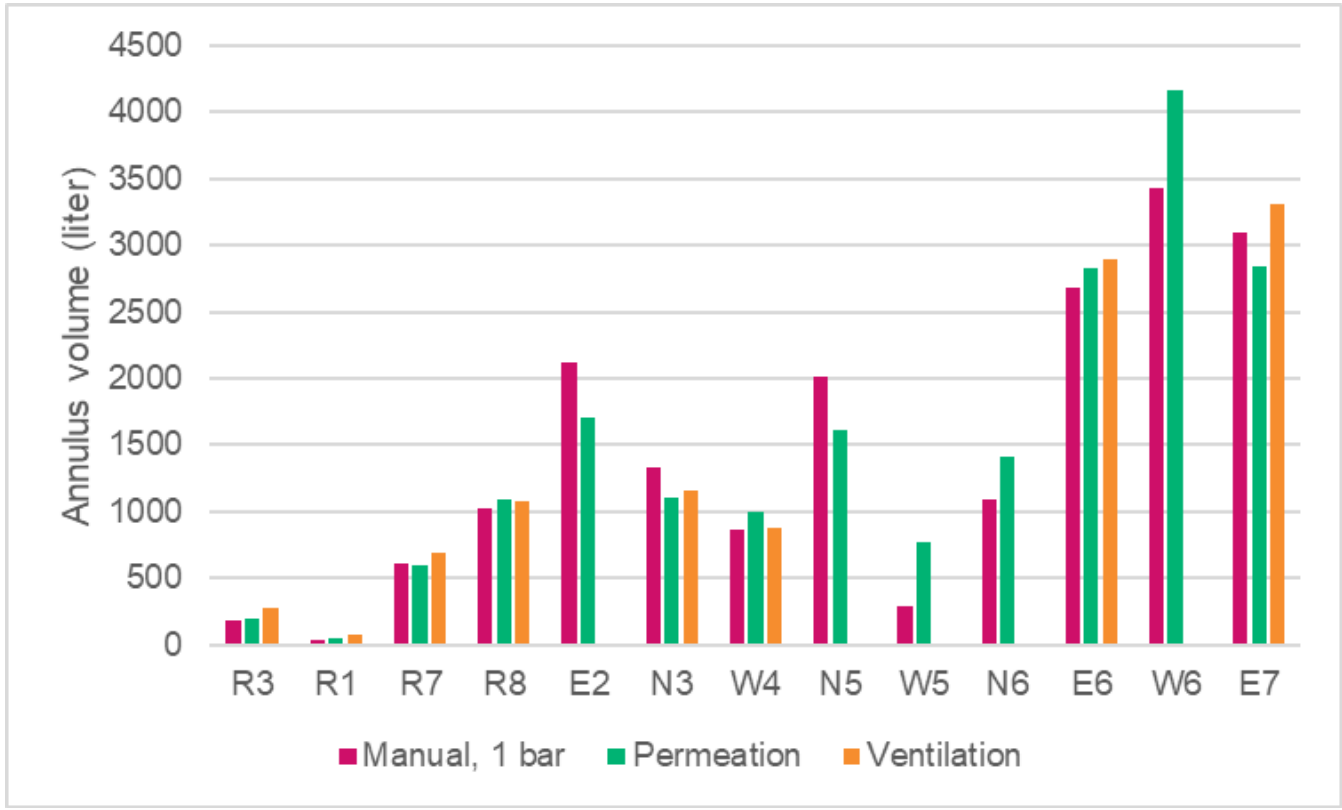
- Remote vs manual
  - Allow for increased test frequency
  - No need for mobilizing offshore personnel and equipment
  - Require stable conditions during testing

- Remote vs automatic
  - Perform test under stable conditions
  - Controlled by permit to work
  - Understanding of how system is working
  - Ensure system resumes monitoring

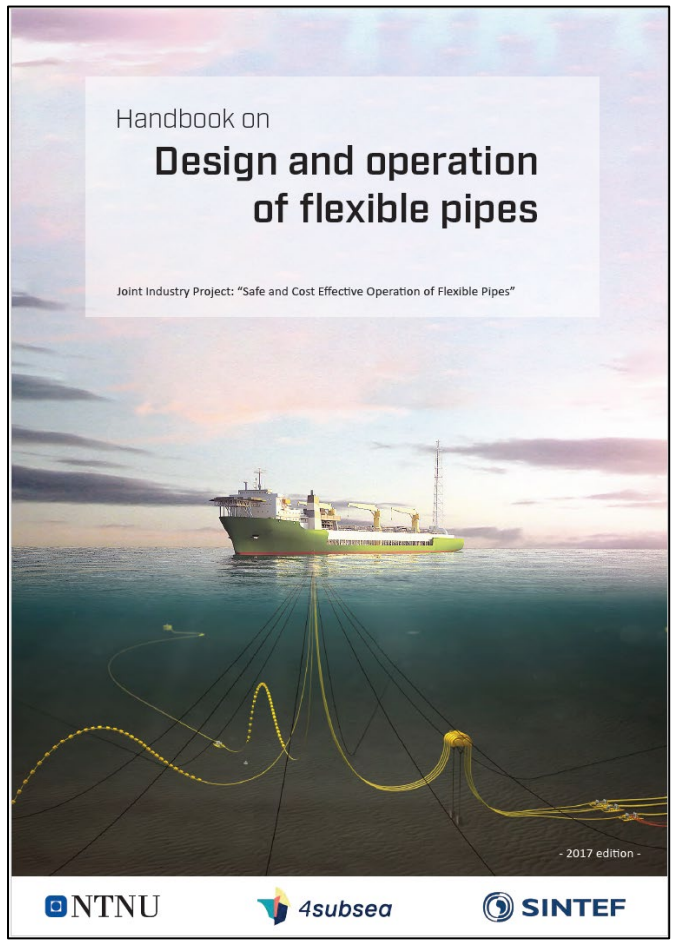
Annulus volume estimation

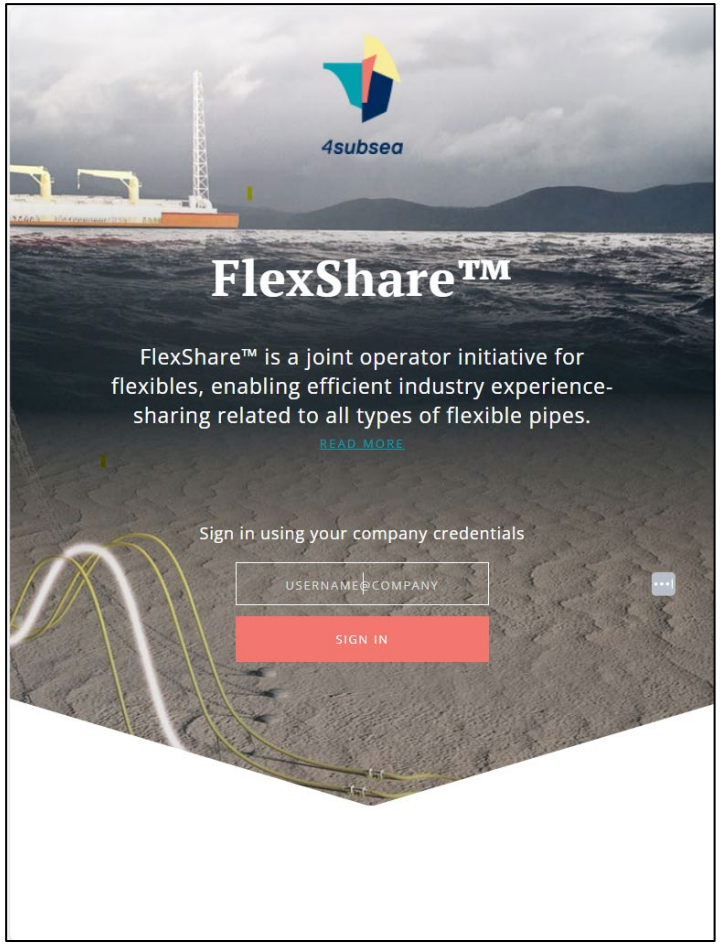






More about annulus vent gas monitoring





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