nZERO

nZero Group:
our brighter future together

Premzero
ENGINEERING FOR NET ZERO

MVC
Meter, Valve & Control
PROCESS MEASUREMENT AND CONTROL SOLUTIONS

nZERO

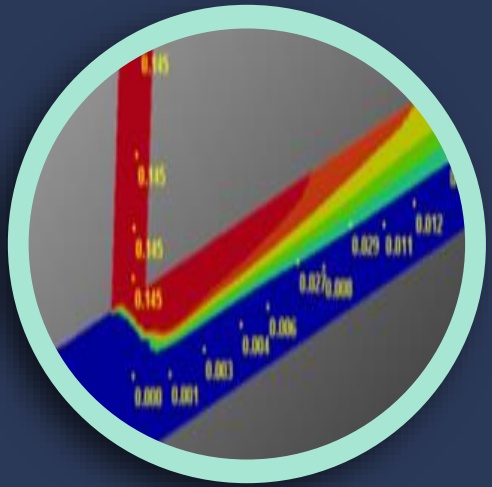
Sign up for our newsletter I Follow us on LinkedIn

THYSON TECHNOLOGY

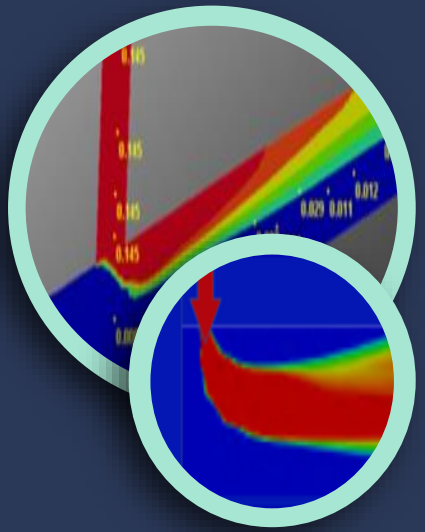
ORBITAL

TECHNICAL CONSIDERATIONS OVERVIEW

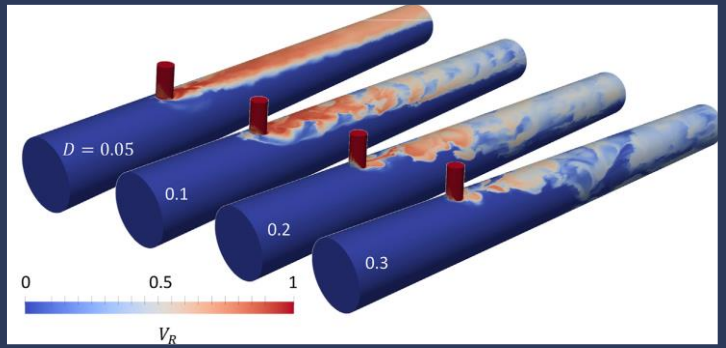
- Hydrogen Production and Flow Rates
- Homogeneous Hydrogen Blending
- Blending Methodology (Direct or Indirect)
- Feeder Operational Conditions
- Hydrogen and Blended Gas Metering
- Hydrogen Measurement and GS(M)R (Gas Quality)
- Blending Control



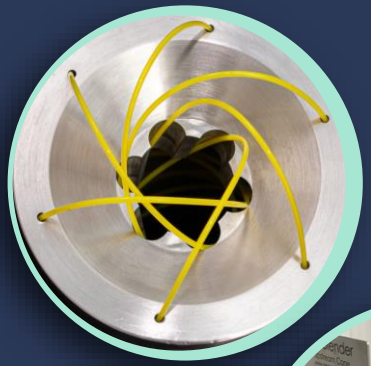
HOMOGENEOUS BLENDING



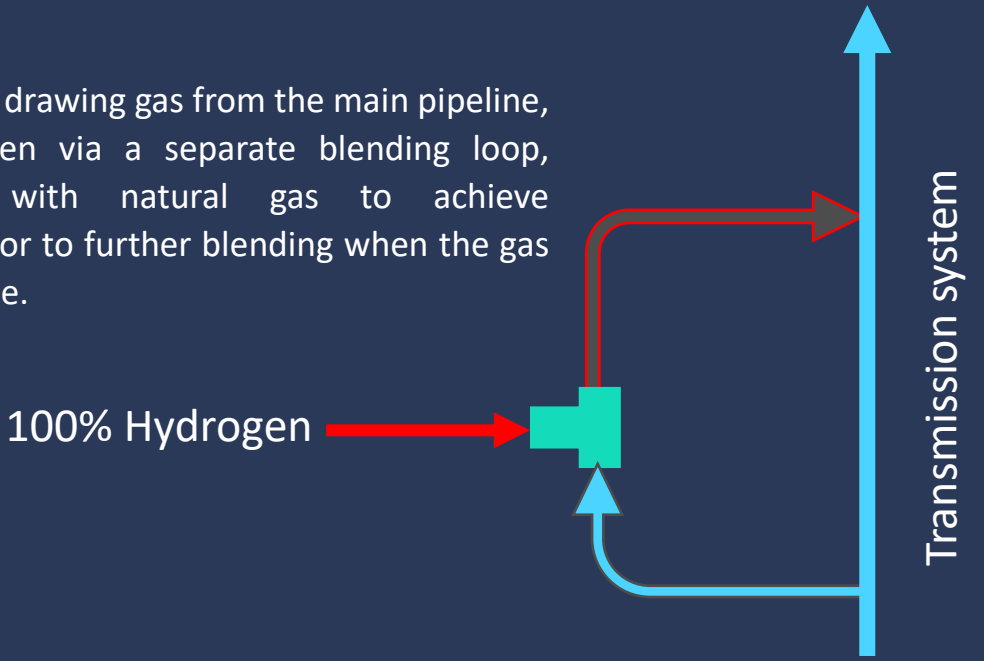
- Embrittlement risk from 100% H2 in contact with steel pipe wall.
- Expected limit of max. 20% H2 blend in NTS.
- Increased risk of high concentration H2 at injection point due to prevailing Nat Gas velocity and buoyancy of H2.
- *ISO 10715 gas sampling guidelines - homogenous blend achieved at 20 pipe diameter downstream of blending point. (Nat Gas into Nat Gas)*



BLENDING METHODOLOGY - INDIRECT

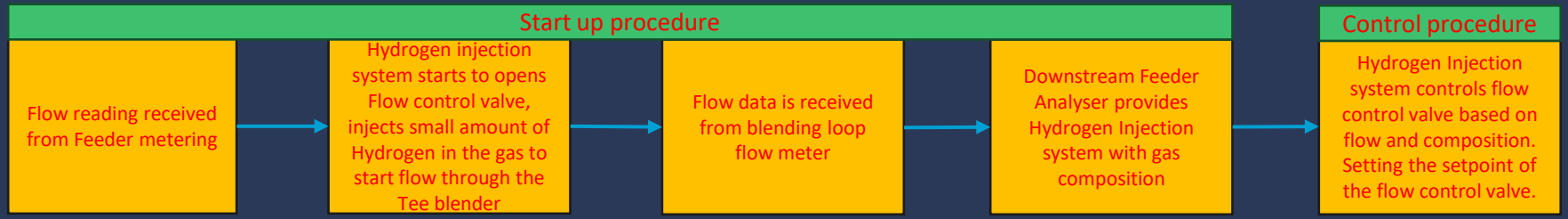


Indirect blending involves drawing gas from the main pipeline, blending it with hydrogen via a separate blending loop, allowing pre-blending with natural gas to achieve homogenous blending prior to further blending when the gas re-enters the main pipeline.



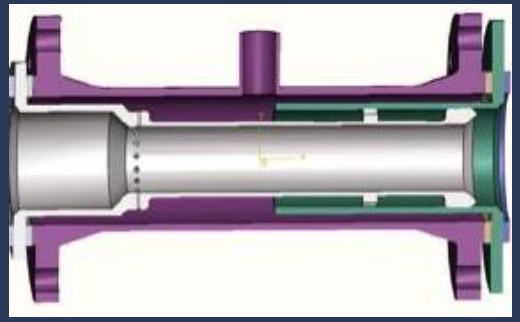
INJECTION CONTROL

Indirect Blending Control

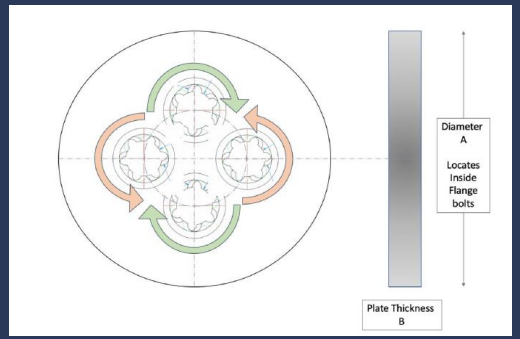


INDIRECT BLENDING TECHNOLOGY

- Hydrogen Tee Blender



- Tee Blender Solo and Quad (Static Mixer)



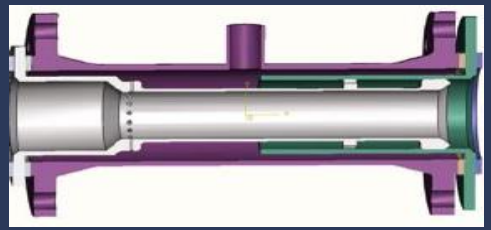
TEE BLENDER

- Manufacturer – nZero Group (UK)
  - HyDeploy Project (UK)
  - Atco (Canada) Alberta
- No moving parts
- No maintenance
- >97% Homogeneity
- Guarantee Blending < 10D (3D)
- Bi-directional flows

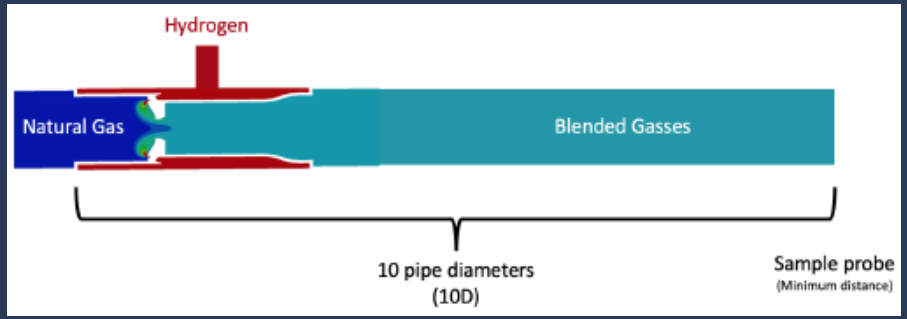
Alberta H2 Blending Station

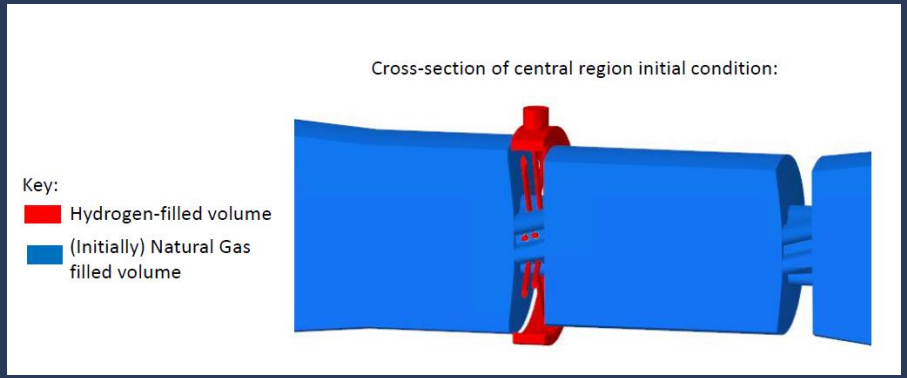
INDIRECT BLENDING – TEE BLENDER

- The product consists of two intersecting cones (inlet – green, outlet – silver). The element shown purple is the pressure containment element. This provides the customer with the flexibility to position and size the injection connection (side branch) which can be an equal or reducing forged Tee or proprietary welded connector to a short length of pipe between welded flanges.



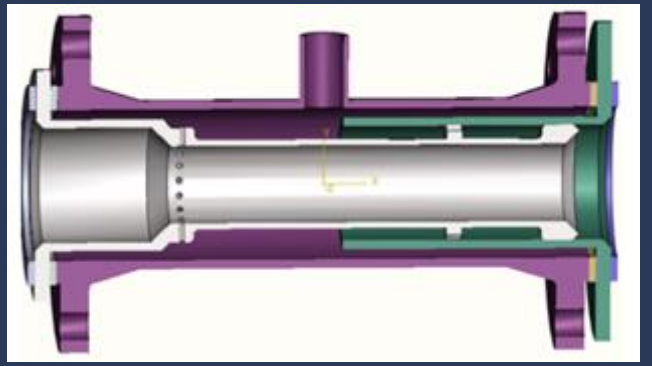
- The overlapping of the two cones provides a telescopic assembly that self positions to accommodate any fabrication tolerances of the customers pipework and gasket thickness variations.
- The assembled blender creates a void on the outside of the cones for the hydrogen gas, from where it feeds through multiple injection jets against the flow of the NTS natural gas. The sizing and direction of these equally spaced gas jets induces a vortex swirl as the combined gases approach an orifice throat.

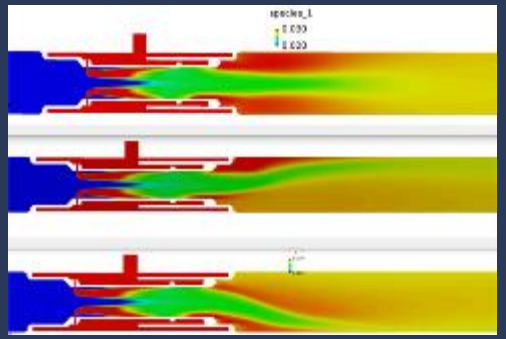


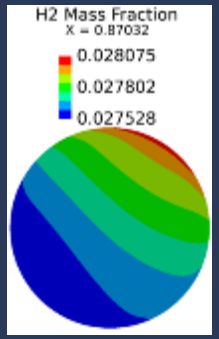


HYDROGEN BLENDING

- Patented (US) Hydrogen Blender
- Gas Network Spec Spool
- Computational Fluid Dynamics
  - - Mixing
  - - Mass Fraction



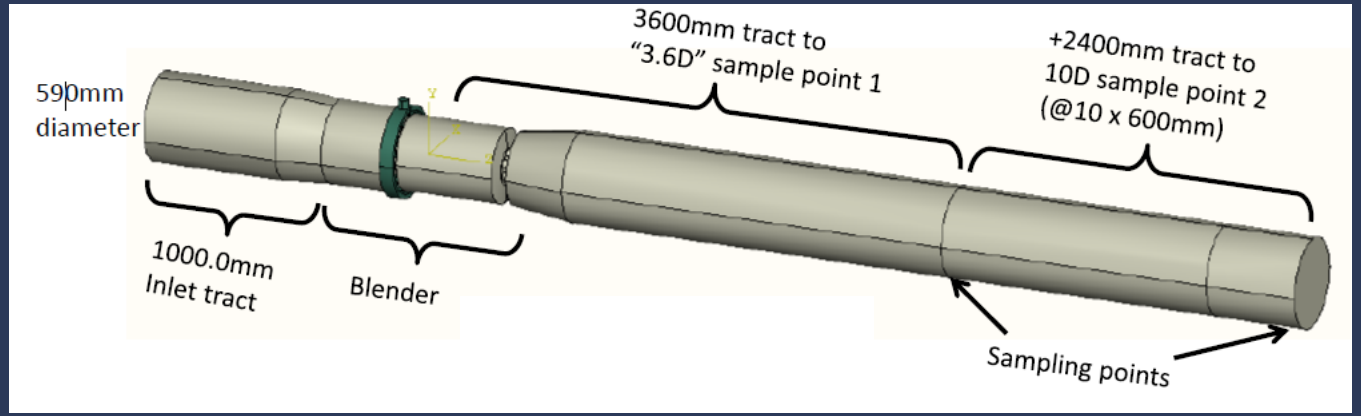




Safety | Service | Success | Sustainability | Strength

H2 BLENDING INFRASTRUCTURE CONCEPT

Tee Blender
CFD Modelling



Natural Gas	Minimum	Maximum
Pressure (Barg)	19	38
Flow (m3/hr)	14,115	510,819
Nominal pipe diameter	600mm	

INDIRECT BLENDING – TEE BLENDER

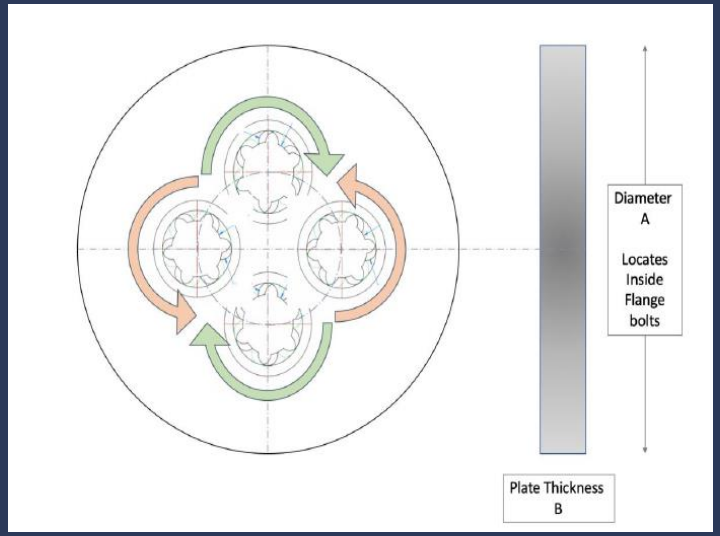
- The blending ratios reviewed are 3:1 in a reverse pipeline flow scenario and 7:1 in forward.
- This has only been modelled for gasses of similar density (biomethane into Natural Gas) previously. However, from the previous experience of inline blending of hydrogen into natural gas it is anticipated that it will be possible to achieve similar performance with hydrogen by increasing the jetting velocity through the equipment.
- The larger scale hydrogen production gives a requirement for a larger Tee Blender, which is to be expected. If the changes in production scale is to alter on a single site, the turn down ratio will need to be established, as very wide hydrogen flowrates may give some non-linearity in performance of the very low end of the hydrogen flow rate.

TABLE: FLOW CHARACTERISTICS FOR TYPICAL TEE BLENDER SIZES

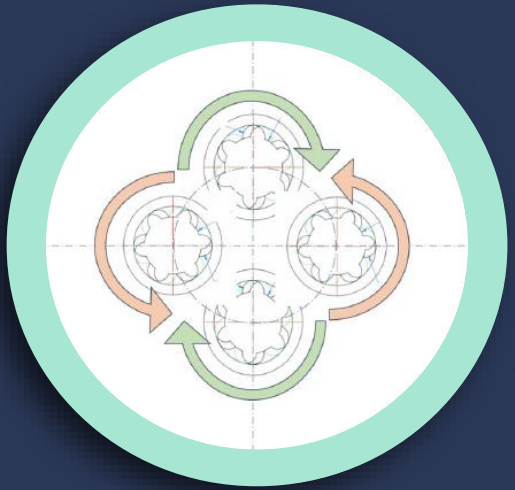
	Small Scale	Medium Scale	Large Scale
Max H2 Flow (SCMH)	5967	29833	89498
Tee Blender Size	6"	10"	16"
Induced Natural Gas Flow in bypass loop (reverse pipeline flow)	17901	89499	268494
Hydrogen Blend Percentage	25%	25%	25%
Induced Natural Gas Flow in bypass loop (forward pipeline flow)	41769	208831	626486
Hydrogen Blend Percentage	12.5%	12.5%	12.5%
Tee blender sizing based on achieving <25% H2 blend ratio within the bypass loop for embrittlement mitigation			

INDIRECT BLENDING – TEE BLENDER QUAD

- Manufacturer – nZero Group
- Simple installation – static mixer device.
- Can be used alongside the Tee Blender for additional blending support.
- Low pressure drops.
- Robust construction.
- Efficiently blend gases due to the ability to perform over wide ranges of blend ratios and flows.



INDIRECT BLENDING – TEE BLENDER QUAD



Principle of Operation –

- Orifice plate which is located inside the associated pipework flange assembly and is machined from certified stainless steel (SS316).

- The velocity of the blending gasses is increased through the mixer as helical swirling is induced. The ‘weir’ created by the orifices when in a horizontal pipework orientation is minimised by aligning the edge of the orifice with the inside diameter of the pipeline. This removes the need for a drain hole in the plate.

Thank you for your time

www.thyson.com

www.orbital-uk.com

Sign up for our newsletter I Follow us on LinkedIn