

Annexure B Part 1 – Carbon Dioxide Specifications (Net Zero North Sea Storage)

1. Core specification

Component	Limit	Units	Notes
CO ₂	≥ 96	mol %	
<u>H₂O</u>	<u>≤ 50</u>	<u>ppm</u> <u>mol</u>	
<u>H₂</u>	<u>≤ 0.75</u>	<u>mol %</u>	<u>Note 1, 2 above apply</u>
N ₂	<u>Combined limit of ≤ 4</u>	mol %	Note 1 – Cumulative inerts and non-condensable limit <u>of ≤ 4mol %</u> (including light hydrocarbons). Note 2 – Additionally for Humber onshore pipeline system the saturation pressure of the mixture shall not exceed 80 barg.
<u>Ar</u>			
<u>Methane</u>			
<u>Ethane</u>			
H₂	≤ 0.75	mol %	Note 1, 2 above apply
Ar	≤ 4	mol %	Note 1, 2 above apply
<u>O₂</u>	<u>≤ 10</u>	<u>ppm</u> <u>mol</u>	
<u>SO_x (SO, SO₂, SO₃)</u>	<u>≤ 10</u>	<u>ppm</u> <u>mol</u>	
<u>NO_x (NO, NO₂)</u>	<u>≤ 5</u>	<u>ppm</u> <u>mol</u>	
<u>H₂S</u>	<u>≤ 5</u>	<u>ppm</u> <u>mol</u>	
CO	≤ 1000	Ppm mol	Note 1, 2 above apply
<u>Mercury (Hg)</u>	<u>≤ 0.0025</u>	<u>ppm</u> <u>mol</u>	
<u>Glycols</u>	<u>≤ 1</u>	<u>ppm</u> <u>mol</u>	

Component	Limit	Units	Notes
<u>Amines</u>	≤ 1	<u>ppm</u> <u>mol</u>	
<u>Ammonia</u>	≤ 10	<u>ppm</u> <u>mol</u>	
<u>Formaldehyde</u>	≤ 20	<u>ppm</u> <u>mol</u>	
<u>Acetaldehyde</u>	≤ 20	<u>ppm</u> <u>mol</u>	
<u>Cadmium</u>	≤ 0.005	<u>ppm</u> <u>mol</u>	
<u>Thallium</u>	≤ 0.012	<u>ppm</u> <u>mol</u>	
<u>Methanol</u>	≤ 350	<u>ppm</u> <u>mol</u>	<u>Cumulative methanol and ethanol limit of less than 350 ppm.</u>
<u>Ethanol</u>	≤ 50	<u>ppm</u> <u>mol</u>	
CH₄	Cumulative light HCs ≤ 4	mol %	Note 1, 2 above apply
Methane	Cumulative light HCs ≤ 4	mol %	Methane same as CH₄—see above. Note 1, 2 above apply
Ethane	Cumulative light HCs ≤ 4	mol %	
Propane & other aliphatic HCs	Cumulative light HCs ≤ 4	Mol %	Note 1, 2 above apply
Heavy Hca (C3+)	Heavy hydrocarbons should <u>shall</u> not shift the dew point below that of pure carbon dioxide e.g. n-C4: $\leq 0.25\text{mol}\%$, n-C6: $\leq 250\text{ppm}$, n-C10: $\leq 5\text{ppm}$.		
H₂O	≤ 50	ppm mol	
O₂	≤ 10	ppm mol	

Component	Limit	Units	Notes
NO _x (NO, NO ₂)	≤5	ppm mol	
SO _x (SO, SO ₂ , SO ₃)	≤10	ppm mol	
H ₂ S	≤5	ppm mol	
NH ₃	≤10	ppm mol	
Methanol	≤350	ppm mol	Cumulative methanol and ethanol limit of less than 350 ppm.
Ethanol	≤50	ppm mol	
Particulates	Particles shall be ≤5 micron in size and with a maximum occurrence of ≤1 mg/Nm ³ .		
Mercury (Hg)	≤0.0025	ppm mol	
Cadmium	≤0.005	ppm mol	
Thallium	≤0.012	ppm mol	
Formaldehyde	≤20	ppm mol	
Acetaldehyde	≤20	ppm mol	
Amines	≤1	ppm mol	
Glycols	≤1	ppm mol	

2. ADDITIONAL REQUIREMENTS

In addition to the requirements set out in Paragraph 1, the following requirements for Teesside Users entering the onshore gathering network must be met with respect to pressure and temperature:

<u>Parameters</u>	<u>Units</u>	<u>Value</u>	<u>Notes</u>
<u>Design Conditions</u>			
<u>Design Pressure</u>	<u>barg</u>	<u>44</u>	
<u>Maximum Design Temperature</u>	<u>°C</u>	<u>75</u>	
<u>Minimum Design Temperature</u>	<u>°C</u>	<u>-29</u>	
<u>Operating Parameters</u>			
<u>Minimum operating pressure (MinOP)</u>	<u>barg</u>	<u>15</u>	<u>Note 1</u>
<u>Maximum operating pressure (MaxOP)</u>	<u>barg</u>	<u>40</u>	<u>Note 1</u>
<u>0.....Maximum operating temperature</u>	<u>°C</u>	<u>50</u>	<u>At User's Delivery Point</u> <u>Note 2</u>
<u>Minimum operating temperature</u>	<u>°C</u>	<u>15</u>	<u>At User's Delivery Point. This is the lowest temperature of the safe operating envelope.</u> <u>Note 2</u>

Note 1: The User's delivery pressure shall be the pressure required to enable the User to deliver CO₂ to the Delivery Point (as defined in the Network Code) after taking account of any, and all, back pressure in the T&SCo network at the Delivery Point ["Delivery Pressure"]. As such, the User's Delivery Pressure may vary and fluctuate depending upon network flow rates, spurline length and configuration of the network from time to time. User's Delivery Pressure requires to always be capable

of meeting the Normal Operating Pressure Range (NOPR, is the range between MinOP and MaxOP for the pipeline network).

Note 2: The User's delivery temperature shall be the temperature resulting from the delivery pressure requirement described in Note 1 and must always be in the range between the minimum operating temperature and the maximum operating temperature inclusive.

~~Note: specific limits to be confirmed by Net Zero North Sea Storage~~