

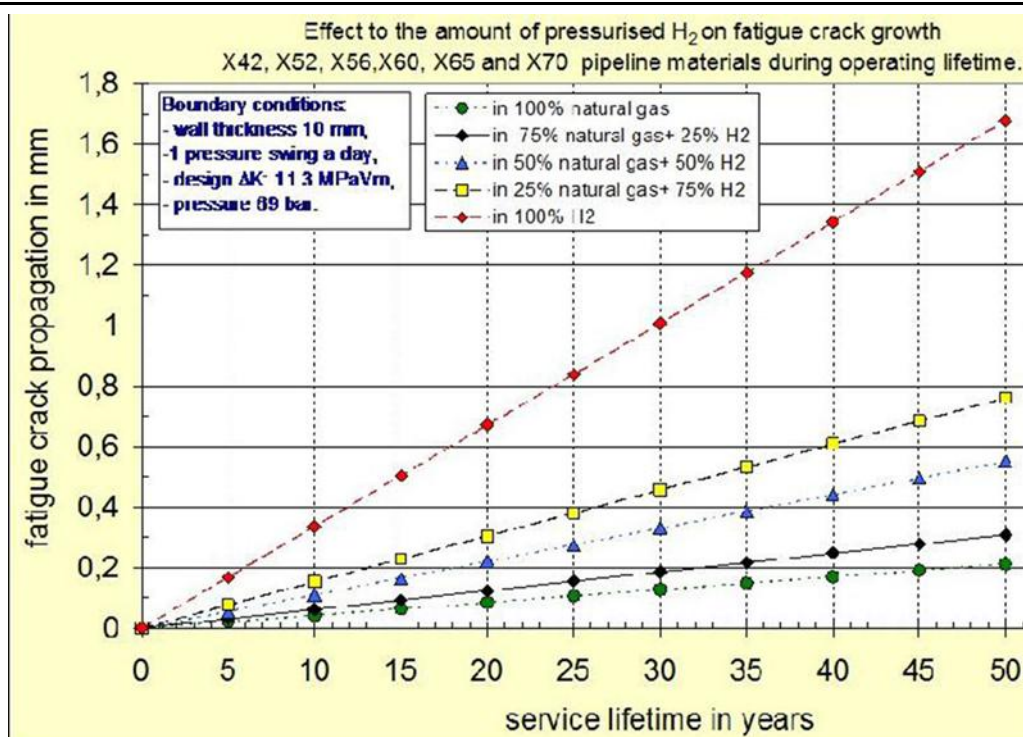
Network Innovation Competition Full Submission

Supplementary Answer Form

Tick if this answer is Confidential: ☐

Tick if this answer has been provided verbally: ☐

Project code:	WWUGN01	Question Number	9
Question date	12 th September 2013	Answer date	16/09/2013
Submission section question relates to	Section 8		
Topic	Exemption to GS(M)R Regulations		
Question	How will you take into account the possibility of hydrogen embrittlement of cast iron and other metallic materials in use on the gas distribution system when		
Notes on question			
Answer	<p>The response to Question 8: 'Please outline your approach to requesting the exemption from HSE, including the issues HSE may raise and the mitigations you consider necessary to gain acceptance' identified the methodology that will be used by WWU. This included the requirement in step 2 to demonstrating the integrity of the assets to be reused. Specifically, WWU will need to demonstrate the integrity of the existing assets, their design specification, maintenance and inspection history etc. While most of the low pressure and medium pressure network network is Medium Density Polyethylene some is metallic pipe mainly steel. The exact locations, material, lengths, diameters and other pipe attributes are recorded in WWU's asset repository.</p> <p>The evidence available suggests that 2% hydrogen is safe. Data reported from the GER HIPS project final report shows that for natural gas hydrogen mixtures containing 25% of hydrogen there is no significant effect on the fatigue behaviour, compared with pure methane, for the following grades of pipeline steels: API 5L X42, X56, X60, X65 and X70, see figure below.</p>		



The above graph shows the growth of fatigue crack versus time for different percentages of hydrogen in methane-hydrogen mixtures for a range of pipe steels. The growth of fatigue crack propagation during operational lifetime for 2% hydrogen mixture is similar to that for 100% methane.

Various studies reported in the NaturalHY and more recently in the GERG HIPS projects show that Yield Strength and Ultimate Strength are not significantly modified by hydrogen even at very high pressure (100 bar and above) or when an electrolyte (e.g. moisture, gas condensate) is present. The pipes used around Wadebridge will operate at a maximum pressure of 2 bar and the gas will be dry.

Hydrogen has an embrittlement effect on pipe steels under the normal operating conditions of natural gas pipelines (ambient temperature and low strain rates) due to the lower tolerance to defects. The presence of a small percentage of oxygen in hydrogen (<100 ppm) significantly reduces the effect of hydrogen on fatigue crack growth and even fully inhibits it. Repair techniques currently used for natural gas pipelines can be used without adaptation for existing natural gas pipelines transporting methane-hydrogen mixtures.

We therefore do not believe that hydrogen embrittlement of metallic pipes with 2% hydrogen will be an issue but this will be fully examined in the work for scope for the exemption.

Attachments

Verbal
Clarifications
(Consultants
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