AN INSTALLATION TO STUDY THE UNCERTAINTIES IN CO_2 TRANSPORT: DESCRIPTION OF CIUDEN´S TEST RIG.

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Text:

The development of Carbon Capture and Storage (CCS) technologies is linked to the development of the CO_2 transport (CT). It is necessary to transport the CO_2 from the capture site to the final safe and permanent storage location by using pipelines, ships or trucks. CT presents still uncertainties that have to be solved in order to validate the full CCS chain (capture, transport and storage).

Fundación Ciudad de la Energía (CIUDEN), a public Foundation created by the Spanish Government, is currently constructing an experimental installation to study the main issues related to CO_2 transport, mainly focused on pipeline transport. This facility is located in Northwestern Spain and will be part of the Technology Development Centre for CO_2 Capture Technologies.

Besides the transport test rig, the Centre will also include a 20 MW_{th} pulverized coal boiler (PC), a 30 MW_{th} circulating fluidised bed boiler (CFB), a fuel preparation unit, a biomass gasifier, a flue gas cleaning train and a CO_2 compression and purification unit (CPU), being the only installation in the world with two large pilot boilers capable of burning a wide range of coals, biomass and pet coke under conventional combustion and oxycombustion conditions.

This paper describes CIUDEN´s CO_2 transport test rig, currently under development of the detailed engineering phase. The installation will include the following process units:
(a) CO_2 filling up of the test rig including two pumps that take CO_2 either from storage vessel or CPU.
(b) High pressure vessel to avoid fluctuations in the flow.
(c) CO_2 pressure and temperature conditioning unit that includes the recirculation pump and a heat exchanger in order to set operation pressure and temperature within the range:
80 barg / 110 barg and 10 ºC / 30 ºC. To operate the test rig in thermal conditions similar to those expected in CO_2 transport pipelines, the facility will be located inside a building with thermal control.
(d) Dosing of contaminants unit including all the equipment necessary to add the contaminants expected in oxy-combustion or pre-combustion conditions. The contaminants initially considered are: H_2O, NO_x, SO_x, N_2, O_2, Ar, CO, H_2, H_2S and CH_4.
(e) Sets of pipes with variable length and different materials: each tube coil has an equivalent length of approximately 500 m and a nominal diameter of 2 inches. Considering the number of

tube coils, the length of the whole test rig will exceed 5,000 meters. It is also possible to by-pass one or several tube coils in order to be adapted to specific conditions.
(f) Test zones that will be designed in order to test instrumentation, corrosion rates in different materials, CO_2 behavior under controlled pressure drops and CO_2 transport conditions considering the modifications of the following independent variables: pressure, CO_2 temperature, ambient temperature, volumetric flow and CO_2 quality.

Figure 1 shows a basic diagram of the installation:

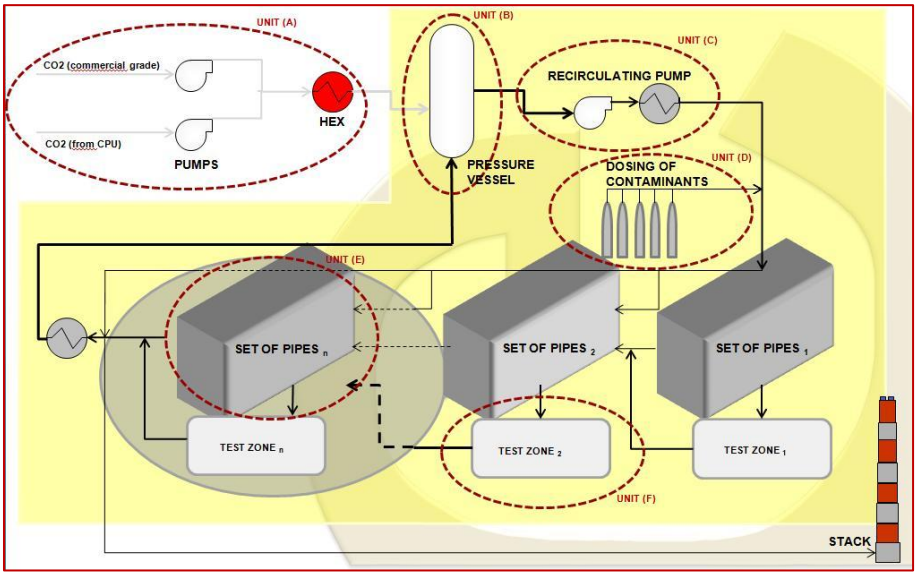

Figure 1.- Schematic process flow diagram.

CIUDEN will develop a complete Testing Campaign, mainly focused on the evaluation of the effect of contaminants on the mechanical behavior of different steels and other materials, corrosion, flow assurance, as well as CO_2 depressurization and its effects on the pipeline.

Due to the semi-industrial size of the installation, and the flexibility of its design, the results are expected to be particularly valuable for the design and construction of commercial CO_2 transport pipelines. Additionally, the facility could be used as a training-room for operators in charge of the operability/maintenance of the industrial CO_2 pipelines and equipment.