Good plant design and operation for onshore and offshore carbon capture installations and pipelines

Second edition

energy institute

GOOD PLANT DESIGN AND OPERATION FOR ONSHORE AND OFFSHORE CARBON CAPTURE INSTALLATIONS AND PIPELINES

Second Edition

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The EI's purpose is to develop and disseminate knowledge, skills and good practice towards a safe, secure and sustainable energy system. In fulfilling this mission, the EI addresses the depth and breadth of the energy sector, from fuels and fuels distribution to health and safety, sustainability and the environment. It also informs policy by providing a platform for debate and scientifically-sound information on energy issues.

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– the Society for the Environment to award Chartered Environmentalist status.

It also offers its own Chartered Energy Engineer, Chartered Petroleum Engineer, and Chartered Energy Manager titles.

A registered charity, the EI serves society with independence, professionalism and a wealth of expertise in all energy matters.

This publication has been produced as a result of work carried out within the Technical Team of the EI, funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

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FOREWORD

In 2006, the then Department of Business, Enterprise and Regulatory Reform (responsibilities now allocated to the Department for Energy Security and Net Zero (DESNZ)) asked the UK Health and Safety Executive (HSE) to determine if there were any health and safety concerns relating to the deployment of large-scale carbon capture and storage (CCS) technology in the UK.

The HSE carried out a significant review of all aspects of the carbon capture and storage chain from the various capture technologies through to the injection points on the offshore platforms. Part of this process involved approaching the Energy Institute (EI) and the Carbon Capture and Storage Association (CCSA), who jointly organised several workshops to identify the key areas for development. The workshops specifically identified a number of areas which they believed merited greater attention.

The concerns were split into two broad subject areas:

1. Modelling the dispersion of any leak of carbon dioxide appropriately.
2. Ensuring good practice from industrial gases sectors is fed into the UK CCS industry and is adequate and appropriate for this new industry.

Modelling the dispersion of carbon dioxide

The HSE was concerned that, whilst commercial models were available to model the dispersion of gases, including carbon dioxide, because they were unable to model solids, assumptions had to be made[1]. As a result, any dispersion modelling using these may not be accurate, less so for impure carbon dioxide. Without a model revision, coupled with validation testing, it would be difficult to use them with any confidence. In identifying this as a need for development, the HSE and EI set about establishing a joint industry group to develop guidelines on *Hazard Analysis for Onshore and Offshore Carbon Capture Installations and Onshore Pipelines*.

Ensuring good practices are used in the CCS industry

Due to solid formation and low temperatures, carbon dioxide has particular properties which affect the choice of materials, plant design and the way that plants are operated and maintained. Although many of these issues are well understood by the industrial gases sector, they are not 'business as usual' for the CCS industry. In response to the concerns raised by the HSE, the EI formed an industry group to work with the HSE to resolve the issues raised. The work formed three discrete documents.

The first document was titled *Technical guidance on hazard analysis for onshore carbon capture installations and onshore pipelines*; the second, *Good plant design and operation for onshore carbon capture installations and onshore pipelines*. The third (which is now incorporated into the other two revisions), which was published three years later and was called *Hazard analysis for offshore carbon capture platforms and offshore pipelines,* complemented the first document.

The documents, which proved to be a well-used resource, were intended for guidance only and to improve the industry's knowledge, to assist developers and operators to carry out hazard analysis, and procure and manage their plant safely. It was accepted when producing the documents that

1 For more information see S. Connoly, L. Cusco, Hazards from high pressure carbon dioxide releases during carbon dioxide sequestration processes. International Symposium Loss Prevention and Safety Promotion in the Process Industries, Edinburgh, 22–24 May 2007. https://silo.tips/download/hazards-from-high-pressure-carbon-dioxide-releases-during-carbon-dioxide-sequest

it would be necessary, at some point in the future, to review the documents. A decade after their publication, recognising both increased interest in CO_2 capture and storage and the work that has been undertaken in the meantime, the EI organised a series of workshops which identified the need to update the earlier documents.

The opportunity was taken to restructure the two documents. All aspects relating to the hazards associated with CO_2 have been drawn together into a single document, to include approaches to ensuring that hazards are appropriately identified, quantified and mitigated. A second document, drawing on experiences from many countries, provides not only guidance on the various elements that make up a chain (omitting geological storage), but also gives assistance on what is currently perceived as good practice in design and operation.

The scope of the CCS chain covered by both of the two new documents is shown in Figure 1.

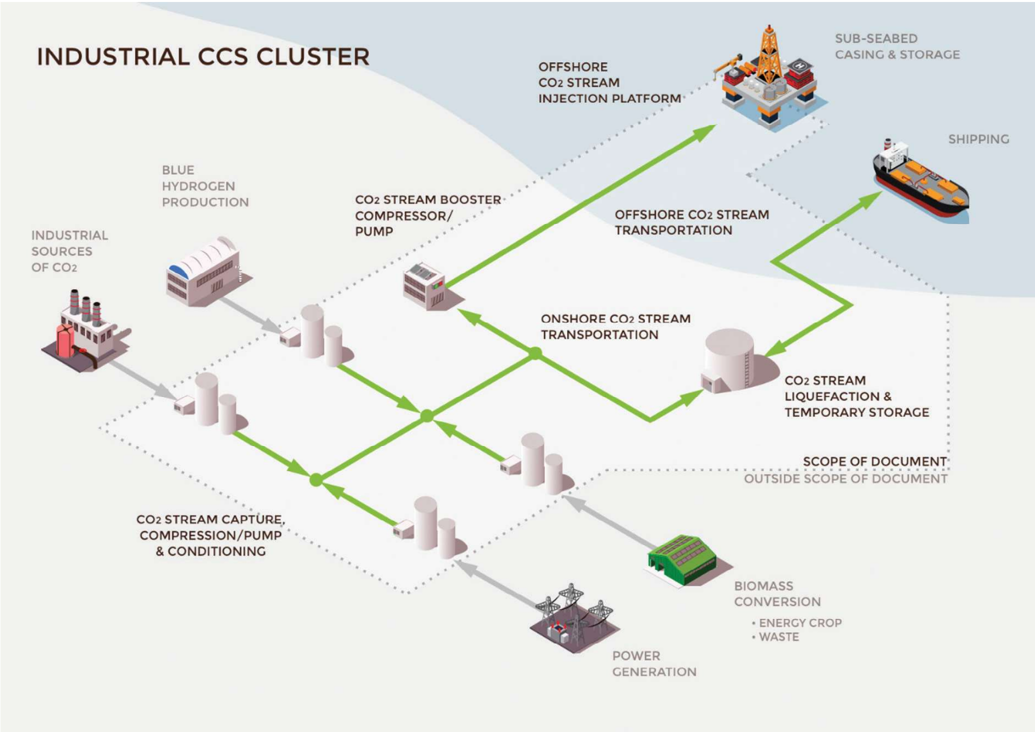

Figure 1: Scope of CCS Chain

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This publication will be reviewed in the future, and it would be of considerable assistance for any subsequent revision if users would send comments or suggestions for improvements to:

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