DEVELOPMENT OF RISK BASED VERIFICATION OF CHEMICAL ABSORPTION PROCESSES BY PROCESS SIMULATION

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Introduction

This work presents the development of a protocol for risk based verification of process modelling and simulation (PMS) for chemical absorption processes. Application of the protocol will address uncertainty and risks associated with the development of the model and the simulation and thus provide confidence and trust to the stakeholders. The motivation for developing the procedure is the increasing challenges posed by the accelerating need for new capture technologies in CO_2 capture and storage (CCS) and the uncertainties and risks that reside in the modelling and simulation of the full scale application. Verification, validation and accreditation (VV&A) methods as well as general techniques for process modelling and simulation (PMS) are developed and established by others. However, no specific method on VV&A directed towards process engineering modelling and simulation has so far been identified by the authors. The current work uses the general principles in the DNV Offshore Service Specification for risk based verification [1] and couples it with generally accepted methods for PMS [4].

Methodology

In the present work the definition of verification is: Confirmation by examination and provision of objective evidence that the specified requirements have been fulfilled. The examination shall be based on information which can be proved true, based on facts obtained through observation, measurement, test or other means. The following is addressed in the protocol:

- Detailed description of executing the verification for PMS following DNV Offshore Service Specification for risk based verification [1], such as simulation specification, risk assessment and definition of verification involvement by three risk-based verification levels (low, medium, high), see Figure 1.
- Development and execution of the verification plan that includes a description of how the different steps in the general framework for PMS will be verified for the different levels of verification. This verification plan is developed specifically for process modelling and simulation of chemical absorption processes for CCS application.

The risk based verification process is described in relation to generally accepted methods for PMS, such as the ones described by Hangos and Cameron [2] and by Banks [2]. Based upon various levels for verification involvement, the procedure describes how to verify subsequent steps in a generalized framework for PMS [4]. These methods for PMS have been extended to form a generalized modelling and simulation framework that is used to develop the verification plan. The general framework constitutes all the major components of an amine based CO_2 capture facility. This technology is used as a base-case since it is anticipated as being the

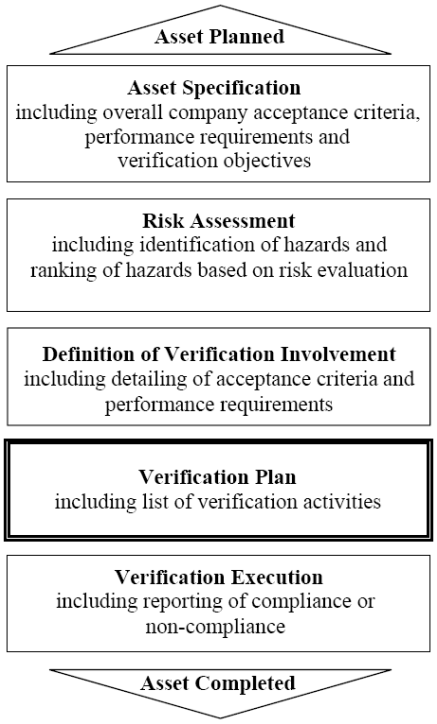

Figure 1: The DNV Risk Based Verification Chain [1].

technology at a maturity level where full scale CO_2 capture can be used is within reach in the near future [5]. Further, these processes have an inherent complexity making them well suited for the establishment of such a protocol.

Verification of simulation of chemical absorption processes

The modelling of typical absorption/desorption facilities is far from trivial due to the complexity of the physical and chemical phenomena occurring. A full model framework for these processes relies on sub-models for e.g. heat/mass transfer, kinetics, hydraulics and chemical/phase equilibria, all of which contribute to the overall complexity and thus also the risk. This work aims at identifying potential pitfalls for PMS of absorption processes and by this develop a risk-based verification protocol in line with DNV OSS-300 [1].

References

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