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The Challenges of Well Integrity on Plug and Abandoned Wells for Offshore Co_2 Storage Site Containment

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Abstract : The oil and gas industry is committed to net zero carbon emissions because the consequences of climate change could be catastrophic unless responded to very soon. One way of reducing CO_2 emissions is to inject it into a depleted reservoir buried underground. This greenhouse gas reduction technique significantly reduces CO_2 released into the atmosphere. In general, depleted oil and gas reservoirs provide readily available sites for the storage of CO_2 in offshore areas. This is mainly due to the hydrocarbons have been optimally produced and the existence of voids for effective CO_2 storage. Hence, make it a good candidate for a CO_2 well injector location. Geological storage sites are often evaluated in terms of capacity, injectivity and containment. Leakage through the cap rock or existing well is the main concern in the depleted fields. In order to develop these fields as CO_2 storage sites, the long-term integrity of wells drilled in these oil & gas fields must be ascertained to ensure good CO_2 containment. Well, integrity is often defined as the ability to contain fluids without significant leakage through the project lifecycle. Most plugged and abandoned (P & A) wells in Peninsular Malaysia have drilled 20 – 30 years ago and were not designed to withstand downhole conditions having >50%vol CO_2 and CO_2/H_2O mixture. In addition, Corrosive-Resistant Alloy (CRA) tubular and CO_2-resistant cement was not used during good construction. The reservoir pressure and temperature conditions may have further degraded the material strength and elevated the corrosion rate. Understanding all the uncertainties that may have affected cement-casing bonds, such as the quality of cement behind the casing, subsidence effect, corrosion rate, etc., is the first step toward well integrity evaluation. Secondly, proper quantification of all the uncertainties involved needs to be done to ensure long-term underground storage objectives of CO_2 are achieved. This paper will discuss challenges associated with estimating the performance of well barrier elements in existing P&A wells. Risk ranking of the existing P&A wells is to be carried out in order to ensure the integrity of the storage site is maintained for long-term CO_2 storage. High-risk existing P&A wells are to be re-entered to restore good integrity and to reduce future leakage that may happen. In addition, the requirement to design a fit-for-purpose monitoring and mitigation technology package for potential CO_2 leakage/seepage in the marine environment will be discussed accordingly. The holistic approach will ensure that the integrity is maintained, and CO_2 is contained underground for years to come.

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