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Please fill in your manuscript title.	Cost and Time Efficient Options of Offshore Wells Plug and Abandonment	
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## ABSTRACT

### OBJECTIVE / SCOPE

Most conventional oil and gas reservoirs reach their mature life and uneconomical wells need to be plugged and abandoned permanently. Previously, the regulatory body didn't consider making the abandonment part of the well development plans. As more reservoirs reach maturity, having a plug and abandonment (P&A) plan during the development stage seems mandatory. This article describes several options for optimizing decommissioning strategies with emphasis on environmentally sustainable operations. Model based approach will be used for analysis which can be converted into innovative digital models.

### METHODS, PROCEDURES, PROCESS

The abandonment of a well is a complex, multistep procedure that can be done in several ways. This paper examines the different well barrier elements, reservoir characteristics, rig and rigless methods, and wellbore complexities and history. The risk assessments and regulatory concerns of P&A process are examined. All possible P&A options will be cross-examined for efficient minimum operating costs and time, not sacrificing the quality of the operation with considering safe and long-lasting environmentally friendly decommissioning.

PETRONAS offshore P&A available data will be analyzed and the innovative approaches, the learned lessons and challenges will be discussed.

### RESULTS, OBSERVATIONS, CONCLUSIONS

For most P&A cases the operation can be conducted rigless which by itself can reduce the cost and time substantially. By assessing the integrity of the cement behind the casing in the cap rock area without interfering with the production tubing string and observing the sustained casing pressure the abandoned wells can be categorized. For each category the decision will be made if the cement remediation behind the casing is needed. For low to medium complexity wells the remediation job can also be performed rigless without needing to pull out the casing or tubing strings.

By understanding each well is unique and by categorizing the wells the safest and most efficient methodology can be applied for placing the plug and decommissioning the well in optimum cost and time. Without needing remediation, rig-less intervention with the help of cap rock restoration functionality, can permanently ensure long-term well integrity.

**NOVEL / ADDITIVE INFORMATION**

The many challenges in plug and abandonment operations are described. After careful analyzing the well geometry, condition, risk assessment for leakage potential and future hazards and considering the regulation in the region the optimum environmentally safe method can be identified. Assorted plans are grouped into the models which are valuable in moving the P&A and upstream operations towards analytics and digitalization as this gives rise to a new way of data analysis and creation of novel techniques for the challenging cases.

An essential aspect of the P&A is, if not properly done, the later consequences could be a geo-hazard disaster and fixing it at that stage would be a costly and high-risk challenge.