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| Please fill in your 5-digit IPTC manuscript number. | IPTC-22727-Abstract |
| Please fill in your manuscript title. | A Delicate Balancing Act Between Casing and Tubing Stress Design Versus Downhole Material Selection for a HPHT Carbonate Development Wells With High Contaminants |


Please fill in your author name(s) and company affiliation.

| Given Name | Surname | Company |
|---|---|---|
| Swee Hong (Gary) | Ong | PTTEP |
| James | Manson | PTTEP |
| Nitipong | Kongpat | PTTEP |
| Colin William Graham | Grant | PTTEP |
| Kittipat | Wejwittayaklung | PTTEP |
| Pornchuda | Konganuntragul | PTTEP |
| Wararit | Toempromraj | PTTEP |
| Chakrit | Chanpen | PTTEP |
| Parthasarathi | Bandyopadhyay | PTTEP |
| Mohamad Kamal | Bin Hamdan | PTTEP |
| Prapaporn | Jantasuwanna | PTTEP |




## Abstract


HPHT wells are typically associated with high complexity, technically challenging, long duration, high risk and high NPT as many things could go wrong especially when any of the critical nitty-gritty details are overlooked. The complexity of this project is amplified with very high level of contaminants compounded by high pressure and high temperature environment.

In the conceptual planning phase for the upcoming development of such project where its scale and severity are unprecedented in the country/region, a fit for purpose casing and tubing design is critically important to ensure the well integrity over its design life is assured. At the same time, cost optimization can be achieved utilizing industry practices, testing and qualification of materials and vast learning from incidents and failures occurred in similar HPHT projects over the last three decades scattered around the world.

This paper intends to outline the challenges and optimization of casing design philosophy which is drawn upon various perspectives such as long term well integrity, drilling operations, working stress design, effect of compaction and subsidence, probability of failure analysis, multi-well thermal analysis, downhole material corrosion performance, connection performance and a combination of all the above in a holistic manner.

A particular focus would be discussing the delicate balancing act between satisfying the working stress design of downhole tubular versus the complexity of downhole material selection work. This project requires materials which could withstand 18 mol% CO2, 20,000 ppm H2S, 190 degreesC and Bottom Hole Pressure up to 11,0000 psi which is unprecented in Malaysia or in the region. With the given challenging environmental condition, this points towards exotic type of Corrosion Resistant Alloys (CRA) materials such as those made from cold working process in order to gain sufficient working strength to cater for high pressure downhole condition. Owing to such materials' manufacturing method, they require specific strength deration in either hoop or longitudinal direction. This is in addition to the temperature deration from the the given environmental condition where cold worked material suffers more profound

effect in high temperature condition than the standard quenched and temperered type CRAs. The additional deration weaken the performance of tubular especially for the liner strings which are designed to handle the strains attributed from the effect of reservoir compaction from mid to late life. Such consideration is critical to ensure that the well integrity remains intact throughout the entire well life.

Comprehensive downhole material testing spanning almost 3 years had been orchestrated and conducted literally on all types of CRA materials available to be made on OCTG tubular to ensure only fit-for-purpose and cost-effective material is selected without leading to any material integrity concern. Thinking out-of-the-box approach is required to achieve such objective which will lead to significant rewards in terms of overall cost saving.

At the point of writing, the work is 90% completed with the remaining 10% work on reservoir compaction simulation is still in progress. It is the intent of the author to submit a full paper in future conferences when the work is 100% completed in early 2023.