20

An Assessment of Conductor Casing Design in Relation to a Titled of Offshore Monopod Fixed Platform

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Erwindo Tanjung
Premier Oil

Abstract

Refer to several sources of SNI, API, Canada nor US Regulations; an overall definition of conductor casing is not only designed as a large pipe to support the well, wellhead and completion equipment and hole stability for initial drilling operation, but also as a conduit pipe to allow circulation of drilling cutting to surface. In most practice of drilling through an offshore fixed platform, conductor pipe is set by driving with hammer, where the depth is set whenever blow per foot (BPF) of driving has reached 80% of hammer capacity, or the force of hammer has reached 80% of conductor strength. This practice does not assess formation integrity below conductor pipe, to assure strong enough to support circulation of drilling cutting throughout surface drilling section operation or not; but have assured as a competent rock to support drilling operation until production life. Practically, a requirement of formation integrity below conductor casing shoe to allow circulation is not an ultimate criterion to be achieved for drilling operation, unless if any shallow gas risk from the geophysical survey result. In relation to common fixed platform condition, conductor casing for a well shall be designed independently from the platform structural integrity. However, a case for Monopod Fixed Platform; position of conductor depth has taken critical impact to the platform integrity during drilling operation. Conductor shall be set deeper enough to case weak formation to assure no loss circulation during drilling, as the loss circulation will obstruct formation integrity that hold the monopod's structure. The impact of loss circulation to the structural pipe of Monopod was outstanding, and abnormal or never happen in the past for similar drilling operation. This paper contains comprehensive discussion of conductor casing requirement for the safest and the most economic drilling operation until end of production life without jeopardizing fixed monopod platform integrity and regulation compliance from various reference of conductor casing requirement, also will debrief drilling loads consideration in existing designing method of Monopod Fixed Platform and recommendation or room improvement from drilling operation side for future designing method of Monopod Fixed Platform to anticipate shallower conductor casing setting depth for drilling.

Keywords: Drilling throughout Monopod Fixed Platform, Conductor Setting Depth in Monopod Fixed Platform, Monopod Fixed Platform Design Consideration

1. Introduction

Particular Offshore Monopod Platform in this paper is shown in Figure.1. The monopod structure has a 56" caisson and 2 x 36" pile. By design of monopod platform, location of wells slot are inside of 56" caisson and outside of 56" caisson. The wells inside 56" caisson could be 2-in-1 or 3-in-1 or even 1 well wellhead design, and for the outer side can be 2, 3, 4, etc well slots depending on the design monopod size; normally more well slots, bigger the monopod. Distance center to center between 56" Caisson to the outer well slots is about 7-8 feet. Drilling operation shall utilize the well slots in the monopod platform. Location of well slot is part of the monopod platform design. Conductor casing will then be installed in the said well slots prior to spud drilling activity. These conductor casing are independently or not fixedly connected to the well slot. For well slots location outside the 56" Caisson, the conductor casing must freely move by the environmental wind, sea current, etc instead of permanently tied-up to

the monopod platform, and for the well slots inside 56" Caisson must be cemented groutly at couple feet below the 56" Caisson. The 56" and 2x36" piles are piled or driven by Hammer, therefore the soil or formation subsurface surrounding the Caisson and the Piles is the one who holding the structure, which can be ilustrated as platform foundation. As the proximity of the well slots to the Caisson and piles is relatively close then effect of drilling hydraulic can impact soil integrity surrounding Caisson and Piles. Whenever the soil can not hold the Caisson and Piles anymore then the platform will lean/tilt.

2. Basic Theory

Following are several references of Conductor/Struktural Casing Definition. This conductor/struktural casing is for drilling. Practically the conductor shall not attach permanently to the monopod structure, which normally be reminded by the Platform Structural Engineering Team. The idea is because the conductor well did not count into life load to the platform (i.e. to prevent giving permanent load to the platform structure integrity). In drilling basic theory and practice, platform structural integrity is also not part of drilling engineering design consideration.

- *Struktural Casing = casing yang harus diletakkan dengan tumbukan, jetting, atau pemboran hingga kedalaman minimum, untuk menahan formasi yang tidak kompak dan untuk mendapatkan kestabilan lubang selama operasi pemboran, kecuali sumur di dasar laut jika struktural casing dipasang dengan di bor maka harus di semen yang cukup mengisi seluruh ruang annulus hingga mudline/permukaan.* Source: SNI 13-6910-2002 (latest version)
- Conductor Casing is a component that provides structural support for the well, wellhead and completion equipment, and often used for hole stability for initial drilling operations. This casing string is not designed for pressure containment, but upon completion of the well it might have a casing head; therefore, it can be capable of containing low annulus pressures. For subsea and hybrid wells, the low-pressure subsea wellhead is normally installed on this casing string. Source: API RP 90, and ISO 16530-1:2017, Petroleum and natural gas industries – Well integrity – Part 1: Life cycle governance, First Edition, March 2017. Global Standards
- Conductor Casing means the casing that is installed in a well to facilitate drilling of the hole for the surface casing (tubage initial). Source: Canada Oil and Gas Drilling and Production Regulations, SOR/2009-315, February 2013. Regulations

From these several references, it can be concluded that the theory of conductor casing for drilling is a conduit pipe that can be driven/pilled or running into the drilled hole to certain depth until reach competent formation that can support a stabilize well throughout drilling operation. Also, conductor casing only design to accomodate low pressure (i.e. shallow gas kick) but can not handle well control situation.

Above references covers consideration of conductor integrity/security itself, but does not cover the consideration for platform structural integrity.

3. Methodology

Practically in drilling operation, conductor casing shall have enough strength to handle hammering load, low pressure containment whenever any gas trap from shallow gas or channelling from other zones, also tensile strength to handle vertical load of well construction that install inside the conductor; therefore the consideration to calculate and or do assessment of impact drilling hydraulic to soil/clay surrounding the conductor and further more to the platform structural integrity is never been available.

There is a scope of drilling engineering consideration to assure enough formation strength to support conductor at its level in all possible working /production loads (i.e. assess formation below the conductor in preventing at weak formation that can introduce to induced pressure loss/loss circulation then causing conductor casing level down); but the focus of the scope is only to its well/conductor integrity, not cover platform structural integrity.

Drilling operation team has considered the local and common practices to design the well, including setting conductor casing.

Driveability analysis sometimes is required to minimize surprise of anticipated number joints of casing, and anticipated Hammer's specification. Wherever the depth can not exactly be known at front. Estimated depth to prepare number joints of casing shall be considered from offset wells.

SIMOPS between all parties are ready at front prior to spud the well. All possible risks shall be declared by all parties to Drilling Operation Team.

Structural design consideration of offshore monopod platform, including limitation or sensitivity boundaries shall be counted and declared to all parties that will work in the platform.

4. Case Study and Discussion

The particular offshore monopod platform in Figure.1 is titled during drilling operation in surface hole section. One of the suspected reason is accumulation of total fluid that spread into formation surrounding the well due to loss circulation drilling. The loss circulation drilling itself is suspected due to setting conductor casing was too shallow in weak formation. The spreading fluid has suspected disturb surrounding clay integrity that hold the structural of platform.

The conductors casing itself was stable; level did not change, not titled/leaned, the integrity was also good (i.e. no collapse, no burst, no crooked) and cement integrity of well construction inside the conductor was also no impact (i.e. no sustained annulus pressure).

The conductor casing was driven/pilled by hammer until refusal depth. The shoe of conductor was shallower than the Caisson depth of monopod structural platform.

An anticipated number joints of conductor casing were ready onboard to get refusal depth.

Platfrom structural integrity of monopod relies on Caisson and Piles with the surrounding soil strength to hold them, whenever the soil is disturbed, the integrity of structural will reduce.

Facts of condition:

1. Referring to practices and standard design of offshore monopod platform, structural engineering team does not consider impact of drilling hydraulic to the Caisson and Piles.
2. As monopod platform and conductor casing are not connected, therefore commonly both of them are separated design and business process.
3. No limitation nor potential risks was declared from any related parties to drilling operation team about sensitivity design of monopod platform and any boundaries limitation for drilling operation.
4. Shallow hazard analysis has been conducted during drilling preparation with result no gas existance.
5. All similar total loss circulation in previous drilling well campaign were not treated and continue blind drilling by keep hole full with sea water.

Formation properties in shallow depth (within open hole interval of 26" surface section) is majorly soft clay and easy to dispere with any fluid/drilling mud. Minimum flow rate in hydraulic drilling is required to lift up the drilled cutting properly to the surface. Failure to do so will lead to pipe stuck.

Formation strength in shallow section is also can not be tested conventionally by drilling operation. The consideration is due to weakness of the strentgh, and no enough compaction of the formation. Failure to control the impact of formation test by drilling operation will cause underground blow out which possible lead to shrinking of platform and jack up rig.

5. Conclusion

- Based on shallow hazard assessment, no significant geohazard during drilling surface hole section in offset wells.
- Loss circulation hazard wasn't found in shallow hazard assessment and offset wells drilling history.
- Drilling surface section has to be drilled in short time manner, due to time sensitive formation and water content sensitive mineral clay could lead to stuck pipe.
- Mud column as the primary barrier makes the priority to keep hole full is the ultimate target to preserve safety of the hole.
- Blind drilling and keep hole full with sea water during loss circulation in surface section, were according to Drilling Operation Manual (DOM).
- This blind drilling and keep hole full is standard and common strategy whenever loss circulation occure in shallow depth.
- Loss treatment by mixing LCM or pumping cement can not be done due to loss rate was very severe/total loss. Complex condition of total loss rate and too shallow of drilling depth of surface hole or total loss circulation depth was causing fluid level in the hole dropped significantly. Fluid level drop will reduce hydrostatic pressure to balance formation pressure significantly. If hydrostatic pressure less than formation pressure happen, gas from formation will intake to the hole and well kick will happen. It is very high risk and could lead to disaster for drilling operation if well kick happen in surface hole section. Therefore the ultimate objective is too keep hole full whenever the losses occur.
- Beside that, formation strength in shallow depth is widely known can not hold the LCM in place to seal the losses.
- Even there is no existance of shallow gas from shallow hazard analysis, ensuring hole full with fluid must be maintained all the times to preserve well barrier anticipating less possible of gas channelling from uncontrol source.
- The ultimate objective for drilling operation is to control the hole (no well control), drilling people, enviromental (no well control) and asset (all surface equipment on the jack up rig and platform)

6. Recommendation

- A typical monopod platform design shall define minimum conductor setting depth for drilling activity.
- Whenever conductor casing is set shallower than the Caisson, limitation of hydraulic impact by drilling circulation shall be declared by platform structural engineering team who understood structural design consideration of platform integrity.
- Procedure, strategy and operational of setting conductor in the monopod platform shall be discussed between drilling team and structural engineering team, and or other relatives parties (see Figure.2).

List of Figures

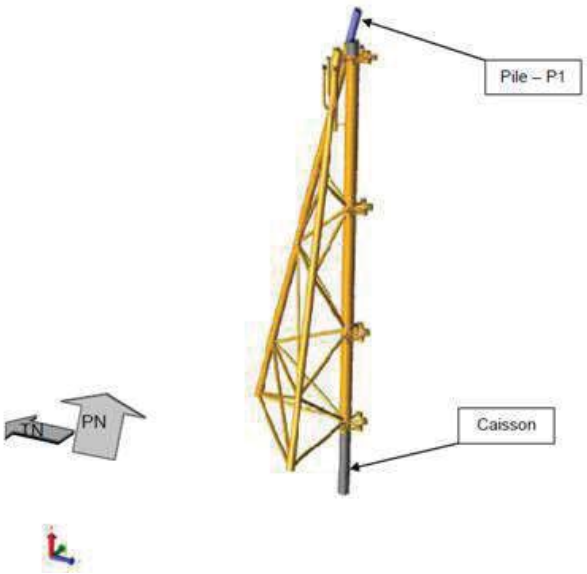

Figure 1. Offshore Monopod Platform Design

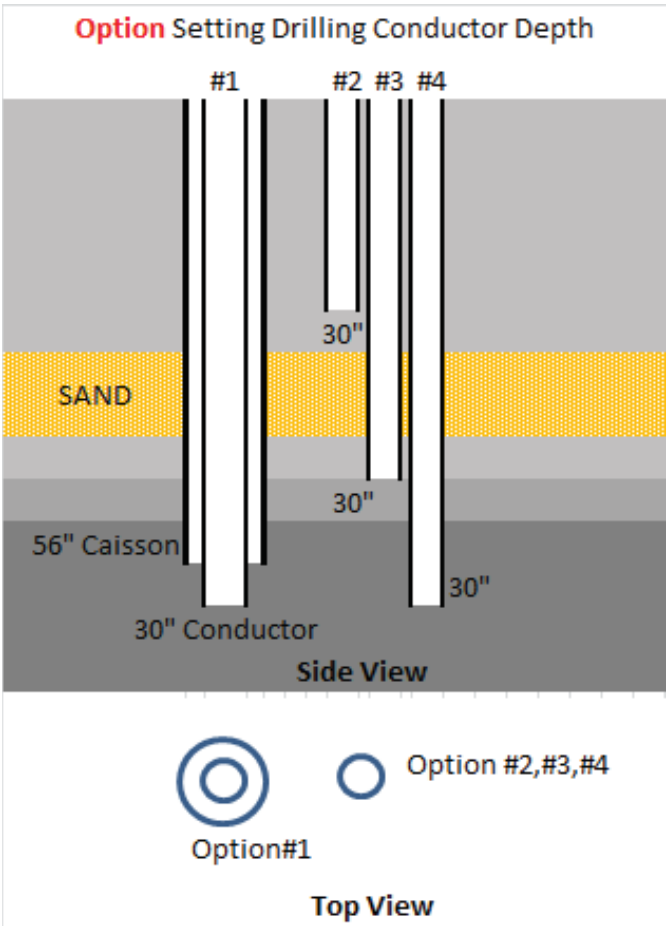

Figure 2. Conductor Casing versus Caisson