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Overview of Company Policy to support of Oil & Gas Drilling Activities

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ABSTRACT: *Success in drilling oil and gas wells is assessed from several points, that's on safety, on target for on-time, and on-budget delivery. The success of the drilling operation cannot be separated from the proper and preparation before drilling. Not only from a technical perspective that needs to be prepared, several non-technical aspects that need to be met in preparation before drilling will be discussed in this article. Some of the non-operational aspects that will be presented in this article are company policies. Company policies include management positions in coordinating drilling operations, how to maintain wells related to Well Control (choosing handling methods, barrier protection, safety margins, volume control, well control drills, pore pressure prediction), Anticollision, drilling risk classification, Emergency Plan and Management of change. All of the above should be regulated in detail by the company and will be discussed in this article, so that readers can determine the company policy parameters for consideration for their company.*

NOMENCLATURE

Symbol	Description	Unit
$MISICP$	maximum allowable shut in casing pressure	psi
LOT	leak of test	psi
MWc	current mud weight	ppg
Ds_{TVD}	depth casing shoe	ft
Hi	Influx Height	ft
iv_{BHA}	Influx volume at bottom hole assembly	bbl
iv_{cs}	Influx volume at casing shoe	bbl
iv_b	Influx volume at bottom	bbl
BS	Bit Size	inch
DS	Drillstring Size outsite diameter	inch
Pp	Pore pressure	psi

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I. INTRODUCTION

The organizational structure of an oil and gas company for drilling activities is given responsibility for the highest position is Vice President Drilling, a high-level executive position or position (senior-level) in the organizational structure that is responsible for all drilling activities carried out in the company.In drilling operations, information management is required for smooth operations, with the support of the availability of integrated tangible and intangible materials [1].Increasing the achievement of drilling success can be achieved by optimizing the drilling management team, by implementing lesson learned from drilling exploratory wells [2], [3].Proposed organizational structure taking into integration and considering several technical responsibilities when an incident occurs, divided activities at company's head office and activities at drilling Rig Site (Figure 1).

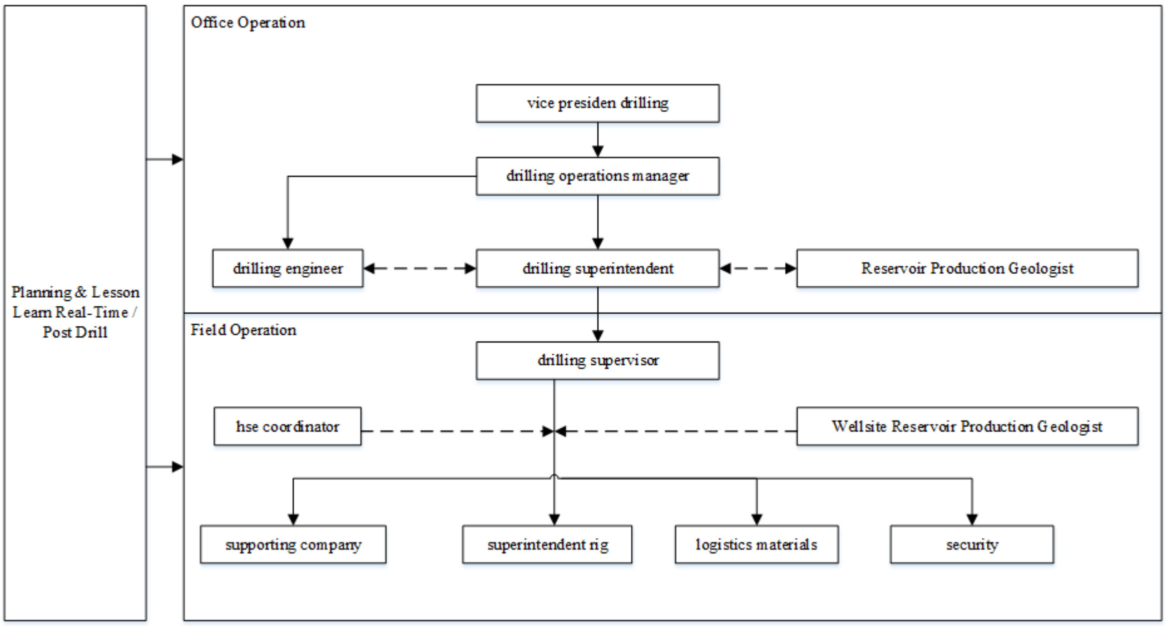

Figure 1. Modified Coordination flow of Drilling Operations and Work Over[1]–[3]

Good drilling project management is the application and integration of the process in starting, planning, implementing, monitoring and controlling and closing in optimizing quality, scope, time, and cost[4]. Integrated projects introduce ten (10) integration of the area of knowledge, scope, time, cost, quality, human resources, communication, risk, procurement and management of stakeholders.

Table ***1*** shows a summary of the operational scope, objects, and objectives of each drilling operations management organizational structure which means that each position is not only carried out according to the scope, but also is integrated between the contractor and owner company[5].The focus of this paper does not only describe operations to be executed in most effective, but includes related technical aspects.

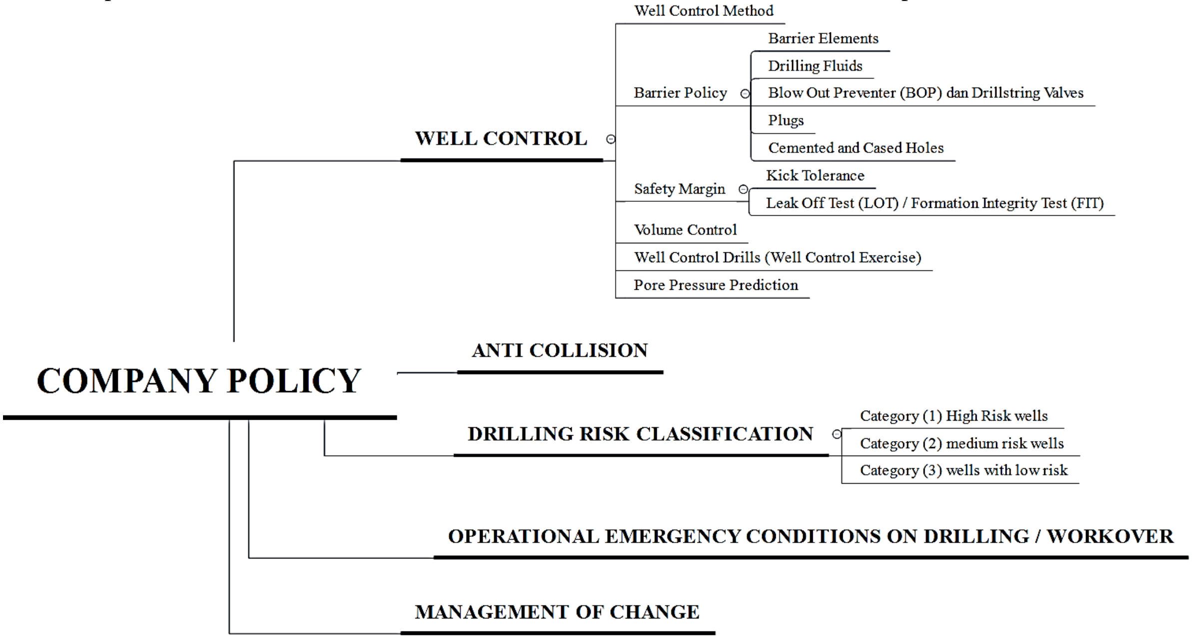

Figure 2. Company Policy for Drilling Oil & Gas Activity

in addition to integrated project management, optimizing drilling is the responsibility of finding possible solutions to any technical problems for which several possible contributing factors [6]. Several concern techniques are applied to oil & gas drilling project management, which are intended to prevent previous problems from reoccurring and to optimize drilling operations[7].Some of the company's policies in technical terms to support drilling success include : Well Control: Barrier Policy, Safety Margin, Volume Control, Well Control Drills, and Pore Pressure Prediction. In addition to Well Control, technical policies also cover anticollision, risk classification, emergency condition and management of changen [7]–[10].

Table 1. Main duties of drilling management operational scope, object and aim [5], [11], [12]

Main Duties	Operational Scope	Object	Aim
Main Duties of Drilling Operations Manager	Plan	procedures, work programs and drilling AFE based on geological prognosis data	ensuring optimization and safety in drilling implementation.
	Evaluate	drilling implementation	ensure alignment of drilling activities in accordance with program and AFE been set minimizing problems drilling
	Determine, monitor, and evaluate	timing of well drilling and execution of operations as well as daily drilling costs	optimizing exploration drilling results
	Define and control	systematic procedures and well completion activities	obtain reservoir data based on subsurface analysis and evaluation results
	Design and evaluate	reports drilling operational activities and evaluations	ensuring availability drilling data for further drilling
	Design	implementation of abandonment well (P&A) activities based on the results of drilling	ensuring alignment with regulations and standards.
	Prepare	closed out documents for the implementation and termination of well drilling in terms of operational and cost to the company	learning from wells so that improvements in planning and execution can be applied to subsequent wells.
Main Duties of Drilling Superintendent	Coordinate, monitor and evaluate	drilling & workover assets based on the division of work area groups in accordance with the established program	produce good quality wells at an efficient cost while prioritizing safety of personnel, company assets and the environment.
	Prepare and ensure	readiness all functions and work partners at technical, pre-spud meetings and daily operation meetings	discuss technical aspects of planning and drilling operations of drilling and workover assets including implementation of P&A
	Develop, monitor and evaluate	recapitulation report data on reservations, job orders and actual use of services & materials	ensure availability of data as a basis for formulation plans for provision services & materials
	Coordinate and verify	accountable and auditable service and material invoices	ensure smooth availability services and materials in drilling operations
	Coordinate, monitor, and evaluate	operational activities of exploitation drilling and workover assets	ensure achievement of excellent operation in accordance with the program and timeframe
	Monitor, review, and evaluate	implementation of Exploitation Drilling Work Plan, and Work Over Asset	achieve operational excellence
Main Duties of Drilling Supervisor	Coordinate, implement, and manage	drilling and workover operations in the field which include time, depth, and cost arrangements/progress	ensure the implementation of activities in accordance with the program that has been set in producing good quality wells.
	Reporting and documenting	operational activities regarding the progress of drilling and workover	smooth operation
	Prepare, coordinate, and evaluate	services and materials related to drilling operations	ensuring availability of services and materials according to specifications of drilling

	Controlling and evaluating	operational constraints on drilling and workover	ensure achievement of problem solving quickly and precisely
	Coordinate and verify	job tickets and job reports, as well as complete invoice documents from Work Partners	completion of closed out process administratively and financially based on a mutually agreedcontract/agreement/MoU
	Arrange	Final Well Report in accordance with applicable reporting standards	ensure the availability of report materials that will be submitted in a closed out report.

II. WELL CONTROL

a. Well Control Method

There are three well control methods known in drilling techniques, in principle they are based on concept of constant Bottom Hole Pressure (BHP)[13]. These methods are Driller Method, Wait and Weight Method and Concurrent Method. Several companies prioritize using Driller Method with consideration of minimizing risk of impact fluid migration kick,cause waiting preparation of Kill Mud Weight[14]–[18]. This must be socialized to partners before drilling operation takes place.

b. Barrier Policy

It is a summary of Drilling Practice, Well Control theory and methods of shutting down wells.Part of baries policy include barrier element, drilling fluid, BOP and Drillstring valve, Plug dan Cemented & Cased Hole[15], [18].

Barrier Elements

Activities related to drilling and work over operations must have a minimum of 2 (two) independent barrier elements (**Error! Reference source not found.**) that are tested to anticipate of flow from inside the well[19].If one of Well Barriers malfunctions, then well activities must be focused on repairing the damage or creating a new alternative Well Barrier[20].Barrier elements must meet the following criteria.

- First, it must be ensured that there is no failure in Well Control both in terms of equipment and operations.
- Second, barriers must be test pressure according direction of flow.
- The barrier used must always consider pressure, temperature and fluid conditions.

The malfunction of a barrier must be repaired immediately, including if the damage at propulsion source.

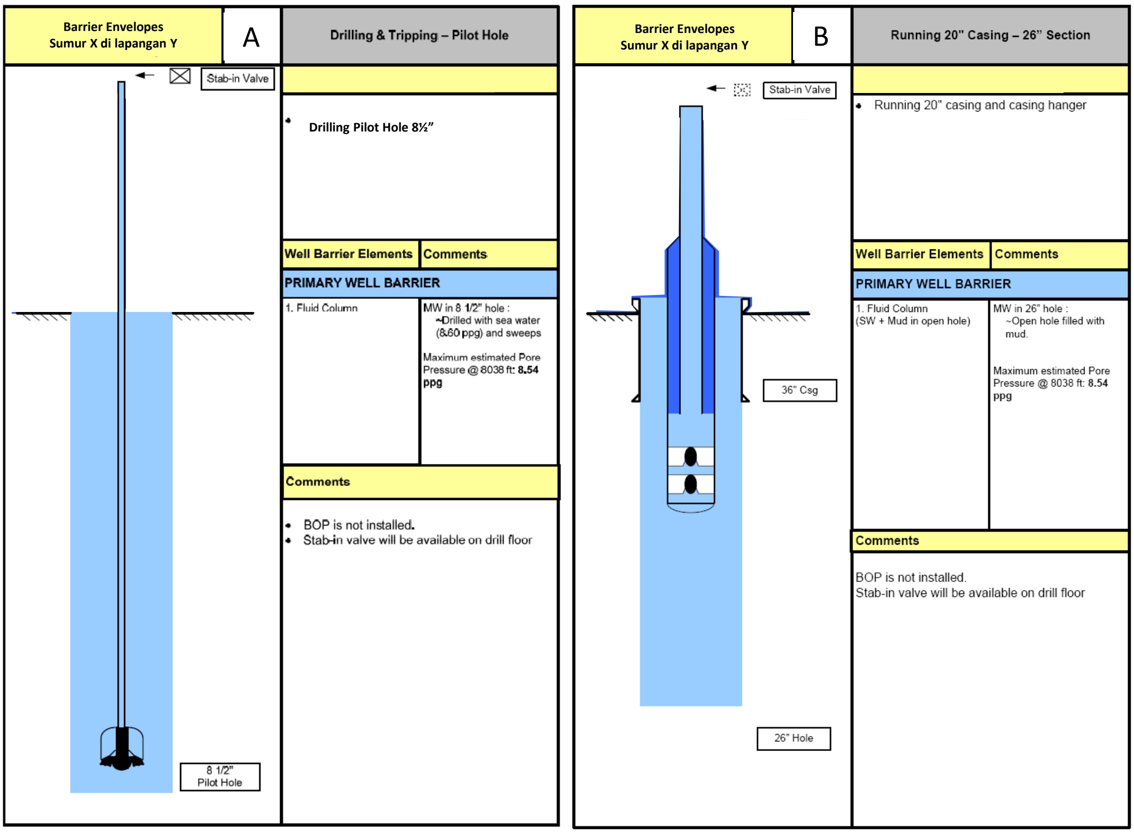

Figure 3. Examples of Well Barriers, (A) Well Barriers During Drilling and Tripping Operations on Pilot Hole Drilling, (B) Well Barriers During Running Casing Operations 20"

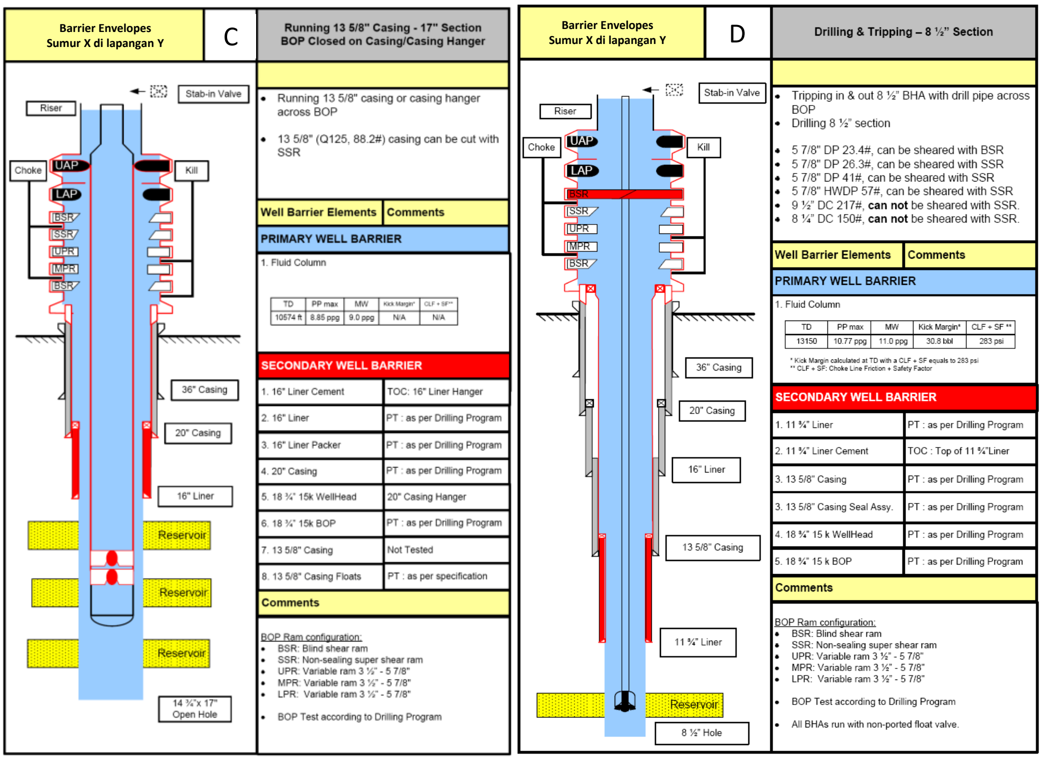

Figure 4. Examples of Well Barriers, (C) Well Barriers During Operations Entering 13-3/8" Casing, (D) Well Barriers During Drilling and Tripping Operations on Drilling 8½"

Drilling Fluids

Drilling &Completion Fluids are qualified as Well Barriers based on fluid specifications[21], observations and tests as:

- After Macondo Blow out Incident, the density of fluid must always have a minimum overbalance of 0.5 ppghigher than pore pressure and 0.5 lower than fracture gradient [22], [23].
- Liquid level should be classified as barrier, only if the liquid level can be monitored continuously[19].
- Blind Drilling can be carried out, if safe enough (annular pressure = 0 psi) without need for additional equipment such as a Rotating Control Head (RCH)[24].

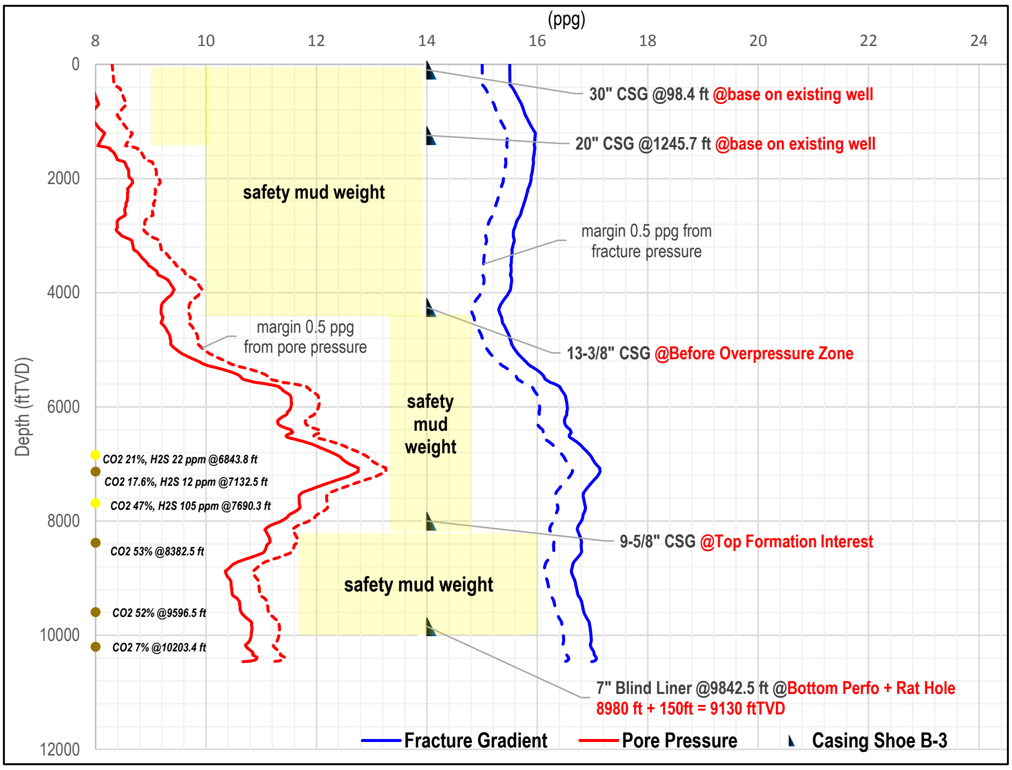

Figure 5. Mud Weight & Casing Setting Depth plan, based on existing well data with safety margin 0.5 above pore pressure and bellow fracture pressure[25], [26]

Blow Out Preventer (BOP) dan Drillstring Valves

Every Non-Shearable and Non-Sealable equipment that will pass BOP must be evaluated the risk, in terms of size and safety proceduresand re-documented[19].BOP must have ability to close pipe annulus in wellbore (drillpipe/workstring, completion tubing, casing)[23]. BOP equipped with shear ram must be capable to cut or close main drillstring assembly in hole, excluding casing [27]. The BOP does not need to have justification availability to able cut drill collars, casing and liners. Here are some of the necessary requirements :

1. Well closing method is done by "Soft Shut In". several authors have indicated that a hard shut-in is preferable in drilling operations, compared to a soft shut-in. The hard shut-in method is when the drilling choke line valves (HCR) are in the closed position; and will be opened after the well is closed. Hard shut-in is the fastest method of closing the well; can minimize the volume of kick entering the wellbore. Soft Shut In means when drilling, the choke line valves (HCR) are in the open position. When a well control situation occurs, the soft shut in procedure allows fluid to flow over the surface of the choke line before the well is completely closed. This is a bad part of the soft shut in procedure because it does not minimize the size of the wellbore influx[17], [28], [29].
2. Space-out distance between rotary table and BOP Stack must be recorded and posted at Driller House.
3. “Non Ported Float Valve” must be used on all BHA drilling to prevent uncontrollable flow up the drillstring during tripping and this type of tool is usually damaged by solid mud particles[30].
4. Inside BOP or FOSV (Full Opening Safety Valve) complete with Cross Overs, must always be on drill floor. When tripping operation is stopped, Stab-in Safety Valves must be installed in Hand Tight Position.
5. Before entering Casing, appropriate Casing Ram must be installed.
6. Before entering Liner, a suitable Liner Ram must be installed. This applies during the process of entering the Liner until before the installation of the Setting Tool.

Plugs

Cement plugs or other plugs can be used as barrier elements, including bridge plugs and packers.In general, regardless of type of plug, a 1000 psi pressure test must be carried out above Formation Strength under Casing Shoe if pressure test is not possible to carry out in direction of flow. For certain cases, the pressure test is adjusted to condition of the casing and formation pressure. For example, when plug cement is carried out on a well that already has many perforations.If a pressure test cannot be carried out, it is possible to carry out a load test of up to a minimum of 10 tons to confirm the depth of the plug[10], [19].

Cemented and Cased Holes

Casing and liners that are not perforated after Cementing and installation of Hanger Packing are included in the Well Barrier category[21].

c. Safety Margin

Kick Tolerance

Kick Tolerance is the maximum volume of gas enters to wellbore and can circulated out safely without causing crack formation. Kick Tolerance must meet two conditions:

- Must be identifiable as a kick.
- Minimum addedvolume (Kick Tolerance) must be measured and recorded.

kick volume must be large enough, so can be recorded when kill well[17], [31], [32].Total *volume gain* when the well has been kill,should be as **small as possible** (10 – 25% from maximum designed Kick Tolerance) so that it is safe to be circulated out[31].The minimum Kick Tolerance or maximum gas volume as basis for casing planning and minimum Kick Tolerance/maximum gas kick volume, *maximum gas kick volume* can be calculated with equation.

1) Determine kick intensity.
   Kick intencity is difference between maximum anticipated pore pressure and planned mud weight [31]. Higher kick intensity is designed to make drilling safe, for exploration wells it is recommended that a kick intensity of 0.5 - 1.0 ppg [33]
2) Determine maximum allowable shut in casing pressure (MASICP)
   Alloable initial shut-in casing pressure which can cause rock fracture at casing shoe depth, Leak of Test data minus current mud weigh at casing shoe depth[34].

$$MISICP = LOT - MWc\ 0.052\ Ds_{TVD} \qquad \text{Eq.1}$$

3) Determine influx height with this following equation
4)

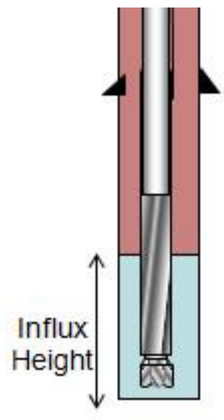

Figure 6. ilustration of Influx height

$$Hi = \frac{(MASICP - (kick\ intencity\ x\ 0.025\ x\ total\ depth_{TVD})}{(MWc\ x\ 0.052) - influx\ gas\ gradient} \qquad \text{Eq.2}$$

5) Calculate influx volume at BHA based on the influx height

$$iv_{BHA} = \left(\frac{BS^2 - DS^2}{1029.4}\right) Hi \qquad \text{Eq.3}$$

6) Calculate influx volume at shoe base on the influx height

$$iv_{cs} = \left(\frac{BS^2 - DS^2}{1029.4}\right) Hi \quad \text{Eq.4}$$

7) Calculate influx volume at the bottom based on the influx volume at the shoe by applying Boyle's Law[35]

$$iv_b = \frac{iv_{cs} \, . LOT}{Pp} \quad \text{Eq.5}$$

Leak Off Test (LOT) / Formation Integrity Test (FIT)

The weakest point of Open Hole Section (commonly at the casing shoe) must tolerate the increased pressure resulting from Kick Tolerance design[36], [37]. Homogeneous Drilling Mud density assumed from surface to that depth[38].

$$LOT_{EMW} = \frac{\frac{LOT}{0.052}}{Ds_{TVD}} + MW_c \quad \text{Eq.6}$$

LOT/Extended LOT or FIT must be done after installation and cementing of casing.LOT / FIT can be eliminated when strength of formation can be known detail during operations when using *Pressure While Drilling*. Fracture pressure can predict from non linear model without running test until formation fracture [39]–[41].

d. Volume Control

During drilling operations it is important to control volume of wellbore. Before POOH drillstring, always make sure the hole in a stable condition[42]. Some very important rules to pay attention:

- Use Trip Tank to monitor gain/loss.
- Drillers and Mud Loggers must always inform each Drilling Mud transfer between tanks, before starting or stopping use of Solid Control Equipment.
- Stop drilling when starting to circulate mud of different densities, especially in transition zones of unknown pressure.
- Keep werllbore full with drilling mud.
- Trip margin based on surge and swab analysis must be carried out after penetrating Permeable Zone.
- If there is an indication of Swab Effect when removing drillstring, drillstringmust re-enter the bottom of the borehole and perform a bottoms up circulation.

Flow monitoring or flow check (if borehole conditions possible) must be carried out before following works: when a drilling break occurs, before removing drillstring from wellbore, when entering casing shoe, and before BHA was pull out of hole through BOP to early kick detection[43]–[45].

e. Well Control Drills (Well Control Exercise)

All crew must be involved in the Well Control drill, this exercise must be carried out repeatedly to achieve acceptable reaction times and the right pace of the personnel involved in Well Control.

- The frequency of Well Control drill during operation must be at least 1 (one) *pit drill* and 1 (one) *kick drill* every two weeks.Ensure drill crews are familiar (pit drill) and the crew can operate (kick drill) with Soft / Hard Shut In Procedure implemented Kick While Drilling,that's can be conducted in either cased or open hole.
- The *Well Control Drill* reaction time of crew involved, must be reported in *Daily Drilling Report*.

f. Pore Pressure Fracture Gradient (PPFG) Prediction

Trendline pore pressure prediction must be made to design drilling mud overbalance as needed. Some method can use to predict pore pressure for pre-drill well, depending on the availability of data (drilling parameter data, log data or velocity daya) and that's data depend on defference faciess lithologi. Some methode like Equivelent Depth [46], D-exponent [47], Eaton's [48], Weakley Method [49], Bowers [50], Compressibility Method[51], Seismic Frequency Based Pore Pressure [52], Drilling Efficiencyand Mechanical Specific Energy (DEMSE) [53]. There are any several prediction methods not presented in this article to be written next article review.

III. ANTI COLLISION

Each new drilling well must have survey data like Inclination and Azimuth, surveys can be carried out with Multi Shot Surveys (MWD or Gyro).Offset wells must have Inclination and Azimuthsurvey data. If the survey data is not available from the offset well, a Inclination and Azimuth survey measurement operation will be carried out. Exceptionsif not possible to take survey measurements (eg abandoned wells, mechanical problems).

Separation factor a numerical value is representative of the distance between wellbore s, taking the error ellipse into account. Before determine the separation factor, it is necessary to determine the separation method to be used. There are traditional separation factors (SF) and oriented separation factors (OSF). SF resulted in over estimated well planning, which became an unnecessary limitation. Taking into account the EOU geometry of all calculations with the same OSF, have the same collision probability[54], [55]. The uncertainty ellipsoid (EOU) is the volume to indicate the magnitude of the wellbore uncertainty.

- Conditions when OSF < 5, requires a report containing information to check the condition of the proximity of the nearest wells during drilling.
- Condition when 1.0 < OSF < 1.5, represents the limit and drilling can still be continued.
- Conditions when OSF <1.0 enter into major risk, the possibility of collision is high and drilling cannot be continued until the risk is reduced.

If will going to drilling well in 1 cluster / twin wells or adjacent wells, an Anti Collision calculation (minimum SeparationFactor 1.1) for well planning.

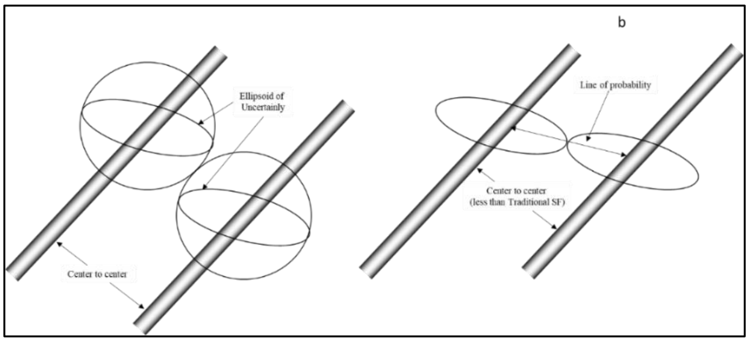

Figure 7. Deference Traditional Separation factor vs Separation Factor(Modified Abdulwarith, 2020)

The distance between wells on the surface (center to center) is at least 6 meters.If there is an additional cellar, then the distance between wells (center to center) must take into account the depth of the Kick off Point of the next well.

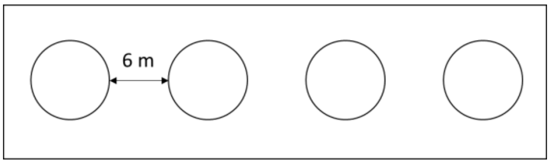

Figure 8. distance between wells (center to center)

IV. DRILLING RISK CLASSIFICATION

Some drilling operations depends on risk level of each well. To implement this, some publication have classification of drilling wells is divided into summary the following categories bellow[56]–[61].

Table 2. Classification Risk Status of Drilling Wells

(1) High Risk wells	• Gas wells. • Exploration wells. • Oil wells with H_2S content ≥ 10,000 ppm. • Oil wells with an estimated Shut-In Well Head Pressure (SIWHP) of ≥ 2,000 psi. • Oil wells nearby vital installations, settlements or public roads (< 50 meters from the boundary of the outer site fence). • Workover wells with low integrity, for example wells with annulus casing pressure of 9 5/8” and/or 13 3/8”.
(2) medium risk wells	• Oil wells (drilling or workover) which are still able to produce naturally (natural flow). • SIWHP estimated oil well < 2,000 psi. • Oil wells with a content of 20 ppm < H_2S < 10,000 ppm.

(3) wells with low risk	• Oil wells (drilling or workover) which are no longer capable of natural production (natural flow). • All wells that are not included in category (1) & (2). • Water Disposal Well

V. OPERATIONAL EMERGENCY CONDITIONS ON DRILLING / WORKOVER

In drilling, it is necessary to form a team to deal with emergencies:With the stage starting from the occurrence of technical problems,Which lead to an emergency oil and gas Drilling Workover, Ended with Drilling / Workover Operational Emergency Condition (OKD) orders for executio.

1) If oil and gas Drilling / Workover operation have technical problems lead to emergency. Operations Management direct reports incidents to VP Drilling's, and provides telephone reports to Director Operations, VP Region or VP Exploration, HSE Function, SCM Function and Public Relations Function. At the first opportunity to make a chronological report on of technical problems which is submitted to VP Drilling and addedwith proposal for Operations Emergency Conditions
2) VP Drilling department at first opportunity verbally reports condition to President Director and GM or VP Exploration depending on type of Drilling / Workover well and informs HSE, SCM and Public Relations. While formally completing the chronology of technical issues that lead to emergency conditions and proposing operational emergency conditions for the relevant oil and gas Drilling / Workover.
3) Drilling department coordinates Emergency Meetings with related departments to produce Response Plans, AFE drafts and Operational Proposals for emergency conditions.
4) President Director evaluates and verifies the Operational Proposals for Emergency Conditions, Emergency Response Plans and AFE drafts and submits that's to government.
5) Domestic oil &gas agencyevaluates and verifies Emergency Operational Proposal, Emergency Response Plan and AFE and Emergency Operational Team. If it is not approved or repairs are required, it is returned to the President Director. If agreed and no correction is required, it is submitted to be signed for execution.
6) President Director forwards Domestic oil&gas agencyapproval and forwards orders to Drilling Function and the Emergency Response Team for follow-up execution.
7) Drilling Function and Emergency Management Team carry out Operational Operations for Emergency Conditions.

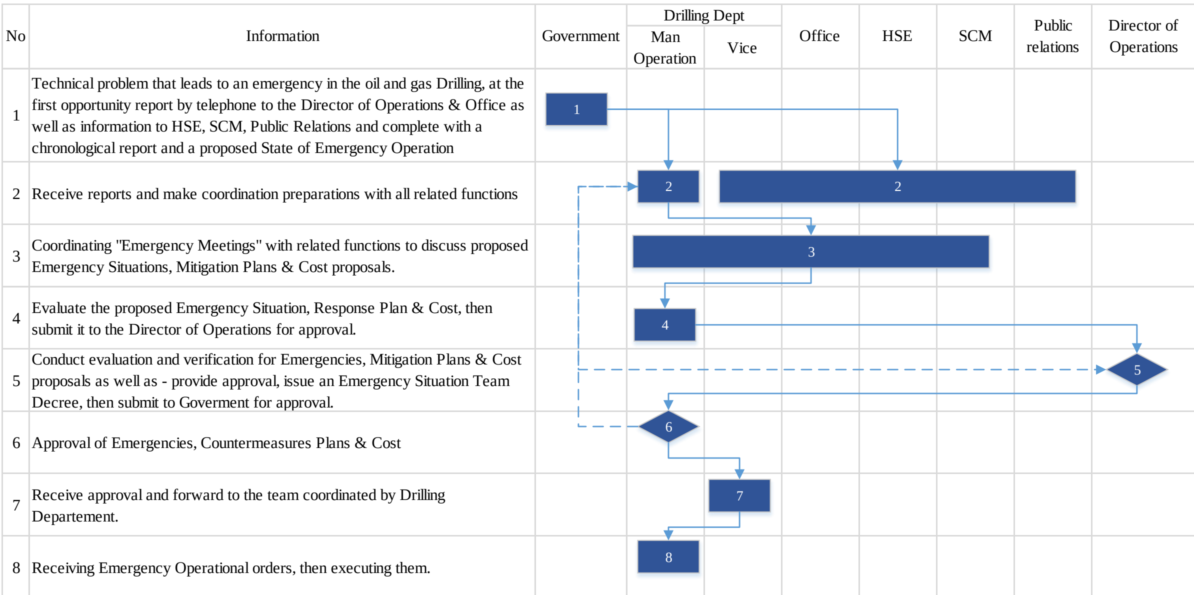

Figure 9. Emergency Organizational Flowchart Diagram

VI. MANAGEMENT OF CHANGE

change is a fact in well drilling projects. Risk management being part of well drilling and management of change is often neglected. This has the potential to create new risks that are not properly evaluated, which can lead to incidents[62]. review of incident investigation, indicates that not acknowledge the change and unplanned event is root cause incident. management of chane must be have essentioal component quality, healt, savety, and environtment (QHSE) management sistem[63].Matters that have not regulated will be decided by highest authority. These changes must be carried out according to the procedure and planned with the following provisions:

- Proposed changes should be discussed at appropriate level of authority.
- The results of changes must be reviewed and analyzed from a technical and QHSE perspective(Risk Analysis).
- Documents/drawings of changes made in full and signed and distributed to related functions.

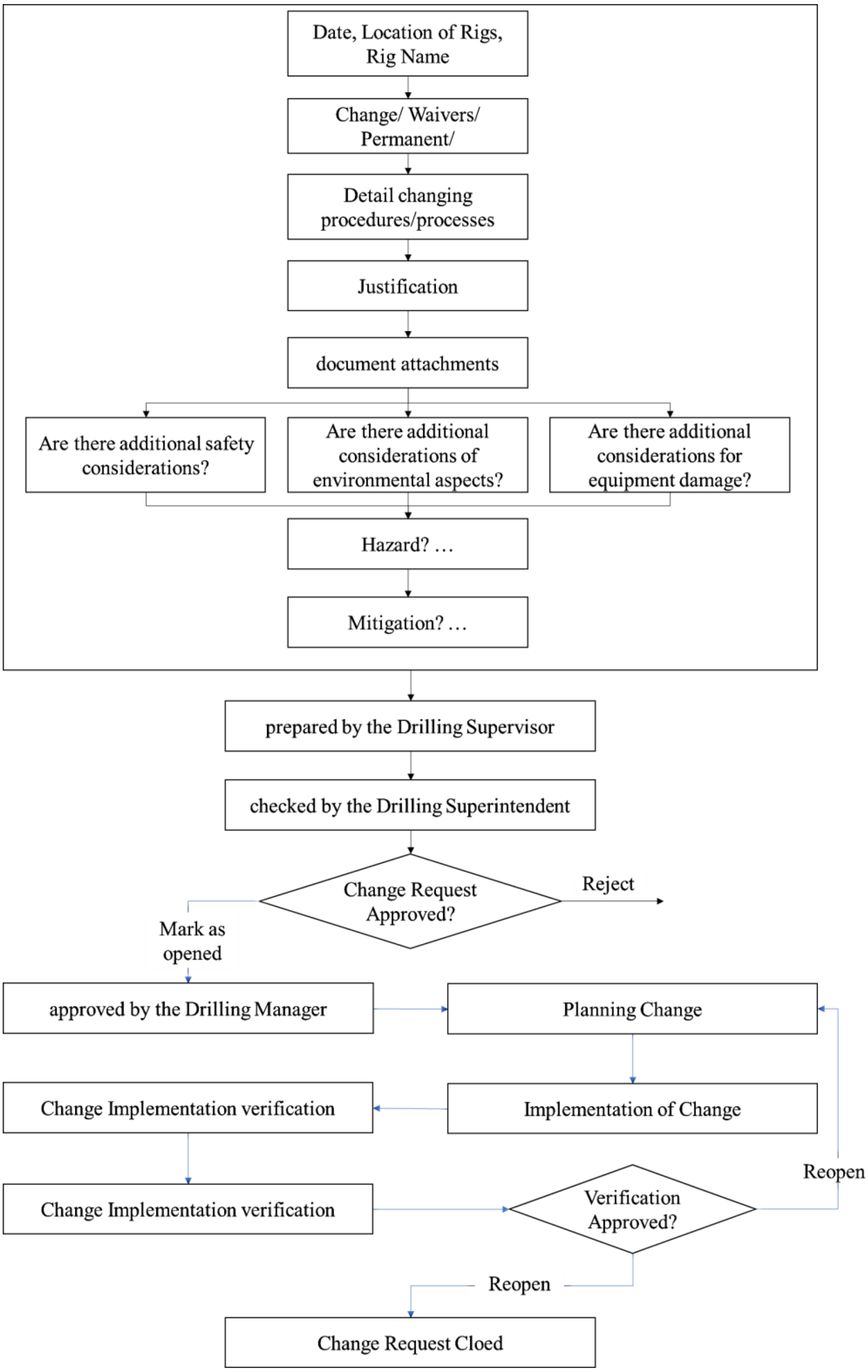

Figure 10. Propose Management of Change Drilling Activity

VII. CONCLUSION

This paper aims to provide an overview of company policies to ensure oil & gas drilling can run safely starting from planning and realtime during operation, based on several references to support the statement's justification.

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