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ANALYSIS OF OCCUPATIONAL SAFETY RISK MANAGEMENT IN CRANE-BASED WELL SERVICES ACTIVITIES IN BUDI FIELD OIL FIELD

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Abstract:
Crane-Based Well Services (CBWS) is a new technology in oil well maintenance in the oil and gas industry. Budi Field, one of the marginal oil fields, has implemented several CBWS campaigns in their oil wells. This study examines the analysis and management of occupational safety risks arising from these activities. In CBWS activities, there are several potential hazards in the stages of its activities, including the danger of gas coming out of the well, the danger of wild sprays, the danger of lifting tools failure, the danger of working at heights, the danger of high-pressure release, the danger of pinch points, the danger of irregular material swings and the danger of crane legs collapsing. Activities with these potential hazards have a high to moderate risk of causing work accidents. To reduce the risk of accidents from CBWS activities, Budi Field has taken mitigation measures for each potential hazard identified. The results of the study showed that the mitigation measures were quite successful, with a decrease in the risk assessment to a mild level so that activities can be carried out with the mitigation that has been carried out. This study shows that much simpler and more economical CBWS activities can be carried out safely and with zero accidents by implementing the recommended mitigation or prevention measures to reduce existing K3 risks.

Keywords: CBWS, Potential Hazards, K3 Risk Analysis, K3 Risk Management

INTRODUCTION

Efforts to increase oil production must be carried out primarily by oil companies with small (marginal) oil production and lifting figures or experiencing a decline in production to maintain business continuity. One of the efforts to increase oil healthy production can be made by performing sound maintenance (thriving services). Generally, well maintenance activities (well services) are carried out using healthy maintenance rig technology or Rig Services (Suryanti et al., 2022). Maintenance with this technology requires very high costs. Budi Field is one of the marginal oil fields in Indonesia. With the company's marginal condition, they are looking for a way to maintain well at the lowest possible cost. CBWS is their choice, and it has been proven to reduce the healthy maintenance budget by up to 90% from using rigs for good maintenance. CBWS technology has yet to be widely used in health maintenance, especially in Indonesia. Budi Field has implemented CBWS as many as 28 CBWS campaigns since 2022, with zero accidents. This study will research how to analyze and manage the risks of CBWS activities.

Purpose and Objectives. This study is intended to analyze the occupational safety risks that arise in CBWS activities in Budi Field and how to manage them to create a zero-incident work environment.

The objectives of this study are:

1. Identifying stages in CBWS activities
2. Identifying potential hazards that may arise in CBWS activities in Budi Field
3. Analyzing risk assessment and managing potential hazards in CBWS activities in Budi Field.

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METHODS

Type/Nature of Research. This descriptive research examines the status of a group of people, an object, a set of conditions, a system of thought or a class of events, namely CBWS activities in Budi Field.

This research is also field research that examines the analysis of the work and activities of the research object. It is carried out to investigate the activities and work of humans in the Budi Field oil field during CBWS activities.

Research Methods. The research method used by the researcher in this study is qualitative, in the form of observation, interviews, and document review, using the researcher as the primary data collection instrument. The data collected is descriptive in words, pictures, and not numbers. The data comes from interview scripts, field notes, photos, videos, official documents, memos, and other notes. Then, the researcher analyzes the wealthy data using inductive data analysis.

Research Object. The research object in this study is the CBWS activities in the Budi Field oil well field, which includes all activities of people involved in the activities, the equipment used, and the surrounding environment, both physical environments such as water, soil, air or weather and non-physical environments such as procedures, competencies, work instructions, communication, and so on.

Population (Social Situation) and Sampling. The researcher entered the CBWS social situation, namely people, places and all activities in the Crane-Based Well Services activities at Budi Field (Mandasari et al., 2023). Determination of interview sampling was carried out purposively using a nonprobability sampling technique, which was selected with specific considerations and purposes. These considerations are made by people who are genuinely involved and understand CBWS activities. They are expected to know what we expect from this study to make it easier to explore the objects/social situations being studied (Dewi et al., 2024).

The core team comprises eight employees directly involved in each CBWS activity: one CBWS supervisor, three healthy services floor operators, three ground/tubings handling operators, and one crane operator. Meanwhile, other employees who are not directly involved, such as medical personnel, security personnel, and work safety personnel, are separate from the core team.

RESULT AND DISCUSSION

Differences between CBWS and Rig Services. By using CBWS, the main principle of the equipment needed when carrying out well service is still met, only replaced with a simpler replacement unit or equipment, as shown in the table below:

Table 1. Difference between CBWS and Rig Services

Description	Well Service Rig	CBWS
Hoisting Unit	Drawworks, Travelling Block, Hook, Air Hoist	Crane
Well Control Equipment	7-1/16" 2K Double Ram BOP Stack + Annular, Choke Manifold, Accumulator	7-1/16" 2K Double Ram BOP Stack, Hydraulic Power Pack

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Pipe Handling Equipment	Tubing Power Tong, Rotary Tong, Elevator, Tubing Spider & Slip, Links	Hydraulic Power Tong, Elevator, Tubing Spider & Slip, Links, Hydraulic Power Pack
Pumping Equipment	Two Mud Pumps	Water Injection Pump
Working Platform	Rig Structure/ Rig Floor	3m X 3m steel working platform

Stages of CBWS Activities and Potential Hazards. Each stage of CBWS has different potential hazards. From what the researcher saw and the results of interviews with several sources and information from references that the researcher obtained, the researcher identified the stages in CBWS activities and several potential hazards from these stages of activity, which the researcher explained using the following chart:

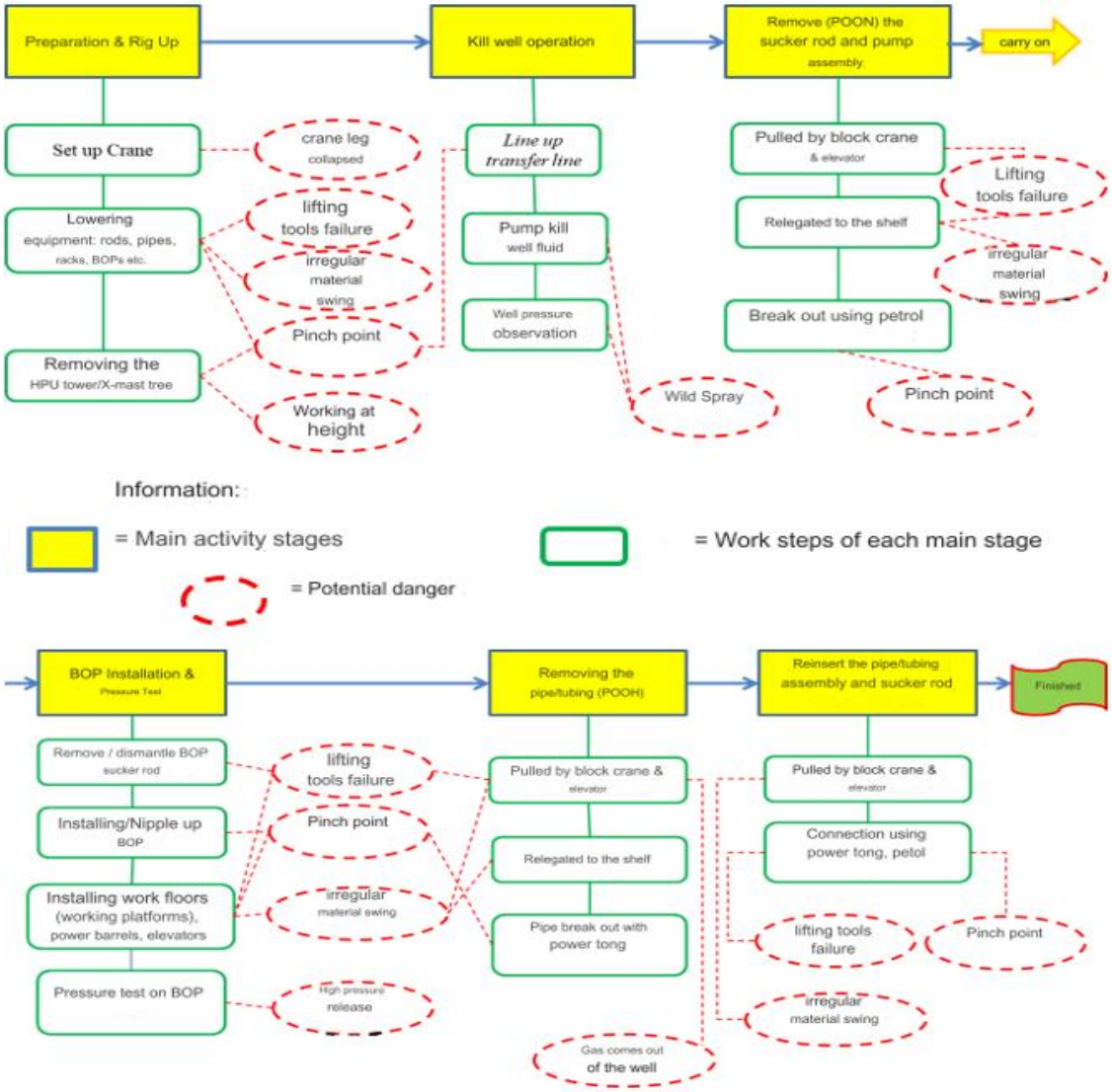

Figure 1. CBWS Activity Stages and Potential Hazards

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From the identification of potential hazards for the stages of CBWS activities, researchers found several potential hazards, including (1) Potential hazards from gas coming out of the well, (2) Potential hazards from lifting tools failure, (3) Potential hazards from wild sprays, (4) Potential hazards from working at heights, (5) Potential hazards from pinch points, (6) Potential hazards from releasing high pressure, (7) Potential hazards from irregular material swings, and (8) Potential hazards from crane legs collapsing.

Risk Assessment. In conducting risk assessment, researchers use Budi Field's risk assessment matrix as below:

Table 2. Risk Assessment

RISK VALUE	ACTION / TIME SCALE
High (15 to 25)	Risk is unacceptable. Immediate Management Controls are Required, and engineers must take remedial action. Risk cannot be accepted at this level.
Medium (5 to 12)	Controls are to be in place as soon as is practicable. Reduced priority management control required Engineered or procedural remedial action. Acceptance of risk at this level requires General Management approval.
Low (1 to 4)	Significant management controls to reduce risk further are not required. Minor adjustments or changes should be considered where the benefit is clear.

Table 3. Risk Assessment Matrix

RISK ASSESSMENT MATRIX PT. X

	Likelihood	A. Likely	B. Probable	C. Possible	D. Improbable	E. Highly Improbable
Hazard Severity/ Consequences	Guide	Activity occurs at least one time per week	Activity likely to occur at least one time per month	Activity is unlikely to be repeated more frequently than once per year	Activity 13 unlikely to re-occur in the next 10 years	Activity is unlikely to re-occur in the life of the field or operation
5	Catastrophic / Disastrous	People: Multiple fatalities of staff or contractors; single fatality of 3rd Party Environment: Spills or emissions with widespread and long-term effects. Recovery measured in decades with little prospect of recovery to pre-activity conditions Assets: Replacement cost of asset likely to exceed US$5,000,000	25	20	15	10	5

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4	Major	People: Single fatality of staff or contractors; Disabling injury to 3rd Party Environment: Spills or emissions with localized long-term effects. Recovery is measured in years to a decade, with little prospect of full recovery from pre-activity conditions. Assets: Replacement cost of asset likely to exceed US$1,000,000 but not exceed US$5,000,000	20	16	12	8	2
3	Significant	People: Lost Time Injury with Permanent Disability to Staff or Contractor personnel Severe injury to 3rd Party, but full recovery expected Environment: Spills or emissions with localized effects. Recovery is measured in months to one year, with some prospects of full recovery from pre-activity conditions. Assets: Replacement cost of asset likely to exceed US$100,000 but not exceed US$1,000,000	15	12	9	6	3
2	Moderate	People: Lost Time Injury with Full recovery to Staff or Contractor personnel Injury to 3rd Party requiring Medical Treatment Environment: Spills or emissions with localized medium-term effects Recovery	10	8	6	4	2

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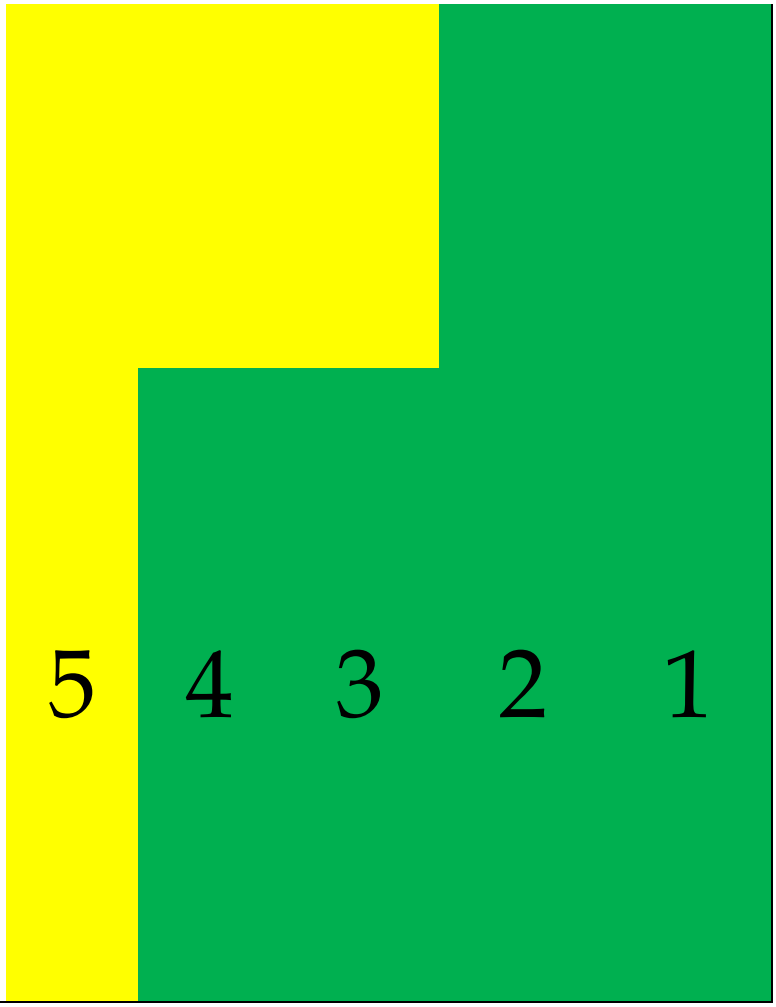
1	Minor	measured in weeks to months with reasonable prospect of full recovery to pre-activity conditions Assets: Replacement cost of asset likely to exceed US$10,000 but not exceed US$100,000 People: Medical Treatment Injury to Staff or Contractor personnel Injury to 3rd Party requiring First Aid Environment: Spills or emissions with localized short-term effects. Recovery is measured in days to weeks, with an excellent prospect of full recovery to pre-activity conditions. Assets: Replacement cost of asset likely to be less than US$10,000	

By using the risk assessment matrix, the results of the risk assessment and risk level of each activity that has a particular potential hazard are obtained as shown in the following table:

Table 4. Risk Assessment and Risk Levels

No	Risk Identification	Risk Assessment		
		Consequence	Possibility	Risk Level
1	Gas comes out of the well	**5** (catastrophic)	**B** (probable)	**20 (high /H)**
2	Lifting tools failure	**4** (major)	**B** (probable)	**16 (high /H)**
3	Wild spray	**5** (catastrophic)	**C** (possible)	**15 (high /H)**
4	Working at height	**3** (significant)	**A** (likely)	**15 (high /H)**
5	Pinch point (pinch point)	**3** (significant)	**A** (likely)	**15 (high /H)**
6	Release of high-pressure	**3** (significant)	**B** (probable)	**12 (medium /M)**
7	Irregular swing of material	**2** (moderate)	**A** (likely)	**10 (medium /M)**
8	Crane's leg collapsed	**1** (minor)	**A** (likely)	**5 (medium /M)**

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The results of the risk assessment analysis show that several stages of activity have a high level of risk (red), and some have a medium level of risk (yellow). The risk level requires mitigation measures to reduce it to an acceptable level so that the work can be carried out safely and without accidents.

Risk Management. To reduce the risk of the CBWS activity, Budi Field took mitigation measures before and during the activity. The author summarizes the risk analysis process along with risk management of this CBWS activity in the following risk analysis table:

Table 5. Risk Analysis Process

Risk Analysis Process									
No	Risk Identification	Initial Risk Assessment			Mitigation Actions	Final Risk Assessment			
		Consequences	Likelihood	Risk level		Consequences	Likelihood	Risk level
1	Gas comes out of the well	5	B	20 / H	Ensure the sound data on gas formation is accurate; Direct the exhaust away from the well; Set a safe distance between all machines and the well; Mobile phone lighters must not be brought; Use a blower; perform routine gas detection; install a wind sock; only those who are authorized may enter; Ensure workers have competency certificates	1	C	3 / L
2	Lifting tools failure	4	B	16 / H	Ensure that there is a certificate of eligibility for tools accessories and a certificate of competence for operators' riggers; Conduct inspections at the beginning and during the activity; Prepare and implement a lighting plan; Choose a crane capacity that suits your needs	1	D	2 / L
3	Wild spray	5	C	15 / H	Ensure accurate well pressure data; BOP is certified according to standards and passes the test; Monitor the well carefully; installs pressure gauge to ensure its condition is good; Personnel on the floor have the appropriate competency certificates	1	D	2 / L
4	Working at height	3	A	15 / H	Only those who have the competence to work at height are permitted. Use Safety body harness according to standards; Inspect the harness and accessories before use; Make sure the ladder steps and anchor points are strong	1	E	1 / L
5	Pinch point	3	A	15 / H	Use the right work tools; Ensure equipment suitability; Identify potential pinch points with stickers, colors, etc.; Remind pinch points during Toolbox talk; Provide hand/finger awareness training; Use appropriate gloves	1	D	2 / L

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6	Release of high-pressure	**3**	**B**	**12 / M**	Pressure testing is carried out by competent personnel. People around move away from the area; There is an announcement of a pressure test; Install barricades/safety; Install whip latch arresters; Install safety relief valves; Ensure calibration inspection of high-pressure equipment; Stop other activities during the pressure test	**1**	**D**	**2 / L**
7	Irregular swing of material	**2**	**A**	**10 / M**	Ensure good crane movement, not in a hurry; Ensure crane operator can see the area well; Ensure there are no obstacles on the lifting path; Use tag line; Prepare to implement lifting plan; Stop if the weather is bad	**1**	**E**	**1 / L**
8	Crane's leg collapsed	**1**	**A**	**5 / M**	Make sure the ground condition is challenging before crane jacking up; Use steel mats; Watch the crane legs when jacking up; Watch for signs of sinking during CBWS	**1**	**E**	**1 / L**

As seen in the table, after mitigating the risks, the researcher found that the final risk level after mitigating all potential hazards from the stages of CBWS activities decreased to a low/green risk level so that CBWS activities can be carried out while still implementing the mitigation actions that have been determined. The success of these mitigation actions is also indicated by the zero accident record carved by Budi Field during the 28 CBWS activities since 2022.

CONCLUSION

1. The stages of CBWS activities contain several potential hazards with a high to medium risk level.
2. Budi Field has implemented and determined several mitigation measures that effectively reduce the risk level of potential hazards in the CBWS activity stages to a low-risk level so that CBWS activities can be carried out safely and without accidents.
3. CBWS is a healthy maintenance method worthy of being chosen by oil companies in Indonesia, especially marginal companies. In terms of cost, it is much cheaper. Work complexity is more accessible and straightforward because there is much less equipment and personnel, and equipment procurement is relatively fast. Regarding work safety, it has been proven that CBWS can be carried out with zero accidents.

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