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Risk Elimination of Using "Striking Wrench" to be Thrown Off when Tightening or Loosening Connection in Workover and Well Services Activity

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Abstract. In PT Pertamina EP's Annual Work Plan, Workover and Well Service (WOWS) has thousands of work programs. Technically, many repetitive activities have high-risk probability of accidents happened, one of them is stud bolt hammering when tightening or loosening connection uses a striking wrench. Approximately, there are 14,400 times per year of stud bolt hammering activities that have occurred in WOWS PT Pertamina EP Rantau Field. Many safety incidents for stud bolt hammering activities have done in some Indonesia Production Sharing Contract.

That work risk has a direct striking on the Company's Key Performance Indicator (KPI), Total Recordable Incident Rate (TRIR). To achieve the excellence goal in safety performance, we must have the mitigation for all risk which potentially occurred in WOWS. One activity in WOWS that has improper control of the risk is the striking wrench can be thrown off when tightening or loosening connection due to the operator miss strike to the wrench.

Authors used the literacy of any International Standard and Company's Procedure to make a tool's design that could eliminate the risk when used a striking wrench. After getting insight and proper tool's design in the previous step, the authors made the 3D model using AutoCAD then simulated the model with ANSYS. The results of engineering steps had to be validated by fabricating the tool and directly using it in the field.

Authors called their 3D model as "PeTrik". From the simulation that had been done, PeTrik could restrain the axial move from a striking wrench. PeTrik could hold the striking force from 7 kg's hammer without experiencing plastic deformation with a maximum strength of 0.41% from its Yield Strength. Validation said that PeTrik could reduce unsafe action up to 100%. Beside eliminating the risk, PeTrik prevented a striking wrench that fell into the cellar that increases rig efficiency from people and time. From the before, tightening and loosening stud bolt connection used two persons became one person for that activity. And also, we could accelerate up to 40% for tightening or loosening activity.

Keyword: safety performance, risk, striking wrench, engineering, validated, PeTrik

1 Introduction

On 2019, PT Pertamina EP Field Rantau has a production target of 2,703 BOPD crude oil and 3.54 MMSCFD gas. Those targets are listed/written in Key Performance Indicator (KPI) Field Rantau 2019. Besides production, the target of KPI's Operational Excellence consists of a Total Recordable Incident Rate (TRIR). TRIR describes the safety performance of a company.

To achieve that target of safety performance, especially in the operation of Workover & Well Services (WO/WS), every risk has to be under control. One of the risks that has not been adequate enough to be controlled is the possibility of striking wrench would be thrown away when used for tightening or loosening the connection of the flange to flange. That risk occurs because there are hammering motion for achieving the optimum of the torque while tightening or loosening the flange's connection happens. The mitigation to keep the striking wrench will not throw away is using of safety rope. The usage of safety rope on the striking wrench can be seen in Figure *1*. The average of every work on well service or well intervention activity is needed 6 times of assembly and disassembly of flange to flange connection using the striking wrench.

Figure 1 The Usage of Safety Rope as a Mitigation

The usage of safety rope as shown in Figure 1 is not optimum enough for safety reasons. PT Pertamina Hulu Mahakam ever happened an incident of Assistant Driller's face was hurt because the striking wrench hit him when assembling the BOP. The striking wrench hit his face when he was tightening the bolt for BOP's assembling process. From that incident, it is needed the effective mitigation to eliminate the risk of the striking wrench will throw away when is used for tightening or loosening the flange's connection on Workover & Well Services activity.

2 Methodology

The authors did literature reviewing the international standard of flange's connection. Then, the authors looked for the standardized procedure about assembling/installing and disassembling/uninstalling of stud bolt and nut.

The stud bolt and nut assembling/installing and disassembling/uninstalling procedure is arranged on Company's Procedure at TKI C-023/A2/EP3300/2018-S0 and ASME B107.410. Based on the procedure, the striking wrench can be used for tightening or loosening the stud bolt and nut in the flange's connection. But it is a needed mitigation process if the mistake of hammering happens.

Engineering strategy is used by the authors for designing the tool for eliminating the risk of the striking wrench that will throw away while using. The authors referred to ASTM A125-96, ASTM A-36, and ASME 16.5 while designing, calculating, and simulating the tool. If the design has fulfilled the requirements of Design, Requirement, and Objective (DR&O), the authors will fabricate the tool. If it has not been yet, the authors will do re-designing and re-evaluating the tool. When the tool's fabrication has finished, the authors will do NDT (Non-Destructive Test) to make sure there is no defect on the tool. After the tool is made sure in the good condition, the authors will occur an experiment for the tool in the field. The experiment is done for validating the tool's design. The methodology that is used by the authors can be seen in Figure *2*.

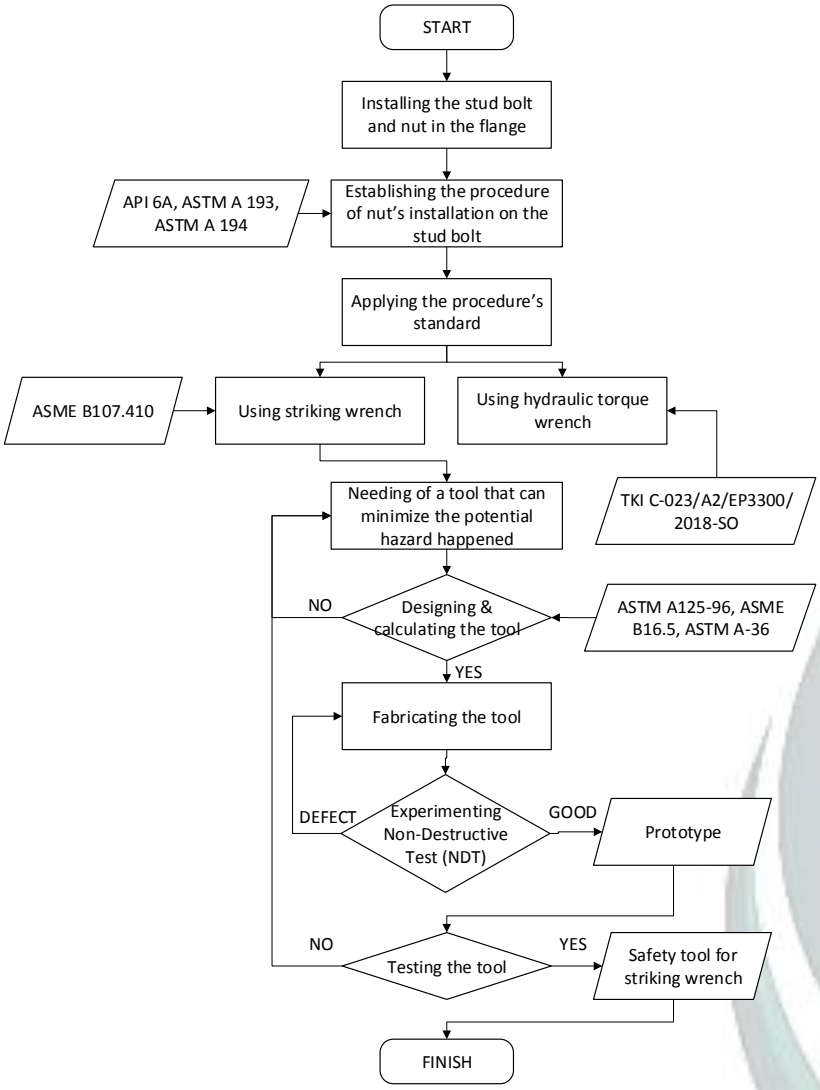

Figure 2 Flowchart of Designing Process

3 Result and Discussion

3D Model (the authors call it 'PeTrik') that has been made is simulated using Autodesk Inventor for knowing the tool's motion. The simulation's result can be seen in Figure *3*. PeTrik can hold the striking wrench and there is no possibility of the striking wrench will throw away to the operator.

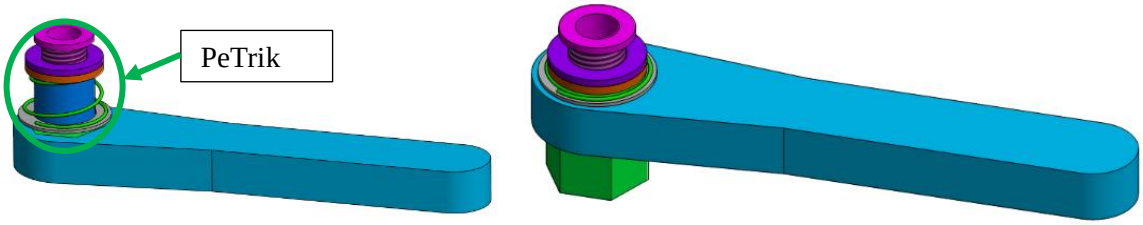

Figure 3 (a) The Striking Wrench's Position While in Nut's Position; (b) Above the Nut

The authors also do the stress simulation using ANSYS for knowing the strength of PeTrik if only beaten by a hammer accidentally. The simulation's result can be seen in **Error! Reference source not found.**(a). The maximum stress that is received by PeTrik when beaten by a 7 kg's hammer is 1.34 MPa. It is only 0.41% from the Yield Strength. It can be mentioned that PeTrik will not be damaged or plastically deformed when beaten by the hammer.

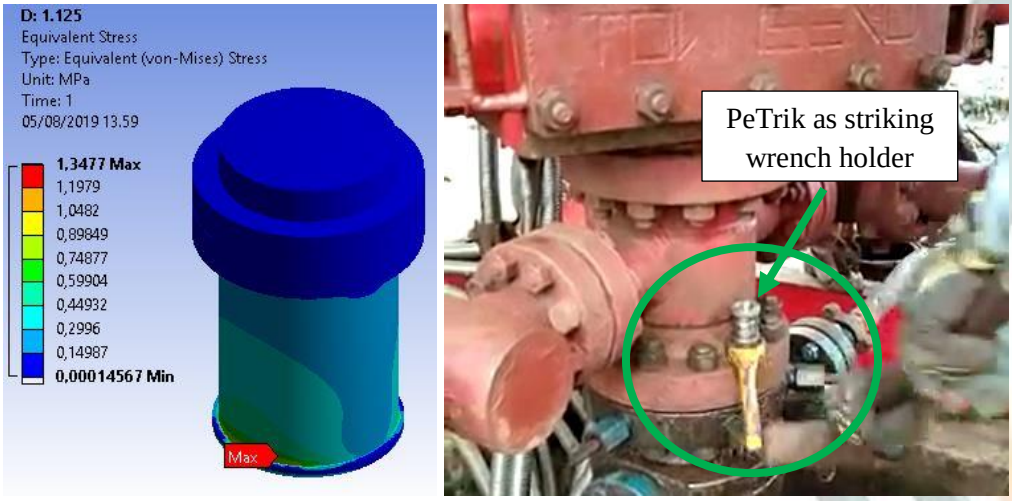

Figure 4 (a) Stress Simulation Using ANSYS; (b) The Usage of PeTrik as Striking Wrench Holder

The design meets with the requirement, can hold the striking wrench and strong enough to hold the load, the authors fabricated PeTrik. Non-Destructive Test has been done and the result say that no defect in the tool, so PeTrik can be used for the next step.

For validating the simulation, the authors try PeTrik in the field directly. While the hammering of striking wrench activity occurs, the axial motion of it is limited (in accordance with the author's simulation). The usage of PeTrik can be seen in Figure 4(b).

Graph in Figure 5 shows that 3 months of PeTrik's implementation in the field can decrease the unsafe action by up to 100%. It is because of the decrease of the unsafe action, the risk of the striking wrench will throw away to the operator can be eliminated.

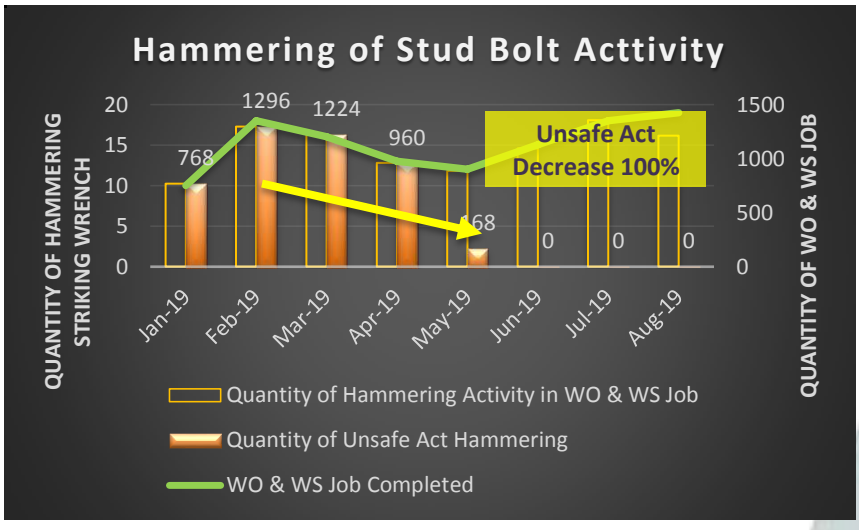

Figure 5 The Decrease of Unsafe Action in Hammering Activity

Another benefit that can be obtained besides eliminating the risk is it be able to prevent the striking wrench will fall into cellar box. It is because of the limited axial direction. The usage of PeTrik in the field can also decrease the number of operators for flange's assembling/installing activity. It used to need 2 operators (1 operator for holding the safety rope and the other for hammering the striking wrench). Now, it only needs 1 operator for hammering striking wrench.

From the observation that has been done by the authors, the usage of PeTrik can also increase the time's efficiency. The flange's installation activity is 40% faster. Table *1* shows the differences of time needed between the current condition and proposed condition.

Table 1 The Comparison Between Current Condition and Proposed Condition

No.	Description	Score	Unit
	Delivery Time Efficiency		
1.	Current activity duration N/U, N/D, BOP / WH	2.5	Hours
2.	Proposed activity duration N/U, N/D, BOP / WH	1.5	Hours
3.	The acceleration of activity duration N/U, N/D, BOP / WH	1.0	Hours
4.	Delivery Time Efficiency	**40%**	

4 Conclusion

To eliminate the risk of the striking wrench will throw away when is used for tightening or loosening the flange's connection in WO/WS activity, it is required a safety tool. It can suppress the axial motion from the striking wrench.

Hammering activity in striking wrench using PeTrik can decrease unsafe action up to 100%. It means that the risk of the striking wrench will throw away when is used for tightening or loosening the flange's connection in WO/WS activity can be eliminated.

Besides of eliminating the risk, PeTrik can also prevent the striking wrench will fall into cellar box. It also increases the efficiency of the rig's performances in the operator and also time.

PeTrik will give huge benefits for the company in the WO/WS activity or kinds of other activity in production or maintenance activity.

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