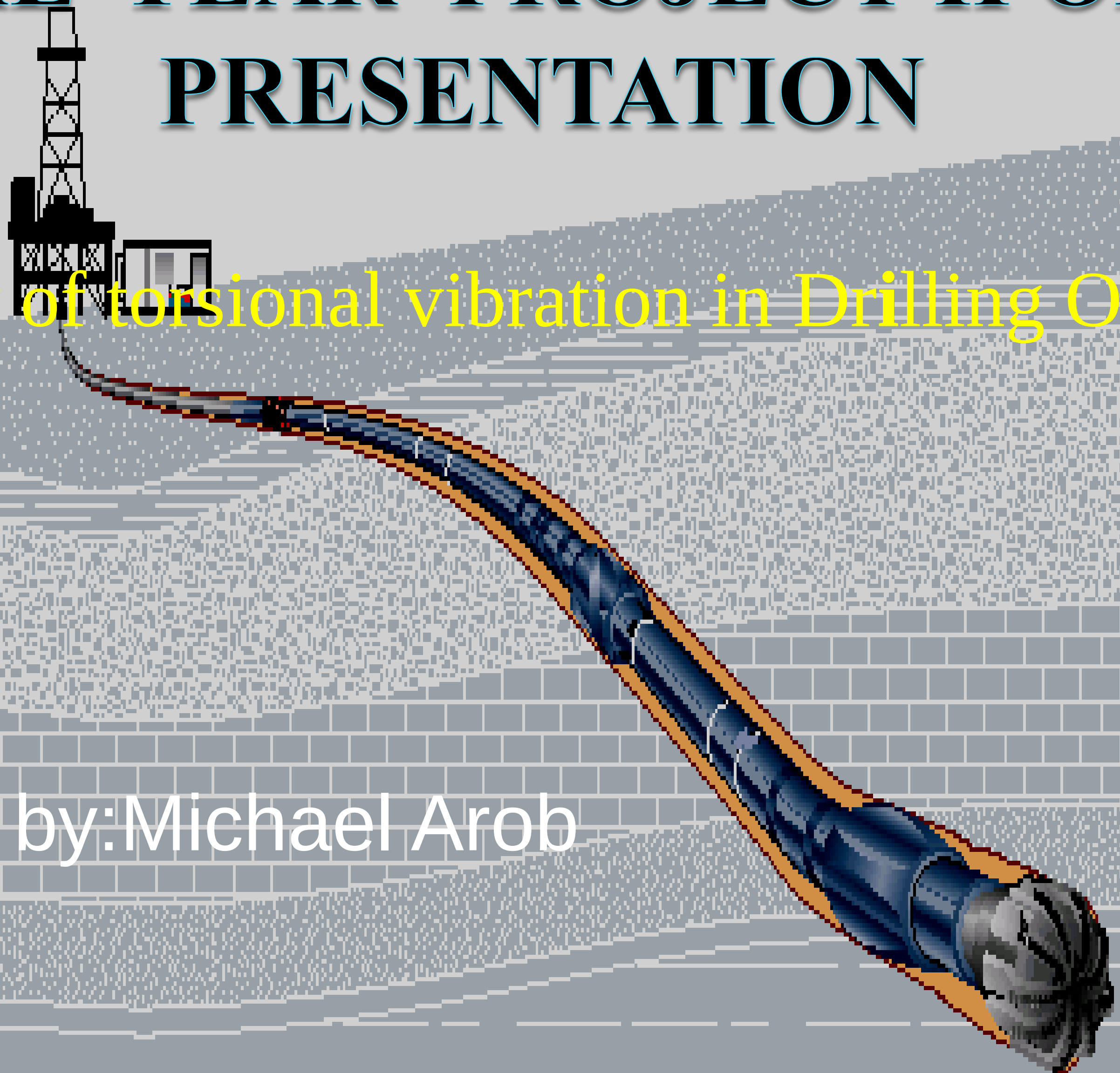
FINAL YEAR PROJECT II ORAL PRESENTATION



Study of torsional vibration in Drilling Operation

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29th April ,2008

PROJECT OBJECTIVES

1. To confirm that generic equation of drillstring can predict failure.
2. To model drillstring generic equation using field data values which had encountered drillstring failure.
3. To Analyze torsional vibration mode in the drillstring.
4. To reduce the effective mode in the drillstring, by considering the parameters e.g. RPM,

PROJECT BACKGROUND

- Drilling operations faces Drillstring problem since the drillstring operation was known to oil and gas industry.

1. Torsional (Stick – Slip Oscillation)
2. Axial (bit bouncing phenomenon)
3. Lateral (whirl motion due to out – of balance of the drillstring)

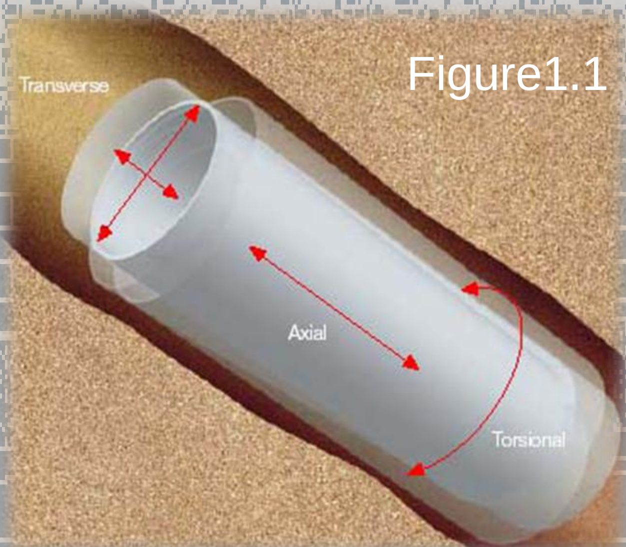
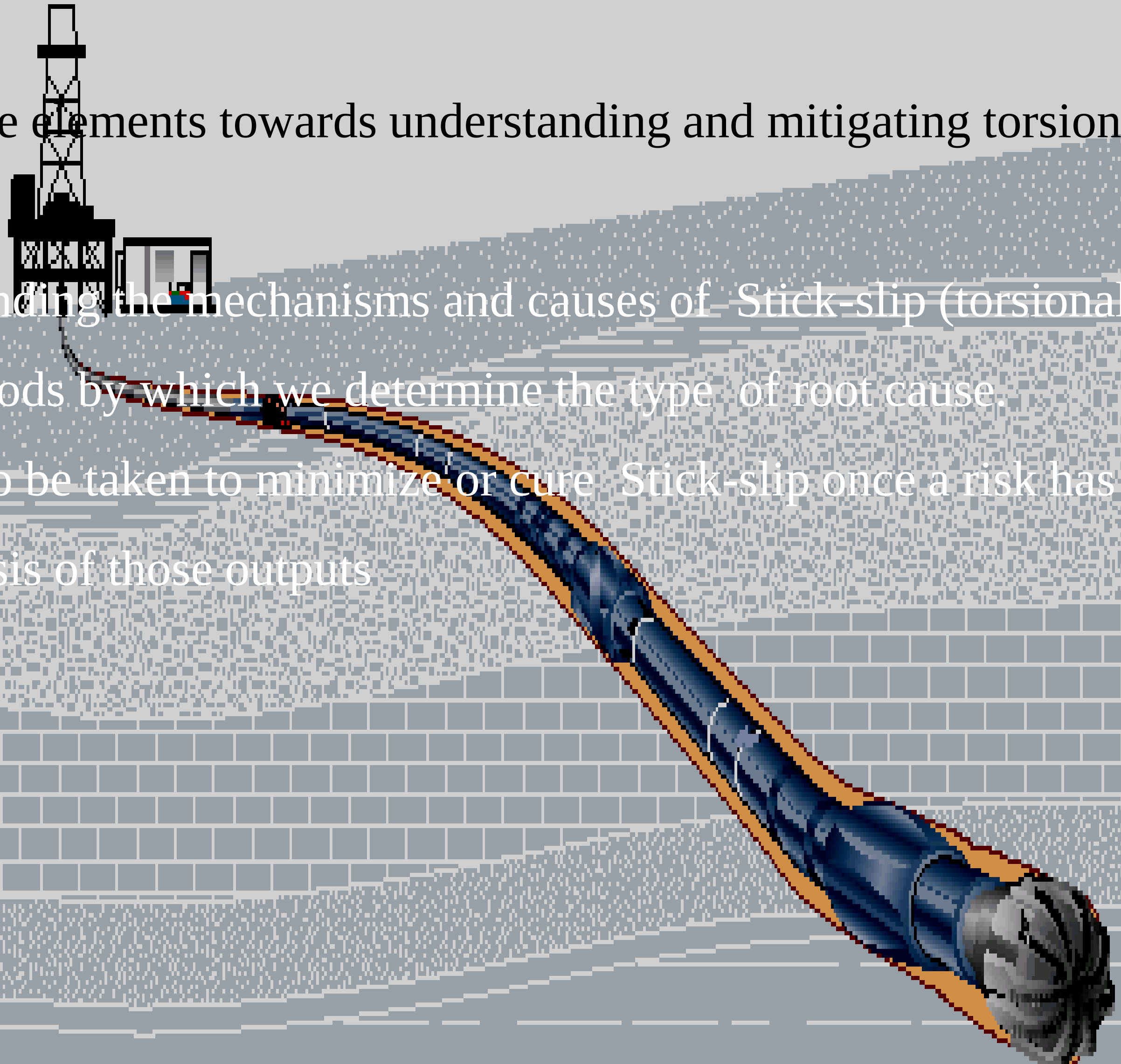


Figure1.1

PROJECT BACKGROUND

There are three elements towards understanding and mitigating torsional (Stick-slip) vibration:



1. Understanding the mechanisms and causes of Stick-slip (torsional vibration).
2. The methods by which we determine the type of root cause.
3. Actions to be taken to minimize or cure Stick-slip once a risk has been ascertained on the basis of those outputs

PROJECT BACKGROUND

Why is it important to Monitor vibration in Drilling operation?

1. Energy supply to bit as RPM and WOB
2. Vibration waste the supply energy

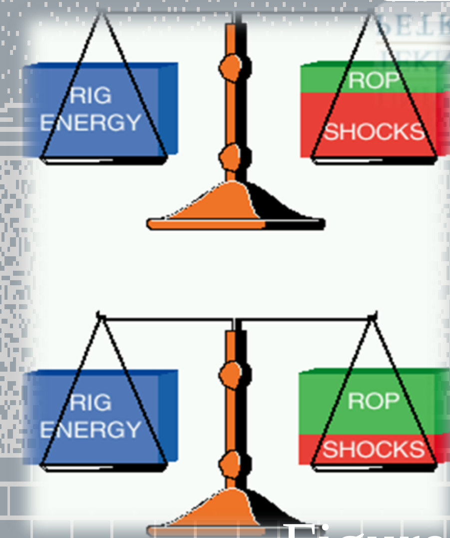


Figure1.2

Cost of torsional vibration

Lower ROP , More Trips , Lost in Hole

Premature equipment failure , Higher Maintenance cost,

Higher Service Company Charges

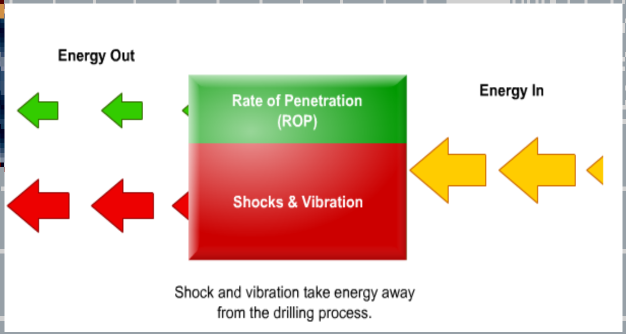
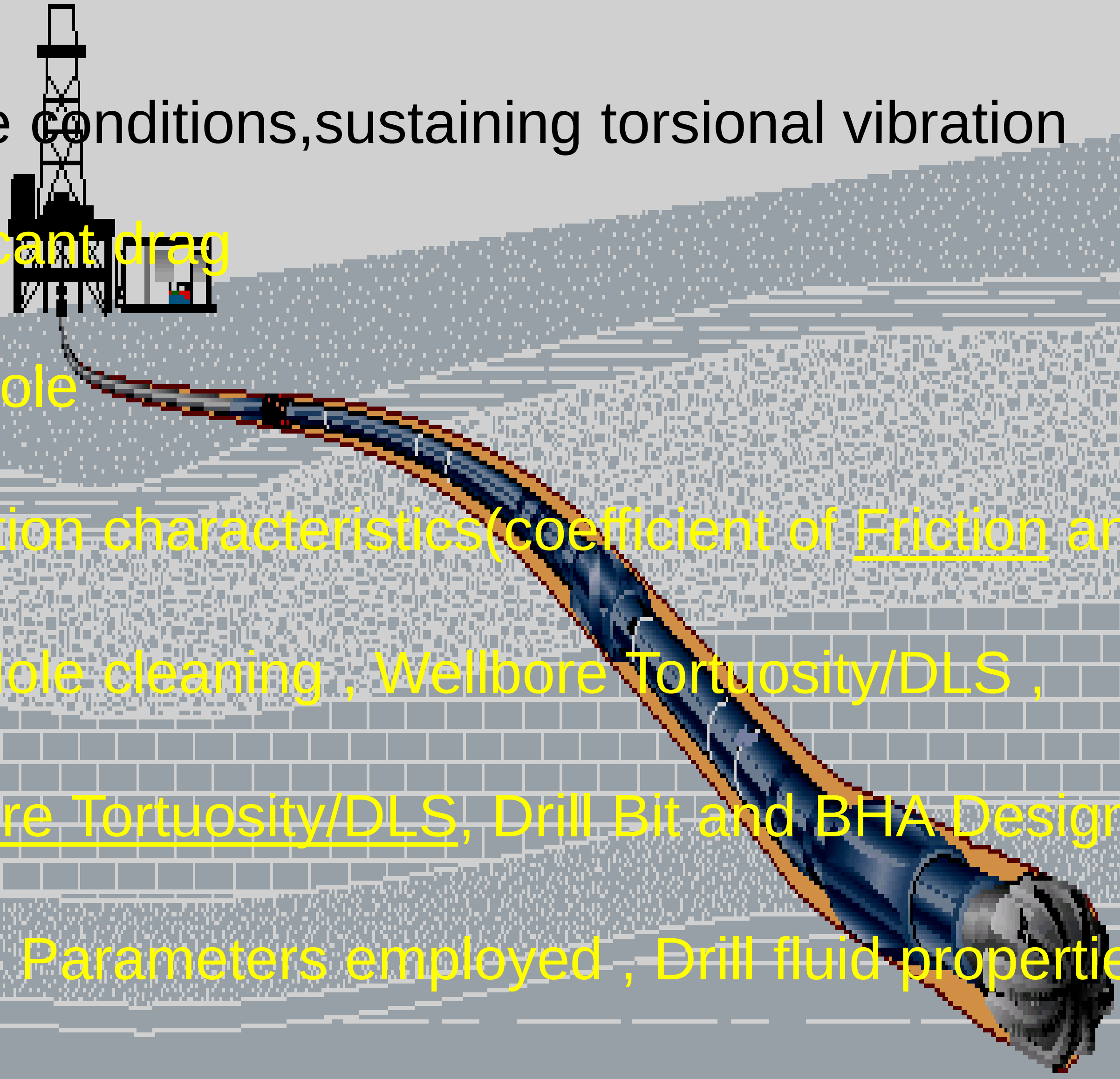


Figure1.3

PROJECT BACKGROUND

Downhole conditions,sustaining torsional vibration



1. Significant drag
2. Tighthole
3. formation characteristics(coefficient of Friction and Restitution)
4. Poor Hole cleaning , Wellbore Tortuosity/DLS ,
5. Wellbore Tortuosity/DLS, Drill Bit and BHA Design
6. Drilling Parameters employed , Drill fluid properties

PROJECT BACKGROUND

Consequences of stick-slip in drilling operation

1. Top drillstring rotates with constant speed
2. Drilling string develop vibration when run at critical rotary
3. Bit rotary speed varies between zero- six times to measured speed.
4. Fatigue of the drillstring system

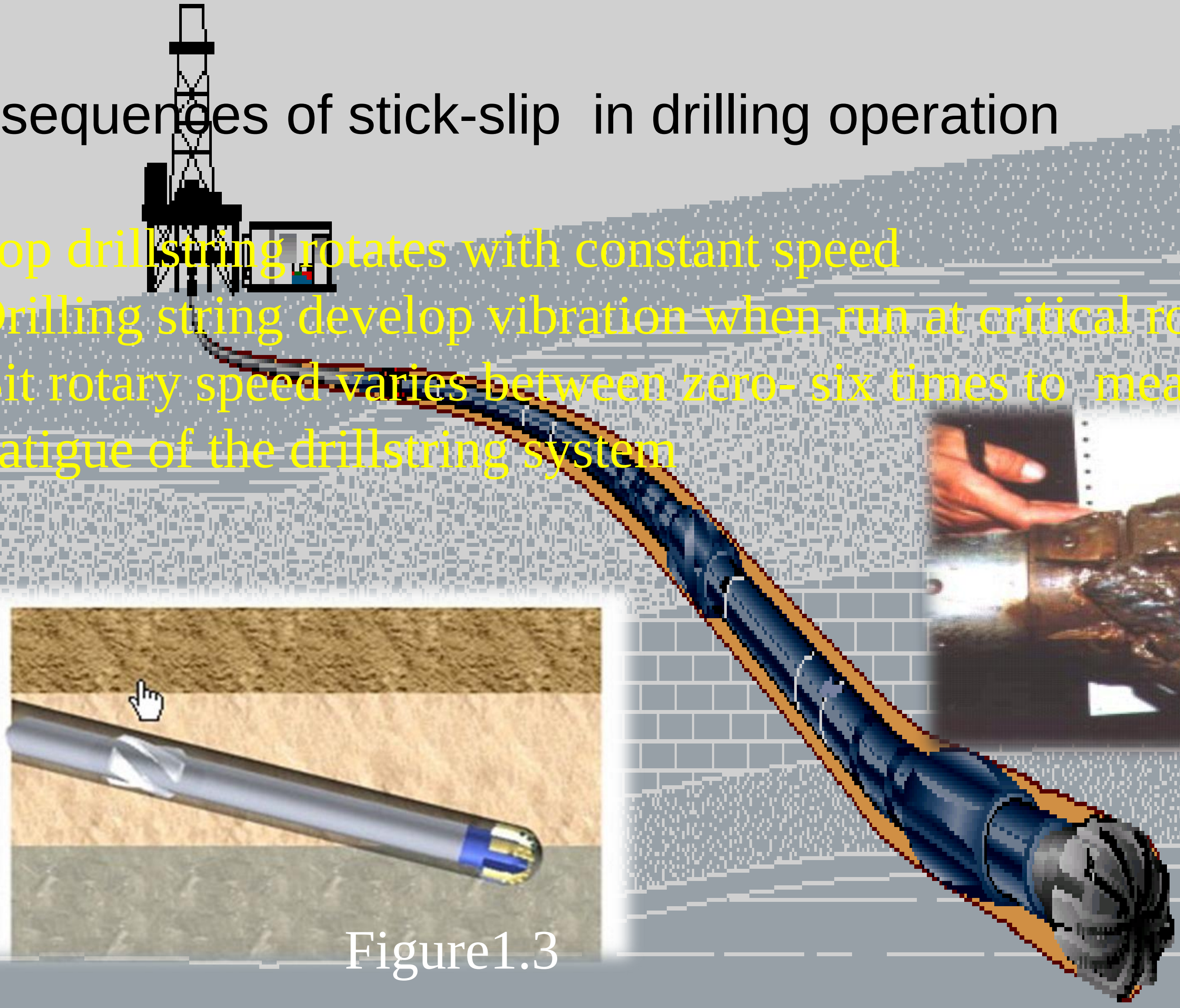


Figure1.3

Figure1.4

LITERATURE REVIEW

1. IADC/SPE Drilling Conference, Dallas, March 3- 6, 1998. this conference was about the problems which are encountered by Drillstring particular vibration modes in drillstring
2. Drilling string develop vibration when run at critical rotary speeds, and these vibration are difficult to control due to the string long length and large mass. Operating at critical speed imports severe shock and vibration damage to the. Schlumberger annual conference of drilling performances, 9th March 2007

PROBLEM STATEMENT

- This project had been focusing on stick-slip vibration as root cause of drillstring failure,assuming other vibration modes stable.
- The complexity problem of arise when the torques exerted on the drillbit is the function of the drilling speed,
- State variable behavior

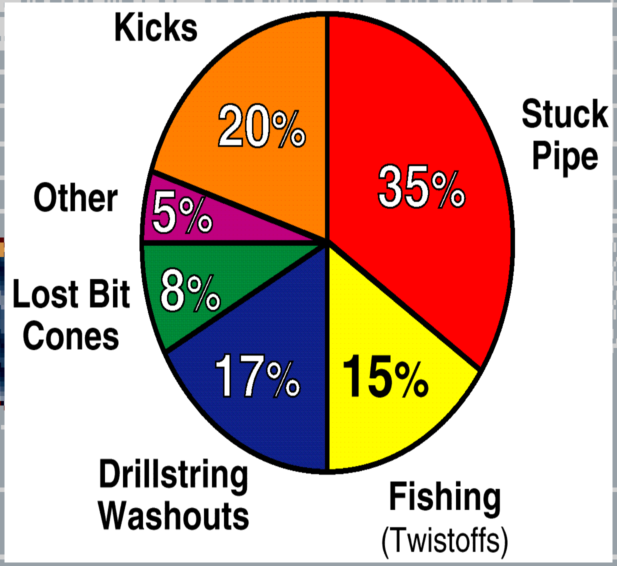


Figure1.5

METHODOLOGY

Gather data of vibration effect in drill operation

Using angular velocity at drillstring upper part of drillstring to identify Drillstring critical point

Using MATLAB to model Drillstring generic equation

Interpret the prediction result

End

Figure1.6

METHODOLGY

Using the generic drillstring equation using field. The below block diagram was build to predict the drillstring responses with two variable input, WOB,RPM and two variable output,ROP and Torque.

$$J_r X^2 + c(X_r - Xbx) + k(X_r - X_b) = T_m - T_r(X_r) \text{ ....1a}$$

$$J_b X^2 - c(X_r - X_b) - k(X_r - X_b) = -T_b(X_b) \text{ .... 1b}$$

METHODOLOGY

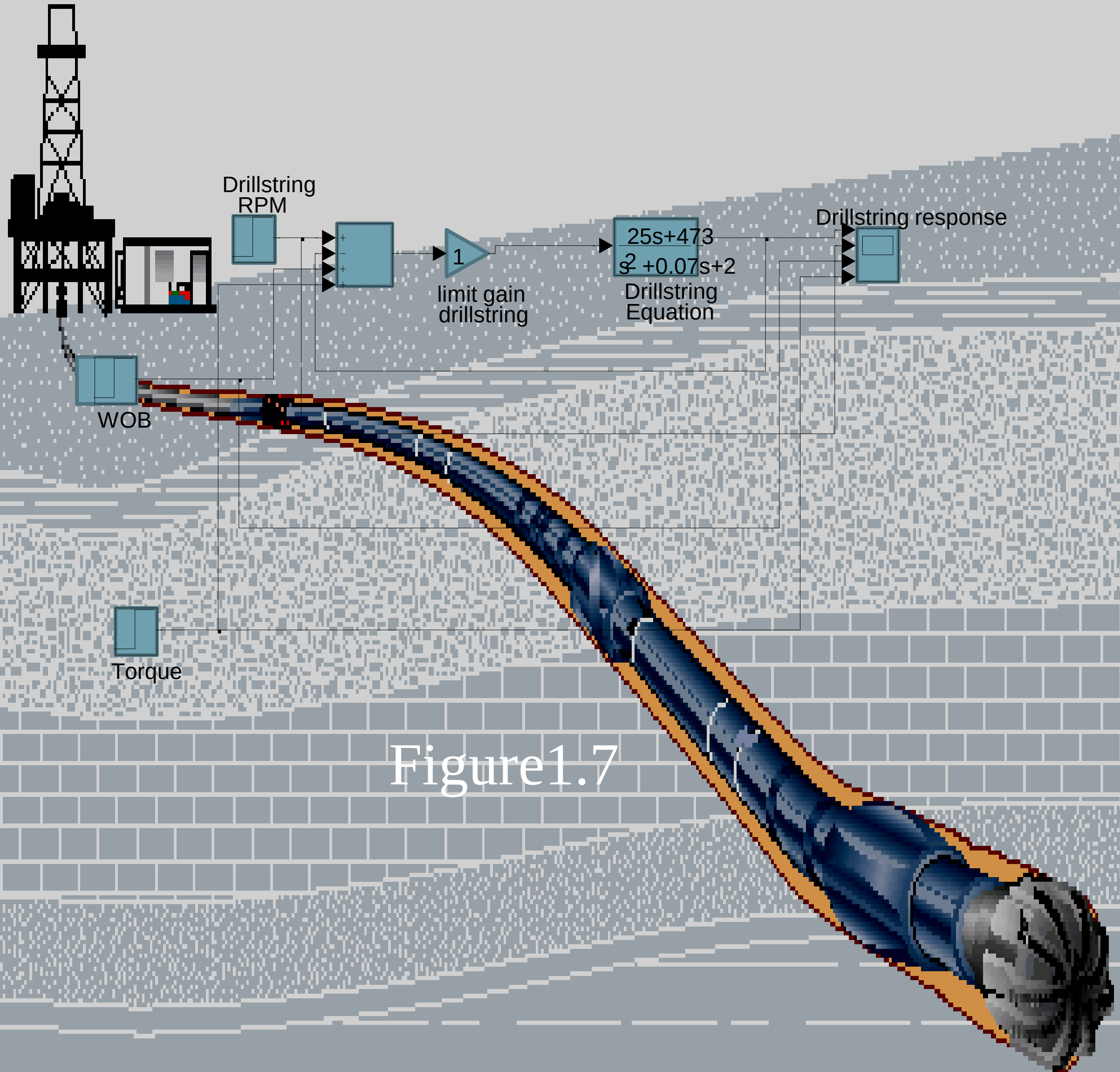
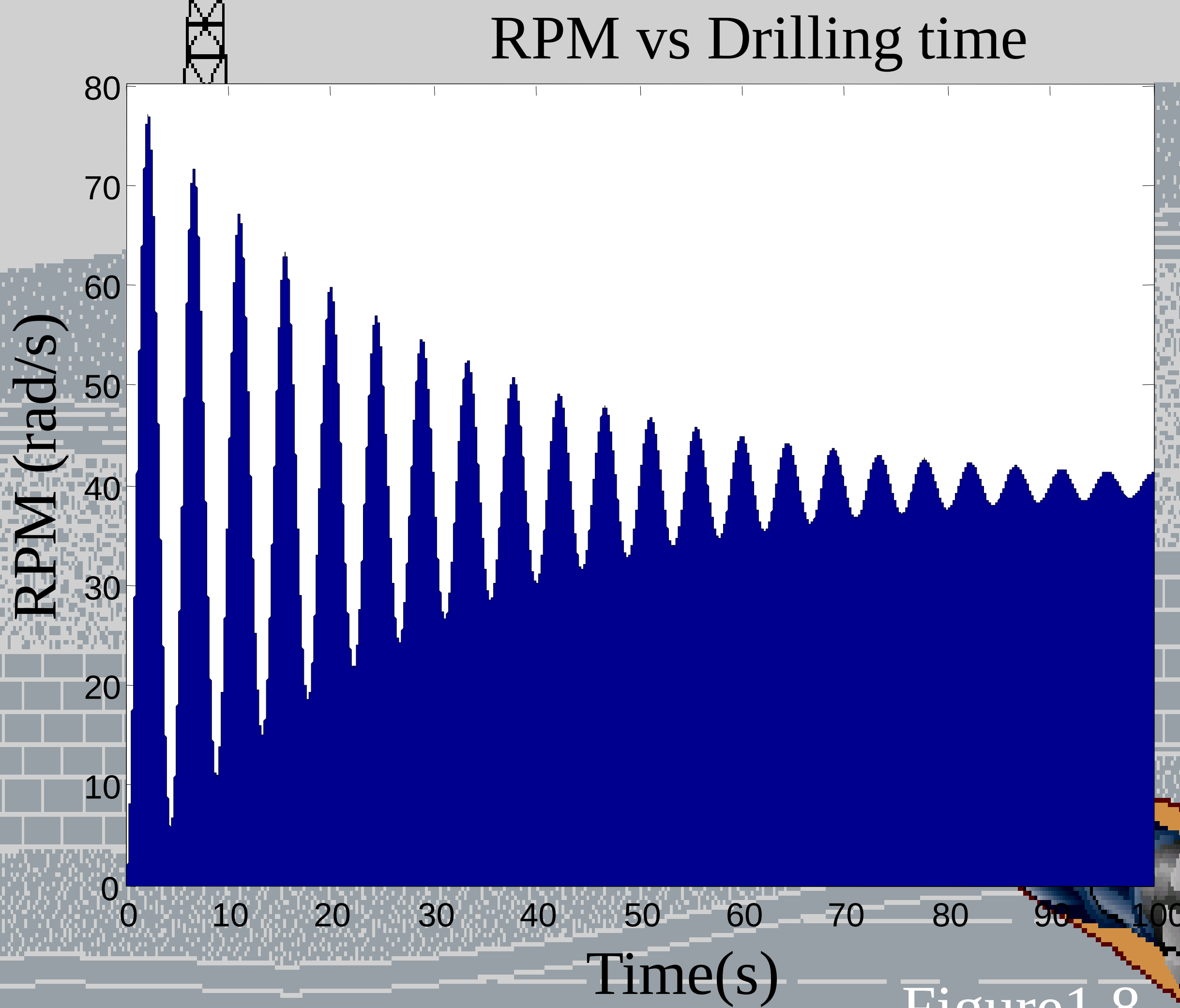


Figure1.7

DISCUSSION & RESULTS



This graph shows Drillstring disturbances With RPM as an input

Figure1.8

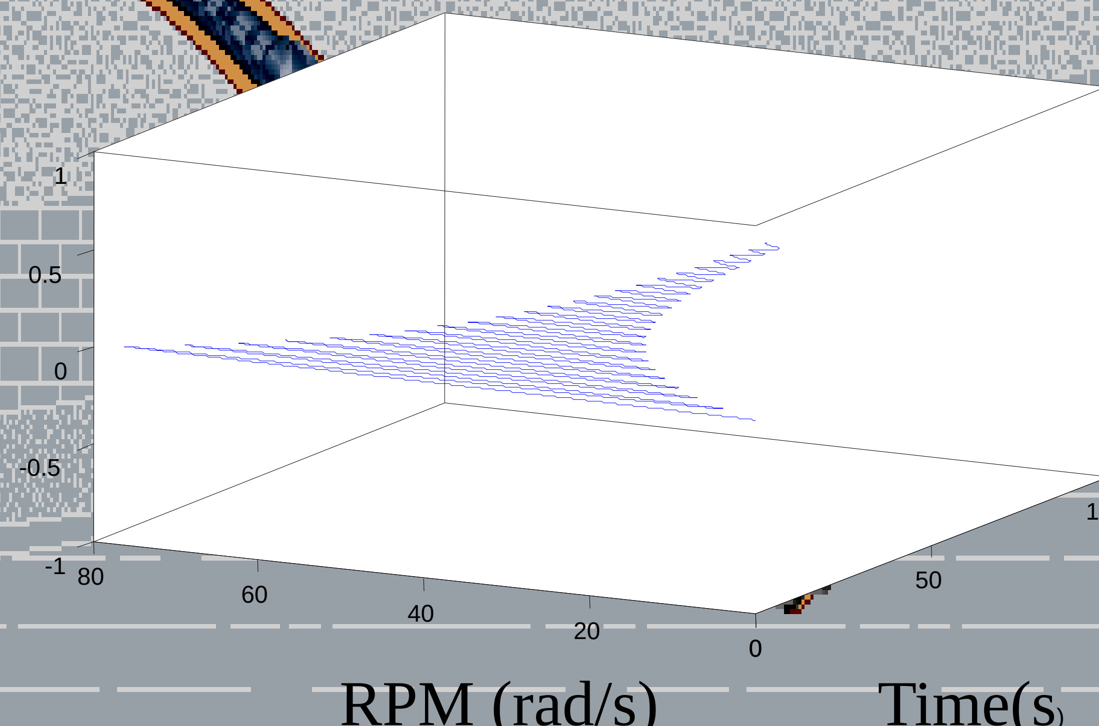
DISCUSSION & RESULTS

Matlab procedure of obtaining the drillstring response

Programs: by inserting the following coding the above graph can be obtain

```
>> num=[473];den=[1 0.07 2]; sys=tf(num,den);
>> t=[0:0.005:100];
>> [y,t]=step(sys,t);
>> plot(t,y)
```

Figure1.9

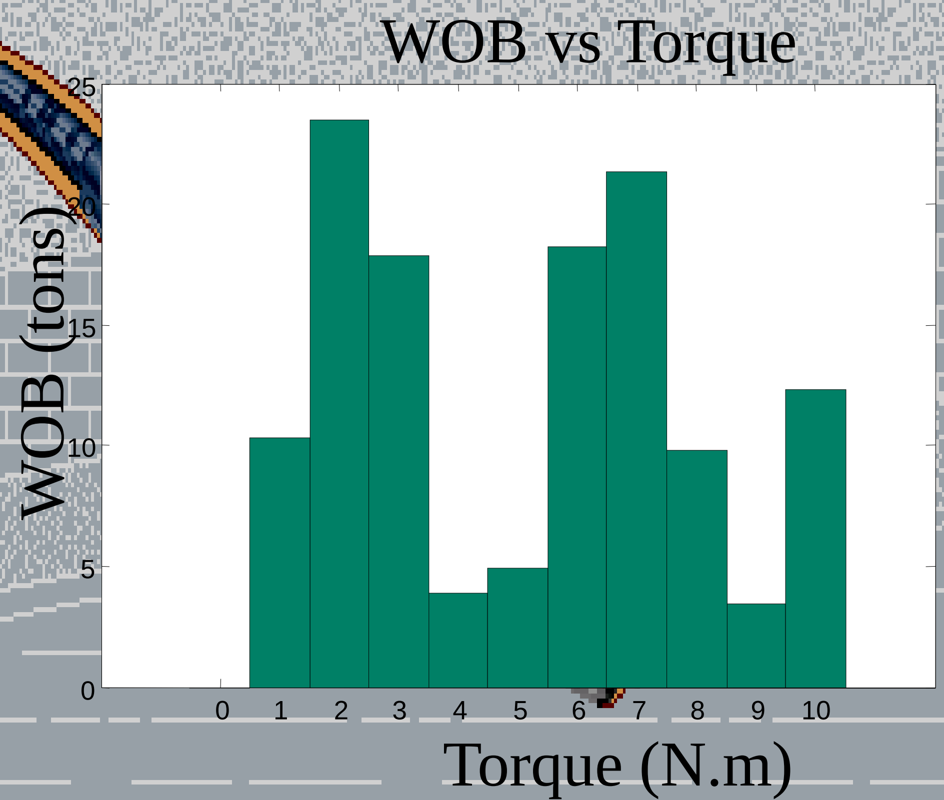


DISCUSSION & RESULTS

- shows how WOB affected the RPM when the PDC bit issue in the hard formation.

- The higher the value of the applied WOB the less value of RPM would be obtained if the situations continue like that the twist off might occur to the drillstring

Figure1.10 Characteristic soft formation WOB vs Torque



DISCUSSION & RESULTS

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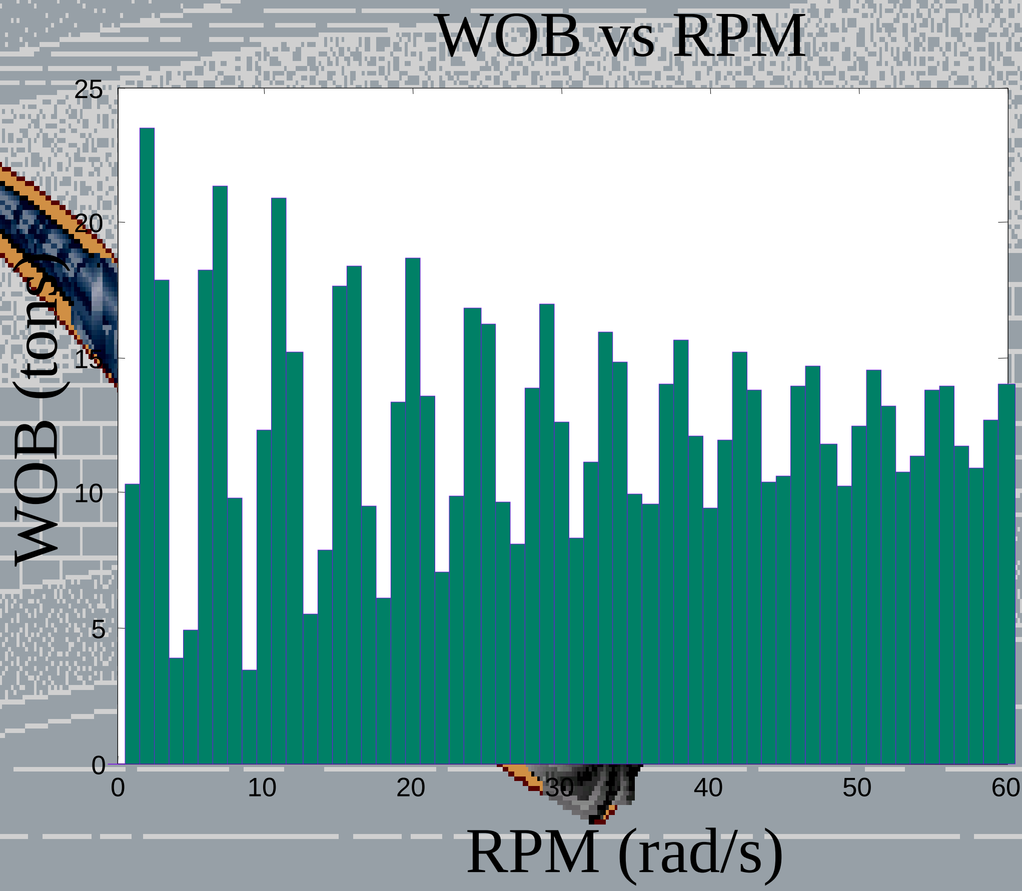
Figure1.11 WOB vs RPM



CONCLUSION

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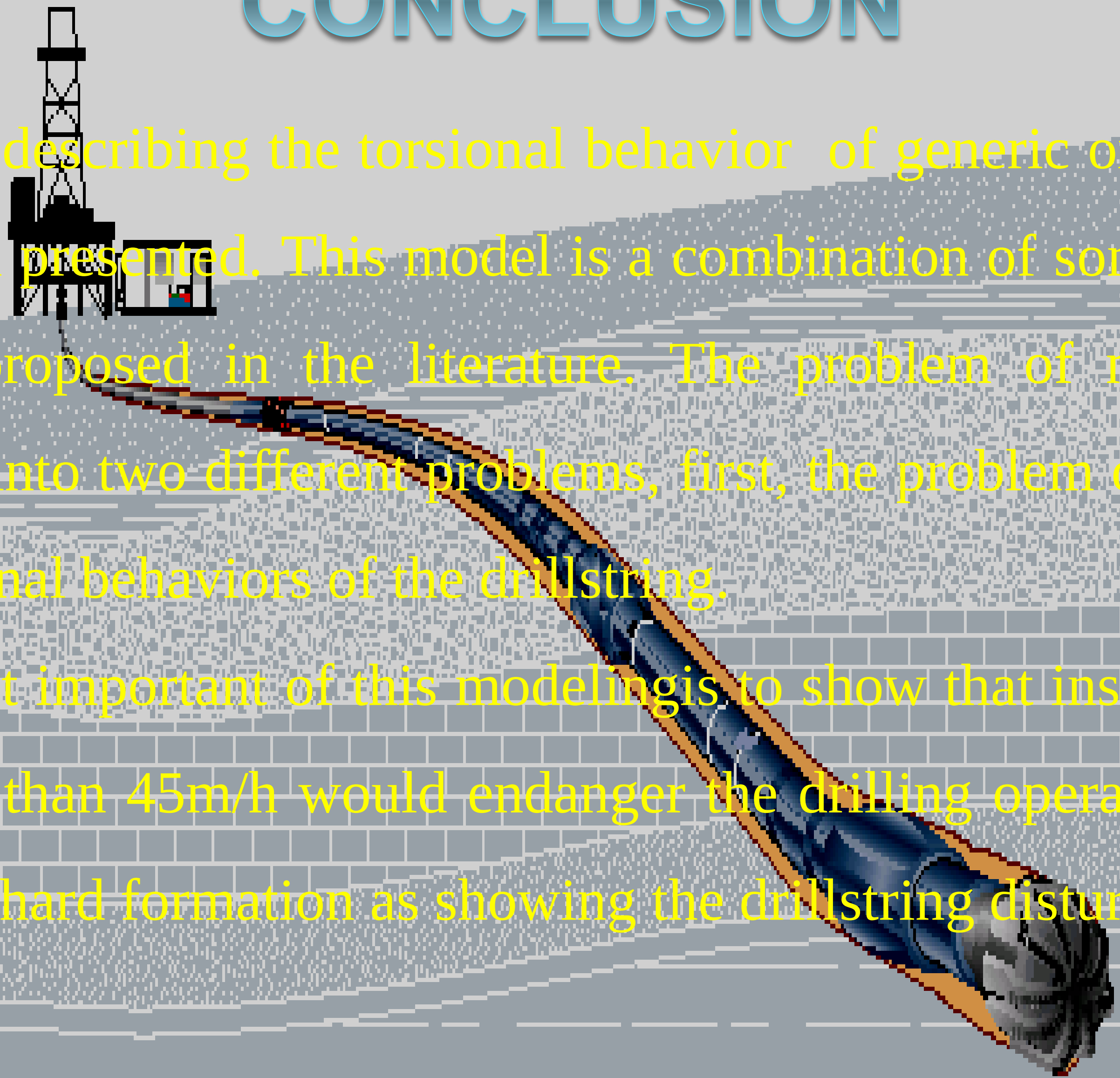
Amodel describing the torsional behavior of generic oil drillstring has been presented. This model is a combination of some previous model proposed in the literature. The problem of modeling is divided into two different problems, first, the problem of modeling of torsional behaviors of the drillstring.

The most important of this modelingis to show that inserting RPM of more than 45m/h would endanger the drilling operation special when it hard formation as showing the drillstring disturbances



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CONCLUSION

Torsional vibration (Stick-slip)

Place top drive in high gear ,ensure soft torque operational

Decrease WOB by 5%and increase RPM by10%

Dose vibration continue

No

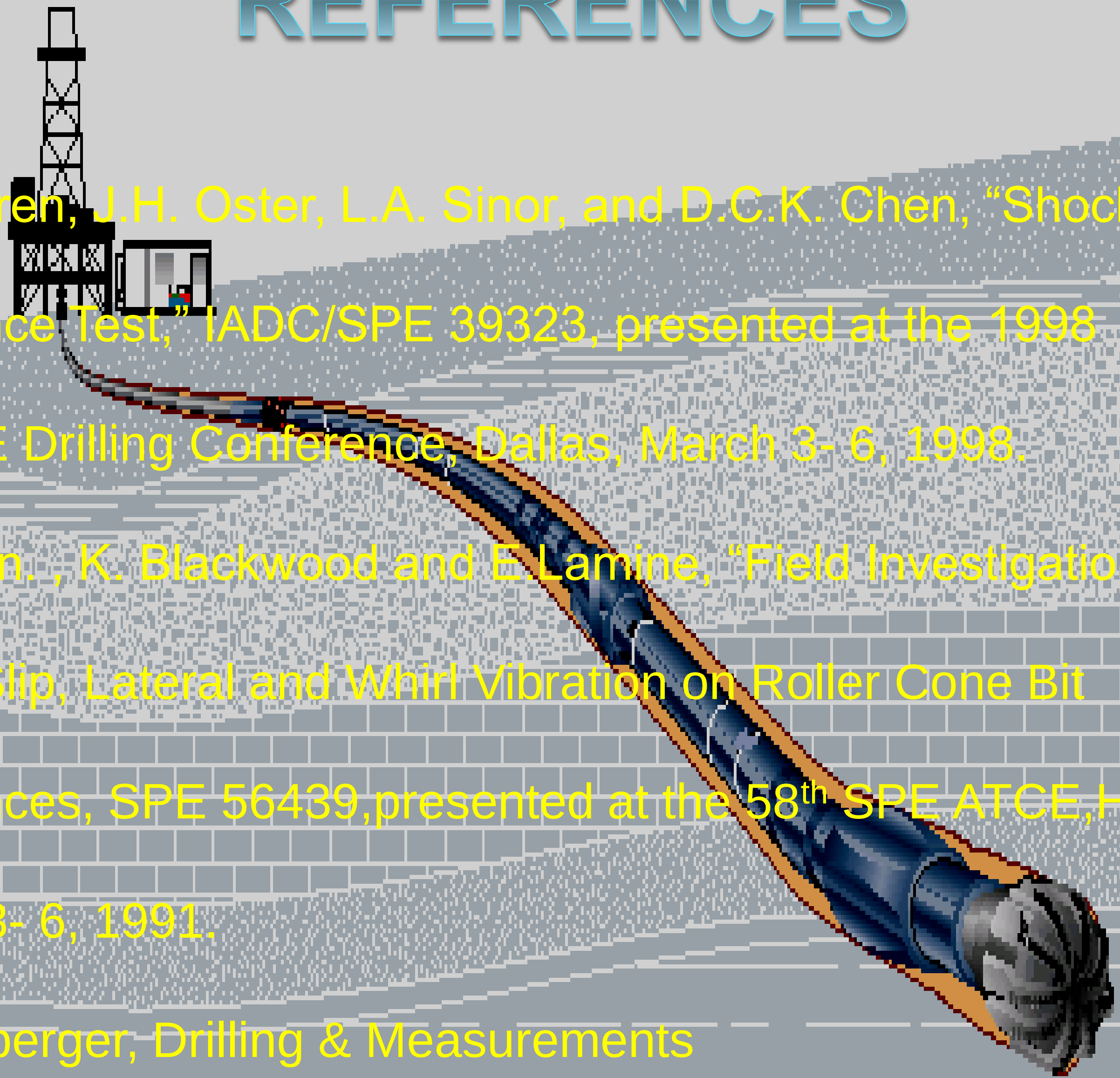
Continue drilling

yes

Off bottom, allow the Torque to unwind then TBCD

repeat three times

REFERENCES



[1] T.M Warren, J.H. Oster, L.A. Sinor, and D.C.K. Chen, "Shock Sub performance Test," IADC/SPE 39323, presented at the 1998 IADC/SPE Drilling Conference, Dallas, March 3- 6, 1998.

[2] S.L Chen. , K. Blackwood and E Lamine, "Field Investigation of the Effect of stick – Slip, Lateral and Whirl Vibration on Roller Cone Bit performances, SPE 56439,presented at the 58th SPE ATCE,Houston, October 3- 6, 1991.

[3] Schlumberger, Drilling & Measurements

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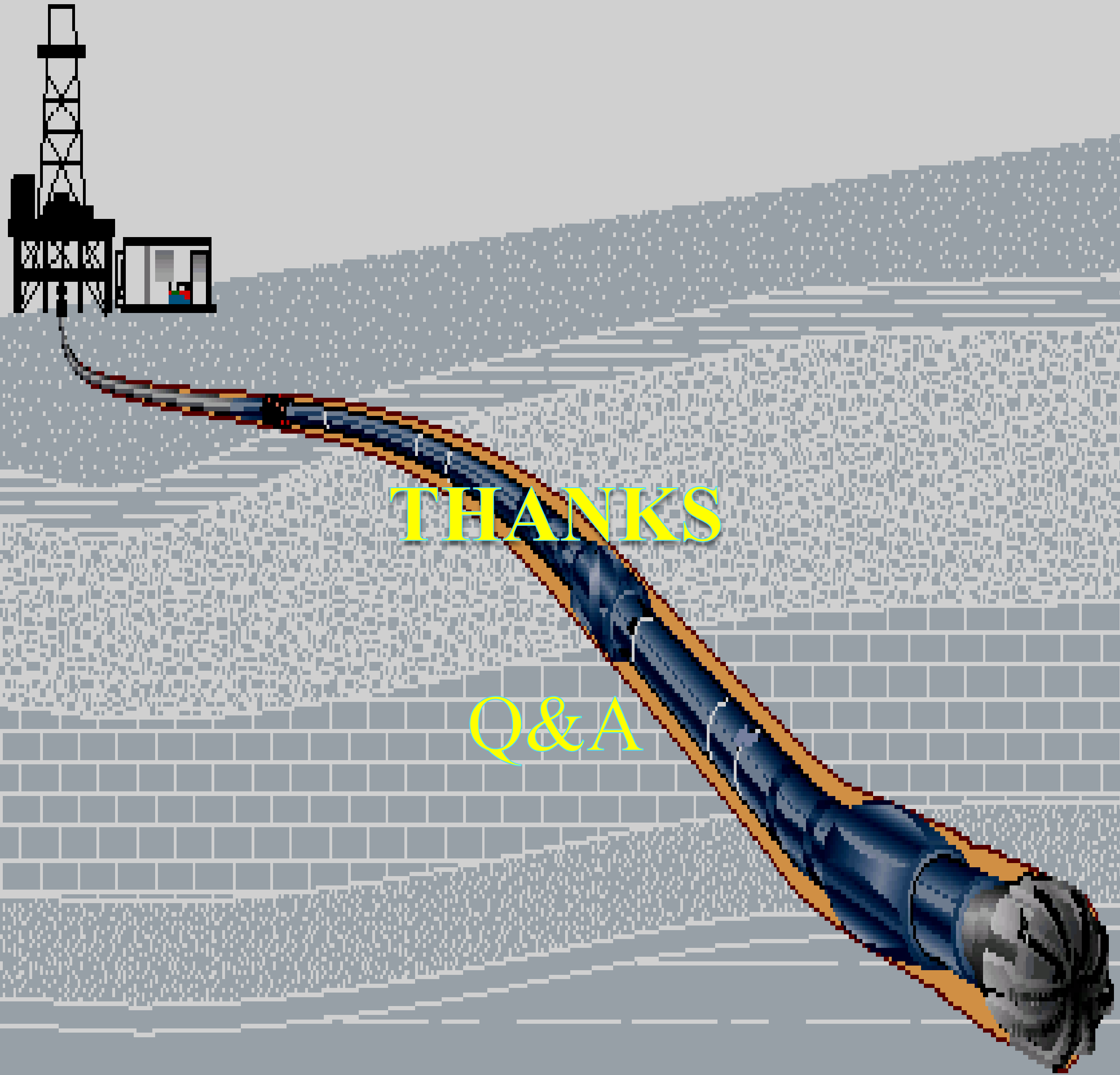

THANKS

Q&A

29th April ,2008