

”SHARING TO BE BETTER”  
”SHARING TO BE SAFER”



## “Sharing to be better”

**Under the direction of OLF, a joint industry task force of Operator and Drilling Contractor personnel has been formed to recommend ways to reduce the number and potential severity of well control events on the NCS.**

**One team recommendation was communicating actual well control incidents that have recently occurred on the NCS so lessons are shared and understood.**

**This is the third in a series of five case histories. This incident highlights the importance of the selection of well design and the need to be ready for the unexpected. Are you ready for the unexpected?**

**Please take some time at your next safety meeting to review this case history and discuss the questions raised during the presentation.**

**It is hoped that sharing of incidents is helpful and any feedback is welcome.**

# Shallow Gas Incident

Be prepared for the unexpected !



# The Site Survey Report

Shallow Gas Warning

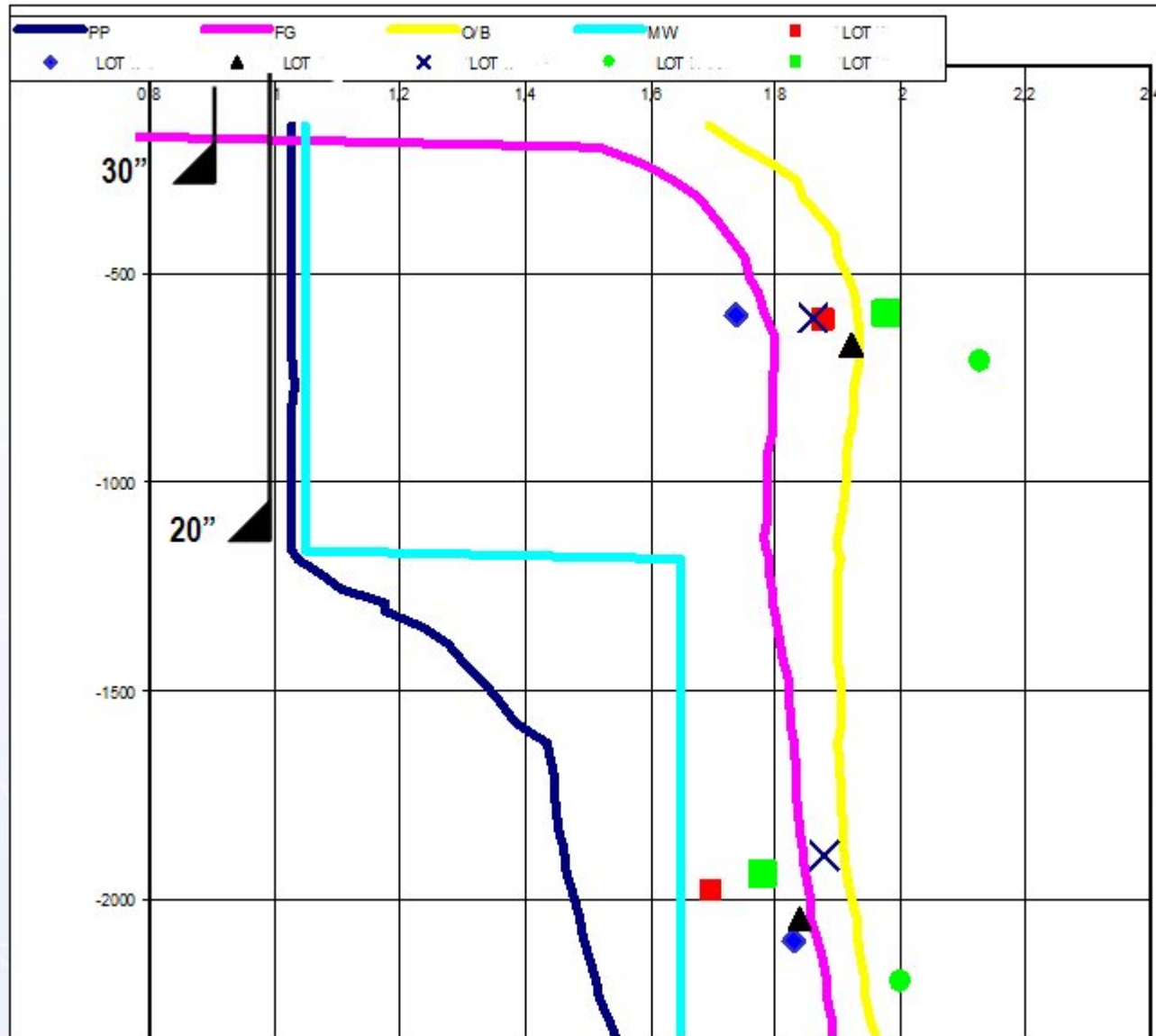
Shallow gas is **NOT** expected at the Planned Well and a shallow gas warning is not issued.

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Site Survey Report

Can we be relaxed ?

# The formation pressures and selected casing design



What do you think is important when designing top hole sections ?

# The formation pressures and selected casing design



What do you think is important when designing top hole sections ?

- Presence of Shallow gas
- Drilling pilot hole or not
- Size of pilot hole
- Type of drilling fluid
- Mud weight
- Setting depth of 20" casing

# Shallow gas Procedure - Interpretation

| Classification | Description   |
|----------------|---|
| High           | An anomaly showing all of the seismic characteristics of a shallow gas anomaly, that ties to gas in an offset well, or is located at a known regional shallow gas horizon.                  |
| Moderate       | An anomaly showing most of the seismic characteristics of a shallow gas anomaly but which could be interpreted not to be gas and, as such, reasonable doubt exists for the presence of gas. |
| Low            | An anomaly showing some of the seismic characteristics of a shallow gas anomaly, but that is interpreted not to be gas although some interpretive doubt exists.                             |
| Negligible     | Either there is no anomaly present at the location or the anomaly is clearly due to other, non-gaseous causes.  |

# NORSOK D-010 interpretation

## 5.7.2.2 Shallow gas risk assessment model

The following should be evaluated to determine the probability of shallow gas:

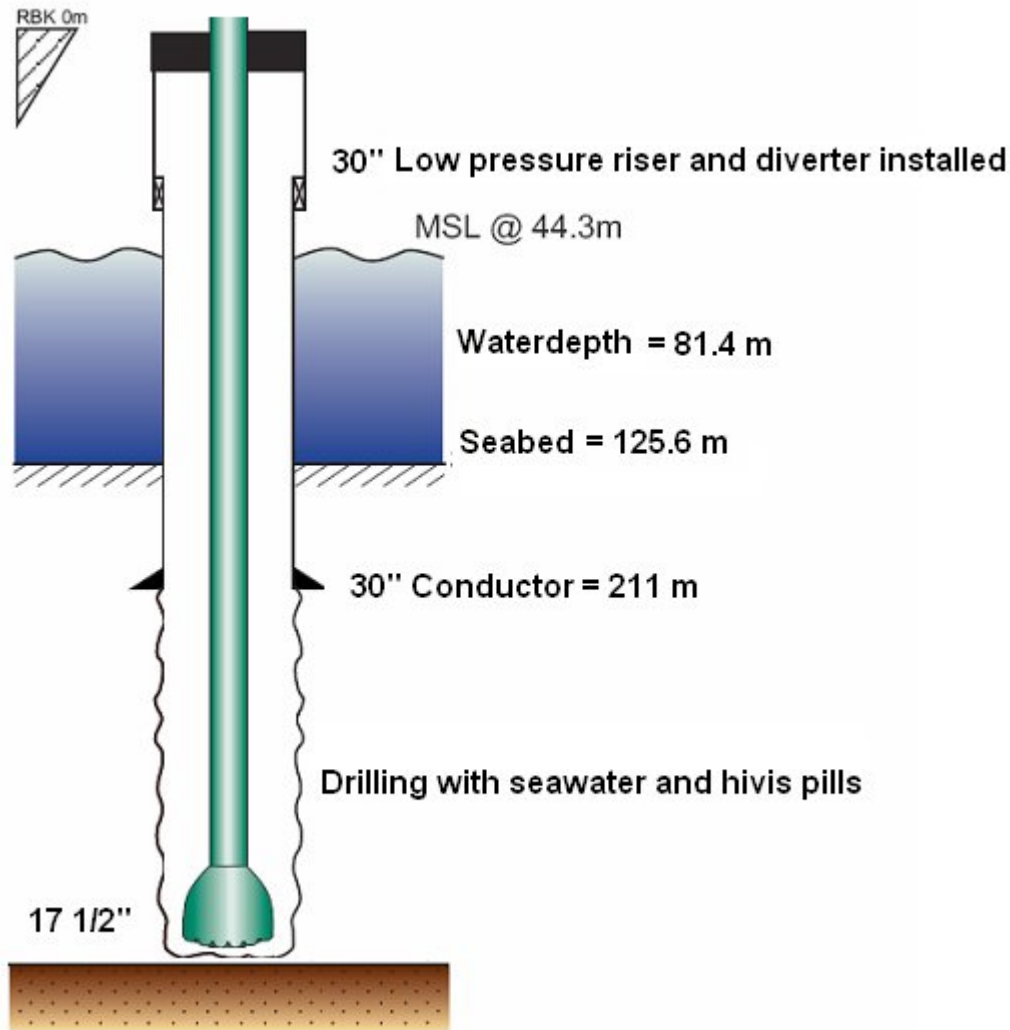
- a) Whether shallow gas is detected in relevant offset wells and in the same formations that will be penetrated in the well. **No**
- b) Whether a structural closure is seen on the seismic that could trap shallow gas. **No**
- c) Whether there are anomalies on the seismic interpretation that could indicate presence of gas. **No**

If the answer to minimum one of the criteria above is yes, the well shall be classified as a potential shallow gas well.

Based on the available data, no pilot hole was planned

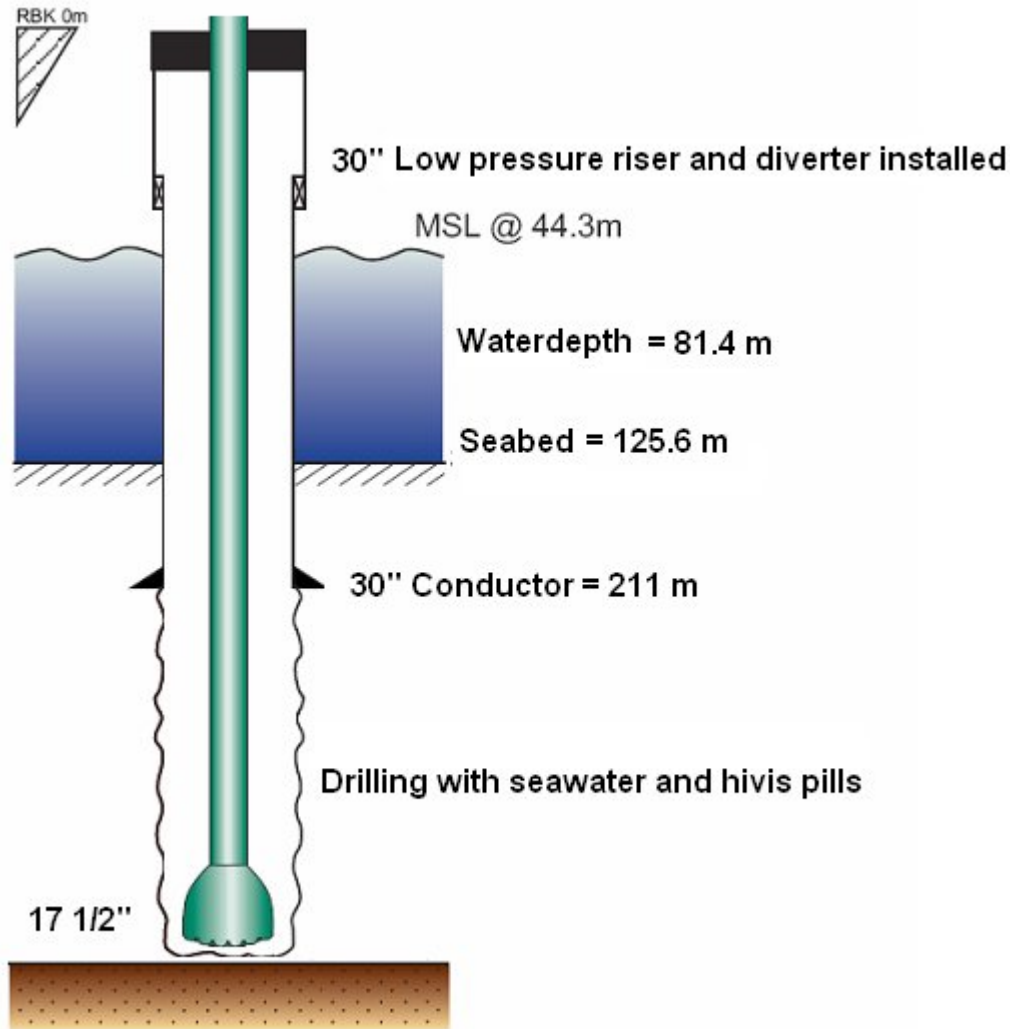


# Minutes before drilling into the gas zone



What preparations would you be making on the rig to be prepared for the unexpected ?

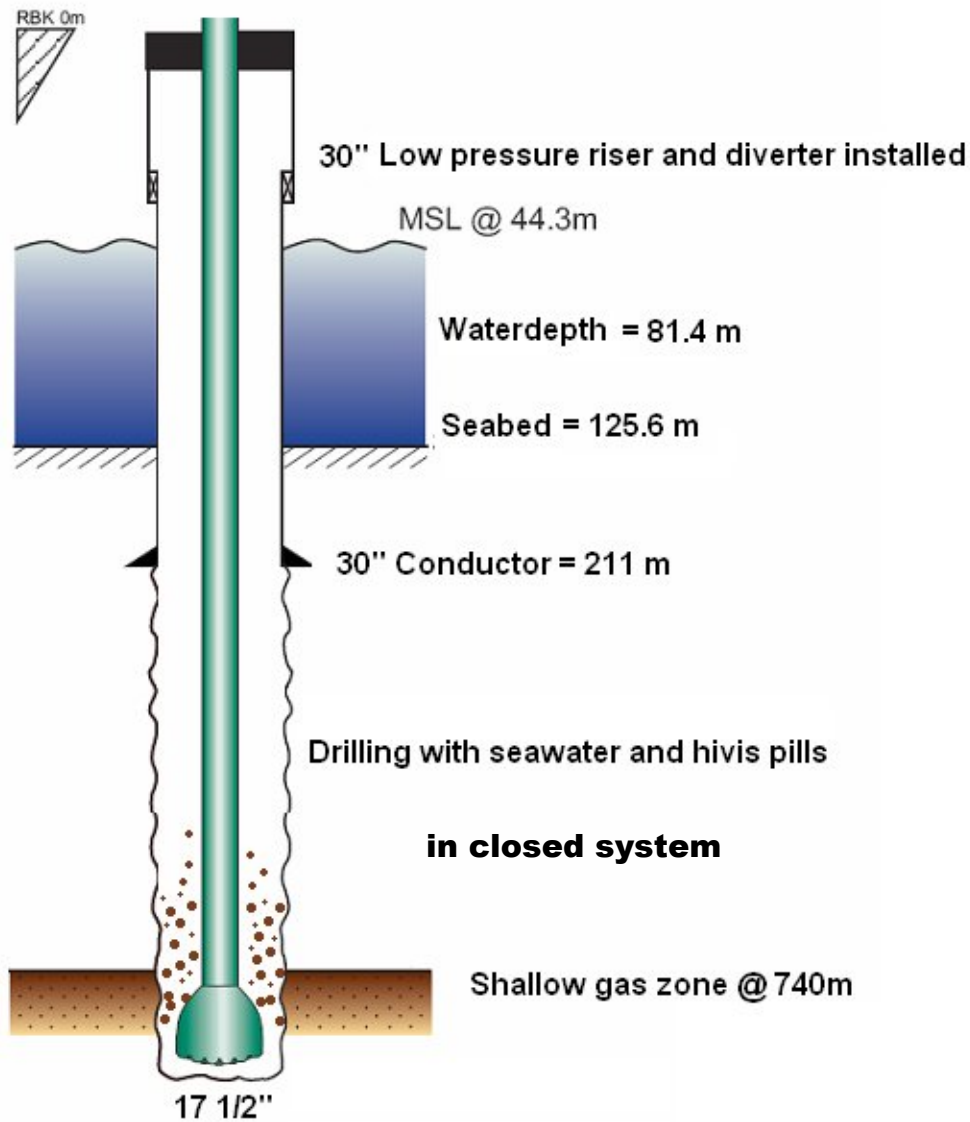
# Minutes before drilling into the gas zone



What preparations would you be making on the rig to be prepared for the unexpected ?

- Install and test diverter
- Flush diverter lines, check wind direction and perform shallow gas drill
- Have kill mud ready prior to drill
- Include Shallow Gas as one of the hazards in the "Well Control Procedure"
- Address the procedure for handling Shallow Gas prior to drill the section.

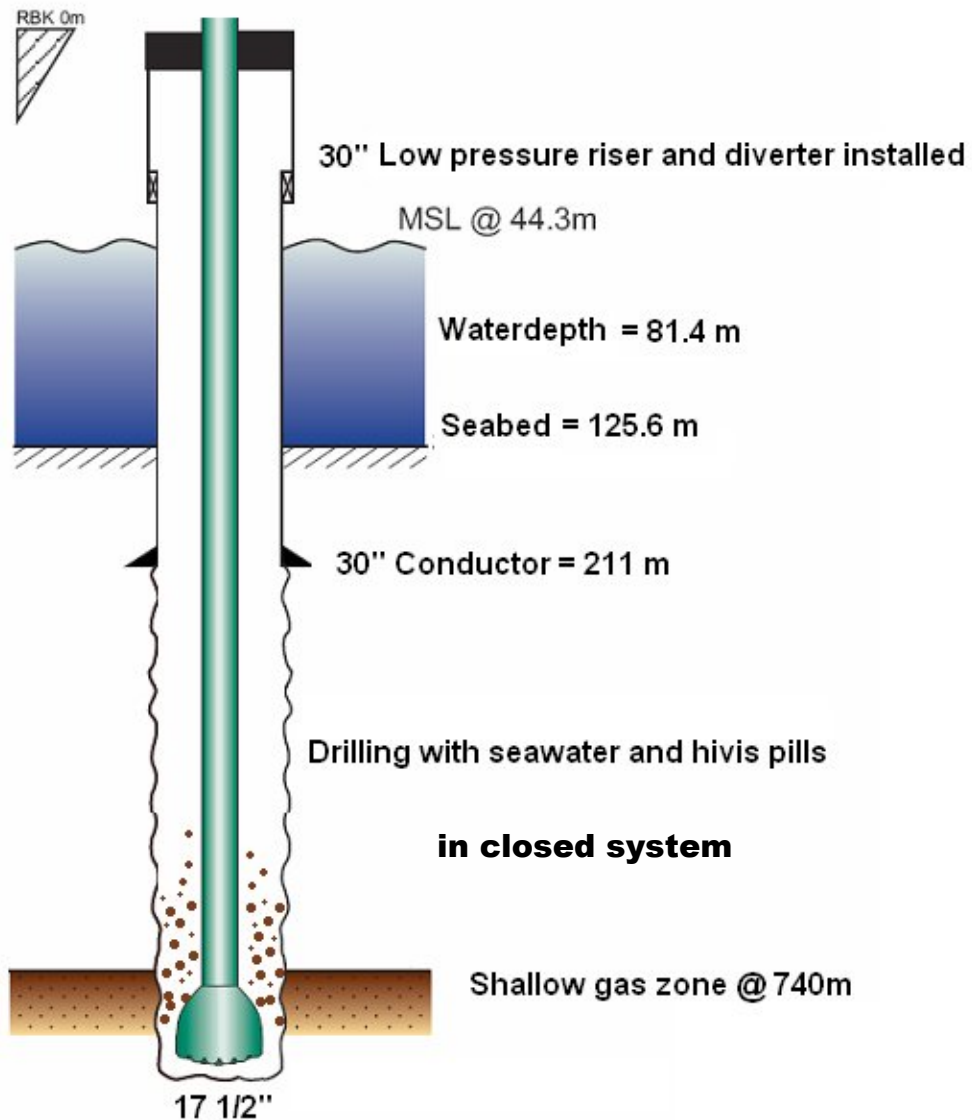
# Drilling into the unexpected gas zone



- ECD dropped from 1.15 sg to 1.10 sg
- Took a gain of 4.6 m<sup>3</sup>

What would you do when such an incident happens ?

# Drilling into the unexpected gas zone

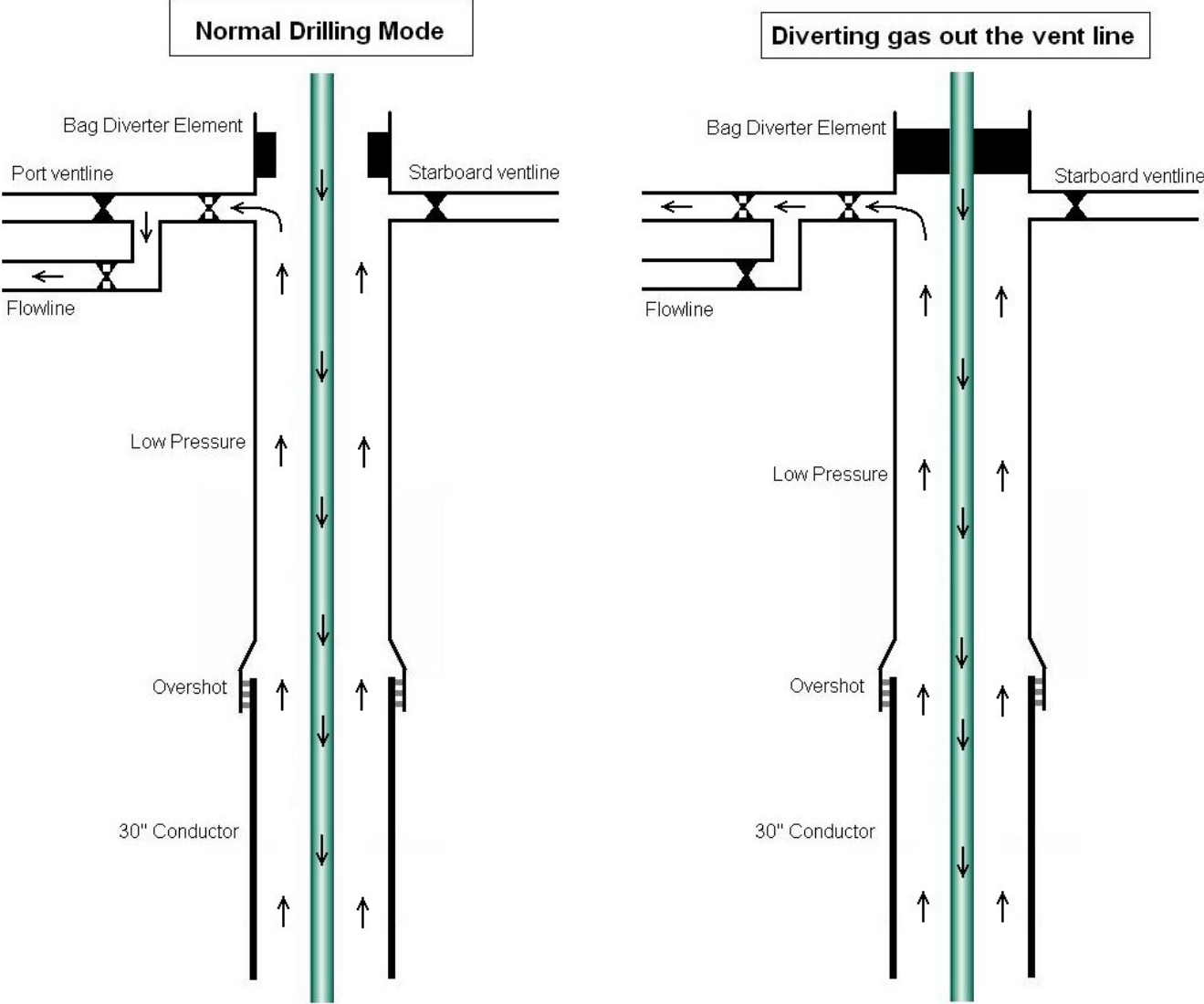


What would you do when such an incident happens ?

- Close diverter element and pump kill mud
- Direct the gas out the pre-selected vent line

The gas stopped after about 10 minutes before the kill mud was in place.

# Diverter system





# Gas out pre-selected vent line



# Operational Consequences

- Had to cement back with gas tight cement
- Drilled a 9 7/8" pilot hole to 1220 m using 1.20 sg mud
- No gas or gas bearing sand zones found
- Displaced well to seawater. Static
- Opened pilot hole to 17 1/2"
- Ran and cemented 13 3/8" casing with gas tight cement (original plan)

Why do you think that this incident did not escalate into a major well control accident ?

## Conclusion after the incident

- The procedures for handling shallow gas was addressed before drilling the section
- Kill mud was ready
- Personnel followed the shallow gas procedure
- The equipment worked as it should
- The shallow seismic was re-evaluated by two companies. None of them could find any sand zone at the depth of the shallow gas influx.



# Conclusion

- Main reason for the incident:
  - Drilled into a sand zone containing gas in overpressure
- Interpretation of shallow seismic did not reveal any shallow gas zone at the planned well location
- The gas zone was too thin to be picked up by seismic tools
- Personnel reacted very professionally and according to the shallow gas procedures
- The diverter equipment worked as it should
- A 9 7/8" pilot hole would still have resulted in gas to surface, but the flow rate would have been smaller

# Lessons learned

## Well planning after the incident for jack-up operations

- Since the incident, the company have decided to drill pilot holes on all the exploration wells
- The pilot hole will be drilled with mud
- Run casing with packer to cater for loss of hydrostatic head when cement is setting up.
- The shallow seismic report is send to another company for a third party verification
- Course "Shallow seismic assessment"

Could this happen on your rig ?  
Are you prepared for the unexpected ?

