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Introduction

This paper discusses the issue of operational limit setting used in DP operations. It traces the history of the WSOG (Well Specific Operating Guidelines) since 1998. The paper also examines the reasons behind its widespread use in DP drilling & other operations.

Modern WSOG in the form we are familiar has its origins with the Ocean Alliance campaign in the late 90’s on the Nyk High, Vema Dome and Helland Hansen prospects in the Norwegian Sea. The WSOG principle was further developed during the commissioning of the drillship West Navion between 1998-2000. WSOG became a cornerstone of the Statoil DP work requirements document which became the principle Corporate DP requirement document, TR1029 in 2000. Since then, a number of other major Operators have introduced corporate DP requirements, all of which contain WSOG as the chosen regime for limit setting offshore.

This paper discusses the European approach to deepwater drilling risk management in terms of limit settings. The paper also discusses 2 incidents. One where WSOG worked as intended and one where WSOG failed in its objectives. A comparison is undertaken.

The paper concludes with a summary of the reasons WSOG has had such widespread use, its benefits and introduces challenges to the industry to ensure its continued effective use.

The presentation at MTS in October 2006 will also include a survey among the attendees in the auditorium. The author will pose a number of pointed questions to the audience in an attempt to generate immediate feedback into the use of WSOG. This survey will provide the MTS DP committee with valuable insight into whether the existing WSOG process does indeed hold worldwide appeal to the industry.

MTS DP Conference 2000 – Reliability Session, a look back 6 years

The subject of degraded status is certainly not new. Included is a quote from the conclusions of the session on ‘Degraded Status’ given to MTS in 2000.

DP vessels will frequently be operating with some equipment that is essential for DP class 2 or 3 unavailable. This can however mean that it is safe to continue working. Thus it is important to make sure each DP vessel has good vessel specific guidelines to manage a degraded situation and that the key DP personnel have enough understanding of the complete design to determine the status correctly. This understanding must enable logical discussion particularly when several relatively minor items are unavailable because their sum could be very significant.

C. Jenman, Chairman, Global Maritime
What is WSOG?

WSOG stands for Well Specific Operating Guidelines. The WSOG document is used to define actions to be taken by a DPO in the event of certain changes to the DP units capability. The WSOG also serves as a DP emergency response primer and ‘ready-reckoning checklist’ for DP Operators. A sample form is included herein.

The WSOG, in a number of forms, is used widely across the DP drilling industry today. The large majority of the world’s DP drilling contractors are making use of the WSOG in the format discussed in this paper. All DP drilling activities on the Norwegian Shelf are conducted using the WSOG regime, and it is the primary method of conducting the station keeping HAZOP and limit setting exercise.

The central tenet of WSOG is that it clearly defines, prior to operations, the 4 different DP operating status conditions against known possible failure modes. WSOG brings together the rigs design basis, changes during design, personnel, clients and so forth.

WSOG is effectively a purpose built ‘HAZOP’ for DP drilling which, because of its design simplicity, has had a great deal of take-up around the world. As well as being a simple and effective tool, it provides the following advantages:

- DP Emergency response matrix is defined
- Assists training of Key personnel without the need to re-train across contractors
- Brings together driller and DPO (drilling and marine)
- Brings together contractor and client
- Shows that the contractor has a credible system
- Demonstrates a ‘case’ of operational risk management
- Allows for and is designed for handling change i.e.
  - New personnel, new equipment, change of site, geographic location & client

One of the major benefits to the DP drilling industry is that drilling supervisors should be able to build a body of experience when operating on different DP units across different contractors. This was seen by Statoil as a great advantage early on.

WSOG is, effectively, a link between known failure events & operating conditions of different type of actions. Each ‘action’, green, advisory, yellow and red have defined, agreed responses. The WSOG form can be amended and/or expanded to capture additional conditions. The WSOG is also valid for use in HAZOPs for operations such as DST and dual activities where additional safeguards may need to be applied. The diagram below shows why the WSOG process works so well.
Map of what WSOG manages to achieve offshore
WSOG - What does it do?

A brief History of Well Specific Operating Guidelines

One of the first semi-formal guidance documents for DP drilling was produced by the UK Department of Energy in March 1982. It came out at a time when the first ‘Pelican Class’ DP ships were occasionally drilling in the UK Sector. This document was very basic by today’s standards but did highlight the need for effective operational limits to be defined.

The concept of well specific limits was included in the document.

Ocean Alliance conducted a drilling campaign in the Norwegian Sector in 1997 and 1998. A great deal of risk analysis was carried out prior to the rig operating. The first version of the Ocean Alliance WSOG was contained in 4 pages and clearly defined the use of the Advisory condition to allow for reporting of events which may lead to higher alert status levels.

The wells drilled by Ocean Alliance during the campaign were:-

1997: Ormen Lange (886m, Norsk Hydro/BP). Original Ormen Lange gas field discovery. Wellbore Entry date 27.07.97. Exit 07.10.97

1997: Vema Dome (1,238m, Operator: Statoil) Wellbore entry date 12.10.97 Exit 22.03.98
1998: Helland Hansen Prospect (684m, Norske Shell)  
Wellbore Entry date 28.03.98. Exit 04.07.98  
Source: PSA

**Statoil development - 1998**

The challenge in 1998 was the acceptance and compliance issues surrounding the entry into service of the Class 3 drillship ‘West Navion’. Within Statoil, a review process began during 1998 following the Ocean Alliance DP campaign. The DP related verification work including the Ocean Alliance Joint Venture Project (Norway) Doc. 1.0 22/09/97 was used as the start point. During late 1999, the station keeping case for West Navion was accepted by the regulator and the WSOG was used from the beginning on operations on the vessel.

Statoil DP Requirements Rev 1  
B&B-TB-10-20E DP Requirements were issued on 20 January 2000, approved 21 February 2000. The first revision of the Statoil DP Requirements document mandated an early version of the WSOG.

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**Statoil WSOG Rev 1 – Feb 2000**

Statoil Rev 2  
Following further involvement within worldwide asset teams, Statoil published the 2nd edition of the corporate requirements document, entitled WR0581, Version 4 on 29.08.2001.
Statoil Rev 3
Statoil re-published the DP requirements as ‘TR1029’ Technical requirements on early 2002.

Other operators such as Norsk Hydro and in 2005, BP, have since issued corporate requirements for DP drilling and well intervention.

It should be noted that all corporate DP requirements issued by Oil majors use the same WSOG process as the principle means of establishing alerts through the definitions of green, advisory, yellow and red alert.

BP Group

BP issued a set of Corporate DP requirements for drilling, testing & well intervention in late 2004. This finally became Version 8 and was issued in February 2005. The BP standard uses the same WSOG process as the earlier Statoil document. A version 9 is due to be released in the summer of 2006.

Industry Presentations

The WSOG process and wider verification model was presented at the IADC Northern Deepwater conference in Stavanger in May 2001. The technical paper presented at IADC used case studies to show how different Oil Operators and drilling contractors are adopting the processes begun in Norway for the benefit of proving an effective operational risk management case for their DP operations.
Influence on Industry

The WSOG model form has had a significant influence worldwide. On 15\textsuperscript{th} November 2004, DNV prepared a report for the US MMS entitled, ‘Guidance on safety of well testing’ Ref. DNV 4273776/DNV. The report includes reference to WSOG in the form presently used.

Operators including Shell/Enterprise, BP, ExxonMobil, Conoco, Marathon, Amerada Hess, Elf Exploration Angola, Woodside, BHP, Apache have all made use of the WSOG form during their drilling campaigns. A number of drilling contractors have adopted this process, in one form or another, in their DP operations manuals.

Diamond Offshore

The following slide shows Diamonds approach. A presentation by Diamond was given at the AADE-DIG Meeting in May 2004. It shows that use of Advisory and Yellow Alert is crucial.

This slide reinforces the point

A copy of a WSOG is included herein for sample:
### DP REQUIREMENTS FOR DRILLING, TESTING & WELL INTERVENTION

<table>
<thead>
<tr>
<th>Condition</th>
<th>Green</th>
<th>Advisory</th>
<th>Yellow</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit/Vessel</td>
<td>Deepwater X</td>
<td>Well: SAMPLE</td>
<td>Operator: BP GROUP</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Intact DP System</strong></th>
<th><strong>DP position footprint</strong></th>
<th><strong>DP heading footprint</strong></th>
<th><strong>Power consumption each network (Rapid configuration)</strong></th>
<th><strong>Thrust consumption each online unit</strong></th>
<th><strong>Position reference available</strong></th>
<th><strong>DP control system (including IAS-DP controllers)</strong></th>
<th><strong>Wind sensors</strong></th>
<th><strong>Motion sensors (MRU)</strong></th>
<th><strong>Heading sensors (Gyro)</strong></th>
<th><strong>DR-UPS</strong></th>
<th><strong>IAS System</strong></th>
<th><strong>Comms systems</strong></th>
<th><strong>Riser limitation LRU</strong></th>
<th><strong>Riser limitation LRU</strong></th>
<th><strong>Wind speed (10m/10s)</strong></th>
<th><strong>Wind direction</strong></th>
<th><strong>Sign, waveheight</strong></th>
<th><strong>Riser twist</strong></th>
<th><strong>Sail rig / Slip joint</strong></th>
<th><strong>Action required</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 5 metres</td>
<td>&gt; 5 metres</td>
<td>6.5 metres OR immediately when recognized by DPO</td>
<td>10 metres</td>
<td>If threat to position</td>
<td>Any failure or loss of performance in any system</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>No controllers or network alarms</td>
<td>3</td>
<td>0.1 to 0.5 deg</td>
<td>0.1 to 0.5 deg</td>
<td>0.20 m/s</td>
<td>Situation specific</td>
<td>0.4 m</td>
<td>45 to 17 deg from BOP</td>
<td>Fully operable</td>
<td>Normal status</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 or loss of backup wind sensor (stb etc)</td>
<td>1 or loss of backup MRU (No. 1)</td>
<td>If threat to position</td>
<td>1 or loss of failure of backup controller</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Loss of one network or one of redundant controllers/servers</td>
<td>1</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>117 deg advice BP Group</td>
<td>Any failure or problem</td>
<td>Normal condition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If threat to position</td>
<td>If threat to position</td>
<td>If threat to position</td>
<td>If threat to position</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>Loss of 2 of the redundant controllers/ servers in any system</td>
<td>1</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Situation specific</td>
<td>Issue alarm and follow procedures</td>
<td>Normal condition</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 13 WSOG Sample
Incidents

Incidents showing ‘good’ and ‘bad’ use of WSOG. The following trees represent 2 events which have occurred during deepwater DP drilling. They are used to highlight two separate occurrences where WSOG use were factors

Incident 1

Class 3 semisub in operation

No WSOG and incorrectly defined degraded conditions

Blackout occurs

Major investigation Helicopters fill the sky. >10 personnel join rig

Full HAZOP using blank WSOG form with everyone involved

>15 hrs of ‘negotiations’ between Rig Owner, crew, consultants and Operator

WSOG for drilling & DST agreed

Everyone happy & consent to drill given based upon WSOG agreed limits

Discussion

This incident shows that the process itself was used as the HAZOP. All 84 boxes were discussed jointly between the Contractor, crew and Oil Company and a number of representatives. Everyone was happy that the exercise was valuable and the rig went back to work. It was interesting that some of the boxes within the WSOG took many hours of discussion to complete. How did the DP Operator cope ‘in operation’ when the debate took such a long time during a meeting. Question.
Incident 2

Class 3 DP drilling
WSOG in place & agreed/signed + Client
Loss of auto heading. Unknown cause
Loss of position > agreed in WSOG for ‘Red’
Vessel keeps working with minor non-consequential report

4 weeks later

Identical incident as 4 weeks earlier. Auto heading loss >80 degrees. Major incident & disconnection with accident

Full HSE investigation leads to investigation of event 4 weeks earlier. Terms the failure to operate correct limits as ‘missed opportunity’.

Continued ‘correct’ use of WSOG re-iterated to Operator

Source: UK HSE & AAIB

Discussion

This incident shows that, even when the correct process has been followed, there can be no substitute for effective training and experience aboard the unit. The major error made in the incident detailed above was the failure to follow the process detailed in the agreed WSOG.

Incident investigation

During investigating any LOP (loss of position) event or blackout even with no LOP, most investigators would immediately ask for the limits in place & the operating mode leading up to the event.
**Additional Uses of WSOG**

The WSOG alert and reporting regime have been, and are in use on well intervention units Regalia, Seawell and Island Frontier, working for Statoil in the North Sea.

The DP Floatel industry in the Norwegian Sector has developed FOGS (Floatel Operating Guidelines) along the same principles as WSOG.

In addition Statoil are currently working on updated requirements for moored units due to the large number of incidents with dropped chains and dragged anchors. The group is proposing WSOG principles to be implemented on moored units as an efficient early warning and HAZOP tool. The non-DP moored unit sector in the US may well find advantages in this approach.
Conclusions

1. WSOG has proved that it has an important role to play in the establishment of safe working practices for offshore drilling units. There are a great number of lessons to be captured from its use.
2. Effective operating limits must be agreed between the contractor and operator at ‘pre-spud’ in order to avoid confusion caused by contractual arrangements offshore.
3. WSOG allows for all manner of ‘change’.
4. In US GOM, some operators view Advisories as ‘crucial’ therefore fundamentally supporting the use of WSOG.
5. WSOG clearly works equally well with drillships and semisubs.
6. Has had a degree of take-up in other non drilling DP sectors such as floatel market.
7. The concept of lessons learnt and continual improvement is allowed using this procedure which must be embraced & continued.
8. Having drilling personnel ‘trained’ in one process has great appeal to Oil Majors. It means that experience can build between rigs/ships of different contractors.
9. Contractors must accept that Operators have a vested interest in operational risk issues. (Procedures, reporting). This will always increase because station keeping incidents will continue.
10. The use of Advisory to handle changes in the units operating status from Non-DP changes is ideal. I.e. Pseudo Oil Based Mud / riser displacement timings. Non-shearable exposure timings.
11. History has shown that by having a mature WSOG system aboard, this will satisfy Oil Operators & regulators verification processes.
12. WSOG eliminates negative reporting if followed correctly. Ref. Incident No. 2
13. Limit setting HAZOP should take place prior to each well. (Even if everything is the same)
14. There must be consensus following the WSOG limit setting exercise & ‘sign-off’.
15. The limit setting exercise should involve, as far as possible, personnel who have working knowledge of the rigs operating criteria. The supply of experienced & competent crew is central here and further re-enforces worries in the industry.
16. Incorrect figures placed in WSOG can make the DP drilling less safe. There have been incidents caused by incorrect figures.
17. Is ideal tool for HAZOP and has been successfully used in other ‘non drilling’ DP scenarios
18. Norway is advancing the WSOG concept for use in moored operations as a early warning HAZOP process.
19. There has been a large ‘take-up’ of this simple form since 1999 which should indicate that the process works.
Real-time feedback Survey

The paper presentation concludes with an open questionnaire to all participants in the hall (audience). The authors, with the help of the MTS committee, would like to conduct a poll of the audience with the following 4 questions:-

1. How many people (in DW drilling) know about WSOG in limit setting regimes? (count)
2. How many people use them on their rigs/ships as policy? (count)
3. How many people present believe that WSOG (in its present form) works well for their operation? (count)
4. How many people wish to change the present method of limit settings for something else? (count)

The authors propose noting the response figures in order to allow the MTS DP committee to use the data in further debate on the limit setting issue.

POST CONFERENCE ANALYSIS

The questionnaire took place and the following represents the findings. We estimated a total of about 75 personnel were present for the survey.

1. How many people (in DW drilling) know about WSOG in limit setting regimes? ANSWER = 19

2. How many people use them on their rigs/ships as policy? (count) ANSWER = 13

3. How many people present believe that WSOG (in its present form) works well for their operation? (count) ANSWER = 14

4. How many people wish to change the present method of limit settings for something else? (count) ANSWER = NIL

Therefore, 68% of personnel involved in DW drilling have WSOG as Policy. 74% approve of the WSOG as it works well. 0% wish to change the limit setting regime in place.

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