SOME ERGONOMIC ISSUES OF DP VESSEL CONTROLS

M Hadfield, Health and Safety Executive, UK

SUMMARY

A number of loss of position incidents have occurred due to accidental, unintentional, transfer of control from DP to manual. The incidents can be attributed largely to poor ergonomic design of the DP control systems.

A particular incident with a drilling rig is described and the weaknesses in the ergonomics discussed.

Similar situations have been found on other vessels. The measures being taken, or considered, by the industry and regulators are described.

1. INTRODUCTION

The Health and Safety Executive, is a UK government department. Amongst other duties, it is the regulator for health and safety in the UK offshore oil industry. It became aware of a loss of position incident on a drilling rig in 2016 and participated remotely in the Drilling Company's investigation. HSE formed the view that it was largely due to poor ergonomics.

A Safety Alert to advise the industry was issued. HSE at the same time, became aware of two very similar incidents worldwide. Since then more have come to light.

The main ergonomic weaknesses were a) inadequate protection against accidental transfer of mode of control from DP to manual and b) no clear indication that mode of control had changed from DP to manual.

The situation on other vessels is discussed together with actions taken by regulators and others.

2. INCIDENT

2.1 SUMMARY

A semi submersible DP drilling rig lost control of position for several minutes while it was connected to a well by its drilling riser pipe. During this time, it was obliged to shear the drill pipe (which passes through the riser and down into the well) and disengage the lower marine riser package, LMRP. The initial loss of control was due to accidental disengagement of the DP system. The crew immediately noticed loss of position but did not appreciate that DP was disengaged. They initially believed there was a technical fault with the DP and it took 6 minutes before they realised the DP was disengaged.

Both the loss of position control and the inadequate initial crew response were largely due to poor ergonomic design of the control system. Firstly, the button for transfer from DP to manual control was not protected against accidental operation. Secondly, there was no clear indication at the DP desk that DP was no longer engaged, and that the vessel was then under manual control.

2.2 CAUSE

The Company's investigation found that the initiation of the incident was accidental, unknowing, operation of the button used to transfer control from DP to manual. (A dual push was required but this gave inadequate protection in this instance.)

2.3 RESPONSE

The DP Operator on the DP desk thought that DP was still engaged and continued to operate at the DP control desk and tried to find a technical fault. There was no clear indication at the DP desk that control had passed from DP to manual lever mode. (The utility panel for selection of DP or manual mode was two desks away from the operational DP desk, and there was no clear indication on his screen.)

As is normal practice, there were two DP operators on duty. Typically, one monitors and adjusts (if necessary) the DP set up for a period of 2 hours while the other is engaged in other bridge work. They then swop over.

If a drilling vessel loses dynamic positioning it will move off its designated location. The riser can accommodate movement within certain limits, but if these are exceeded the riser tensioner system, or other parts of the riser package, will reach the end of its travel and serious damage can result either on the drilling rig or the subsea well. To avoid this, it is normal to make an emergency disconnect. This requires the driller to shear the drill pipe with the shear rams in the seabed blow out preventer, BOP. (He must first adjust the height of the drill string to ensure that there is not an unshearable drill pipe joint in way of the shear ram.) Valves on the seabed BOP and the bottom of the riser, LMRP, are then closed and the LMRP is disconnected from the BOP on the top of the well. The riser is then hanging freely below the drilling rig as it drifts off location. Depending on all the circumstances, if this is not done before the riser limits are reached, it may prove

impossible to perform some or all of these actions. In the worst scenario, for some situations, oil and gas could reach the drilling rig or sea surface and threaten the installation.

An out of position alarm is raised once a 'warning circle' is reached. Everyone then knows that unless position control is regained, an emergency disconnect must be affected and that there may be very little time to do so, depending on how quickly the rig is moving off location. An emergency disconnect in itself has high cost consequences. Recovery can take many days. The rig must be repositioned and reconnected to the well – assuming the well owner is prepared to allow the rig to continue. The drill and sheared drill pipe left in the well must be recovered before a new drill string is made up to continue the work.

In this highly pressured, stressful period, the bridge team's effort is divided between trying to regain position control and preparing for emergency disconnect by keeping the driller (situated near the drill floor) informed. An added complication in this incident was that a supply vessel was connected and bunkering fuel to the rig at the time. The bridge crew had to liaise with this vessel and arrange its disconnection.

The offshore installation manager, OIM, of course came to the bridge at this time.

In the event, after 1 minute an alert was issued to the drill floor, at 3 minutes, the 'red' limit of 8 metres off location was reached and the emergency disconnect sequence commenced. At 5 minutes successful emergency disconnect was achieved as the LMRP was unlatched from the BOP.

At 6 minutes it was realised that vessel mode of control was in manual, and the bridge team was then able to control the position of the vessel.

2.4 ERGONOMIC FACTORS

The control desks and layout are shown in Figures 1,2 and 3. During the incident, the middle DP desk was the operational desk at which the DP operator was working.

The buttons to select mode of control are in a small utility panel on the riser management desk which was two desks to the operator's left. Fig 3 shows the DP selector button illuminated to show DP is selected. The adjacent button would select manual lever control, and that button would then be illuminated.

Two main ergonomic factors contributed to this incident:

2.4(a) Inadequate protection against accidental change of DP status – mode of control

The only protection against accidental activation was a double push requirement on the button. This required two pushes within 2 seconds.

Better protection measures are given in American Bureau of Shipping Guidance, Ref 1. Section 2 Controls 2.7 Prevention of Accidental Activation states:

> Controls should be designed and located so they are not susceptible to accidental activation. Methods to reduce the likelihood of accidental activation include:
>
> i) Locating and orienting the control so that bumping is unlikely to cause activation
> ii) Providing sufficient control resistance to prevent unintentional movements
> iii) Requiring complex motions for control activation, such as an interlock or rotary motion
> iv) Restricting access to controls by isolating them or by providing a cover guard or physical barrier

2.4(b) Inadequate Indication of Status or Mode of Control

There was no clear indication at the DP control desk that DP was disengaged and the vessel was now under manual control. The desk in use was the middle desk – OS#2 in Fig1.

The main message on the DP screen was 'THRUSTER NOT READY'. In the circumstances this is not helpful. It could indicate a variety of situations. It certainly does not convey the fact that the mode of control had switched from DP to manual.

(DP screens can be very busy containing much information. There may have been a small display somewhere on the screen from which change of mode of control could be inferred.)

The most obvious indication would have been the light on the lever manual button on the utility panel which would have become lit rather than the adjacent DP button. However, that is not actually very obvious being some distance from the then operational DP desk and (it is believed) both lights were the same colour.

The equipment did not comply with Industry guidance. For instance, the ABS Guidance, Ref 1, Section 3 2.4 'Status Information' states:

> - Visual displays should provide a positive indication of the state of the equipment such as: ready, running, not running, etc.

Similarly, the IMO Circular, ref 2, Section 3.4.1.3 states:

- The active (control) mode should be clearly displayed.

2.4(c) Other Ergonomic Aspects

The investigation found that it was likely that the manual button had been accidentally activated when someone was working at the Riser Management desk. It might have been leant on or notes might have been taken above the button. Possibly papers or documents needed for this work had been placed on top of the button. It is recognised bad practice to place anything onto DP desks in this manner. However, the equipment designers do not seem to have provided a suitable place for such papers.

The company also found that the audible alarms did not comply with good practice on alarm management. This aspect is not considered further in this paper.

2.5 CORRECTIVE ACTIONS TAKEN

Soon after the incident, a cover guard was fitted to the utility panel as shown in Fig 3.

Other actions taken by the company included a ban on objects, including paper, being placed on DP consoles, increased DPO participation in Emergency Drills, and such drills to include unexpected change from DP to Manual mode.

3. OTHER INCIDENTS

In 2016, NOPSEMA, the Australian regulator, and the US Coast Guard issued safety alerts about very similar incidents relating to a Dive Support Vessel and a Drill Ship respectively. The alerts are listed as Refs 4 and 5.

IMCA, the International Association of Marine Contractors, has issued a 2018 Bulletin, Ref 6, saying it was aware of 9 similar incidents for the three years, 2015 thru 2017, of which 6 were with double push button and 3 were with single push button.

4. HSE EXPERIENCE

Since the 2016 incident, this topic has been inspected when HSE Maritime Integrity inspectors have visited DP installations.

It has been found that most of the vessels originally had no protective covers over the control mode selector switches. (Switches may be button or other type.) About half those visited had at some point fitted protective covers. Where no cover was present, the owner was required to fit one. To date this has been done willingly.

Such covers are normally held onto the control desks by adhesive, because screwing or bolting them in place could jeopardise the warranty on the equipment.

It has been found that DP systems from the incident's manufacturer have the same weaknesses in information display. There is no clear indication of the mode of control (manual or DP) at the DP screens, and the same alarm message 'THRUSTERS NOT READY' would appear. In comparison to fitting a protective cover, improvements to this aspect are less easily achieved because they require software changes and the active involvement of the equipment supplier.

On initial contact, the DP manufacturer felt there was nothing wrong with their systems and equipment.

It has also been found on a number of vessels that there was no suitable place for papers, checklists or notes etc, to be positioned. In one case a shelf had been fitted by the crew on the side of the bridge chair for this purpose.

It seems likely that either ergonomic expertise was not involved in the design of the control desks by the manufacturers or the original customers or it was somewhat ineffective.

5. WIDER INDUSTRY RESPONSE

At the 2017 IRF, International Regulators Forum, AGM in Denmark, NOPSEMA, with HSE backing, presented the latest information on the risk posed by design-induced human error for DP systems. The offshore industry regulators agreed to pursue these issues in their jurisdictions.

Additionally, NOPSEMA has delivered the presentation at industry conferences and included a number of articles in their 'Regulator' magazine. They also wrote to global DP manufacturers seeking information on the steps they have taken regarding the tolerance of their systems to human error. From the four that responded there was a general recognition that double-press buttons are susceptible to human error.

One DP manufacturer issued a DP Information Letter in March 2018. This states that for decades the double push button has been an accepted means to act as a safety barrier against accidental deselection of DP mode. Several vessel owners have requested the company to provide an additional barrier of either a protective cover or a software function providing screen based pop-up dialogues. (These would require confirmation of deselection of a control mode.) The manufacturer prefers the software option and considers that the decision to install an additional barrier is the owner's responsibility.

6. CONCLUSION

The incident described, plus several others, would probably not have happened if there had been better protection against accidental deselection of the DP mode of control.

There is increasing recognition that a double push button does not by itself provide adequate protection. In the offshore oil industry, many installations and vessels have now fitted protective covers over the mode selection switches. This is one of the recognised protective measures in American Bureau of Shipping guidance.

Effective response to the loss of position was delayed, because, contrary to industry guidance, there was no clear indication on the DP screen of the current mode of control – which would have indicated that control had transferred from DP to manual. The author is not aware of improvements directly meeting this requirement. However, software modifications are becoming available which require transfer of mode of control to be confirmed before implementation.

Other ergonomic weaknesses present were inadequate locations for papers and documents, and unhelpful alarm arrangements.

It would appear that, at the design stage, Human Factors ergonomic expertise was either not employed by the manufacturer or the original customers or it was somewhat ineffective.

7. REFERENCES

1. 'Guidance Notes on The Application of Ergonomics to Marine Systems'
American Bureau of Shipping 2013

2. 'Guidelines for Vessels with Dynamic Positioning Systems'
International Maritime Organisation MSC Circular 645

3. 'Some Ergonomic Issues of DP Vessel Controls', Health and Safety Executive (HSE)
Safety Alert Bulletin ED3 2016
http://www.hse.gov.uk/safetybulletins/dp-vessel-controls.htm

4. 'Vessel loss of position whilst diving in close proximity to a hydrocarbon facility'
NOSPEMA (National Offshore Safety and Environmental Management Authority)
Safety Alert 62 June 2016
https://www.nopsema.gov.au/assets/Safety-alerts/A484748.pdf

5. 'Lessons Learned: Dynamic Positioning Ergonomics'
USCG National Centre of Expertise
'Drill Down' Issue 7-LL October 2017
https://www.dco.uscg.mil/OCSNCOE/The-Drill-Down/
in the listing item 7.

6. 'IMCA DP Station Keeping Event Bulletin 01/18'
International Marine Contractors Association
February 2018

8. AUTHOR'S BIOGRAPHY

M Hadfield has been a Specialist Inspector in the Maritime Integrity team of the Energy Division of the UK Health and Safety Executive since 2009. He deals with the marine integrity aspects of floating offshore installations through inspections, incident investigations, and safety case assessment.

9. FIGURES

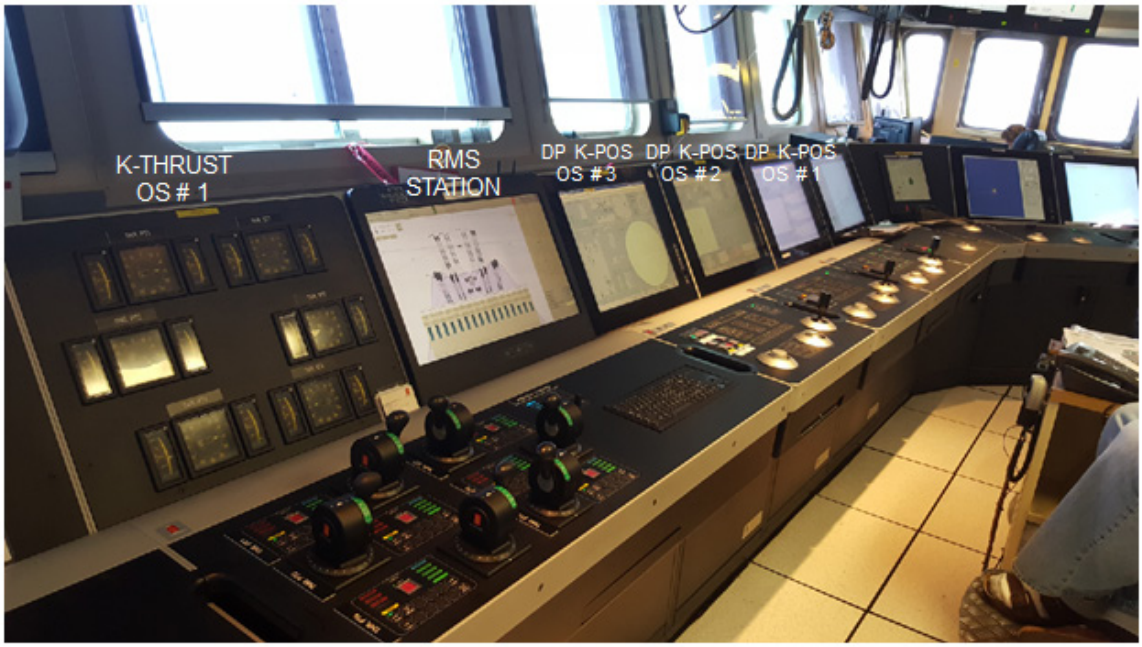

Figure 1: Bridge View showing manual lever control desk, RMS riser management desk, and three DP control desks.

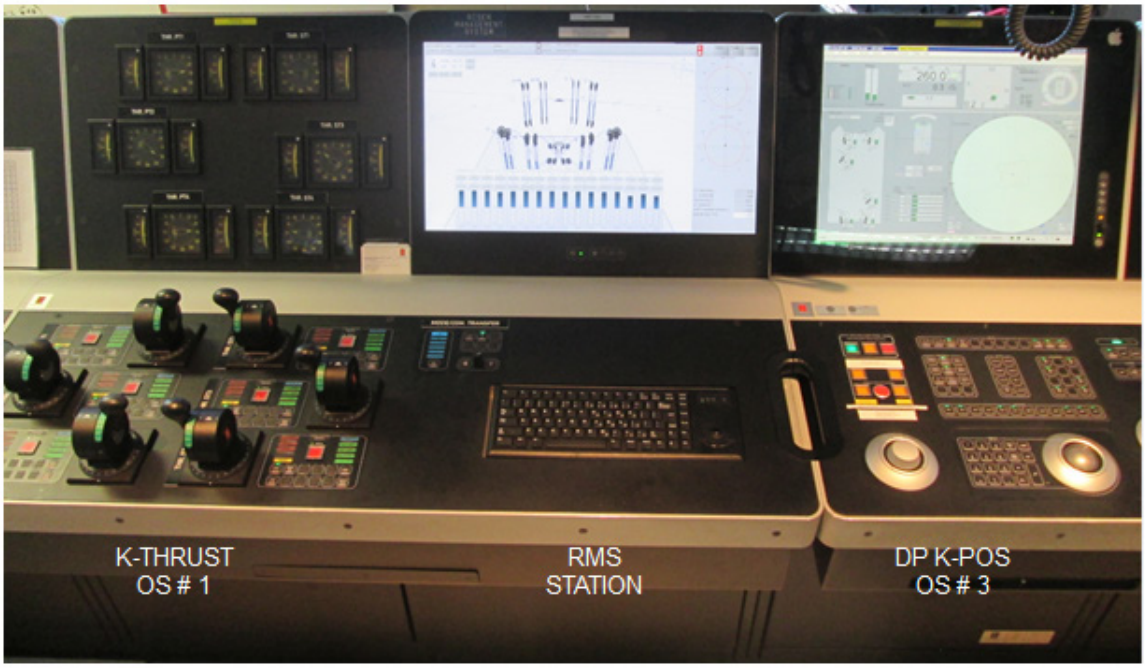

Figure 2: Close up of manual lever desk, riser management desk, and one DP desk. The utility panel is top left on the riser management desk

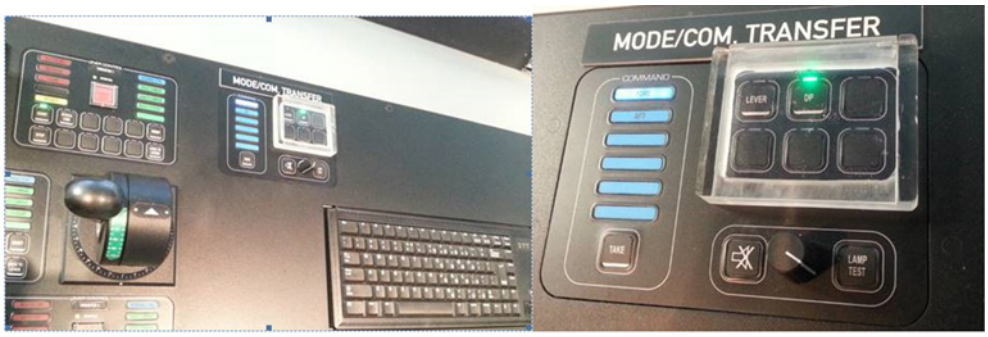

Figure 3: Close ups of (left) a manual lever control and the riser management desk, and (right) the utility panel with a protective Perspex cover fitted after the incident.