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DP PAST, PRESENT & FUTURE

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SUMMARY

Fifty years of DP is a small line in time. This paper looks at just the last 30 to help keep todays DP performance and safety in perspective. It is in three parts; past, present and future. The past part outlines the evolution of good practice between 1980 and 1994 and then covers the major changes shortly thereafter with the boom of new DP Class 2 and 3 vessels and the soaring expectations of clients. The present part shows how there has been a shift (a drift off perhaps) in expectations and a growing concern with safety. It concentrates on the DP Class, the DP work and the DP Guidance and compares past expectations with present expectations to provide input to future predictions. The future part gives three scenarios and takes them down in a logical sequence. One is pessimistic, one is optimistic; the third is the one in between and perhaps more likely. Each of these is discussed as it affects different DP work. The foundations of safe and reliable DP is also discussed and the most important area for attention to achieve the optimistic path.

PAST

The offshore industry started to take DP seriously in the early 1970s and there were several companies interested in producing a DP control system. However by the mid-70s there were three main suppliers Honeywell, GEC and Kongsberg. Initially the most successful was Honeywell in California and the new boys on the block were Kongsberg. The increase in demand at this time came from marine contractors who were being pushed by diving contractors. The diving contractors could see an increase in demand for their services from offshore projects needing saturation diving spreads. The water depths for offshore structures had become marginal for air range diving.

These early vessels were installed with a single analogue DP control system with no UPS, only one position reference on line and just enough power and thrust for good weather. If there were spring tides the power and thrust was very marginal but generally the divers stopped work before the DP capability was exhausted. Redundancy was not the prime consideration; recovery of the divers came first. There were many single failures but in comparison to what had been used before there was an improvement. The DP performance of different vessels was well known to divers; they judged each DP vessel by the following observations.

- The frequency of having to abandon the dive
- The ability to make a move and stop accurately
- The DP footprint during their working periods

The latter could be seen as well as felt as the clump weight made the shape of a footprint on the seabed. It was foot shaped because the vessels at this time were mono-hulled and the surge oscillation is always greater than the sway on this type of vessel. The early DP control systems did not learn in the same way as systems do today nor were the thruster curves so well documented and set up so there was a significant difference between vessels; divers spread bad news very quickly about any vessel that had a large footprint.

The DP problems caused concern but there were not so many problems that the set up was deemed 'unsafe' as it would be today. The reasons for this are in part because if the DP failed it was obvious and the station keeping control then reverted to manual control which is what the bridge team were used to before the DP was installed. Position only had to be maintained enough to safely recover the divers. This did not mean perfect station keeping; the critical factor was the speed of the position loss. It meant the dive support work was safe if the position loss (drift off) could be reduced so the divers could swim to safety.

In these circumstances it was also easy to blame the equipment; the DP operators did not have difficulty explaining any position loss they only had to defend their ability to hold station in manual control and this was difficult to measure unless they made contact with the offshore installation.

Nevertheless the suppliers of DP control systems were delighted to respond to "equipment" problems and offer dual redundant DP control systems. These were however not bumpless initially i.e. if the system being used to command the thrusters failed there was no certainty that the backup would have the same set point. So a drive off could take place when changing from one system to the other. Tests to show this does not happen with modern systems are still done but the circumstances now are such that the backup should always be the same. The two DP control systems also had a UPS but just one for both control systems because the U in UPS stands for ***Uninterruptable***. It took a few years for it to be realised that a UPS could completely fail. Today we have at least 2 separate UPS units and often both supply both DP control systems. The DP control systems were also able to accept 2 position references, one on line and one hot stand by. The effort and attention tended to be towards the DP control system and not to the "machinery". The norm for DP vessels was one engine room and just enough power and thrust for conditions in which divers could work.

By the end of the 1970s it was clear that some DP rules or guidelines were necessary. The range of DP DSVs varied greatly between the early conversions to the latest purpose built vessels. The initiative to set some guidelines came from the UK DOE (Department of Energy) and the AODC (International Association of Offshore Diving Contractors) and a set of guidelines was developed in 1978-9 and published in 1980 in the UK. There were several inconsistencies in this first document and as several of the marine contractors and one of the DP control system suppliers were Norwegian there was a need to get at least a North Sea agreed set of guidelines. The discussions were in progress in 1980 but it was not until 1983 that the first set of international DP guidelines was jointly published by the UK DOE and the Norwegian NPD. These were the foundation for what has followed but they only applied to dive support vessels.

It is worth examining some points made in these guidelines and thinking about how loss of position is viewed today.

1. No single fault shall cause a catastrophic failure
2. Never exceed vessel's capabilities
3. Capable personnel
4. FMEA
5. Withstand the loss of one thruster
6. Withstand the loss of one diesel generator
7. Withstand the loss of one switchboard
8. No failure to full thrust allowed for any propeller
9. Three position references: 2 on line + one standby
10. Duplex DP control system or Simplex + Joystick

There is implied acceptance that if something fails there will be a loss of position but there was confusion with respect to withstanding failures; e.g. one thruster and one diesel generator when one switchboard is also mentioned. This is understandable if the design has four tunnel thrusters (two forward and two aft) and two directly driven main propellers. However today we still see DP vessels using the one thruster failure as a criterion for assessing a safe working DP capability. The most surprising point however is that diving support was allowed with one DP control system and a joystick back up. The reasons for this were pragmatic; there were vessels working like this and the failure rate with unacceptable results was not causing concern in 1983. Nevertheless the difference was seen as significant and some oil companies would not hire these vessels if they could avoid it. This helped the vendors of DP control systems.

The other point that is worth making here is that CPP (Controllable Pitch Propellers) were the norm and almost without exception they could fail to full thrust. This same requirement was in Class Rules but the vessels with CPPs that failed to full were still given Class Certificates. Evidence that this prevailed is perhaps best illustrated by the UK HSE studies into DP shuttle tankers part of which was presented at the MTS DP conference in 2006 in the paper entitled FPSO and Shuttle Tanker Positioning.

During the 1980s these guidelines were applied, with mixed success to DP vessels doing other work like ROV support and cable laying and accommodation or multirole support. Here the vessels that come to mind are the Tharos, Stadive and Iolair. The Tharos had a Honeywell system, the Stadive a GEC system and the Iolair a Kongsberg system. These guidelines and the range of differences between vessels also triggered much testing of DP vessels. The contracts were generally short so that vessels were passing from one oil company client to another within a few weeks. The effects of this were vessels were getting tested many times per year. Lots of good weather time was consumed and frustration within the marine contractors grew and created a DP ‘wind of change’.

It was in this environment that DPVOA was started with Global Maritime as the secretariat and the support of both the UK and Norwegian Authorities. The advantage to the UK DOE was that they would no longer fund the collection and publication of DP incidents to a single source and yet this work would continue. The advantage to the marine contractors was that with luck they would stop frequent DP testing and make it once a year, at a time and place of their choosing.

The history of DP for this time is well documented elsewhere but in summary the early 1990s achieved the following.

- Annual DP trials
- IMO MSC 645
- M103 Guidelines for the design and operation of (all types of) DP vessels
- IMO MSC 738 (Currently IMCA M117)
- International DP Guidance
- Merger of DPVOA and AODC

From IMO MSC 645 all the Classification Societies were able to revise their widely different notations for DP vessels and reflect the DP equipment classes therein. On reflection MSC 645 has stood the test of time quite well. Not all Class Societies got equivalence right first time and since this time they have diverged significantly. This IMO document is not perfect; the three points that are questioned most frequently are as follows.

1. Why is a power management system optional?
2. Why are open and closed bus ties optional?
3. Why doesn’t 2x DGPS and 1x HPR not meet DP Equipment Class 2 and 3?

At the time of drafting there were vessels without a power management system that had been accepted as meeting this new draft. These vessels carried out DP operations with all diesel generators on line and the DP control system was relied on to stop ordering thrust for which there was no power. In other words there was power management but not a separate processor for this purpose. The other point is that power management was not well defined and that is really the case today. Power has to be managed but the extent to which this is done is optional; as power generation systems have grown so has the scope and redundancy of the PMS. The requirement not to lose position means the vessel must not blackout; this implies that the power generation has to be managed.

The open and closed bus-tie option was included because this also reflected the view of the industry at the time. The flag states represented in the working group included UK, Norway, USA, Poland and China but agreement hinged round the first two. The main bus tie situation remains unchanged today; open bus ties are de rigueur offshore Norway and it is very difficult to state that blackout is impossible from every possible fault with closed bus ties and be correct. Indeed DP incident data has shown that blackout is possible even with an open main bus tie breaker. In the DP drilling incident, (Ref. IMCA M211 2009) it shows that a single fault on one diesel generator caused the blackout and although the bus tie opened it didn't prevent the loss of all the thrusters and a disconnection.

On the last question the text in IMO MSC 645 is unfortunate but reflects the situation in 1992 when it was drafted. There were 3 types of position reference, mechanical (taut wires), acoustic (HPR) and radio. The latter covered Syledis (SYstem LEgere pour mesure le DIStance) , Artemis, MicroFix and similar systems. GPS was in existence and being tested for DP use at this time but was not accepted as a position reference. It would in any case fit into the 'radio' box. The clause in IMO MSC 645 is shown below.

When two or more position reference systems are required, they should not all be of the same type, but based on different principles and suitable for the operating conditions.

If a vessel is using a GPS fix and a GLONAAS fix and one acoustic fix then MSC 645 is in the author's opinion, being complied with. It is also complied with if two independent HPR fixes and one DGPS fix is being used. Compliance is not achieved with 2xGPS and 1xHPR nor is it complied with by 3xDGPS and 1xHPR even if there are ten transponders in the LBL array. There is of course a case to make here, (especially as the IMO HSC Code is quoted as a reference for DP FMEA work) concerning risk, reliability and redundancy. If the failure rate for DGPS was 1×10^{-5}/year and a failure could be managed safely why are 3 independent position references still essential? DGPS is not this reliable and even today all DGPS fixes are rejected on loss of their differential corrections on many newly commissioned DP vessels. As can be seen from the DP incident reports (M211 DP Incidents 2009) DP work is carried out with just DGPS and all can fail at the same time. Such failures are categorised as sensor failure but the underlying cause is the DPO or his management.

PRESENT

The present situation with DP is that it is peculating into all offshore vessels and many vessels that would not have expected to be DP are not just DP but DP 2. This has created a significant demand for DP qualified personnel and a massive disparity in the type, quality and value of DP experience. The guidance on training and experience was written with DP DSVs in mind primarily and construction vessels secondarily; they were not written with deepwater drilling in mind. At the time there were drillships working on DP and they had one DP operator on duty and two DP operators on board working a 12 on 12 off rota. In addition these operators were often not marine watchkeepers. Electrical technicians were used. Today this has changed and marine personnel are used almost exclusively. There are also two of them on watch, one on the desk and one nearby. The duties the second man performs vary extensively between different DP vessel types and also between vessels of the same type. At one end of the scale the second man is checking the first while at the other end of the scale he is tied up with other work in another part of the bridge. It is difficult to say the first is the only safe way to operate. It is also difficult to justify the latter practice especially when it is against DP guidance and in many cases against the particular vessel's own operations manual or Company Safety Management System.

The other major change is that it is increasingly difficult for the DPO or any one of the key DP personnel, to blame his DP equipment when there is a loss of position; an increasing number of DP vessels have a data recording system which can show very clearly the sequence of events leading up to a position loss.

The good thing about the DP control systems today is that change over between them is bumpless and although most still have alarms for A≠B these alarm are not heard and are seldom tested. Even trying to make one DP controller different to prove the 2 out of 3 voting with a triplex system is difficult. To DP personnel brought up with these alarms from old systems like the ADP 503 these recollections are laced in nostalgia. Despite this significant improvement in the reliability of DP control systems there has been pressure, supported by Statoil in Norway for further and deeper testing of DP control system. This is enormously expensive and dubious in value. Nevertheless marine and drilling contractors have spent these considerable sums and been led to believe that this has made their vessels superior. This is often not the case. If they had spent one tenth of this money writing and verifying a DP operations manual that is worthy of this title and making sure it was properly used the impact on DP safety would have been much greater.

From a situation where many DP vessels only just had enough power and thrust for the conditions in which they could work, we have moved to a position where many vessels have significant redundancy in terms of the number of thrusters and diesel generators. This would not be the situation in a 10 year storm perhaps but for most of the year there is enough spare capacity to maintain position after the design worst case failure plus one diesel generator or thruster being unavailable. However, as with all good things, there is a downside to this if care is not exercised. Taking DP drilling as an example the failure of a diesel generator in good weather would (or should) cause an Advisory Alert even if the particular DG was replaced by the next standby machine. The situation would then most likely revert to Green. If a second failure took place making one thruster also unavailable a similar process would take place and the rig could again revert to Green status. This situation however is not in the operations manuals or in the FMEA report and yet the worst case single failure effect might be significantly different.

The situation is potentially quite serious if the weather deteriorates because the combination of one thruster and one DG could significantly reduce the DP capability if the new worst case single failure takes place. In other words the whole WSOG is no longer valid and action should have been taken to modify it before the weather deteriorated. This sort of situation is further affected if the practice of shutting down thrusters is common place. The probability of a thruster not starting when wanted is much higher than the probability of a thruster not delivering a sudden load increase when it was already running. There certainly is an advantage in not running a CPP thruster if it is not needed; the same is not true for a VSD thruster.

Although the DP2 and DP 3 requirement is for 3 position references, and 3 gyro compasses there is a growing practice of having some additional redundancy so that DP Class can be maintained if one unit fails. Some DP vessels have 5 or 6 position references, 4 gyro compasses, 3 MRUs and 3 anemometers. This is commendable provided the hook up, commissioning and testing is all done properly and the relevant key DP personnel know how to manage them. This means for the DP controller and the individual position references.

There are very few offshore projects that do not use DP vessels, the pictures of all the DP vessels in Macondo Prospect area when the relief wells were being drilled illustrated just how important DP is to the offshore industry and probably just how critical DGPS has become. DP is used for Exploration, Construction, Production and Export. It is used for absolute stationary positioning, relative positioning with respect to a moored or moving unit and it is used for following a track. However the certification and approval of DP is based on the vessel being free to move in surge, sway and yaw without any external force other than the environmental loads from wind, waves and current. This is not altogether satisfactory because for the following DP work there are other loads and influences to take into account.

- Drilling Unit (Riser loads)
- Shuttle Tanker (Hawser)
- Flotels (Gangway)
- Heavy Lift Vessel (Lift)
- Pipelay (pipe)

For the first three the loads are small if the position is kept well and in the case of the Flotel the gangway remains free. There have been cases where the position loss has increased suddenly on EDS on a drilling unit. There has been significant instability caused on shuttle tankers and heavy lift vessels but the most significant external loads come from S-Lay operations. In all cases the DP capability plots do not take into account the working situation. For S-Lay the DP design worst case failure capability plots do not consider the thrust used to keep the pipe tension for example. So the vessel can be classed as DP 2 or 3 but if laying pipe is in effect DP 1.

Position references in common use at present comprise the following.

- Satellite
  - DGPS (GLONASS as a standalone system is not used successfully)
  - DARPS (Shuttle tankers primarily)
- Acoustics
  - LBL*
  - SSBL/USBL *

  *Sometimes with inertial navigation 'fill ins' to help with update rates
- Line of sight systems
  - Artemis (9.7-9.8GHz),
  - Fan Beam (Laser),
  - Cyscan (Laser),
  - RADius (5.51-5.61GHz)
  - RADAscan (9.2-9.3GHz)
- Mechanical
  - Vertical Taut Wire
  - Horizontal Taut Wire
  - Gangway

DP class 2 or 3 is given if a vessel has any three, even if one or more system is only hire for the vessel's initial trials. DP Class is also frequently given when two of them are DGPS systems. The Classification takes no account of the work the vessel is designed to perform and whether the installed position references are suitable for the relevant marine operations involved. IMO MSC 645 makes it clear that the position references have to be suitable for the marine operations that the vessel is designed for. Position references are shown to be the biggest cause of DP incidents from M211 but on closer inspection this is misleading because so many of the reports are not really incidents because there was no loss of position but downtime. Of the 75 shown only 33 can reasonably have caused a loss of position. A breakdown of these is shown below.

Environmental forces 4 (A couple of these the operator should have avoided by earlier action)

Loss of all gyro compasses 2 (This should never have been possible)

Fault on one diesel generator 3 (These were serious incidents and could all be blamed on the set up)

Fault on one thruster 5 (The reports do not state whether they were all CPPs)

Loss of all DGPS 3 (No other position references so set up can be blamed)

DP software 2 (No close out to confirm this and no detailed information)

Design Worst Case Single Failures 2 (Position excursion assumed to have happened)

Operator Error 12 (This is 2 more than in M211)

It is clear however that it would be quite simple to blame the key DP personnel for most of these incidents because of a direct mistake or a poor initial set up or failure to check properly. Report 39 illustrates this point well. There were 7 thrusters but only 5 were on line; a fault on one diesel generator then caused the loss of 3 of the 5 thrusters leaving just two on line to keep the drilling unit in position. There was insufficient thrust and a red alert.

DP drilling units have for several years used a WSOG (Well Specific Operational Guidelines) with an Advisory Alert. This was developed, in part because red alerts were following straight after yellow alerts and there was no time to properly consider redundancy degradation. From the above this seems to have failed and this is also the author's recent experience. The WSOG is a good development but, like everything else if it is not properly set up and used it can have the opposite effect to that intended.

The WSOG approach is beginning to be applied to all DP work as evidenced by the DNV RP E307 entitled Dynamic Positioning Systems - Operation Guidance. This is essentially the document MTS published last year. The WSOG concept is used and called ASOG's (activity specific operational guidelines). Each vessel has a design safest mode of operation', but this is not always clear from the FMEA. GM wrote a document called "The safest Mode of Operation" for IMCA several years ago but the Marine Committee at the time decided not to publish it to the membership because it would be controversial. This scheme sets out a method of making clear in as few words as possible the safest mode of operation for a (DP) vessel during a particular operation and puts triggers in place for a risk assessment prior to a potential further degradation of the operation. As such it is a decision aiding tool based on the WSOG-approach for drill rigs.

For the crew it should be an easy way to see how the vessel should be set up. It does not relieve them from the obligation to be familiar with the FMEA. However with the personnel movements within the industry and the complexity of many FMEA's it is a good tool to start with. As with every good initiative there are some downsides to be avoided. Firstly the scheme could give some charterers the impression they can rent less high standard vessels. Obviously this should then be reflected in the decision aiding tool and limit the working limits from the vessel. Secondly it relies on key DP personnel reading and thinking until they are sure they understand the approach and content. In the author's experience this can and does take place when first introduced and at the beginning of a project when time and cost are reasonably under control. It breaks down when this contractual climate changes and the key DP personnel change out over the period. Initial implementation is the easy bit keeping it active is the hard unrewarding work.

FUTURE

Optimistic	Middle Way	Pessimistic
DP vessels irrespective of DP Class technically assessed properly before hired	DP vessels increasingly assessed technically before they are hired	DP vessels hired by contract departments from basic vessel details and DP Class
Key DP Personnel experienced, interested and tend to serve same vessel for long period	Contractors systems for the management and retention of personnel are good and usually effective	Key DP personnel bored and just counting the days on board before the next 3 or 4 weeks leave or the next job on a different vessel
Safest Mode of Operation used and WSOG or ASOG are common practice so DP vessels do not exceed the DP capability they will be left with after the design worst case failure	Awareness increases about the safest way to set up for DP work and errors are rare	Safest Mode of Operation used without thought and equipment degradation not given the risk assessment needed to amend the WSOG/ASOG
FMEA relevant, active and right	FMEA reasonable but not very detailed and focus is more on DP manuals	FMEA old and irrelevant
DP trials relevant, active and findings closed out	Most DP trials done except some that are difficult or take too long	Trials reduced to simple function tests and box ticking
DP operational manuals relevant, regularly revised and read	DP Operations manual has withstood the test of time and nobody has energy to fight to change it	Generic DP operations manual used with a few copy paste edits that provide doubt that is not questioned
Several small DP incidents that are reported, followed up and closed out	Several small DP incidents; some are reported and followed up but closed out uncertain	Several small DP incidents that are discussed on board but not reported, followed up and closed out
No serious loss of position so that a safe situation can be successfully achieved with no more than lost time and/or minor damage	Either ☜ ☞	A serious loss of position that causes pollution and/or loss of life and/or equipment damage and significant liability to vessel owner's management and oil company client

The optimistic is goal setting text that is achievable and will from time to time be achieved on a few vessels from time to time.

The pessimistic possibility reflects all the worst situations that do exist but seldom all on the same vessel at the same time. However 'seldom' means that in the ever increasing population of DP vessels the chances are not very low.

The middle way shows situations that have been found during audits of DP vessels over the last two years. The easiest prediction of the future is to say it will continue very much as it is at the moment.

The effects of a loss of position however are quite different depending on the work that a DP vessel is doing; the table below summarises the situation for various types of vessel and work.

		Worst Possible Effects		
DP Vessel Type	Work Assumed	Drive Off	Drift Off	Large Excursion
Supply	Close to structure	Collision and major damage	Collision but minor damage	Contact; damage negligible but downtime
Dive Support	Divers in habitat	Death to 2 or 3 divers	Injury to 2 or 3 divers	Minor injury to 1 or 2 divers
Accommodation	Gangway in use	Injury to 2 or 3 personnel on gangway at auto-lift and damage to gangway	Minor injury to 2 or 3 personnel exiting gangway	Gangway auto-lift and downtime
Rock Dumping	Close to structure	Collision and major damage	Collision but minor damage	Contact; damage negligible but downtime
Pipe S-Lay	Pipe lay with high tension	Pipe damage (running buckle) if tension lost	Pipe damage and minor injury to 1-2 personnel in firing line	Pipe over tension and downtime for close out
Drilling	Well Testing in <500m	Blowout, Loss of life, pollution and fire	Blowout, Loss of life, pollution and fire	Downtime
Heavy Lifting	10,000t load stabbed	Loss of life structure and DP vessel	Injury and major damage	Injury and major damage

The above is illustrative to make the point that the consequences are quite different depending on the work that the DP vessel is doing but the DP guidance, rules and expectations tend to be the same for all. It is clear that the latter two merit much more attention than the others yet it is the diving support that tends to get the most detailed attention. There are annual trials, there is incident reporting and close out. The original focus for DP guidance was diving and because the divers quickly know about position loss it is always difficult to hide errors and failure. The early DP DSV incidents forced the changes through.

A well-known British Prime Minister Harold Macmillan when asked what represented the greatest challenge for a statesman replied: 'Events, my dear boy, events'. This is equally true in many areas and it is apt for DP as well. The history of DP use has been very good but there have been several significant near misses. BOPs have been pulled over and dragged across the sea bed but luckily no blow-out took place. Emergency disconnections have failed and risers have been stretched and broken. Offshore installations have been hit but most did not do much damage; one holed a DP vessel that had to go into dry dock another caused a platform fire. DP vessels have also caught fire (Engine rooms) but there was no loss of life. Divers have been dragged around but there have been very few deaths from position loss; umbilical management has been a bigger problem (keeping them away from thrusters). The conclusion is however that there have been enough near misses to be make the chance of a catastrophic DP incident likely sometime in the next ten years unless the industry continues to strive towards the optimistic column.

Considering events that force great change, sunspot activity has restarted and the 11 year cycle will peak in 2012-13 but there is also another cycle of about 100 years for coronal mass ejections, or solar storms; the last one was in 1859. The effects were significant; no compasses no telegraph communications and two thirds of the sky red. If this was to occur in 2012-13, and it is overdue, there would be 30 minutes warning and then all networks and digital systems could fail.

Global Maritime have been innovative in the DP market for thirty years and have recently assessed where they can once again add value to the quality assurance of DP systems. From looking at hundreds of DP incident reports over thirty years it can be concluded that the one point that would make the most difference is making sure that the key DP personnel know the DP system on the vessel which they serve exceedingly well. If this was met to a very high level many unwanted situations would not occur. The many differences between vessels in terms of power and thrust and position references would all be properly compensated for and the assessments for WSOG or ASOG would stand up to any audit or enquiry.

To achieve this vessel experience is needed but also the DP documentation has to be correct and straight forward to read and understand. This starts with the FMEA and initial proving trials. If these are high quality they help set up the marine operations manual, the safest mode of operation and the annual trials and the WSOG and ASOG. The majority of FMEA orders are from shipyards and they are not interested in DP operations; they are only interested in getting Class acceptance. In this FMEA process it is also almost impossible to get the shipyard to fund attendance at any factory acceptance testing. When FMEA practitioner has managed to do this the quality of the delivered product is improved with no delay and no increase in project cost to the shipyard. The other benefit from FAT attendance is that the person(s) doing the FMEA work get an early opportunity to discuss the product with the supplier and so improve the failure analysis and the focus and duration of final proving trials.

The DNV ESV Notation allows a non-HIL but similar service because the purpose of ESV is to provide enhanced system testing beyond what can ordinarily be achieved by conventional DP FMEA testing. GM is working to achieve this enhanced testing, as outlined in rule application A100 with the use of a ‘Scenario Engine’ in the form of a laptop that interfaces with the target system to be tested. The approach is different to that used by others. The ‘Scenario Engine’ is an I/O manipulation and noise generation device that modifies actual input signals to create robust test routines that provide a greater and more detailed level of testing than conventional methods with reliable repeatability. The target systems after application of modified system inputs are monitored for system response.

The significant benefit of this proposed methodology over conventional testing is as follows:-

- More testing can be carried out within same time frame.
- Repeatability of the test.
- Signals can be manipulated in a more sophisticated manner to assess plant response.
- The target system can be assessed at FAT.

The advantage over the present HIL testing is thought to be the avoidance of the problems of the in line test computer and a significant cost reduction in comparison to HIL as presently executed.

The guidance note to DNV Rules for Ships, January 2011 Pt.6 Ch.22 Sec. 1 - A101 states as follows:-

Application of any ESV verification or test method should provide an additional broader and / or earlier verification of the applicable requirements when compared to normal classification test activities required for the target system(s).

The rule as currently written does not consider all methods to which ESV can be proven and the rule may need to be revised to include other valid methods of system assessment. GM is in discussions with DNV and we have positive feedback. The testing of this new scenario engine is scheduled to take place in the first week of October and the first results should be available for the MTS conference on 11th and 12th October.