Dynamic
Positioning
Committee
Marine Technology Society

**DYNAMIC POSITIONING CONFERENCE**
**September 17-18, 2002**

**Workboats**

# DP Integration and Technology Growth on Workboats

U.H. (Jack) Rowley

*Engine Monitor, Inc.*

# DP Integration and Technology Growth on Workboats

*Abstract:*

In the past several years, the Workboat industry has seen a dynamic growth in the technology and integration requirements for dynamic positioning capabilities. This paper will begin with a short history of the implementation of DP on workboats and how the emerging requirements and technology growth is affecting other related vessel systems. Rationale for the increased requirements as seen by the oil industry customers and the regulatory industries will be discussed, as well as the different levels of DP system redundancy. Since successful DP system operation involves direct integration with the primary vessel thruster controls, these second tier control surfaces are now required to meet added regulatory qualifications. This further necessitates the controlled integration of an overall DP Systems level approach to workboat installations. Furthermore, these burgeoning demands for the higher technology and more complex regulated systems have had a direct impact on all aspects of vessel cost; from acquisition construction and system integration requirements, to the operational life cycle costs of the vessel and ultimately back to the vessel day rate charges to the oil industry customer. This paper will focus primarily on existing and emerging Dynamic Positioning requirements, its integration with other vessel systems and the continued technical requirements growth as it relates to the workboat and crewboat industry, and will not focus on any vendor specific DP systems. The author will discuss solicited input from workboat/crewboat operators and oil industry end-users to express their views on the current trend of DP and their vision for the future technology needs of the DP System as related to the workboat industry.

*Author:*

U.H. (Jack) Rowley is the General Manager for New Orleans based Engine Monitor, Inc. (EMI). Jack Rowley has a Degree of Ocean Engineer (Naval Architecture) and Master of Science in Mechanical Engineering from MIT (1985) and a Bachelor of Science in Electrical Engineering from University of Oklahoma (1977). As a retired U.S. Navy Lieutenant Commander, Jack Rowley has a broad experience as a Navigator, Ships Engineer and Deck Officer on Navy Destroyers and as an Engineering Duty Officer Program Manager for the Navy Landing Craft Air Cushion (LCAC) Hovercraft construction program. He has held responsibilities in areas of production, quality control, testing and contracts management. Since retiring from the Navy in 1990, Jack Rowley has held executive and management level positions for both Government and commercial contractors and has been actively involved as a consultant and project manager for several high visibility marine projects. His primary areas of interest include ship control, vessel monitoring systems and high performance marine vehicles. Since joining EMI in 1998, he has been actively involved with major projects including ice load monitoring on an oil exploration rig in the Caspian Sea, development of a new engine control system and the development and manufacturing of the newly introduced EMI Integrated Dynamic Positioning System. Mr. Rowley is a member of the Society of Naval Architects and Marine Engineers (SNAME), American Society of Naval Engineers (ASNE), the U.S. Naval Institute (USNI) and is an active Rotarian.

## 1.0 Introduction

Given the rapid growth of the Offshore Oil and Gas Industry in the past four to five decades, the infrastructure and technologies to support the growth had to keep pace. With the ever increasing push to deeper and deeper water, the need to stay at a precise location for drilling resulted in the development of the Dynamic Positioning concept. As it was perfected by the drilling vessels and rigs, it was only a matter of time before it would be mandated to the vessels that support the drilling rigs. Luckily, the technology growth of computers paralleled that of the offshore industry and allowed for continuous development and improvement in the Dynamic Positioning Technology. Any such rapid growth of this type, however, is not without its problems and issues. This paper examines the growth and development of the workboats that support the drilling infrastructure, along with the influences of the regulatory agencies and cost implications of the increased demands placed upon the vessels and their operators.

## 2.0 A Short History

Prior to 1950, the majority of the oil and gas exploration and exploitation were conducted on land and in shallow water where jack-up rigs and fixed platforms could be used. The increased use of the automobile, aircraft and bus transportation drove the need for oil industrial complex expansion and the oil industry began to look toward deeper water for additional oil assets. Without the ability to “touch the bottom”, barges and drillships would have to rely on mooring systems and winches to maintain station for drilling operations. When depths began exceeding 500-1000 meters, this also became increasingly difficult, necessitating the need for a new technology.

In 1961, a small drilling vessel, the M/V Cuss-1, was outfitted with four manually controlled steerable propellers. Positioning was by means of radar ranging to buoys and sonar ranging to underwater beacons. This improved technology, albeit still manual, allowed the Cuss-1 to conduct drilling off the coast of California and Mexico in water depths up to 3500 meters. At approximately the same time, the M/V Eureka was outfitted with a rudimentary analogue control system with a taut wire reference system. At 130 feet in length, the Eureka was equipped with steerable propellers forward and aft, along with her standard main propulsion system. This effectively was the first actual record of a vessel operating in an automatically controlled “Dynamic Positioning” mode.

Additional vessels with rudimentary DP systems quickly came on line to support the industry. Most of the original vessels all used basic analogue type systems with no redundancy. As the computer technology was introduced and matured during the 1970’s and 1980’s, the Dynamic Positioning technology matured with it. By 1980, there were about 65 vessels with some form of DP installed and this quickly grew to over 150 by 1985. By 1999, there were well over 500 vessels with various levels of reliable and redundant DP systems installed operating in a wide variety of applications relating to dynamic positioning.

## 3.0 Current DP Status

It has now become a standard for almost all new construction workboats, utility boats, OSV’s and PSV’s to be delivered with some level of DPS. While in the past few years, the installation has been primarily DPS-0 with some DPS-1, most vessels are now being delivered with DPS-1 and some DPS-2. In the recent two years there has been an emerging need for larger crewboats to serve the deepwater rigs. As a result, several crewboats have also added DPS during new construction, generally being delivered with DPS-1. Because of the increased demand for the vessels to have a dynamic positioning capability, there has also been a large push to backfitting DP systems to some of the older vessels, even to the effect of upgrading vessels with DPS-0 to a DPS-1 configuration which generally means removing the original system and replacing it with a completely new system. In effect, to be able to support the current offshore oil industry, DP has become a necessity, and is no longer a luxury to have.

In addition to the growth in the number of DP systems being installed, there is a continued push by the oil industry and the regulatory agencies to mandate increased safety and redundancy. As a result, some vessels are now being fully "notated" by the regulatory agencies, at considerable increase in new construction costs.

## 4.0 Standard Configurations

Each of the three primary regulatory agencies, ABS, DNV, Lloyds, as well as IMO, offer rules for various levels of Dynamic Positioning certifications. References for the basic DP requirements are as follows:

- ABS Steel Rules 2002 Part 4, Chap 3, Sec 5, Para 15
- Lloyds Rules for Class of Ships, Jul 2001 Part 7, Chap 4, Section 1-7
- DNV Rules for Class of Steel Ships, Jan 1990 Part 6, Chap 7, Section 1-7
- IMO Maritime Safety Committee (MSC) Circular 645 dated 6 Jun 1994

Although all are members of the International Association of Class Societies (IACS), significant differences remain evident in the requirements for the varying DP levels to achieve class notation. The author has expanded on a table originally provided in DNV Part 6, Chapter 7, Section 2, Table E1 and has noted the different classification designations for each of the agencies and highlighted some of the key differences.

| ***Subsystem or Component*** | | ***Minimum Requirements in Group Designation*** | | | |
|---|---|---|---|---|---|
| | ***ABS*** | ***DPS-0*** | ***DPS-1*** | ***DPS-2*** | ***DPS-3*** |
| | ***DNV*** | ***AUTS*** | ***AUT*** | ***AUTR*** | ***AUTRO*** |
| | ***Lloyds*** | ***DP(CM)*** | ***DP(AM)*** | ***DP(AA)*** | ***DP(AAA)*** |
| | ***IMO MSC/Cr645*** | ***Not Recognized*** | ***Class 1*** | ***Class 2*** | ***Class 3*** |
| **Power Systems** | Gen and Prime Movers | Non-Redundant | Non-Redundant | Redundant | Redundant separate compts |
| | Main Switchboard | 1 | 1 | 1 with bustie | 2 with n/o bustie in separate compts |
| | Bus-Tie Breaker | 0 | 0 | 1 | 2 |
| | Distribution System | Non-Redundant | Non-Redundant | Redundant | Redundant through separate compts |
| | Power Management | No | No Optional - IMO | Yes Optional - IMO | Yes Optional - IMO |
| **Thrusters** | Arrangement of Thrusters | Non-Redundant | Non-Redundant | Redundant | Redundant in separate compts |
| | Hold station with single thruster failure | No | No for ABS, IMO and DNV; Yes for Lloyds | Yes | Yes |
| **Control** | Auto Control – No. of Computer Sys | 1 | 1 | 2 | 2 + 1 in alternate control station |
| | Manual Control – Joystick with auto heading | No | Yes | Yes | Yes |
| | Single Levers for each Thruster | Yes | Yes | Yes | Yes |
| **Sensors** | Pos. Reference Sys. | 1 | 1 for IMO, 2 for others | 3 | 3 with 1 in alt control station |

| ***Subsystem or Component*** | | ***Minimum Requirements in Group Designation*** | | | |
|---|---|---|---|---|---|
| | ***ABS*** | ***DPS-0*** | ***DPS-1*** | ***DPS-2*** | ***DPS-3*** |
| | ***DNV*** | ***AUTS*** | ***AUT*** | ***AUTR*** | ***AUTRO*** |
| | ***Lloyds*** | ***DP(CM)*** | ***DP(AM)*** | ***DP(AA)*** | ***DP(AAA)*** |
| | ***IMO MSC/Cr645*** | ***Not Recognized*** | ***Class 1*** | ***Class 2*** | ***Class 3*** |
| | Ext. Wind Sensors | 1 | 1 - DNV, IMO; 2 for Lloyds and ABS | 2 for ABS, DNV, Lloyds; 3 for IMO | 2 with 1 in alt control station; 3+1 for IMO |
| | VRS/MRU | 1 | 1 for DNV; 2 for Lloyds; ABS, IMO is not addressed | 2 IMO is not addressed | 2 with 1 in alt control station; IMO not addressed |
| | Gyrocompass | 1 | 1 for DNV 2 for Lloyds and ABS | 2 for ABS, DNV, Lloyds; 3 for IMO | 3 with 1 in alt control station |
| **Misc** | UPS | 0 | 1 | 1 | 1 + 1 in separate compt |
| | Alt Control Station for backup Unit | No | No | No | Yes |
| | FMEA | Yes for ABS and DNV; No for Lloyds | Yes for ABS and DNV; No for Lloyds | Yes | Yes |
| | Consequence Analyzer | No | No | Yes | Yes |
| | Performance Capability Rating (PCR) | Used only in Lloyds as a factor that gauges the percentage of time the ship can remain on station when subjected to a set of standard environmental conditions with all thrusters and then with most effective thruster inoperative | | | |
| | Environmental Regularity Number (ERN) | Used only in DNV as a factor used to indicate the position keeping ability of the vessel with all thrusters operating, minimum effect of single thruster failure and maximum effect of single thruster failure | | | |

The most recent entry into the regulation of DP operations is the U.S. Coast Guard. Commander, Eighth Coast Guard District New Orleans (D8(m)) issued Policy Ltr XX-2002 dated XX Jul 2002 regarding the "Use of Dynamic Positioning by Offshore Supply Vessels for Oil and Hazmat Transfers". This policy specifically governs only OSV type vessels of Subchapter I, L, and T in water deeper than 300ft that are engaged in the transfer of Oil and Hazmat materials while in the DP mode. The reference used for DP Criteria is the IMO MSC Circ 645 standard listed above. In general the policy states that in order to conduct Oil and Hazmat transfers while on DP in water deeper than 300ft, the vessel must either 1) have a Class 2 or Class 3 DP system, 2) meet alternate requirements regarding thruster redundancies and redundant DP computers with consequence analysis or 3) use breakaway fittings with quick closure valves. The policy further states that the Coast Guard will not conduct additional inspection activities to enforce the policy but will consider the Policy as guidance when investigating any causalties involving OSV's using DP operations.

## 5.0 DP Class Notation or Certification

The requirements as listed in the para 3.0 table above are applicable for vessels seeking ABS, DNV or Lloyds "Class Notation". In general, a Notation is not a requirement for the overall vessel to be classed and is generally assigned as an added certification only at specific request. The key to receiving the class notation, however, is much larger than just submitting the plans and information showing that the vessel meets the requirements in the above table. Specifically, to receive the class notation, it also requires additional certifications on the engines, thruster and second tier controls, including all computers, steering, engine controls, etc. These additional requirements result in a considerable increase in the cost to the vessel construciton to achieve this DP Class Notation.

As an example, ABS section 4.3.5/15.9.1 requires that all control systems are to comply with the rigorous environmental testing of ABS section 4-9-7, originally intended for vessels to be assigned the ACC or ACCU notation. ABS has established that this testing is a requirement for all second tier control and DP related equipment that includes:

- Engines
- Thrusters
- Steering
- Engine Controls
- All DP related computer equipment, I/O modules and displays

The only way to meet the requirements is to either use an ABS Type Approved product or to undergo expensive and rigorous testing on the second tier specific system. In the case of the engines and thrusters, there is a large cost adder for notated engines, resulting in many of the vessel owners, choosing instead to get a DP system on the vessel, but not having it "notated".

In the case of IMO, an alternate compliance documentation exists in the form of a Flag State Verification and Acceptance Document (FSVAD) that can be issued in accordance with IMO/MSC Circular 645. The purpose of the FSVAD is to ensure that the vessel is operated, surveyed and tested according to vessel specific procedures and that the results are properly recorded. This document, once issued requires periodic recertification.

## 6.0 Regulatory Agencies Oversight of DP Vessels

While the above shows some differences in the requirements that exist for DP notation, it is understood that these rules have been developed to meet the rapid growth of the DP industry and many of the rules were originally developed specifically for the drill ships and rigs that were the pioneers of the industry. It was not until the last few years that a large number of workboats began receiving increasing numbers of DP systems and then started to ask for Regulatory certification or notation. As a result, there were a number of questions even among the regulatory agencies about the applicability of some of the rules directly to the workboat industry. As a result, the vessel owners and shipyards began to question the rules and the subsequent enforcement. As the author discussed this paper with several shipowners and DP vendors this topic came up in almost all conversations. Each of them wanted the author to address the perceived inconsistencies of the regulatory agency's own interpretations and the consistent slow response to specific questions and/or concerns.

It should be stressed that none wanted to do away with the regulations and all felt that they were needed to ensure consistencies in DP requirements. But the prevalent feeling was that the rules should be clearly and consistently stated among all the agencies. They must then be rigidly enforced equally for all vessels, shipyards, and vessel owners. The feeling was that there are still several sections of the rules that have not been clarified and can be interpreted differently among designers, shipyard engineers, owners and the regulatory engineers. A specific area in question was the requirements for what constitutes the second tier control equipment and the specific requirements to achieve notation.

Many of the issues regarding the regulations relate not to the enforcement of the DP regulations but specifically how to enforce them on a workboat when they were originally written for a drill vessel or a Dynamically Positioned Drilling Rig. Perhaps the answer might be the breakout of a separate set of DP requirements specifically for the workboat industry whose function it is to service the drill rigs. It is understood that this would be a challenging task since the consolidated workboat DPS rules would need to be signed off by all regulatory agencies and the USCG. These rules would then be unique to the workboat offshore support industry and be independent of the added extensive requirements imposed upon the 24 hr / 7 day DP rigs and pure DP vessels. A single set of simple, clear and concise rules for these workboat type vessels that adequately reflect the needed redundancies and safety issues would go a long way to assist the industry in providing consistent DP capable vessels that meet the needs and safety concerns of the major oil companies in support of their offshore rigs, while staying affordable to the owner and to the dayrate required.

In the interim, it is suggested that the regulatory agencies could provide written clarifications to specific workboat related issues/regulations as they are addressed by the industry and publish them in the form of a formal notice. In the age of the Internet, this can be easily done by placing them on the internet site where both the question and response can be made available for review by all concerned.

## 7.0 Workboat Standard and Enhanced Modes of Operation

While there exists a large number of applications for Dynamic Positioning and a number of DP specific vessels have been built for cable laying, dredging, drilling, etc., the basic workboat, or Offshore Supply Vessel, has five basic modes of operation that include:

- Dynamic Positioning - to hold the vessel position and heading
- Hold Heading or Autopilot - to hold heading only when transiting
- ROV Following - to hold station and heading while following a remote operated vehicle
- Joystick - for manual integrated operation of the thrusters
- OFF

Unlike the drilling rigs that must maintain DP operations 24 hours a day, 7 days a week, the workboat only operates in DP while actually servicing the rig. The remainder of the time, the workboat either transits in autopilot or loiters near the rig using joystick or manual operations. Effectively, the DP requirements and demands on a workboat are considerably different than those placed on a deepwater drilling rig.

Since the standard workboat DP system also has an extensive number of navigation inputs of gyros, DGPS's, and Motion/Vertical Reference Units (MRU/VRU), it should be possible to utilize some of this high priced equipment when the workboat is not in a DP mode. Examples include the display of navigation information when the system is OFF or in Autopilot during transit. Additional consideration should be given to the display of roll/pitch/list/trim information for vessel loading and unloading at the pier and the rig and even the possible overlay of a radar or ECDIS display when in the autopilot or joystick mode. This will require a new thought process for the DP vendors to add these capabilities to their workboat specific DP systems. Effectively, since the electronics needed to supply some of these displays are already part of the system, only the software needs to be modified. Some of these system features are already offered by a couple of the DP vendors as either standard or optionally priced additions. As the demand for these options grows among the vessel owners, more of the existing DP systems are expected to standardize on these added features.

## 8.0 Operator Training and Retention

While the training criteria for Rig DP Operators is clearly defined and established, this is not the case for training of DP operators on workboats and OSVs. In fact, this author knows of no specific training that is required or mandated by the regulatory agencies for workboat Captains. The only known reference to training is in the recent July 2002 USCG Policy statement which states only that "the licensed deck officer on watch during DP operation must be suitably trained and/or qualified to operate the DP system". No mention of the type of training is specified. Proficiency is generally learned through "On-the-Job" training onboard the vessel while under the supervision of another Captain that has some DP experience. While some workboat operating companies do send their operators to one of the DP training centers, this appears to be the exception and not the rule. Most small operators cannot afford to send a Captain out of state for a week long training course that is still geared primarily to rig operations.

Once a Captain is trained in the use of a specific vendor DP system, he becomes more marketable to other operators and retention becomes an issue. He becomes particularly attractive to an owner that is just beginning DP operations. While this is a problem that must be addressed at the operating company level, it nevertheless demonstrates the need for qualified DP level operators within the workboat fleet.

As the regulation and safety of DP on workboats continues to become more of an issue, it is expected that this will be further addressed in the future by the regulatory agencies.

## 9.0 Emerging Computer Technologies

While DP has been in use for over 40 years, the most innovate technological advancements affecting the DP market have occurred within the past 5-10 years; the growth of computing power. Specifically, this includes:

- Faster computer processors allowing increased access speed to/from the sensors and thrusters
- Increased computer memory and higher level program software allowing for more complex algorithmic processing to improve the controllers and their associated control logic.
- Increased memory further allows for embedded utility routines to be placed on the computers to act as "Built-in-Test" logic to assist in troubleshooting problems or run as background monitors
- Higher level Programmable Logic Controllers (PLC) which are now mini-computers themselves, allowing for better access to the sensors and thruster interfaces
- Improved computer networking that has higher speed and greater data reliability that can link not just between computer servers and their user interface but also with PLC's that link directly to the sensors and thrusters, thereby greatly reducing the amount of cable and numbers of conductors that must be run between the pilothouse and the engine room.
- Redundant PLC's with "hot-backup" capability coupled with dual Safe-Net type networks to prevent any loss of program or memory during single failures of any type
- Remote access to computers on vessels via satellite and/or cellular connections will allow for troubleshooting from the technicians office instead of making a trip to the vessel. At a minimum, it should allow for trouble-isolation prior to sending the technician, thereby ensuring the correct technician and parts are sent for repair.

The original DP systems were analogue based, followed by embedded programmable modules. Now many use the full power of the computer and their associated operating systems. The speed of the processors and the ability to datalink multiple stations with PLC type input/output interfacing, will allow more versatility in design, and a significant reduction in the amount of cable that has to be run between the pilothouse and the enginerooms. When this is coupled with a "hot-backup" solution to prevent any loss of data, the reliability and safety of the systems should increase dramatically.

While the above computer technologies have immediate application to the Dynamic Positioning equipment onboard the vessel, it also has extensive application to the Ships Alarm Monitoring and Control Systems and is also used by the electronics manufacturers in everything from the "Black Box" Radar to the full "Integrated Bridge System". As the technology becomes available, some vessel owners are quick to embrace it, while others are not.

Effectively, the desire to put this new technology on the vessels is generally dependent on how "technologically savvy" the vessel owner and the vessel Captains are. We live in an environment where we and our children are continuously exposed to the new technology in everything from their VCR/DVD to their Nintendo games. Many young Captains on today's workboats grew up playing video games and are versed in computers and the Internet. As more of these "techno-Captains" come into positions of increased responsibility in their respective companies, the newer technology will not only be embraced, but it will be demanded. They will have an understanding of how this technology can improve their vessel productivity and possibly decrease their overall operational cost. They will drive the electrical and electronics vendors to be more efficient in their systems and realistic in their solutions.

## 10.0 DP Integration with Ship Systems

By necessity, the DP system must integrate with the thrusters, the steering and the position sensors. In many cases, these systems are provided by different vendors. This could be as many as four for more if the steering, engine controls bow thruster controls, electronics and DP are all provided by different companies. The use of 3 or more on many installations is currently the norm. This then necessitates that the first part of any DP system installation must be the "DP Integration Meeting". At this point, the owner and/or shipyard act as the integrators to ensure that the different vendors communicate and the signals are properly provided by the thruster and steering vendors to the DP vendor. Additionally, and of even more importance, is the selection of a vendor to provide the "DP Switch" which is used to shift in and out of DPS Mode. While it may seem trivial in its title, it is, in fact, one of the more difficult problems in the overall DP system installation, requiring extensive integration of ready signals in the proper sequence for correct transfer between modes. In more complex systems, usually DPS-2 or higher, an Independent Integrator may be hired to advise the owner/shipyard and to perform all of the integration regulatory submittal requirements such as the Failure Modes and Effect Analysis (FMEA) and DP Test Procedures.

Effectively, it can be seen that the key to success of the DP system installation and testing will be communications between all the parties concerned in the system development. Failure to complete any single item in the integration can easily result in DP Trials delay and/or failure. Almost all DP test problems can generally be traced back to some lack of follow up or lack of communications between the vendors that must interface with the DP system and the DP provider. When a problem does occur, the general result is the "pointing of fingers" at the each other, leaving the shipyard or owner to sort out who is responsible and which vendor he needs to correct the problem. In most cases, this results in both time and money additional cost if the wrong vendor is called out and a second or even third must be called out later to correct the final deficiency.

One could make the argument that the DP vendors should become the integrators, offering and providing full package solutions from the thruster controls to the sensors. Some DP vendors appear to be moving in this direction and the shipyards and owners are looking for this type of solution. Since none of the DP vendors manufacture all of the components, this may require key teaming arrangements or an internal company policy to acquire or develop the capability. The advantages to a single vendor solution for the shipyard/owner include:

- No need for DP Integration Meetings
- Single point of responsibility for all DP related component drawings and integration
- Removes the need to pay extra for a system integrator
- Less personnel on the vessel during trials
- Need to call out only one vendor when a problem occurs during normal operations

While the first two issues indirectly affect cost, the remaining items affect it directly. Over the life of the vessel operations, this could be significant, considering that a “DP Problem” on a vessel could be related to any one of the engine controls, steering or the DP system itself. When all are different vendors, the operating companies generally call all of them out at the same time to quickly get the system back on line, thereby paying for three technicians instead of just one that is trained in all systems.

## 11.0 DP as Part of Vessel Design Criteria

There are many cases where Captains with extensive DP experience on different vessels note that some vessels DP better than others, requiring less power or just holding in a better circle. In general this can be attributed to the vessel design. The current method of ship design, at least in the United States, is to take an existing hull and modify it to the customers needs and then add the Dynamic Positioning System. With the increased importance placed on the ability of the vessel to be able to DP in many different environmental conditions, more emphasis must be placed on the DP integration during the initial phases of ship design, instead of making it an “add-on”. A considerable number of factors affect the ability of the vessel to properly DP either directly or indirectly. These include:

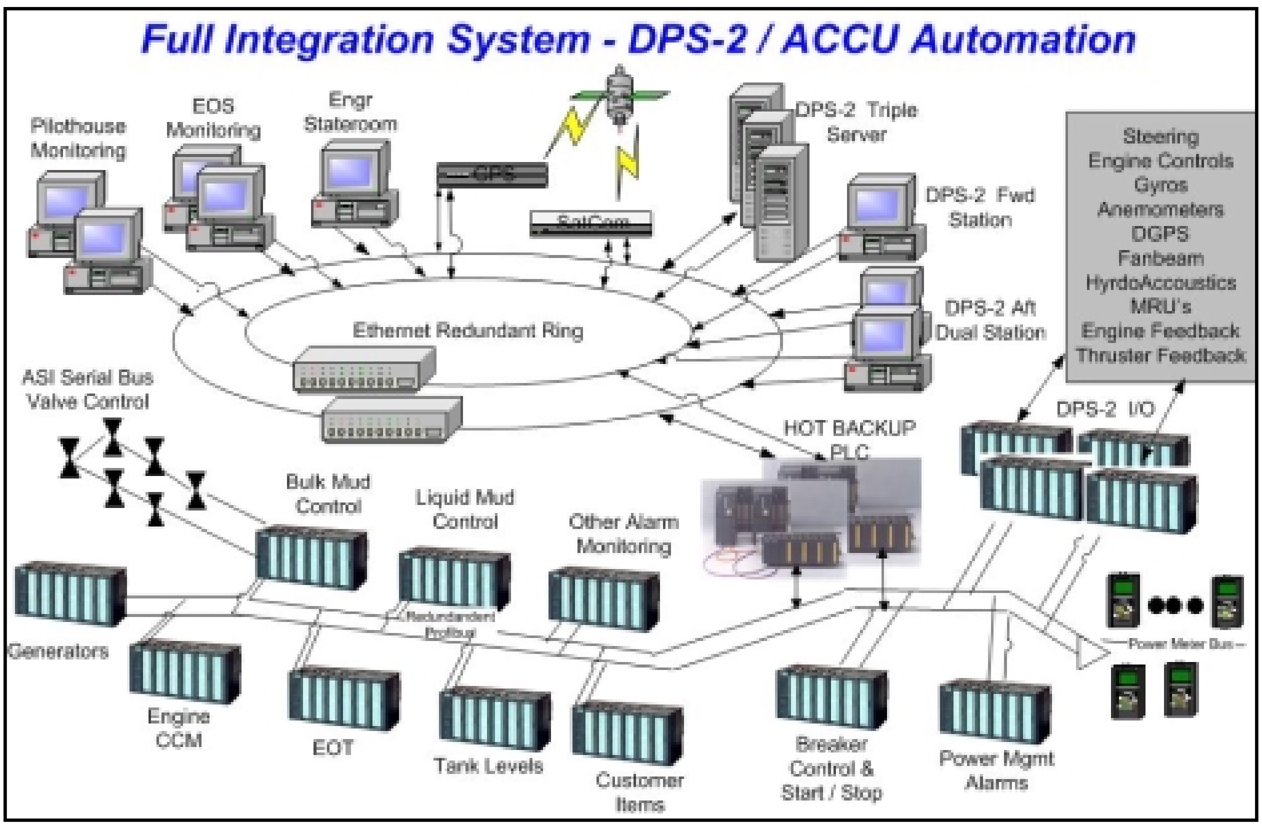
- Amount of thrust for each thruster
- Relative amount of thrust between bow and stern
- Thruster locations on vessel and their location relative to each other
- Rudder Size and torque
- Sensor type and locations
- Hull Resistance
- Vessel Waterplane Area
- Vessel Draft Area
- Vessel Sail Area

Because of the fact that DP has always been an after-the-fact installation, many Naval Architects do not have a full understanding of these factors effect on the ability of the vessel to remain dynamically positioned. As a result there is no consideration given to the early level design decision impact on the potential DP envelope. With the requirement that most, if not all, new construction Offshore Vessels will require some form of DP, it may be time for the designers to take a closer look at the design decision implications on the ability of the vessel to meet DP requirements. This will require that the owners requesting the design, specifically write a DP requirement into their overall vessel design criteria. This will undoubtedly result in the development of vessels that will increase their DP capability and DP environmental envelope.

## 12.0 DP Integration with Automation

As offshore supply vessels get larger and as the regulatory agencies get further involved with the vessel requirements, there is also a push for increased automation. A number of recent vessels have been, or are being, designed to receive an ACCU notation for reduced engine room manning. This requires the use of extensive computer based automation, generally in the form of a dual Ethernet Network Ring and/or dual "hot backup" type PLC's. This automation includes all alarm monitoring, tank level monitoring, bulk and liquid mud cargo transfer as well as extensive valve control. Power management can be easily added, as well as customer based inputs for monitoring and control.

As the automation levels of the vessels are increasing, the designer must also look at the possibility of integrating the DP system into that same network and draw upon the safety and reliability of an existing dual network rather that duplicating it. In the case of the DPS-2 requirements, a considerable amount of redundancy is required. Rather than have an entirely separate system from the DP system, a large amount of this redundancy can be shared with the automation system as shown in the generic block diagram below. Full integration of control and automation is supported by all of the DP vendors, however, it is the ship owner that will need to specify this type of system before the shipyard will supply it. The primary driver in this case is the perceived cost and complexity of the system, however a close look at the basic design shows it to be an easier installation for the shipyard, because of the greatly reduced cable requirements induced by the networking concept. In fact, the reduced cost of cable and cable installation labor can be significant in a networked design such as is shown below.



## 13.0 DP Impact on Vessel Cost

There is no argument that the addition of any level DP system on the vessel will increase the cost of the overall vessel. The two primary drivers of DP cost are the Level of the DP and whether or not the vessel is to "DPS Notated" by a regulatory agency. Specifically, the following items relate to cost drivers for higher level DP installations.

- More complex installations requires more trained personnel
- More Labor may be required for the installation
- Additional sensor equipment required; additional gyros, DGPS, Fanbeams and/or Hydro acoustic sensors
- Additional thrusters required for "loss of thruster" condition for DPS-2 and above
- Increased lifecycle operating costs of additional and increasingly more complex equipment

The following increased cost items relate to the "Notation" of the vessel by a regulatory agency versus not notating the vessel.

- Second Tier testing requirements of associated controls
- Additional certifications required for thrusters
- Additional Plan submittal requirements associated with the Notation such as the FMEA, Test Procedures, etc.

In addition, the use of multiple vendor involvement (different vendors for engine/thruster controls, steering, DP, electronics) results in additional cost through

- Loss of any type of reduced cost as a result of single vendor packaging
- Additional technicians on the vessel during checkout and commissioning
- Additional technicians on the vessel during seatrials
- Additional technician callouts during problems encountered during post warranty operations results in increased life cycle operating costs

Collectively, the above increased costs can relate to hundreds of thousands of dollars in increase in the initial price of the vessel and post-delivery operational costs. These costs invariably must then either be absorbed by the shipowner or will be passed on to the oil industry in the form of demand for increased day rates.

## 14.0 Controlling Costs

While there is little that can be done to control the costs of mandated or regulated requirements relating to thruster, control and/or sensor requirements, there are certain items that can result in decreased costs if the ship owner is actively involved in the decision process of the shipyard requirements for DPS. Several of these have been addressed earlier in this paper and are summarized below.

- Design the vessel from the "bottom up" as a DP vessel. This should increase the efficiency of the hull form and thrusters, and thereby reduce the operating costs.
- Consider the networking of multiple systems with the DP when automation is used. Use networked designs to greatly reduce the amount of cable that must be run during the construction phase. The further use of dual networks will also increase reliability and safety. In many cases, the decrease in the amount of cable that must be provided and installed easily can make up for the increased technology.

- Look for a single source integrator that will be solely responsible for all facets of the DP from initial design to the lifecycle maintenance. This integrator must be responsible for the supply, testing and operational maintenance of all the DP related systems including the controls, steering, DP sensors and DP system.

## 15.0 The Future of DP on Workboats

There is no argument among the industry that DP on Offshore Vessels is here to stay. Virtually all new construction workboats, utility boats, OSVs, PSVs and some crewboats are now receiving DP and an increasing number of vessels are being backfit. This trend is expected to continue but, most probably, with an increase in regulation. It is expected that the Offshore Oil Industry customers, in an effort to ensure safe and reliable operations at their rigs, will increase their demand for the regulatory “notation” of vessels and further system redundancy, specifically for DPS-2 and in many cases for DPS-1.

As the vessels continue to grow in size and get the higher levels of DP, the trend towards increased systems monitoring, alarming and automation seems to grow with it. Automation systems are transitioning to computer and PLC based systems and away from the traditional “idiot light” concepts. This trend will allow for the integration of multiple systems on a common redundant bus, as discussed previously. The DP vendors will need to progress with the technology by modifying their systems accordingly to further meet these new requirements, inclusive of providing additional navigation information integration into the DP system when not operating in DP mode.

It is believed that the workboat industry can also expect to see tighter audits and verification of DP capabilities by the major oil companies to ensure that the DP systems are adequately certified, maintained and operated by qualified Captains.

The Offshore demand for safety and reliability will continue to result in increased redundancy requirements. Currently the DPS-1 level requires only one DP computer plus an independent integrated joystick. To get the level of redundancy necessary to ensure continued operation with the loss of the DP computer, two DP computers will be necessary, thereby requiring the need to either go to a DPS-2 level with automatic switchover or add a second full computer to a DPS-1 level for manual switchover.

All of the items above, however, are not without additional cost to the vessel owner. It is apparent that the mandating of continued higher requirements will ultimately need to be paid for in increased dayrates by the major oil companies that want the added security of the redundant and regulatory “notated” vessels.

The bottom line is that the trend of the new offshore deepwater supply vessels will be toward higher level, integrated, added capability DP systems with “notation” by a regulatory agency. It is in the best interests of the owner/operators to ensure that accountability is maintained by all those involved, from the design agent, to the shipyard, to the regulatory agencies and ultimately to the DP vendors and integrators.