DYNAMIC POSITIONING CONFERENCE

TRAINING

Dynamic Positioning Operator Training

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My pleasure at being before this excellent forum is diminished solely by the fact that my experience covers only deep water drilling. If my points of view are shaded to other types of operations, it is not intentional: it is lack of knowledge of that operation. This intends to address the relationship between you and the end user, the DP operator.

When beginning to plan this paper, I ran ideas for it by a friend and described all the disciplines that ought to be covered. He was moderately impressed by the plethora of materials, sciences, disciplines, and problems that I mentioned. “That requires lots of brains,” he said, “and of which you have in insufficient quantities.” I admitted that he was right, but that I had lots of experience and was just about to attend yet another school. “I am reminded of the Scarecrow in the Wizard of Oz,” he pondered. “Remember, the Scarecrow told the Wizard that what he needed was a brain. ‘You don’t need a brain’ replied the Wizard. ‘You need a certificate of completion!’ The Wizard produced a nice diploma, thereby satisfying the Scarecrow and all the others.”

Too frequently we end up with certificates and buzz words that make us conversational and mollifies our peers, but with too little depth to be effective when the seas rise up in fury and the wind howls for our souls. Dynamic positioning is—at last—becoming popular. I and a very few others have been at this business for a number of years, and our basic training came generally from experience, and much of that early experience was painful indeed. Now, with new builds coming in at a fast pace and more and more interest in DP deep water drilling, there is a crucial shortage of trained DP operators. Too, even after they have been trained, there is a maturation period of a year or more . This current condition of dynamically positioned vessels leads to three major points that must be addressed:

A germane and viable training program should be instituted by every operator of a DP vessel. To be effective, this program must be based on the company’s doctrine, the vessels capabilities and limitations, and inculcate the many disciplines involved in making a free-floating ship stay put by way of thrusters. Obviously much background should be made available regarding propulsion, lift, drag, computer models, weather, generator loading, emergency procedures, and so on.

The second point is about the instructor. Where are you going to get qualified, experienced people who can be effective teachers? They are pretty rare these days, because many qualified operators can not teach very well. To make it more plausible, a standardized syllabus of instruction should be fashioned by the most capable staff available. The guy at the DP console, after all, is the man dealing with your $250,000,000 investment, and you’ll sleep better at night if you are confident that the DPO knows what he is doing, knows his equipment, understands seriously inclement weather, and can be depended upon to make right decisions. **A new DPO will make decisions based upon what he has been taught.** Thus, this all must start in your training program: If you don’t have one, get one, or your nights will be quite long.

At last we address recruiting and recruits. Since you can’t fill DP vacancies with experienced men, you must scour the woods for the best possible trainee. DP is a fully mature discipline and requires a lot of time for an operator to be termed complete. It is

therefore incumbent upon us to find categories of people who can be trained more efficiently and who learn quickly. Too, these people will be required to work alone and with no one in higher authority to ask for help when they are in trouble. Finally, to assure a return on your investment, the recruit should be one who will be dedicated to DP *on your vessel* for a number of years. You should hope to avoid getting into the eternal training cycle brought about by recruiting the wrong people and in which you never have a fully trained staff of DP operators. This is because they have found job advancement, more money, can't work alone or under severe duress, have become a BCO on a semi, can get paid more money with the other company, &c., &c.,ad nauseum

So, by way of introduction, salient points have been covered and will be explored in detail. We shall examine what makes a progressive and effective training program and how it should be put together and by whom. We will take a look at those who will be tasked to administer it and the curriculum that they should present to this new generation of DP trainees. We shall invest some discussion of whom will be successful candidates for our efforts.

DOCTRINE

Doctrine might also be titled *mission* or *strategic considerations*. From it comes the decision by powerful entities to build or convert something into a dynamically positioned vessel. Underlying analyses go well beyond cost: they include life-expectancy of the vessel, what kind of power plants and thrusters, and how many are to be installed? What kind of registry and licensing? In what environment and depths will the vessel operate? How much income per unit of time must be realized to pay for it and provide a profit? How much profit? Shall there be additional or peripheral missions besides drilling? What? It is well to remember that operating in the North Sea's shallow waters, rough surfaces, and general winds is in no way similar to operating in the Gulf of Mexico's deep water and annual hurricane conditions: the company should decide *where* the unit will work and construct it accordingly. Will a merger or a large loan be more viable? Will debt help or hurt, or do we wish to be taken over? Other questions must be satisfied:

- Full time, or partial DP?
- Category I, II, or III?
- Does DP continue in the face of critical actions and weather?
- Does a major profit center require DP operations?
- Where can we acquire DP operators?
- What kind of DP system best meets our needs?

In a military environment, these questions would relate directly to the stated doctrine of the service: what do we wish to accomplish and at what cost? The answers would be forthcoming from the various staffs, particularly Plans and Operations. Once goals and budgets are set, manning documents would be prepared and the Command and Control element would initiate action.

I use this illustration purposefully, to demonstrate that there are many questions that are not answerable shipboard once the vessel is operational. Therefore goals, doctrines, and mission statements must derive from Corporate and be passed down crystal clear in the form of guidelines. All supporting documentation should be available locally,

such as schematics, operations manuals, limitations, emergency procedures, responses to hurricanes, fires, deaths, and so on. Qualifications and types of manning and license requirements must be published, *and a training program should be budgeted, manned, and planned for at this time.*(Needless to say, I am not solely addressing DP in this regard.) There is no other way to plan doctrinal goals and their implementation than this.

Once operational, corporate fates are in the hands of operators. That is why there must be a productive training program, because all that time and money will ultimately be placed in the hands of a single individual in the middle of the night in gale force winds and angry seas, and the ship is short a thruster and two generators. That sounds a bit like company-sized warfare.

It is. Command and Control can now only observe from afar. There are many levels of supervisors and support troops, but the drilling operation and the DP operation are the infantry. One of the infantry's doctrinal missions is to take and hold ground. That is what we do at the drilling and DP levels: we arrive at pre-selected real estate, set up against nature's and other onslaughts, and complete our assigned tasks efficiently. Many condition-specific problems are solved at the local level while carrying out the general doctrinal philosophies of C-and-C. When things get really terse, DP will take all the power it needs—up to and including shutting down drilling—in order to preserve location. That failing, it is up to DP to cogently and timely set up a safe disconnect scheme in order to alleviate or minimize damage and cost.

CURRICULAE

There are a number of areas that will benefit the DP candidate. Assuming that a competent and intellectually qualified student has been selected for training, he should be given instruction in at least the following general categories:

Specifics of DP system, including
- power train and thruster control logic
- control loops and the PID controller
- alarm conditions and defaults
- user interfaces and hardware procedures
- Manual thruster operations, including joystick and manual heading control
- Integral determinants and management
- Failure modes and single point failure areas
- Load shed and anti-blackout features, settings
- Buttons, key board
- Loop cycle sequences

Parallel equipment theory, setup, and calibration:
- VRU setup and calibration
- Acoustics, including pertinent SBL, LBL, and combinations
- Processing units
- Information highways
- DGPS
- ERA, ARA, ESA
- Gyros, anemometers, Doppler current meter, etc.
- Other germane devices (Artemis, fan lasers,and such.)

- Peripheral equipment operations
  - SCRs
  - Diesel Generators
  - PLCs
  - UPSs
  - I/O cabinets
  - Prop motors
  - Thrusters and mains
    - DC-SCR fixed pitch thrusters
      - Power factor vs. load and RPM
      - Thrust vs. load and RPM
    - AC-Variable frequency fixed pitch thrusters
      - Power factor vs. load and RPM
      - Thrust vs. load and RPM
    - AC-Variable pitch thrusters
      - Power factor vs. load and RPM
      - Thrust vs. load and RPM
    - DC-Reversible mains
      - Forward thrust power curves
      - Reverse thrust power curves
      - Single and dual shaft operations
  - Transfer of control
  - Data logging and retrieval
- Hydrodynamics
  - Lift and drag curves
  - Bernoulli equations
  - Coefficients and dimensionless calculations
  - Dynamic pressure, Q
  - Rheological characteristics of sea water
  - Propeller blades
  - Turbulence
  - Stall and cavitation
  - Noise
  - Tunnel thrusters
  - Azimuthing thrusters
  - Induced and parasite drag
- Environmental data and modeling
  - Low pressure and weather systems
  - Aerodynamic drag calculations
  - Feed forward function
  - Low Frequency inputs to the model
  - Kalman filter and extended Kalman filter
  - Least squares fitting (linear regressions)
  - Springs and damping
  - Power required vs. power available

Thrust required vs. thrust available

Power Plant:

Characteristics of 2 and 4-stroke power plants
Single/dual voltage distribution systems
Single vs. split buss operations
Power limiting algorithms
Rationale in running fewer/additional generators
Generators and generator controls
kW sharing between generators and busses
kVar sharing between generators and busses
kVA vs. kW ratings
Ops with 2 or more types of generators on a buss
Starting and synchronizing under load
Response speeds under variable loads
Performance under overload conditions
3-phase power
kW, kVa, kVAR
Power factor
Effects of SCR harmonics
Basic diesel engine start/stop/run characteristics
Starting procedures and timing
Shutdown procedures and timing
Consequences of light load running
Consequences of full load running
Consequences of variable load running
Fuel efficiency vs. load

Protocol

Dealing with unwanted/un-needed company in the control room
Handling non-operational requests (the sun is in my eyes, need a lee)
Communications during crisis
Dealing with your boss
Dealing with your boss's boss, etc
Dealing with the company man

Simulator training: a number of formal and vendor-sponsored schools exists. Within narrow frames, these facilities are valuable, but generic. You want your DP guys to gather vessel-specific and system-specific training. It is advisable to have an onboard simulator running your own software, power, thruster, and keyboard arrays.

Alarms and emergency procedures
Joystick operations
Blackout operations
System failures
Trouble-shooting of DP and peripheral systems
Finite maneuvering—absolute and relative
Navigation

Stack and stops operations and calculations
Disconnect calculations and procedures
Inclement weather and sudden squalls
Turns and vessel maneuvering
Course tracking and way points
Capabilities plots and exploration
Communications and coordination exercises (driller, ET, electrician…)
Converging phenomena (ballast, sudden inclemencies, lees}

RECRUITS

In some fortunate circumstances, there are superb engineers and/or electrical specialists who also operate the DP systems on their ships. These men are exceptional, and also rarer and rarer, as they are needed to sit in seats like yours. On the whole, nowadays, you are not going to be able to recruit people like this: your recruits are going to be schooled elsewhere, either as recent graduates from formal institutions or as graduates of other professions.

Consideration should be given to the type of job this is: it is long-lasting, lonely, and boring, if not under extreme duress. Too, the DP operator is genally the final authority in the DP business: no one knows as much about it as he does, therefore there is no help available to him, outside the other DP operator (who is happily ensconced in his bed). This job is very much like that of a military or commercial aircraft pilot. He is an overall specialist in *operating* the vehicle in any number of envelopes and perils: formation, combat operations, air-to-air gunnery, ground attack, instrument conditions, and so on.He is not an electronics technician/mechanic/meteorologist/hydraulics expert/gun smith, but he can *operate* all of it. If something breaks or is shot out from under him, he manages by alternate procedures until he can get the airplane home, where an ET or an engine man can make repairs. When airborne, there is no other help available to him.

The DP operator will be working in similar conditions: wind, squall, breakage, and any number of worrisome events. He will operate *your vessel*, managing malfunction and tropical storm from his isolated post. No one else is available to relieve him, EXCEPT that he has local help from ET, engineering, electrical…professionals to repair whatever becomes dysfunctional. This is the job for which you are recruiting, a guy to sit under the gun and make your expensive vessel turn a profit, while keeping every crewman safe and dry. Whom should you recruit? What kind of person makes the best DPO?

He requires a certain intelligence with working knowledge of basic trigonometry and coordinate systems. He must be mature enough to be able to sustain hours and days of isolated boredom, and he must be able to handle sudden, serious events of weather and machinery. He must be reliable and be able to handle pressure. He must understand all aspects of vessel attitude, both absolute, relative, local, and universal. It will be necessary to follow myriad procedures, communicate effectively, trouble shoot equipment, and to make correct decisions *every time he's called upon.* Most of all, he must be a complete systems operator. Where do we find this guy?

We have had good luck with ex-military men whose jobs had required navigation, decision-making, and under-pressure performance. The successful operators known to me, and whose experiences transfer across, derive from all the military services. These men

have brought stability to the DP world: they are usually older, and they stay there.Their experience and maturity are of immense value.

Maritime academy graduates have been valuable, their young and supple minds being the envy of us grumpy old men. They are skilled in maritime laws and equipment and up to date in the latest computer whizzbangs. They may be less permanent than the older guys in the DP environment, but our mates have become fine DP operators and will be immensely valuable as DP-skilled captains and OIMs. Licensed operators are a plus, but licensing--so far--is not prerequisite; I hope it will not become so.

Here it is incumbent that we realize what a DP operator does. He manipulates a complex control system, not the ship. In this way, he is dissimilar to marine operations. The DP operator must understand and control his system, which will control the ship in turn. The crossover between marine systems and DP control systems are *not the same thing.* Your recruiting efforts should take this into account, because mariners are not inherently DP operators any more than the reverse would be true. DP is little interested in transit navigation, rudders, tanks, and the like, but rather controllers, thruster allocation logic, integral, and so on.

Needless to say, we like computer experts, which reminds me of a tale by my friend, Kenneth Jenssen from Simrad. A doctor, an architect, and a computer scientist were arguing about whose profession was the oldest, going all the way back to the Garden of Eden. The doctor proclaimed that medicine was obviously oldest, because Eve was made of Adam's rib, an incredible surgical feat by God Himself. The architect disagreed. He said, "In the beginning were chaos and void, and out of that, He made the Garden and all the world. God was and architect first." The computer scientist, drawing circles in the dirt with his foot, said, "Well, where do you think all that chaos came from?"

There are others, so long as personalities match the job: navigators, pilots, mathematicians, hydrologists, computer specialists, and the like. It would probably be well if, during the interview process, these potential recruits also interviewed with one or more of your experienced DPOs. They will work together under the most demanding conditions and long hours; it is best if they are compatible.

In the years that I have taught new DP trainees, I have seen much in needless expenditures of time and effort, because unqualified people were selected to be trained. Also, many who were qualified and capable failed to remain at the job long enough for the company to recover their expenditure. In your recruiting, it is advisable for you to first pick people who have the skills and grit to do the job, and second, find those who will remain AT the job for some time. Unhappily, DP is rather a dead-end street, and the pay is marginal for highly skilled and critical people. These conditions have wrought a suit-case parade in recent months. I expect that compensation and benefits will soon have to improve in order to recruit quality people and hold onto those that you already have.

Very important, too, is washout. Those who are marginal or worse should be recognized as soon as possible and eliminated from the training program. We can not teach like certain military institutions, to wit, fear, sarcasm, and ridicule. We do not have a commitment from our people in terms of time. Still, excellent pedagogy should be provided to fulfill the dual missions of training those who can and eliminating those who can’t. Here's why:

- It's no use to have expert help in Houston when you have an emergency on the rig.

- Since the time duration from equipment failure to disconnect is SHORT, it is of no use to have expert help in San Diego or Kongsburg at such time.
- There is a high MTBF on DP equipment, so local ETs--who work on so much stuff--*may* not be as proficient as they once were when it does fail.
- If DPOs can not see the symptoms and interpret things leading to failure, they may not be able to distinguish the egg from the chicken, or even the bed post.

In other words, the DP operator should be able to effectively discern what is going wrong, rather unlike my father. He had us kids in the back of his pickup truck, with which he was towing a cement mixer. We were going to a job some miles away from town. A deer jumped the fence and came running across the highway and ran smack into the cement mixer, which began to oscillate laterally, and which my dad felt in the steering. He--not having seen the deer--rolled down his window and beat his door, flat-handed to get our attention and yelled, "You kids settle down back there, or I'll wear you out!"

INSTRUCTORS

Instructors must, of course, be knowledgeable about their job, and they must be good communicators, unlike the three old gentlemen proceeding by rail through the little town of Wimbley. The first one awoke and, looking out the window, asked, “Is this Wimbley?” The second looked at his watch and replied, “No, this is Thursday”, to which the last one said, “So am I: let’s get off and have a drink.”

One of the things that should be done early is the drafting of a syllabus and curriculum that will standardize and complete a formal presentation of theoretical, as well as practical, applications. This presentation MUST address control systems and control loops and software logic. It may be that two or more men will be required for presentation. Some effort should go into provisioning a classroom and its equippage The class room portion of my current syllabus is thirty hours of theory (see above curriculum) followed by fifteen hours of DP computer/menu/keyboard/alarms instruction. This is supplemented with about thirty hours of simulator exercises with an instructor and as much as the student can stand of personal practice. The student is also required to be present at the actual DP unit to observe and participate in operations.

When he is ready, we qualify the student to sit for moderate periods alone in the DP room. The DP operator may take meals or see after other affairs *away from* the DP room. Of course, the student knows how to phone or page for help. This is mandatory in preparing the man for the responsibilities of making decisions and of becoming comfortable while working alone.

All this time, we teach him to trouble shoot the various systems. Here is an area where expert help is good. Call in an engine professional to point out the fine points of his operation crossing ours. When the student can perform these functions, he is pretty much ready to go out on his own.

Unlike, in closing, one that I had some time back. He was on duty when my opposite number experienced a moderately serious breakage. When I came on tour, I quizzed him about what happened, and his answers were clever and accurate. Then I asked him how he knew precisely WHEN the event occurred. He said, “That’s easy: It happened just before the DPO said, ‘Oh! Shoot!’”