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Session 5

Thrust Required and Holding Capacity

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THRUST REQUIRED AND HOLDING CAPACITY

The determination of the minimum thrust to successfully dynamically position a drillship is complex.

First, there is no general agreement on the selection of a suitable maximum operating environment for DP drilling operations. There is even less agreement on a "storm" environment and the functions a DP system would be expected to perform in such an environment. Modern practice tends toward the ship being able to "hover" in a storm environment, rather than stationkeep. Hovering is loosely defined as the ability to control heading and maintain some headway in the storm.

Second, the performance of the stationkeeping system is typically stated in terms of static holding capacity. Even so, some difficult problems still arise. For example, the selection of the appropriate strategy to allocate thrust between moment generation (heading control) and force equilibration is non-trivial.

Third, although the simplest approximation for estimating the required thrust is static holding power, in reality the dynamic nature of the environmental forces acting on the drillship must be considered. This introduces the complexity of the duty cycle performance of the machinery and capability of the power plant to respond quickly varying loads.

This session will explore the procedures used to verify the stationkeeping performance of two new, large drillship designs, offer a simplified criteria for judging the adequacy of installed thruster and power plant for a DP vessel and provide for a panel discussion of thrust requirements for DP vessels.

HSSC NUMBER

Current stationkeeping systems are sized for a specified design storms which can range from a 10 year winter storm to a 50 year hurricane. The design procedures call for calculating the environmental loading at all headings and then to look at the thruster loads and engine loads at these headings. If the loads are less than 80% for a reasonable range of headings, say 30°, then the stationkeeping system is considered to be sized properly.

The this procedure is attractive owing to its simplicity and to the intuitive nature of the governing parameters. There are however a couple of problems with the method. Firstly there are uncertainties with wave drift loading especially for large un-tethered vessels. The analytical models for wave drift are not very precise and the predicted loads are very high and comprise perhaps one-third of the total dp capacity. Much of the required stationkeeping is dependent on a load that not easily calculated or understood. Secondly there is some argument as to actual the wave height to assume for the hurricane case (which is normally the defining load). It is possible to predict a maximum wave associated with a 50 year hurricane but to endure that wave one has to be unlucky enough to be hit by a 50 year hurricane and to also hit by the strong side of that hurricane where this wave resides. The probability of being hit by that hurricane <u>and</u> by being located in the small area where this maximum wave occurs is much less than that for just suffering the hurricane.

Even there were a better approach for calculating the wave load the method does not directly address those instances where dp vessels have lost station. The Discoverer Seven Seas has operated continuously in dp mode for 21 years. During this time the vessel never lost position for lack of power or thrust during "design storms". There were a couple of occasions when she was overpowered but both of these occurred when the vessel became beam to a sudden high wind. It was not intended to get into that position but sometimes things happen and there is always that possibility. Moreover in both instances the high wind was somehow influential in getting into that situation so it is not correct to say that these are mutually independent events.

Because of this we propose to also use as a design criteria the performance of a dp vessel with a high wind on the beam with no sea or current. We define a dimensionless number **HSSC** (pronounced the hissic number and derived from **<u>H</u>**oward **<u>S</u>**hatto's **<u>S</u>**anity **<u>C</u>**heck). The number is simply the ratio of 80% of available thrust to the loading from a 61 kt beam wind. For a well designed system the **HSSC** number should be greater than 1.

Also proposed is a method for sizing the engine plant. Again it is based on field experience with the DSS. The power plant should be sized to deliver full power to all thrusters plus one and simultaneously carry the shipservice load. There should be sufficient number of engines to not be short in the event one skid is down.

These two rules should be used with existing guidelines to size thruster and engine capacity for dp rigs. They are based on field experience. The methods may not be as eloquently stated as those for API or DNV but nonetheless will be a requirement if Shatto or Herrmann are contracted to qualify the dp system.

HSSC Number

A Dimensionless Ratio for DP System Performance

$$HSSC = \frac{(0.8)\,Available\ Thrust}{Beam\ Wind\ Load\ @\ \ 61\ Kts}$$

so

$$HSSC = \frac{(0.8) n T_f\, P_i}{B_d V_{61}^2}$$

and also

$$P_{Tot} = P_i(n+1) + 15\sqrt{nP_i}$$

where

n = Total Number of Thrusters

P_{Tot} = Total Installed Power [HP]

P_i = Continuous Power Rating of a Single Thruster [HP]

T_f = Thruster Performance Factor [kn / MW] or [kips / HP]

B_d = Beam Wind Drag Coefficient [kn / (m/s)^2] or [kips / kt^2]

V_{60} = 61 kt Wind Speed or Equivalent [m/s] or [kt]

and for Proper DP Performance

HSSC $\geq$ 1