DP - Capability and Comparison

Comparison of the dynamic positioning (DP) ratings of ships is commonly made but not always understood.

This ESCA overview briefly outlines the main points relating to DP notation and to provide the reader with some context when considering comparison between ships and their DP ratings.

Readers seeking a more comprehensive understanding of DP matters should refer to the IMO "Guidelines for Vessels with Dynamic Positioning Systems" (Circular 645), Classification Societies' rules & standards, published literature from organisations such as the International Marine Contractors Association (IMCA) e.g. and other authoritative sources.

Some basics:

- A dynamically positioned vessel means a unit or a vessel which automatically maintains its position (fixed location or predetermined track) exclusively by means of thruster force.
- DP requirements are set by Classification Societies interpreting the guidance provided by IMO Circular 645.
- IMO DP equipment class identifies the degree of redundancy the system provides; i.e. 1, 2 or 3. Classification Societies provide their own notation relating to the IMO equipment class to allow for differences in Classification Societies' rules, and any exemptions made.
- Redundancy means the ability of a component or system to maintain or restore its function when a single failure has occurred.
- Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.
- Failure mode effect analysis and capability assessments in a range of defined environmental conditions are key factors in any assessment of a DP vessel.

IMO Requirements and Classification Societies:

In respect of DP, ships are surveyed by classification societies during build and operation to standards compliant with the Class rules and the requirements of IMO, Flag State and industry. The classification societies define their interpretation of the IMO guidelines with different notation terminology. For instance, Lloyds Register use class notation of DP1, DP2 and DP3 while DNV use the terms DYNPOS, DYNPOS AUT, DYNPOS AUTR similarly. Other classification societies use different class notation.

For simplicity the Lloyds Register notation is used in this note, as it aligns with the colloquial expression used in most DP discussions.

In 1977 Det Norske Veritas (DNV, now DNV GL) established the Environmental Regularity Number (ERN) to indicate the effectiveness of a DP system under metocean conditions. In 2016 DNV GL introduced a new DP Capability Standard (DNVGL-ST-0111 – Assessment of Station Keeping Capability of Dynamic Positioning Vessels) with the stated objective of providing a unified standard for industry. It addresses both the intact vessel condition and the worst-case single failure conditions corresponding to the vessel's Dynamic Positioning class notation.

Some background:

Before DP became available and when anchored moorings were not an option, ships involved in position sensitive operations, when stationary or at very low speeds, maintained position control manually. An accomplished seaman could achieve a sufficient degree of balance of the various dynamic forces acting on the vessel, maintaining position by manual control to achieve the task in hand. This required a level of skill, derived from experience of ship handling, an intimate knowledge of the vessel, its manoeuvring characteristics and a sense of what the immediate environment (wind, waves and currents) was doing and might do. The intended operations were constrained by the operability limits of the vessel in this mode.

Of course, nothing stays the same for long at sea and a slight wind shift, change of current or momentary lapse of concentration, would soon upset the hard-earned equilibrium. Joystick systems were introduced which simplified control, in that fewer knobs and levers needed to be managed to achieve a desired result, and so a degree of fine tuning was made more accessible.

The industry soon required better operability and a broader operating envelope to conduct ever more challenging operations, to increasingly higher safety standards and demanding commercial objectives. Computer aided positioning was developed which evolved into DP systems to facilitate these operations, allowing more precise control and so widening the scope of work which could be achieved: A vessel could maintain more accurate positioning for longer periods, allowing more challenging tasks to be undertaken.

Rapid or unexpected changes can create difficult situations; a large wind shift, a lost thruster or main engine, an interruption of the navigation/ position reference system, etc., often required the DP operator (DPO) to take the system back into manual control. By providing backup, segregation and or duplicate elements to the system and ensuring electrical supply through design, increasing levels of redundancy were provided. To this day however the DPO remains an integral and significant part of a DP system as continued surveillance and intervention are as essential now as ever before.

DP Control:

The principal components of a DP system are:

- Propulsion, rudders and thrusters
- Position reference systems (e.g. electronic navigation, taut wire, hydro acoustic systems)
- Generating plant and connectivity
- Electrical switchboard
- DP control desk(s)
- Computer system and software
- Motion reference units
- Environmental sensors (Anemometers, current meters (e.g. ADCP), accelerometers)
- Trained and competent DPOs
- Effective management systems including those for quality and planned maintenance

As with any marine operation it is essential to plan and control the operations within a vessel's operable limits. With all elements functioning correctly a vessel will operate within its designed DP envelope. Exceeding a vessels capability will result in a departure from the design envelope, regardless of DP rating. Consequently, maintaining control requires system availability appropriate to the environmental conditions likely to be experienced. Redundancy levels can be considered in the context of the criticality of position control and essential up-time on site.

A DP system relies on the effectiveness and performance of each component. A high degree of engineering and development goes into these vessels and the higher the DP rating the more expensive they are to design, build and operate. The quality, competence and continued performance of the human element is just as critical as the hardware and software, arguably more so in fact, as the control of the system is directly under the influence of the DPO. Also, the continued performance of each element of the system is entirely reliant upon the effectiveness of the management and maintenance systems employed and the competence of the engineers and technicians maintaining them.

Summary:

DP1 A DP system which provides full automation of the control system but with less than 100% redundancy of its system elements.

DP2 A system that provides 100% redundancy across all system elements.

DP3 A DP2 system with improved physical segregation and protection of key system elements from fire and flooding, as well as achieving higher degrees of redundancy of systems, meeting the necessary design standard and reliability.

Any system is only as good as the weakest component. The adequacy and effectiveness of the training and management systems established by the ship operators, owners and charterers are equally part of the system.