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Drilling system of mobile offshore drilling rig - Configuration and technical requirement

海洋移动钻井平台钻井系统配置和技术要求

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3 Terms and definitions

The terms defined in GB/T 23505-2017 and GB/T 28911 apply together with four terms given here. A mobile offshore drilling rig (3.1) is an offshore mobile drilling platform that moves between different oil and gas fields to carry out drilling; a note says that it is used mainly for the exploration and development of offshore oil and gas resources, drilling exploration wells and production wells, and that it is divided by working water depth into shallow water and deep water drilling rigs, each fitted with the drilling system matched to that depth.

A shallow water drilling rig (3.2) is a drilling rig whose maximum operating water depth is not greater than 165 m, given in the original as 550 ft, and a note says it is mainly the jack-up rig. A deep water drilling rig (3.3) is one whose maximum operating water depth is greater than that figure, and a note says it is mainly the semi-submersible rig and the drillship. The maximum hook load (3.4) is the maximum load, static and dynamic, that the equipment can bear as determined from the material strength and a specified safety factor, that is the maximum load the hook of a drilling or workover rig can lift at the largest number of lines; the definition is taken with modification from GB/T 23505-2017, 3.1.4.

4 General

4.1 The configuration and the technical requirements shall meet the relevant rules of the classification society and shall also satisfy the requirements of offshore oil and gas exploration and development, working with the other systems of the platform for efficient and safe drilling; the fire, explosion and operating safety requirements of the platform; the environmental requirement of zero pollution from platform discharges; the requirements of single well and multi well operation for exploration and production wells; the requirement that automated drilling be efficient and coordinated with no interference between items of equipment; the platform design input conditions and the interface requirements towards the other platform systems; and the interface requirements towards third party drilling equipment, such as remotely operated vehicles, mud logging equipment, well testing equipment and cuttings handling systems.

4.2 The recommended configuration of the key systems or equipment of a shallow water drilling system is given in Table A.1 of Annex A and that of a deep water drilling system in Table A.2.

5 Configuration

5.1 The drilling system comprises the hoisting system, the rotating system, the automated tubular handling system, the heave compensation system, the riser system, the well control system, the mud circulating system, the bulk material system and the drilling control system.

5.2 A hoisting system with a conventional drawworks is made up mainly of the derrick, the drawworks, the travelling block, the crown block, the deadline anchor, the drilling line drum and the wire rope; a hoisting system with hydraulic cylinders is made up mainly of the derrick, the cylinders, the hydraulic power unit, the sheave blocks and the guide frame. The configuration shall meet GB/T 25428 and GB/T 19190. The derrick shall have a main structure strong enough for the maximum hook load, with strength and overall stability calculations based on the drilling conditions and the defined working environment; a height that suits stand handling, with at least 10 m of clear height kept between the top drive elevator and the top of the stand; a base size suited to the stand capacity of the fingerboard and to the fingerboard type, and a top size suited to the installation dimensions of the passive drill string compensator and the active crown block compensator; a main structure and outfitting able to withstand offshore corrosion, preferably galvanized; a design that allows the derrick to be lifted in panels, in sections or as a whole, with the main beams and supporting structures preferably connected by anti-fall bolts and the interior arranged for maintenance, personnel safety and comfortable operation; and a form and function suited to efficient tubular handling and tripping. The drawworks shall meet SY/T 5532 and the drilling line SY/T 5170.

5.3 The rotating system is made up mainly of the top drive and the rotary table and shall meet GB/T 31049 and SY/T 5080. The top drive shall have constant power and constant torque regulation, preferably by wide frequency alternating current variable frequency drive; hydraulic telescopic guide rails that extend to the well centre or retract for stowage; an elevator and tools for making up and breaking out tubulars; and an internal manual and remotely controlled blowout preventer whose pressure rating matches the well control equipment.

5.4 The automated tubular handling system is made up mainly of the knuckle boom crane, the catwalk machine, the iron roughneck, the pipe racking machine and the fingerboard, and shall meet GB/T 3766, GB/T 7932 and GB/T 7935. The crane shall have interchangeable boom grippers for different items; the catwalk machine shall convey tubulars and be fitted with a nose tilting device and a side loading device for automatic loading, with a dedicated riser rack and riser crane where risers are to be conveyed; the iron roughneck shall make up and break out tubulars at the well centre and the mousehole, and on a deep water rig shall also handle casing and should have a built-in mud bucket; the racking machine should be variable frequency driven and fitted with a lifting arm and a guide arm so that it can move and rotate freely between the racking area and the well centre area; and the fingerboard shall take drill pipe, drill collars and casing, its capacity matching the drilling depth of the platform.

5.5 The heave compensation system is made up mainly of the passive drill string compensator, the active crown block compensator, the travelling block compensator, the riser tensioner and the casing tensioner, and shall meet GB/T 30217.1, SY/T 6913 and SY/T 7460. Its capacity and cylinder stroke shall match the platform type and the working

environment; it shall have dedicated cylinders, a hydraulic power unit, accumulator bottle banks, an air system, a control panel and gas bottles; the hydraulic fluid shall be a fire resistant or water based fluid, preferably an environmentally friendly water based fluid; and the riser tensioner shall be of the wire rope type or the direct acting cylinder type.

5.6 The riser system is made up mainly of the riser spider, the gimbal, the telescopic joint, the tension ring, the flex joint, the riser, the riser pup joint, the riser fill valve, the buoyancy modules and the running and pressure testing tools, and shall meet GB/T 30217.1 and SY/T 6913. The telescopic joint shall use two different power sources, pneumatic and hydraulic, with automatic changeover on failure; risers may be stored horizontally or vertically; handling equipment and maintenance arrangements shall be provided as needed; the outside of the riser shall carry the kill line, the choke line, the booster line and the hydraulic line; risers and buoyancy modules shall suit the working water depth and environment of the platform; riser lifting gear shall have anti-swing capability in horizontal or vertical lifting; and the riser connector should be of the large angle unlocking type, with high strength large angle alignment devices on the riser connector and the wellhead connector.

5.7 The well control system is made up mainly of the diverter, the blowout preventer, the choke and kill manifold, the mud gas separator, the blowout preventer control equipment and the diverter control equipment, and shall meet SY/T 5053.2, SY/T 5323 and SY/T 6868. It shall suit the well fluid and the wellhead pressure. The diverter shall have two emergency discharge lines interlocked with the mud return line. Blowout preventers are divided by working environment into surface and subsea; a surface stack should have four rams and a subsea stack should have not fewer than five, of which one shall be a drill pipe shear ram, one a casing shear ram and one a variable bore ram, and a deep water stack shall have an emergency disconnect function. Each side of the stack shall have not fewer than two choke and kill line outlets, one kill line outlet being on the lowest ram preventer. The choke and kill manifold shall have an antifreeze injection device, and both the choke side and the kill side shall have at least two glycol injection ports and two pressure test connections. The valve material of the manifold shall match the blowout preventer, resist corrosion by hydrogen sulfide and similar media, and be of material class EE or better. Subsea blowout preventer control equipment shall also have a control umbilical and reel, a subsea control pod and a remotely operated vehicle control panel, and the diverter control system shall have a hydraulic power unit, hydraulic control valves and instruments, accumulator banks and a diverter control unit.

5.8 The mud circulating system is made up mainly of the high pressure mud pumps, the high pressure manifold, the fill pump, the mixing pump, the mixing hopper, the big bag machine, the bag cutting machine, the liquid additive skid, the chemical addition tank, the high shear mixer, the mud scraper, the distributor, the shale shakers or mud cleaners, the return mud handling equipment, the desilter, the desander and the degasser, and shall meet SY/T 5612. The low pressure part shall have handling, mixing and conveying equipment for bulk material and additives so that mud can be batch mixed to a set density