inlet at a vertical distance with a predetermined minimum submergence and adapted for pumping cold water from the caisson up to the floating production unit for use as cooling medium by production equipment of the floating production unit, and a sump tank, attached to the bottom side of each of the caissons such that each through-opening thereof is in fluid communication with a volume inside the sump tank, the sump tank being located between the bottom side of the hull and the at least two caissons when mounted, defining a sump volume extending between the bottom side of the hull, when the sea water intake riser system is mounted thereto, and the bottom side of each of the caisson over the entire width of the at least two caissons, and having a through-opening in a bottom side and being connectable to an upper end of a riser pipe.

During use, the lift pumps are located with their inlets at a predetermined distance below the waterline. During normal pumping operation, the water level in the caisson is lower than the outside water surface, generating a pressure difference for water to flow into the caisson from the riser pipe through the sump tank, where water is pumped to the topside facilities on deck using the lift pumps. The sump tank positioned between the caissons and the bottom side of the hull holds a constant body of water, which acts as a buffer volume between the water inflow at the bottom side and the water outflow at the lift pumps. Under FPU periodical heave motions, water pressure inside the riser will naturally move up and down, which would cause the water level inside the caissons to rise and fall if directly connected to the riser. Within the fixed volume of the sump tank, no such movement is possible, resulting in a more stabilised pressure at the through-opening at the bottom side of the caisson, limiting the water level movement inside the caissons. Further, due to multiple caissons being connected to the top side of the sump tank, the caissons have a width equal to maximum the width of the sump tank divided by the amount of caissons connected thereto, which reduced width effectively reduces the distance over which the water may move, creating an individual water column around each respective lift pump and reducing variations in water level around each lift pump. The pump submergence and riser diameter are determined based on a required design flow rate and to prevent the lift pumps running dry and suffering from subsequent pressure loss. Due to the reduction in water level variation around each lift pump, the pressure variation at the predetermined minimum distance from the bottom side of the caisson is reduced. The constant body of water present in the sump tank, between the predetermined minimum distance from the bottom side of the caisson and the through-opening in the bottom side subsequently levels out any pressure differences between the individual columns of water. Thus due to the constant volume of water being present in the sump tank and the use of individual caissons around the lift pumps, the pressure variations at both the through-opening of the sump tank and around the inlets of the lift pumps are reduced significantly, resulting in the SWIR system having a more constant operating efficiency, substantially independent from sea conditions and riser pipe sizing.

Generally, riser pipes have a relatively large diameter of at least 0.75 m, but preferably at least 1 m, to allow sufficient water intake using only a single SWIR system. A distance between the inlet of each of the lift pumps and the water-line is preferably at least 10 meters, which is governed and predetermined by a hydraulic study of SWIR system with sump tank.

Further, due to the substantially equal height of the caisson to the vertical height of the hull and having the bottom side substantially near to the bottom side of the hull, the open top side of the

Claims

1. A sea water intake riser system (100; 100') for a floating production unit (1), comprising at least two caissons (120), wherein the height of each caisson is substantially equal to a vertical height (L) of a hull (5) of the floating production unit (1) and extends, when mounted to the hull (5) of the floating production unit, from a predetermined minimum distance (126) from the bottom side of the hull up to at least the water-line (WL) during use, each caisson (120) comprising an open top side and a through-opening in a bottom side (123);
a lift pump (140) arranged inside each of the caissons (120) and having an inlet at a vertical distance (141) with a predetermined minimum submergence (d) and adapted for pumping cold water from the caisson (120) up to the floating production unit (1) for use as cooling medium by production equipment (10) of the floating production unit, and
a sump tank (125), attached to the bottom side (123) of each of the caissons such that each through-opening thereof is in fluid communication with a volume inside the sump tank (125), the sump tank being located between the bottom side of the hull and the at least two caissons (120) when mounted, defining a sump volume extending between the bottom side of the hull, when the sea water intake riser system is mounted thereto, and the bottom side (123) of each of the caisson over the entire width of the at least two caissons (120), and having a through-opening (155) in a bottom side (128) and being connectable to an upper end of a riser pipe (150).

2. The sea water intake raiser system according to claim 1, wherein the caisson (120) and sump tank (125) are provided with mounting elements (119) for mounting the caissons (120) and sump tank (125) externally to and at a predetermined distance from the hull (5), the sump tank (125) having a bottom side substantially near the bottom side of the hull.

3. The sea water intake riser system according to claim 1 or claim 2, wherein a riser pipe (150) is removably mounted into the through-opening (155) of the sump tank (125) with an upper end, the riser pipe (155) having a free opposite lower end, which is provided with a strainer water-inlet (160), the riser pipe being adapted for transporting water from the water-inlet into the sump tank (125).

4. The sea water intake riser system according to any one of the previous claims, wherein the riser pipe is at least 300m long.

5. The sea water intake riser system according to any one of the preceding claims, wherein the sea water intake riser pipe (150) is a substantially flexible riser pipe, being provided with

a ballast at the lower end.

6. The sea water intake riser system according to claim 5, wherein the sea water intake riser pipe (150) comprises
at least one reinforced pipe (151) which is with a first end fitted into the through-opening of the caisson,
and a string of main body standard pipes (152, 153) which is with a first end connected to a second end of the reinforced pipe, which length of the string is configured as a pipe having a nearly neutrally buoyant weight when submerged in water.

7. The sea water intake riser system according to claim 6, wherein the string of main body standard pipes (152, 153) comprises a material with a specific strength belonging to a group of polymers comprising polypropylene and polyethylene.

8. A floating production unit comprising a sea water intake riser system as defined in any one of the preceding claims 1 – 7.

9. The floating production unit according to claim 8, wherein the floating production unit is a semi-submersible production unit.

10. The floating production unit according to claim 8 or 9, wherein the floating production unit is equipped with a crane (7) for installing pipe pieces (151, 152, 153) from a top deck (6) of the floating production unit through the caisson (120) onto one another to form or elongate the sea water intake riser.

11. A method of manufacturing a caisson for a sea water intake system for a floating production unit according to claim 1.