CLAIMS

1. A subsea well system comprising: a subsea equipment (10) adapted for mounting on a subsea wellhead; an equipment package (40, 80) that lands on the subsea equipment (10); and a hub (26) on the subsea equipment (10) for mating with a corresponding connection on the equipment package (40, 80) to establish fluid communication between the equipment package (40, 80) and the subsea equipment (10), the subsea well system being characterized by:

a first alignment member (54, 84) that mates with a corresponding second alignment member (14) as the equipment package (40, 80) lands on the subsea equipment (10); and

a third alignment member (56, 88) that mates with a corresponding fourth alignment member (20) as the equipment package (40, 80) continues to land on the subsea equipment (10),

wherein the third alignment member (56, 88) has a chamber (70) for trapping sea water when the equipment package (40, 80) is being landed on the subsea equipment (10).

2. The system of claim 1, wherein the third alignment member (56, 88) is a receptacle (56, 88) that has an orifice (58, 90) in fluid communication with the chamber (70) and to the sea to allow sea water trapped in the chamber (70) to bleed out to the sea at a desired rate during landing of the equipment package (40, 80).

3. The system of either of claims 1 or 2, wherein the third alignment member (56, 88) is a receptacle (56, 88) that is connected to a flow control valve (76) that is in fluid communication with the chamber (70) in the receptacle (56, 88) and the sea to allow sea water trapped in the chamber (70) to be released out to the sea at a desired rate during landing of the equipment package (40, 80).

4. The system of any of claims 1-3, wherein the second alignment member (14) has a length selected so that the second alignment member (14) mates with the first alignment member (54, 84) before the fourth alignment member (20) mates with the third alignment member (56, 88).

5. The system of claim 4, wherein:

an inner diameter of the first alignment member (54, 84) is larger than an inner diameter of the third alignment member (56, 88);

an outer diameter of the second alignment member (14) is larger than an outer diameter of the fourth alignment member (20).

6. The system of any of claims 1-5, wherein the fourth alignment member (20) is mounted to the subsea equipment (10) within the third alignment member (56, 88), the third alignment member (56, 88) mounted to the equipment package (40, 80); wherein the mating of the third alignment member (56, 88) with the fourth alignment member (20) traps sea water within the chamber (70) of the third alignment member (56, 88).

7. The system of any of claims 1-6, wherein the subsea equipment (10) is one of the following:

a.) a Christmas tree;

b.) a manifold;

c.) a pipeline end manifold; or

d.) a pipeline end termination.

8. The system of any of claims 1-7, wherein the first alignment member (84) has a chamber (70) for trapping sea water when the first alignment member (84) mates with the second alignment member (14), as equipment package (40, 80) is being landed on the subsea equipment (10).

9. The system of claim 8, wherein the first alignment member (84) has an orifice (86) in fluid communication with the chamber (70) and to the sea to allow sea water trapped in the

chamber (70) to bleed out to the sea at a desired rate during landing of the equipment package (40, 80).

10. The system of either of claims 8 or 9, wherein the first alignment member (84) is connected to a flow control valve (94) that is in fluid communication with the chamber (70) and the sea to allow sea water trapped in the chamber (70) to be released out to the sea at a desired rate during landing of the equipment package (40, 80).

11. The system of any of claims 1-10, wherein each of the first, second, third, and fourth alignment members (54, 84, 14, 56, 88, 20) form part of an array of alignment members (54, 84, 14, 56, 88, 20) such that each of the alignment members (54, 84, 14, 56, 88, 20) are disposed diagonally across from an identical alignment member (54, 84, 14, 56, 88, 20).

12. The system of any of claims 1-11, wherein the third alignment member (56, 88) is a receptacle (56, 88) mounted on the equipment package (40, 80) and the second and fourth alignment members (14, 20) are pins mounted on the subsea equipment (10).

13. A subsea well system comprising: a subsea tree (10) adapted for mounting on a subsea wellhead; a flow control module (40, 80) that lands on the subsea tree (10); and a hub (26) on the subsea tree (10) for mating with a corresponding connection on the flow control module (40, 80) to establish fluid communication between the flow control module (40, 80) and the subsea tree (10), the subsea well system being characterized by:

a first alignment member (54, 84) mounted on the flow control module (40, 80) that mates with a corresponding second alignment member (14) mounted on the subsea tree (10), as the flow control module (40, 80) lands on the subsea tree (10); and

a third alignment member (56, 88) mounted on the flow control module (40, 80) that mates with a corresponding fourth alignment member (20) mounted on the subsea tree (10), as the flow control module (40, 80) continues to land on the subsea tree (10),

wherein,

the third alignment member (56, 88) has a chamber (70) for trapping sea water when the flow control module (40, 80) is being landed on the subsea tree (10), the third alignment member (56, 88) having an orifice (58, 90) at an upper end of the chamber (70) to allow sea water to bleed out to sea at a desired rate during landing of the flow control module (40, 80);

the second alignment member (14) has a length selected so that the first alignment member (54, 84) mates with the second alignment member (14) before the third alignment member (56, 88) mates with the fourth alignment member (20);

an inner diameter of the first alignment member (54, 84) is larger than an inner diameter of the third alignment member (56, 88);

an outer diameter of the second alignment member (14) is larger than an outer diameter of the fourth alignment member (20).

14. The system of claim 13, wherein the hub (26) is located on the subsea tree (10) for mating with a corresponding connection on the flow control module (40, 80) to establish fluid communication between the flow control module (40, 80) and the subsea tree (10).

15. The system of either of claims 13 or 14, wherein the third alignment member (56, 88) is connected to a flow control valve (76) that is in fluid communication with the chamber (70) and the sea to allow sea water trapped in the chamber (70) to be released out to the sea at a desired rate during landing of the flow control module (40, 80).

16. The system of any of claims 13-15, wherein the first alignment member (84) also has a chamber (70) for trapping sea water as the second alignment member (14) enters the first alignment member (84) when the flow control module (40, 80) is being landed on the subsea tree (10);

the first alignment member (84) having an orifice (86) in fluid communication with the chamber (70) and to the sea to allow sea water trapped in the chamber (70) to bleed out to the sea at a desired rate during landing of the flow control module (40, 80).

17. The system of claim 16, wherein the first alignment member (84) is connected to a flow control valve (94) that is in fluid communication with the chamber (70) and the sea to allow sea water trapped in the chamber (70) to be released out to the sea at a desired rate during landing of the equipment package (40, 80).

18. The system of any of claims 13, wherein a sealing element (72) is located between the third alignment member (56, 88) and the fourth alignment member (20) to facilitate trapping of sea water as the third alignment member (56, 88) mates with the fourth alignment member (20).

19. A method for landing an equipment package (40, 80) on a subsea equipment (10), the method being characterized by the steps of:

providing the equipment package (40, 80) with a plurality of alignment members (54, 84, 14, 56, 88, 20) facing downward, the subsea equipment (10) with a plurality of alignment members (54, 84, 14, 56, 88, 20) facing upward;

lowering the equipment package (40, 80) onto the subsea equipment (10) and causing the alignment members (14, 20) of the subsea equipment (10) to stab into the alignment members (54, 84, 56, 88) of the equipment package (40, 80); and

trapping sea water between the alignment members (14, 20) of the subsea equipment (10) and the alignment members (54, 84, 56, 88) of the equipment package (40, 80) as the alignment members of the subsea equipment (10) stab into the alignment members (54, 84, 56, 88) of the equipment package (40, 80), thereby

slowing the downward movement of the equipment package (40, 80) during landing with the trapped sea water.

20. The method of claim 19, being further characterized by the step of:

releasing the trapped sea water from the subsea equipment (10) and equipment package (40, 80) alignment members (54, 84, 14, 56, 88, 20), at a desired rate to slow the landing of the equipment package (40, 80).

What is claimed is:

1. A subsea well system, comprising:

a subsea equipment adapted for mounting on a subsea wellhead;

an equipment package that lands on the subsea equipment;

a hub on the subsea equipment for mating with a corresponding connection on the equipment package to establish fluid communication between the equipment package and the subsea equipment;

a first alignment member carried by the equipment package and positioned to receive a corresponding second alignment member connected to the subsea equipment to thereby mate with the second alignment member when the equipment package is being landed on the subsea equipment to provide for establishing alignment of the equipment package with the subsea equipment when being landed thereupon;

a third alignment member carried by the equipment package and positioned to receive a corresponding fourth alignment member connected to the subsea equipment to thereby mate with the fourth alignment member when the equipment package is being landed on the subsea equipment to provide for further establishing alignment of the equipment package with the subsea equipment when being landed thereupon,

the third alignment member comprising: a chamber for trapping sea water when the fourth alignment member enters an opening in an end of the third alignment member, and an orifice extending through a portion of the third alignment member; and

a flow control valve in fluid communication with the sea water trapped within the chamber and configured to allow the sea water trapped within the chamber to be released at a desired rate to provide a soft landing of the equipment package onto the subsea equipment.

2. The system of claim 1, wherein the third alignment member is a receptacles;

wherein the orifice is in fluid communication with the chamber; and wherein the flow control valve is further in fluid communication with the sea to allow the sea water trapped in the chamber to bleed out to the sea at the desired rate.

3. The system of claim 1, wherein the third alignment member is a receptacle connected to the flow control valve; and wherein the flow control valve is configured to be remotely operated by a remote operating vehicle (ROV) to allow the sea water trapped in the chamber to be released out to the sea at the desired rate.

4. The system of claim 1, wherein the second alignment member has a length selected so that the second alignment member mates with the first alignment member before the fourth alignment member mates with the third alignment member.

5. The system of claim 4, wherein:

an inner diameter of the first alignment member is larger than an inner diameter of the third alignment member;

an outer diameter of the second alignment member is larger than an outer diameter of the fourth alignment member.

6. The system of claim 1, wherein the fourth alignment member is mounted to the subsea equipment, the third alignment member mounted to the equipment package; and wherein the system further comprises a sealing element located adjacent the opening in the end of the third alignment member to facilitate trapping the sea water within the chamber of the third alignment member when mating the third alignment member with the fourth alignment member.

7. The system of claim 4, wherein the subsea equipment is one of the following:

a.) a Christmas tree;

b.) a manifold;

c.)a pipeline end manifold; or

d.)a pipeline end termination.

8. The system of claim 1, wherein the first alignment member has a chamber for trapping sea water when the first alignment member mates with the second alignment member, as the equipment package is being landed on the subsea equipment.

9. The system of claim 8, wherein the first alignment member has an orifice in fluid communication with the chamber and to the sea to allow sea water trapped in the chamber to bleed out to the sea at a desired rate during landing of the equipment package.

10. The system of claim 8, wherein the first alignment member is connected to a flow control valve that is in fluid communication with the chamber and the sea to allow sea water trapped in the chamber to be released out to the sea at a desired rate during landing of the equipment package.

11. The system of claim 1, wherein each of the first, second, third, and fourth alignment members form part of an array of alignment members such that each of the alignment members are disposed diagonally across from an identical alignment member.

12. The system of claim 1, wherein the third alignment member is mounted on the equipment package and the second and fourth alignment members are pins mounted on the subsea equipment.

13. A subsea well system, comprising:

a subsea tree adapted for mounting on a subsea wellhead;

a flow control module that lands on the subsea tree;

a hub on the subsea tree for mating with a corresponding connection on the flow control module to establish fluid communication between the flow control module and the subsea tree;

a first alignment member mounted on the flow control module and configured to mate with a corresponding second alignment member mounted on the subsea tree, when the flow control module is being landed on the subsea tree to provide for establishing alignment of the flow control module with the subsea tree;

a third alignment member mounted on the flow control module configured to mate with a corresponding fourth alignment member mounted on the subsea tree, as the flow control module is being landed on the subsea tree to provide for further establishing alignment of the flow control module with the subsea tree, the third alignment member having a chamber for trapping sea water when the fourth alignment member enters an opening in a lower end of the third alignment member when the flow control module is being landed on the subsea tree, and an orifice at an upper end of the chamber to allow trapped sea water to be bled out of the chamber; and

a flow control valve in fluid communication with the chamber via the orifice and configured to allow the trapped sea water to be released at a desired rate to provide a soft landing of the flow control valve onto the subsea tree, wherein

the second alignment member has a length selected so that the first alignment member mates with the second alignment member before the third alignment member mates with the fourth alignment member;

an inner diameter of the first alignment member is larger than an inner diameter of the third alignment member; and

an outer diameter of the second alignment member is larger than an outer diameter of the fourth alignment member.

14. The system of claim 13, wherein the hub is located on the subsea tree for mating

with a corresponding connection on the flow control module to establish fluid communication between the flow control module and the subsea tree.

15. The system of claim 13, wherein the flow control valve is further in fluid communication with the sea to allow sea water trapped in the chamber to be released out to the sea at the desired rate.

16. The system of claim 13, wherein the first alignment member also has a chamber for trapping sea water as the second alignment member enters the first alignment member when the flow control module is being landed on the subsea tree, the first alignment member having an orifice in fluid communication with the chamber and to the sea to allow sea water trapped in the chamber to bleed out to the sea at a desired rate during landing of the flow control module.

17. The system of claim 16, wherein the flow control valve is a first flow control valve, and wherein the first alignment member is connected to a second flow control valve that is in fluid communication with the chamber of the first alignment member and the sea to allow sea water trapped in the chamber to be released out to the sea at the desired rate during landing of the flow control module.

18. The system of claim 13, further comprising a sealing element located between the third alignment member and the fourth alignment member to facilitate trapping of sea water as the third alignment member mates with the fourth alignment member.

19. A method for landing an equipment package on a subsea equipment, comprising:

providing an equipment package with a plurality of alignment members facing downward, and a subsea equipment with a plurality of alignment members facing upward,

lowering the equipment package onto the subsea equipment and causing the alignment members of the subsea equipment to stab into the alignment members of the equipment package;

trapping sea water between at least one of the alignment members of the subsea equipment and a corresponding at least one of the alignment members of the equipment package as the at least one of alignment members of the subsea equipment stab into the corresponding at least one of alignment members of the equipment package, thereby

slowing the downward movement of the equipment package with the trapped sea water; and

releasing the sea water trapped between the at least one of the alignment members of the subsea equipment and at least one of the alignment members of the equipment package, at a desired rate to provide a soft landing of the equipment package onto the subsea equipment,

the releasing performed through use of a flow control valve in fluid communication with the trapped sea water and configured to allow the sea water trapped within the chamber to be released at a desired rate.

20. The method of claim 19, wherein the flow control valve is further in fluid communication with the sea to allow the trapped sea water to bleed out to the sea at the desired rate.