CUMING CORPORATION

TECHNICAL NOTE 600-12
OFFSHORE TECHNOLOGY
Part 2 – Subsea Production
December 14, 2009

1.0 There are two basic types of offshore operations, as shown in **Figure 1** on Page 3:

- Exploration – Drilling to locate oil and gas under the sea; this is a short-term activity, with a typical well taking 30 to 90 days to drill. After evaluation of the site has been completed, the drill rig caps the well and sails away.
- Production – Extraction of the oil and gas from beneath the sea floor and removing it to a place where it can be refined and distributed; this is a much longer-term activity, with large wells remaining in place for 20 years or more.

2.0 The syntactic foam products Cuming Corporation makes can be divided into:

- Flotation – Products, such as drilling riser modules, that provide buoyancy to support oilfield equipment; the largest use at present is in exploration drilling.
- Insulation – Products, such as syntactic foam coatings on subsea flowlines, that provide thermal insulation to keep the oil warm and free-flowing in production.

3.0 Among the principal types of floating production rigs are semisubmersibles, spars, tension leg platforms (TLPs), and floating production storage and offloading (FPSO) vessels. Examples of these rigs are illustrated in **Figure 2**. Smaller oil fields are often exploited by the "tieback" method, in which pipelines are run from the new wells to a nearby rig already in position over an existing field. The tieback method saves a lot of money and helps make small offshore oil fields economically viable.

4.0 A typical wellhead is diagrammed in **Figure 3**. Every well is capped by a "subsea tree," an assembly of remotely actuated valves for controlling the flow of well products out of the earth. Depending on the size of the field, the flow from a number of trees may be collected in one or more "manifolds" for further consolidation. Connector pipes called "jumpers" link individual pipes to the manifolds. In deep water, specialized assemblies called "sleds," "PLEMs," or "PLETs" (pipeline end manifolds or terminations) assist in joining the pipelines to the manifold. All of these pieces of machinery, some of them very large, are prime candidates for thermal insulation. If the subsea equipment is not well insulated, then the oil and gas may cool, leading to precipitation of paraffins or hydrates that can clog up the well and prevent flow.

5.0 Unless the field is a tieback to another existing platform, the subsea wellhead must be connected to the surface so that its oil and gas can be exported for use. This requires some form of "riser," or vertical conduit. It is important to make a distinction between <u>drilling</u> risers (TN 100-11 Part 1) and <u>production</u> risers. Exploration drilling risers are seldom in the water for more than 60 days at a time. Production risers, on the other hand, are in continuous use for a long time, perhaps 20 years or more, and may be exposed to elevated temperature, a much more severe service. The several forms of production risers are shown in **Figure 4**, ranging from simple "top tension" risers to complex riser "bundles." In many cases, a combination of both buoyancy and insulating material is necessary to equip these risers for efficient operation in deep water.

6.0 **Figure 5** shows a bundled production riser tower similar to towers supplied for fields offshore West Africa. The buoyancy provides support during horizontal tow-out and installation, upward tension to keep the riser in vertical position over the well, and alignment of the riser's numerous pipes and lines. Insulation is required for the "hot" lines. Such assemblies are sometimes called "hybrid risers" because they include both rigid and flexible components. The flexible risers permit relative motion between the top of the tower and the floating vessel. Flexible risers may require thermal insulation as well as distributed buoyancy modules to maintain proper drape and location over the well.

7.0 **Figure 6** illustrates *C-THERM* "pour-in-place" insulation applied to a piece of subsea equipment. Metal molds are fabricated to fit around the article and provide adequate thickness for the insulation material, typically about two to three inches. The syntactic foam is mixed, evacuated, and poured into the mold cavity. A chemical reaction in the syntactic foam causes it to solidify over several hours into a rigid solid. After solidification is complete, the mold is removed. Another approach is to use "pack-in-place" syntactic foam that can be mixed and applied by hand, very much like modeling clay. The advantage of this method is that molds are unnecessary, saving both time and money. Installation is quick, simple, and inexpensive. **Figure 7** shows a worker applying "pack-in-place" *C-THERM* insulation.

9.0 Often all kinds of *C-THERM* syntactic foam materials are used together to provide a total insulation system. An example of this is shown in **Figure 8**, where pour-in-place, pack-in-place, and pre-cast materials are combined on a large sled bound for the Gulf of Mexico. The result is a fully integrated insulation package that achieves maximum thermal efficiency and cost effectiveness. This kind of installation is normally performed in the field, at a shipyard or in a customer's facility. Cuming Corporation's experienced field service crews are well equipped and prepared to go wherever necessary.

10. The newest trend in deploying offshore oil and gas pipelines in deep water is to lay them by reeling, in which the pipe is wound around large drums or reels. A typical reel lay vessel is shown below. For this application, the insulation material must be flexible enough to undergo reeling and unreeling without cracking, yet strong enough to withstand the high temperature and pressure of service on the sea floor. Cuming Corporation now has a new family of syntactic foam products designed expressly for this demanding service, with temperature ratings up to 275^{o} F (135^{o} C). Cast-on-pipe products are manufactured at the company's factory in New Iberia, Louisiana.

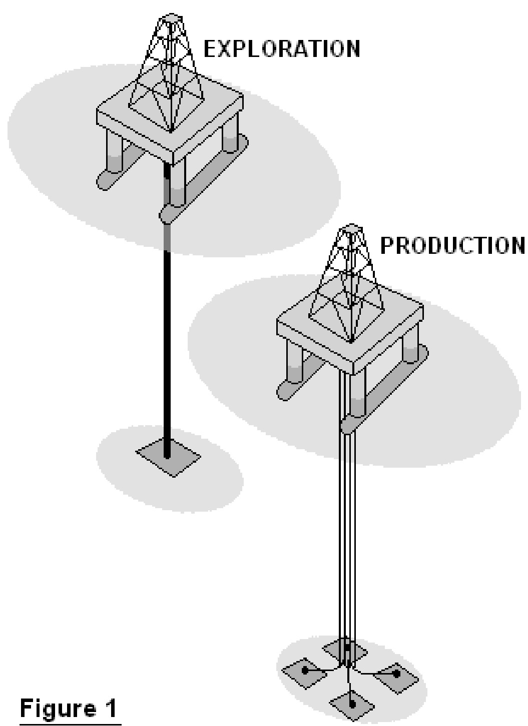

Figure 1

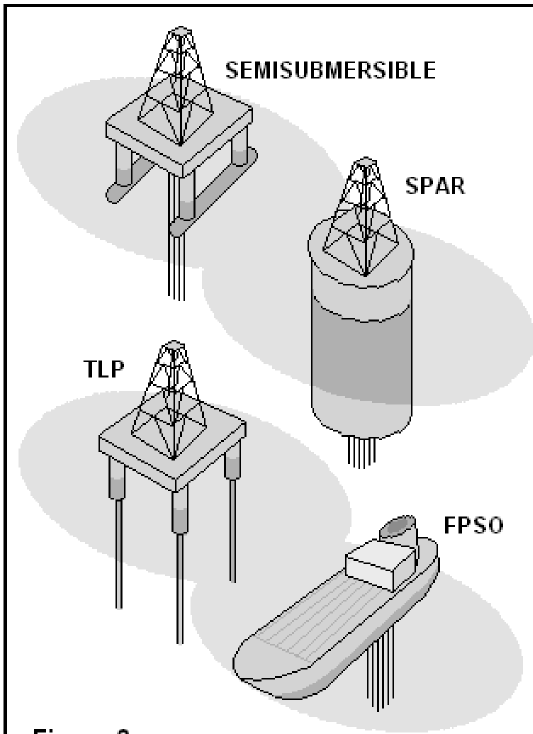

Figure 2

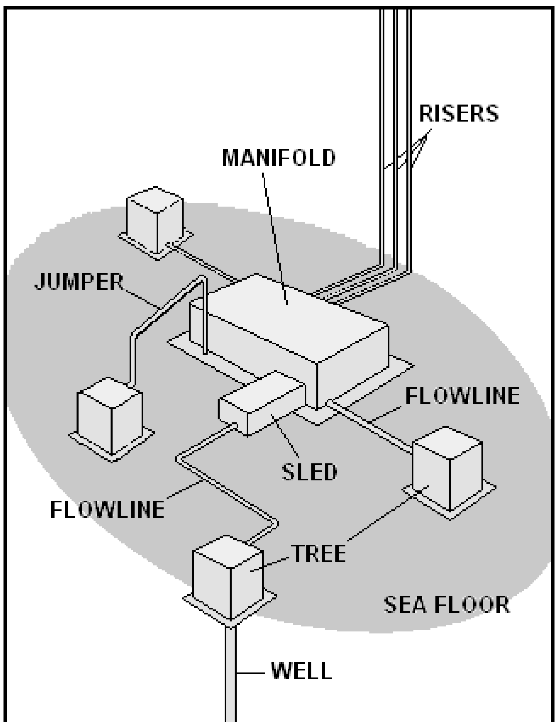

Figure 3

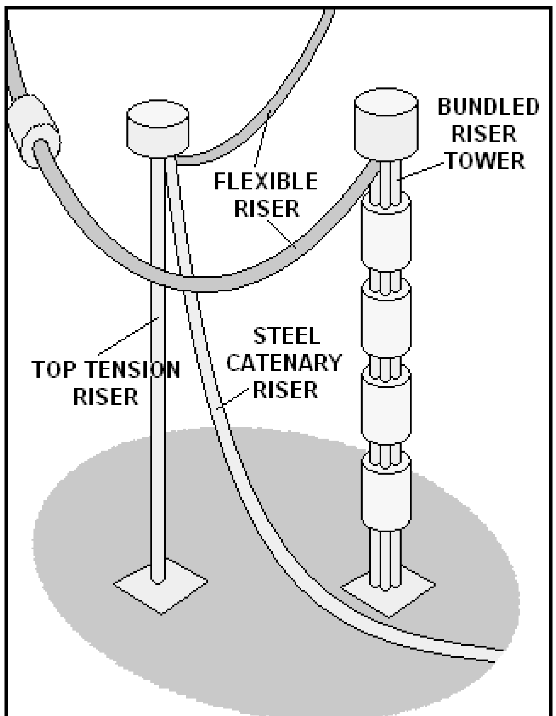

Figure 4

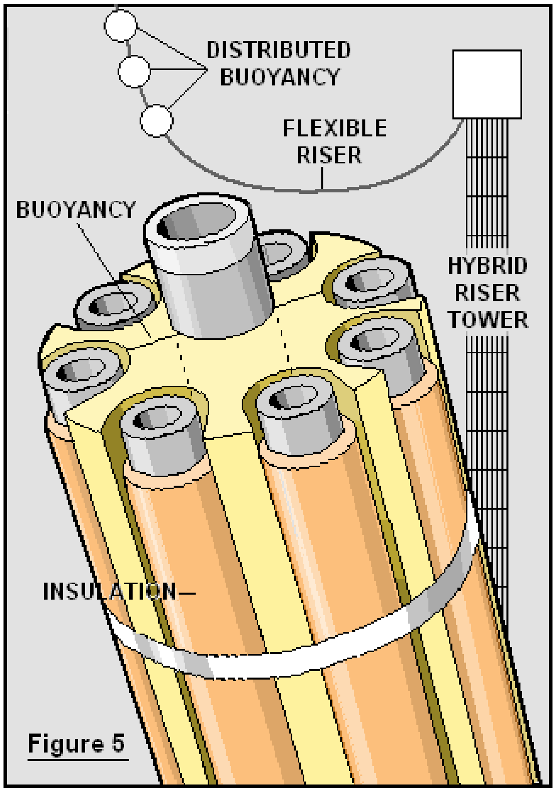

Figure 5

Figure 6

Figure 7

Figure 8