5 CONSTRUCTION AND INSTALLATION

5.1 Philosophy

The MOPU concept has the distinct advantage over conventional jacket and topsides construction methods of allowing the offshore installation of a mechanically complete, fully commissioned production facility without heavy lifts or extensive offshore hook-up and commissioning.

The MOPU will be constructed, commissioned, and installed using the following key philosophies:

- hull design and construction using as much of a "standard" MODU as possible. This technique of using the hull as the main support structure without drilling equipment will allow MODU designers and constructors to use as much of their standard design and fabrication practices to minimize cost and allow for potential reuse after decommissioning;
- design of topsides module(s) to be installed to the extent possible in large mechanically complete, pre-commissioned pieces. Module(s) will be designed to be installed onto the hull at an atshore integration yard, thus allowing fabricators to take advantage of installations independent of weather;
- final mechanical integration, commissioning, and testing of all systems atshore, prior to tow to field, to allow for higher utilization of labour and equipment without the expense of offshore hook-up; and
- minimal final offshore hook-up and commissioning. Offshore activities will be limited to the final hook-up of the subsea wells and equipment, offshore pipeline and startup of production.

EnCana intends to maximize onshore completion and pre-commissioning and to minimize offshore hook-up and commissioning scopes of work without compromising safety.

EnCana has committed to construction of the accommodations unit(s) and flare structure in Nova Scotia. The construction and installation philosophy will address additional design, construction, commissioning and transportation requirements to ship and integrate these components with the remainder of the MOPU.

5.2 Schedule

5.2.1 Development Phase

The schedule for the development phase of the project is set out in Figure 1.3. The revised concept definition for the Deep Panuke Project was completed through 2005 and the first half of 2006. The project is currently in the tendering stage for the bid competition phase for the MOPU. The initial phase of detailed design will be conducted as a competition with an expected duration of nine months.

Following completion of the regulatory process and at the conclusion of the bid competition phase, EnCana will make a decision regarding full project sanction.

Assuming sanction and after contract awards, the Project will then engage in detailed engineering and procurement. Subsequent onshore fabrication at existing facilities will occur prior to installation offshore.

Hull and topsides fabrication is scheduled to commence late third quarter 2008, with the MOPU hull and topsides ready for atshore integration first quarter 2010.

It is anticipated that the export pipeline and flowlines will be constructed in either 2009 or 2010. The tie-ins to the MOPU and to either the M&NP facilities or to the SOEP pipeline will be completed after the MOPU and the export pipeline installation is complete.

Hook-up and offshore commissioning activities will commence in the third quarter of 2010 once the MOPU has been transported to its field location. First gas is anticipated to be produced in the fall of 2010.

5.2.2 Production Operations Phase

The operations phase of the Project is forecast to begin in late 2010, and is estimated to last approximately 13 years in the Mean case with production from the field continuing through late 2023. The P90 case for the project has a life of approximately 8 years, and the P10 forecast indicates a Project life of approximately 17.5 years.

5.3 MOPU Facilities

The hull portion of the MOPU is expected to utilize the basic design premise of an existing MODU jackup with the minimum number of changes required to accept the topsides production facilities. Some modifications are expected for additional safety and control systems, which must be integrated platform wide and other specific modifications, including appurtenances, risers and umbilicals, which interface with the sea and seabed below. However, the intent will also be to minimize the deviations from the standard MODU design so that re-conversion of the unit back to a drilling unit can be readily accommodated in the future, if desired.

The hull design will be structurally capable of withstanding the environmental design conditions for offshore Nova Scotia on a year-round basis; these MODUs are generally referred to as “harsh environment jack-up rigs”.

The production topsides will house all the production equipment and will be located on the hull maindeck in the areas where the drilling package is normally located. The hull will be designed to carry the larger live loads of the drilling activities in this area of the hull; therefore, locating the topsides in this area is ideal from a structural perspective. The topsides will be constructed in modular format. The expected weight of the production facilities is 6000 tonnes and a single module is preferred from a construction and commissioning perspective. However, multiple modules can also be utilized should this be a better fit for the selected hull. Final arrangement will be determined during detailed design. The modules will be designed to be installed onto the hull structure and will be supported by the main girders/bulkheads within the hull.

The construction philosophy for the topsides will in general be based on a single (or several) module(s). The single module will most likely be a pancake-build, which involves completing the various levels of the topsides, stacking one level on top of the other placing equipment into location during the operation. The decks will be constructed from pre-fabricated plate girders, rolled sections and pre-rolled long length tubulars. The intent is to maximize opportunities for equipment installation and the subsequent erection of pipework, cable trays and support steel prior to deck stacking operations.

The accommodations unit(s) will be designed to be constructed in Nova Scotia and therefore may have a design and build plan, which will allow for transportation to the integration site and integration of the unit with the remainder of the MOPU, if required. Special considerations will include design of interface systems for power and utilities as well as loadout and lifting. The accommodations unit will be designed for a minimum continuous POB complement of 68 persons and steady state POB of approximately 30 persons; however, a higher POB design basis may be considered if the MOPU contractor chooses to use a MODU accommodations design to allow for easier conversion back to MODU operations in the future. Final accommodations size and layout will be determined during detailed design.

The flare structure will also be designed to be constructed in Nova Scotia and therefore must also accommodate the loadout, transport, and installation considerations similar to the accommodations unit(s). The flare structure is expected to be a tubular lattice-type structure and may be vertical or a boom type configuration. It will be in the order of 70 m above the topsides production facilities top most deck and will house the HP and LP flare lines and flare tips.

The topsides module(s) and the MOPU hull may be fabricated at separate locations and then brought to a common yard where they will be integrated. The topsides will be installed onto the MOPU hull and the remaining construction work will then be completed. It is crucial to the effectiveness of the offshore phase that all the construction and commissioning work is as complete as possible prior to the MOPU sail away for installation.

The key drivers during the construction and installation phase will be as follows:

- ensure design deliverables arrive on site when required;
- ensure equipment arrives on site when required in a complete tested and commissioned state; and
- ensure bulk materials are available on site when required.

The philosophy adopted for the fit-out of all disciplines will be to maximize the amount of work which can be completed in advance of deck stacking and structural completion while work-faces are open, reducing congestion, increasing safety and allowing milestone dates to be realized. Once deck stacking is complete, coordination of fit-out activities will be of major importance to ensure that access is given to allow tasks to be completed in the correct sequence. A fit-out driven program allows early completion of testing activities, which in turn, helps to define priorities. Area completions are considered as important as system completions and attention is given to the efficient management of areas and area releases to allow commissioning activities to proceed.

Once testing activities commence, additional consideration will be given to access to work areas and personnel safety; weekend and nightshift working will be utilized as required.

5.4 Mechanical Completion

Mechanical completion will denote the conclusion of all construction work, inspection and static testing prior to dynamic testing and livening-up with power and fluids. Mechanical completion will, at a minimum, include the following:

- locating, installing, connecting and testing all ‘tagged’ equipment;
- installing, completing non-destructive testing, pressure testing, flushing, drying and reinstating all piping systems;
- completing all chemical cleaning;
- completing all oil flushing;
- installing and testing all electrical systems;
- installing and testing all instrumentation systems; and
- completing all leak testing.

To facilitate handover from the construction team to the commissioning team, each of the systems will be sub-divided and allocated to a sub-system. Each sub-system will relate to a specific element or group of elements that are to be commissioned. As each sub-system is certified as mechanically complete, responsibility for the particular sub-system will be transferred to the commissioning team. No further construction work will be allowed, and a permit to work system will then be enforced.

5.5 Commissioning

The objective of the commissioning phase is to safely and economically bring utilities, production and export systems into service and to achieve a handover of these systems to producing operations while demonstrating their performance within the specified design criteria.

The following principles will be adopted as part of the overall commissioning strategy:

- early involvement of commissioning personnel to assist in the detail design and planning phases;
- maximization of commissioning at the vendor's work-site through factory acceptance tests and system integration tests;
- planning of fabrication and commissioning activities so that overlap, as far as practical, can be achieved to facilitate the commissioning process;
- maximizing onshore pre-commissioning and commissioning of systems;
- accessing vendor expertise by including the vendor representatives on the commissioning team;
- utilizing operations maintenance and operations personnel in the commissioning team; and
- operating commissioning workpacks to ensure the safe and controlled handover to producing operations, via the project completions system.

Commissioning representation will be established at the commencement of the design phase so as to define commissioning package limits, advise designers, review the developing design with a view to effective commissioning, and prepare commissioning procedures.

As the construction phase gets underway, the commissioning team will proceed to preparation of plans and schedules, identification of requirements for materials, spares and consumables, establishing contracts for logistics and support services, and attendance at factory acceptance tests on major equipment.

Finally, members of the commissioning team will be assigned to construction sites to familiarize themselves with the plant and undertake pre-commissioning activities.

5.6 Loadout

Transportation of the topsides module(s) from the fabrication site to the quay for loadout onto a barge will typically be accomplished by means of self-propelled trailers installed under each component to suit the final barge grillage support arrangements. Construction supports will be arranged to provide the same trailer space as the barge grillage supports. Alternatively, the topsides module(s) will be loaded onto the barge by skidding. It is anticipated that specialised loadout contractors will be used to execute the loadout operations.

The contractor will engineer and install the loadout and ballasting requirements for the floating barge and operate ballasting systems during the loadout.

Immediately after the topsides module(s) have been transferred to their final position on the barge, the trailers and all loadout correction ballast will be removed, the module(s) sea fastening installed and the barges prepared for towing.

5.7 MOPU Transport and Installation

Installation activities include the transportation and installation of the completed MOPU.

During the early stages of the detailed design phase of the Project, it will be important to ensure that the MOPU is designed to be transportable by the most economical means. Accordingly, until the MOPU fabrication yard is known, it will be essential to maintain design flexibility.

The actual installation of the MOPU at the offshore location is the same as the installation of a typical jack-up drilling rig. That is, the MOPU jacking system will be activated to raise the hull above the sea level to its final design elevation.

Installation will be in accordance with installation manuals, which will provide full details of the sequence and content of each operation. The Project's EPP will be integrated with the development of the installation manuals. The following summarizes the installation activity for the MOPU:

- tow the MOPU to the offshore site;
- jack the MOPU legs down to the seafloor;
- jack the hull out of the water to the pre-loading elevation;
- perform pre-loading operations and jack the hull to the final design elevation; and
- installation of scour protection material (if required).

5.8 Export Pipeline Installation

The following sections describe the typical installation methods that will be used for the export pipeline. It should be noted that landfall, nearshore, directional drilling and pipeline pull-in sections are not applicable for the SOEP Subsea Option.

5.8.1 Landfall Preparation

Well in advance of the pipelay vessel's arrival on site, the landfall will be prepared to receive the export pipeline. The landfall will consist of a conventional open cut trench construction.

The landfall area will be graded in preparation for the pipeline and pull-in winch and reels. It is anticipated that due to the soil conditions at the site, some blasting may be required but, if required, will be conducted in the "dry" only. Blasting requirements will be defined during the detailed design phase after the geotechnical survey has been performed.

It is anticipated that the pull-in arrangement will consist of a single linear winch tied back to either a temporary pile or block anchor. Final operational details for the pull-in procedure will be confirmed once a pipeline contractor has been selected, and a detailed site and soil inspection has been performed.

Once the pipeline has been pulled in, the trench will be mechanically backfilled to ensure cover depth and protection. The remaining landfall site will be returned to conditions similar to original conditions.

5.8.2 Nearshore Pre-Lay

Prior to the arrival of the pipelay vessel, the export pipeline route for a distance approximately 1 km from the shoreline will be pre-trenched. Floating equipment will be used that is capable of digging glacial till. Additional localized drilling and blasting may be required close to the shoreline. Upon completion of the pipeline pull-in operation, this section will be mechanically backfilled. Fisheries interests will be notified well in advance of pipelay operations using the "Notice to Mariners" and by direct contact with key fisheries representatives.

5.8.3 Directional Drilling

As an option to trenching in the nearshore area, directional drilling is considered another potential method for bringing the pipeline ashore. This method would require drilling an oversized hole from the shore to an offshore tie in point approximately 1 km offshore (KP1). To install this section of the pipeline, the pipeline would be pulled from the pipelaying barge at KP1, through the drilled hole, to the onshore drill site. The onshore component of the pipeline from this point to the tie in with the M&NP pipeline would be installed in the conventional manner.

An analysis of the directional drilling option will compare technical feasibility, potential environmental effects, and costs of this method against those of seabed trenching and backfilling for the nearshore installation.

The use of directional drilling as a nearshore installation alternative is currently under review and evaluation. This decision will be made in conjunction with the pipeline contractor in either late 2007 or early 2008.

5.8.4 Pre-Lay and As-Laid Surveys

An independent survey vessel with a full workclass remotely operated vehicle (ROV) will be mobilized to undertake surveys and provide export pipeline installation assistance. Just prior to the mobilization of the pipeline installation spread(s), the survey vessel will be mobilized and will conduct a pre-lay survey of the pipeline routes.

During the installation, the survey vessel will perform pre-lay and as-laid surveys and will provide installation assistance and touchdown monitoring during critical operations. Such operations are anticipated to be required when laying through boulder fields and bedrock outcropping as well as during pipeline crossings.

Upon completion of the pipeline laydown, the survey vessel will complete the as-laid survey. The as-laid survey will also provide a visual survey of the pipeline.

5.8.5 Pipeline Pull-in

Prior to the arrival of the pipelay vessel, the pull-in cable will be pre-installed in the pipeline trench and buoyed off at a convenient point offshore.

Once the pipelay vessel is on location, the pull-in cable will be recovered by one of the supporting anchor handling vessels and will be transferred to the pipelay vessel. Once the pipelay vessel has recovered the cable, it will be connected to the export pipeline pull-in head.

The lay-vessel will arrive on site with a ‘string’ of pipe on the firing line with the pipeline lay-down head at the top of the lay-vessel ramp. The linear winch will pull the pipeline onto the beach as the lay-barge simultaneously welds further sections of pipe onto the string. This process is continuous until the pipeline end has reached the designated point. The winch will then retain tension on the pipeline pull-in head while the pipelay vessel ‘lays away’ from the shore pull location. The winch will retain tension on the head until sufficient pipe has been laid on the seabed to provide enough ‘hold back’ tension to allow the pull-in cable to be released.

5.8.6 Pipelay

The installation method will be to ‘S-Lay’ the export pipeline from a conventional pipelay vessel. Figure 5.1 illustrates a gas pipeline being installed, with the stinger in the water and the pipe being fed from the underside of the vessel. The actual vessel to be used cannot be determined at this time and may be either a conventional pipelay vessel, which is controlled by the use of anchors, or a dynamically positioned vessel, which is controlled by the use of thrusters located at the bow and stern. If an anchored vessel is used, the anchors will typically weigh 25 tonnes and will be positioned using an anchor-handling vessel. The function of the anchor-handling vessels is to transport the anchor from the lay-vessel to the designated anchor point. The lay-vessel transfers the anchor to the vessel using a davit crane. Once on station, the anchor-handling vessel lowers the anchor to the seabed using a winch. Each anchor location will cover an area on the seafloor of approximately 4 m wide by 4 m long with a chain section cable running from the anchor to the barge. Typically, 12 such anchors are used. The reverse procedure is adopted when the anchor is recovered.

There are a very limited number of pipelay vessels capable of installing the subsea pipeline. The final selection of the pipelay vessel will be based on technical capability, availability, and cost.

Figure 5.1 Typical Pipelaying Vessel – Castoro SEI

For the export pipeline, the nominated vessel will set up at-the-beach pull location approximately 1 km from landfall and the pipeline will be pulled onto the beach as described previously. Once the export pipeline has been pulled-in, the vessel will 'lay away' and continue along the pipeline route. With respect to regions of complex lay, such as through the rocky outcrop, the dedicated survey vessel will assist with laying operation. The survey vessel will perform touchdown monitoring using an ROV and will check the route ahead of the pipelay vessel.

While laying pipe in close proximity to the SOEP pipeline, an exclusion zone will be set up to eliminate the risk of damage. In addition, if the pipelay vessel uses anchors (as opposed to dynamic positioning), where the anchor cables cross the SOEP pipeline and there is potential for the cable to reach the pipeline, a buoy will be placed on the anchor cable. In the unlikely event the anchor cable breaks, the buoy will prevent the cable from falling onto or damaging the SOEP pipeline. Details of the final anchor handling program will be determined with the selected pipeline contractor.

The pipeline will be sealed with a temporary 'head' at the end of the pipe and laid down adjacent to the MOPU field centre location.

5.8.7 Pipeline Stabilization

In order to stabilize the pipeline on the seabed, concrete weight coating will have been applied prior to delivery of the pipe to the pipelay vessel. It is anticipated that the pipeline will be buried in the zones where the water depth is less than 85 m for on-bottom stability reasons. For water depths greater than 85 m, the pipeline has sufficient on-bottom stability and thus will not be buried. This will be performed using sub-sea trenching equipment, which will trench the pipeline and so that after the soil has backfilled, there will be approximately 1 m of cover.

There are two main methods that may be used to form the trench for pipeline burial. The first option is to use a towed plough. In this method the plough is deployed from a host vessel and lowered over the pipeline. The pipeline is raised into the chassis of the plough and the ploughshares are closed below the pipeline. As the plough moves forward, under control of the host vessel, it forms a V-shaped trench into which the pipeline is lowered. The second option is to use a self propelled subsea digging tool. This type of machine is positioned over the pipeline and moves forward. Hydraulic digging arms are used to form the trench underneath the pipeline. Alternatively, strong jets of water may be used to fluidize the loose material under the pipeline, to ensure that the pipe is lowered as far as possible into the V-shaped trench. For either option, backfill of soil from the sides of the trench will cover the pipeline.

In the rock outcrop area, where trenching may not be possible, the option to stabilize the export pipeline with rock will be investigated during detailed design. Additionally, span rectification using rock may be performed in any locations where high stress in the pipeline would otherwise occur due to excessive undulations in the seabed. The source of such rock will likely be onshore from an existing rock quarry, such as that in Mulgrave, Nova Scotia.

5.8.8 Pipeline and Flowlines Commissioning

The export pipeline for both M&NP and SOEP Subsea Options and the production and injection flowlines will be hydrostatically tested. It is necessary to treat the seawater introduced into the pipeline and flowlines with corrosion inhibitors and biocides to protect the interior pipe surface if the time between the installation of the pipeline/flowline and its commissioning into service exceeds the timeframe allowed for leaving untreated seawater in the pipeline. Leaving untreated seawater in the pipeline for more than one month can establish conditions which permit corrosion to occur at a later stage in the life of the pipeline. The introduction of treatment chemicals is a safety measure for the prevention of corrosion over the life span of the pipeline.

For the M&NP Option, the pipeline will be installed cleaned, gauged, flooded, and hydrotested. The pipeline spool between the pipeline and MOPU will be installed and the pipeline will be leak tested, dewatered, dried and nitrogen packed. The hydrostatic test fluid will be discharged at the MOPU location.

For the SOEP Subsea Option, the pipeline will be installed cleaned, gauged, flooded, and hydrotested. The pipeline spool between the pipeline and MOPU will be installed and the pipeline will be leak tested, dewatered, dried and nitrogen packed from the MOPU location. The hydrostatic test fluid will be discharged at the SOEP subsea tie-in location.

The flowlines will be installed cleaned, gauged, flooded and hydrotested. The flowline spool between each flowline and the MOPU will be installed and the flowline leak tested. For the flowlines, it is unknown at this time whether the hydrostatic test fluid will be discharged at the MOPU or at the individual wellhead locations. This will be determined during detailed design.

All the water introduced into the line will be thoroughly filtered to 50 microns. During filling, cleaning, gauging and hydrostatic testing, chemical inhibition package(s) will be continuously injected into the seawater. The chemical inhibition package may include: dye to aid in the detection of leaks; a biocide to control marine organisms and sulphate reducing bacteria; a corrosion inhibitor; and a dissolved oxygen scavenger to minimize corrosion on the interior of the pipeline. During the filling cycle, some spillage of this water may occur at the pig receiving station offshore. This occurs when excess hydrostatic water is required to push the pig into the pig receiver at the end of the pipeline.

The chemicals to be used in this application will be selected from a list of chemicals approved for use in Canada and approved for offshore discharge through the *Offshore Chemical Selection Guidelines* (NEB et al. 1999). Since the installation program for the pipeline and flowlines is still under development and a supplier has not yet been selected, the definitive treatment chemicals cannot be specified.

A study, consisting of two components, will be undertaken to confirm predicted effects of the selected chemicals discharged into the environment. A toxicity bioassay program (first study component), will be undertaken prior to discharging these compounds. The bioassay will employ samples of the proposed chemical diluted in seawater to emulate the mixtures of chemicals and concentrations proposed for the hydrostatic test program. The results will be applied in a plume dispersion model (second study component) to confirm that there will be minimal effect to the marine environment around the platform. Prior to undertaking this study, the parameters and scope of the bioassay study will be discussed with Environment Canada and Fisheries and Oceans Canada.

The onshore section of the export pipeline will also require hydrostatic testing, which may be conducted concurrently with the offshore section of the pipeline as discussed above, using the same seawater source and treatment chemicals.

Should the schedule of the onshore section of the pipeline installation be changed, then a separate hydrostatic test may be required. Under this circumstance, the hydrostatic test water could be left in the onshore pipeline until the offshore testing is completed and the hydrostatic test water discharged with the offshore hydrostatic test water.

5.9 Subsea Installation

The subsea infrastructure required to be installed includes the following:

- flowlines;
- umbilicals;
- SSIV assembly;
- hot tap (SOEP Subsea Option); and
- subsea protection structures.

The flowlines and umbilicals will require trenching for on-bottom stability, protection and potentially for insulation purposes. The trenching methods have been discussed in Section 5.8.7. Pipeline and flowline commissioning has been discussed in Section 5.8.8.

5.9.1 Flowlines

The following three options are being considered for the in-field flowlines:

- rigid flowlines laid from a pipelay barge
- flexible flowlines
- reeled rigid flowlines

The variability in the execution of the three options lies primarily in the laying method of the in-field flowlines.

The rigid flowlines laid from a pipelay barge option will be an "S-lay" installation from a conventional pipelay vessel. This installation method is the same method used for the export pipeline as discussed in Section 5.8.6, which involves the transportation of short pipeline sections to the pipelay barge where they are welded together and placed onto the seafloor.

The flexible flowline option is based upon the flowlines being manufactured onshore and loaded onto installation reels, which will be transported by cargo vessel to the installation vessel. Alternatively, the installation vessel would load and transport the flowlines from the manufacturing facility to the Deep Panuke field location. The installation vessel will anchor the flexible flowline end with a clump weight and then lay the flowline along a pre-surveyed corridor to the well location. Each flowline will be laid in turn, until all the flexible flowlines are installed.

The reeled rigid flowline option is based upon the short pipeline sections being transported to an onshore spool base location where they will be welded together into a continuous section and inspected. The installation (i.e. reel) vessel will be mobilized to the spool base where the flowlines will be 'reeled' onto the vessel's reel or carousel. The vessel will transport the flowlines to the Deep Panuke field location where the flowlines will be 'reeled' from the vessel and placed on the seafloor.

5.9.2 Umbilicals

The subsea umbilicals will be manufactured and loaded onto installation reels which will be transported by cargo vessel from the manufacturing facility to the installation vessel mobilization port.

The installation vessel will load the umbilical reels and sail to the Deep Panuke field location. The vessel will likely set up adjacent to the MOPU where a pre-installed J-tube messenger wire will be passed to the lay vessel and the umbilical will be subsequently pulled into the MOPU J-tube prior to lay away to either the wellhead or the SSIV where it will be temporarily abandoned for later tie-in by a diving support vessel (DSV). Each umbilical will be laid in turn until all the umbilicals are installed.

5.9.3 SSIV Assembly

There will be a SSIV assembly located on the export pipeline within 150 m of the MOPU. This SSIV assembly consists of a check valve complete with a small diameter bypass containing an on/off actuated buy back gas valve. The buy back gas valve will be controlled via an umbilical from the MOPU.

5.9.4 Hot Tap (SOEP Subsea Option)

For the SOEP Subsea Option, sales product is transferred from the Deep Panuke MOPU via a 15 km, 510 mm [20 inch] export pipeline to the existing SOEP 660 mm [26 inch] pipeline. The connection to the SOEP pipeline will be by a subsea tie-in, referred to as a “hot tap”. The hot tap process involves the connection of a tee (i.e., branch nipple) and an isolation valve onto the existing pipeline through which a “coupon” can be cut out of the existing pipeline while the pipeline is still operational. The branch nipple connection can either be attached by welding or installing a mechanical clamp.

“Welded” hot tap activities can be described as follows:

- expose buried pipeline section by airlifting sediments;
- remove weight and corrosion coating;
- install and commission welding habitat;
- inspect pipeline;
- weld branch nipple onto pipeline;
- install reinforcement sleeve;
- install branch nipple flange;
- install isolation valve;
- remove habitat;
- install “hot tap” machine;
- perform “hot tap”;
- remove “hot tap” machine; and
- install “hot tap” protection structure.

“Mechanical” hot tap activities can be described as follows:

- expose buried pipeline section by airlifting sediments;
- remove weight and corrosion coating;
- inspect pipeline;
- install mechanical clamp;
- install “hot tap” machine;

- perform “hot tap”;
- remove “hot tap” machine; and
- install “hot tap” protection structure.

The “hot tap” structure is connected via a spool piece to a Deep Panuke tie-in structure which houses the equipment that will be required at the end of the Deep Panuke export pipeline. This equipment includes a manual isolation valve, a check valve and provision for a temporary subsea pig receiver. A protection structure will be placed around each of the SOEP pipeline hot tap equipment and the Deep Panuke pipeline tie-in equipment.

5.9.5 Protection Structures

The protection structures for the wellheads, hot tap/tie-in and the SSIV assembly will be fabricated onshore and transported by cargo vessel or barge to the installation vessel. The installation vessel will lift the structures into their appropriate position and they will be attached to the seabed most likely by piling.

5.10 Hook-up and Final Commissioning

It is intended that the MOPU will be commissioned as fully as possible onshore. The scope of the offshore hook-up phase will likely be limited to the final tie-in of the following items:

- installation of final subsea hook-up spools between the MOPU and the flowlines;
- installation of final hook-up spool between the MOPU and the export pipeline;
- installation of the jumper spools between the MOPU legs and the topsides for flowlines and export pipeline;
- pull-in and final connection of the subsea umbilicals;
- installation of miscellaneous equipment and materials; and
- final commissioning activities.

The priorities for the hook-up phase will be to ensure that the platforms provide a safe working and living environment, to establish that life support systems are fully operational, to commission all utility and process systems, and to introduce the first hydrocarbons to the process facilities.