



Nº: I-ET-3000.00-1500-942-PMU-001

PÁGINA: 1 de 10

AREA: INSTALLATIONS VESSELS OF FLEXIBLE PIPES

TÍTULO: **INSTALLATION METHODS**

INDEX OF REVISIONS

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AS INFORMAÇÕES DESTES DOCUMENTOS SÃO PROPRIEDADE DA PETROBRAS. SENDO PROIBIDA A UTILIZAÇÃO FORA DE SUA FINALIDADE.

1. PURPOSE

To show the installations methods currently used by PETROBRAS and some basic requirements for single laid pipes.

2. APPLICATION

All operations using the following equipment: Flowline Hub (FLH), Vertical Connection import Module (MCVi) and Vertical Connection export Module (MCVe), actuated by ROV with hot stab.

For Pull in and Pull out, all the operations where the risers' entrance is located close to surface, respecting the operational limits of the vessel.

3. DESCRIPTION

3.1. Direct vertical connection

Direct vertical connection is that performed by the laying vessel itself, without aid from a drilling rig, connecting the flexible pipeline to a sub sea interface (well or manifold)

Some cautions with VCM must be taken before operations commence. VCM shall be received in advance and stored on the vessel. The flange must be checked and cleaned. The hub, whether at well or manifold, where the VCM will be connected must have its heading, coordinates and height checked; corrosion cap shall be removed (if there is one, as per manufacturer's criteria) and the hub must be properly cleaned with ROV aid. A transponder might be placed on seabed, close to the hub, to provide back-up positioning, while the ROV itself is not at the bottom.

If the FLH/EHDM has a pole, it must be checked if it fits on deck center hole. Supporting pad-eye must be aligned with the A-Frame central sheave. The support for the seal fitting shall be positioned nearby, and the MCV set upon this support by 6t Crane. After the seal fitting is done, take the support away from the stern and put it in storage area where it will not get in the way of the operations. Also, MCV technician at the vessel shall inform work pressures for ROV hot stab and assist planning which tools will be carried by each ROV, when and how the ROVs will change, if this is necessary.

3.2. Pull in and Pull out

Pull in and Pull out are operations carried out together between the vessel and a Stationary Production Unit, therefore whose operations should be coordinated simultaneously by both offshore teams, and that exposes the vessel to emergency hazards that may occur on units, as they may stay connected indefinitely. So, extra

cautions must be taken during a transference: check channel and communication tools, use of a back-up positioning system, check limits and functionality of pulling system, confirm tug boats presence to maintain FPSO heading, check absence of offloading vessels operating in tandem; in the presence of I-tubes, confirm messenger cables passed through I-tubes identifying which pipe belongs to each tube. Some of the equipment utilized in the pull in/pull out maneuvers like hydraulic shackles, heaving line shooter etc. might have been idle for long time. Make sure they're working properly with enough anticipation before they're actually necessary.

4. OPERATIONS SEQUENCE

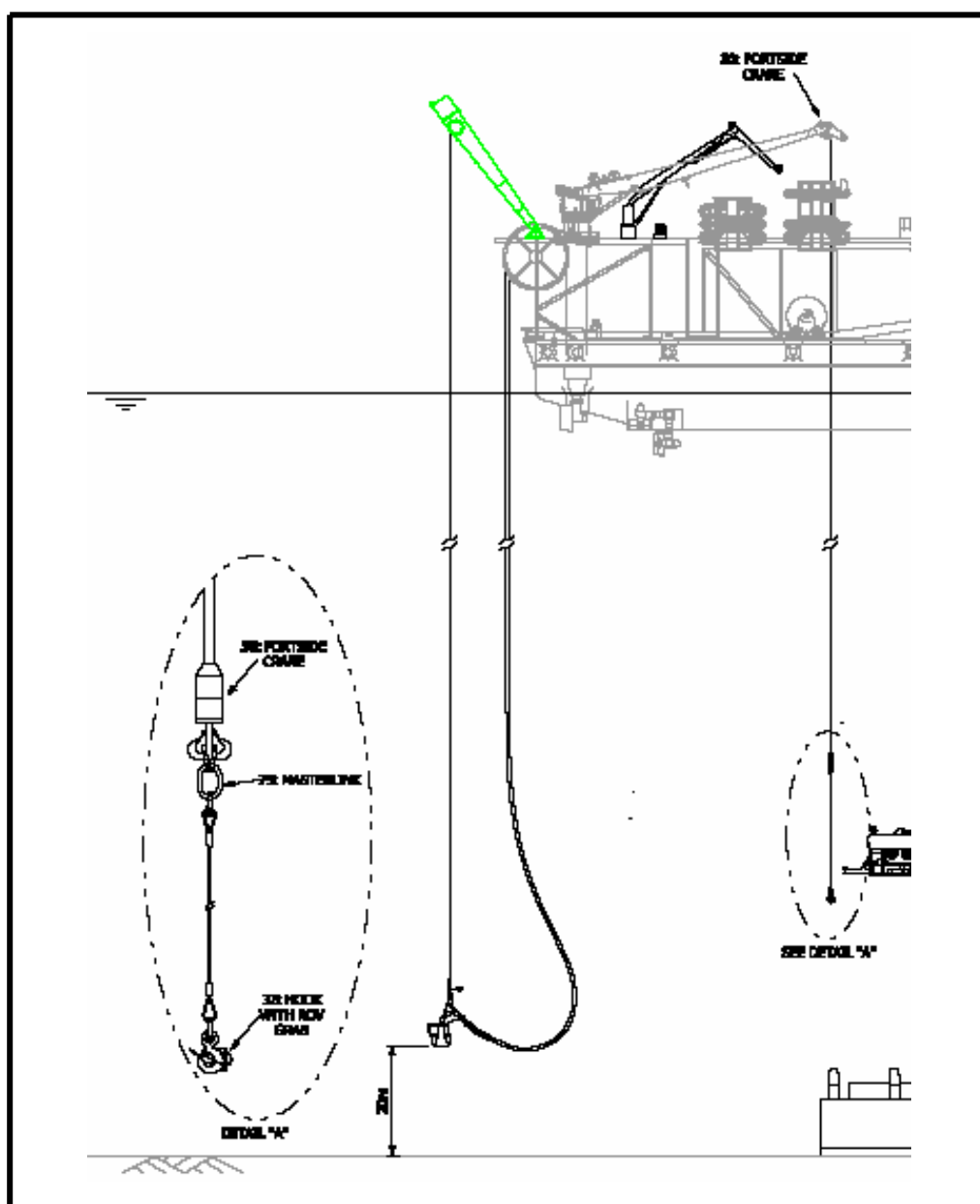
4.1. Routine Procedure for First End Direct Vertical Connection

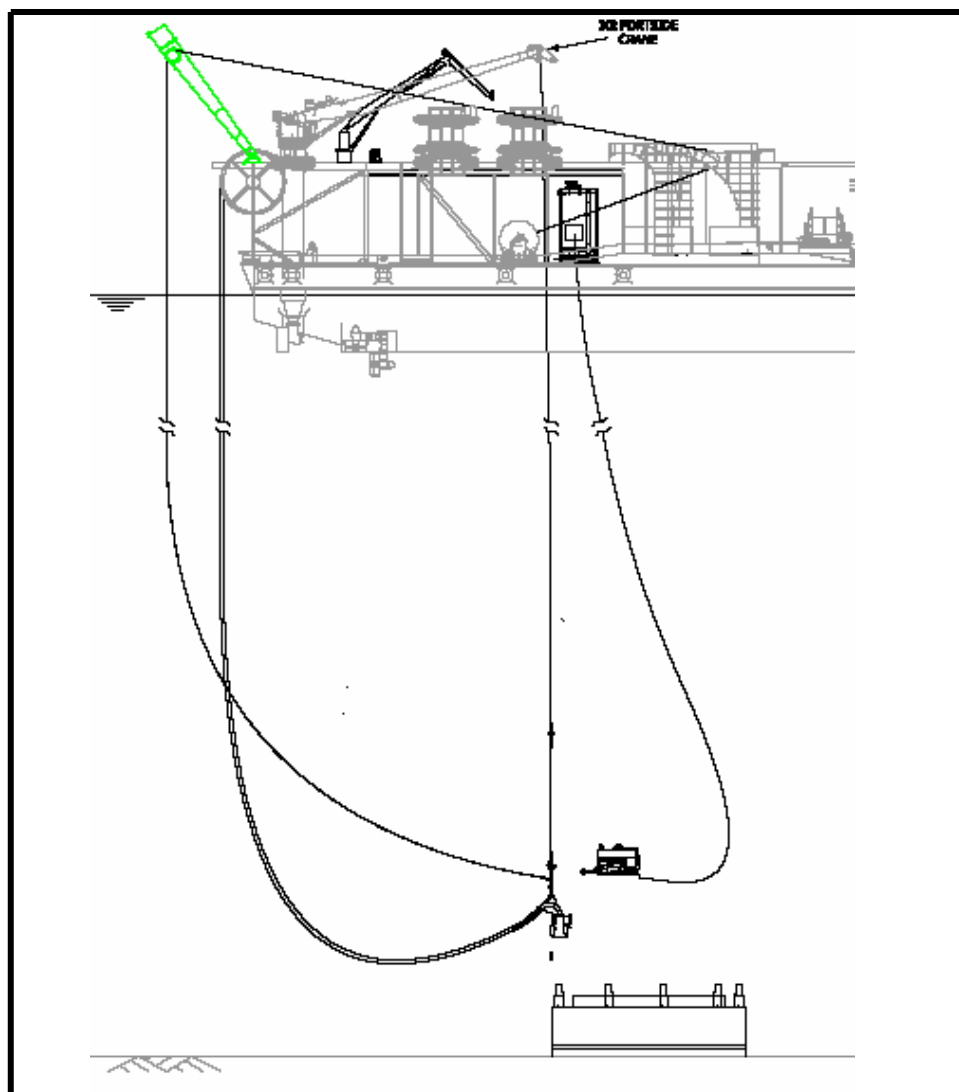
4.1.1. Operations sequence

Item	Description
1	Place VCM on deck center, its flange turned forward, supporting it as needed to ease connection with pipe end fitting. Attach tag lines to the VCM.
2	Execute all tests and preparation on equipment, such as seal plate change, following manufacturer's instructions, under equipment technician orientation. Install running tool if there is one.
3	Pull pipe (or umbilical) first end from its basket to deck, according to Routine Procedure, if it wasn't pulled so far. Connect pipe end fitting to VCM flange.
4	Perform a leak test on flanges junction. Pass auxiliary winch cable through A-frame center sheave and leave the socket close to VCM.
5	Assemble overboarding and descent sling between auxiliary winch and VCM supporting device (padeye, running tool, etc). Rigging shall be designed to fit this device and other specific requirement.
6	Place the vessel receiving the current from bow portside. Recover auxiliary winch, lifting VCM.
7	Start turning A-frame towards stern. Pay auxiliary winch so as to avoid invading the A-frame sheave with socket. Control load swinging with winch cables.
8	Complete overboarding opening A-frame totally. Release winch cables when VCM reaches splash zone, recovering them completely.
9	Continue the descent paying out auxiliary winch and tensioners at the same rate. During first 50m of the descent, use load cells to guarantee that the line is not taking any load from the VCM. Monitor VCM configuration with ROV from 50m depth, all the way down.
10	Stop descent with VCM 20m above seabed. Install a recovery sling on Portside 30t Crane, using a transponder for ease localization, and send it down. Require ROV to locate and grab its hook. If needed, turn Crane boom toward stern to reduce ROV path.
11	Require ROV to capture descent sling on VCM with recovery sling hook. Transfer load from auxiliary winch to Portside Crane, paying out winch cable
12	Turn the Portside Crane boom toward midship, monitoring operation with ROV on a safe position.
13	Start final approach between VCM and hub, checking heading, double catenary configuration and auxiliary winch cable position.

14	Wait for best sea conditions and pay out 30t Crane fast to connect VCM on hub. ROV shall alternate frontal and side views for a better comprehension
15	Keep wires slack after connection to avoid undesired removal due to swell. Follow manufacturer's instructions to perform final locking procedure.
16	Release 30t Crane cable first and recover it completely before auxiliary winch. Use ROV to cut or remove strops or open hooks as applicable.
17	Remove running tool if applicable, bringing it up hanged on auxiliary winch cable, through stern. Use 10t winch cables to control its swing on entrance.
18	Pay out a few meters of pipe so as to keep VCM steady and TDP safely away from stern. Adjust vessel position to fulfill both conditions.

4.1.2. Drawings of operations





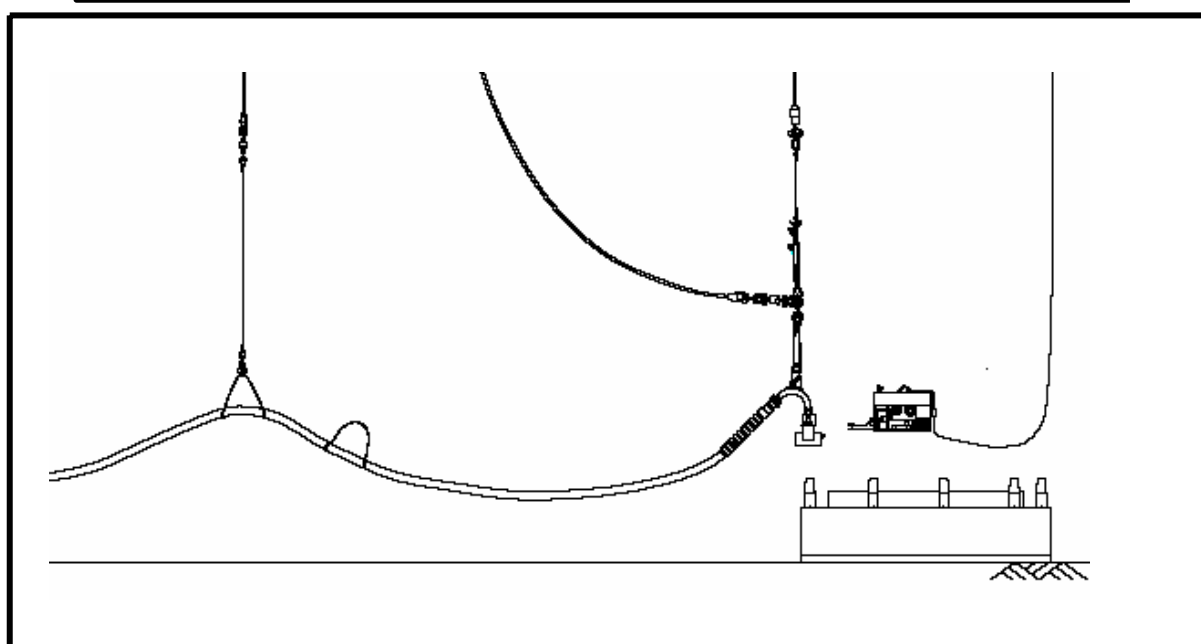
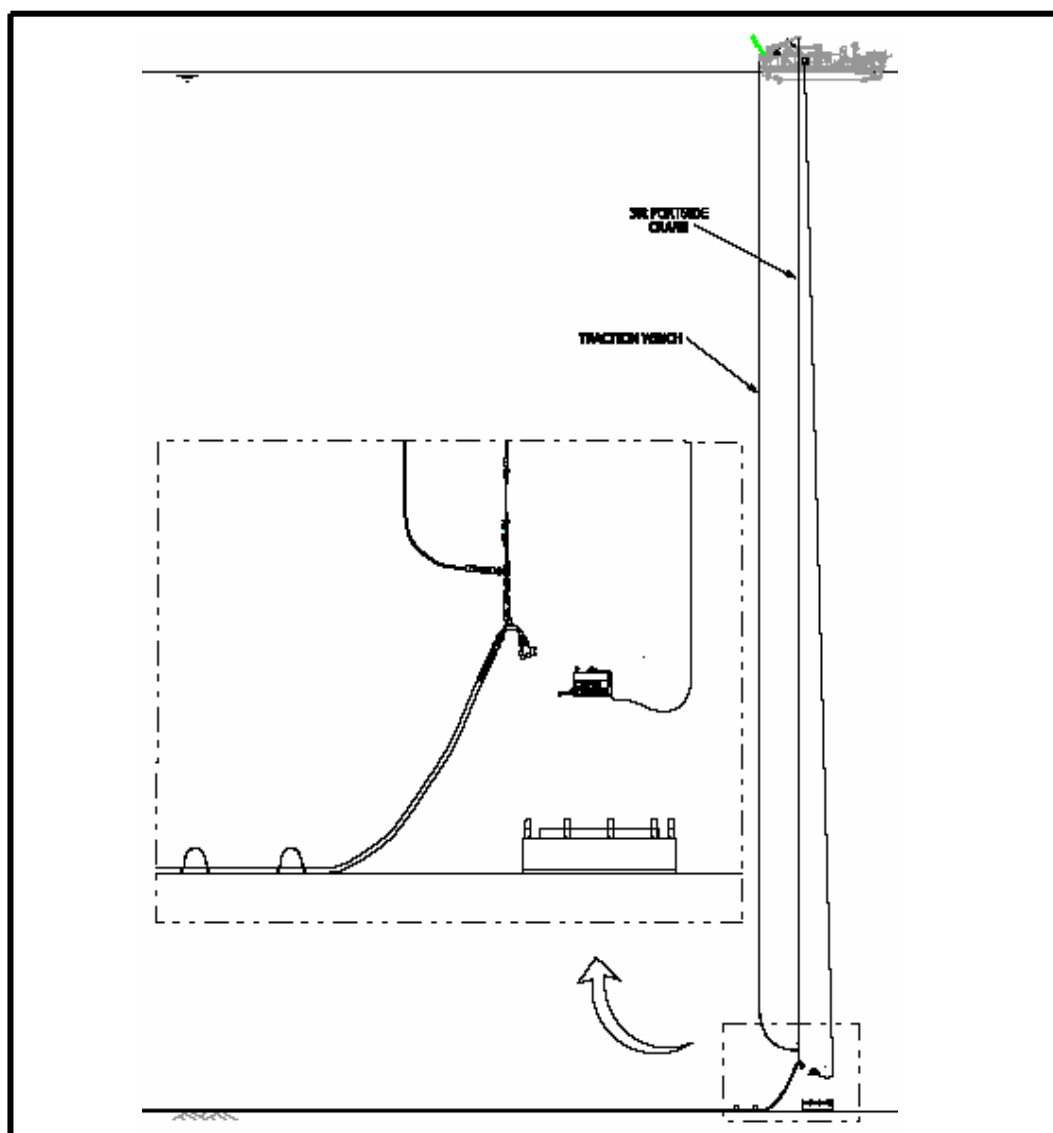
4.2. Routine Procedure for Second End Direct Vertical Connection for Pipe Length Greater than WD

4.2.1. Operations sequence

Item	Description
1	Connect second end of pipe on traction or auxiliary winch as it gets out of the basket gutter, and open all tensioners.
2	Attach polypropylene cables on position specified on Executive Procedure. If required, for safety against tanglement of bundle into thrusters, use an extra cable to keep this end stretched.
3	Install insert for retractable deck clamp on pipe's second extremity.
4	Perform second end outboarding according to Routine Procedure. When polypropylene reaches retractable deck, stretch the extra cable. Advice the bridge about this situation, the DP desk will then cooperate to prevent loose ropes to get fouled into thrusters either by turning off or discharging sternwards.
5	Move retractable deck out and pay out winch cable enough to sit the pipe inside the clamp.
6	When pipe load is completely supported on clamp, slack winch cable and release it from pulling head.

7	Retrieve pulling head from end fitting, keeping the flange protected.
8	Assemble second end connection sling on VCM's supporting device (padeye, running tool, etc); this sling shall be designed for each VCM and attached to traction winch. Assemble a sling for overboarding and transport of the VCM.
9	Attach tag lines on VCM and suspend it with Starboard Crane. Open A-frame and carry VCM until retractable deck, using tag lines (winches or capstans) to remove lateral swing.
10	When VCM is at retractable deck, remove its flange protection. Approach both flanges slowly. Twist pipe on retractable deck to align bolt holes, if needed (bolt alignment can be done through VCM, if it has a rotating flange).
11	Connect both flanges and perform leak test. Release Crane from VCM and retrieve its cable.
12	Recover traction winch, suspending the pipe from retractable deck clamp. Remove insert from pipe. Inform the DP desk that extra rope is ready to be released; wait for their authorization to slack it and retrieve.
13	Start paying out winch cable and move to lay pipe on track. Turning stern thrusters on is safe from now on.
14	Lay pipe on track all along VCM descent. Follow TDP with the ROV. Stop with VCM nearly 20m above seabed.
15	Perform a try-out of the VCM landing over the manifold hub, while it's still hanging only from the winch wire. The trial has the aim to check if line laying has been done with enough accuracy to allow the connection itself, or if relaying will be required, in which case It can be done straight away and in safer manner without the Crane and hung wires attached to the VCM and pipe.
16	Approach the VCM to the manifold, but deviating sideways so that VCM can be close to the seabed as it were sitting on the hub; the extra length (can be measured with acoustic fixes and/or sonar shots) will be then compared to the designed hump overlength.
17	If Direct Vertical Connection is judged feasible after the trial, then proceed to further connecting Crane and hump wire, otherwise recover the VCM and relay up to when length is OK to perform connection.
18	Assemble a recovery sling on Portside Crane and send the cable all the way down. If needed, for better positioning, use a transponder on cable end.
19	Locate recovery hook with ROV, capture it and bring it close to the VCM. Request ROV to grab the second end sling with this hook. If the wire end is blown by current and ROV is not managing to approach and connect to VCM rigging, consider to bring VCM closer to surface so that the effect of current is mitigated. The Crane wire might then be connected much before it can support the load of the catenary; a second ROV following at the VCM will be required as control of the Crane wire slack is required.
20	Pay out winch cable, in order to transfer load to Portside Crane. Turn Crane boom towards midship.
21	Assemble another recovery sling on auxiliary winch routed to portside and send it down. Capture its hook with ROV and capture polypropylene handlers. Recover the cable to form a vertical overlength. Some problem with current as pointed in step 19 may arise.
22	Adjust vessel heading, get close to hub and wait for better sea conditions to do the connection. Pay Crane cable fast to sit VCM on hub.
23	Follow all landing, locking and seal test procedure as defined by the VCM manufacturer's, operating as needed with ROV.
24	Release winch cables from their respective slings, cutting sacrificial cables if required with ROV, and retrieve them to deck.

4.2.2. Sketches of operations

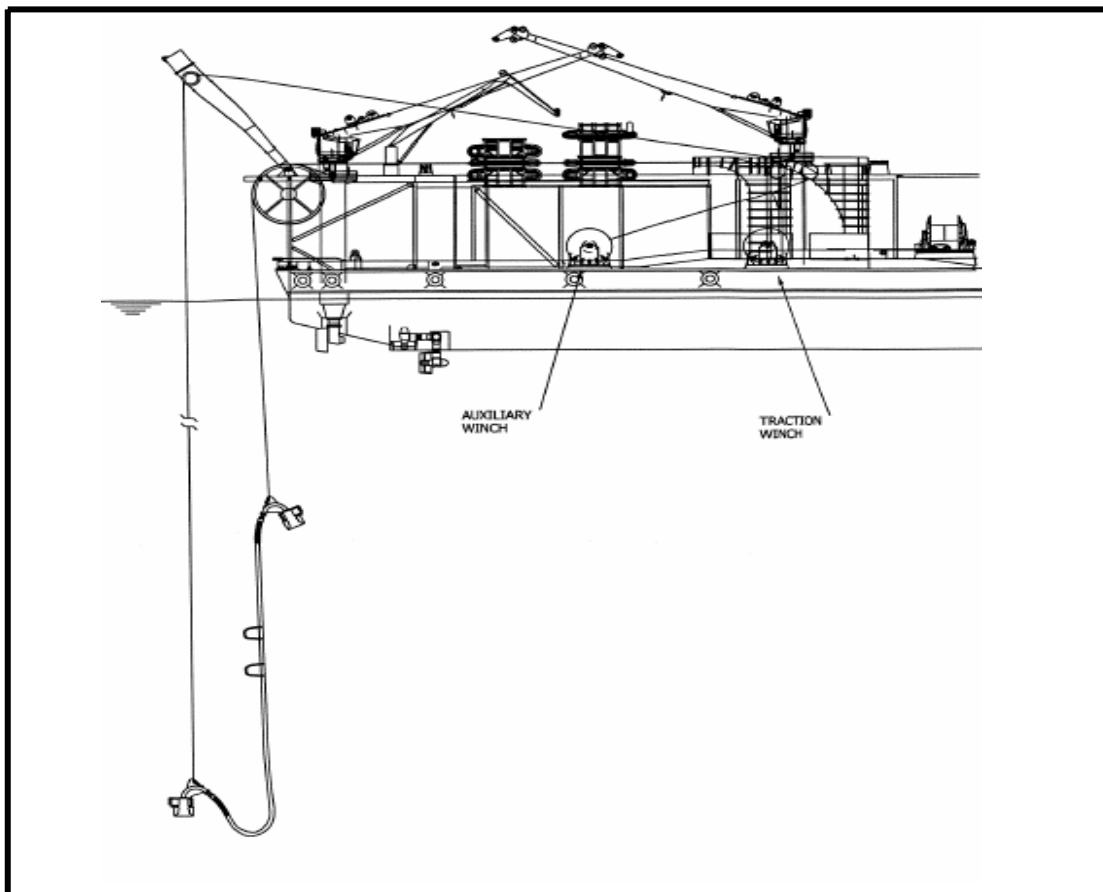


4.3. Routine Procedure for Second End Direct Vertical Connection for Pipe Length Shorter than WD

4.3.1. Operations sequence

Item	Description
1	Follow steps 1-9 of Routine Procedure for First End Direct Vertical Connection.
2	As pipe's second end comes out of the basket, attach it to traction winch and tension the cable. Open the tensioners and pay out, moving pipe end towards the deck.
3	Stop this maneuver to install polypropylene cables on position specified on Executive Procedure. If required, for safety against tanglement of bundle into thrusters, use an extra cable to keep this end stretched.
4	Follow step 3-12 of item 4.2.1 above.
5	Continue paying out simultaneously traction and auxiliary winch cables, in order to maintain a safe catenary configuration as the pipe goes all way down. Care to achieve good configurations for both VCM's.
6	Stop the descent with first end VCM about 20m above seabed. Follow steps 10-17 of Routine Procedure for first end direct vertical connection. Pay out or recover traction winch cable as required to achieve safe configurations as it is done.
7	Pay out a length of traction winch cable so as to keep VCM steady and TDP safely away from stern. Adjust vessel position to fulfill both conditions.
8	Follow steps 14-24 from item 4.2.1 above.

4.3.2. Sketch of operations

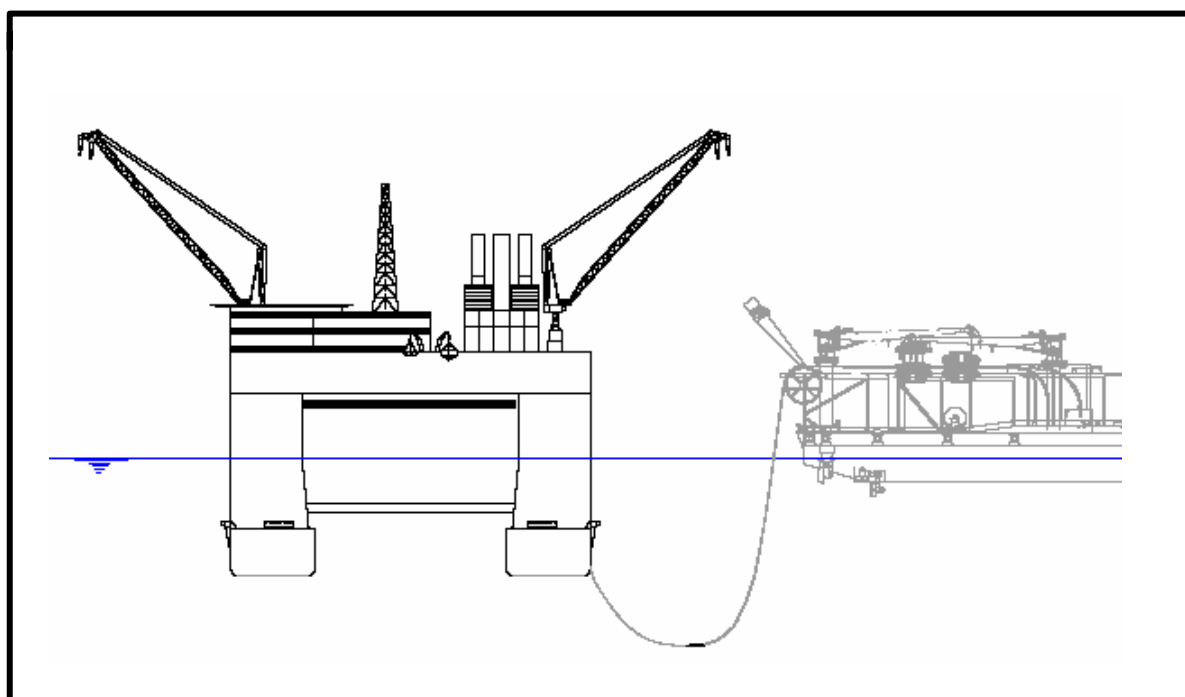


4.4. Routine Procedure for First End Pull in

4.4.1. Operations sequence

Item	Description
1	Bring the flexible line extremity (plataform side) from the basket and through the tensioners on the working deck. Install the stopper collar in the position specified by the Drawing of Line Composition and the collar / set of slings to hold the stiffner (pull in kit);
2	The Laying Vessel aproach the plataform and receive the pull in wire on board and connect to the slings;
3	Than, the riser is transferred to the plataform, following the steps described on the procedure, maintaining a double catenary configuration with a top angle (plataform) that doesn't cause excessive forces;
4	The pull in team settles the riser on its support and releases the wire of the Laying Vessel;
5	Recover the wire back on board and move the ship away from the platform, paying the riser, forming a duble catenary necessary to achieve the designed catenary configuration;
6	Install the Uraduct outer wrap at the proper lenght in the lower section of the riser;
7	When the catenary configuration is achieved, the Laying Vessel start the process of laying of flowline towards the X-Tree or manifold.
8	At the specified length, the holding collar and the set of chains for the pile anchor will be installed. Place the holding collar close enough to the pile anchor, facilitating the work of the ROV;

4.4.2. Drawing of operations



4.5. Routine Procedure for Second End Pull in

4.5.1. Operations sequence

Item	Description
1	When the MCV is properly locked and tested, resume laying the flowline towards the platform;
2	Place the holding collar close enough to the pile anchor, facilitating the work of the ROV;
3	Install the Uraduct outer wrap at the proper lenght in the lower section of the riser;
4	Install the stopper collar in the position specified by the Drawing of Line Composition;
5	Also install the collar and the set of slings to hold the stiffner (pull in kit). Make sure the designed catenary configuration will be achieved by checking the marks and/or end fittings position on the seabed;
6	The Laying Vessel approach the plataform and receive the pull in wire on board;
7	Transfer the riser to the plataform following the steps described on the procedure;
8	The pull in team settles the riser on its support and releases the wire of the laying vessel;
9	Recover the wire back on board and move the ship away from the platform;
10	An ROV, not necessarily the one of the laying vessel, connects the holding collar chain to the pile anchor.

4.5.2. Drawing of operations

