

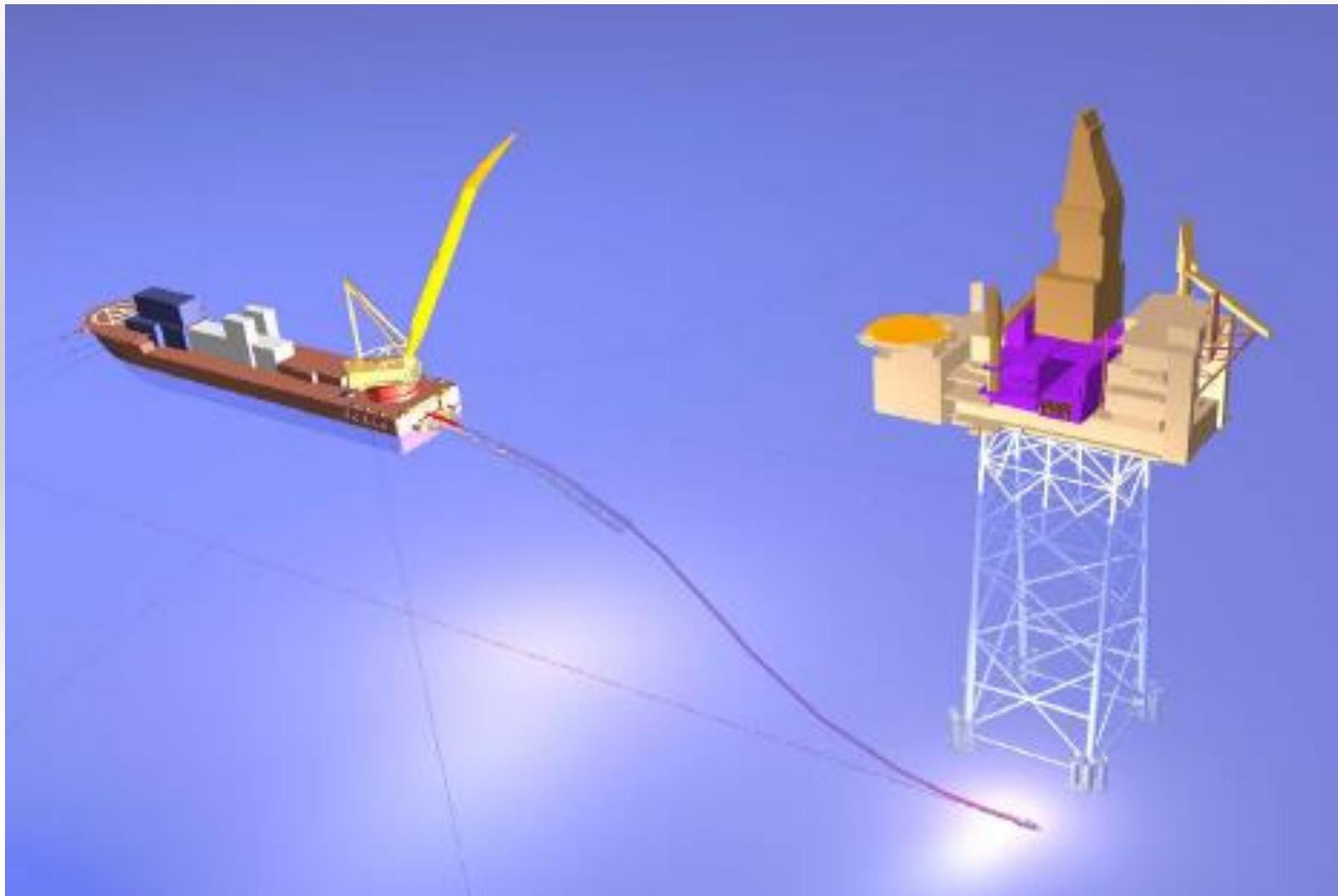
Deep Dive Session

– Construction Methodology Series

**“S-Lay Method of Pipeline Installation
- Pipelay Initiation Methodologies”**

By
Ng Eng Bin
Proprietor, Submarine Pipeline Consulting Engineers (SPiCE)

Schematic Showing Pipelaying By Conventional Lay Barge (S-Lay)



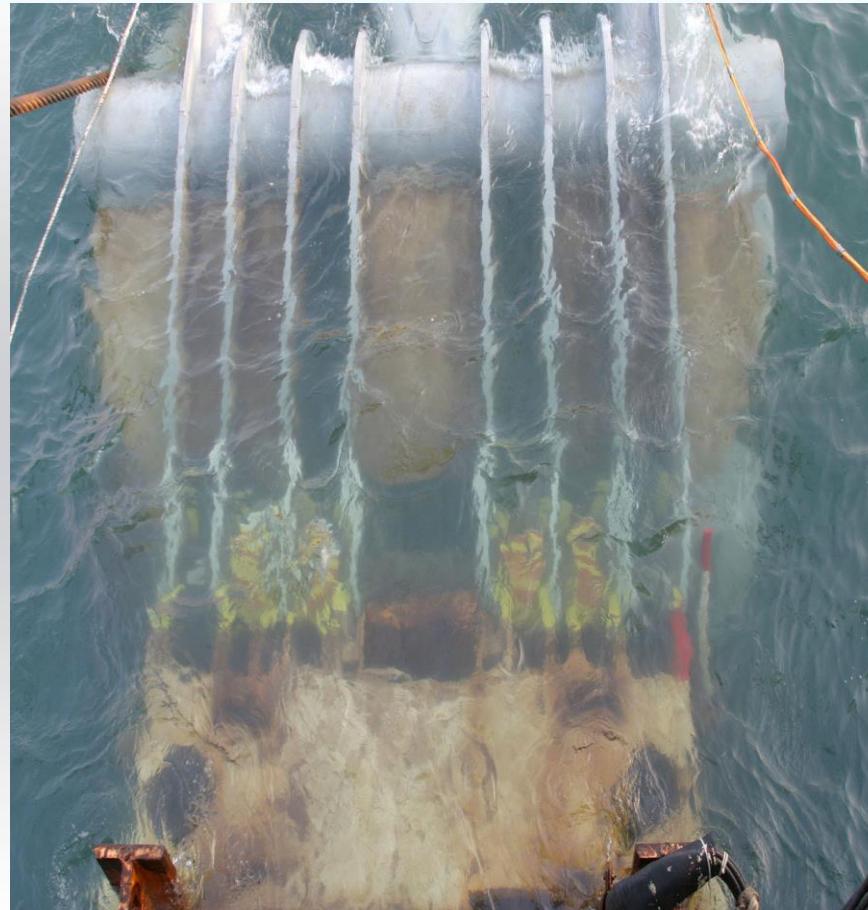
Definition of Pipelay Initiation

- What is meant by pipelay initiation?
 - ✓ *Pipelay initiation is the process in which pipeline fabrication and installation is initiated.*
 - ✓ *In order to initiate pipelaying, the start-up head of the pipeline needs to be anchored to 'something' so that when the pipeline the lay vessel moves forward as pipeline is fabricated, the pipe does not move with the vessel and tension can be applied to control pipeline stresses.*
- What does pipelay initiation entail?
 - ✓ *Establishment of an anchor or hold-back point/device*
 - ✓ *Procedure to fabricate initial length of pipeline and bring this to this anchor point*
 - ✓ *Securing of the start-up head to the anchoring point*
 - ✓ *Subsequently, 'normal' lay process may commence*

Types of Stingers

- A stinger is the structure that is attached to the stern of the pipelay vessel to extend support for the pipeline before it is suspended in water.
- There are general 3 types of stingers in use for S-lay method of installation:
 - Floating trussed stingers
 - it is positively buoyant, so when not supporting pipeline, it floats on surface
 - Floating articulated stingers
 - it is positively buoyant, so when not supporting pipeline, it floats on surface
 - “Fixed” stingers
 - it is negatively buoyant, so when not supporting pipeline, it is still submerged at a fixed depth
- Sometimes, hybrid stingers are used

Typical Floating Trussed Stinger & 'hitch point' at stern of lay barge



Floating trussed stinger is positively buoyant and can move in vertical direction. Adjustment is made by adjusting buoyancy in stinger.

Typical Articulated Stinger (McDermott)



Hitch segment – only one required



Intermediate segment (up to 4 can be used)



Sled segment: only one is used

Fixed Stingers



Fixed stingers have fixed radius on the stinger.
Once connected to lay vessel, it is extremely difficult
(if not impossible) to adjust radius

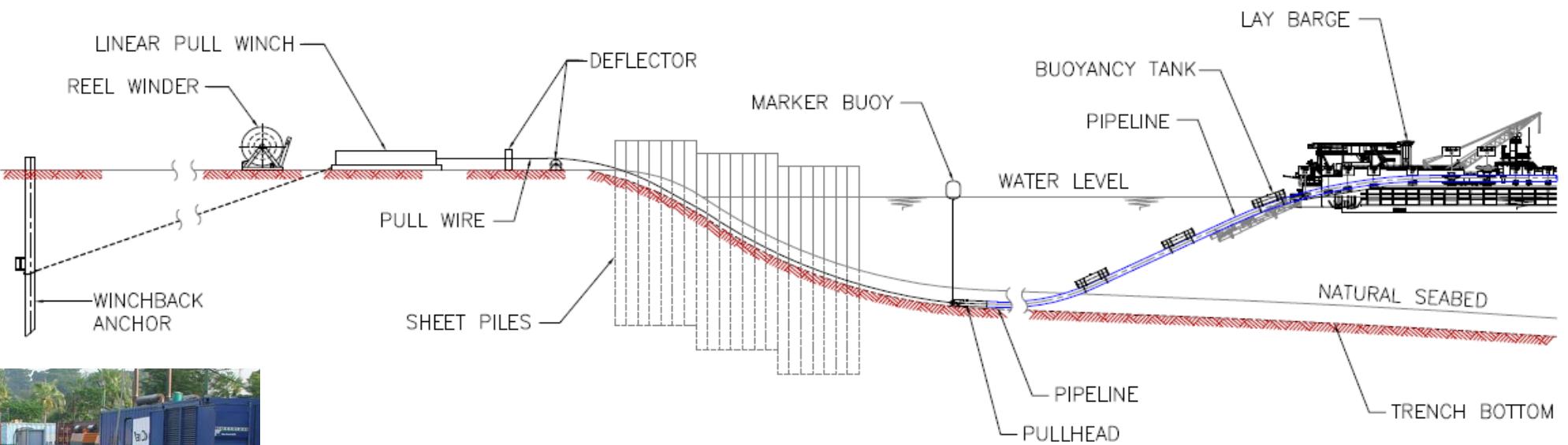
Typical Hybrid stinger: Combined Trussed with floating articulated 2nd segment (Geocean)



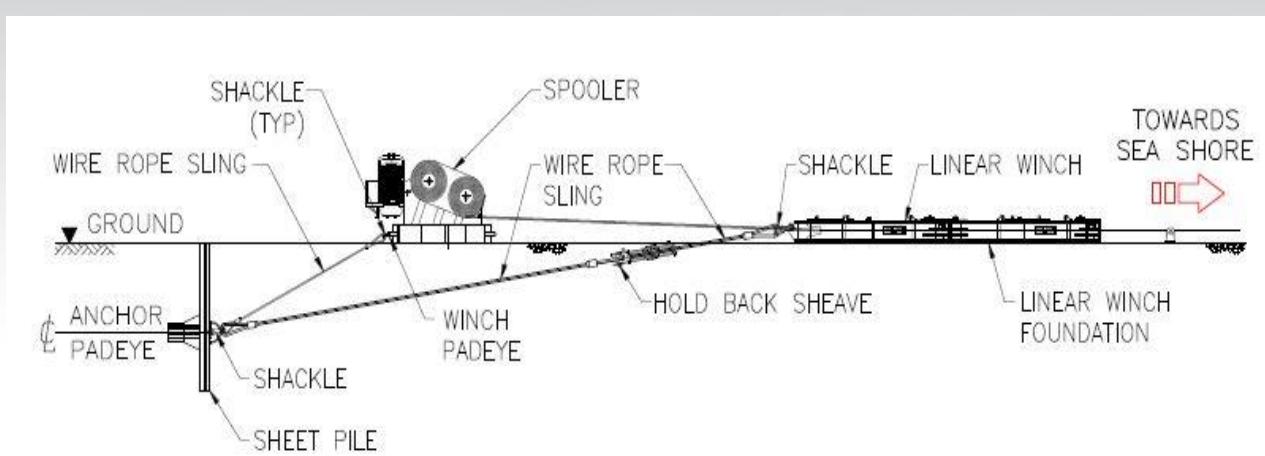
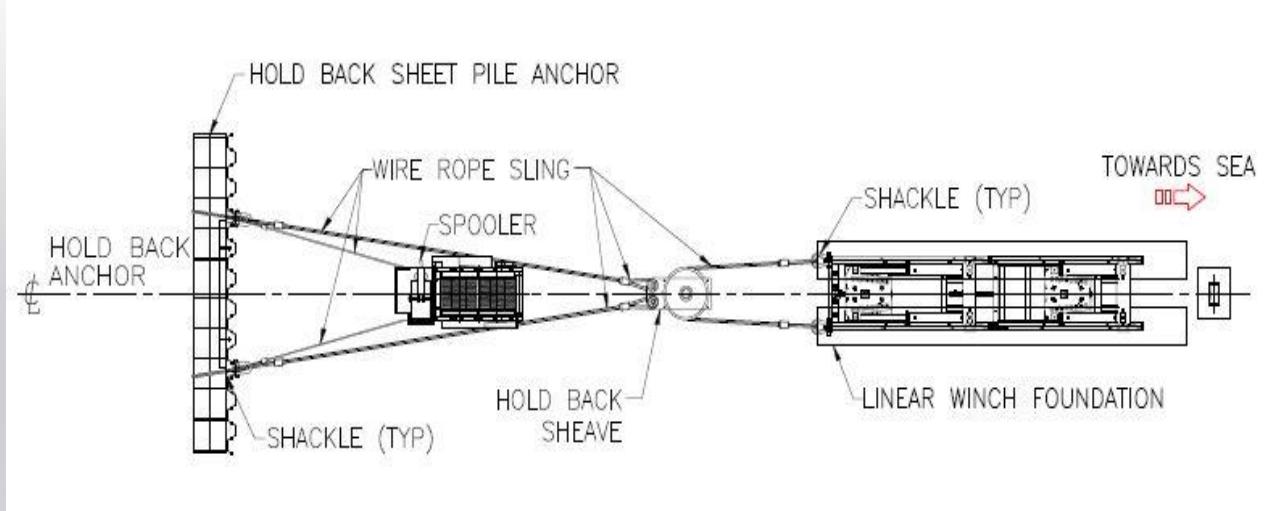
Shallow Water Initiation

- Shore/Beach Pull

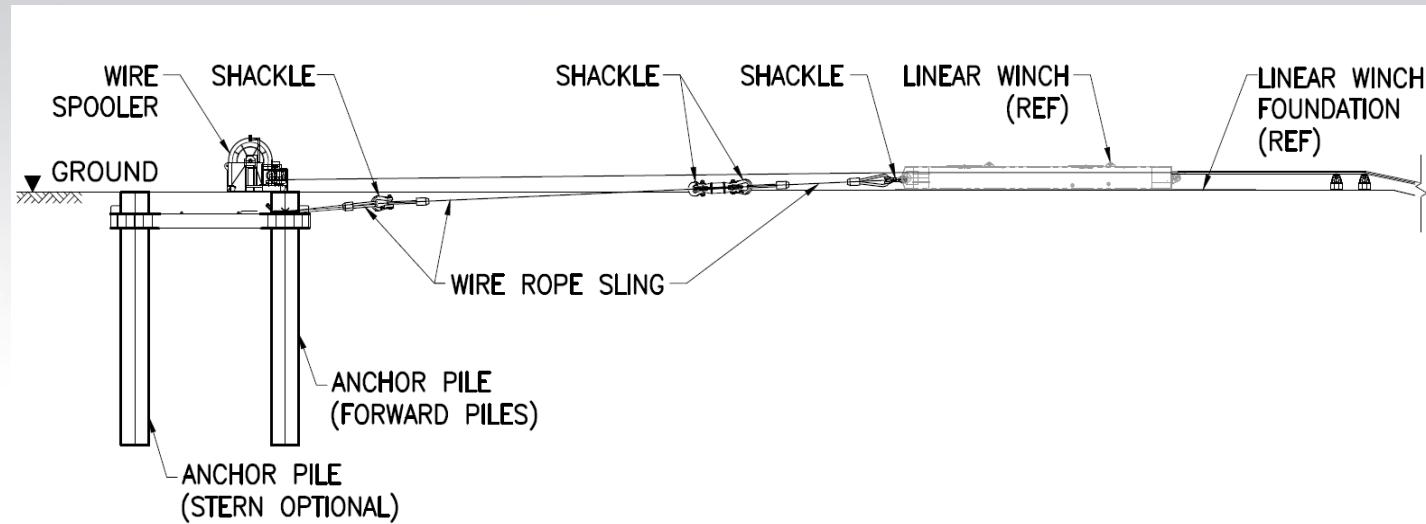
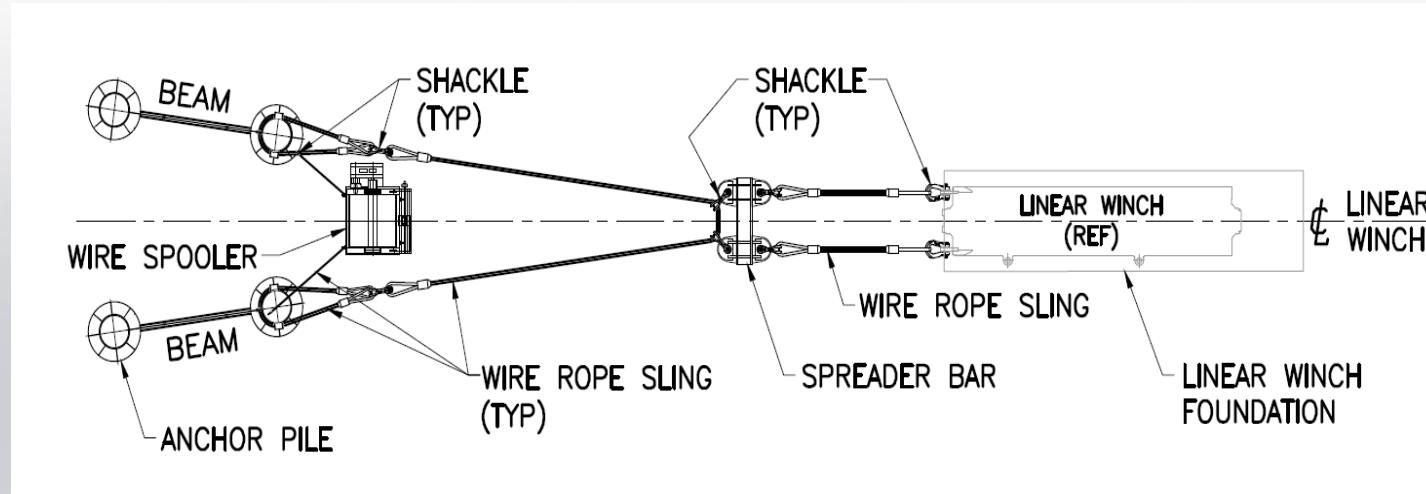
Concept for the Pipelay Initiation at Shore Approach using Linear Pull Winch



Typical Concept for Hold-back Device (using Sheet Piles)

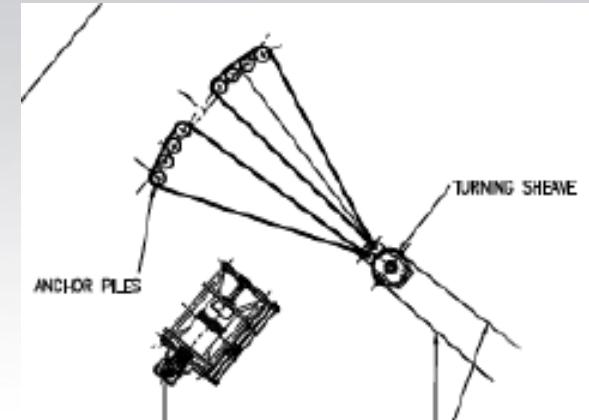


Typical Concept for Hold-back Device (using Tubular Anchor Piles)

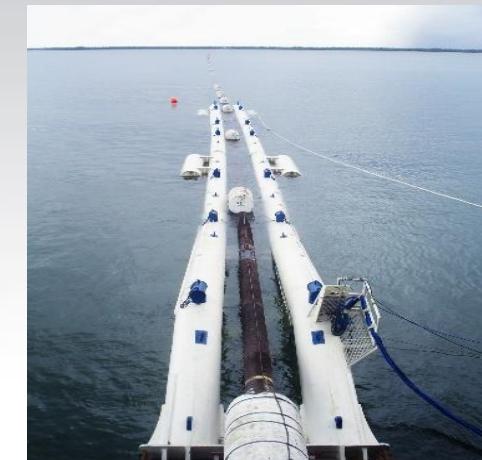
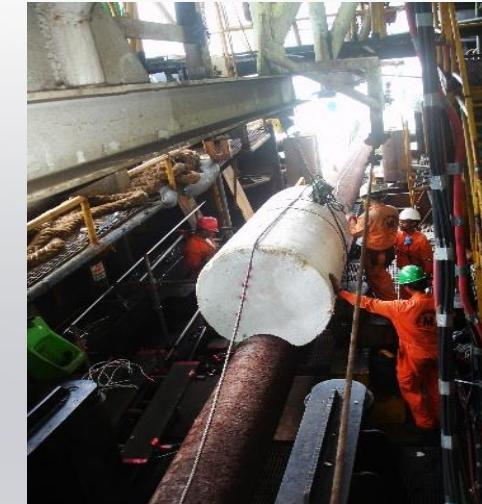


Other Concepts for Hold-back System

- *There is no hard-and-fast rule on how a 'hold-back' anchor should be designed or look like*
- *Different contractors will have different preferences, but principles will remain the same, i.e. it must be able to withstand the axial force exerted by the pulling device*
- *Below examples from Sapura*



Examples of shore pull where land-fall based linear winch was used to pull pipeline to landfall (Hyundai)



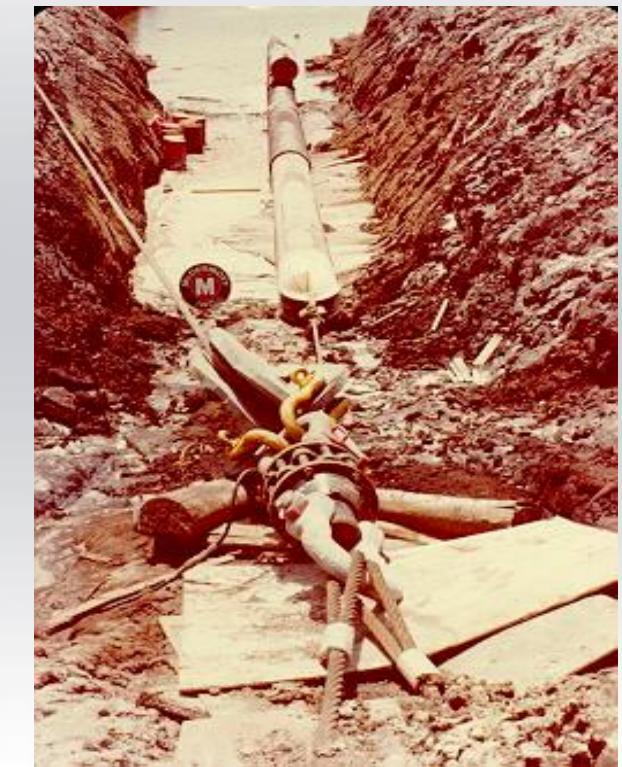
Rigging up of Articulated Stinger for beach pull (McDermott)



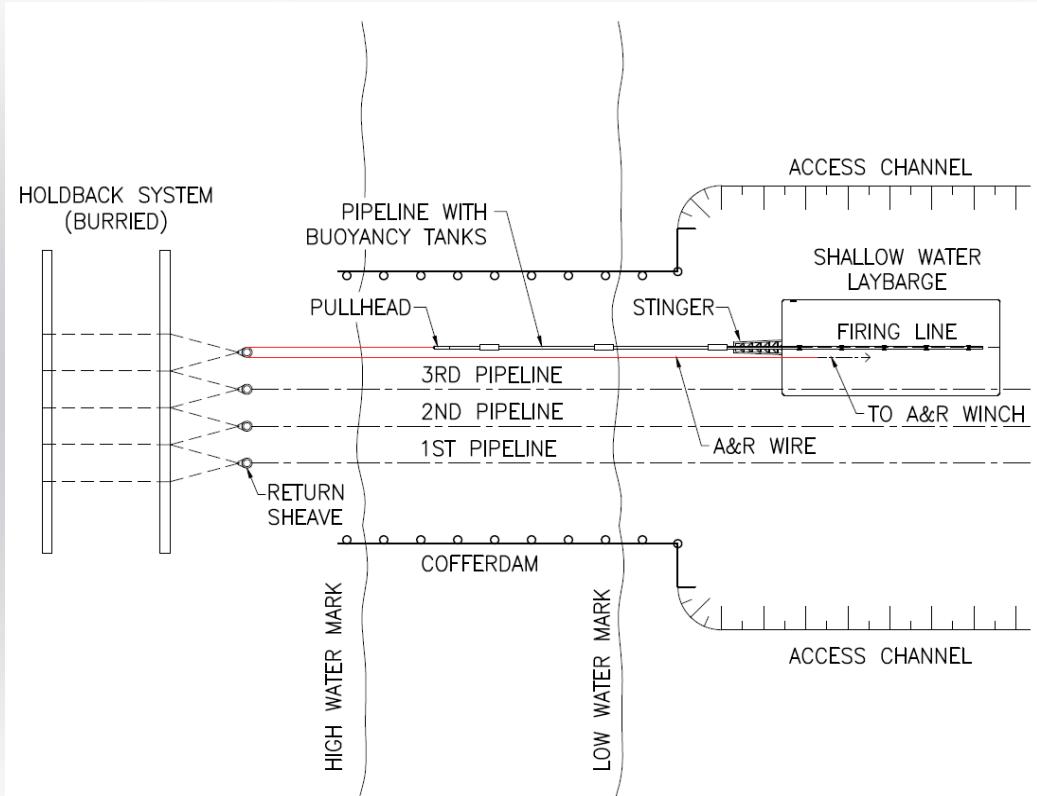
Pipelay Initiation – Pullhead being Pulled to Beach Using Return Sheave at Landfall and Laybarge Mooring Wire to pull



Shore Pull Operation using anchor pile at landfall, return sheave and pull winch mounted on vessel (McDermott)



(Left) Conceptual arrangement for multiple shore pull
(Right) Examples of multiple shore pulls



Examples of multiple pipelines pulled to shore using onshore anchor point, return sheaves and vessel's A&R winch and wire (Hyundai)



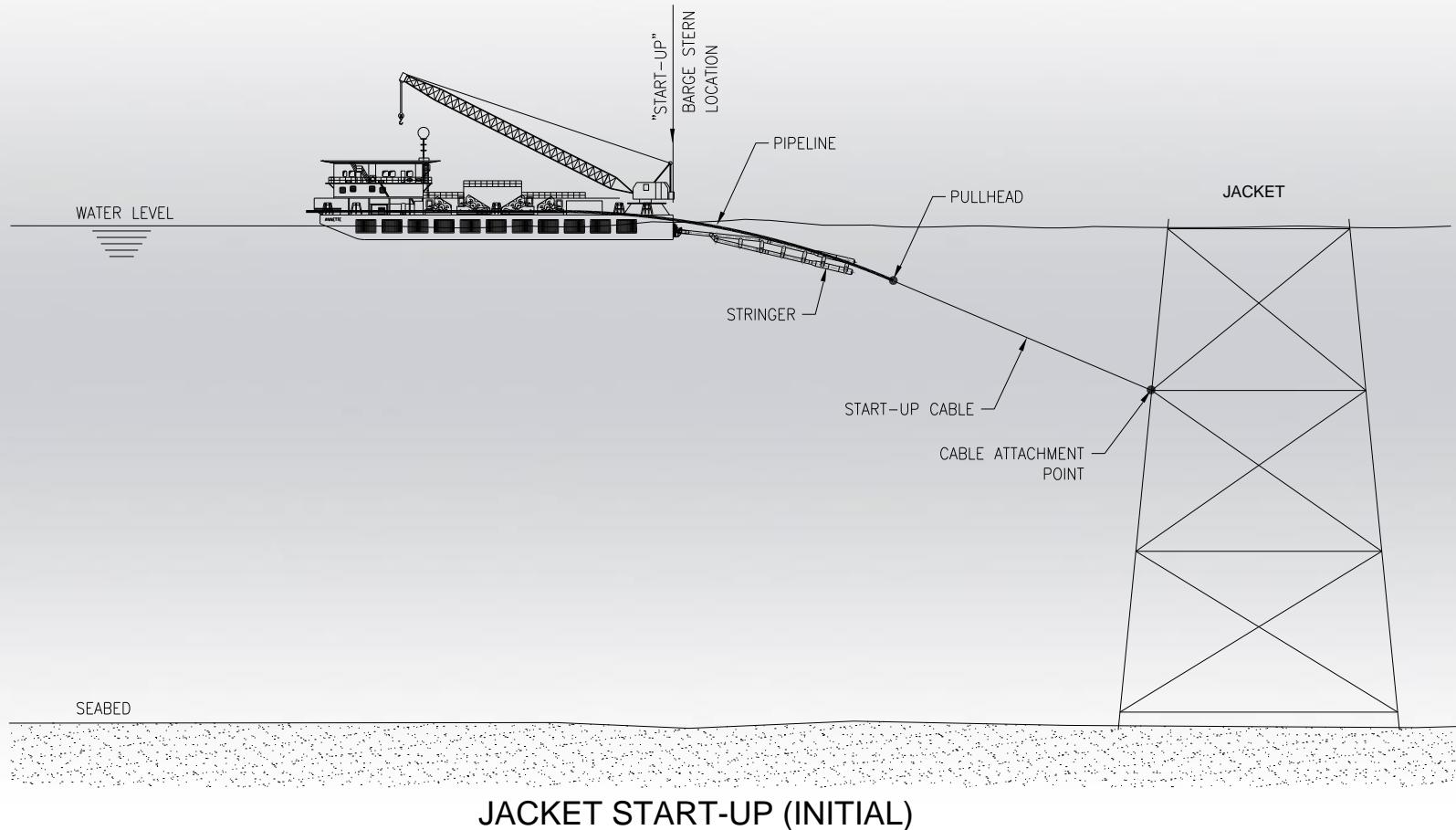
Shallow Water Initiation

In-field Pipelines

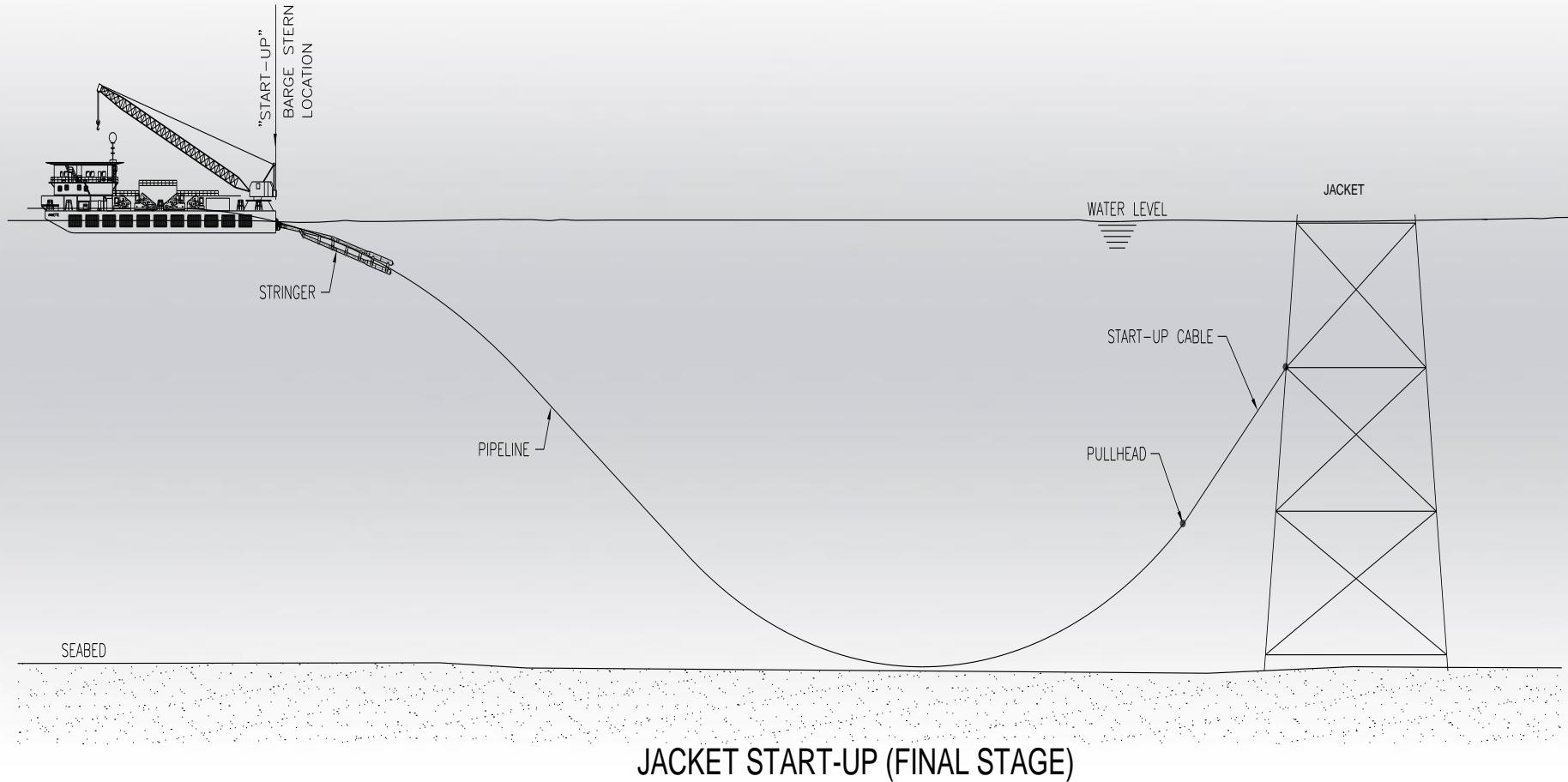
Hitching up of Articulated Stinger in strong current for subsequent 'jacket start-up'



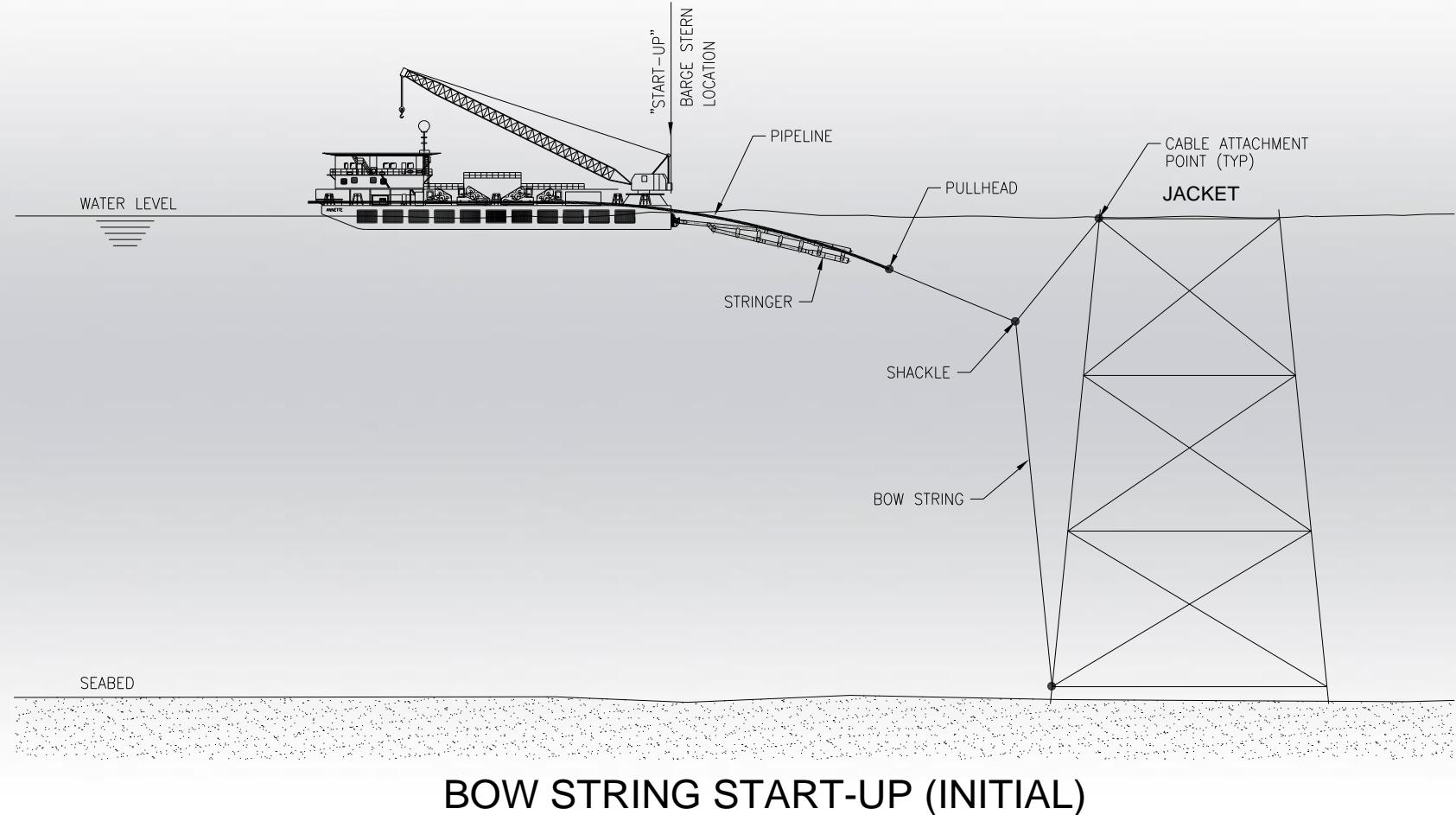
Schematic showing typical Jacket Start-up (Initial stage)



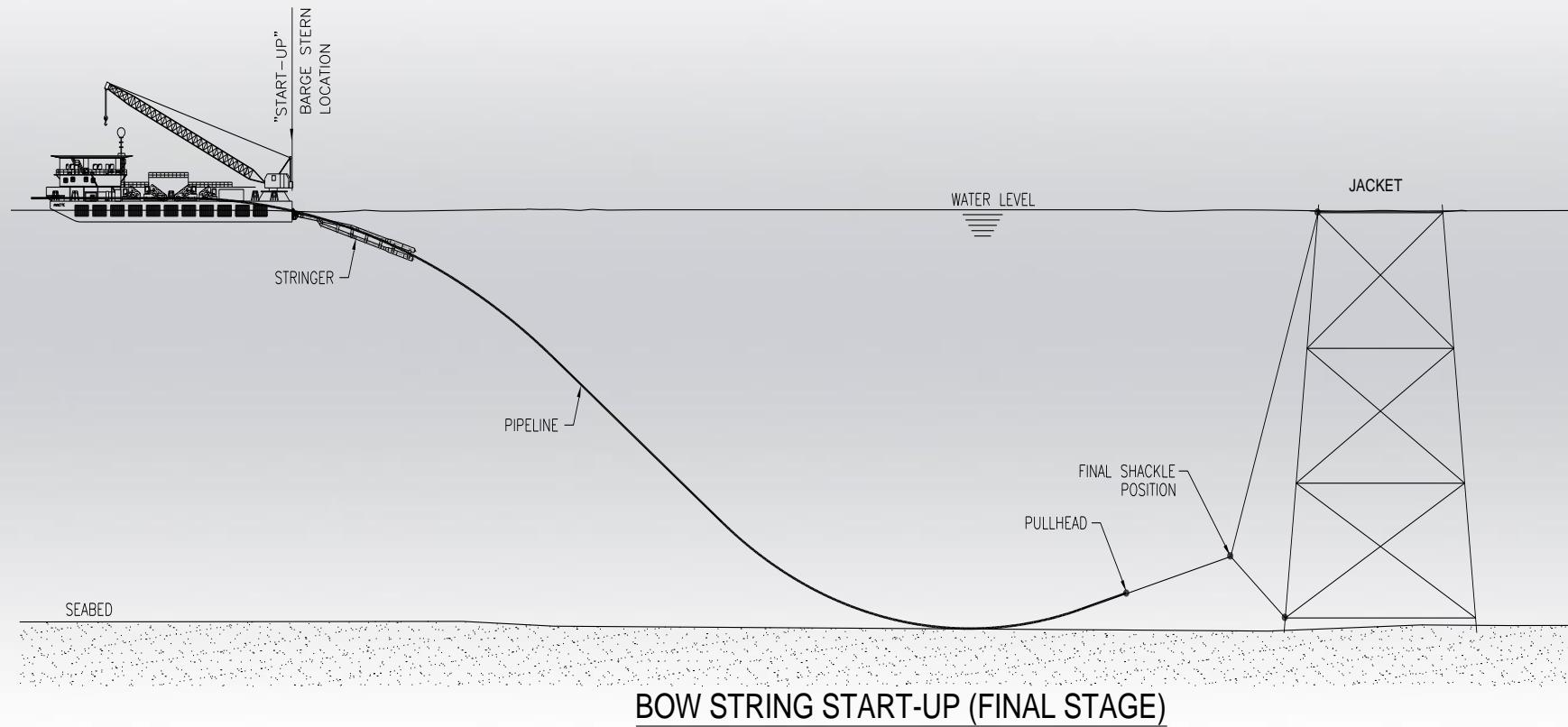
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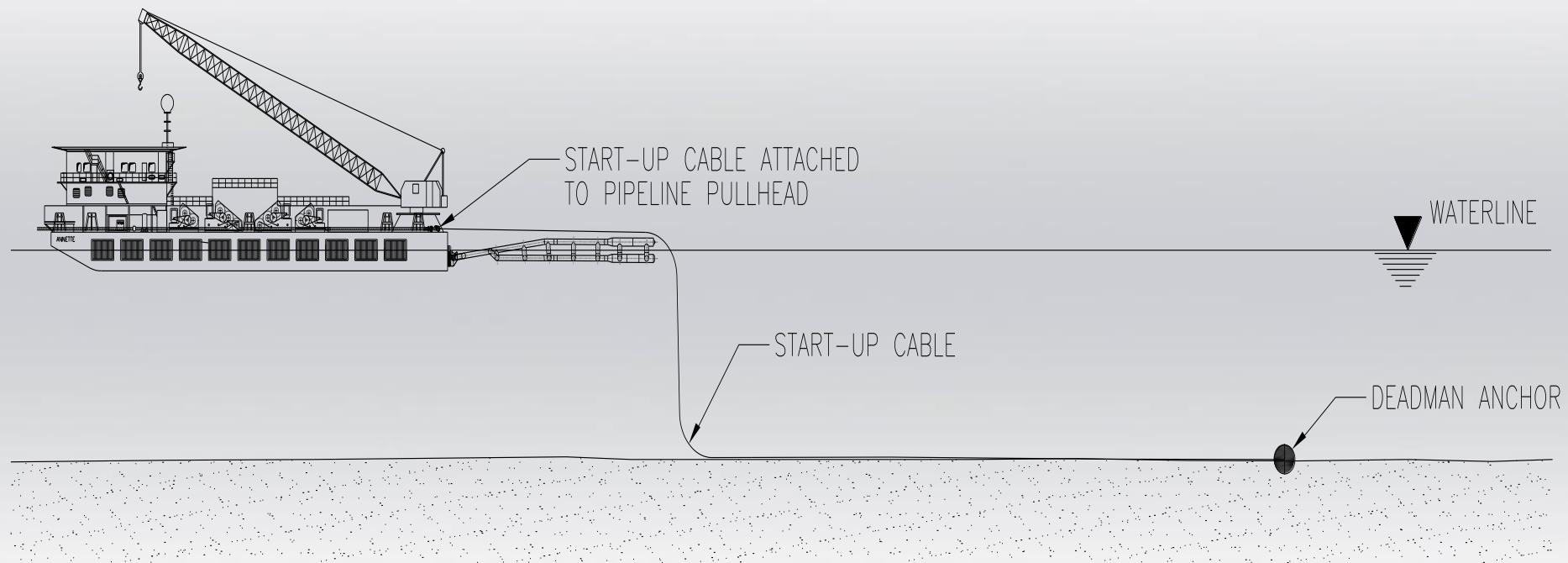
Schematic showing typical Bow String Start-up (Final stage)



Schematic showing typical Bow String Start-up (Final stage)

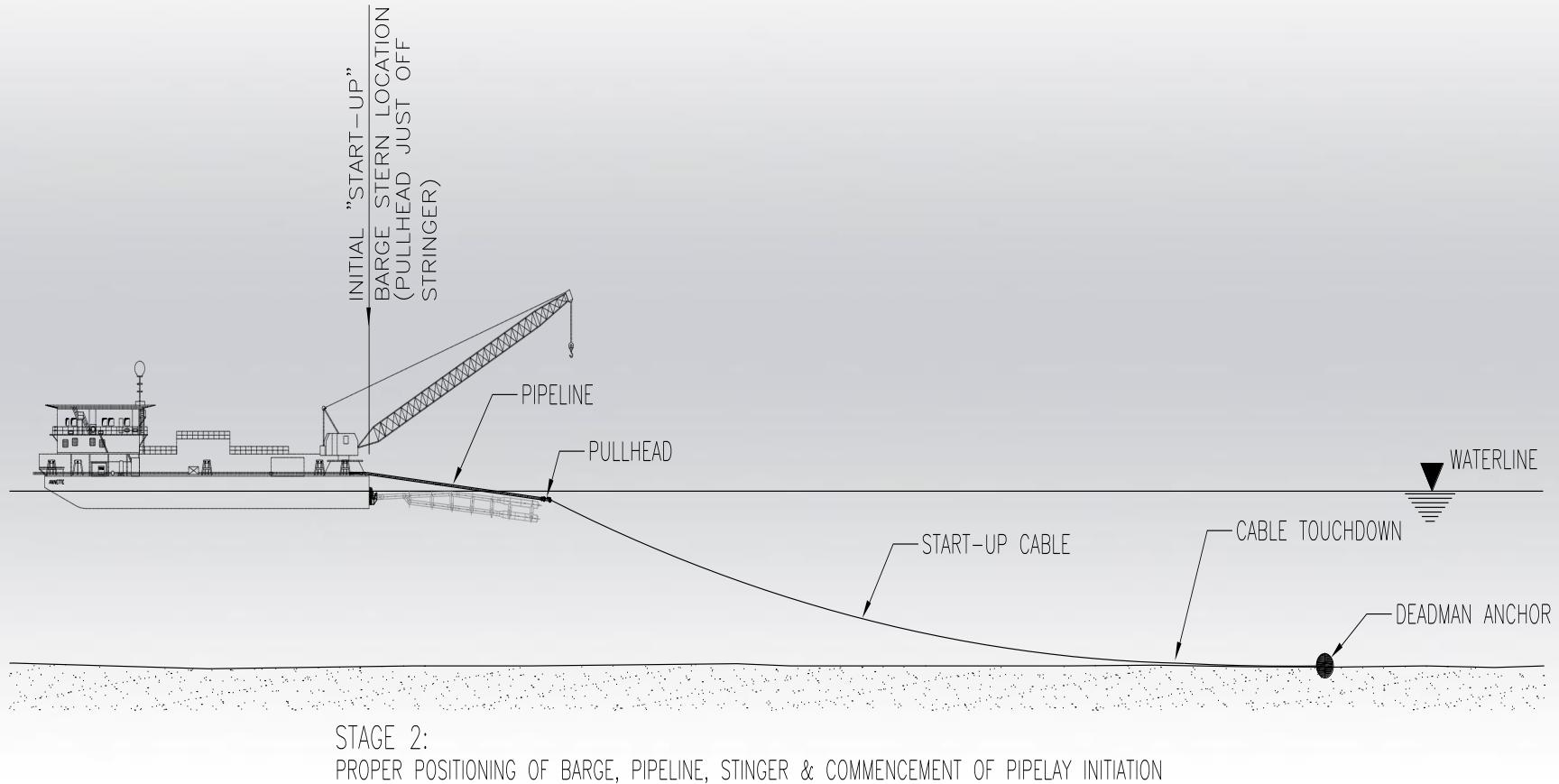


Schematic showing typical Deadman Anchor Start-up (Initial stage)

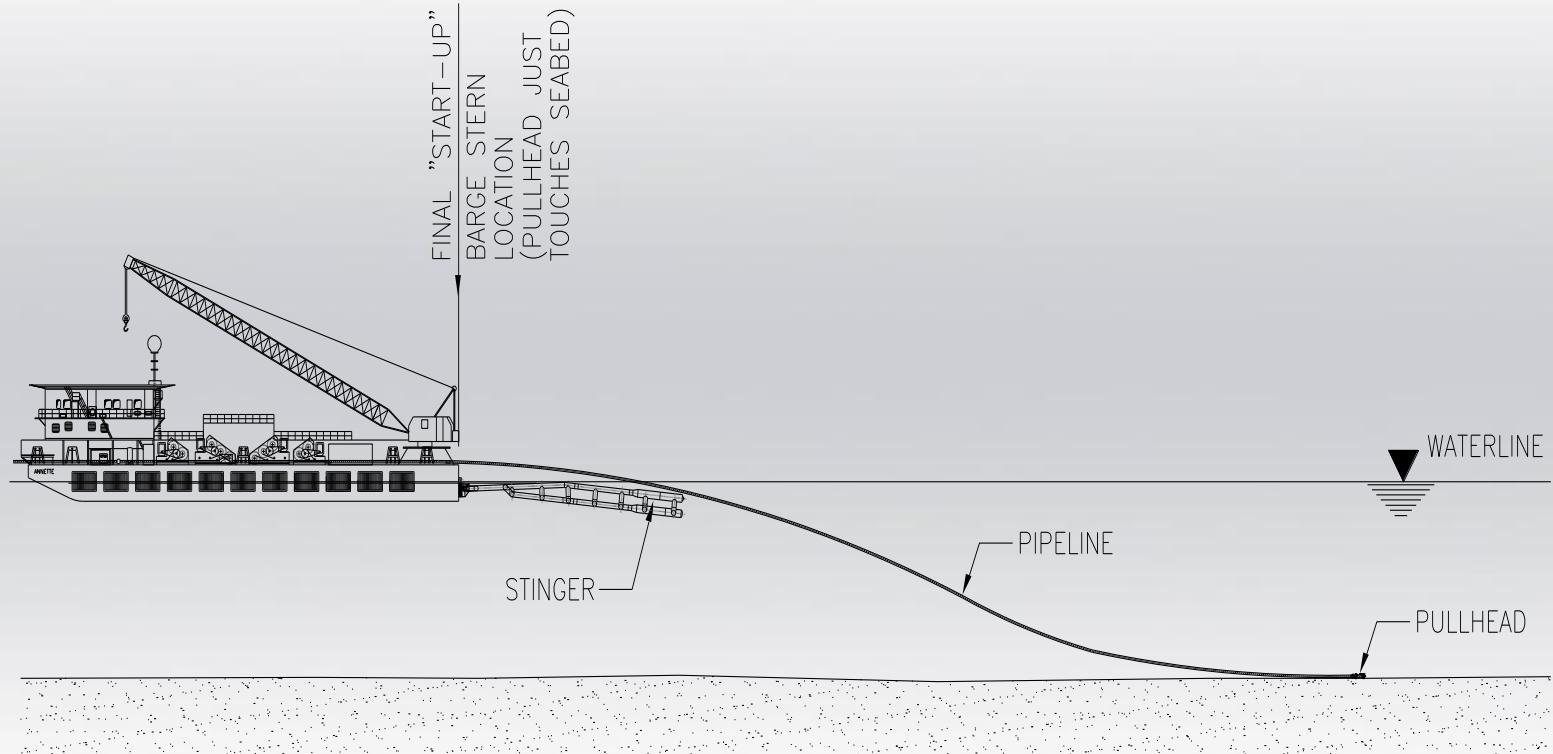


STAGE 1:
ATTACHMENT OF START-UP CABLE TO PULLHEAD

Schematic showing typical Deadman Anchor Start-up (Intermediate stage)



Schematic showing typical Deadman Anchor Start-up (Final stage)



STAGE 3:
END OF PIPELAY INITIATION & COMMENCEMENT OF NORMAL PIPELAY

Conventional S-Lay Pipeline Installation : Push-Pull Method (Geocean)

Shallow Water Initiation

- Shore/Beach Pull

Shore Pull using push-pull method (Geocean)



Tensioner used for pushing (instead of pulling) pipe towards landfall after welding



Buoyancy Drums Used to Provide Positive Buoyancy so that pipeline floats



Pipeline Floating towards Landfall Point (pushed by tensioner and pulled by tug)



Tug hands over pull wire to Marsh Buggy
as it gets to shallow for tug to operate



Pulling of Pipeline towards Landfall by Marsh Buggy and Backhoe



Final stages of push-pull operation



Collection of oil drums after being stripped from pipeline to allow it to settle onto Seabed



Re-instatement of Site at End of Project (Including Planting of Mangrove Seedlings)

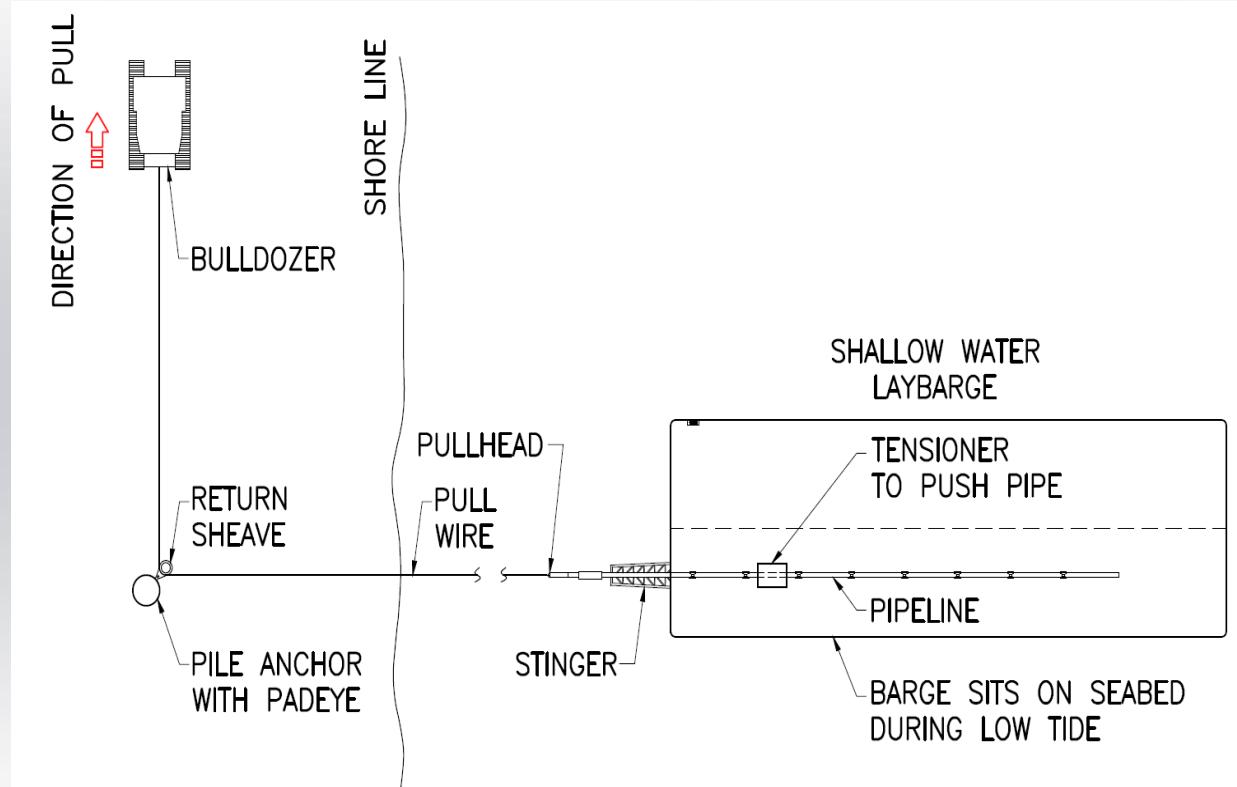


Backfilling after Pipeline has been Installed



Variation of "Push Pull" Method (Geocean)

- Return sheave at landfall and bull dozer

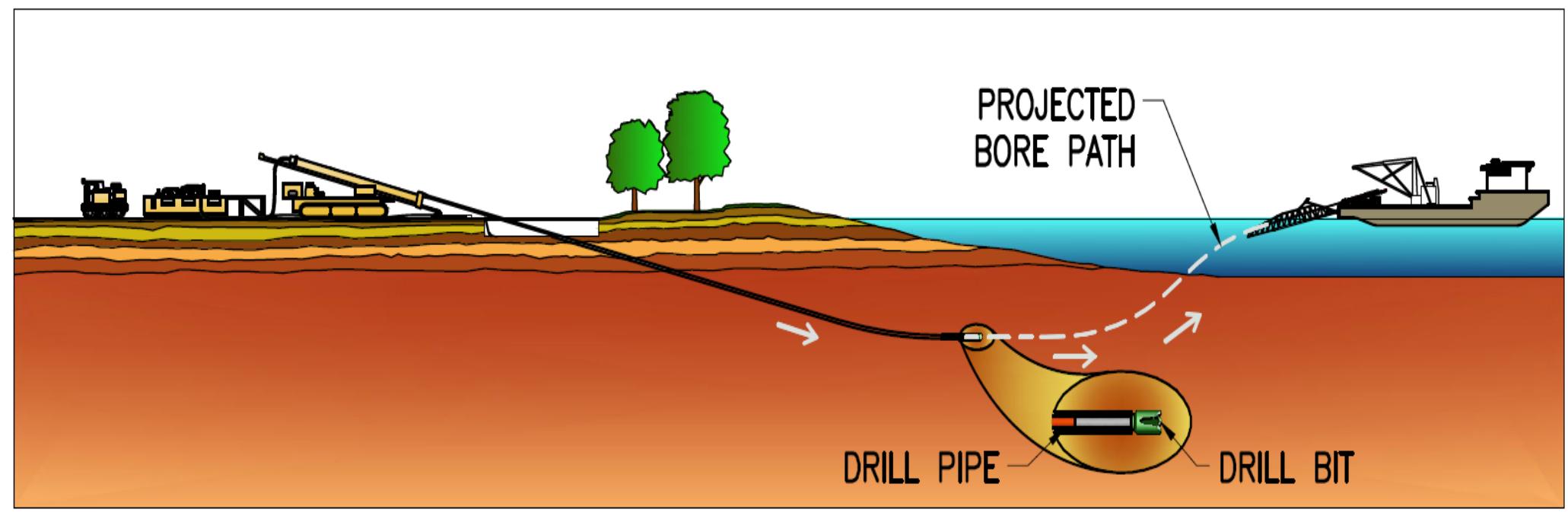


- Pull wire is transferred from landfall to laybarge and connected to pipeline pulling head
- Other end of wire is run through sheave block and connected to bull dozer
- As pipe is welded, it is pushed out by tensioner and pulled to shore by onshore bull dozer
- Oil drums are attached to pipeline at regular intervals on laybarge to make pipe buoyant

Shallow Water Initiation

- Horizontal Directional Drilling

Schematic showing layout for landfall HDD operation (Pipeline pulled in from offshore)



- *Drilling from landfall location*
- *Pipeline fabricated on laybarge and pulled in through drilled hole*

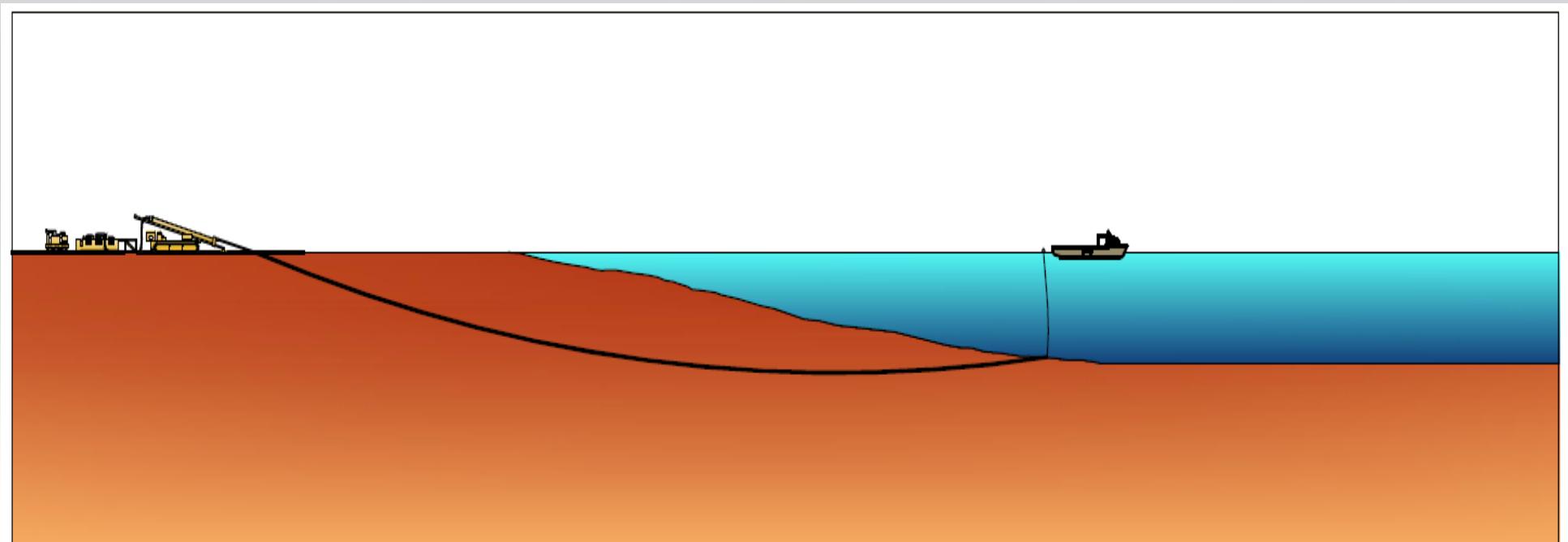
An example of landfall HDD operation for installing pipeline at shore approach



An example of landfall HDD operation for installing pipeline at shore approach

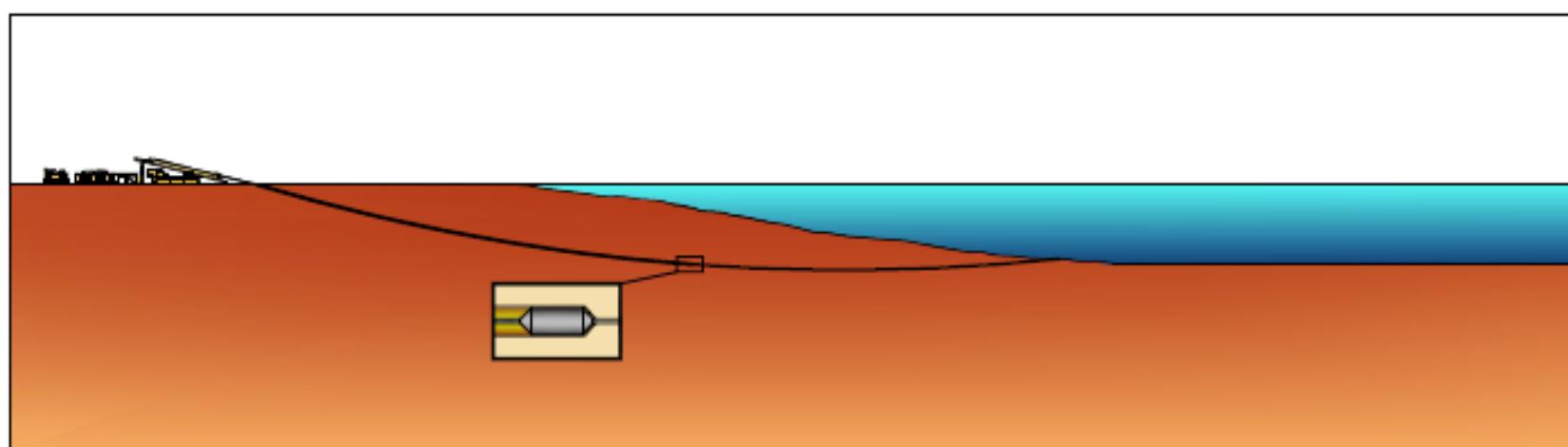
Drilling of Pilot Hole

- ✓ *Pilot hole is drilled from shore based HDD equipment to a designated "exit" point offshore*
- ✓ *A jet-head assembly is used at the "front" of the drill pipe*
- ✓ *On exiting the seafloor, compressed air is blown through the drill bit to aid location of exit point*



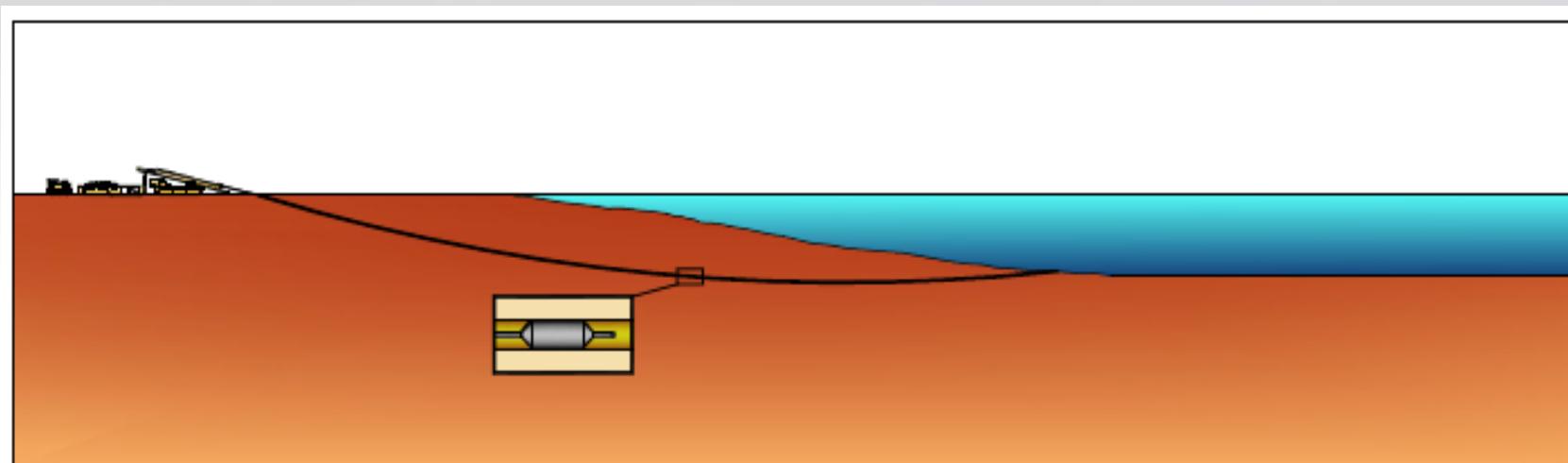
Reaming of bore hole

- Pilot hole is forward reamed using barrel reamers
- Hole diameter will be 50% larger than size of product pipe



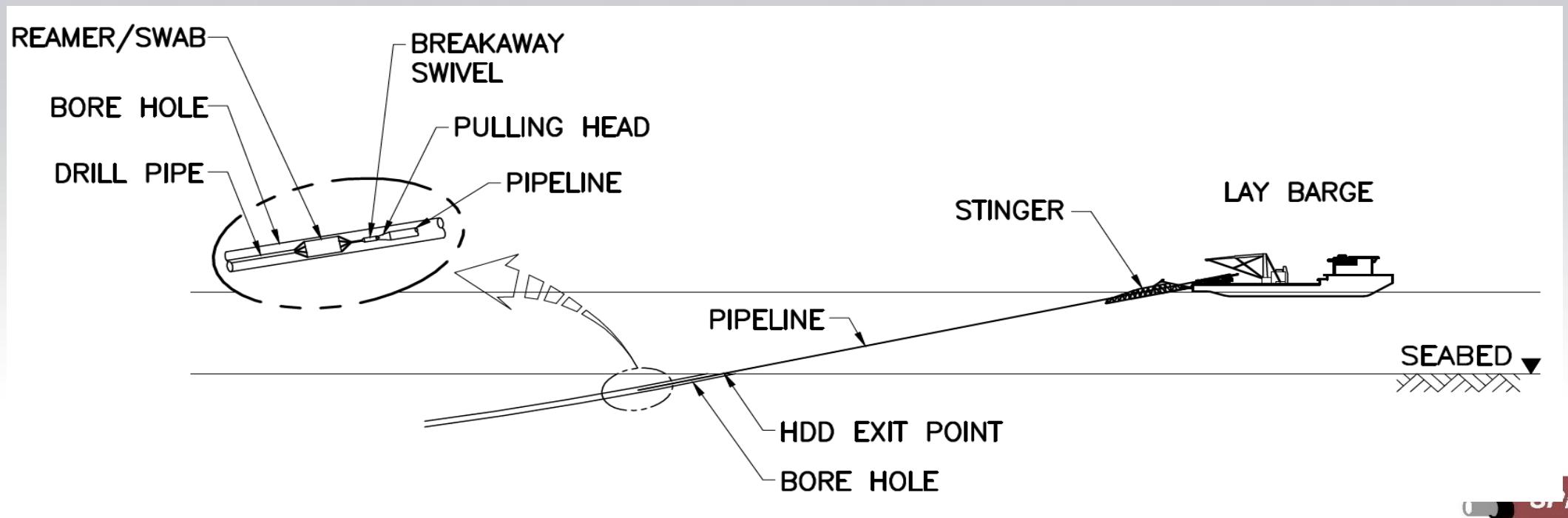
Hole Swabbing/Cleaning

- *On completion of the reaming the bore hole will be swabbed with a suitable size barrel swab*
- *The swab is advanced from the entry surface to the sub-sea exit location and then back to the entry surface location*
- *High pressure sea water is discharged at the leading end of the swab as it is advanced into the bore hole hydraulically clearing the bore hole of debris*
- *The swab will verify hole gauge to a suitable size*



Pulling-in of Product Pipeline

- Reamer/swab is retrieved by laybarge and connected to pipeline pulling head
- As line pipe is welded on the laybarge, the pipeline is pulled into the HDD bore hole
- When the pipeline pulling head reaches the HDD entry point, pulling head is anchored
- Normal pipelaying follows



Reamer/swab is retrieved by laybarge



Reamer/swab is connected to pipeline pulling head

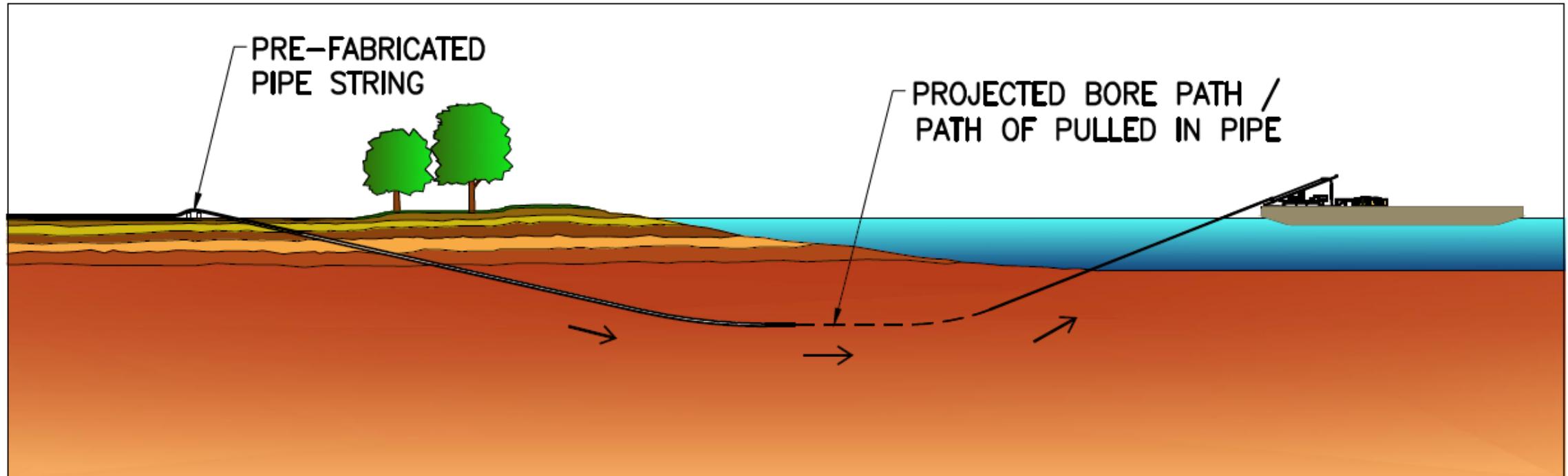


Pipeline is pulled into the HDD bore hole towards landfall as it is being welded



Pipeline pulling head at the HDD entry point
and all HDD equipment removed

Schematic showing layout for landfall HDD operation (alternative)
(Pipeline fabricated onshore and 'forward thrusted' into HDD hole towards Offshore)

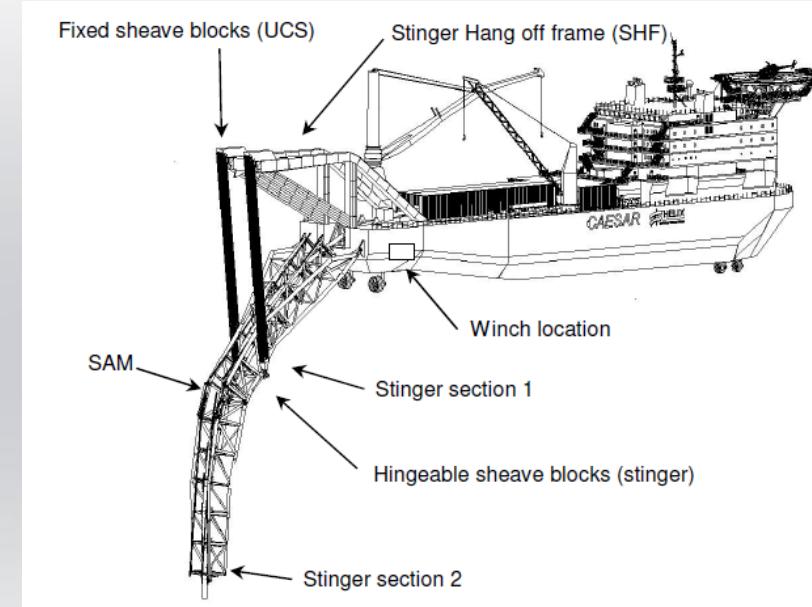


- *The principle for the 'landfall to offshore pipe pull-in' methodology is similar to that for 'offshore to landfall pipe pull-in' methodology*
- *Instead, pipeline is fabricated onshore and forward thrusted into HDD hole*
- *Laybarge is used to retrieve the pulling head, remove head and then commence pipelaying*

HDD by Forward Thrusting

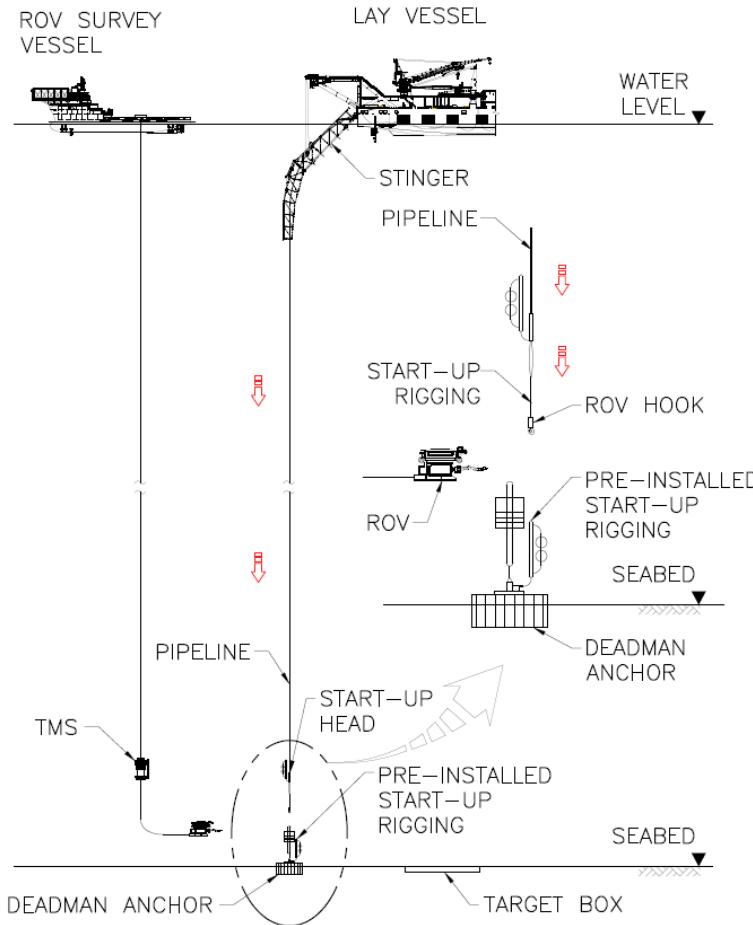


Deep Water Pipelay Initiation

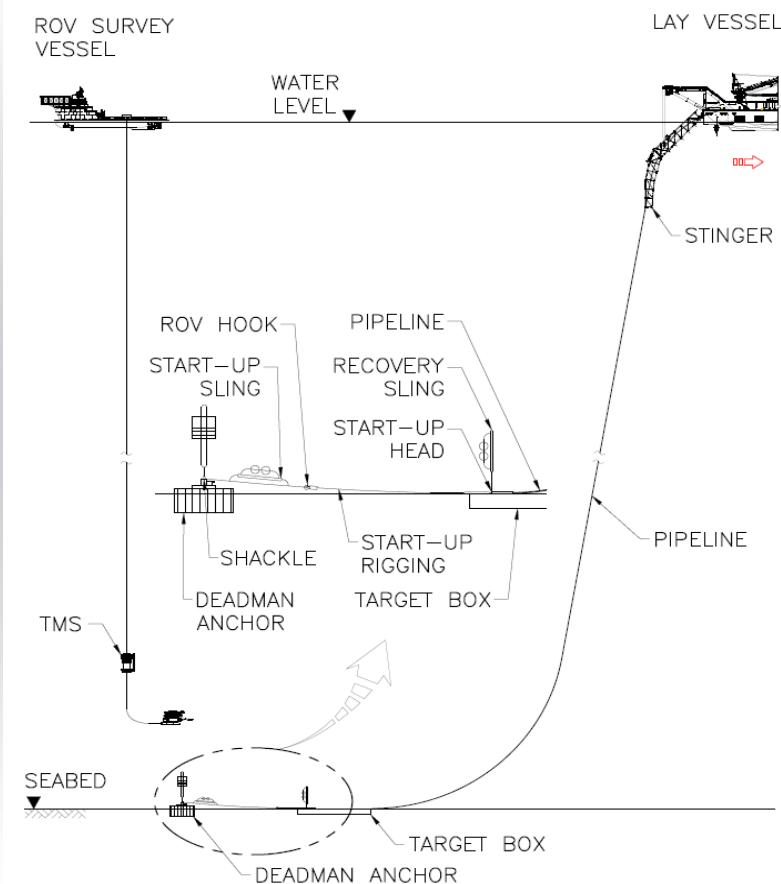


- DP 2/3 Pipelay Vessel (too deep for mooring lines)
- Almost always fixed stinger
- Stinger of minimum radius
- Almost vertical lift-off at stinger tip

Typical Pipelay Initiation in Deep Water using Pre-installed Deadman Anchor



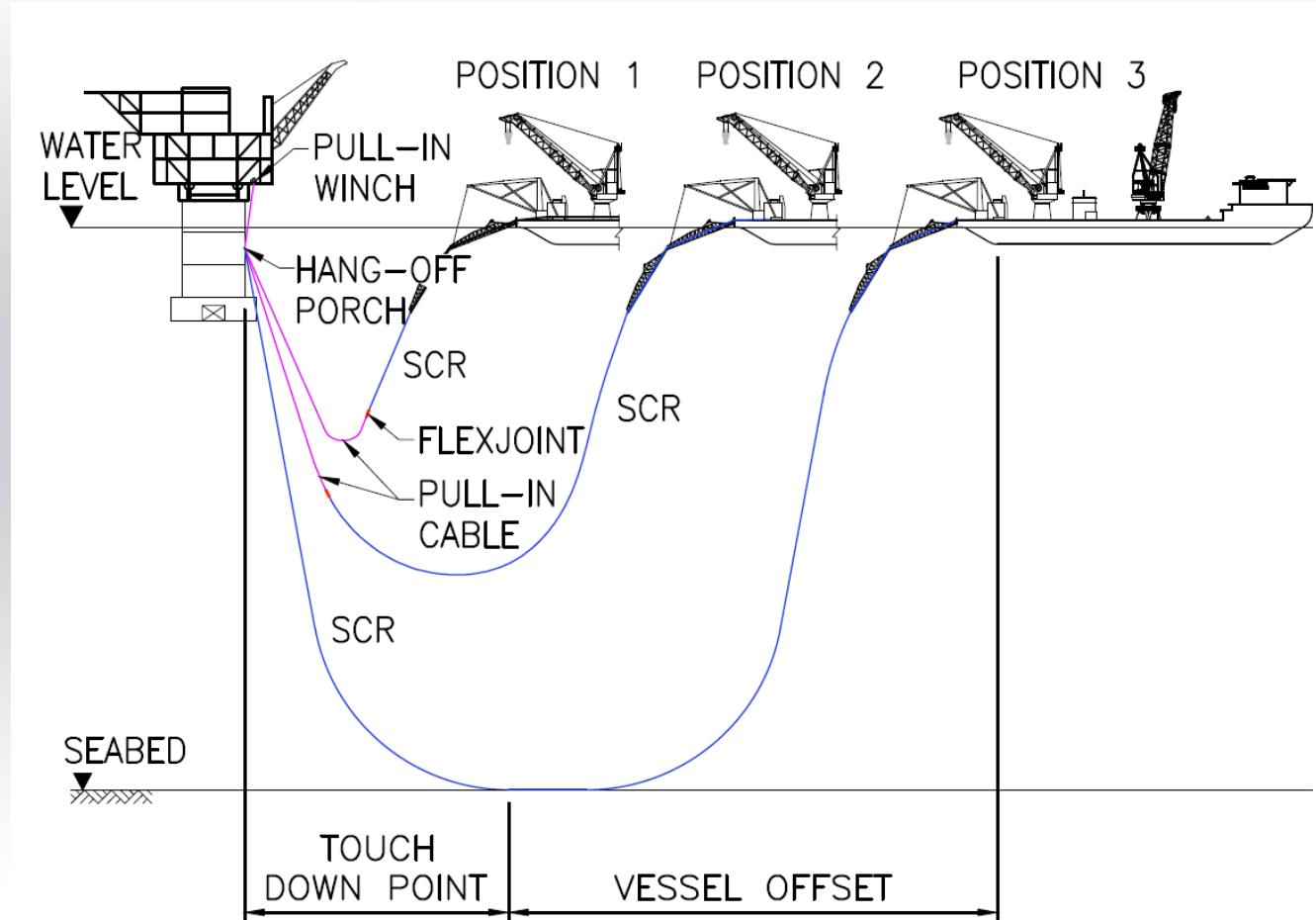
Initiation head rigging on the pipeline is connected to the pre-installed start-up anchor wire



Controlled laying after hook-up to start-up wire/cable

Schematic showing initiation of deep-water pipeline to a floating production facility

- this is also known as first end start-up of steel catenary riser



Pipeline between platform and touchdown point is called Steel Catenary Riser even though they form part of the continuous pipeline

For more details on Pipelay Initiation, refer to my new book:
"Subsea Rigid Pipelines – Methods of Installation"
Chapters 2 & 8

J-lay Method of Installation



Controlled Depth Tow Method of Installation



Surface-tow Method of Installation



SUBSEA RIGID PIPELINES
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ISBN 978-1-5437-5144-4
9 781543 751444

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PARTRIDGE

SUBSEA RIGID PIPELINES
— Methods of Installation

By Eng-Bin Ng

S-lay Method of Installation



Reel-lay Method of Installation



Stalk-on Method of Riser Installation



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Thank You!

Questions?

