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vessels

ROVs &
suport toolings

special machines

ROV
multi-tasking

conclusions

VLVnT Workshop

Enabling technologies for deepwater operations

Amsterdam, October 7th, 2003

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summary

Deployment to sea bottom: support vessels

Underwater operations

- ROVs + support tooling; example of operation
- specially developed machines with dedicated power and control: one example from recent experience
- ROV multi-tasking: dedicated machines for individual operations, operated through ROVs: one example case

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fundamental capabilities for deepwater installation

deployment to seabed and positioning over site with adequate accuracy

capability to work in very deep water by remote control with dexterity and safety

engineering of equipment and operations

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Marine Spread for deployment to sea bottom

Support vessels

Conventional vessels for auxiliary services:

- barges
- tugs

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Support vessels
Example: Polar Prince

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Support vessels
Example: Polar Prince

length (LOA)	94.1	m
beam	22.0	m
draught	7.1	m
clear deck area	1,000	m^2
deepwater crane capacity (2000 msw)	75	t
(constant tension and heave compensated)		
A-frame capacity	100	t
stern roller	60	t
moonpools:	two: 7x 6,5 m and 4,9 x 5,2 m	

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Support vessels
Example: Polar Prince

Propulsion and Thrusters:

- 2 x 4.3 kW CP propellers in nozzles
- 3 transverse thrusters
- 2 azimuth thrusters

Dynamic Positioning

- fully redundant system DP2, 2 DGPS

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Support vessels
Example: Maxita

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Support vessels
Example: Maxita

length	162	m
beam	38	m
draught	9	m
deck capacity	18,000	t
deck area:	3,800	m^2
accommodations:	84	berths
craneage:		
main hook	600	t
auxiliary hook	200	t
heave compensation to	+/-1.6	m

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Support vessels
Example: Maxita

tunnel thruster Fwd	800	HP
azimuth thruster Fwd	2 x 3,600	HP
azimuth thruster Aft	2 x 2,780	HP

DP System DP 2 , fully redundant Simrad 702

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Underwater works: Remotely Operated Vehicles

- Typical “Working Class” ROVs are free-flying vehicles linked to surface through an electric umbilical

- ROVs are typically powered by a submersible electric motor rated about 100 to 150 HP; this motor generates hydraulic power; ROV users are typically hydraulic

- Typical ROV missions include use of manipulators and of specific support toolings

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Underwater works: other vehicles

- Manned submersible vehicles are not of normal use in the offshore industry

- Autonomous Underwater Vehicles (AUV) are used in the industry for a limited number of job types, especially survey. Possible further development may lead to increased possibility of use in other activities, such as data gathering for maintenance. Low power availability and poor station keeping capability prevent their use as work class ROVs.

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Underwater works: Remotely Operated Vehicles

Typical underwater works by ROVs include:

- survey
- assistance for deployment to sea bottom
- manipulation
- small tasks on subsea equipment (e.g.: cleaning, cutting), assisted or not by manipulators

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ROVs
Example: Innovator

- vessels
- **ROVs & suport toolings**
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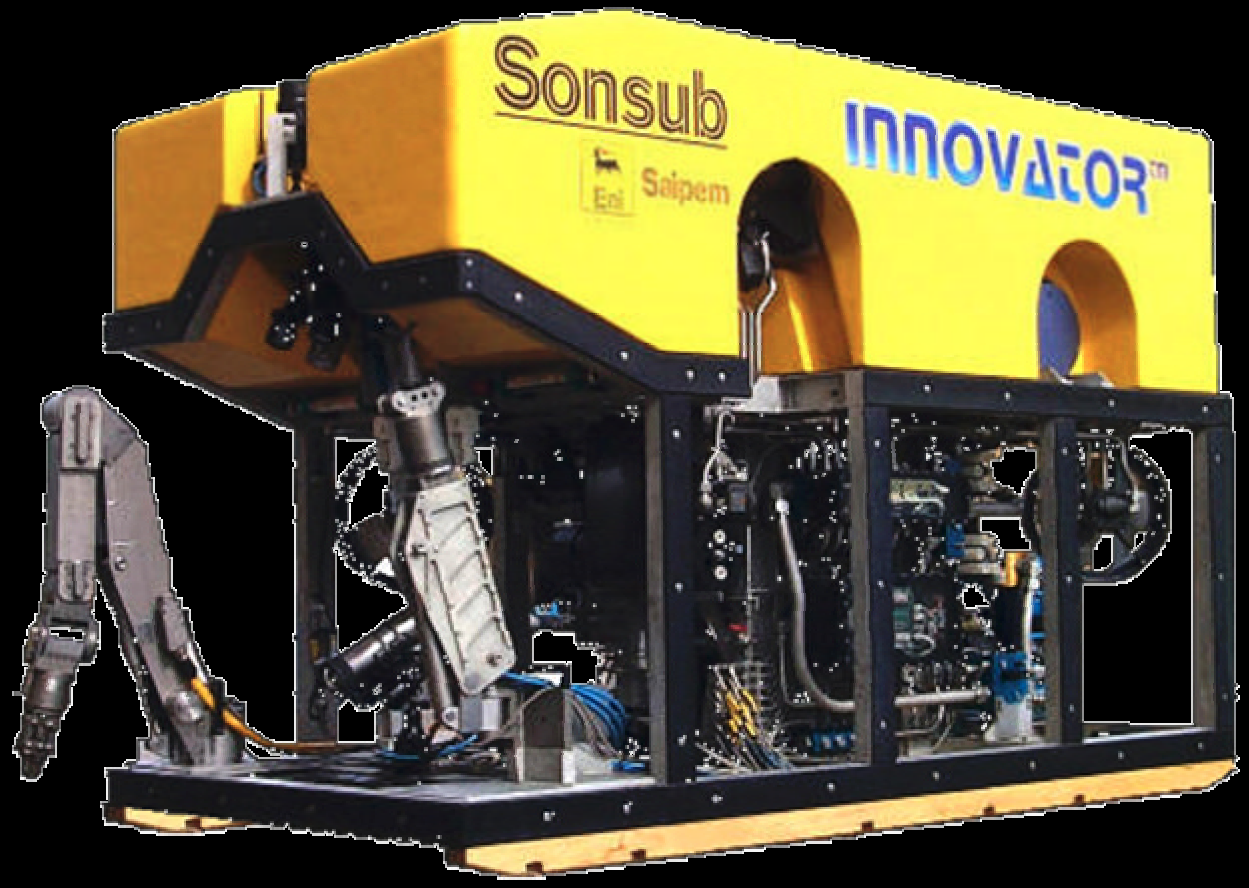

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ROVs:
Example: Innovator

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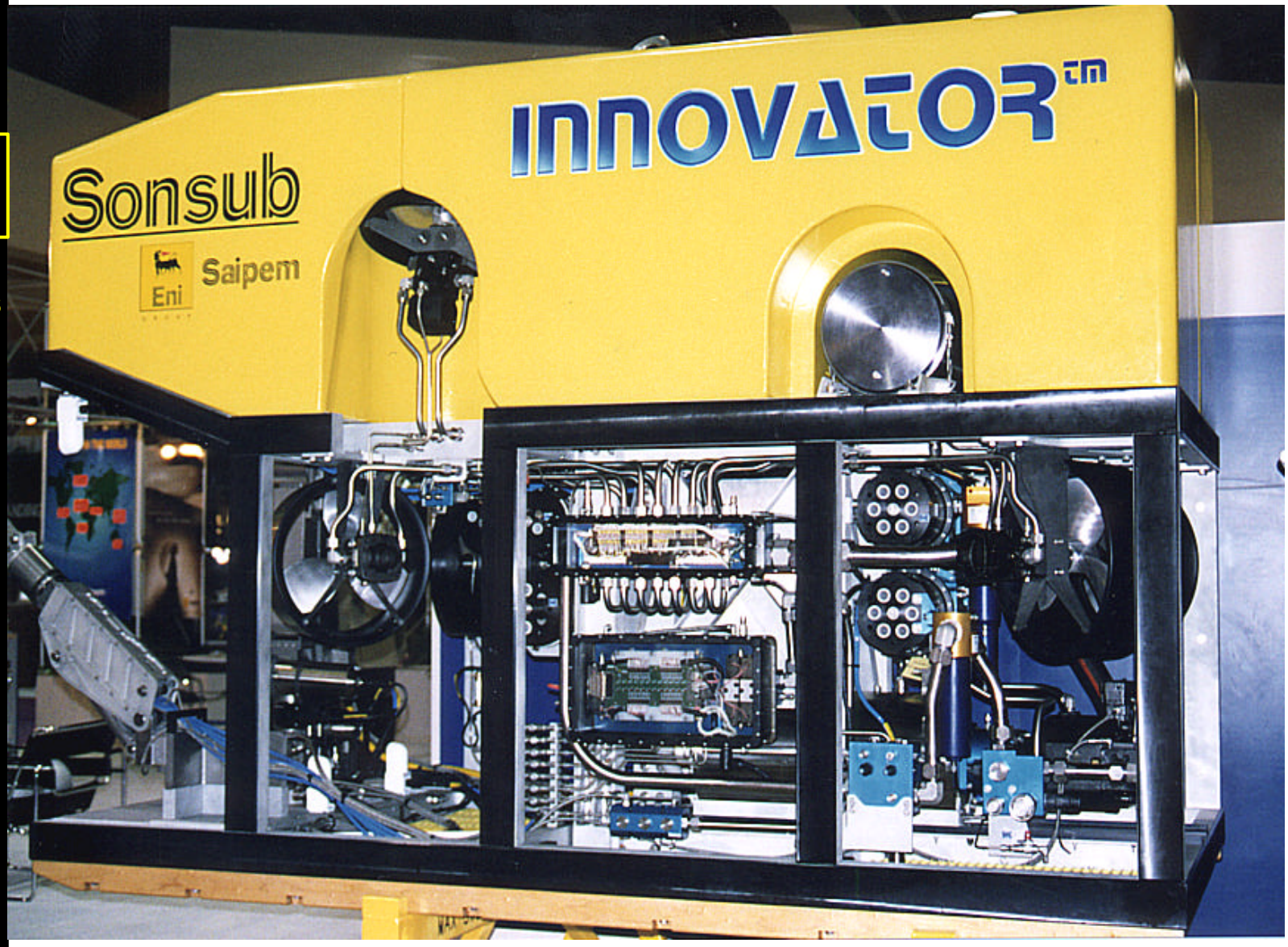

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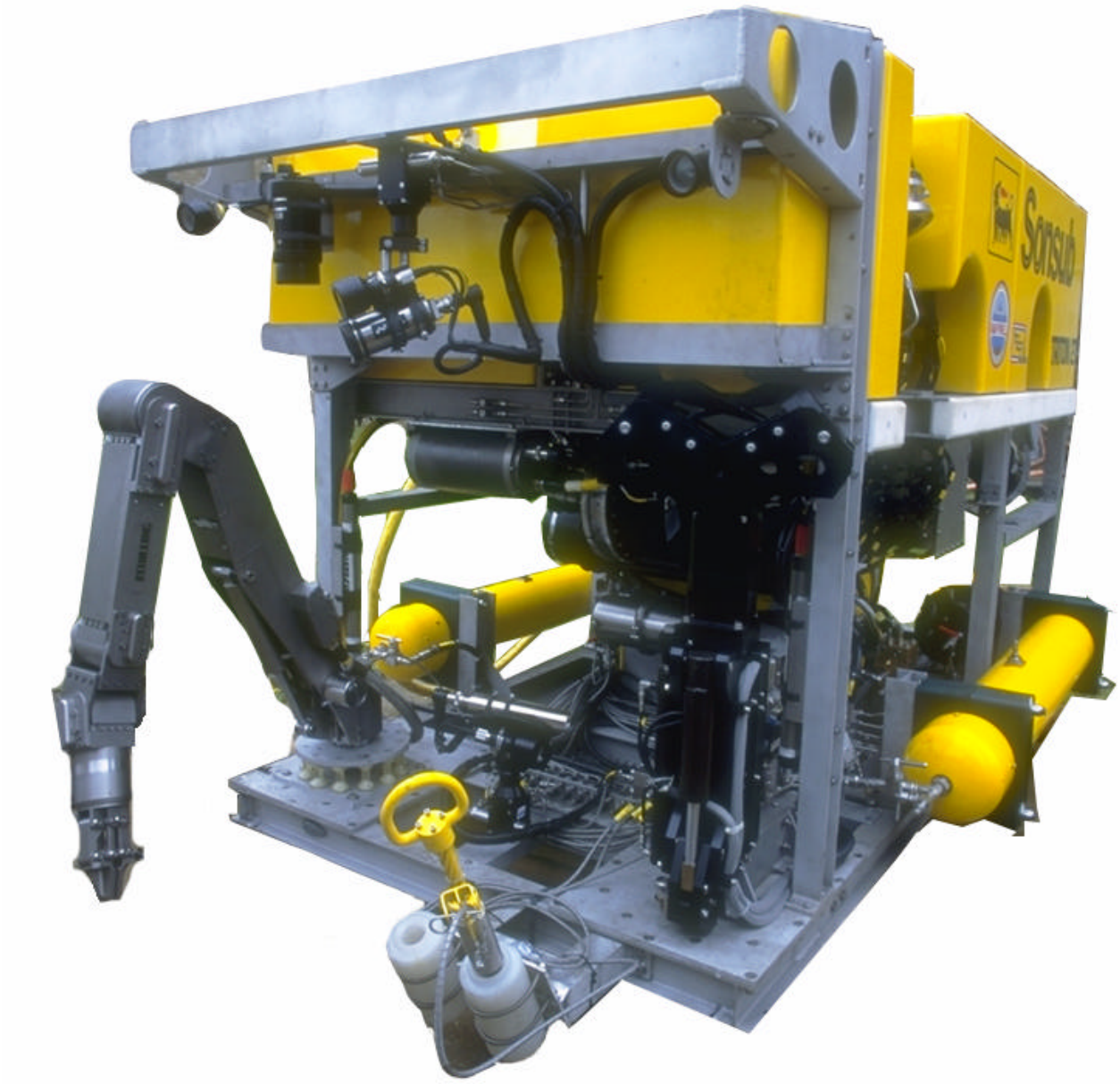
ROVs:
Example: Innovator



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Innovator main data

Dimensions (LxWxH): 3.00 x 1.50 x 2.00 m

Payload 3 kN

Depth capability 3,500 msw

(two Innovators upgraded to 4,000 msw)

Hydraulic Power System

one electric motor 150 HP; 4,200 V, two shaft ends

Hydraulic Power Unit (HPU) driven by electric motor

Propulsion System

Seven Curvetech hydraulic thrusters

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Innovator main data

- max thrust capacity, forward/lateral 10 kN
- max thrust capacity, vertical 6 kN
- through-frame lifting capacity 140 kN
- power through umbilical 500 HP
- capability for automatic heading and trimming
- ring laser gyro
- extended tether

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ROVs: the Tether Management System

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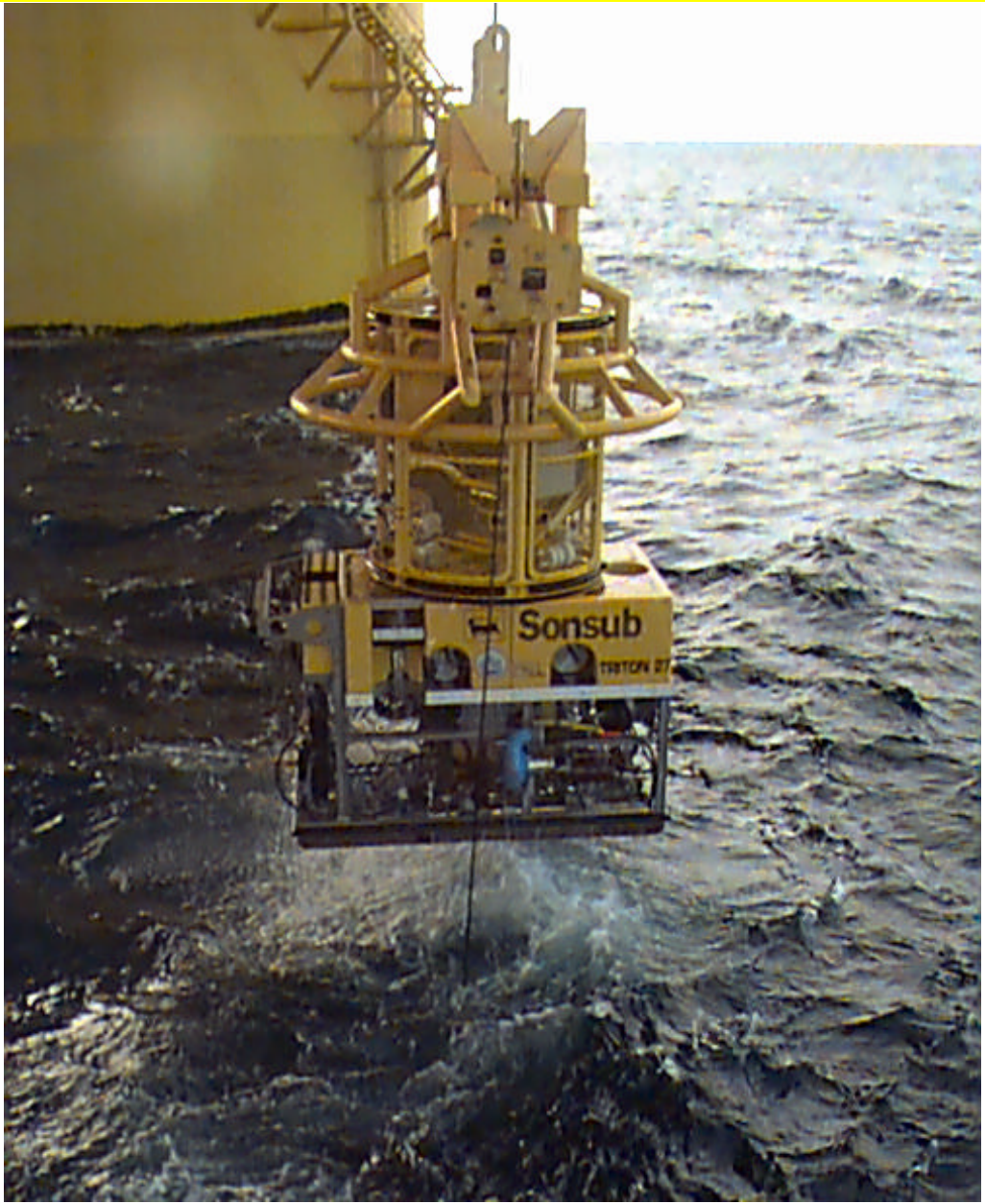
ROV and TMS being deployed



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Extended tether - horizontal excursion

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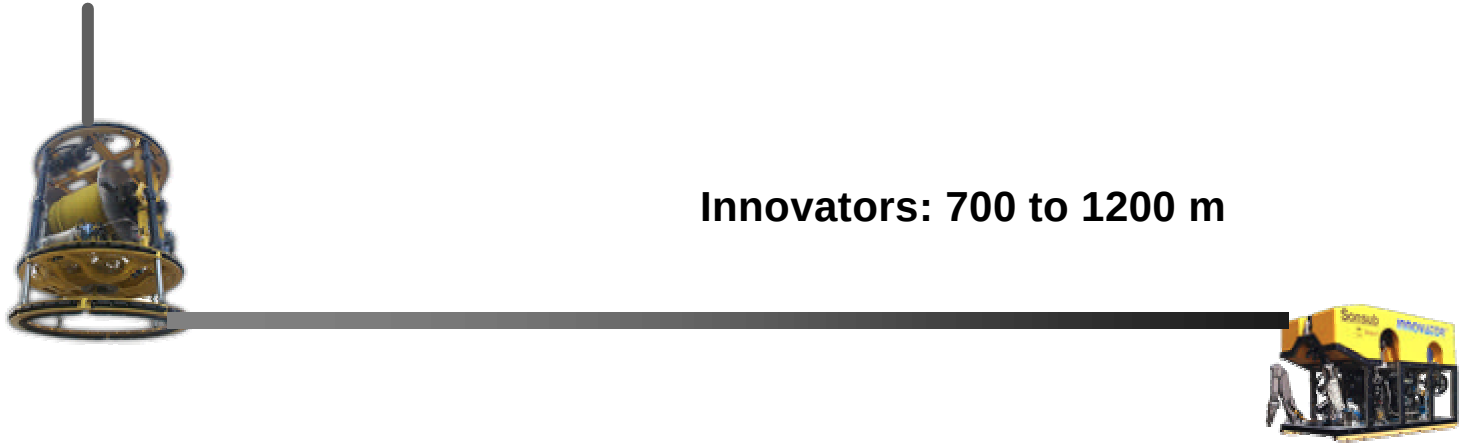
typical for standard ROVs: 200 - 300 m



Innovators: 700 to 1200 m

0 200 m 400 m 600 m 800 m 1000 m 1200 m

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Examples of support toolings for ROVs

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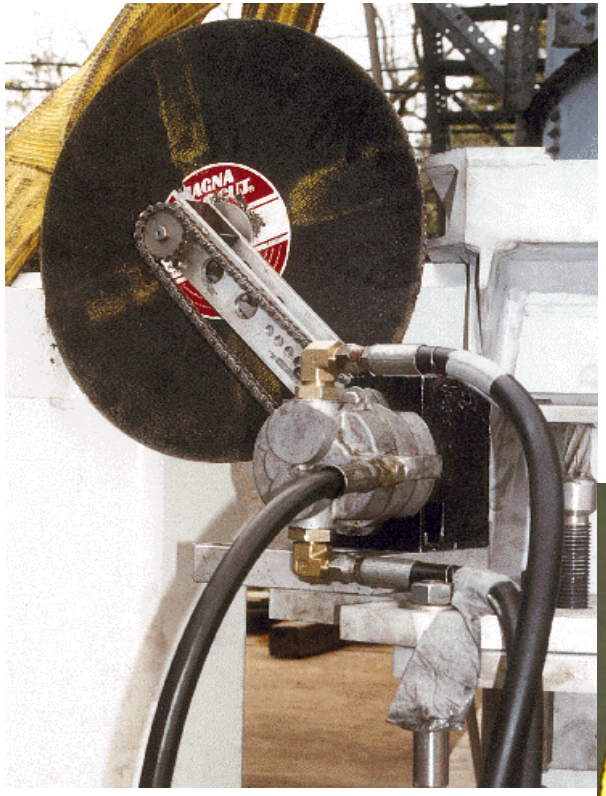

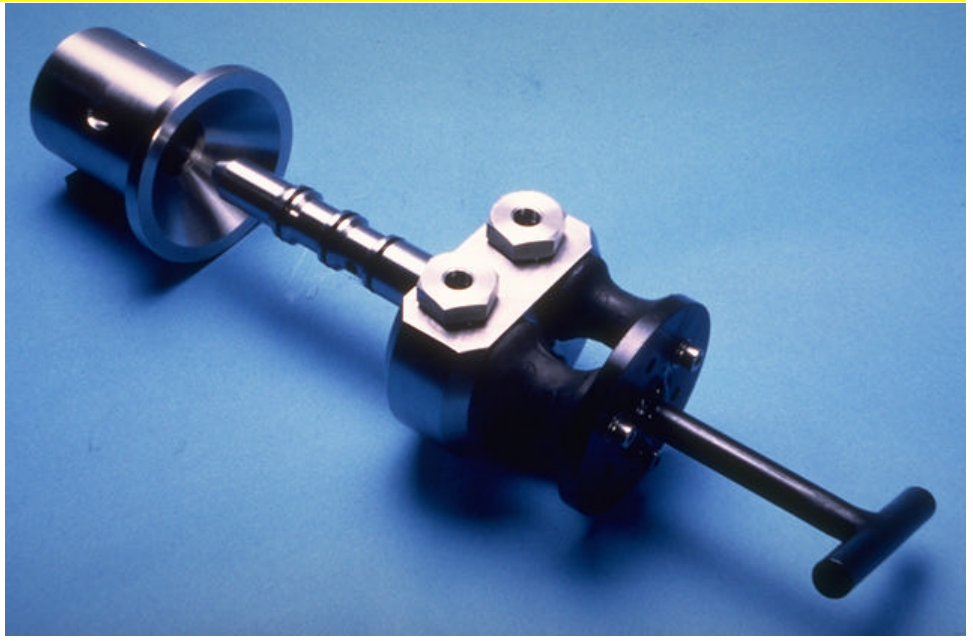

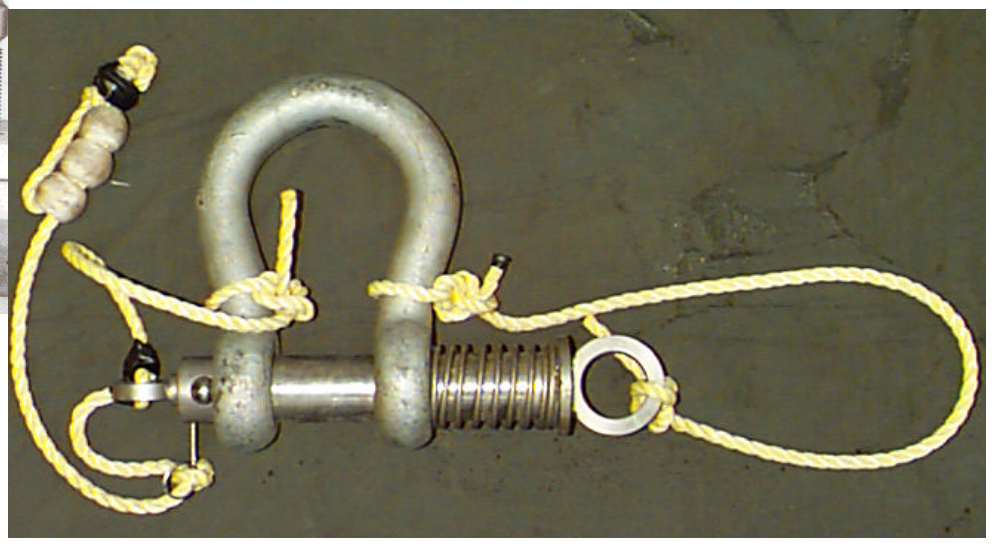

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Example of ROV operation

Tapping operation: cutting a 700 mm dia hole through a steel plate on a sunken vessel and fitting a valve on it

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Specially developed machines

In some cases special machines are designed and built on purpose, to carry out specific jobs which are not within ROV capabilities

One example follows: Beluga

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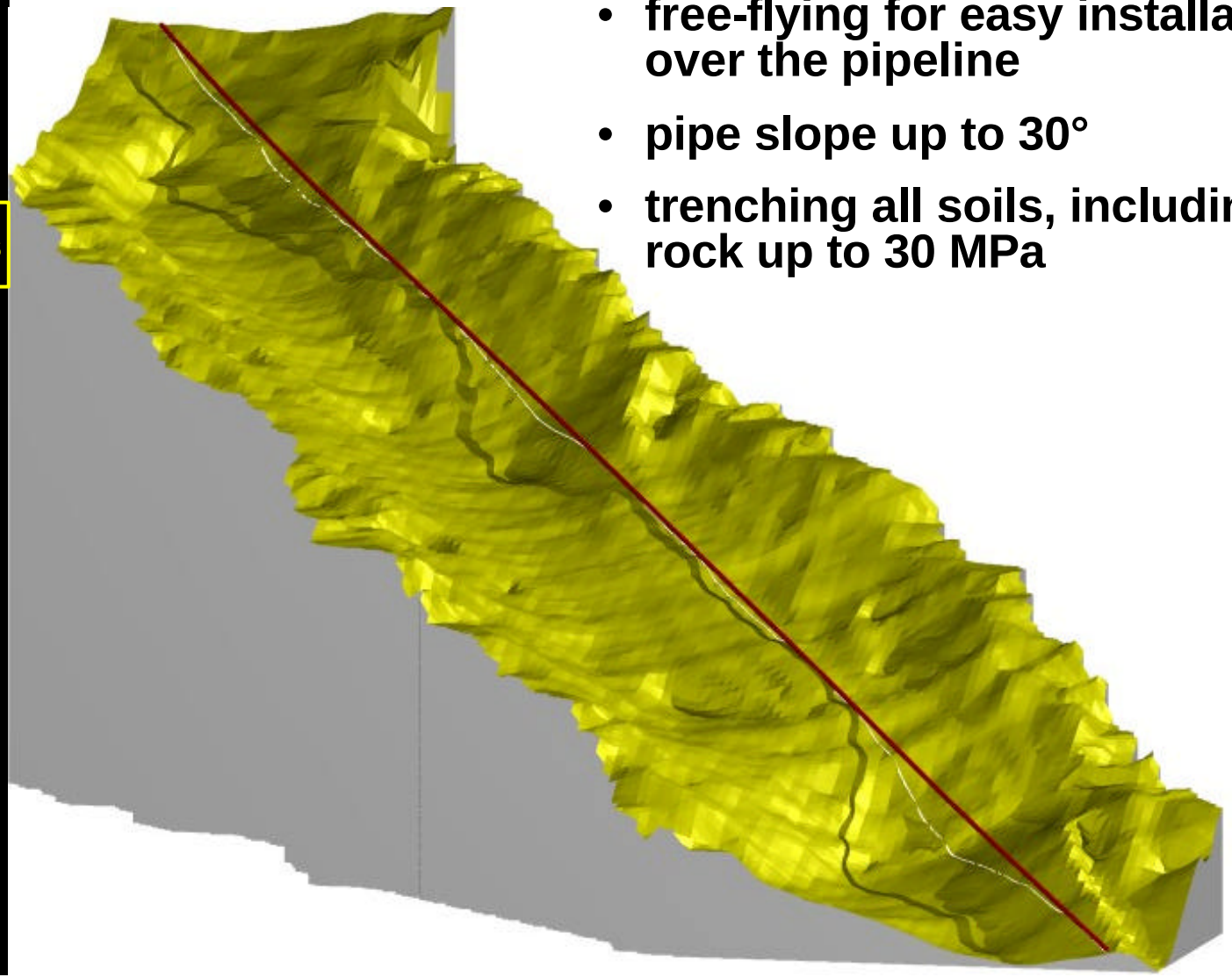
Mission requirement: pipeline burial for free-span correction



- very deep water: up to 2,200 m
- free-flying for easy installation over the pipeline
- pipe slope up to 30°
- trenching all soils, including rock up to 30 MPa

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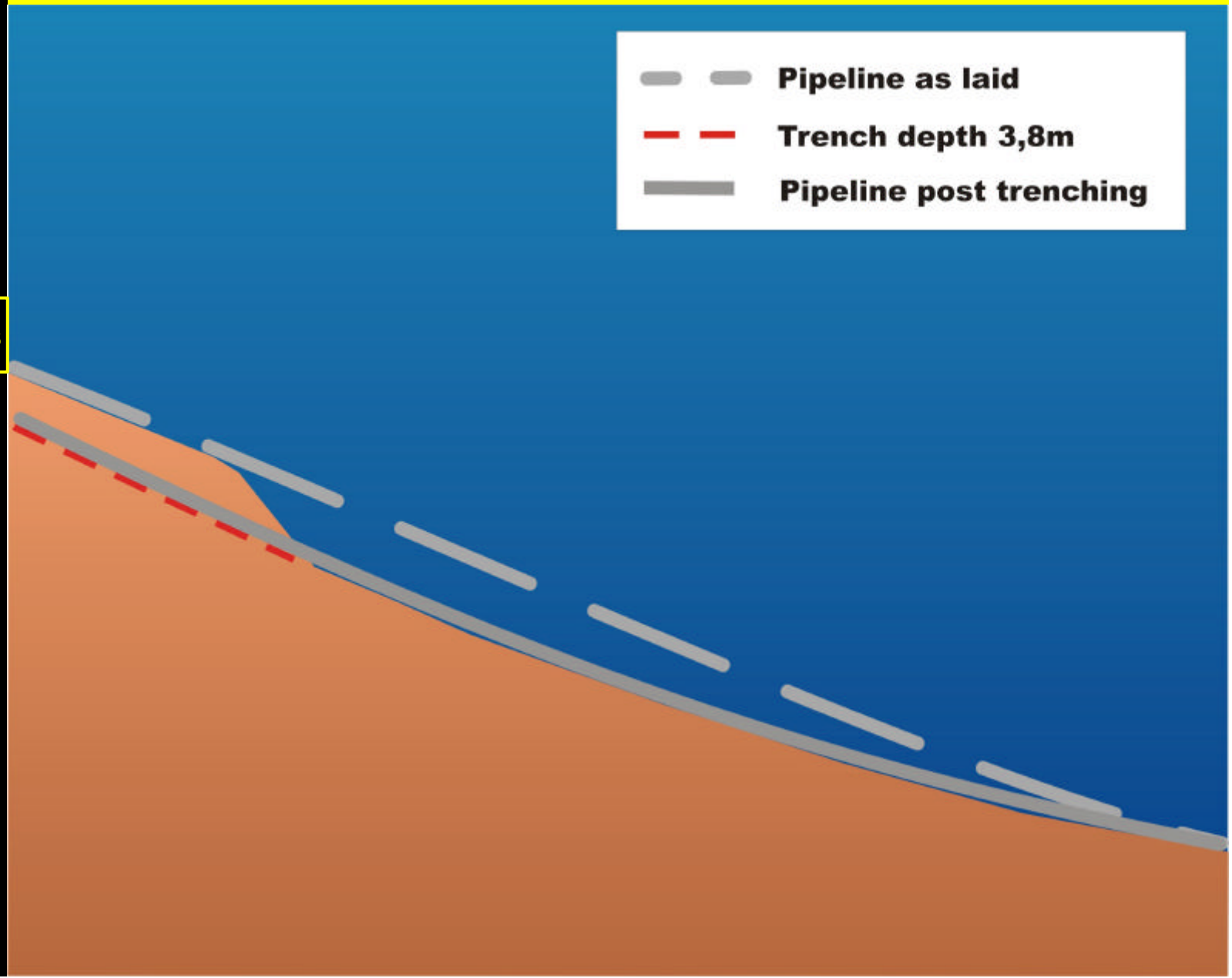
Mission requirement: pipeline burial for free-span correction



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Beluga

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Beluga

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Beluga main data

max water depth	rated 2200 mwd
pipeline size	24”, adjustable for other sizes
weight in air	38 tonnes
free-flying	8 thrusters @ 8 kN each
dimensions (L x W x H,m)	8 x 2.5 x 4.5
total power on vehicle	2 x 280 kW @ 4.2 kV
trenching by	2 cutting discs for variable trench profile
suction by	2 pumps rated 1000 m3/h each
trench size	max 1.5 m one pass, capable of multipass and trench widening

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Beluga

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animation to show how Beluga works

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Subsea tool multi-tasking

This mode of operation consists of making use of ROVs and interfacing them with specially developed machines, to carry out specific tasks

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Subsea tool multi-tasking

- individual special machines are developed to perform specific operations
- these machines are operated through ROVs, by using their power, which is transferred through hydraulic wet-mateable connectors
- control is either performed through ROVs (for simple cases) or from a surface separate control station. In both cases the link to surface is through the ROV umbilical.
- wet mateable connector systems to transfer hydraulic power and electric power/signal have been successfully developed and are the basis for extended use of multi-tasking

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Wet mateable connector plate

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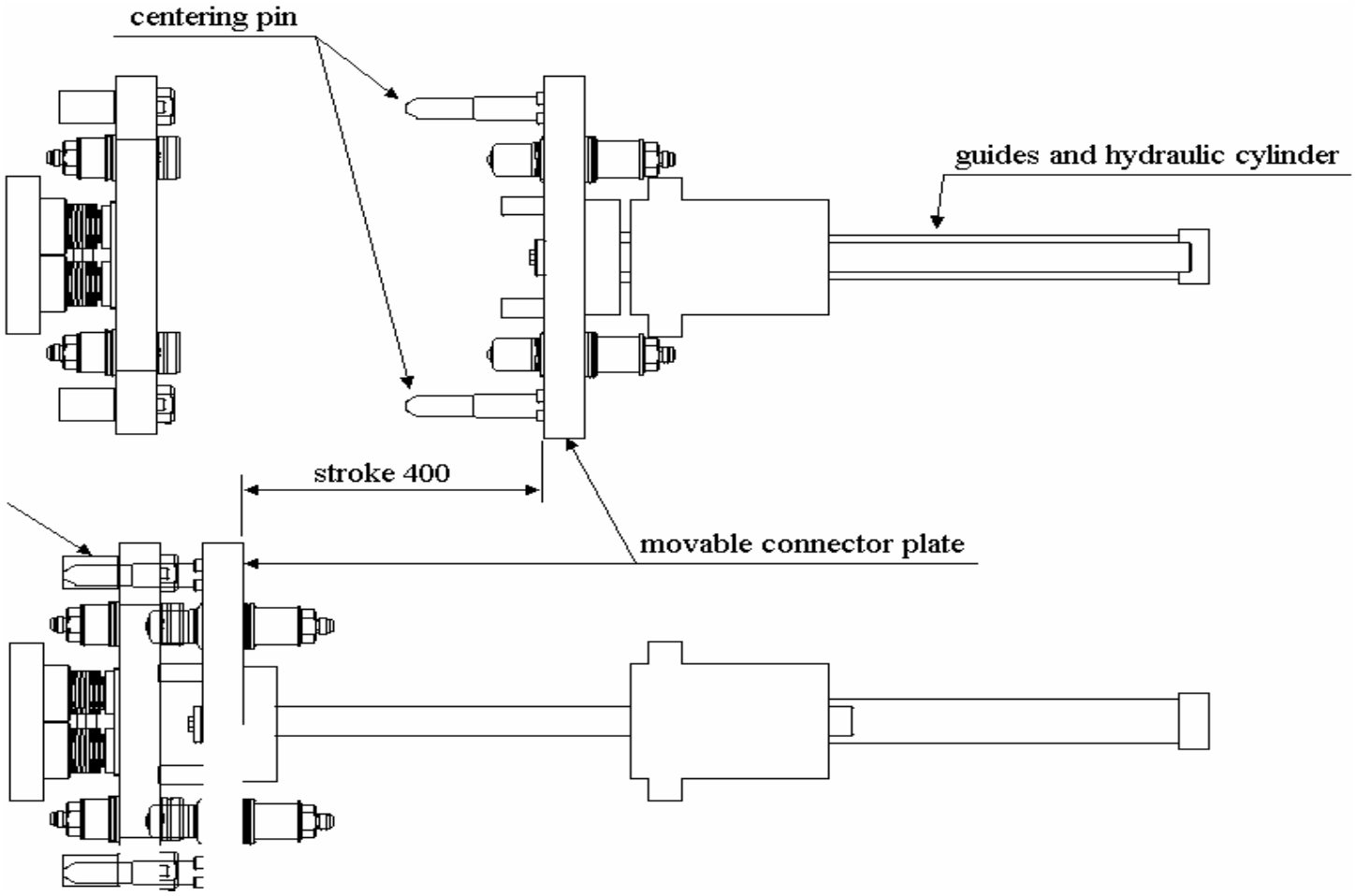

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Wet mateable connector plate: example (fixed part)

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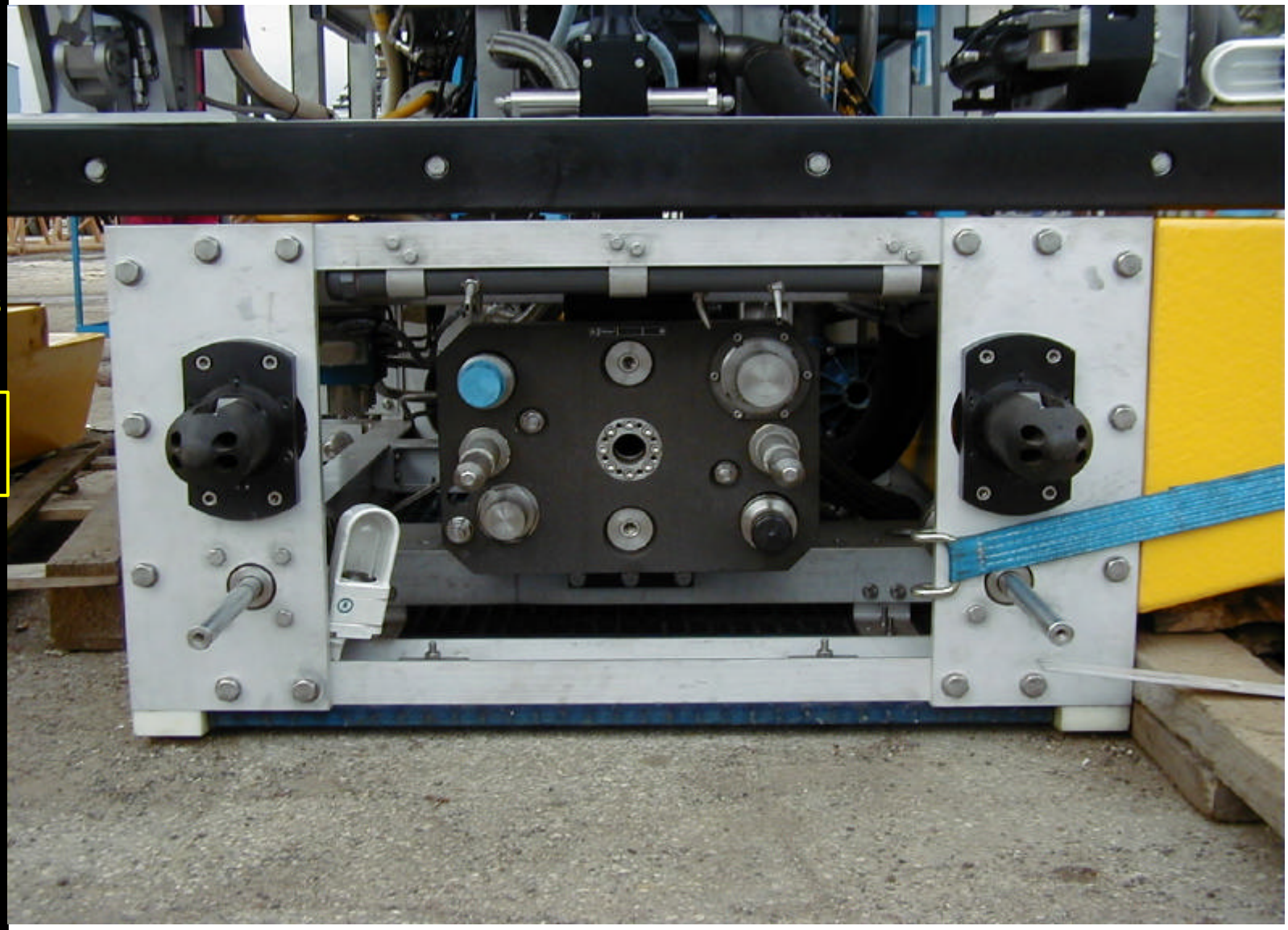
Wet mateable connector plate: example (moving part)



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ROV docking and mating over underwater user

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video to show connector mating

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Subsea tool multi-tasking: example from experience

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BRUTUS: an underwater system for pipeline tie-ins

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Conclusions

- present technology enables capabilities to deploy underwater systems to water depth up to 3000 m and more
- general purpose equipment to do operations in such water depths are available to the industry
- specific dedicated equipment, to be used in combination with available equipment, can be developed on the ground of established engineering methods
- high level equipment engineering and operation engineering are required. Both of them are within capabilities of the offshore industry today.