

Specification of a 6,000 m work class ROV and LARS

1. Introduction

NWO-NIOZ Royal Netherlands Institute for Sea Research is the national oceanographic institute and performs and promotes academically excellent multidisciplinary fundamental and frontier applied marine research addressing important scientific and societal questions pertinent to the functioning of oceans and seas. NIOZ serves as national marine research facilitator (NMF) for The Netherlands scientific community. This tender aims at the purchase of a work class Remote Operated Vehicle (ROV) allowing full ocean depth (6,000m) operations. In addition to the ROV itself this tender includes a Launch and Recovery System (LARS), winch, control container and an additional control room as well as the scientific spread needed for ROV operations. This document describes the ROV itself, its components and operational capacities.

2. Abbreviations

Abbreviation	Definition
2D	Two-dimensional
7F	Seven Function
AC	Alternating Current
ADCP	Acoustic Doppler Current Profiler
AFT	Stern of rear side
AISI	American Iron and Steel Institute
b/w	Black and White
CPU	Central Processing Unit
CRI	Color Rendering Index
DC	Direct Current
DNVGL	Det Norske Veritas (DNV) and Germanischer Lloyd (GL).
DVL	Doppler Velocity Log
EMC	Electromagnetic Compatibility
EU	European Union
FAT	Factory Acceptance Test
FTP	File Transfer Protocol
FWD	Forward side
GPS	Global Positioning System
HD	High Definition
HiPAP	High Precision Acoustic Positioning
HMI	Human-Machine Interface
HPU	Hydraulic Power Unit
ILO	International Labour Organisation
INS	Inertial Navigation Systems
IP	Ingress Protection
ISO	International Organization for Standardization
JIC	Joint Industry Council
KVM	Keyboard Video Mouse
LARS	Launch And Recovery System

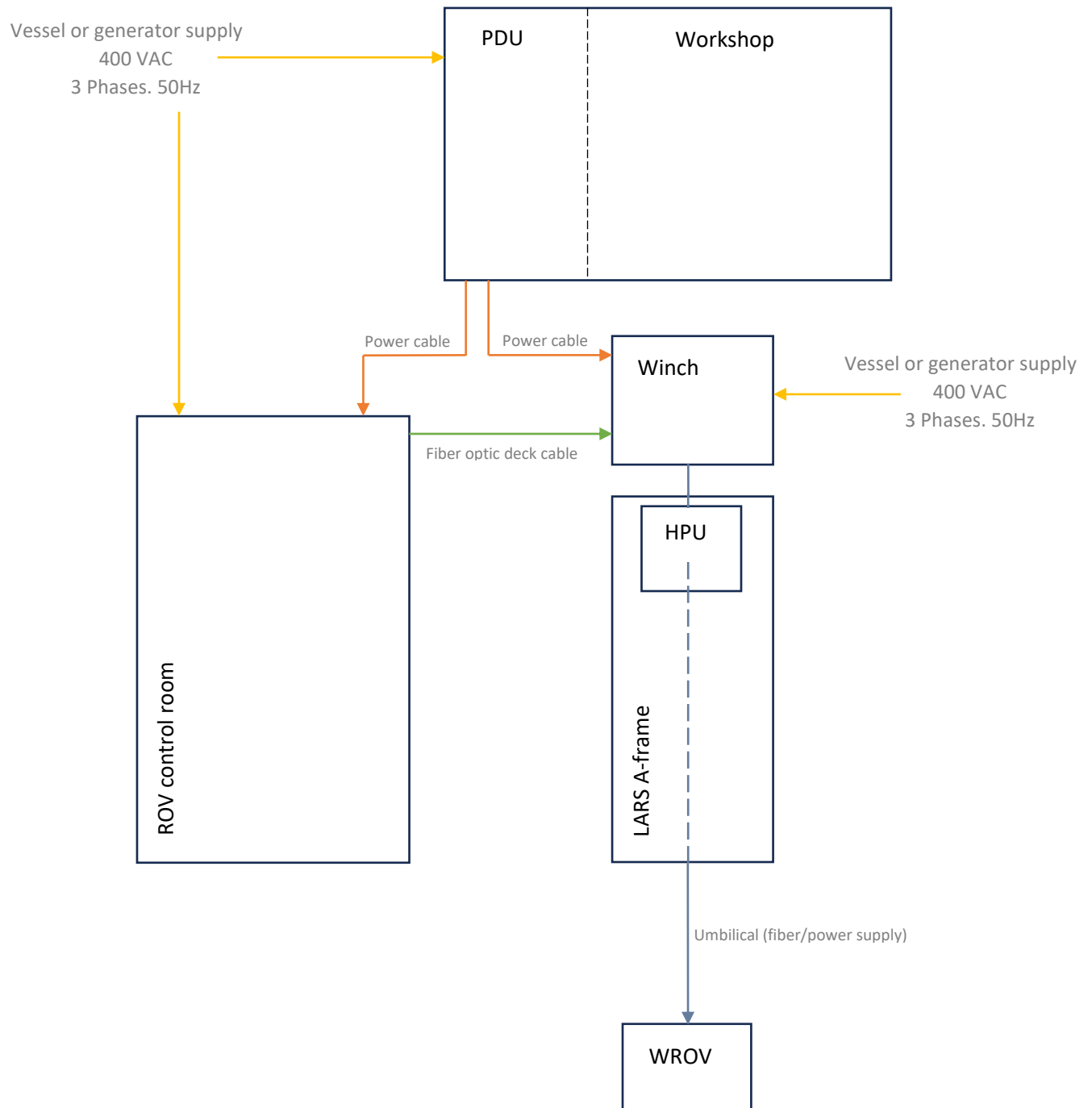
LED	Light-Emitting Diode
MED	Marine Equipment Directive
MSW	Meter sea water
NIOZ	Koninklijk Nederlands Instituut voor Onderzoek der Zee
NMF	Marine Research Facilitator
NWO-I	Stichting Nederlandse Wetenschappelijk Onderzoek Instituten
PDU	Power Distribution Unit
PC	Personal Computer
PLC	Programmable Logic Controller
P&T	Pan and Tilt
PoE	Power over Ethernet
PTC	Positive Temperature Coefficient
RAL	Reichs-Ausschuß für Lieferbedingungen und Gütesicherung – standardized colour system.
ROV	Remote Operated Vehicle
RV	Research Vessel
SA	Abrasive blast cleaning standard
SAT	Sea Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SD	Standard Definition or Secure Digital
ST	Standard
SWL	Safe Working Load
TCU	Thruster Control Unit
TMS	Tether Management System
TTL	Transistor-Transistor Logic
UHF	Ultra-High Frequency
UPS	Uninterruptible Power Supply
USBL	Ultra-Short Base Line
UTP	Unshielded Twisted Pair
VAT	Value Added Tax
VAC	Volts Alternating Current
VDC	Volts Direct Current
VHF	Very High Frequency

Standard	Definition
DNV-ST-E271 2.7-1	Offshore containers, edition 2021-10 - Amended 2023-03 This standard (ST) applies for transport related requirements for offshore containers with respect to design, manufacture, testing, certification, marking and periodic inspection.
DNVGL-ST-0378	Offshore and platform lifting appliances, edition 2019-07 - Amended 2021-10 This standard provides requirements for certification and verification of cranes intended for load handling outside vessel while at sea (offshore cranes), and load handling onboard offshore units/installations (platform cranes).
DNV-OS-D201	Offshore standards, electrical installations, Edition July 2022. This offshore standard provides principles, technical requirements and guidance for design, manufacturing, and installation of electrical installations on mobile offshore units and floating offshore installations.

3. Application and intended use

The ROV will be used to perform marine research in seas, oceans, fjords and possibly lakes. Deployments can vary between several hours up to 24 hours and preferably more. The ROV will be used from the NIOZ research vessel Anna Weber-van Bosse, currently under construction, but will also be used on other comparable research vessels.

4. Simplified ROV system lay-out



5. Work Class ROV with a depth rating of 6,000 m

General purpose hydraulic work class ROV, having a compact and integrated mechanical architecture, powerful and accessible hydraulic functions and a user-friendly real-time control system. The ROV will be a free flying ROV without a TMS.

The depth rating of all options and sensors will at least have a similar depth (6,000 m) rating as the ROV.

5.1. General system requirements

General	
i.	Tenderer will operate an ISO 9001 certified quality assurance system, or will operate a solid quality assurance system of its own.
ii.	All containers, LARS A-frame, winch etc. to be equipped with earthing cables.
iii.	Interference-free operation is essential for all electronic equipment on board research vessels. The manufacturer will actively contribute to preventing EMC and EMI related malfunctions and must therefore at least comply with guidelines according to IEC 60533.

Lifting directives	
iv.	The containers need to meet DNVGL-ST-E271 (formerly DNV 2.7-1) standards, as well as being A60 rated.
v.	Certified lifting slings attached to the containers or supplied with the containers.
vi.	Certified lifting slings attached to the LARS A-frame and winch or supplied with the LARS A-frame and winch. Lifting devices are designed, tested and certified according to ILO. Compliance certificate issued by DNVGL. Lifting devices are frame, pad eyes and lifting sling.
vii.	The lift point arrangement includes an additional lift point for emergency recovery, i.e. allows for lifting the ROV without use of the termination bullet.
viii.	All lifting appliances load tested to minimum 2x SWL.
ix.	If tenderer conforms to alternative international agency standard, they need to address this in their bid for a compliance check by NIOZ.

Equipment (design) directives	
x.	For material and fabrication as well as design criteria the standard for offshore and platform lifting appliances DNVGL-ST-0378 will be used.
xi.	Electrical installations in compliance with the regulations relating to maritime electrical installations / DNV-OS-D201 Offshore standards, electrical installations, Edition July 2022.
xii.	All stress calculations are based on 4x SWL load cases.
xiii.	The manufacturer will comply with the 2014/90/EU directive for all equipment delivered.
xiv.	All equipment has to stay within “normal road transportable” dimensions.
xv.	If tenderer conforms to alternative international agency standard, they need to address this in their bid for a compliance check by NIOZ.

Paint and coating requirements				
xvi.	The containers, LARS A-frame and winch to be painted in the below defined colours and marked with appropriate logos which will be supplied by NIOZ.			
	All containers	RAL 9010 (commercial white)		
	LARS A-frame and winch	RAL 5017 (traffic blue)		
xvii.	Remove oil, grease, salt and other contaminants with a suitable detergent followed by fresh water. When the surface is dry: abrasive blast cleaning to SA2.5 (ISO 8501-1).			
xviii.	For the containers, LARS A-frame and winch Zinc Aluminium layer 85/158 using Schoop metal spraying will be applied.			
	Followed by:			
	1st layer	Hempadur 15553	RAL stand.	50 µm
	2nd layer	Hempaprime multi 500	RAL stand.	150 µm
	3rd layer	Hempaprime multi 500	RAL stand.	150 µm
	4th layer	Hempaxane 55030	RAL 9016	75 µm
	An equal quality coating system may be offered, after approval of NIOZ.			
xix.	The entire bottom side of the container will be coated using 200 µm Hempinol bitumen or equal, after blast cleaning for this Hempinol.			
xx.	The roof of the containers will be made anti-slip by adding Sikagrip, or equal, to the final layer.			
xxi.	The winch, the LARS and the containers will each be provided with a measurement report.			
xxii.	All layer thicknesses are regarded as minimum values.			

FAT – SAT	
xxiii.	FAT The tenderer shall host (at no additional cost) NIOZ technicians for factory acceptance testing of the ROV systems, manipulator systems, navigation systems and all other supplied systems and instruments. Standard FAT according to DNVGL's Standard, May 2016 or equal.
xxiv.	SAT The ROV will be tested over a period of 7 days (7 days are including mobilisation onto the vessel and demobilisation from the vessel. The transport to/from port of mobilisation/demobilisation is not included). The test location will be Porto (Portugal). The timing of the SAT to be agreed between Tenderer and NIOZ and is subject to vessel's expedition itinerary. The launch and recovery methods of the ROV using the LARS aboard the RV Anna Weber-van Bosse will be demonstrated during the sea acceptance test. The tenderer will submit a detailed test and time schedule for both FAT and SAT to NIOZ in advance for approval. All tests will be reported in an acceptance report for the ROV and all other supplied systems.

Training / technical support	
xxv.	Tenderer has to include an operational training for 6 NIOZ employees and maintenance training for another 6 NIOZ employees.
xxvi.	The SAT will also be used for training purposes.
xxvii.	24/7 technical helpdesk service will be available.
xxviii.	Tenderer to specify possible on-site trouble shooting possibilities and response time, location and day rates (in EURO).
xxix.	Tenderer to indicate if they have an ROV service centre in Europe. If so, where this centre is located.

Documentation	
xxx.	All systems have to be delivered with, at least: - One operational and technical manual (hard copy). - One fabrication record book (hard copy). - One electrical documentation record book / manual (hard copy). - Digital files have to be available of all documentation (delivered on portable data storage device, via an online portal, via a file sharing platform or FTP site). - All documents delivered in English.

5.2. ROV system

Minimum ROV requirements	
General	
i.	ROV system depth rated to at least 6,000 msw constructed of materials suitable to the subsea environment.
ii.	Dimensions: approximately 2,700 x 1,700 x 1,850 mm (L x W x H) + height of skid.
ROV performance	
iii.	Bollard Pull FWD/AFT at least 700 kg
iv.	Bollard Pull LATERAL at least 600 kg
v.	Bollard Pull Vertical UP at least 600 kg
vi.	Bollard Pull Vertical DOWN at least 650 kg
vii.	Speed FWD > 1.6 m/s
viii.	Speed LATERAL > 0.8 m/s
Thrusters	
ix.	Hydraulic driven and all with thruster guards.
Storage and operational environment	
x.	Equipment storage temperature -20 °C to +70 °C
xi.	Equipment operation temperature in air 0 °C to +45 °C

xii.	Equipment operation temperature in seawater -5 °C to +32 °C
Auto functions / accuracy	
xiii.	Required automated functions: auto-heading, auto-depth, station keeping and mid-water station keeping.
xiv.	Heading +/- 1° Pitch +/- 1° Roll +/- 1° Altitude +/- 100 mm Depth +/- 75 mm Auto Pos +/- 100 mm (limited by sensors used) Auto Track +/- 100 mm (limited by sensors used)
Trim function range	
xv.	Pitch +/- 10° Roll +/- 10°
Mechanical interfaces	
xvi.	Four docking receptacles underneath the ROV.
Payload	
xvii.	250 kg with manipulators, standard sensors, cameras, lights and P&T installed.
xviii.	ROV fitted with minimum 250 kg lead ballast in place of payload to always ensure a stable platform.
Lifting	
xix.	The lift-point is manual movable to accommodate for in-air trimming.
xx.	Through frame lift capacity: 3,000 kg.

5.3. ROV hydraulic system

ROV Hydraulic system	
General	
i.	The Remotely Operated Vehicle (ROV) will be fitted with two hydraulic systems. In this setup, two distinct pumps are operated by a single electric motor. This configuration is intended to separate the hydraulic circuit that powers the thruster motors from the auxiliary system. The main hydraulic system is specifically for controlling the thrusters, while the auxiliary hydraulic system is meant to provide power to additional equipment. All user interfaces for this system are conveniently positioned for easy access. No separate tooling HPU is required.
Hydraulic power pack	
ii.	Tenderer is required to provide a hydraulic power pack that delivers adequate power for both the main hydraulic system, responsible for the thrusters, and the auxiliary hydraulic system, which powers all auxiliary equipment. Tenderer to specify in their bid the following details: - Hydraulic pump type, preferable Rexroth A10VSO 140 or equal. - Number of filters used and type of filters. The system needs to have at least two water absorbing filters with pressure sensing line connected to the monitoring system. One filter for the auxiliary system and one filter for the main system.
Thruster control unit	

iii.	The TCU is a remotely operated hydraulic manifold designed to regulate oil pressure to the thrusters. Tenderer to describe the system in detail in their bid.
iv.	The ROV is equipped with minimum: - 4 horizontal thrusters, SA300 or equal. - 3 vertical thrusters, SA300 or equal.
General function valve pack	
v.	There will be two general function valve packs, easily accessible in front of the ROV, one port and one starboard. Each general function valve pack will be fitted with the following features: 10 proportional directional valves / JIC connections (low flow valves (min 10 l/min @ 200 bar) proportional flow & pressure control).
Compensator	
vi.	The ROV will be equipped with compensators which compensate for variations in oil volume in the different hydraulic systems. Variations in oil volume will be monitored by an analogue linear sensor.
Reservoirs	
vii.	Two identical reservoirs, one for each hydraulic system. The reservoir compensates for variations in oil volume. Variations in oil volume are monitored by an analogue linear sensor.
Hydraulic fluid	
viii.	The ROV system will be delivered with hydraulic oil. Tenderer to specify the proposed oil and other oil options. The ROV system will be compatible with eco marine friendly 'green oil'.
Tubing & fittings	
ix.	User hose connection points are of JIC type or quick connectors.
x.	All tubing and fittings are made of stainless steel 316L.
Interfaces	
xi.	Connectors for deck HPU, reservoir and compensator fill points.
xii.	Interface for 7 function Atlas or equal manipulator on port side.
xiii.	Interface for 7 function, TITAN 4 or equal manipulator on starboard side.
Actuators	
xiv.	1x lower Pan & Tilt unit (for camera's). Electric P&T is preferred for the cameras.
xv.	1x upper Pan & Tilt unit (for camera's). Electric P&T is preferred for the cameras.
xvi.	2x tilt unit for in the light rack to accommodate lights. Tilt unit either electrical or hydraulic.
xvii.	2x tilt units for light in the ROV skid. Tilt unit either electrical or hydraulic.
Connections	
xiii.	For hydraulic connection of external project equipment, the following high flow valves are (minimum) available in addition to the two general function (low flow) valve packs and valves required to run 7F manipulators, camera tilts, light tilts and skid: - 4 high flow valves (90 l/min @ 200 bar) proportional flow & pressure control. - 1 full flow valve (200 l/min @ 200 bar). If Tenderer deviated from above minimum requirements, Tenderer to qualify the available hydraulic connection, the flow rate and pressure.

5.4. ROV electrical system

ROV electrical system	
General	
i.	The electrical system in the ROV will be used for the installed sensors, P&T, cameras and lights and tool skid. All power distributed to external users, such as lights, cameras and sensors can be switched on/off and isolated from topside. All power lines are protected by individual fuses. Tenderer must provide an electrical system that supplies ample power to all the specified equipment. Tenderer to specify the maximum input power of the full spread (as specified in this specification).
Light box	
ii.	A 10-port light control box with easy access in the front of the ROV provides 30A at 115 V/120 V total light power or higher.
Connectors	
iii.	The system has to have as minimum the follow connectors: - 10 video (6ip +4pal) - 18 survey (232,485,tll, 3x ethernet*) * Ethernet (1x phins,1xmultipbeam, 1 spare). By default, the ROV will provide 24 VDC, 48 VDC and 115 VAC.

5.5. ROV power system (PDU) and ROV workshop

ROV power system (PDU) and ROV workshop	
General The power distribution unit and ROV workshop will be combined in one 20 ft container. The PDU and workshop must be separate sections, divided by a wall with a door. The PDU will manage the incoming power and distribute the power within the ROV system. The PDU will contain voltage regulator; voltage regulation capabilities to ensure that the electrical components receive stable and consistent voltage levels, overcurrent protection and integrates sensors and instruments; facilitate the integration of these components by providing power distribution and control interfaces for them.	
Power input	
i.	System to operate from 50 Hz, three phase, 400 VAC (onshore one phase 230 VAC 16 A, 50 Hz). If needed frequency converter (50 Hz to 60 Hz) to be offered by tenderer.
ii.	Onshore power (230 VAC) is required to keep the UPS' charged, containers warm/cool, lights and computers operational.
PDU	
ii.	Two separate cabinets, one containing the necessary breakers, contactors, overload relays and signal transformers. The other cabinet serves as a termination and isolation point for all high voltage connections.
iii.	The PDU section is fully insulated and air conditioned.
iv.	Power output to be sufficient to power the ROV system at maximum depth, via LARS A-frame/winch.
v.	Local power monitoring requirements: - Voltage in.

	- Frequency in. - Phase detection (to be protected in case of wrong connection, alarm in the ROV control. Alarms to be logged on a server). - Contactors on/off status. - Insulation monitoring of all high voltage transformers secondary side.
vi.	Remote power monitoring and control requirements: - Insulation monitoring of all high voltage transformers secondary side. - Supply voltage/current/frequency/phase (400 VAC). - Breaker status (on/off/trip). - Contactors on/off status voltage and current for all ROV supply (high voltage side).
ROV Workshop	
vii.	The ROV workshop has to be equipped with an alarm and fire extinguishers. Additionally, it has to be feasible to connect the alarm system within the container to the warning system on the bridge of the vessel. Emergency lights have to stay on via an UPS.
viii.	Air conditioning unit for workshop (heating and cooling). Tenderer to define the air conditioning unit. Preferable the condenser unit outside the container with salt water resistant coating and paint and the air conditioning electrical parts in a control box inside the container.
ix.	Clear-com unit installed in ROV workshop.
x.	The container needs to have a second door or an emergency hatch.
xi.	Adequate workbenches and workstations provide space for assembling, disassembling, and working on ROV components and systems.
xii.	Adequate storage space for ROV components, spare parts, tools, equipment, and consumables ensures organization and accessibility. One separate chemical cabinet to store aerosols, paint cans, other chemicals. Cabinet will be yellow and preferable close to the door.
xiii.	Adequate cabinets for manuals, schematics, technical specifications, maintenance logs, and other documentation.
xiv.	Sufficient LED light in the ROV workshop, especially above the work bench to ensure safe working conditions. Above the work bench 750 lux (adjustable) and overall 500 lux (CRI >90).
xv.	Stainless steel breakout-box for internal connections. Breakout-box has to contain at least the following connections: 2x Clear-Com and 4x UTP.
xvi.	Full set of tools and equipment necessary for maintenance and repairs that may occur during operations, for in the ROV workshop. Tenderer to specify or confirm specifications of full set of tools.

5.6. Cameras, lights and lasers

Cameras	
i.	ROV shall be fitted with two (2) subsea HD colour cameras for general video capture and one (1) low light subsea monochrome camera for pilot navigation. Brackets and cabling to be included: - 1x upper P&T 4K colour camera. - 1x lower P&T unit with 4K colour camera and 1x b/w camera. Additional cameras on the system: - 1x docking b/w camera. - 1x aft colour camera.

	Note: where possible and options exist, IP cameras are preferred (IP camera with low lag: preferable < 100ms).
Lights	
ii.	ROV to be fitted with primary lighting: 6 + 6 LED lights for videography each giving at least 3,000 lumens of light. Lights with independent tilts in the light rack. All lights will be 115 V/120 V. Brackets and cabling must be included. Lights to be dimmable and controlled from the ROV control room.
iii.	The ROV will be equipped with 2 LED mud lights, one starboard and one portside, a docking LED light and aft camera LED light.
iv.	Additional lights as required or recommended by the offered camera systems vendors.
Lasers	
v.	Double beam green laser (with cables) for on the upper P&T 4K colour camera.
vi.	One second double beam green laser with cables.

5.7. ROV manipulators

ROV manipulators	
i.	Manipulator 1 is to be installed on the front starboard of the vehicle and shall consist of a 7 function manipulator arm. Manipulator 1 has to be a Schilling Robotics TITAN 4 or equal.
ii.	All joints of Schilling Robotics TITAN 4 or equal manipulator (with the optional exception of the jaw) shall include high resolution angular position sensor feedback.
iii.	Schilling Robotics TITAN 4 or equal manipulator shall have a full extension horizontal reach of at least 1500 mm and a lift capacity at full extension of at least 120 kg (in water).
iv.	Schilling Robotics TITAN 4 or equal shall have a parallel jaw gripper with maximum opening of at least 99 mm.
v.	Video signal for camera to be routed through manipulator slave controller (Schilling Robotics TITAN 4 or equal manipulator), via ROV to surface control room.
vi.	Manipulator 2 is to be installed on the front portside of the vehicle and shall consist of a 7-function manipulator arm Manipulator 2 have to be a Schilling Robotics ATLAS, or equal.
vii.	Schilling Robotics ATLAS or equal manipulator shall have a full extension horizontal reach of at least 1500 mm and a lift capacity at full extension of at least 245 kg (in water).
viii.	Schilling Robotics TITAN 4 or equal shall have a parallel jaw gripper with maximum opening of at least 175 mm.
ix.	Both manipulators shall be depth rated to at least 6,000 msw and be constructed of materials suitable for the subsea environment.
x.	All grippers to be compliant and mate readily with standardized tooling handles (T-bar, D-handle, Fishtail handle).
xi.	Manipulator will have full telemetry (joint positions as a minimum) from the arm available topside in digital signal format with full communications protocol documentation provided to facilitate break out to user systems.

xii.	Tenderer to provide technical support, documentation, serial protocols, schematics and all other necessary documentation support to facilitate user system integration as per points mentioned above.
xiii.	Schilling Robotics TITAN 4 wrist camera.

5.8. ROV control room

ROV control room	
The ROV control room hardware is to be installed into a 20' control container. Overall design philosophy: The control system will be a real time CPU based system where the main goal is to keep it simple to operate and understand, easy to fault find, but at the same time giving the advanced functionality that today's ROVs require in terms of interfaces and functions. The ROV control room must have a spacious and ergonomic layout and must, at least, meet the following requirements:	
Power input	
i.	System to operate from 50 Hz, three phase, 400 VAC (onshore one phase 230 VAC 16 A, 50 Hz). If needed frequency converter (50 Hz to 60 Hz) to be offered by tenderer.
ii.	Onshore power (230 VAC) is required to keep the UPS' charged, containers warm/cool, lights and computers operational.
General	
ii.	The ROV control room has to be equipped with an alarm and fire extinguishers. Additionally, it must be feasible to connect the alarm system within the container to the warning system on the bridge of the vessel. Emergency lights have to stay on via an UPS. Computer/navigation system to be fitted with an emergency system/UPS to power the ROV control computers and navigation instruments in the event of a full power loss for at least 10 minutes.
iii.	Air conditioning unit for control room (heating and cooling). Tenderer to define the air conditioning unit. Preferable the condenser unit outside the container with salt water resistant coating and paint and the air conditioning electrical parts in a control box inside the container.
iv.	Sufficient LED light in the ROV control (3000K LED CRI > 90). Light dimmers must be available in the control room.
v.	The container needs to have a second door or an emergency hatch.
vi.	System includes hand control units as the primary device for pilot control of ROV.
vii.	Main system SCADA/PLC control components.
viii.	The ROV control room shall have provision of status monitoring during operation, including, but not limited to earth fault detection and shut down system on high voltage, earth fault detection system on ROV low voltage system, electric/hydraulic motor voltage and current, hydraulic pressure, hours run indicator, ROV umbilical turns counters, depth readout, water ingress alarms, hydraulic compensation system, failure alarm system, diagnostic system, etc.
ix.	Provision to be made on ROV control room for power and signal cabling through sea/weather rated 'pass through' for connection of GPS antenna and IP camera and lights for viewing of deck on ROV control room roof.
x.	Stainless steel breakout-box on the outside of the ROV control room for 4x Clear-Com, 8x UTP RJ45, 4x video rj45 (PoE, for deck cameras).
xi.	Stainless steel breakout-box on the outside of the ROV control room for glass fibres connectors (6x ST connectors).
xii.	Deck lead / armoured cable to be provided for interconnection of ROV control room systems through sea/weather rated pass through to: Ship power (via PDU)

	and signal comms for connection to bridge, ship network and ship navigation instruments; winch (power and fibre passes) and LARS A-frame.
Video wall – monitors and computer systems	
xvi.	Video wall / ROV monitoring (HD) screens.
xvii.	Video wall / ROV monitoring screens to be positioned on the short side of the container.
xviii.	19" Distribution telecommunication and data racks.
xix.	Clear-Com main unit plus headset and RS-703 belt pack for use of system outside the control room and VHF/UHF unit.
xx.	ROV control room must be fitted with a digital video recording system and overlay system (Visualsoft or equal including visual overlay) for at least two 4K channels and one SD channel. The system must provide storage space for at least 24 hours recording (and the possibility to extend the storage space) per channel. KVM switch to supervisor desk to control video logger and administration PC (PC issued by NIOZ).
xxi.	Voice-over system (microphone, headphone, microphone stand, microphone shock mount if required, acoustic treatment system to reduce background noises, etc.).
xxii.	System computer and necessary interface boards.
xxiii.	Operator computers for graphic display of control software.
xxiv.	Telemetry system.
xxv.	Minimum 6 empty slots of 2U DIN in the 19" rack (expansion for survey kit must be possible).
xxvi.	Easily accessible cables routing behind the video wall / 19" racks.
ROV Pilot chairs / chairs additional personnel	
xxvii.	Two (2) identical pilot chairs (Recaro seat or equal) creating an ergonomic work position / chairs based with swivel and swivel lock. Possibility to sea fasten the chairs.
xxviii.	Each pilot station contains the main ROV control joystick, manipulators and tooling control joysticks, auto function control panel, touch screens, Clear-Com push bottoms, Clear-Com microphone and trackball mouse for PC interface.
xxix.	Three (3) additional work positions for scientists / supervisor with three in height adjustable office chairs. View from scientists' positions on videowall has to be unobstructed. Width supervisor desk to be approx. 1200 mm.
xxx.	Adequate cabinets for manuals, schematics, technical specifications, logs, and other documentation.

5.9. Auxiliary equipment and functionalities

Auxiliary equipment and functionalities	
i.	A forward-looking scanning sonar fitted as basic navigational aid for pilot. 2D multibeam imaging sonar, BlueView or equal.
ii.	A primary INS solution for ROV, iXblue Phins 6000 or equal.
iii.	2x Kongsberg HiPAP 502 USBL Cnode mini transponder. Transponder to be charged from a ROV's 24 V during operations. TTL signal from control room transponders, in responder mode.
iv.	A pressure/depth sensor (Digiquartz or equal) is to be supplied with mounting for installation on the frame of the vehicle and will be integrated with the primary INS.

	The pressure sensor is to measure absolute pressure and provide high accuracy 0.01%
v.	DVL, Teledyne workhorse navigator or equal, including ADCP capability.
vi.	Auto heading/depth/altitude.
vii.	Hands free navigation & station keeping. Including an automatic height above bottom control system and mid-water station keeping.
viii.	Hand control unit & graphical user interface.
ix.	Iridium beacon, Novatech iBCN or equal for asset tracking and recovery.
x.	ROV strobe/Flasher as emergency location devices.
xi.	Extra interfaces, power and data, for additional new sensors must be available. Tenderer to advise the number of extra interfaces.

5.10. *Scientific system*

Scientific system	
General	
i.	The ROV will be delivered with a skid for scientific purposes with hydraulic operated front drawer and a manual operated aft drawer. Height of the skid will be 480 mm. The drawers will have compartments for either bio boxes, push cores, samples, discharge points to let the water out of the boxes, etc. The skid will be delivered with a minimum of 100 kg lead ballast.
ii.	The skid contains the following features: - Port and starboard skid section. - 1x Front drawer. - Min. 2x LED light with independent tilt. - 1x b/w pencil camera in the skid. - 1x Hydraulic cylinder with 600 mm stroke.
iii.	In addition to the skid as described above, there will be open space in the ROV itself for storage of various project equipment (minimum 250L open space through the entire ROV). The areas for project equipment inside the ROV, on the port side and starboard side, will be shown in figures to be made by the tenderer.
iv.	Power and communication interface of the skid has to be easily accessible.

6. Umbilical

Umbilical	
i.	A torque balanced and steel armoured umbilical manufactured by Nexans, DeRegt or an umbilical of equal quality/specifications.
ii.	Max diameter: Ø 26 mm.
iii.	Total length: 6,600 m.
iv.	Depth rating 6,000 m.
v.	3 x copper power conductor, 10 mm ² , 4.5 kV; - DC resistance max: 2.0 Ω/km . - Colour coded insulation.
vi.	2 x copper power conductor, 1.5 mm ² , 3.3 kV: - DC resistance max: 13.4 Ω/km. - Colour coded insulation.
vii.	1 x separate tube for fibre optic elements: - 4 single mode fibres (9/125 µm): - o Attenuation @ 1,310nm < 0.6 dB/km. - o Attenuation @ 1,550nm < 0.4 dB/km. - In a stainless steel tube with filling gel. - Polypropylene sheath.
viii.	An alternative conductor and fibre optic setup may be proposed, after approval of NIOZ.
ix.	Armouring: - Galfan coated wires treated with a corrosion protective compound.
x.	Temperature rating during storage and operation: min. -20 °C, max. 70 °C.
xi.	ROV umbilical to provide enough tensile strength / lift capability to recover the unpowered ROV to sea surface.
xii.	The umbilical has to be suitable for the use of floats. Tenderer to specify the floats.
xiii.	Tenderer to indicate: - Umbilical outer diameter. - Weight in air. - Weight in seawater. - Minimum dynamic bending diameter, compliant with the umbilical winch. - Breaking strength. - Tension at conductor yield.

7. Umbilical winch

Winch	
ROV System to be supplied with an electrical ROV winch system to manage the umbilical from a control panel and remotely from ROV control room.	
Technical (general)	
i.	Winch to be fitted with a length of 6,600 m of steel armoured umbilical as specified in umbilical specification chapter. Self-contained all steel welded construction with drum, level wind and drive motors.
ii.	Winch to include necessary slip-ring passes (4) for the comms and power requirements of the ROV.
iii.	The winch has to be a front spooled level device.
iv.	A compact design of the winch is required resulting in a small footprint, low weight and easy to mobilize.
v.	A steel base with a maximum width, excluding fastening brackets, of 3,000 mm and a maximum height (in transport mode) of 4,000 mm.
vi.	Underneath the winch a drip/water tray must be installed.
vii.	The umbilical winch has to be fitted with an automatic lubrication system.
viii.	ROV winch to be fitted with level wind mechanism and an umbilical constant tension (CT) mode.
ix.	Winch to include necessary slipring passes for the electricity, fibres, comms and power requirements of the ROV.
x.	ROV winch to be fitted with: controls on side of winch; mobile controls allowing the winch operator to move on deck; remote winch controls capability from inside the ROV control room.
xi.	Umbilical winch to be fitted with internal and external cooling. NIOZ intention is to use the system from 200-6,000 m.
Performance	
viii.	Winch has to be equipped with a constant tensions system.
ix.	Minimum SWL of the winch 120 kN.
x.	With the umbilical diameter as specified the expected speed at 3,000 msw (middle layer on the winch drum) must be at least 1.1 m/s.
Construction	
x.	Electrical driven spooling gear. A stainless-steel encoder is placed on the level wind trapeze guiding spindle.
xi.	Spindle is driven by frequency-controlled motor and gear. Together with the encoder placed on the winch drum a PLC controls the cable spooling.
xii.	"Fail safe" disc-brake mounted on each motor.
xiii.	Sacrificial sea fastening clamps: 1 set of sea fastening clamps for welding to special bottom frame. Bolts for fastening brackets to winch foundation included.
xiv.	Lebus sleeves have to be installed on the umbilical winch.
Electrical system, components and control system	
xiv.	Main switch board: - Separate item in stainless steel AISI316L, IP56 for installation inside crash frame. - Cabinet equipped with special ventilation system. - Frequency converters for winch motor drives with encoder feedback card for closed loop vector control.

	- Frequency converters will be installed in separate part of the cabinet isolated from the PLC and rest of control system. - Frequency converter for level wind system. One PLC for winch control, and constant tensioning control. - Easy “on-site” recovery of PLC via provided SD card containing program backup. Backup is valid for the supplied winch, installation of the backup on other winches prohibited. - Level wind is controlled via PLC, programmed to suit actual cable diameter. - The PLC receives pulses from encoders placed on drum and level wind and thereby calculates the necessary movement of level wind to match the movement of the drum.
xv.	Brake resistor: - Separate unit in stainless steel AISI 304/316L for installation on winch. - Brake resistor air cooled, temperature monitoring in brake resistor with PT100 sensor, connected to alarm in control system. Temperature displayed in HMI. - Brake resistor divided in sections. Each section supports one frequency converter. Each section can easily be replaced in case of malfunction without affecting the other sections.
xvi.	Electrical drive motors: - Electrical motors 4 poled with brakes. - Cast iron motor and junction box for 400 V @50 Hz frequency-controlled operation 0-50 Hz. - IP56 - Forced cooling for low-speed operation 0 Hz. Anti-condensation heating 230 V. - 3 x PTC in winding. - Encoder for closed loop frequency control.
xvii.	Motor supervision: one PT100 sensor per frequency converter connected to alarm in control system. The sensor also controls the cooling fan on the motor. The start/stop temperature is adjustable. Read out of temperature in HMI.
xviii.	Motor redundancy: - Switches for emergency drive with fail on one of the main motors, electric brakes or frequency converters are placed inside the main electrical cabinet. - It is possible to operate the winch with one motor / frequency drive out of operation.
xix.	Safety on winch: - Protection around moving parts on winch. - Flashing lamp indicating remote control of winch, incl. 5m cable and magnetic foundation.
xx.	Constant tension “latched”: torque control. – When the ROV is latched to the A-frame and the (low tension) strain on the cable is relieved, it is possible to switch to low constant tension, and the winch will follow the movement of the A-frame. If the ROV drops out of the latch, the control system will detect the failure and switch to full torque, thereby preventing dropping of the stack.
xxi.	Joystick scale: to avoid the ROV to “tip over” because of too high launch speed, the launch speed can be adjusted from 50-100 % via the HMI.
xxii.	Ethernet: ethernet port on PLC and frequency converters. Enable remote reading and programming online, access provided by customer.

xxiii.	Main controls: stainless steel AISI316L, IP56 box for open deck location, including: - PLC operator panel in color touch screen with: Winch status, Set-up winch/level wind, Alarms. - All operation of the winch is on the touch screen, including handshake function for transferring command to remote control. - Joystick. - Emergency stop. - Cable 15 m. - Pedestal in stainless steel for deck mounting of control box. - HMI controlled feature at protected high user level for raising torque to 125%, intended for load testing of termination.
xxiv.	Heating: main switchboard, motors and junction boxes (if possible) are equipped with electrical heating. During storage, an external supply of 220 VAC, 50 Hz is needed to maintain the heat function.
Slip ring installation	
xxv.	The slip ring has to be capable of managing the pre-defined umbilical (including the number of fibres in the umbilical).

8. LARS A-frame

LARS A-frame	
The tenderer will suggest a launch and recovery method for the provided ROV utilizing the LARS A-frame from the NIOZ research vessel Anna Weber-van Bosse. The LARS A-frame must be compatible with the provided ROV system and has to feature a compact design, resulting in a small footprint, low weight, and ease of mobilization. The LARS has to, at least, meet the following requirements:	
Technical (general)	
i.	A steel base with a maximum width, excluding fastening brackets, of 2,500 mm and a maximum height (in transport mode) of 3,500 mm.
ii.	The LARS must be as compact as possible. A LARS which doesn't lift the ROV through the A-frame has therefore the preference e.g. a trolley system.
iii.	The LARS needs to be self-erecting (without additional support of e.g. the vessel's crane).
iv.	Minimum outreach to centre line of cable from edge of foundation bracket: 5,500 mm.
v.	The LARS is designed for the use of the ROV including the science skid.
vi.	In the maximum outreach position of the LARS the ROV including skid will be at least 2 m above the design water line of the RV Anna Weber-van Bosse.
vii.	All necessary spooling, sheaves and lock latches to operate LARS with the ROV. Tenderer to specify offerings in detail.
viii.	LARS to be equipped with an automatic lubrication system.
ix.	All additional required and recommended safety equipment for operation of the LARS such as lights, barriers etc. Tenderer to specify offerings in detail.
x.	Sea fastening clamps: 1 set off sea fastening clamps for welding to deck. Bolts for fastening and sacrificial brackets to A-Frame foundation included.
xi.	Working area: grated floor panels complete with oil drip tray in working/docking area.
xii.	Working area: free from trip hazards, gaps in the structures must be closed and high-power connections or high-pressure hoses have to be protected, at all times.

xiii.	All painted surfaces subjected to foot traffic have non-slip finish.
xiv.	LARS controls offerings as per industry standard. Relayed status of LARS and controls into ROV control room. Tenderer to specify offerings in detail.
xv.	Floodlight system on LARS A-frame legs (preferable LED lights).
xvi.	Control panel with necessary relief valves, check valves and control valves for local control of all LARS A-frame functions.
xvii.	Connection hoses of 10 m long between control panel and LARS A-frame.
xviii.	Docking head unit is directly connected to the A-frame top bar.
xix.	The LARS has to be provided with a latch indicator (to confirm a successful docking/locking).
xx.	Detailed specification is required of full LARS system load path and deck loading under static conditions and including specification of and performance under the maximum permissible significant wave height and wave period.
xxi.	All connections which need to be connected/disconnected during mobilisations/demobilisations have to be quick connectors (excluding high power connections).
xxii.	A remote-control system (via belly box) for the LARS and winch operations. Tenderer to specify offerings in detail.
Hydraulics	
xxiii.	Hydraulic A-Frame (rated for lifting beyond maximum loading of offered ROV in maximum operating sea conditions). Exact maximum design dynamic loadings of LARS to be provided by tenderer
xxiv.	Main hydraulic cylinders: hydraulic cylinder for A-frame tilt with stainless steel piston rods and rotational flow divider. Hydraulic cylinders: hydraulic cylinders for docking head extension etc. with stainless piston rods and bearings.
xxv.	Hydraulic hoses will be MED certified.
xxvi.	Hydraulic control panel and HPU preferably to be integrated in the A-frame.
xxvii.	If required connection hoses of 10 m long between the control panel and the HPU
xxviii.	Transit crash frame to protect the winch and HPU, if required.
Power input	
xxix.	LARS hydraulic power supply integrated into LARS base, to operate from 50 Hz, three phase, 400 VAC. If needed frequency converter (50 Hz to 60 Hz) to be offered by tenderer.
xxx.	All necessary armoured deck leads to operate LARS with the ROV. Tenderer to specify offerings in detail.
xxxi.	Motor cable, control cable, earthing, marking etc. according to DNVGL's Electrical Installations, July 2015 and offshore standard DNVGL-OS-D201.

9. Options

Options	
The tenderer is requested to provide a quotation for the following optional items as an option on the standard ROV spread as described in the sections above.	
Training	
i.	An ROV simulation program will be quoted as option. The ROV simulation program has to provide standard functionality for the offered ROV equipment and allow accurate simulation of the equipment in a subsea environment in free space (no operations within structures or confined space are expected and therefore don't have to be simulated).
ROV control room	
ii.	The ROV will support remote 'over the horizon' control functionality will be quoted as an option. Onshore control will give access to "everything" and works in parallel with the local control.
iii.	An additional multiplexer to fibre for a separate survey network will be quoted as option.
Video wall – monitors and computer systems	
iv.	Video wall / ROV monitoring (HD) screens with touch screens.
ROV Pilot chairs / chairs additional personnel	
v.	Electrical controlled seat position adjustment of the two pilot chairs (Recaro seat or equal).
Scientific equipment	
vi.	Multibeam echosounder, 400 kHz, Teledyne Reson T20-S
vii.	Sound Velocity Meter, Valeport or equal
viii.	EdgeTech 2205 Dual Frequency Side Scan Sonar 600/1,600 kHz, DISCOVER Playback & J-STAR Maintenance Software.
ix.	Suction sampler and carousel. The Suction Sampler consists of the following main components: - Suction hose with suction nozzle and ROV handle. - A suction pump. - Separator head where the samples are separated from the water flow and into the sampling bucket. - Carousel with room for 8 off sampling buckets. - A motor for operation of the carousel. - Carousel support structure designed for easy removal of the entire carousel out of (the aft) of the ROV skid. No disconnection of hoses are required to remove carousel. - 8 sampling buckets of at least 3 litres. One camera for visual control of the carousel rotation and monitoring of the sampling bucket to be filled.
x.	Option: 3 Bio boxes - The bio box has cubic shape with dimensions of appr. 300 x 300 x 300 mm. - The bio box has an almost water sealed construction. - The bio box is equipped with a drain plug.
LARS A-frame	

xi.	Options must be offered on any additional subsystems, which the tenderer feels would add value or enhance safety and performance. Tenderer to specify offerings in detail.
xii.	An accurate load sensor for measuring the umbilical load during deployment.
Spares	
xiii.	A spare parts and consumables kit, for 2-year operation based on 2 months deployment /year; - An advised spare parts & consumables list including item prices will be included. The spare part and consumables have to be supplied for the complete system (ROV incl. auxiliary pump, main pump, sensors, thrusters, main electro motor, tools & skid), LARS A-frame, umbilical winch incl. umbilical, ROV Control Room and the PDU/workshop).
xiv.	Tenderer to advise on lead time for spares and consumables.

10. Miscellaneous

Miscellaneous	
The complete ROV system including LARS, umbilical winch, control room, PDU and workshop container, etc. have to be fully ready for operation.	

11. Warranty

The standard warranty period is one year after successful delivery and acceptance of the ROV.

The warranty will comprise:

- Repair or replacement of defective components. Please indicate respond time including delivery of component(s) to a location in Europe.
- Technical support service (phone/email) for assistance in solving problems during operation of the ROV.
- Software maintenance and new software releases: the tenderer is required to provide information regarding software maintenance support and the release of new software after the warranty period. They have to specify the duration for which updates of the provided software will be shared with NIOZ and outline any associated costs after this period.

12. Quotation

All prices quoted must be all-inclusive (i.e. including but not being limited to shipping, packaging, delivery, ancillary costs and all other costs/expenses), be expressed in Euro only and exclusive of VAT. CIP transport to NIOZ in the Netherlands.

Tenderers must confirm that all prices quoted in the Tender will remain valid for six months commencing from the tender deadline.

The quotation shall specify the lead time for spares and consumables.

13. Additional information

A General Arrangement of the RV Anna Weber van Bosse can be requested at projects@nioz.nl. A mutually signed NDA agreement will be mandatory.