



**ALL OCEANS**  
MECHANICAL HANDLING UNDERWATER

# THE BLUE ECONOMY



**EFFICIENT ADAPTABLE TECHNOLOGY  
DO MORE WITH LESS  
= AC-ROV + MAC-ROV + Shuttle**

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# The MAC-ROV and the BLUE ECONOMY

Access all oceans with MAC-ROV systems. A ground breaking BLUE ECONOMY approach to underwater visualisation, discovery, work and recovery.

The Blue Economy is about developing more efficient and adaptable solutions that do more with less and the MAC-ROV and Shuttle systems have been developed to do just this.

## INTRODUCTION

The team behind it all is the same one to have established the AC-ROV as the class leading hand carry, 100m underwater inspection system, and the 3000m Fly-Out option for mounting to larger submersibles. This capability is complemented by decades of experience in the design and delivery of LARS and TMS with depth ratings up to and exceeding 6000m across all marine and underwater market sectors around the world.

Demand for an ROV bigger and deeper rated than the AC-ROV led to this development but not before some detailed analysis of what drives underwater vehicle selection. The question that the team asked themselves was; Given that ROVs are a fundamental access tool, how small can a capable, all depth, ROV access system be?

The essential access functions are; Deploy, Locate, Observe, Sample / Work and Recover. This identifies the ability to "Observe" as a stand-alone function. The same question also reinforces the fact that a "system" is much more than just an ROV.

Given all the skills and experience to develop complete all ocean access systems, the challenge then becomes how to do more with less. The experience with delivering Fly-Out ROV systems across a range of applications confirmed the benefits of having a highly mobile observation camera for overcoming the visualisation challenges faced by bigger work and survey class ROVs.

The MAC-ROV is a 4k and HD camera platform. A 500mm (20") cube shape with six degrees of freedom. The Shuttle is a flexible payload and mission driven deployment and recovery system allowing more to be done per dive. The Shuttle specified here is 1Te x 6000m (20,000 feet), and 1.5m x 1.2m x 1.3m high.

### Some Mission Specific Shuttle payloads:

**Artefact and Sample Recovery:** One MAC-ROV Fly-Out, a 7 function Schilling manipulator (Titan, Atlas or Orion), geology corer and a bathyswath.

**Cinematography:** Two MAC-ROV Fly-Outs, each configured with different lights and cameras, whilst the Shuttle supports additional cameras and high density mobile flood lighting. IE; 3 independently controllable platforms separating lighting from cameras.



## OPERATIONAL SYSTEMS

- Surface deployed tethered Systems to 300m
- Surface deployed TMS Systems to 1000m
- Host mounted Fly-Out Systems to 6000m
- Complete Mission Driven Shuttle Systems to 6000m (separates or containerised)

## TRANSPORT AND SUPPORT

- 1.5Te Trailer (Tow and Throw) to 300m. 200 – 380kg x 5kw
- 6m (20 foot) or bigger boat. Systems to 300m. 200 - 300kg x 5kw
- 12m (40 foot) or bigger boat. TMS Systems to 1000m. 3Te x 35kw
- 24m (80 foot) or bigger boat. Shuttle System as separates to 6000m. 6Te x 25kw
- 36m (120 foot) or bigger vessel. Single lift containerised Shuttle systems to 6000m. 10Te x 25kw. Integrated into 20 foot DNV GL 2.7-1 to 6000m. 14Te x 25kw

## MAC-ROV

### DIMENSIONS / STRUCTURE

- Size:** 500mm (20") cube
- Weight:** 90kg (200 lbs) in air
- Operating Depth:** 6000m or less (20,000 feet) - See additional data
- Payload:** 17kg (38lbs)
- Structure:** Full displacement, low drag and snag free shape. Multiple thread inserts for option mounting

### PROPULSION / MOBILITY

- Thrusters:** 8 twin prop, torque balanced, ducted thrusters. Brushless DC drive, rim driven, open centre, magnetically coupled FFPB. 4 vector horizontal and 4 vertical
- Speed:** 3 knots lateral / 23.2kg (50 lbs) thrust. 2 knots vertical / 17.2kg (38 lbs) thrust
- Mobility:** Full six degrees of freedom with get home redundancy

### BUOYANCY / BALLAST

Overall shape defined by 3 layers of bolt together syntactic buoyancy sandwiching the thruster pack and camera / electronics bottle. Variable ballast is mounted on two easy access side rails on the bottom block

### INSTRUMENTATION / TOOLS

- Cameras/Video/Lighting:** 4k fwd facing camera. 2 x HD fwd facing and 1 x HD rear facing cameras
- 4 x 1700 lumen camera tracking lights. 2 x fwd & 2 x rear. All lights dimmable 0 - 100%
- Instrumentation:** Heading, Gyro, Depth, low comp level, internal condition (temp and humidity), WI
- Navigation and tracking:** USBL (option), Sonar (option)
- Options:** Manipulator, thickness gauge, laser scaling, CP Probe, sediment sampler, wheels

### AUXILIARY POWER and INTERFACES

- 24vdc / 12vdc / 5vdc via multiple connection options and power to 36w
- 200vdc and power to 300w and connectors to suit
- Interfaces:** 1 x 1gb Eth / 10 x analogue OUT / 2 x dig.IN / 4 x analogue IN / 4 x RS232 / 2 x Canbus

### SUPPORT

**Tow and Throw / Live Boat Systems:** Complete systems to 300m available fully integrated into a 2.4 x 1.2m x 1500kg box trailer including weather proof control room, generator and davit. Easy installation to small boats.

**Power requirement:** 380 / 440vac, 3ph, 50/60 Hz, 5kw. Surface power unit and controls housed in 1 x 19" rack transport case incorporating PC, camera switching and solid state video recording.

**Controls and Monitors:** 1 x wireless single hand 3D flight controller. 1 x wireless, touch screen tablet incremental flight controller and system interface. 2 x 20" 4k monitors (main screen and 4 way split screen).

### ADDITIONAL DATA

- The MAC-ROV is a 6000m capable design and not a shallower system pushed deeper. This benefits shallower systems as it comes with the best in single mode fibre optic telemetry as standard allowing real time simultaneous 4k video, HD video and data transfer.
- Thrust and projected area relationship allows the MAC-ROV to turn and hold station in a current.

## MAC-ROV and TMS (FLY-OUT)

**Work Capabilities:** The MAC-ROV and its TMS must be mounted to a larger "Host" submersible or as payload on a Shuttle. Observation activities in support of the host in busy, congested and high risk environments.

**Buddy Operation:** Looking after the interests of the host, watching it's tether, providing a different perspective of an operation, monitoring transit movements in tight spaces, checking integrity of out of sight host hardware.

**Scout operation:** Flying in advance of the host to assess risks or advancing into areas that the host cannot reach or the risk is too great.

**Shuttle operation:** As above and more

### HOST SUPPORT

**System:** 250kg in air. 120kg in water (TMS and Tether and MAC-ROV, Electronics and PSU bottle, cables etc)

**Power Requirements:** 320/520 vac, 50/60Hz, 5kw OR 180/260vac, 1ph, 50/60 Hz, 3.5kw (reduced performance). Single mode fibre optic communications and control.

## SHUTTLE (1Te to 6000m)

Flexible Payload, Mission Driven Submersible complete with LARS

**Work Capabilities:** All that would normally need a Work Class ROV can now be mounted to a Shuttle. Operations that need the most mobility (visual monitoring) are carried out by a MAC-ROV Fly-Out. The Shuttle can be suspended and towed for wide area survey before being moved closer to any discoveries. At this stage the MAC-ROV can carry out closer visual inspection. Anything then determined as requiring physical intervention is done by landing the Shuttle at the target. The MAC-ROV will guide and land the Shuttle and then continue to provide buddy support.

**Operating Depth Options:** 1500m, 3000m, 4500m, 6000m

### DIMENSIONS / STRUCTURE

**Shuttle:** 1500mm x 1200mm x 1300mm high x 90kg open and passive frame. Higher options available

**LARS:** 3.5m outreach telescopic A-Frame. 2.2m square skid base with fold out platform and handrails

**Snubber:** Umbilical sheave, Load Latch, Rotate, Snug, Swing damping, tracking flood lights and cameras

**Control:** Full 7 function, single operator and wireless, providing complete "stand clear" launch and recovery

**Umbilical Winch:** Sized for up to 6500m of electro optical lifting umbilical with integral drive system

### POWER / PROPULSION

The Shuttle incorporates 3 off 5kw, 3ph power take-off points and a data and control interface node

Any single payload package would typically be limited to 5kw continuous

The Shuttle itself can be configured as a mobile platform with thrusters, and be fitted with cameras and lights. There are also options for changing its weight and buoyancy at depth.

### WEIGHTS

**Shuttle:** 100kg dry, 70kg wet

**MAC-ROV Fly-Out:** 250kg dry, 120kg wet (6000m)

**Bathyswath (6000m):** 50kg dry, 20kg wet

**7 Function Manipulator:** 100kg dry, 65kg wet and 250kg lifting @ 1.6m (6000m Atlas)

**General Shuttle Outfit:** 250kg dry, 150kg wet. (Power distribution, electronics etc 6000m)

**LARS:** 4800kg (A-Frame with Snubber, Umbilical winch, Umbilical and Power supply 6000m)

**Control Room Outfit:** 200kg

### SHIPBOARD SUPPORT

380/440vac, 50/60Hz, 25kw. Cooling water

Minimum deck space 6.1m x 2.44m (20 foot ISO Container) plus access space

### ADDITIONAL DATA

1. The LARS, Snubber, Winch and light weight lift umbilical are applicable to all depth ratings.