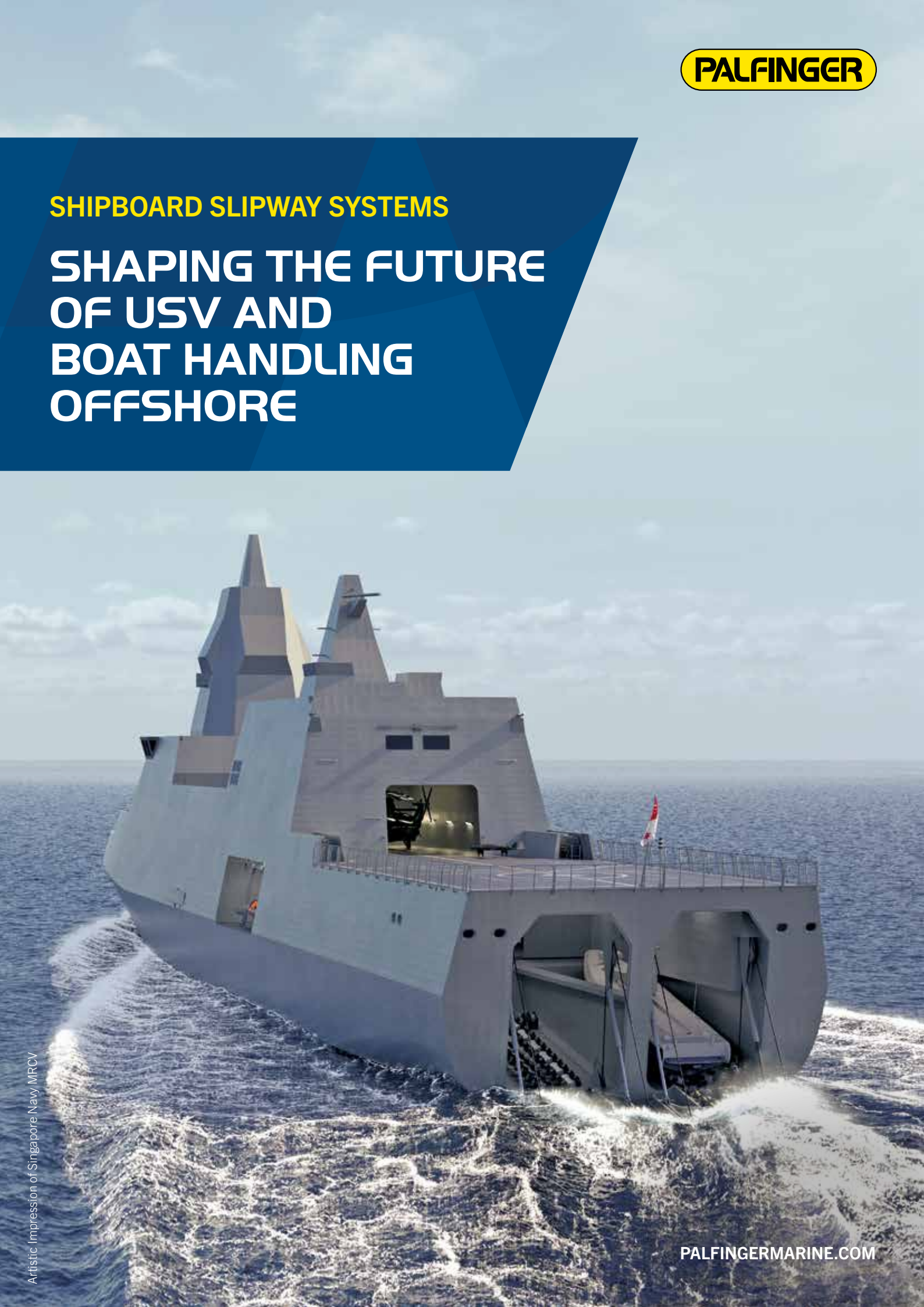
PALFINGER

SHIPBOARD SLIPWAY SYSTEMS

SHAPING THE FUTURE OF USV AND BOAT HANDLING OFFSHORE



Artistic Impression of Singapore Navy MRCV

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SLIPWAY SYSTEMS
OVERVIEW

PALFINGER IS SHAPING THE FUTURE OF USV AND BOAT HANDLING OFFSHORE.

Shipboard slipway and stern entry systems are one of the most interesting development fields in the Naval technology industry today and as an innovation leader within the industry, we at PALFINGER take pride in being at the forefront of this specific field.

Whether the watercraft is manned or unmanned, PALFINGER's Slipway Systems eliminate most of the typical challenges and risks related to launch and recovery of USV's and watercrafts offshore.

Innovative, customized and reliable Slipway Systems

- Slipway Systems with quad wheel-drive units
- Slipway Systems with single wheel-drive units
- Slipway Systems with boat cradle

Daughter Craft Range

- Patrol boats
- Rigid inflatable boats
- Fast rescue boats
- Crew transfer boats
- Work boats
- Daughter crafts
- Life boats
- Unmanned surface vehicles
- Underwater vehicles
- Autonomous water vehicles
- Special water vehicles
- Catamarans

Vessel Range

- Navy vessels
- Coast guard vessels
- Offshore vessels
- Expedition cruise vessels
- Offshore fish farm vessels and installations
- Wind farm service operation vessels
- Government and law enforcement vessels
- Special vessels and offshore installations

Application Range

- USV operations
- Patrol and interception
- Shuttle services
- Standby and rescue
- Oil recovery
- Lifeboat recovery
- Crew transfer
- Military operations
- Cruise expedition operations
- Operations on/off unmanned vessels
- Operation of unmanned water crafts

System Benefits

Safe operation:
PALFINGER MARINE's Slipway Systems eliminate the need for; lifting, hooking, mechanical connection or use of painter lines and arrester wires during LARS operations, significantly reducing the risk of dangerous situations and accidents occurring during launch and recovery of daughter crafts.

PALFINGER MARINE's Slipway Systems are designed for increased safety by implementing close guiding in all phases of launch/recovery. This reduces the risk of damage and accidents caused by collisions between daughter craft, mother vessel and handling equipment.

Regardless of whether the daughter craft is manned or not, PALFINGER MARINE's Slipway Systems eliminate the need for manual support or interaction from the boat crew during launch and recovery.

Crew and passenger comfort:
Launch and recovery operations with PALFINGER MARINE´s Slipway Systems are designed to be safe, comfortable and easy, even in harsh weather conditions.

The wheel-drive units ensure a very harmonic and "gentle" load distribution to the boat hull, which ensure a smooth and seamless transition in and out of the slipway. Launch and recovery by use of rubber drive wheels also protect the hull of the daughter craft and serves to extend its life-time.

Operational envelope, systems performance and speed
PALFINGER's Slipway Systems eliminate the need for complex tasks and highly coordinated efforts from multiple crew members during launch and recovery operations. This increases safety of operations as well as the operational weather envelope and speed of operations. PALFINGER's single-operator Slipway Systems are very easy and intuitive to use, enabling vessel personnel to become proficient operators in a short period of time.

Unmanned crafts:
PALFINGER MARINE's Slipway Systems can handle unmanned crafts such as Unmanned Surface Vehicles (USV's).

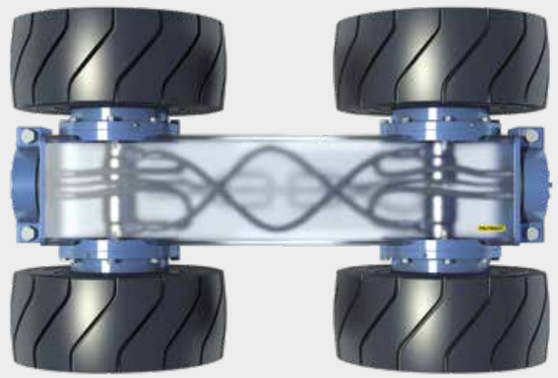
Versatility:
PALFINGER MARINE's Slipway Systems can handle crafts with different hull shape, propulsion system and weight. PALFINGER MARINE's Slipway Systems can handle multiple crafts and transfer crafts from the slipway to a stowage position on the mother vessel.

Rules and regulations:
Slipway Systems are normally not categorized as lifesaving equipment. As such, certification and inspections regime in accordance with SOLAS rules would normally not be applicable.
As the system eliminates the need for lifting of free-hanging loads, certification and inspections regime in accordance with rules for lifting appliances would normally not be applicable.

REFERENCE PROJECTS

VESSEL TYPE	SLIPWAY QTY
ERRV	1
PSV & Stand-By	1
Special Purpose	1
Rescue Support Ship	2
Expedition Cruise Vessel	2
Multirole Frigate	12
Oceangoing Patrol Vessel	4
Offshore Patrol Vessel	2
Littoral Mission Vessel	16
Fireboat	1
Fire/Rescue Command Boat	2
Fireboat / Command Boat	1
Multirole Combat Vessel	12

SLIPWAY SYSTEMS WITH QUAD WHEEL-DRIVE UNITS



GENERAL

The hydraulic powered, semi-automatic Slipway System consists of a number of wheel-drive units (quad units) in two (or multiple) rows that rotate on axes to automatically adapt the slipway to the hull shape of daughter craft during launch and recovery operations.

Daughter craft can engage the slipways at a range of speeds, up to 7 knots higher than the speed of the mother vessel with some systems. When a boat enters the slipway, the overrunning clutches allow free rotation of the wheels in the recovery direction until the boat speed and wheel-drive speeds match.

At that point the hydraulically powered wheel-drive units take over under single-operator control and dock the daughter craft safely inside the slipway. End stoppers automatically set the craft in parking and stowage positions and engage fail-safe brakes on the wheel-drives.

MAX. SEA STATE FOR SLIPWAY OPERATIONS

The structural strength of the system is high and is normally not the limiting factor. Test and operational use of PALFINGER MARINE's Slipway Systems have been performed in Sea States above 7 with the mother vessel steaming ahead at low speed.

Safe operations at high Sea States are highly dependent on:

- Mother vessel heading and speed
- Mother vessel responsiveness (RAO Profile)
- Waves and wind pattern
- Boat driver's skills

QUAD WHEEL-DRIVE UNITS	
Wheel-drive unit configuration:	4 wheels on each wheel-drive unit
Brakes:	1 for each wheel
Hydraulic motors:	1 for each wheel
Over-running clutches:	1 for each wheel
Number of quad wheel-drive units:	Depending on length of slipway
Length of quad wheel-drive units:	1526 mm
Width of quad wheel-drive units:	960 mm
Wheel diameter:	Ø 600 mm
Wheel-drive units tilt mechanism:	2 x Bearing arrangement
Wheel-drive unit tilt range:	+/-20°
Max. freewheel speed, inlet:	0-240 m/min (0-7 knots)
Max. freewheel speed, outlet:	0-35 m/min (0-1.1 knots)
Drive assist speed, in and out:	0-25 m/min (0-0.8 knots)
Max. depth for installation:	2 meter below water surface
Max. load, each wheel:	4 tons
Weight (each wheel-drive unit):	Approximately 725 kg

MODEL: PQBS

Slipway System with quad wheel-drive units

VARD 1 06 Platform Supply Vessel, used with permission from VARD

Configuration

- One pair of immersed quad wheel units on vessel transom/sill
- Requires immersed sill and foundations for first pair of quads
- Quad wheel-drive units on deck structure (slipway slope)

OPTIONS

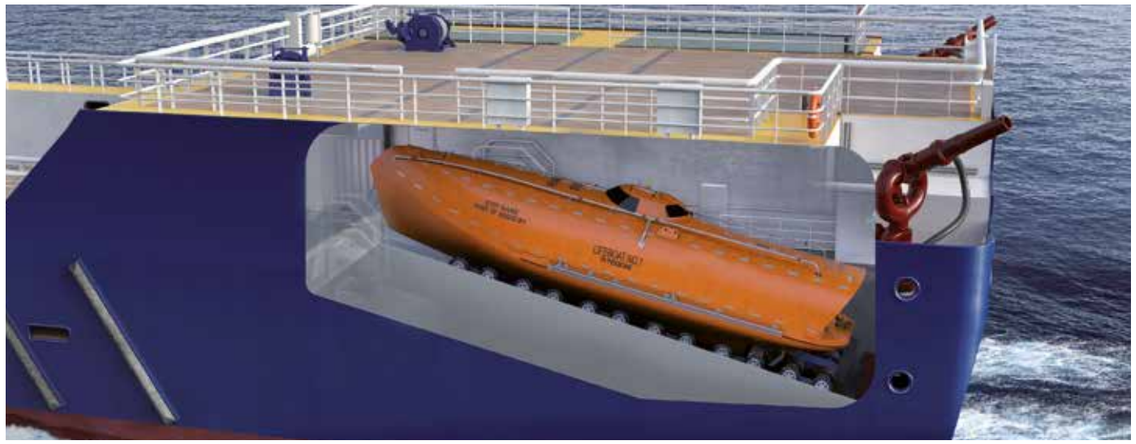
Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 30 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on vessel transom
Boat guiding system:	Tilting quad wheel units

Slipway with 12° slope angle

Quad wheel-drive units mounted directly on deck structure (slipway slope).



Suitable for lifeboat recovery operations

MODEL: PQBS-T

Slipway System with quad wheel-drive units

VARD 1 06 Platform Supply Vessel, used with permission from VARD

Configuration

- One pair of immersed quad wheel units on vessel transom/sill
- Requires immersed sill and foundations for first pair of quads
- Slipway cradle with quad wheel-drive units
- Tilt-mechanism for slipway cradle

OPTIONS

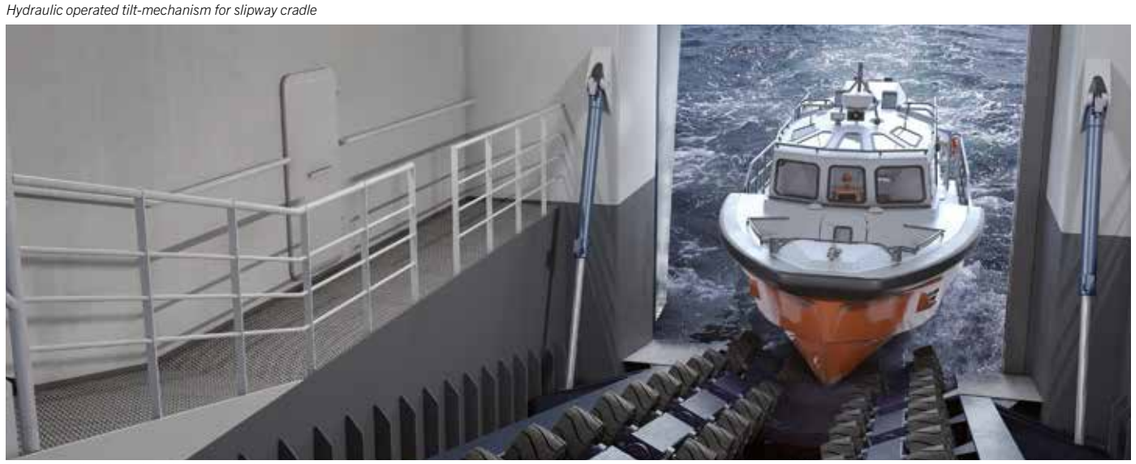
Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 30 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on vessel transom
Boat guiding system:	Tilting quad wheel units
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle movement:	Hydraulic operated cylinders

Slipway cradle with quad wheel-drive units

Hydraulic operated tilt-mechanism for slipway cradle



Slipway cradle in launch and recovery position

MODEL: PQBS-T-P TYPE 1

Slipway cradle and parking cradle with quad wheel-drive units

VARD 1 06 Platform Supply Vessel, used with permission from VARD

Configuration

- One pair of immersed quad wheel units on vessel transom/sill
- Requires immersed sill and foundations for first pair of quads
- Slipway cradle with quad wheel-drive units
- Tilt-mechanism for slipway cradle
- Parking cradle for additional boat

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch by accumulator
Emergency recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 30 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on vessel transom
Boat guiding system:	Tilting quad wheel units
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle movement:	Hydraulic operated cylinders
To/from parking position:	By quad wheel-drive units

Parking position for additional boat(s

Slipway cradle in launch and recovery position

Suitable for handling boats with different hull shapes, weights, COG's and propulsion systems

MODEL: PQBS-T-P TYPE 2

Slipway System with quad wheel-drive units

Boat #1 in launch/recovery position on slipway cradle

Boat #1 in elevated position on slipway cradle

Boat #1 in parking position on parking cradle and boat #2 in elevated parking position on slipway cradle

Boat #1 in parking position on parking cradle and boat #2 in launch/recovery position on slipway cradle

Configuration

- One pair of immersed quad wheel units on vessel transom/sill
- Requires immersed sill and foundations for first pair of quads
- Low-built slipway cradle with quad wheel-drive units
- Tilt-mechanism for slipway cradle
- Parking cradle for additional boat

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch by accumulator
Emergency recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 30 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on vessel transom
Boat guiding system:	Tilting quad wheel units
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle movement:	Hydraulic operated cylinders
To/from parking position:	By quad wheel-drive units

MODEL: PQBS-D

Slipway System with quad wheel-drive units

Configuration

- Slipway cradle with quad wheel-drive units
- Drive and support mechanism for slipway cradle

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Parking position for additional boat(s)
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 15 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on slipway cradle
Boat guiding system:	Tilting quad wheel-drive units and guide bumpers
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle suspension:	Load bearing travelling rails
Slipway cradle movement:	Hydraulic operated rack and pinion drive system
Max. frame outreach:	Designed to vessels waterline

Slipway cradle in launch and recovery position

Rack & pinion drive mechanism for slipway cradle

Suitable for handling of unmanned vehicles or vehicles with stern drive or outboard engines

MODEL: PQBS-D-P

Slipway System with quad wheel-drive units

VARD 614 Expedition Cruise Vessel, used with permission from VARD

Configuration

- Slipway cradle with quad wheel-drive units
- Drive and support mechanism for slipway cradle
- Parking position for additional boat (quad wheel-drive on deck structure)

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 15 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi automatic with single operator
Slipway slope length:	According to customer's request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on slipway frame
Boat guiding system:	Tilting quad wheel-drive units and guide bumpers
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle suspension:	Load bearing travelling rails
Slipway cradle movement:	Hydraulic operated rack and pinion drive system
To/from parking position:	By quad wheel-drive units

Quad wheel-drive units mounted on slipway cradle

Rack & pinion drive mechanism for slipway cradle

Parking position for additional boat (quad wheel-drive on deck structure)

MODEL: PQBS-D-S

Slipway System with quad wheel-drive units

Configuration

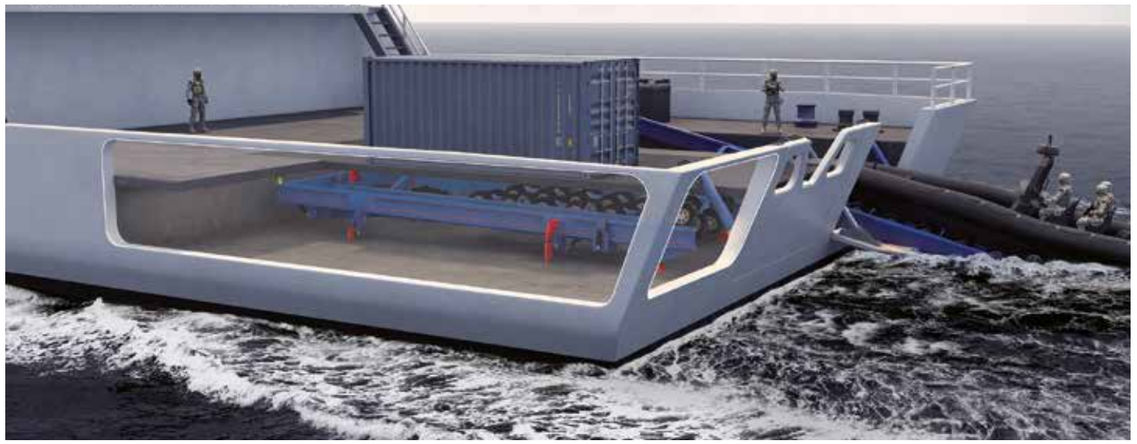
- Support frame structure for drivable slipway cradle
- Tilt-mechanism for stowing of support frame below deck
- Slipway cradle with quad wheel-drive units
- Drive and support mechanism for slipway cradle

OPTIONS

Remote control from daughter craft
Radio remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)
Hydraulic operated tilting mechanism for slipway frame

MAIN FEATURES

SWL:	Up to 15 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on slipway cradle
Boat guiding system:	Tilting quad wheel-drive units and guide bumpers
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle suspension:	Load bearing travelling rails
Slipway cradle movement:	Hydraulic operated rack and pinion drive system
Max. cradle outreach:	Designed to vessels waterline
Stowing of slipway frame:	By crane or tugger winch



Slipway cradle stowed and secured below hatch cover. Container on top of hatch cover.

Quad wheel-drive units mounted on slipway cradle

Drive-able slipway cradle (In/Out)

MODEL: PQBS-T-D-P

Slipway System with quad wheel-drive units

Cybele 90m MCMV vessel design and ARCIMS Modular USV system, used with permission from Babcock International and ATLAS ELEKTRONIK UK Ltd.

Configuration

- Tiltable support frame-structure for slipway cradle
- Slipway cradle with quad wheel-drive units
- Drive and support mechanism for slipway cradle
- Parking position for additional boat
  (Quad wheel-drive units on deck structure or on skid)

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Parking position for additional boat(s)
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 12 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway slope length:	According to customers' request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Submerged guide rails and wheel-drive units on slipway cradle
Boat guiding system:	Guide rail and tilting quad wheel-drive units
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle suspension:	Load bearing travelling rails with hydraulic tilt mechanism
Slipway cradle movement:	Hydraulic rack and pinion drive and tilt mechanism
Max. cradle outreach:	Designed to vessels waterline
Parking position for 2nd boat:	Parking cradle with guide rails and tilting quad wheel-drive units

Submerged guide rails and drive wheel units on deployable slipway cradle, supported by tiltable slipway frame

Slipway frame and deployable cradle at launch/recovery angle. Powered parking cradle in front of tiltable slipway frame for transfer of boat to/from the deployable slipway cradle

Tiltable slipway frame with deployable cradle and powered parking cradle for additional boat

MODEL: PQBS-D-C

Slipway System with quad wheel-drive units

PQBS-D-C Slipway System in parking position. Image of ARCIMS USV is used with permission from Atlas Elektronik UK.

Configuration

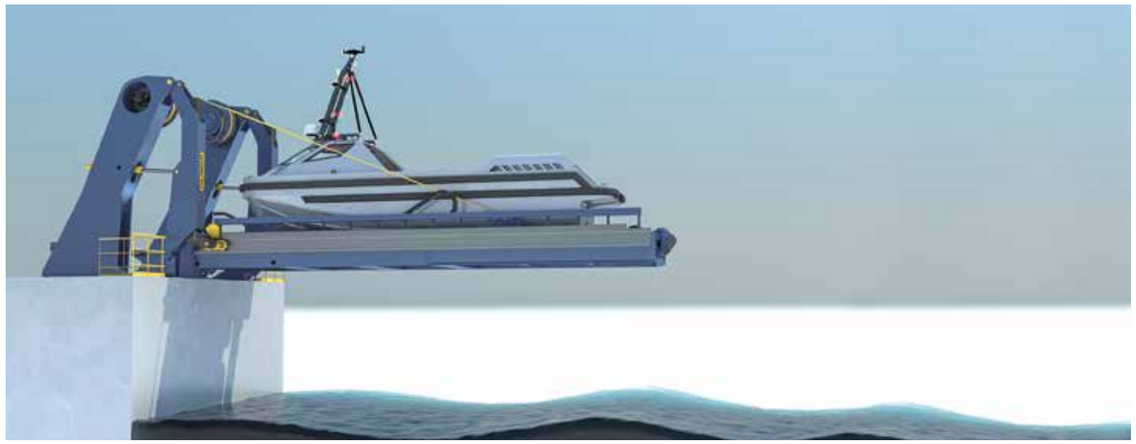
- Modular system design for easy installation and retrofit on open deck
- Drivable slipway cradle with rollers and hydraulic drive mechanism
- Quad wheel-drive units mounted on slipway cradle
- Twin-jib crane for outboard deployment of slipway cradle
- Telescopic jib's for lowering and elevating the cradle
- CT-winches for support and control of the cradle

OPTIONS

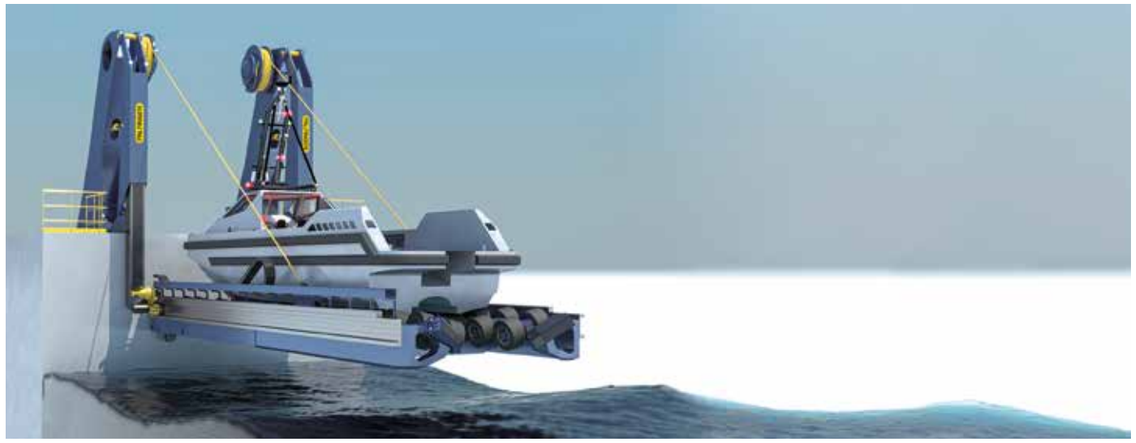
Higher vertical outboard cradle travel (if possible/feasible)
Optimized SWL and slipway cradle size
Dedicated hydraulic power unit (HPU)
Containerized HPU and control systems
Power and control system redundancy
Radio remote control from daughter craft
Various remote control options on vessel side

MAIN FEATURES

SWL and boat legth:	Up to 22 tons and 14 meters
Quad wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and automatically adapting to different hull shapes
Slipway operation:	Up to Sea State 6 (with single-operator)
Outboard cradle deployment:	By twin jib crane
Slipway LARS angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged quad wheel units on slipway cradle
Boat guiding system:	Tilting quad wheel-drive units and guide rails or deflector flaps
Slipway cradle dimensions:	Designed to purpose and water crafts to be used
Slipway cradle suspension:	Load carrying bogie wheels and CT-winches with interface towards cradle
Horizontal cradle movement:	By pinion drive, folding jibs and CT-winches
Vertical cradle movement:	By telescopic jibs and CT-winches
Intercafe to deck strucure:	Prepared for bolting to counter foundations in deck structure



Slipway cradle in outboard transition position



Slipway cradle lowered to optimal launch and recovery height

Slipway cradle lowered to optimal launch and recovery angle

MODEL: PQBS-R

Slipway System with quad wheel-drive units

Quad wheel-drive units mounted on slipway cradle

Suitable for handling of unmanned vehicles or vehicles with stern drive or outboard engines

Mechanism for extension and retraction of slipway cradle

Configuration

- Slipway cradle with quad wheel-drive units
- Drive and support mechanism for slipway cradle

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 15 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel-drive units on slipway cradle
Boat guiding system:	Tilting quad wheel-drive units and guide bumpers
Slipway cradle dimensions:	Designed to purpose and vessel interface
Slipway cradle suspension:	Load bearing deck foundation with glide bearings
Slipway cradle movement:	Hydraulic operated cylinders
Max. cradle travel:	Designed to purpose
Max. cradle outreach:	Designed to vessels waterline

MODEL: PQBS-SR-E-P

Slipway System with quad wheel-drive units

Quad wheel-drive units mounted on foldable stern door/ramp and on slipway cradle .

Configuration

- Stern door/ramp with quad wheel-drive units
- Quad wheel-drive units on slipway cradle
- Boat transfer unit on slipway cradle
- Slipway cradle elevator
- Boat parking cradles
- Overhead traveling cranes for payloads

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Skidding system for boat parking cradles and containers
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

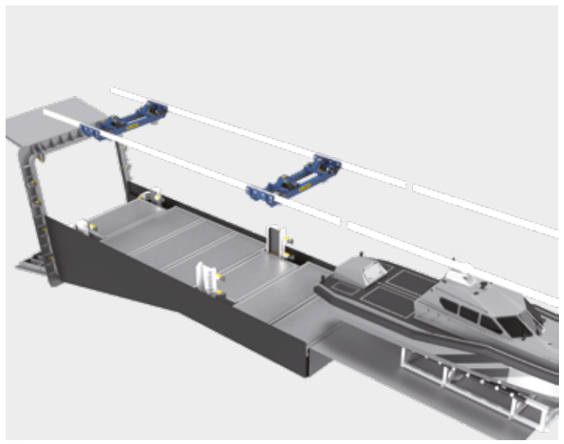
SWL:	Up to 25 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel-drive units on stern door/ramp
Boat guiding system:	Tilting quad wheel-drive units on stern door/ramp
Stern door/ramp dimensions:	Designed to purpose and vessel interface
Door/ramp movement:	Hydraulic operated cylinders
Slipway cradle dimensions:	Designed to purpose and vessel interface
Cradle elevator movement:	Hydraulic operated cylinders
Boat transfer unit:	Hydraulic operated twin-wheel-drives mounted on hydraulic operated transition unit (yellow color)

Slipway cradle in launch/recovery position

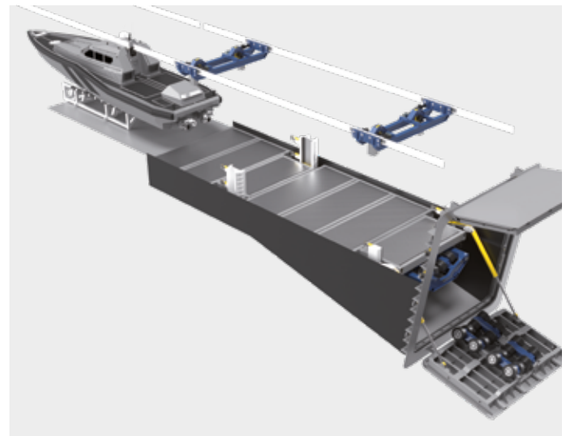
Slipway cradle in elevated position

Boat parking cradle in transfer position

Boat transferred to parking cradle



Slipway well/recess covered by removable hatches



Slipway System in stowed position, allowing other types of operations to be conducted through the upper half of the stern door

MODEL: PQBS-E-P

Slipway System with quad wheel-drive units

Littoral Operations Support Vessel, part of the multi-role SALVAS family of designs from BMT, used with permission from BMT Defence& Security UK Ltd.

Configuration

- One pair of immersed quad wheel units on vessel transom/sill
- Requires immersed sill and foundations for first pair of quads
- Quad wheel-drive units on slipway cradle
- Slipway cradle elevator
- Boat transfer unit
- Boat parking cradles

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Boat parking cradles
Skidding system for boat parking cradles and containers
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 15 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel units on vessel transom
Boat guiding system:	Tilting quad wheel units
Slipway cradle dimensions:	Designed to purpose and vessel interface
Cradle elevator movement:	Hydraulic operated cylinders
To/from parking cradle:	By quad wheel-drive units and boat transfer unit

Slipway cradle elevator; Extendable boat transfer unit

Slipway cradle elevator; Extendable boat transfer unit

Boat parking cradles for wide beam boats and narrow beam boats

MODEL: PQBS-MB-B

Slipway System with quad wheel-drive units

Configuration

- Quad wheel-drive units on deck structure
- Submergible slipway slopes (by ballasting vessel)
- Buffer devices for each boat parking position

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Explosion proof equipment for use in hazardous areas

MAIN FEATURES

SWL:	Up to 30 tons
Wheel-drive system:	Hydraulic
Quad wheel-drive units:	Tilting and adapting to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	0° slope angle / 1.75° (partial ballast)
Slipway access/entrance:	Via submerged wheel-drive units on deck structure
Boat guiding system:	Tilting quad wheel-drive units and buffer devices
Buffer devices:	Hydraulic operated

Quad wheel-drive units on deck structure in mission bay

Submergible slipway slopes (by ballasting vessel down)

Buffer devices for each boat parking position

SLIPWAY SYSTEMS WITH SINGLE WHEEL-DRIVE UNITS

GENERAL

The hydraulic-powered, semi-automatic Slipway System consists of a number of single wheel-drive units in parallel rows. The tilt, height and distance between the wheels can be manually adjusted to conform to a range of daughter craft hulls.

Daughter craft can engage the slipways at a range of speeds up to 7 knots higher than the speed of the mother vessel. When a boat enters the slipway, the overrunning clutches allow free rotation of the wheels in the recovery direction until the boat speed and wheel-drive speeds match.

At that point the hydraulically powered wheel-drive units will take over under single-operator control and dock the daughter craft safely inside the slipway. End stoppers automatically set the craft in parking and stowage positions and engage the fail-safe brakes on the wheel-drives.

MAX. SEA STATE FOR SLIPWAY OPERATIONS

Test and operational use of this Slipway System have been performed in Sea States 3 with mother vessel steaming ahead with low speed.

Safe operations at higher Sea States may be possible but is highly dependent on:

- Stern entry arrangement
- Mother vessel heading and speed
- Mother vessel responsiveness (RAO Profile)
- Waves and wind pattern
- Boat driver's skills

SINGLE WHEEL-DRIVE UNITS	
Wheel-drive unit configuration:	1 wheel on each wheel-drive unit
Wheel angle and transverse spacing:	Manually adjustable
Brakes:	1 for each wheel
Hydraulic motors:	1 for each wheel
Over-running clutches:	1 for each wheel
Number of single wheel-drive units:	Depending on length of slipway
Wheel diameter:	Ø 434 mm (Foam filled)
Max. freewheel speed, inlet:	0-240 m/min (0-7 knots)
Drive assist speed, in and out:	0-25 m/min (0-0.8 knots)
Max. slipway slope angle:	up to 12°
Max. payload for slipway:	up to 12 tons
Max load, each wheel:	2 tons
Weight (each wheel-drive unit):	Approximately 420 kg

MODEL: PSWS-SR

Slipway System with single wheel-drive units

Configuration

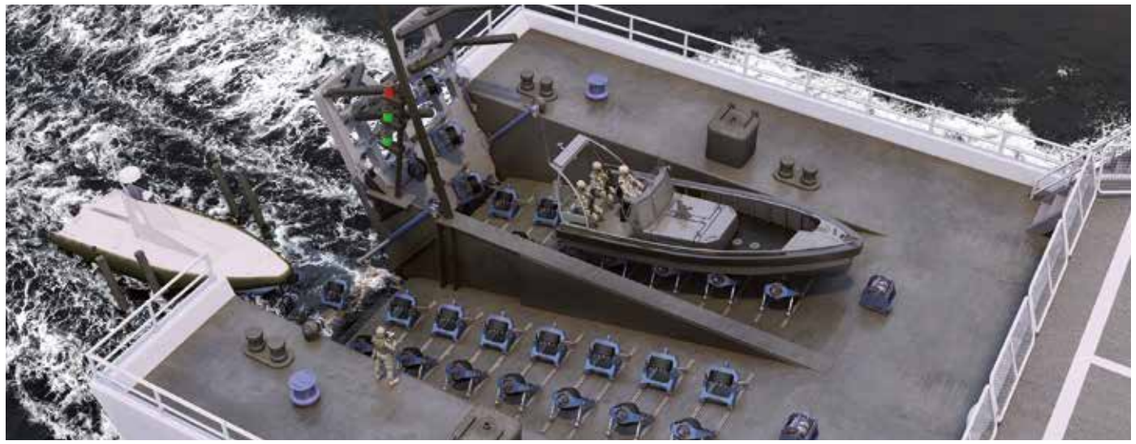
- Single wheel-drive units on slipway slope
- Stern ramp with single wheel-drive units

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Parking position for additional boat(s)
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 12 tons
Wheel-drive system:	Hydraulic
Single wheel-drive units:	Manually adjustable to different hull shapes
Slipway operation:	Semi-automatic with single-operator
Slipway slope length:	According to customers request
Slipway angle:	Up to 12 ° slope angle
Slipway access/entrance:	Via submerged wheel-drive units on stern ramp
Boat guiding system:	Wheel-drive units and guide poles on ramp
Stern ramp dimensions:	Designed to purpose and vessel interface
Ramp movement:	Hydraulic operated cylinders



Single wheel-drive units on slipway slope

Stern ramp with single wheel-drive units

Suitable for launch and recovery of USV's

MODEL: PSWS-T-D

Slipway System with single wheel-drive units

PSWS-T-D Slipway System and 6,5 meter RIB with twin outboard engines

Configuration

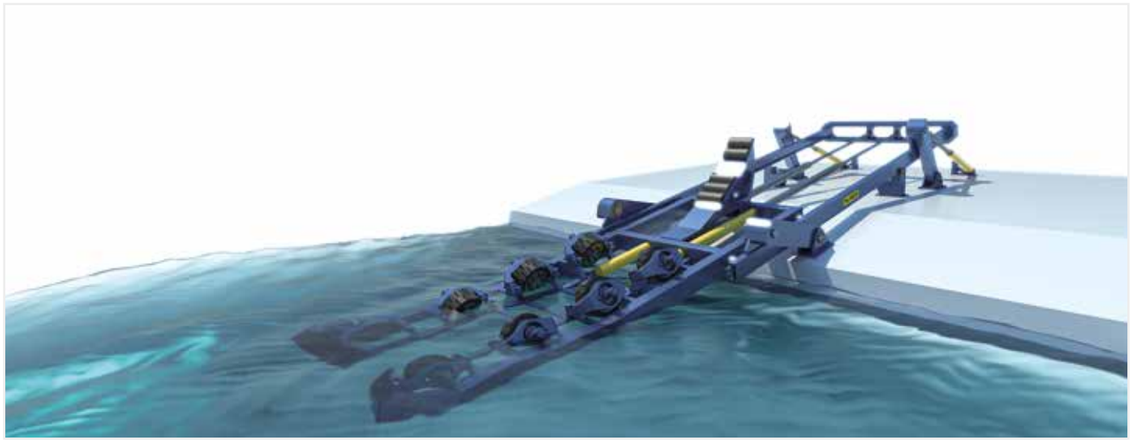
- Tilt and support frame for slipway cradle
- Drivable slipway cradle with single wheel-drive units
- Guide arrangement on slipway cradle
- End stop and parking support on slipway cradle

OPTIONS

Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Multi-axis adjustment of wheel-drive units
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

SWL:	Up to 6 tons
Wheel-drive system:	Hydraulic
Single wheel-drive units:	Manually adjustable wheel angle to adapt to different hull shapes
Boat length:	6 - 12 meter
Slipway angle:	Up to 12° slope angle
Slipway access/entrance:	Via submerged wheel-drive units on slipway cradle
Boat guiding system:	Boat guide and deflector plates at slipway entrance
Slipway frame dimensions:	Designed to purpose and vessel interface
Slipway frame suspension:	Load bearing tilting arms
Slipway cradle movement:	Hydraulic cylinder driven tilt and drive mechanism
Max. frame outreach:	Designed to vessels waterline
Power supply for frame and cradle	Via energy chain

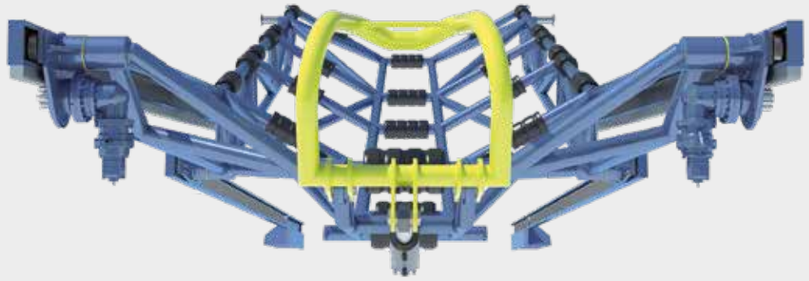


Slipway frame and cradle in launch and recovery position

Boat with twin outboard engines, fully recovered into the extended slipway cradle

Cradle with 12m RIB fully retracted and slipway frame tilted inwards to parking position.

SLIPWAY SYSTEMS WITH BOAT CRADLE



BOAT CRADLE

The boat cradle is an open and light tubular steel design, which minimizes forces induced by waves and currents. The boat cradle is supported by mechanical load bearing support/drive rails and wheel/bearing arrangements on both sides of the boat cradle structure.

The inside of the boat cradle is fitted with fenders to protect and guide the water craft during launch and recovery. A weak-link mechanism protects the boat cradle against higher forces than it is designed to withstand. The “bow section” of the boat cradle is fitted with an automatic mechanical securing clamp. The clamp is hydraulic operated and equipped with a quick-lock function.

The stern end of the boat cradle is designed for easy and safe access during launch and recovery and to avoid any conflicts with daughter craft’s drive system. The system is also well suited for handling of crafts with multiple outboard engines or stern drives.

BOAT CRADLE DRIVE SYSTEM

Rails on each side of the boat cradle serve as guide and support mechanisms for the boat cradle while it is travelling up and down the slipway slope. One of the guide rails on each side of the slipway slope is fitted with a tooth rack for the drive system.

Longitudinal movements and heave/lowering of the boat cradle is done by hydraulic powered pinion drives mounted on each side of the boat cradle. The hydraulic pinion drive motors are fitted with automatic overrunning clutches, allowing residual energy from the water-craft to be transferred into forward motion of the boat cradle in case the water-craft is approaching the boat cradle with excess speed.

BOAT CRADLE ELEVATOR

Vertical movements are driven by the two mechanical support and guide rails on each side of the boat cradle. The mechanical support and guide rails (located on the stern of the vessel) guide the boat cradle to the horizontal parking position when the boat cradle is retracted by the rack and pinion drive system.

MAX. SEA STATE FOR SLIPWAY OPERATIONS

This system is designed for operation in Sea State 3.

Safe operations at higher Sea States may be possible but is highly dependent on:

- Mother vessel heading and speed
- Mother vessel responsiveness (RAO Profile)
- Waves and wind pattern
- Boat drivers skills

MODEL: PSEC

Slipway System with boat cradle

VARD 7 085 OPV, used with permission from VARD

Configuration

- Extendable and retractable slipway cradle

OPTIONS

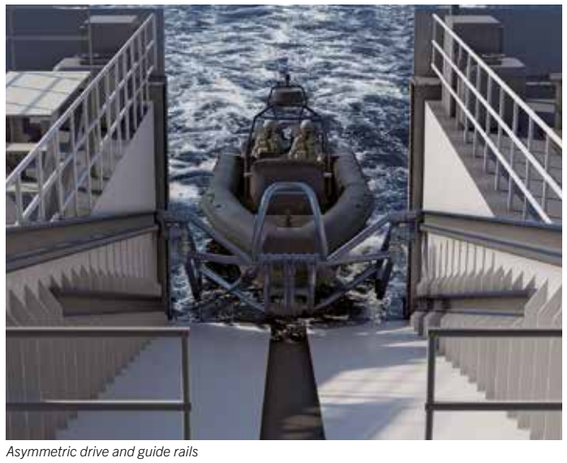
Remote control from daughter craft
Various remote control options on vessel side
Power and control system redundancy
Emergency launch and recovery by accumulator and UPS
Parking position for additional boat(s)
Higher slope angle and/or SWL (if possible/feasible)

MAIN FEATURES

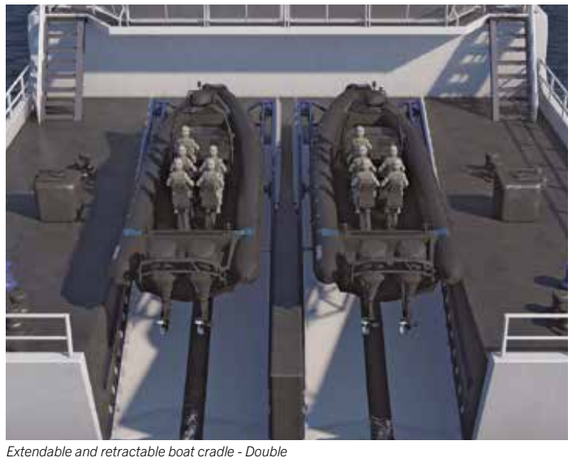
SWL:	Up to 5 tons
Boat cradle:	Tubular steel frame with fenders and passive rollers
Slipway operation:	Semi-automatic with single-operator
Cradle shape and dim.:	Designed to purpose and boat(s)
Slipway angle:	Up to 15° slope angle
Slipway access/entrance:	Via submerged slipway cradle
Boat guiding system:	Cradle shape incl. fenders, rollers and bow clamp
Cradle suspension:	Load bearing travelling rail
Cradle movement (In/Out):	Hydraulic operated rack and pinion drive
Cradle elevation (Up/Down):	By asymmetrical guide rail system
Boat securing mechanism:	Hydraulic operated bow clamp
Recovery of boat:	Boat thrusting against cradle while cradle is retracted
Recovery method:	Gradual transfer of boats weight from water to cradle

Extendable and retractable boat cradle - Single

Extendable and retractable boat cradle - Single



Asymmetric drive and guide rails



Extendable and retractable boat cradle - Double

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