Elements of Submarine Rescue
INTERVENTION SYSTEMS

- SEARCH AND SURVEY EQUIPMENT
- UNDERWATER INTERVENTION TOOLS – ROV & ADS
  - First assets on scene
  - Deploy by fast surface vessels
  - Use multiple units as necessary for wide area coverage
SEARCH & SURVEY

Pinger Receiver

- Locates pingers on DISSUB’s, torpedoes, downed aircraft, etc.
- Can be used from vessel, by diver, ADS, or ROV

Side Scan Sonar

- Provides underwater search capabilities
- Locates DISSUB and other subsea items
- Identifies subsea hazards
SEARCH & SURVEY

Underwater Telephone

- Voice Communications
- Ship – DISSUB – Rescue Vehicle – ADS
- Proof of Life
- On Board Status Assessment

Pinger Localization

- Pinpoint DISSUB location
SEARCH & SURVEY

Integrated Navigation System

• Full surface & subsea asset positions
• Multiple target positioning
• Rescue planning
• Data management and recording
• Portable or built in
Intervention and Salvage Systems

Remotely Operated Vehicle (ROV)

- Conducts assessments
- Debris clearance
- Provides backup for ADS
- Multi-use for salvage to 3000m
Intervention and Salvage Systems

Atmospheric Diving System

- Extensive worldwide support network
- Multiple launch and recovery options
- Salvage and other tasks as well as submarine rescue
- 365 or 610 meters
Intervention and Salvage Systems

Mixed Gas & Saturation Dive Systems

- Some Navies elect to also use conventional diving systems to provide shallow water intervention capability.
- Portable or fixed installation
- Conducts shallow water intervention and assessment
- Surface supplied air/mixed gas or saturation diving
Life Extension for Survivors

Emergency Life Support System (ELSS)

- Extends life support until arrival of rescue systems
- Oxygen candles, Carbon Dioxide scrubber material, food, water and medical supplies
Life Extension for Survivors

Submarine Emergency Ventilation & Decompression System (SEVDS)

- Reduces CO2 levels
- Provides breathing air
- Provides decompression
Ship Integration
MOSHIP – Submarine Rescue Mother Ship Requirements

- 400 m² deck area
- DP Class II
- Built-in search, localization and communications transducers and hydrophones
- 2500 tonne per sq meter deck capacity (nominal)
- 35 rescue personnel accommodation
- 100 to 150 PAX with Navy and survivor space
- Hospital and first aid facilities
- Casualty cold storage
- Area Lighting
- Fresh water wash down
- Alarms and communications
- Power – 2 x 1000 kVA (or dedicated DSRV system generators)
- Fast rescue boat(s) - RHIBS
- Helicopter pad
- SOLAS equipment
Ship Integration

Ship Interface Template Set (SITS)

- Provide LARS and system alignment foundations for international submarine rescue systems on a MOSHIP or VOO
- Shortens mobilization time
- Overcomes certification delays
Ship Integration – NATO SITS
Ship Integration

YARD & ASHORE SERVICES

OceanWorks has previously recommended shore facility requirements and yard space

The following dockside facilities are recommended for vessel mobilization:

• 12.2 m truck access and turning area
• 100 to 300 sq m area for truck standing during offload sequence
• 2 x 150 tonne crane
• 2 x container fork lift – max load 35 tonne
• Longshoremen and riggers
• Welding teams and equipment
• 24 hour per day security
DOCKSIDE TRAINING & BERTHING

OceanWorks recommends the following facilities for hands on training and in water activity dockside:

• Dock apron suitable for installation and set up of LARS in full operating condition
• Dock apron space suitable for set up of all support equipment in full operating condition
• 10 to 15 m minimum depth
• 3 dock side exercises minimum per year
• 1 At sea full deployment per year (minimum - 2 recommended)
• 90 to 150 m length vessel berthing for load out required
Ship Integration

Dedicated MOSHIP – Submarine Rescue Mother Ship

Consider outfitting of multi-purpose Submarine Rescue Mother-ship (s) with complete complement of rescue equipment rated to 600 msw including:

- Capability to carry either SRDRS or NSRS or Self Owned Rescue Vehicle
- TUP and rescue decompression chambers
- Auxiliary equipment
Intervention, Rescue and Towing Ships

Consider outfitting of high speed, multi-purpose Intervention Vessels for search, survey, life extension, towing, and salvage with extensive subsea rescue assets including:

- Submarine Ventilation System
- ELSS pod system
- Mixed Gas / Saturation Diving & Decompression System
- ADS and LARS
- ROV and LARS
- Towed Side Scan Sonar
- UWT, Integrated Navigation etc
OceanWorks International

SUBMARINE RESCUE SYSTEM & VEHICLE ELEMENTS
RESCUE SYSTEM ELEMENTS

- RESCUE VEHICLE = SRV or RORV
- CONTROL AND WORKSHOP VANS
- LAUNCH AND RECOVERY SYSTEM
- DECK CRADLE
- DDC & TUP CAPABILITY – 70 – 80 PAX
- AUXILIARY EQUIPMENT

- INTEGRATED NAVIGATION AND COMMUNICATIONS SYSTEM FOR MULTI-VESSEL OPERATION
- SPARES AND CONSUMABLE STORAGE
- FOUNDATION TEMPLATE SETS
- FIT TO DEDICATED SHIP OR VESSEL OF OPPORTUNITY
KEY CAPABILITIES

- DECK SPACE: 300 – 400 SQ M
- TOTAL SYSTEM WEIGHT: 300 – 500 M Tonne
- DEPTH CAPABILITY: 650 M
- VEHICLE RESCUE CAPACITY: 16 to 18 PAX
- DDC CAPACITY: 70 – 80 PAX
- DDC DEPTH (INTERNAL): 5 BAR
- AIR TRANSPORTABLE: C-130, C-17, C-5, IL-76
  ANTANOV 124, 225
INTEGRATED SYSTEM WITH TUP

- LARS
- CONTROL VAN
- MTL
- SDC 2
- UMBILICAL WINCH
- PRM
- DTL
- DECK TEMPLATES (SITS)
- SDC 1
- AUXILIARY VAN
- GENERATOR VAN
- AIR & O2 STORAGE
RESCUE VEHICLE OPTIONS

RORV – TETHERED SYSTEM
- PATENTED ARTICULATED SKIRT
- UNLIMITED POWER & ENDURANCE IN HIGH CURRENT
- REAL TIME COMMAND, CONTROL & COMMUNICATION WITH SURFACE
- HIGH SEA STATE LAUNCH AND RECOVERY
- WORLDWIDE OPERATOR RESOURCES
- WORLDWIDE ROV BASED TECHNOLOGY
- US NAVY INTEROPERABILITY

SRV – UNTETHERED SYSTEM WITH ARTICULATED SKIRT
- PATENTED ARTICULATED SKIRT
- CONVENTIONAL SUBMERSIBLE CONFIGURATION
- CONVENTIONAL LAUNCH AND RECOVERY – DIVER ASSIST
- SIMPLIFIED SURFACE CONTROL
- TRADITIONAL OPERATION & TRAINING
- MODERN BATTERY TECHNOLOGY
- DATA TETHER PER NATO

SRV – SEMI-TETHERED NATO TYPE
- CONVENTIONAL SUBMERSIBLE CONFIGURATION
- CONVENTIONAL LAUNCH AND RECOVERY – DIVER ASSIST
- SIMPLIFIED SURFACE CONTROL
- TRADITIONAL OPERATION & TRAINING
- MODERN BATTERY TECHNOLOGY
- DATA TETHER PER NATO
CONCEPT BASED ON MODIFIED 1970 VINTAGE LOCK-OUT SUBMERSIBLES
NEW DESIGNS RETAIN SAME OPERATING PRINCIPLES

PRINCIPAL DRAWBACKS

• Limited battery power duration with risk of mission interruption, particularly in high current, low visibility conditions

• Delay for battery recharging between dives

• Total reliance on on-board personnel for all operational decisions once the SRV leaves the surface due to intermittent through water communications and lack of continuous, real time data links.

• Requirements for swimmer assisted launch and recovery
RESCUE VEHICLE OPTIONS – TETHERED vs FREE SWIMMING

TETHERED REMOTELY OPERATED RESCUE VEHICLE – RORV

1995 – ROYAL AUSTRALIAN NAVY SEEKS MORE COST AND OPERATIONALLY EFFECTIVE RESCUE CAPABILITY – THE URGENT DELIVERY REQUIREMENT HELPED DRIVE THE RORV DEVELOPMENT BASED ON COTS HARDWARE

“REMORA” – WORLD’S FIRST REMOTELY OPERATED RESCUE VEHICLE FEATURING ARTICULATED SKIRT AND TETHERED, REMOTELY OPERATED VEHICLE TECHNOLOGY WITH SURFACE CONTROL, UNLIMITED POWER/ENDURANCE AND REAL TIME DATA AND COMMUNICATIONS WITH MANNED RESCUE COMPARTMENT SUBSEA

PATENTED ARTICULATED SKIRT

Revolutionary design allows mating capability with submarines lying at pitch or roll angles to 45 or 60 degrees without alteration of vehicle trim

- NATO STANDARD MATING CONFIGURATION
- HYDRAULIC POWERED AND CONTROLLED ANGLE VARIATION
- 0 TO 45 DEGREE MATE BY DIAGONAL ROTARY CHANGE
- OMNI-DIRECTIONAL APPROACH TO DISSUB/CURRENT BY HORIZONTAL ROTARY CHANGE
- DSRV REMAINS IN STANDARD NEUTRAL TRIM
- THRUST RELATIVE TO CURRENT UNAFFECTED BY ORIENTATION
- ELIMINATE COMPLEX BALLAST SYSTEMS
- SIMPLIFIES PILOTING CONTROL
- REDUCES MATING TIME
- AUTOMATIC ANGLE RESET AND FUNCTIONS
- SIGNIFICANT ADVANTAGE OVER OTHER SRV CONFIGURATIONS
OceanWorks UN-TETHERED – SRV WITH ARTICULATED SKIRT
OceanWorks EXCLUSIVE TECHNOLOGY
OceanWorks UN-TETHERED – SRV WITH ARTICULATED SKIRT
OceanWorks EXCLUSIVE TECHNOLOGY

RESCUE COMPARTMENT & SKIRT
IDENTICAL TO RORV CONFIGURATION
OceanWorks EXCLUSIVE RESCUE TECHNOLOGY

• DEPTH - 650 MSW
• PRESSURE HULL – HORIZONTAL CYLINDER
• PERSONNEL CAPACITY – 18 MEN
• HATCHES – BOTTOM HATCH AND END HATCH FOR TRANSFER UNDER PRESSURE
• MAIN POWER – 230 HP TOTAL – DUAL HPU
• HOTEL POWER – REDUNDANT SUPPLY
• SPEED - +3 KNOTS
• WEIGHT – 22 TONNES
• CONTROL – DUAL, REDUNDANT TELEMETRY SYSTEM
• FIBER OPTIC UMBILICAL & DATA TRANSFER
• ARTICULATED TRANSFER SKIRT
OceanWorks EXCLUSIVE RESCUE TECHNOLOGY

- Tethered system
- Surface supplied power – unlimited endurance.
- Proven air transportability.
OceanWorks EXCLUSIVE RESCUE TECHNOLOGY

Articulated Transfer Skirt

- Manway to DISSUB
- 2000 ft rated
- 45 degree mating capable
- Omni-directional Approach
- Eliminate complex ballast systems
- Detachable for transport
Control Van
• Controls navigation and maneuvering of the RORV
• Central Command center
• Three operator control stations
  • Pilot
  • Navigator
  • Operations Supervisor
  • Auxiliary station for Life support monitoring

Umbilical Winch
• Electro-Optical Cable
• Active heave compensation
• 900 meters of armoured umbilical.

Deck Cradle
• Hydraulic Lift Capture
• Surrogate Umbilical Winch
• Towline Winch
RORV LIFE SUPPORT AND CONTROL FEATURES

- Redundant life support systems are self contained and controlled on board, with added benefit of continuous surface display, monitoring and recording via tether
- Conventional water ballast system controlled on board
- Emergency jettison and ascent systems, with added redundancy due to tether
- Two on board attendants operate life support, adjust ballast and provide general assistance and first aid as survivors are transferred into the rescue vehicle.
- Real time, 2 way voice and data communication
LAUNCH AND RECOVERY SYSTEM

- Diverless launch & recovery
- Active / Passive Heave Compensation
- 3 – Piece A-Frame Assembly
- Over-boarding power sheave and Umbilical load Alleviator
- Operator Platform
- Launch Latch Assembly
- Snap Load Alleviator
- Redundant Lift Winches
- Cursor Frame
- Hydraulic Power Unit
Custom size and configuration linked to customer vessel and submarine crew size.

DDC/DTL System with RORV and LARS (chamber enclosure walls not shown for clarity)
DECOMPRESSION & TRANSFER UNDER PRESSURE

May be deck mounted or built into vessel below decks. The system includes:

- 2 x DDC – 30 man main lock – each with 4 man outer lock
- 1 x DTL 18 man transfer capacity
- 1 x Extendable Pressurized Man way) for mate DTL to vehicle
- 2 x Flexible Bellows Spool Pieces (FBSP) for DTL to DDC connection
- 1 x Dive System Control Van (DSCV)
- 1 x HP Air Compressor – Environmental Control System (HPAC-ECS) module
- 1 x LP Air Compressor (LPAC) module
- 1 x HP Oxygen and Treatment mix (HPO2) storage module
- 1 x HP Air (HPA) storage module
AUXILIARY EQUIPMENT

- Generator Van – redundant power supply
- Workshop Van & Tools
- Spares and Consumables Van
- Mass Simulator – water filled load testing
- Air Transport Pallets
- Air Transport Level Loaders
- Mobilization Container & Rigging
- Training Simulator
- Other Miscellaneous
SEA TRIALS
PRODUCT LIFE

- 25 Year design life (based on assumed fatigue cycle)
- Structured preventative maintenance program – system availability 98%
- 5 year – general service/refit
- 10 year – major refit and obsolescence upgrade

CERTIFICATION

- ABS Rules for Building and Classing Underwater Vehicles, Systems, Hyperbarics-2010
- Annual Survey
- Special Periodical Survey (3 year cycle)
- Surveys linked to OceanWorks internal Safety and QA Audit plan
RORV - Air Transportability

- The entire US Navy rescue system has been designed for rapid mobilization and modular transport.
- Each piece of equipment has a transport frame and/or custom aircraft pallet for air transport.
- System air transport has been demonstrated using both military and commercial aircraft.
OceanWorks provides full service, through life Product Life Cycle support:

- Reliability and maintainability engineering
- Preventative, predictive and corrective maintenance planning
- Spare parts supply
- Packaging, handling, storage and transportation
- Obsolescence management
- Maintenance support
- Training – hands on & simulator
- Operations support
THANK YOU!