JFD

Submarine Rescue Systems

1973 - present day

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1973. Origins

Over 40 years ago a coordinated, multinational rescue effort culminated in the recovery of Roger Chapman and Roger Mallinson from their Pisces III submersible. After more than 76-hours trapped on the seabed, and with fewer than 20 minutes of life support remaining, their rescue was the first of its kind and, at 480 metres, remains the deepest ever performed.

Roger Chapman would go on to dedicate his life to the safety of those who spend their lives subsea by founding Rumic, the company that would eventually become JFD.

In the years that followed, Roger and the team he formed would transform the humble manned submersible from an unconventional tool for exploration, into today's preferred method for submarine rescue.

The manned submersibles of today owe their existence to the North Sea oil industry which drove their adoption as a means of exploration.

The operational doctrines developed in these formative years underpin manned submersible operations today. Indeed, many of those early pioneers have played important roles in the development of every submarine rescue system since.

It was during this era of rapid advancement, trials and failures, that the benefits of free-swimming submersibles over their tethered counterparts was proven.

Superior manoeuvrability and the ability for a pilot to have 'eyes-on' his subject, remain two of the key benefits that make this free-swimming submersible design the world's preferred method of submarine rescue.

Only a few technological challenges would need to be overcome in order to transform these submersibles into what we would recognise today as a Submarine Rescue Vehicle (SRV).

First Generation

First Generation Submarine Rescue Systems were designed around the fundamental principles introduced by those early manned, free-swimming submersible operators.

Over the course of the following 20 years, a series of technological barriers would be overcome, and the submarine rescue vehicle as we know it, would cement its place in the world.

The conversion of LR5's fibreglass hull into a fully TUP capable chamber was the first major technological advance that would define the era and provide the benchmark for all systems that would eventually follow. Launch and Recovery using A-Frames and divers became commonplace. Battery technology and through-water communications improvements made it possible to operate the submersible for extended periods of time, ultimately enabling the modern day rescue cycle.

The final piece of the puzzle - the ability for a submarine rescue system to be rapidly, reliably mobilised to a remote port, using commercial and military aircraft - would ensure these new systems could respond to a submarine emergency anywhere on the planet. The submersible rescue vehicle, LR5, began life as a diver lock-out-vehicle. It wasn't until she was converted from GRP to steel that submarine rescue became truly viable.

The steel hull and mating skirt enabled, for the first time, the transfer of personnel from a disabled submarine (DISSUB) into the rescue chamber at elevated pressures.

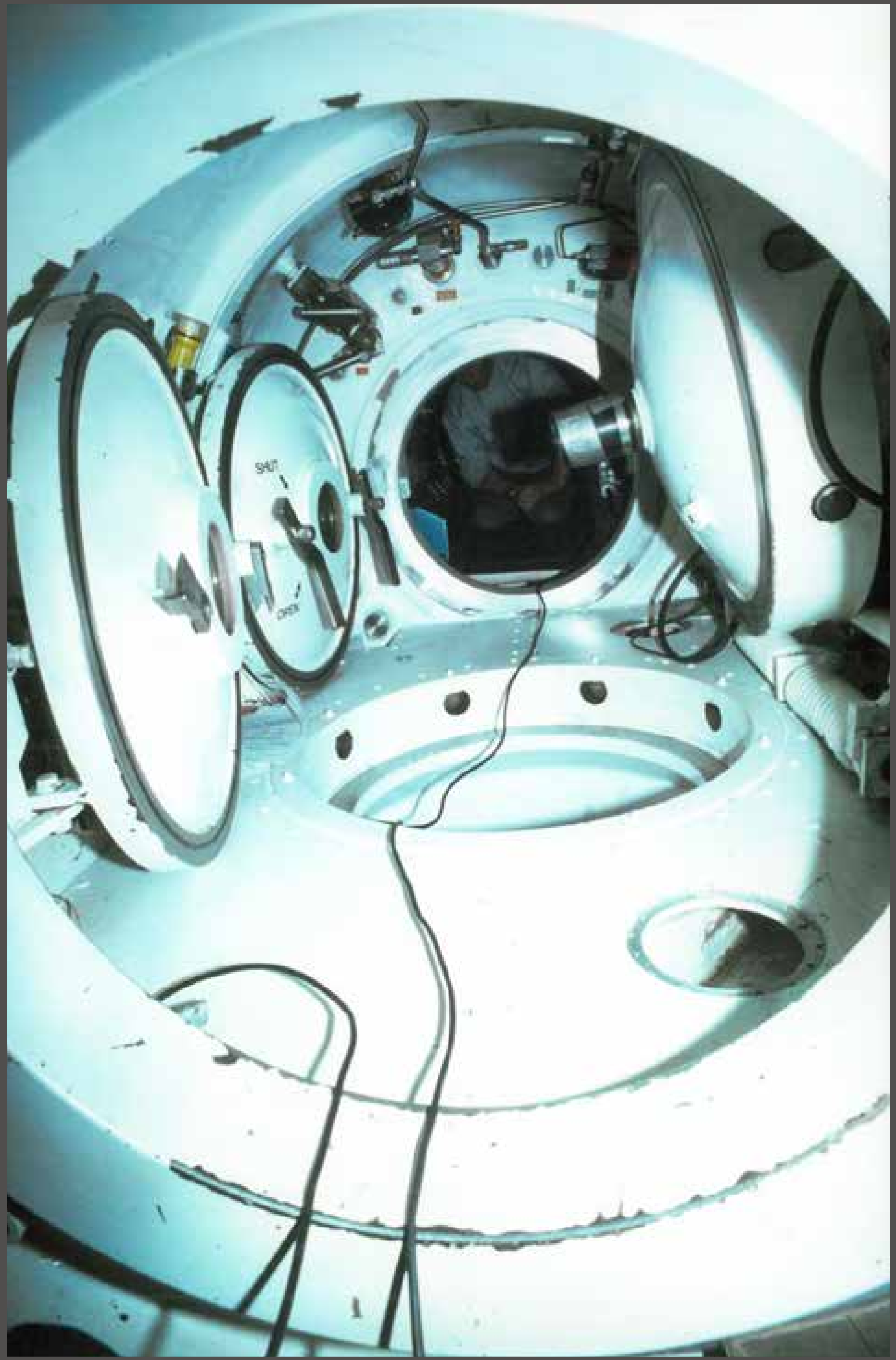
Rescuees could now be transferred to surface decompression facilities to receive hyperbaric treatment and, thus, avoid decompression sickness or "the bends".

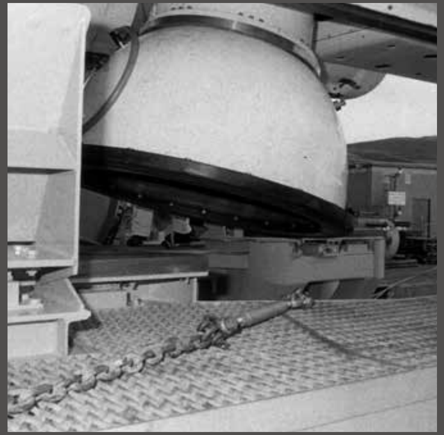
Many features and technologies found on these early craft can be identified in refined, revised or re-designed versions on today's submarine rescue systems.

The single lift point common to modern day SRVs is a dramatic example of the ongoing effort to optimise and simplify every aspect of submarine rescue.

Joy stick controls, touch screen technology and digital gauges used today all trace their origins to these early systems.

First Generation rescue systems, such as the JFSRS currently serving in Australia, would change and adapt as technology, understanding and requirements evolved. Continuous improvement means that the First Generation JFSRS remains one of the most capable flyaway systems in operation today.





UKSRS / JFSRS

First Generation Submarine Rescue System designed, built, operated and maintained by JFD for the UK, and latterly, Australia. The JFSRS remains one of the most capable flyaway systems in operation.

2005. Priz Rescue.

Five years after the Kursk tragedy in which 118 submariners lost their lives, the Russian government accepted international assistance to rescue the crew of the stricken AS28 Priz.

Crew and equipment were flown from Glasgow to the Kamchatka peninsula and mobilised to a Vessel of Opportunity. Following the clearance of debris and the removal of the cabling which entangled the vessel, all seven crew members were safely recovered to the surface.

The rescue was performed using the remotely operated vehicle assets of the First Generation UKSRS. The event made international news and the world witnessed the incredible capability of flyaway rescue systems.

Second Generation

In response to the Kursk and Priz incidents, larger and predominantly nuclear-powered navies desired a dramatic increase in rescue capability. Requirements calling for higher capacity rescue and decompression assets would drive the development of Second Generation Submarine Rescue Systems.

Operator safety took a huge step forward with innovations like diverless launch and recovery, driving down risk. Their manufacture also saw dramatic improvements as parallelised build strategies allowed vehicle interiors, exteriors and hulls to be manufactured simultaneously.

Second Generation systems were designed to take advantage of nuclear navies' ability to transport large amounts of equipment by air or to supply modern ships as dedicated host platforms.

Characterised by their large size and complexity, these Second Generation systems benefit from unparalleled capacity and capability.

Removing the hull from the critical path was an innovation which allowed DSAR-5 and DSAR-6, for Korea and Singapore respectively, to be delivered in parallel.

JFD's parallel build strategy allowed for reduced costs and significantly shorter delivery times than previous generation SRVs.

This build strategy would have knock-on benefits too. The strip-down, inspection and re-build process of these modular SRVs would prove to be a far simpler operation than previous generation vehicles. The cost - both financial and in time - of through-life maintenance and certification is greatly reduced.

Second Generation submarine rescue systems are notable for their introduction of a number of improvements designed to reduce risk to operators and equipment.

Diverless launch and recovery removed the requirement for personnel to be in the water during potentially hazardous operations in high sea states.

Fine grained pilot controls and sophisticated electronic systems improved the performance, manoeuvrability and safety of the SRV during the precise mating procedure.

Integrated mating skirts, in addition to aiding manoeuvrability, reduced the height of the SRV on deck, reducing the risks associated with re-supply and maintenance.

DSAR-5
Second Generation Submarine Rescue System designed, built and maintained by JFD for the Republic of Korea.
DSAR-5 operates from the dedicated mother ship, Cheong Hae Jin.

DSAR-6
Second Generation Submarine Rescue System designed, built, operated and maintained by JFD for the Republic of Singapore.
DSAR-6 operates from the dedicated mother ship, Swift Rescue.

NSRS
TUP Decompression System NSRS submarine rescue chambers.

SIZE & CAPABILITY
NSRS is one of the largest, and most capable systems in operation.

Introducing the Third Generation

JFD's Third Generation Submarine Rescue System design is the result of an internal research and development programme which set out to bring together the incredible capabilities of the preceding generations with a focus on lightweight, efficient design.

The operating regime perfected by the submersible pioneers of the 70's and 80's would underpin the system's operating philosophy. The technical advancements of First Generation systems would form the foundation of the flyaway, free-swimming SRV-centric design. Improvements in technology, practice and procedure found in Second Generation systems would feature throughout.

JFD's Third Generation submarine rescue systems bring about a renewed focus on efficient design and optimising Time to First Rescue. For conventional Navies and those with modest air-lift capability, they offer a significant step-change in real-world capability.

The Third Generation 'Vision'

Submarine Rescue is perceived as both a political and humanitarian tool, but it exists for one purpose; to save life following a submarine incident. With each new generation of rescue system, there is an obligation to improve.

The key to maximising the chances of successfully rescuing the crew of a distressed submarine (DISSUB) is in recognising that for any equipment to be useful, it must first be able to get to the site of the DISSUB. As such the speed and reliability with which any flyaway system can be deployed must be carefully balanced against its effectiveness and capacity once on site.

Simply, if a rescue system is unable to reach a DISSUB in time, no matter how large and capable it is, it is useless.

The classic measure by which all submarine rescue systems have been judged is their theoretical Time to First Rescue (TTFR); the target time from call-out to arrival at the DISSUB.

When designing its Third Generation submarine rescue system, JFD concentrated not on the shortest theoretical TTFR, but the ability to deliver a robust, acceptable TTFR across a wide range of scenarios.

In other words, to provide the best possible chance of saving life.

THIRD GENERATION REFERENCE DESIGN
JFD's reference design was developed against a set of generic, but well-considered and representative requirements, rather than those of one specific customer.

Design Drivers

The route to an effective system therefore lies in providing no lesser capability, whilst minimising the support required by unpredictable and variable external assets; minimising the numbers of aircraft and trucks, maximising the number of potential VOOs, and minimising embarkation time and the amount of dockside support required, driving down the risks associated with deploying within an acceptable TTFR.

To do this any solution must:

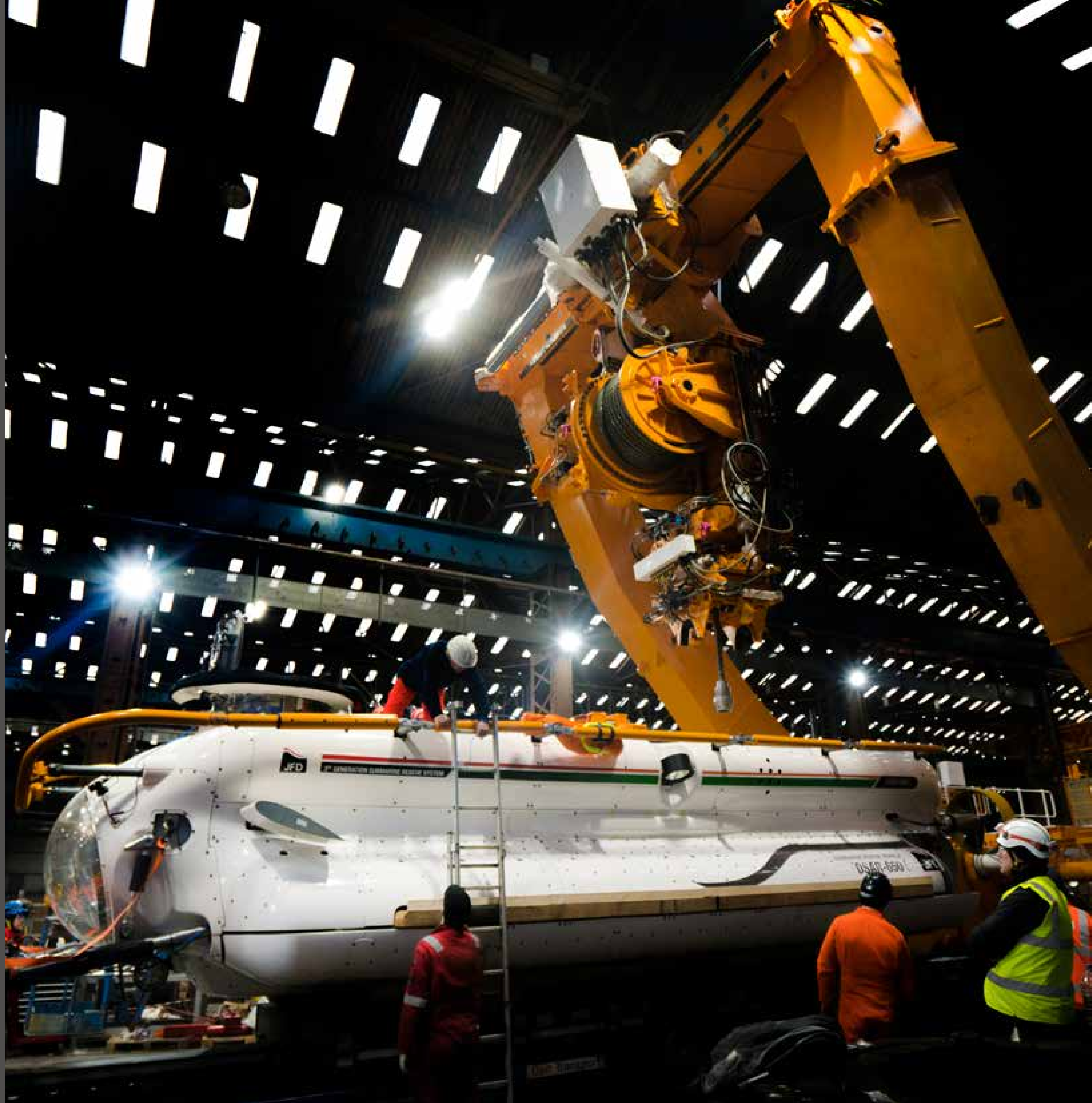
Minimise reliance on outside assets, including:

- The number of trucks and abnormal loads required
- The number and size of aircraft required
- Maximising the number of vessels which can carry the system

Minimising the time and risk associated with mobilisation, including:

- Minimising the number of cranes and welders required
- Minimising deck loadings
- Maximising flexibility in layout
- Reducing the number of interfaces to a minimum

Developing such a solution is challenging, particularly doing so within the framework of regulation and classification society rulesets which are not necessarily aimed at such unusual or highly optimised systems. The application of rules and conventions must be considered and be proportionate to the overall mission objective.



Key System Features

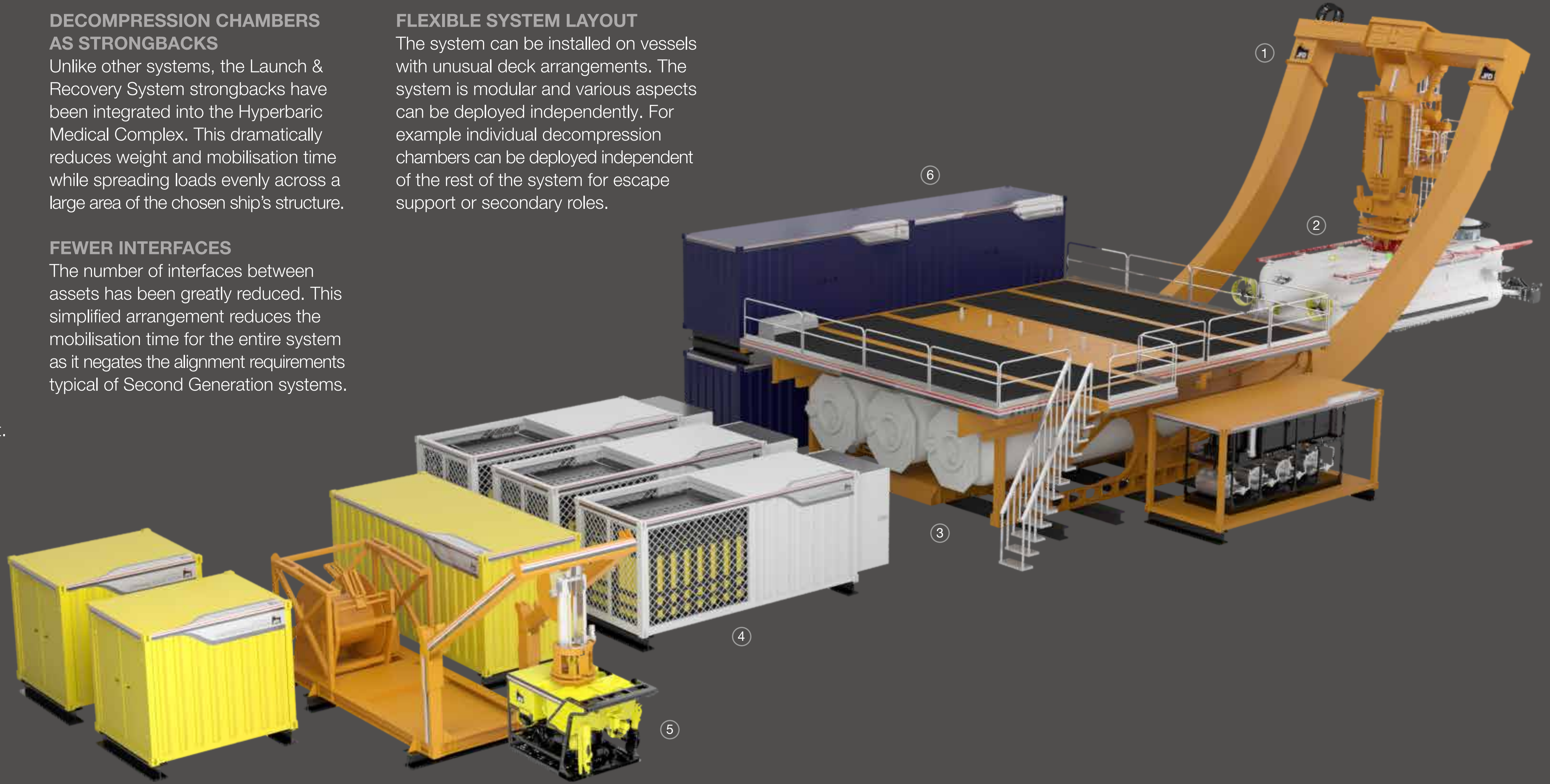
A FREE SWIMMING DSAR CLASS SRV
An adaptable and reliable system, based on 'simple' technology, allowing for repairs and maintenance while offshore with a minimal spares package. Lightweight, quick to deploy and with incredible endurance, DSAR is a proven class of SRV with three similar submersibles in operation worldwide.

VERTICAL TRANSFER UNDER PRESSURE
Vertical TUP reduces the footprint, weight and complexity of the entire system, reducing the time required for deployment and installation. Revised geometry in the SRV eases casualty handling through the new arrangement.

DECOMPRESSION CHAMBERS AS STRONGBACKS
Unlike other systems, the Launch & Recovery System strongbacks have been integrated into the Hyperbaric Medical Complex. This dramatically reduces weight and mobilisation time while spreading loads evenly across a large area of the chosen ship's structure.

FEWER INTERFACES
The number of interfaces between assets has been greatly reduced. This simplified arrangement reduces the mobilisation time for the entire system as it negates the alignment requirements typical of Second Generation systems.

FLEXIBLE SYSTEM LAYOUT
The system can be installed on vessels with unusual deck arrangements. The system is modular and various aspects can be deployed independently. For example individual decompression chambers can be deployed independent of the rest of the system for escape support or secondary roles.



1. **LAUNCH & RECOVERY SYSTEM**
Following a rescue, the LARS positions the SRV above one of three man-ways, allowing rescuees to enter directly into the Hyperbaric Medical Complex below.

2. **DSAR-CLASS SUBMARINE RESCUE VEHICLE**
Accommodates up to 17 rescuees per dive-cycle and interfaces directly with Decompression System below.

3. **DECOMPRESSION SYSTEM**
Hyperbaric Medical Complex accommodating up to 90 personnel for medical and hyperbaric treatment. Integrated with Launch & Recovery System for efficient mobilisation.

4. **DDC SUPPORT CONTAINERS**
Primarily provides high pressure air and therapeutic gasses to the Hyperbaric Medical Complex.

5. **REMOTELY OPERATED VEHICLE SYSTEM**
ROV & Side Scan Sonar provide search, survey, debris clearance and intervention capabilities.

6. **SUPPORT CONTAINERS**
Contain equipment and spares required to operate and maintain the entire system while at sea.

Concept of Operation

DISSUB DECLARED
Submarine downed and distress signal transmitted to authorities.

AIRCRAFT LOADING
Equipment loaded onto aircraft utilising air handling equipment supplied as part of system.

BASE LOAD-OUT
ISO standard transportable equipment begins load-out and transport to chosen airport.

AIRCRAFT DEPARTURE
Each aircraft takes two hours to load and departs when ready.

Concept of Operation

AIRCRAFT UNLOADING
Each aircraft takes one-hour to unload onto 40' ISO standard lorries and departs for MOPORT.

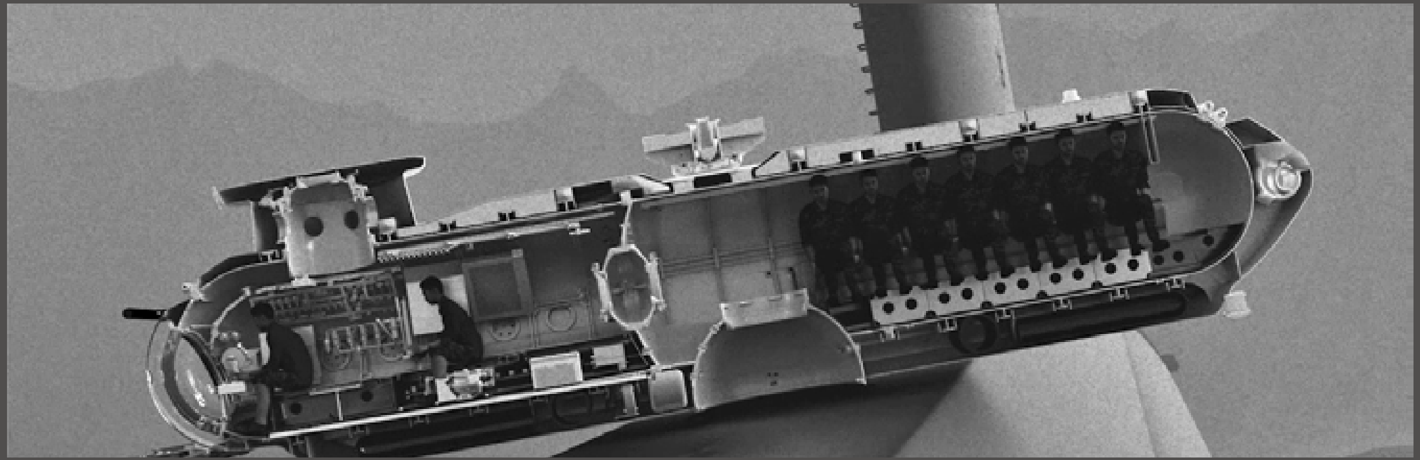
LAUNCH ROV
Following transit to datum and side scan survey, ROV is launched to deploy tracking transponders.

MOSHIP MOBILISATION
Assets are installed onto twist lock bases of pre-engineered VOO and commissioned.

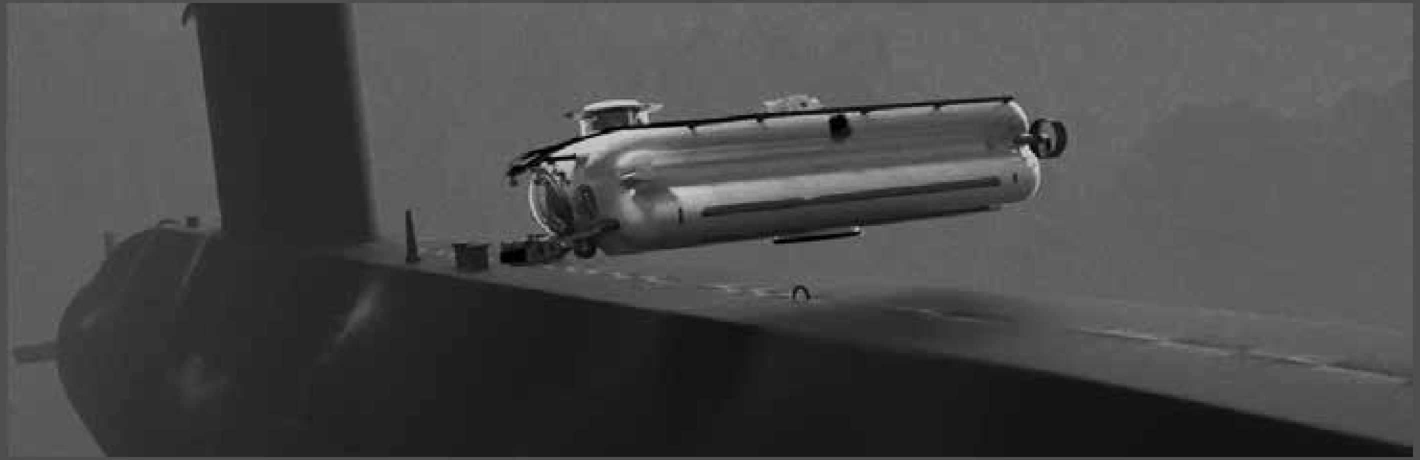
EMERGENCY LIFE SUPPORT STORES POD POSTING
Up to three pods may be delivered per ROV dive.

Concept of Operation

SRV LAUNCH
Following pre-dive checks, the SRV is launched over the stern of the MOSHIP.



RESCUEE TRANSFER
Rescuees are transferred into the SRV under pressure equal to that of the DISSUB.



SRV APPROACH AND MATING
SRV Pilot manipulates trim and thrust to manoeuvre into position and mate with DISSUB.

SRV RECOVERY AND ALIGNMENT WITH TUP
SRV is aligned to TUP Transfer Manway prior to being clamped into position.

Concept of Operation

HYPERBARIC TREATMENT
Up to 90 rescuees receive staggered medical and decompression treatment across three triple-lock chambers.

REPEAT RESCUE CYCLE
SRV performs multiple rescue cycles in order to return all DISSUB crew to the surface.

On time. On location.
Nothing else matters.

JFD

Aberdeen | Bremen | Cape Town | Glasgow | Perth
Portsmouth | Rome | Singapore | Sydney | Vaxholm | Virginia