VLVnT
Installation and Maintenance of the submarine network

The Maintenance aspect present some difficult as their cost is very high.
For this reason it's important:

- Redundancy where possible
- Reliability prevision
- Develop recovery and deployment techniques to avoid DP vessels
- Develop tools to increase automation

Criteria for selecting the Km3 Power System components is long term reliability

The reliability target for the Km3 Node Power System is a Mean Time Between Failures (MTBF) on the order of 500,000 hours which is equal to approximately 60 years.
This high value is due to number of nodes (String/Tower). With 60 node we expect a failure every year. For the control system the reliability could be more high 1,000,000 hours MTBF.

Reliability Results from other subsea application

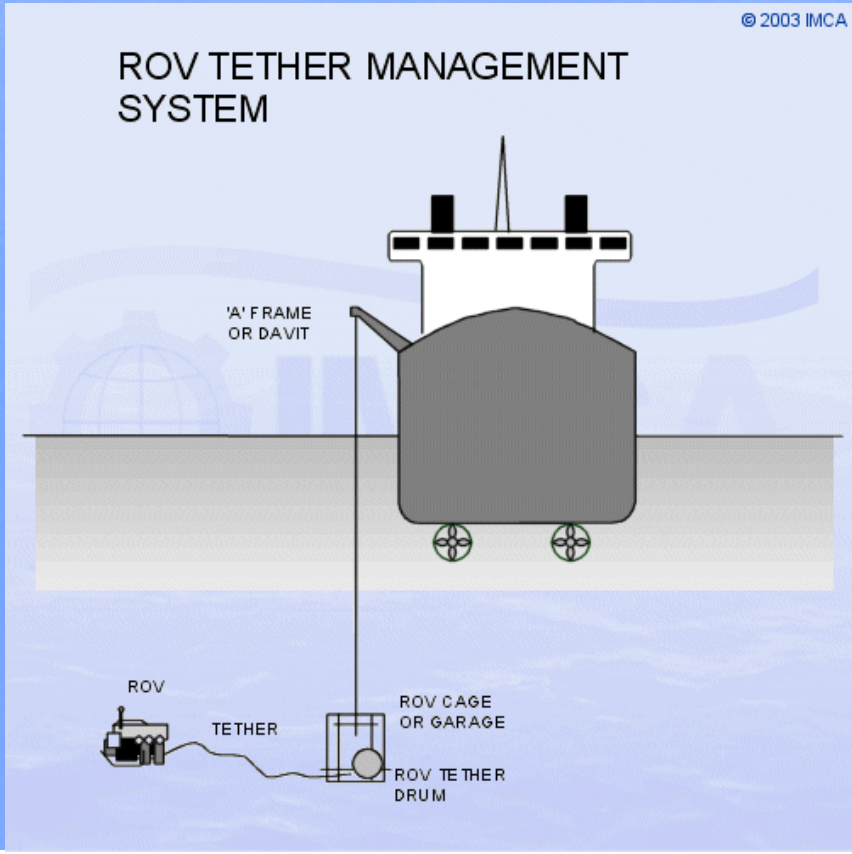
Node MTBF	No Failures*	</= 1 Failure*	</= 2 Failures*	</= 4 Failures*
30 Years	43%	71%	81%	89%
60 Years	61%	86%	92%	95%

* Failure is defined as loss of node

- calculations show that with node MTBF of 10^6 hours, half the nodes will fail in the lifetime of the project
- improving this performance is essential
- a plan of test to destruction, rather than estimate MTBF, may be a useful alternative

1. Using a special vessel equipped with dynamic positioning system and a ROV with robotic manipulator driven by the umbilical.

2. Use a bottom mounted ROV supplied by the underwater electro-optical cable



DP Vessel Limitation

- Building the electric network with the Junction Box Hubs for string connectors is to be considered as a standard job for a DP vessels and ROV when strings/towers are not yet installed.
- More complicate and dangerous is the same operation from the surface when delicate optical sensors have been installed in instrumentation field.
- The Maintenance Costs could be very High and implies:
  - a choice on the limit of fault string/towers that remain inactivated
  - Redundancy
  - Reliability of the entire system

Special DP vessel and ROV techniques

Assumptions:

- To deploy main Junction Box and string/towers underwater connecting stations together with the cable network for the string field
- The secondary JB have been deployed by the special DP Vessel with ROV and they are in their final location on the seabed.

Autonomous Underwater Robot on a bottom rail

- The concept is to relay in a bottom referenced fixed path for an Autonomous Underwater Vehicle also fitted with robot to operate the string connectors and with self-propulsion to move them in the field for installation and maintenance
- The fixed path is obtained with a rail network to reach the individual string location

Rail Features and Construction

- Rail is made out light composite profile fixed to the bottom in sections
- Its deployment must be done by DP Vessel and ROV
- Underwater assembly can be assigned to a special version of the AUV which would align, connect and fix to the seafloor the modular rail sections.

Rail Network Design

- Rack-rail will be only a passive path fitted with mechanical stoppers in the limits and the cross over. No points are provided.
- From a side line with two end stations (Terminuses) an array of 90 degrees rail sections is made for the corresponding number of the string line
- On the right and on the left of these sections reaches to individual string/tower stations are provided.

Rail Design Criteria

- Propulsion on the rack rail is obtained by motors fitted on the vehicle.
- Changing of direction is obtained by elevating the whole vehicle by a piston with a plate located on its lower surface and by a 90 degree rotation. Lowering the vehicle in this new direction and retracting the piston will complete the changing in direction.

Autonomous Underwater Robot Features

- Energy is obtained by set of battery.
- Battery are regularly recharged when the AUR is docked at the docking terminuses located at both ends of the side rail section.
- All AUR actions are pre-programmed.
- Tasks and coordinates are down-loaded, from shore by the communication system, at the Docking station.
- An Under Water winch is provided at the Docking Terminuses to link the strings with the surface in up-down modes

Autonomous Underwater Robot Modules
Main Characteristics

- Rack rail interface actuators for propulsion and direction changing piston
- Battery Package
- Engine Room
- Electronic Compartment
- Automatic Clutching System and its Sensors
- Strings Manipulating System