

V-LIFE F.A.Q.

FREQUENTLY ASKED QUESTIONS

WHAT DOES V-LIFE DO?

V-LIFE is a dynamic process that offers a preventative and active 'healing' solution for low Insulation Resistance (IR) caused by water ingress in subsea electrical cables, umbilicals and connectors.

HOW DOES V-LIFE WORK?

V-LIFE uses a patented process that works by the transmission of a passivation signal between the system electrical power conductors and Earth to produce an electrokinetic/electrochemical effect that increases the Insulation Resistance.

HOW IS V-LIFE CONNECTED TO MY SYSTEM?

V-LIFE is an advanced feature of the Viper Innovations' V-LIM Line Integrity Monitor device (the hardware). The V-LIM unit is installed in the topside Electrical Power Unit (or similar) and is connected between the subsea power conductors and Earth.

HOW IS V-LIFE ENABLED?

The V-LIFE process is enabled by the uploading of a valid software configuration licence file into the V-LIM unit. A licence file is issued by Viper Innovations upon payment of a licence fee which has a time limited validity period based on the duration purchased. "V-LIFE mode" may be enabled at any point after the V-LIM has been installed up until the licence file becomes invalid. A new licence file can be purchased from Viper Innovations at any point and Viper will provide notification in plenty of time before a licence expires. Please contact Viper for further details regarding the various licensing options.

HOW IS A V-LIFE ENABLED V-LIM UNIT INSTALLED?

Viper Innovations have successfully upgraded control systems to incorporate V-LIM hardware with V-LIFE functionality into equipment originally supplied by at least six different subsea control system suppliers. A

range of installation options are available to meet the needs of a particular system or configuration. Viper create bespoke installation procedures and can either deploy an experienced Engineer to install V-LIM/V-LIFE on your behalf or provide training to suitably competent personnel. Installations can be undertaken offshore or at Viper's facilities depending on requirements.

WHAT ELSE IS MONITORED BESIDES IR WHEN V-LIFE IS ENABLED?

When in "V-LIFE mode", the V-LIM continues to monitor Insulation Resistance as well as other parameters of the electrical distribution system (e.g. Insulation Capacitance, Line Voltage, Line Current, etc). The V-LIM touchscreen front panel displays a real-time graphical representation of the system Insulation Resistance and the effect of the V-LIFE process.

WILL V-LIFE WORK ON MY SYSTEM?

Prior to the installation of a V-LIFE enabled V-LIM, an assessment is made regarding the suitability to the specific subsea system. Systems which are unlikely to receive a positive result will not be recommended for V-LIFE. Following successful installation and IR recovery, monthly assessments are carried out to ensure that the optimal results are achieved and maintained.

I HAVE SUBSEA TRANSFORMERS IN MY SYSTEM, CAN I USE V-LIFE TO MONITOR AND RECOVER LOW IR ON INFIELD UMBILICALS AND OTHER EQUIPMENT ON THE SECONDARY SIDE OF MY SUBSEA CIRCUITS?

Yes, using our V-SLIM unit, which is a subsea version of the V-LIM. The V-SLIM can be deployed as a retrofit unit or embedded in new OEM equipment to monitor the secondary side of subsea transformers. V-SLIM can be V-LIFE enabled which allows low insulation faults to be rejuvenated even on systems with subsea transformers. This is particularly advantageous on systems with

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infield umbilicals which are difficult to fault find and costly to replace.

WHAT ARE THE ADVANTAGES OF V-LIFE?

V-LIFE has the potential to improve the Insulation Resistance of the subsea distribution system as a whole and limits further water ingress into cables and connectors. Furthermore, when successful, V-LIFE reduces the need for system downtime and/or subsea campaigns to replace hardware.

DOES V-LIFE USE PATENTED TECHNOLOGY?

Yes. Patents have been granted in the UK as well as various international territories.

CAN THE V-LIM BE INSTALLED WITHOUT V-LIFE ENABLED?

Yes. Many of our customers take the proactive approach of upgrading their system to a V-LIM prior to their Insulation Resistance degrading to the point of concern. This allows them to enable V-LIFE quickly without the need for an offshore mobilisation when the system IR decline starts.

WILL V-LIFE WORK IF THE LOW IR IS CAUSED BY A CONNECTOR FAULT, OR DOES IT ONLY WORK ON DEGRADED UMBILICAL CORES?

V-LIFE works on all the components within a subsea electrical distribution system, including cables and connectors, provided that the fault is due to water ingress.

WILL V-LIFE WORK ON COMMUNICATIONS AS WELL AS POWER CABLES?

Yes. V-LIFE has been used on both combined and separate power and communication cables.

WILL V-LIFE AFFECT SUBSEA COMMUNICATIONS WITH THE CONTROL SYSTEM?

No. V-LIFE has been deployed onto various system architectures and has been demonstrated to have

no impact or effect on communications between the topside control system and the subsea equipment.

WILL V-LIFE WORK ON SYSTEMS WITH INDUCTIVE COUPLERS RATHER THAN CONDUCTIVE CONNECTORS IN THE SUBSEA POWER CIRCUIT?

The V-LIM unit and V-LIFE process would work on the electrical equipment (i.e. conductors and connectors) up to the inductive couplers or transformers.

IS IT APPLICABLE FOR INSULATIONS MADE FROM BOTH PE & XLPE?

Yes. The V-LIFE process is independent of insulation material and will work with cables made using Polyethylene (PE) and Cross-Linked Polyethylene (XLPE) insulation.

WILL V-LIFE AFFECT OR BE AFFECTED BY SUBSEA CATHODIC PROTECTION SYSTEMS?

No. The V-LIM unit and V-LIFE process do not affect the subsea cathodic protection system. Conversely, Impressed Current CP systems do not affect the operation of the V-LIM unit or the V-LIFE process.

CAN V-LIFE BE USED ON GREENFIELD SITES AND NEW UMBILICALS?

Yes. The V-LIM unit can be installed into greenfield sites (i.e. new developments) or retrofitted into brownfield sites (i.e. existing developments) and can be fitted into new or existing equipment using one of several installation options available. V-LIFE can be used without any negative effects on new or existing systems.

CAN DIVER OPERATIONS CONTINUE WHEN V-LIFE IS IN OPERATION?

The voltage and current impressed onto the system by the V-LIFE process will not exceed that of the Production Control System (PCS) communications and/or power signals. Therefore, any restrictions that are in place for normal diver operations on the system in question will

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be unchanged by the application of V-LIFE. If the V-LIFE process is to remain active with the PCS de-powered, then advice should be sought from Viper Innovations.

HOW IS V-LIFE CONNECTED TO THE EPU AND UPS?

A V-LIM unit that is going to be configured in “V-LIFE mode”, is connected to the system in the same way as if it were in standard “V-LIM mode”. The V-LIM “Mains Supply” connector requires connection to a fused 110/240 VAC (50 / 60 Hz) supply and the “Line” connector requires connection in parallel to the EPU output circuit so that measurement signals can be applied to the system. The measurement signals applied have no effect on the EPU output voltage or frequency being supplied to the subsea control modules.

WILL V-LIFE WORK ON HIGH VOLTAGE POWER CABLES?

The maximum Line Voltage that can be connected directly to the V-LIM unit is 1000 VAC. So, the application of the V-LIFE process is limited to this voltage for direct Line connections. The V-LIM unit has been tested with a range of Line interface modules for applications at >1000 VAC and it may be possible for the V-LIFE process to be activated. Please contact Viper Innovations to discuss specific requirements.

WHAT ARE THE EFFECTS ON THE HOST CONTROL SYSTEM POWER CIRCUIT?

When in “V-LIFE mode”, the V-LIM unit applies a common-mode passivation signal to both power cores (L1 and L2) and, therefore, will have no detrimental effect on the control system power supply.

WHAT VOLTAGE IS IMPOSED ONTO THE EXISTING SYSTEM?

The absolute maximum voltage that can be applied to the Line by the V-LIM unit is 110V (including in “V-LIFE mode”). Regardless of the voltage applied, the current will not exceed 0.8mA under any circumstances, even under an external fault condition (e.g. a short to earth).

The applied voltage is a complex signal waveform dynamically configured to achieve the electrokinetic and electrochemical effects.

WHAT WILL HAPPEN IF V-LIFE IS SWITCHED OFF AFTER A PERIOD OF OPERATION – WILL THE IR REMAIN AT A HIGH LEVEL?

Following removal of the V-LIFE signal from the Line (i.e. the V-LIM unit is taken out of “V-LIFE mode”), the system Insulation Resistance will fall at a rate dependent on the inherent failure mode of the system, eventually returning to around the initial value that was present before V-LIFE was applied. This fall will typically be over a period of hours or days. Therefore, the V-LIFE process needs to be permanently switched on to maintain the increased IR in the subsea system. Viper Innovations retain spare V-LIM units to ensure replacements can be quickly mobilised.

IS THE IR MEASUREMENT FROM V-LIFE CONSISTENT WITH THAT MEASURED BY AN INSULATION TESTER (MEGGER)?

The V-LIFE effect is not permanent. Following removal of the V-LIFE signal from the Line (i.e. the V-LIM unit is taken out of “V-LIFE mode”), the system Insulation Resistance will fall at a rate dependent on the inherent failure mode of the system, eventually returning to around the initial value that was present before V-LIFE was applied. As a consequence, the comparability of IR readings taken using Insulation Testers (e.g. a Megger) is dependent on the duration that “V-LIFE mode” has been switched off prior to taking the measurement. Therefore, an Insulation Tester IR result may be lower than the result measured and reported when “V-LIFE mode” was enabled.

CAN V-LIFE BE FITTED TO A CHANNEL WITH A LOW IR?

Installation experience has verified the performance of the V-LIFE process on systems with an initial IR as low as around 20 kΩ. However, despite this, Viper strongly

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recommend that V-LIFE is enabled in good time before the system IR has degraded to this low level and, preferably, when the IR is still $>100\text{ k}\Omega$. This will help to mitigate any sudden drops in system IR or other changes in conditions. Please contact Viper to discuss specific system conditions.

WHAT IS THE IR MEASUREMENT RANGE WHEN V-LIFE IS ENABLED?

When V-LIFE is enabled, the measurement range is from $1\text{ k}\Omega$ to $500\text{ M}\Omega$.

DOES V-LIFE SACRIFICE ANY COPPER IN THE PROCESS?

A small amount of copper is used in the creation of the passivation layer which comprises a non-conducting precipitate. Whilst a system with V-LIFE applied uses copper in the process, the resulting copper loss is less than a low IR system without V-LIFE applied. For further detailed information, Viper completed a unique investigation into copper loss in subsea electrical systems and the paper, entitled "Low Insulation Resistance", can be found on our website under "Resources".

DOES V-LIFE WORK WITH AN EXISTING THIRD PARTY IMD?

The V-LIFE process is a unique feature of the Viper Innovations V-LIM unit and will not work whilst an existing third party Insulation Monitoring Device (IMD) is connected to the circuit. This is due to incompatibilities of signals applied to the system by the various devices.

Therefore, the third party IMD must be removed from the circuit so that the V-LIM unit can be installed and "V-LIFE mode" enabled.

DO WE REQUIRE A SITE SURVEY?

Viper Innovations has extensive experience in the installation of V-LIM units into many systems and equipment from several different suppliers. Interface Engineering and procedures can be completed using detailed systems schematics, General Assembly drawings and photographs in the majority of applications. A site survey could be arranged if required, but is generally not essential.

CAN REFERENCES AND / OR TESTIMONIALS BE PROVIDED?

Several of our V-LIFE customers have agreed to answer direct questions from prospective V-LIFE users and Viper can provide contact details upon request. Case studies of previous V-LIFE installations can also be found on our website under "Resources".

HOW LONG DOES IT TAKE FOR V-LIFE TO HAVE A VISIBLE AFFECT ON THE IR?

The responsiveness of the V-LIFE process is dependent on several factors. For example, the system design, age, presence of any inherent faults, location, environment, water ingress, etc. The V-LIFE process can be effective in a matter of hours or days. Viper generally recommend applying the V-LIFE process to the system for a minimum period of one week in order to assess the responsiveness.

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