



PROACTIVE MINI UPGRADES FOR MV DRIVES

It's all about your MV drive's maintenance & upgrades

Importance of proactive maintenance & upgrades

MV drives are one of the critical power components of your plant. It has high influence on your plant operation control along with supporting devices such as HMI, PLC, I/O modules etc. It's essential to maintain its health for uninterrupted operation as it directly controls the process.

Inadequate maintenance over a period could allow the deforming factors such as temperature, moisture, dust, old age components/logics, water pressure and flow, cyber threats, poor inventory planning to magnify its effects on your drive and end up with substandard performance, unexpected breakdowns, insupportable OPEX, insufficient critical spares etc. Proactive maintenance is the only way to maintain your critical power equipment safe and healthy by keeping the deforming factors in control.

Power Conversion's proactive approaches

Based on supplier information and field experience in different operating environments across the globe, Power Conversion presents a set of proactive mini upgrades to its MV drives. As their name, they are mini, in terms of budgets, pre-requisites, implementing time and modification aspects. Based on modification aspects, we have confined this mini upgrade under two categories namely,

1. Audit plans – No modifications
2. Upgrade solutions – Minor hardware/software addition/modification

1. Audit plans

Power Conversion recommends 'Audit plans' for your MV drives to understand the condition & performance of various components of your MV drive and to take necessary on time maintenance to avoid unexpected breakdowns and deficient spares. It's a simple inspection

approach as there is no modifications in your existing drive set-up. Audits will be performed at site by PC experts and reports with recommendations will be submitted for preventive actions.

How does it differ from a regular check and what is the long run benefit to customers?

- *Unlike a regular check, these audits are framed and comprehensive with appropriate measuring tools to monitor the operating ranges of different components of drive, which enables the customer to understand the current status of their drive by comparing it with recommended operating ranges.*
- *It will also serve as a baseline reference for future plant expansions or modernizations.*

2. Upgrade solutions

Power Conversion recommends 'Upgrade solutions' to its MV drives to make them more protective and efficient towards the deforming factors in every aspects.

These minor modifications could save your drives from major breakdowns and complete replacements. End to end support will be given by GE experts including drawing update. All available upgrade solutions are classified as below based on the type of modifications for easy reference.

- a) **Hardware upgrades** : Replacing old age components, additional protective components/schemes as add-ons for safe and economical operation.
- b) **Software upgrades** : Few software updates for user friendly operation and to prevent cyber threats
- c) **Combined upgrades** : combination of software and hardware modifications for safe operation

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An overview of available audits and upgrade solutions

Proactive mini upgrades for MV drives – An overview

1. Audit plans (No modifications)	1-1. Cooling system audit/maintenance (M-O-I)	1-2. EMC audit (M-O-I)	1-3. Stack in stock health check (M-O-I)	
2. Upgrade Solutions (upgrades contain software/hardware addition/modification)				
2a. Hardware upgrades	2a-1. Pre-emptive Protection scheme (M-O-I)	2a-2. PP-R to PP-S Manifold upgrade (IB before 2014) (M-O-I)	2a-3. SCN804 power supply replacement (M-O-I)	2a-4. Varistor and fuse replacement (M-O-I)
	2a-5. Addition of fuses to gate drivers (M-O-I)	2a-6. HMI addition to wheelhouse (M-Merchant/offshore)	2a-7. Humidity sensor addition (M-O-I)	2a-8. Beckhoff module's load sharing improvement (M-O-I)
	2a-9. HMI replacement (M-O-I)	2a-10. Cooling water hose replacement (M-O-I)	2a-11. MV7 integrated maintenance PC (M-O-I)	
2b. Software upgrades	2b-1. Cyber protection for human interface (M-O-I)	2b-2. Lever auto calibration (M-Merchant only)	2b-3. Reduced Power Test (RPT) (M-O-I)	2b-4. Power mode synchronization (M-Merchant only)
	2b-5. Beckhoff module diagnostics improvement (M-O-I)	2b-6. Health monitoring software for DCcapacitors (M-O-I)		
2c. Combined upgrades	2c-1. Anti avalanche upgrade (M-O-I)	2c-2. Manual activation of power mode upgrade (M-Merchant/offshore)		

M-O-I : Applicable to Marine – Oil & Gas - IPWW

**Predefined/customized upgrade clusters are available for batch upgrades*



PROACTIVE MINI UPGRADES FOR MVD DRIVES

Summary & modifications details

Customer concerns	Solutions from GE	
<p>1. Audit plans</p> <p>1-1. Various environmental factors and continuous water flow & pressure may affect the health & performance of cooling system components</p> <p>1-2. Electromagnetic interferences may cause EMC issues like interrupted communication/losof signals, nuisance trips, etc.</p> <p>1-3. Spare stacks that stored more than 5 years may not be in ready to use condition and can create uncertainty of using it in a breakdown</p>	<ul style="list-style-type: none"> ➤ Cooling system audit/maintenance, a detailed study to inspect the health of various components of cooling system ➤ EMC audit, step-by-step approach to reduce electromagnetic compatibility. (EMC) disturbances ➤ Stack in stock health check, a comprehensive inspection to identify the readiness & functional status of stacks that stored for a long time 	<p>No Modifications</p> <p>No Modifications</p> <p>No modifications, stacks need to be sent to PC factory</p>
<p>2. Upgrade solutions : a. Hardware upgrades</p> <p>2a-1 High inrush currents while starting MV drives affects premagnetizing transformer of precharging circuit and leads to driver failure</p> <p>2a-2 Leakages in the coolant circuit can reduce the coolant pressure and may cause drive trips</p> <p>2a-3 Old power supply with classic components may create serviceability issues during breakdowns</p> <p>2a-3 Age old varistor and fuses may be affected by environmental conditions and may allow high voltage surges to pass through</p>	<ul style="list-style-type: none"> ➤ Pre-emptive protection scheme, a vigilant formula to safeguard the pre-magnetizing transformer before breakdown ➤ PP-R to PP-S Manifold upgrade to reduce risky leakages at the joints ➤ SCN804 power supply replacement to upgrade your power supply with new age components ➤ Varistor and fuse replacement to save your drive system from high voltages surges with new age components 	<p>Hardware Modification</p> <p>Hardware Modification</p> <p>Hardware Modification</p> <p>Hardware modification</p>



PROACTIVE MINI UPGRADES FOR MVDRIVES

Summary & modifications details

	Customer concerns	Solutions from PC	
2a-5	Short circuits at primary side of the power supply can propagate to gate driver circuit and create major damages	➤ Addition of fuses to gate drivers to safeguard your gate driver circuit from short circuits	Hardware Addition
2a-6	Limited propulsion data to wheelhouse crew leads to high dependency on ECR crew & delay in instant decisions at critical conditions	➤ HMI addition to wheelhouse, for same information level and for quick decisions without delay & dependency	Hardware Addition
2a-7	High humidity creates condensation. Unidentified condensation may end-up with unexpected flashovers	➤ Humidity sensor addition, a simple add-on solution to shield your drives from condensational flashovers	Hardware Addition
2a-8	Beckhoff I/O racks are getting power from a head station. Overloading leads to head station failure and drops communication	➤ Beckhoff module's load sharing improvement to calculate and improve the load sharing thereby avoids head station overloading	Hardware Addition
2a-9	Connected operation leads to better process control and easy maintenance	➤ HMI replacement for plant wide system integration in an easier way with a single instrument	Hardware Addition
2a-10	Temperature, moisture, dust, water pressure and flow over an period can change material properties	➤ Cooling water hose replacement to reduce the unexpected risks by replacing the old hoses	Hardware replacement, based on audit
2a-11	Separate laptop increases the risk of losing availability of equipment and information within, mostly caused by external factors	➤ MV7 integrated maintenance PC to keep on-hand information of your drive's performance, system alarms and faults	Hardware Addition
2. Upgrade solutions : b. Software upgrades			
2b-1	USB sticks may propagate powerful malwares through standalone machines which doesn't have internet for online surveillance	➤ Cyber protection for human interface to protect your standalone machines from cyber threats	



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Summary & modifications details

	Customer concerns	Solutions from PC	
2b-2	Speed levers without proper calibration may end-up with lever damages and triggering alarms	➤ Lever auto calibration to calibrate the speed levers automatically without GE FSE's intervention	Hardware Addition
2b-3	Preliminary conditions and the flawlessness of the drive must be checked before starting the drive for safe operation	➤ Reduced Power Test (RPT) , an automated sequence through HMI to check the condition of drive components before starting the drive	Hardware Addition
2b-4	The synchronized operation of propulsion drives is affected in 'rough sea' power control mode which is initiated by bad weather at sea bases	➤ Power mode synchronization to ensure the synchronized operation of propulsion drives in 'rough sea' power control mode	Hardware Addition
2b-5	Failure in Beckhoff modules interrupts process data communication which may stop the propulsion unexpectedly	➤ Beckhoff module diagnostics improvement , a simple addition of diagnostic mimic to highlight the failure modules instantly	Hardware Addition
2b-6	Ageing leads to progressive reduction of capacitance, resulting in voltage ripple that may cause trips	➤ Health monitoring software for DC capacitors , a software program to monitor the lifespan of DC capacitors	Hardware Addition
2c. Combined upgrades			
2c-1	Short circuit in any IGBT can spread the same to other IGBTs and create unexpected breakdowns of drive system	➤ Anti avalanche upgrade to restrict the propagation of short circuits among IGBTs	Software and hardware modification
2c-2	Synchronous operation of propulsion drives in all weather condition is a mandatory criteria for a vessel	➤ Manual activation of power mode to enable the 'rough sea' power control mode manually in normal weather to ensure the synchronous operation of propulsion drives	Software and hardware modification



PROACTIVE MINI UPGRADES FOR MVDIVES

Salient points

1. Audit plans				
		Applicability	Site implementation time *	Frequency
1-1	Cooling system audit/maintenance	AI MV7 & SD7 water cooled drives	2 FSE days/drive for audit & 3 FSE days/drive for maintenance if parts are available at site (which excludes hose & manifold replacement as both are optional)	Every 5 years/ Maintenance
1-2	MC audit	AI MV7 & SD7 water cooled drives	2.5 FSE days/drive	Every 5 years/ Maintenance
1-3	Stack in stock health check	All spare stacks of MV7 & SD7	Stacks need to be sent to PC factory	Every 5 years/ Maintenance
2. Upgrade solutions : a. Hardware upgrades				
		Applicability	Site implementation time *	Frequency
2a-1	Pre-emptive protection scheme	All MV7 drives without it	2 FSE days/drive	One time upgrade/CMU
2a-2	PP-R to PP-S Manifold upgrade	All MV7 water cooled drives (IB before 2014), FR manufactured	3 FSE/4 days/drive	One time upgrade/CMU
2a-3	SCN804 power supply replacement	SD7 & Palix drives	2 hours/SCN804 card with 1 FSE	Every 10 years/ Maintenance
2a-4	Varistor and fuse replacement	SD7 drives	2 FSE days/drive	Every 10 years/ Maintenance
2a-5	Addition of fuses to gate drivers	MV7312/MV7309/ MV7308/ MV7306/ MV7304, not for high frequency power supply	1 FSE day/drive	One time upgrade / CMU

* Site implementation time may vary based on drive type/architecture/site conditions etc.



PROACTIVE MINI UPGRADES FOR MVDIVES

Salient points

		Applicability	Site implementation time *	Frequency
2a-6	HMI addition to wheelhouse	All propulsion system without HMI on wheelhouse	2 to 5 FSE days/vessel depending on no of HMI added and vessel configuration	One time upgrade/CMU
2a-7	Humidity sensor addition	AI MV7 & SD7 water cooled drives	1 FSE day/drive	One time upgrade/CMU
2a-8	Beckhoff module's load sharing improvement	II MV7 & SD7 drives with Beckhoff racks	1 FSE/0.5 day/drive	One time upgrade/CMU
2a-9	HMI replacement	All MV7 & SD7 drives with old QP HMI/keypad HMI	3 FSE days/drive	One time upgrade/CMU
2a-10	Cooling water hose replacement	All MV7 & SD7 water cooled drives	3 FSE/4day/drive	Every 10 years based on 1-1 audit results/ Maintenance
2a-11	MV7 integrated maintenance PC	All MV7 drives	2FSE day/drive	One time upgrade/CMU

2b. Software upgrades

		Applicability	Site implementation time *	Frequency
2a-1	Cyber protection for human interface	All types of maintenance PCs & HMIs	1 FSE day for 3 to 5 computers	One time upgrade/CMU
2a-2	Lever auto calibration	Drives with remote I/O with Buk B / C type levers connected to Wago 750-461/000-200 type connectors	1 FSE day/vessel	One time upgrade/CMU

* Site implementation time may vary based on drive type/architecture/site conditions etc.



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Salient points

2b-3	Reduced Power Test (RPT)	MV7 with RXi-042 or Rxi-142 controller	FSE days/drive	One time upgrade/CMU
2b-4	Power mode synchronization	All MV7 & SD7 drives without it	1 FSE for 2 days/vessel depending on site conditions	One time upgrade/CMU
2b-5	Beckhoff module diagnostics improvement	All MV7 & SD7 drives with Beckhoff racks	1 FSE/day/drive (depending on the vessel architecture too in case of marine)	One time upgrade/CMU
2b-6	Health monitoring software for DC capacitors	All MV7 & SD7 drives	1 FSE days/drive	One time upgrade/CMU
2c. Combined upgrades				
		Applicability	Site implementation time *	Frequency
2c-1	Anti avalanche upgrade	MV7315 & MV7312 drives equipped with either GDR111 or PIB671 gate driver for Marine and MV7 3kV range drives (DFE driver for Induction motor) for O&G, IPWW	1 FSE day/drive	One time upgrade/CMU
2c-2	Manual activation of power mode	Drives with remote I/O with Buk B / C type levers connected to Wago 750-461/000-200 type connectors	1 FSE for 2 days/vessel depending on site conditions	One time upgrade/CMU

* Site implementation time may vary based on drive type/architecture/site conditions etc.



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Predefined mini-upgrade clusters from Power Conversion

Predefined mini-upgrade clusters from Power Conversion*				
C1. Cooling system	1-1. Cooling system audit/ maintenance	2a-10. Cooling water hose replacement		
C2. Cooling system Upgrade solutions	2a-2. PP-R to PPS Manifold upgrade			
C3. Marine HMI & software enhancement	1-2. EMC audit	2a-6. HMI addition to wheelhouse	2a-9. HMI replacement	
	2b-1. Cyber protection for human interface	2b-2. Lever auto calibration	2b-3. Reduced Power Test (RPT)	
	2b-4. Power mode synchronization	2b-5. Beckhoff module diagnostics improvement	2c-2. Manual activation of power mode	
C4. HMI & software enhancement	1-2. EMC audit	2a-3. Reduced Power Test (RPT)	2a-9. HMI replacement	2b-1. Cyber protection for human interface
C5. I/O modules enhancement	2a-1. Pre-emptive protection scheme	2a-3. SCN804 power supply replacement	2a-4. Varistor and fuse replacement	
C6. Additions & replacements	2c-1. Anti avalanche upgrade	2a-3. SCN804 power supply replacement	2a-4. Varistor and fuse replacement	
	2a-5. Addition of fuses to gate drivers	2a-7. Humidity sensor addition	2c-1. Anti avalanche upgrade	
C7. 'Rough sea' power mode upgrades (Marine specific)	2b-4. Power mode	2c-2. Manual activation of power mode		
<i>*Please ensure the applicability based on segment & drive type before proceeding</i>				
<i>**Customized/partial predefined upgrade clusters are also possible upon request</i>				