

Work Instruction

MantaRay Battery Dismantle and Assembly

Vehicle Number

Revision: A.2

Revision Date: 12-Apr-24

DOCUMENT OWNER: Subsea Manager, Operations

Revision	Date	Description	Author	Reviewer	Approver
A.1	23-Sep-23	IDC	SRJ	HB	//
A.2	12-Apr-23	IDC	SRJ	HB	SRJ

Work Instruction Completion Certificate

Equipment	Serial Number	Notes
HAUV MantaRay	MR-01	
Battery Unit		STBD FWD
Battery Unit		PT FWD
Battery Unit		PT AFT

Battery Dismantle			
All works have been carried out in accordance with this work instruction.			
Name	Position	Date	Signature

Battery Assembly			
All works have been carried out in accordance with this work instruction.			
Name	Position	Date	Signature

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List of Abbreviations

Terms and Abbreviations	Definition
BMS	Battery Management System
EHSQ	Environmental, Health, Safety and Quality
EPOD	Electronic Pod
FOD	Foreign Object Debris
kWh	kiloWatt / Hour
VDE	Accredited electrically safe tooling [Verband der Elektrotechnik]

Table 1 Terms and Abbreviations

1. Introduction

The purpose of this Work Instruction is to provide referenced guidance to be used in conjunction with the Saab Sabertooth Operators manual and Saab training to safely and efficiently handle, dismantle and assemble the MantaRay batteries.

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2. EHSQ

2.1 Procedure minimum safety requirement.

- Adherence to Battery handling rules as described with in the Sabertooth Operator Manual Document Ref [9].
- The persons undertaking the procedure:
 - have received suitable training and have been assessed as competent to safely conduct the work.
 - are in good health, absent of fatigue, distraction, and stress.
 - are a working as a team of two.
- The work environment is suitable for the work to be carried out:
 - Clear of distraction
 - Clear of persons not involved in the operation.
 - Climatically sound
- Full sanitizing of the persons involved in the procedure of Foreign Object Debris (FOD)
Example: Pens, wedding rings, watches, ID passes, coins.

3. Reference Documents

3.1 PXGEO Documents

Reference	Document Number	Title
1.	HOU-1	Task Risk Analysis
2.	HOU-3	Opening / Closing Sabertooth EPODS
3.		
4.		
5.		
6.		
7.		
8.		

Table 2 Reference Documents - PXGEO

3.2 3rd Party Documents

Reference	Document Number	Title
9.	40-4162700	Sabertooth Technical Manual
10.	20-416266	Battery Module Complete
11.	N/A	Kokam SDS LC Danger Rev4
12.	SLPB 90216216 / ZC04	Kokam Technical Specification
13.	DWG 20-4162666	Battery Module Complete
14.	N/A	Battery Test Summary Section 38.3
15.		
16.		

Table 3 Reference Documents - 3rd Party

4. Overview

The standard MantaRay vehicle is powered by 3 x 10kWh LiPo battery units contained within the two vehicle EPODs.

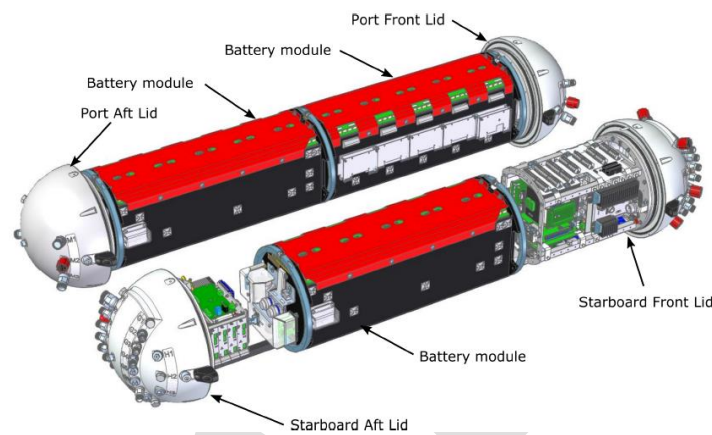


Figure 1 MantaRay Vehicle batteries Starboard and Port

Each battery unit contains 5 x Battery modules connected in series.

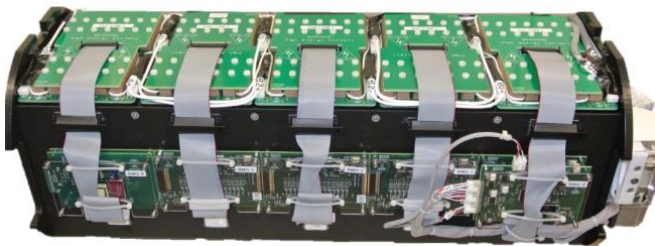


Figure 2 Battery Unit with 5 x Battery Modules



Figure 3 Battery Module

	Battery Unit	Battery Module
Energy	10 kWh	2 kWh
Max voltage	290 VDC	59 VDC
Min voltage	240 VDC	47 VDC
Size L x W x H		
Weight in air	90 Kg	15 Kg

Table 4 Leading Particulars

5. Equipment

Equipment	Part Number	Notes
Insulated workbench		
HV Insulated gloves		
HV Rescue hook		
Fire Extinguisher		LithX
Insulated fuse holder		
VDE Torx driver <ul style="list-style-type: none"> #20 #30 		
Insulated socket and wrench <ul style="list-style-type: none"> 8mm 		
Hex driver 3mm		
Spanner 8mm		
Insulated terminal screwdriver		
Insulation tape		
Terminal insulation caps		
Cable ties		
5 x Internal battery module storage box and fuse		
5 x External battery module storage case.		
Silica Gel Bags		

Table 5 Required Equipment

6. Disassembly Procedure

6.1 Battery One

Battery Serial Number																				
Vehicle Battery Location																				
Step	Task	Note																		
1.	The purpose of this task plan is to detail the actions to be taken to safely dismantle a MantaRay battery	INFO																		
2.	DO NOT UNDERTAKE THIS PROCEDURE WITHOUT THE CORRECT TRAINING AND CERTIFICATION. DO NOT UNDERTAKE THIS PROCEDURE WITHOUT SATISFYING SHEQ REQUIREMENTS IN SECTION 2	MANDATORY																		
3.	Place battery on an insulated, clean, and level worksurface.																			
4.	Confirm battery is secure on the worksurface.																			
5.	Remove and discard Silica Bags																			
6.	Confirm no BMS / Processor activity. LEDs illuminated.																			
7.	Remove the battery box top protection cover.																			
8.	Detach 2 connectors from Battery 4 +ve. Fit connector insulation caps. Secure away from work area.																			
9.	Detach the connector from Battery 0 -ve. Fit connector insulation cap. Secure away from work area.																			
10.	Disconnect 5 x BMS ribbons cables starting with B4 then in sequence B3,B2,B1,B0.																			
11.	Disconnect the battery module connections in the following order; <table><tr><th>Connection</th><th>Removed</th></tr><tr><td>B0 +ve</td><td></td></tr><tr><td>B1 -ve</td><td></td></tr><tr><td>B1 +ve</td><td></td></tr><tr><td>B2 -ve</td><td></td></tr><tr><td>B2 +ve</td><td></td></tr><tr><td>B3 -ve</td><td></td></tr><tr><td>B3 +ve</td><td></td></tr><tr><td>B4 -ve</td><td></td></tr></table>	Connection	Removed	B0 +ve		B1 -ve		B1 +ve		B2 -ve		B2 +ve		B3 -ve		B3 +ve		B4 -ve		
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B4 -ve																				

Battery Serial Number			
Vehicle Battery Location			
Step	Task		Note
12.	Measure and record each battery module voltage.		
	Battery Module	SN	
	B0		
	B1		
	B2		
	B3		
	B4		
13.	Cover ALL battery terminals with electrical insulation tape.		
14.	Remove 5 x Battery modules from BMS carcass using the lifting handles and place on a suitable surface.		
15.	Fit a transportation fuse on to the +ve terminal of each battery module.		
16.	Store each battery module within both the internal storage box and external storage case.		

Table 6 Disassembly - Battery One

6.2 Battery Two

Battery Serial Number																				
Vehicle Battery Location																				
Step	Task	Note																		
1.	The purpose of this task plan is to detail the actions to be taken to safely dismantle a MantaRay battery	INFO																		
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Table 7 Disassembly - Battery Two

6.3 Battery Three

Battery Serial Number																				
Vehicle Battery Location																				
Step	Task	Note																		
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Table 8 Disassembly - Battery Three

7. Assembly Procedure

7.1 Battery One

Battery Serial Number																																
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6.	Examine the 5 x battery module chambers for FOD and the condition of the securing foam.																															
7.	Prepare the battery modules post storage; <ul style="list-style-type: none">Remove modules from internal and external storage boxesRemove the fuses from each of the battery module +ve terminalInspect the external condition of each battery module																															
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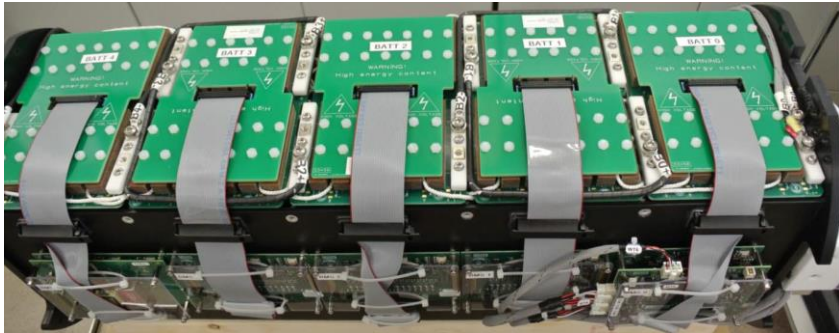
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14.	Refit the battery box top cover																			
15.	Replace silica bags. Mark with date.																			

Table 9 Assembly Battery One

7.2 Battery Two

Battery Serial Number																																
Vehicle Battery Location																																
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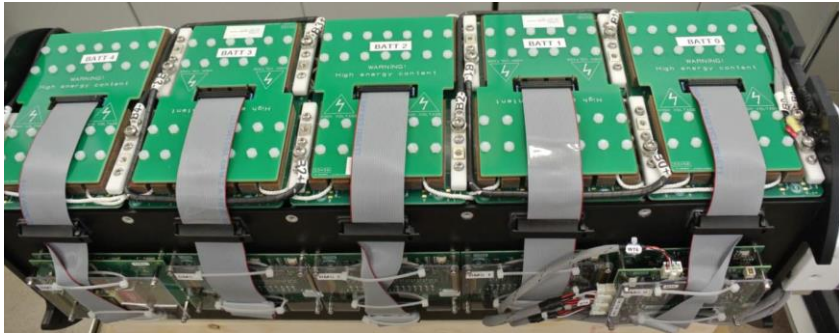
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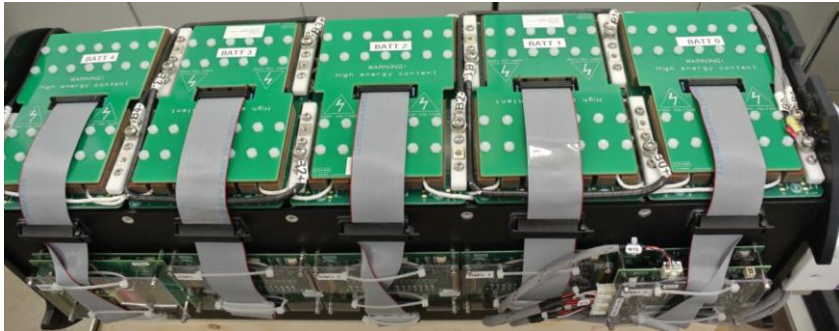
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