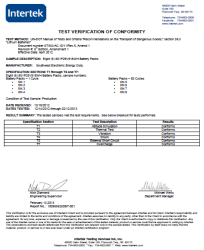
SOUTHWEST ELECTRONIC ENERGY GROUP

Advanced Battery Solutions

Underwater Intervention 2019:

Novel ABS Approved Pressure Tolerant Lithium Ion Battery Modules for MUVs

Leon Adams, VP



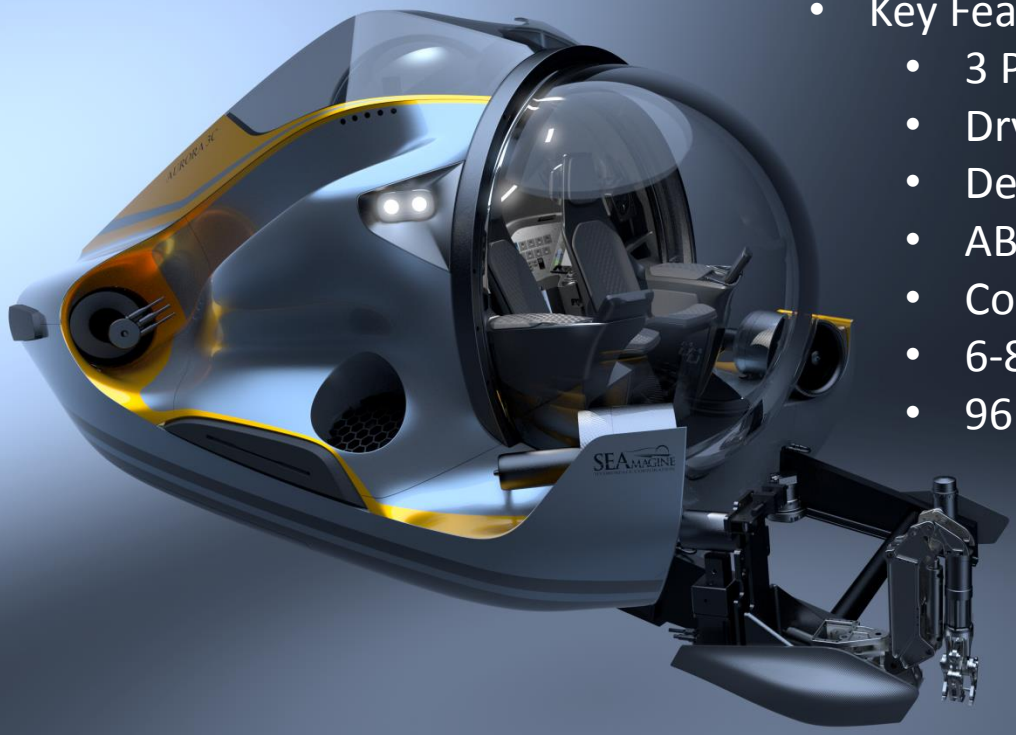
Agenda

- ***MUV***
- Battery Module
- MUV Battery System using Battery Module
- ABS Type Approval- PDA of Battery Module
- Battery Module Tests
- Summary

SEAmagine Aurora 3C Submarine-MUV

Key Features

SEAMAGINE
HYDROSPACE CORPORATION



- Key Features
  - 3 Person 1ATM Submersible
  - Dry Weight of 3800 Kg
  - Depth Rating 457 m (1500 ft)
  - ABS Classed
  - Compact Size
  - 6-8 Hour Mission Time
  - 96 Hours of Reserves

SEAmagine Aurora 3C Submarine-HUV Battery System Requirements:

SEAMAGINE HYDROSPACE CORPORATION

- **Key Battery System Requirements**
  - **Pressure Tolerant to 3000M Depth**
  - **240 Volts DC Power Bus**
  - **40 AMPs Max Continuous Current**
  - **High Reliability**
  - **Easy to Use**
  - **Modular for Flexibility, Jettison Safety**
  - **ABS Type PDA approved**
  - **ISO Certified Manufacturer**
  - **Available, Reasonable Cost**
  - **Good Technical Support**

Agenda

- MUV
- ***Battery Module***
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SWE

SOUTHWEST ELECTRONIC ENERGY GROUP

Advanced Battery Solutions

SeaSafe II - “Into a PBOF Case”

Easy to Integrate Smart Battery Modules

Lithium Ion Polymer with Patented, Integrated Battery Management System

Pressure Tolerant
6000 Meters Depth

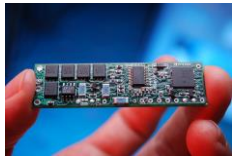
Smart Module

		30V	24V
Voltage (V)	min	26.4	23.1
	NOMINAL	**29.6**	**25.9**
	max	32.4	28.4
Current (A)	**Max Dschg (cont.)**	**40**	**40**
	Max Dschg (30s pulse)	45	45
	Max Dschg (60 us pulse)	90	90
Capacity	Ah-Nom	28	28
@ 90% SOC	Wh-Nom	829	725
Dimensions (in)	H	10.0	10.0
	W	3.2	3.2
	L	9.9	9.9
Weight (lbs)	In Air	20.9	20.9
	In Sea Water	9.7	9.7
Temp Op. (Deg C)	Discharge	-20 to 60	20 to 60
	Charge	0 to 45	0 to 45

Patented Safety Protection BMS in Every Module Takes Worry Out, Keeps Safety and Performance In

SOUTHWEST ELECTRONIC ENERGY GROUP
Advanced Battery Solutions

SEASAFE II BMS



Imbalance Avoidance
- 3 types of balancing, optimizes battery health

Reduces Aging Impact
- Cell short detection
- Metal dendrite prevention

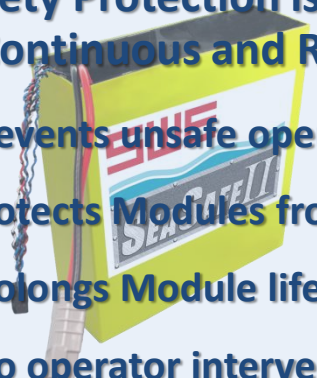
Prevents Overheating
- Thermal control

Charge Strain Prevention
- Autonomous charge control in each Module

Safety Back-Up
- Redundant Short Circuit Fuse Protection

SEASAFE II SMART MODULE

Safety Protection is Automatic, Continuous and Redundant



- ✓ Prevents unsafe operation
- ✓ Protects Modules from damage
- ✓ Prolongs Module life
- ✓ No operator intervention

Advanced SWE Safety Protection & Reliability Suite

Classic Li Ion Safety Features Now Configurable

Prevents Excessive Discharge/Cuts off on Short Circuit

No Charging Outside Safe Cell Temperature Spec

Prevents Excessive Charging/Overcharge

Over/Under Voltage Avoidance

No Discharge Outside Safe Cell Temperature Spec

SAFE, RELIABLE, FLEXIBLE BATTERY SOLUTIONS FOR SUBSEA

SeaSafe Observer

SOUTHWEST ELECTRONIC ENERGY GROUP
Advanced Battery Solutions

SeaSafe II Battery State of Health, State of Charge, & More Status

- Read Post Mission or Run Time
  - RS485 Modbus
- Easy to Use Windows PC Graphical User Interface
  - Or customer line command driven comm
- For Information only.
  - Not needed for battery operation.

SECTION 3. SWE SEASAFE OBSERVER™ DASHBOARD

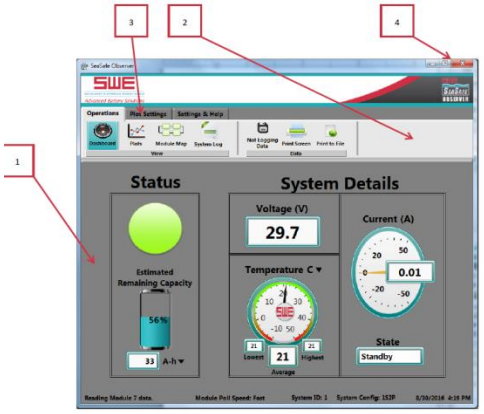


Figure 1 - SWE SeaSafe Observer™ Home Screen

1. **Display Area:** All graphs and charts will be displayed here once those functions have been selected.
2. **Ribbon:** Most of the functions for **SWE SeaSafe Observer™** are controlled from the ribbon.
3. **Ribbon Tabs:** Various functions of the **SWE SeaSafe Observer™** are on the other tabs shown and will be explained in detail later in the manual.
4. **Window Functions:** Minimize, Maximize and Close the **Observer™** Window using these standard application buttons.

SECTION 4.3. MODULE MAP

The **Module Map** button will bring up a graphical representation of the system as defined by the system configuration in the config file. Additionally, this screen will display the overall system voltage, current, and capacity, as well as the average of all of the modules' temperatures in the system.

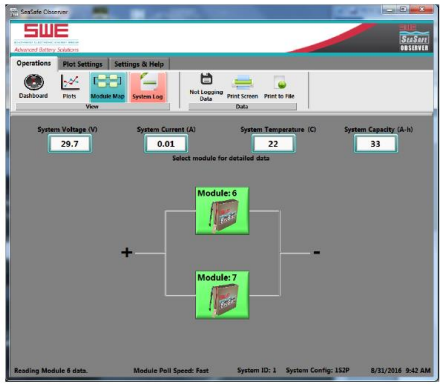


Figure 11 - Module Map

SECTION 4.2. PLOTS

The **Plots** button will show a real-time plot of the battery pack's Current, Voltage, Temperature, and Capacity. Each axis has its own color-coding, scaling, and individual chart markers to distinguish the plot lines on a screen if displayed or printed in black and white or grayscale.

Similar to the **Temperature** and **Current** displays on the **Dashboard**, you can click on any of the numbers listed on the different axes in order to re-scale them to your preferred liking.

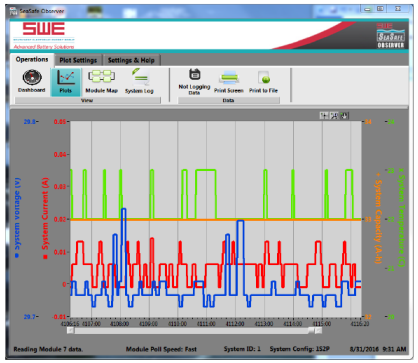
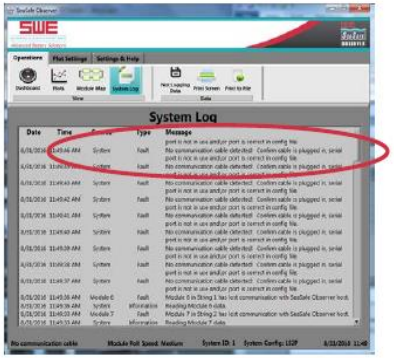


Figure 10 - Plots view

If a fault is detected, the **System Log** icon will turn red to bring your attention to this.



Agenda

- MUV
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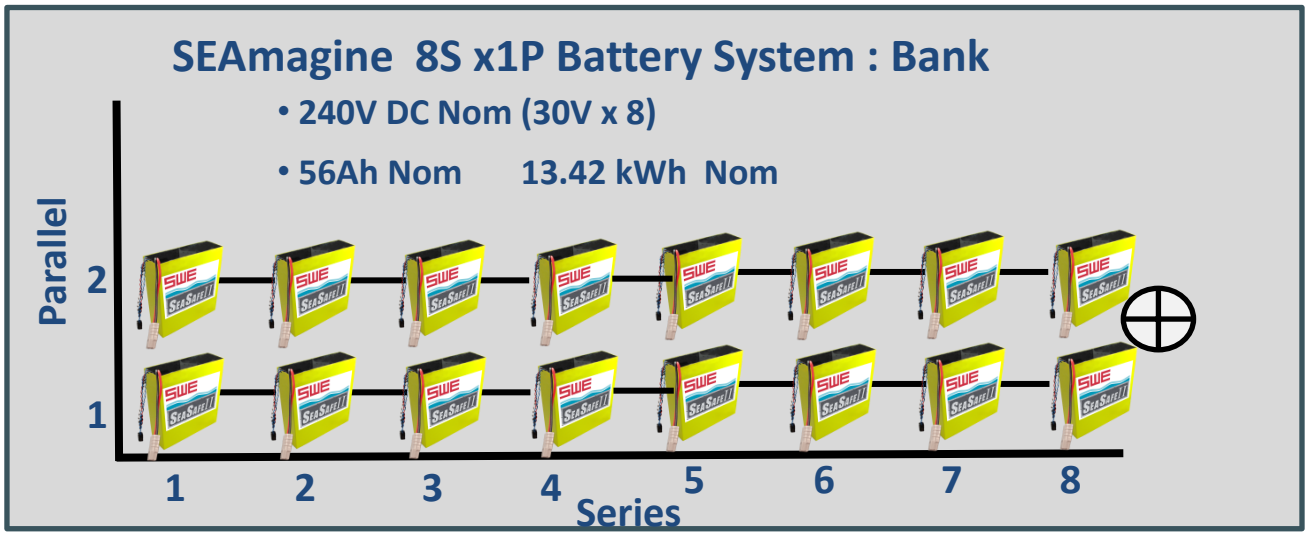
Configure Battery System by Connecting Battery Modules in:

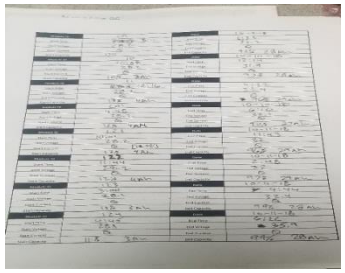
SOUTHWEST ELECTRONIC ENERGY GROUP
Advanced Battery Solutions

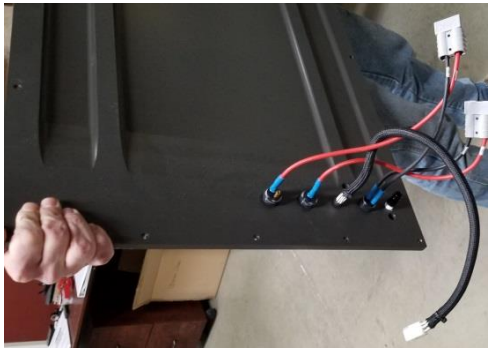
- Series Increment for Voltage (V) Strings
  - SEAmagine = 8S X 30VDC Nom each = 240 VDC Nom
- Parallel Strings for Capacity or Power(Ah or Amps)
  - SEAmagine = 2P X 28 Ah Nom each = 56 Ah Nom
  - = 2P X 40 Amps Max X 0.8 =~ 64 Amps Max Cont.
- SEAmagine: 2 Parallel Battery Banks
  - 240 V Nom; 26.8kWh Nom



Battery Bank

Using 8S x 2P SWE SeaSafe II 28V 28Ah Smart Battery Modules





Agenda

- MUV
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- MUV Battery System using Battery Module
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SeaSafe II, SeaSafe Direct
ABS Certified

CERTIFICATE NUMBER
17-HS1687100-PDA

DATE
08 Dec 2017

ABS TECHNICAL OFFICE
Houston ESD - Electrical

CERTIFICATE OF
DESIGN ASSESSMENT

This is to certify that a representative of this Bureau did, at the request of

SOUTHWEST ELECTRONIC ENERGY GROUP

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of this assessment are detailed on the pages attached to this certificate.

Product: **Battery**

Model: **SeaSafe II, SeaSafe+Direct**

This Product Design Assessment (PDA) Certificate 17-HS1687100-PDA, dated 08/Dec/2017 remains valid until 07/Dec/2022 or until the Rules or specifications used in the assessment are revised (whichever occurs first).

This PDA is intended for a product to be installed on an ABS classed vessel, MODU or facility which is in existence or under contract for construction on the date of the ABS Rules or specifications used to evaluate the Product.

Use of the Product on an ABS classed vessel, MODU or facility which is contracted after the validity date of the ABS Rules and specifications used to evaluate the Product, will require re-evaluation of the PDA.

Use of the Product for non ABS classed vessels, MODUs or facilities is to be to an agreement between the manufacturer and intended client.

AMERICAN BUREAU OF SHIPPING

Ting Jiang
Engineer/Consultant

SWE SeaSafe II, SeaSafe Direct ABS Approved

MKH/av
Project – 3998543
Task-T1687100

8 December 2017

Type Approval - Product Design Assessment
Lithium Ion Battery, Marine & Offshore Application
Models: SeaSafe II, SeaSafe+Direct (PDA Cert No: 17-HS1687100-PDA)
Drawings and Documentation as per attached list

Southwest Electronic Energy Group (SWE)
823 Buffalo Run
Missouri City TX 77489

Attention: **Mr. Brett Levins**
Mr. Sridhar Sana

We have received your declaration stating that the materials in the requested assessment are free from Asbestos and your applications for Type Approval-Product Design Assessment dated 13 October 2017. In this regard we are pleased to advise that we have completed the product design assessment phase of the type approval process. Enclosed are your original copies of the **Certificate of Design Assessment (PDA)**. Your details are published on our web site at www.eagle.org and can also be downloaded there.

The PDA Models have been reviewed in accordance with the following ABS Rules:

- Rules for Building and Classing Steel Vessel Rules (SVR), 2017
- Rules for Building and Classing Steel Vessels under 90 meters (295 feet) in Length (Under90m SVR, 2017
- Rules for Building and Classing Offshore Support Vessel (OSV), 2017
- Rules for Building and Classing Mobile Offshore Drilling Unit (MODU), 2017
- ABS Guide for Use of Lithium Batteries in the Marine and Offshore Industries (Battery Guide), 2017

ABS Approval Review Completeness

Drawing List

Engineering Office:	Houston ESD - Electrical	
Submitter:	SOUTHWEST ELECTRONIC ENERGY GROUP (415315)	
Drawing No	**Revision No**	**Drawing Title**
Correspondence	-	PO 0409302
Correspondence	-	TA APP
Correspondence	-	Correspondence
SSD 8S Verification Module 5	02	Specification Seasafe Direct Modules
ABS PDA Submittal Overview	01	ABS PDA Package Seasafe Direct and Seasafe II
Z1287-DFMEA_5S_10S_BMS_Module	04	Design Failure Mode and Effects Analysis
5S-10S BMS Validation	01	Validation Test Result Report
SSD_8S_Validation_Module_4	00c	Validation Test Plan-Module#S8-04
KQ13-XA05-01R0	-	Transportation Certificate
BBCV2.MH27732	-	Lithium Batteries - Component
SSII 8S Validation Module 5	00a	Validation Test Plan-Module 5-8S
SSII_8S_Verfication_Modules_1_2_5_6	02	Specification Seasafe Modules
G100959525DET-001_SeaSafe_UNDOT38_3_Cert_Test Report	-	UN 38.3 Battery Testing 8S1P29V918WH Battery Packs
HS3390641	-	ABS Sea Safe II Module
50082358-001	-	Secondary Cells
Kokam_SLPB72216216_MSDS	-	Material Safety Data Sheet
SeaSafe Battery Potting MSDS	-	Material Safety Data Sheet Section 1
Z1266	02	Design Specification 5-10S BMS Booster Board
Z1265	02	Design Specification 5-10S BMS Host Board
Z1272	04	Seasafe Direct Module
46793028.3302	-	Pre Assembly
Z1264	03	Specification 5S-10S BMS Modules
Z1306	04	Specification Seasafe Direct Modules

Z1274	03	Seasafe Direct Module, Standard
SeaSafe_Direct_Assembly_Procedure_Example	-	Connect PCA to Cell #1
Z1337	02	Seasafe II Module, Standard
Z1335	04	Seasafe II Module
User's Manual	-	SeaSafe Communication Advanced Users Manual
Z1341	03	Specification Seasafe Module
Battery Module User's Manual	-	SeaSafe II And SeaSafe Direct Users Manual
Basic User's Manual	-	SeaSafe_Communication_Basic_Users_Manual
SWE #46791828.3302	-	SWE SeaSafe Direct Datasheets
SWE #46791828.3311	-	SWE Seasafe II 18V Battery Module Datasheet
Z1236	02	Specification 5S-10S HCM Firmware
Z1236	01	Specification 5S-10S HCM Firmware
6 pages Data Sheet	-	Test Date Plots
Z1469	01	IEC 62619:2017 Test Report SeaSafe Modules
Z1468	02	ABS PDA Package for SeaSafe Direct and SeaSafe II Batteries
Z1386	02	SWE SeaSafe ABS Test Plan and Report
SWE Test Reports	-	Test Reports per 4-9-8 Table1
Z Data Sheet	-	Vibration in Z
X and Y Data Sheet	-	Vibration in X and Y
Cold Data Sheet	-	Cold
Dry Heat Data Sheet	-	Dry Heat
Damp Heat Data Sheet	-	Damp Heat
Correspondence	-	Enclosure Email dated 1 December 2017

- **Component Design Failure Modes and Effects Analysis (DFMEAs).**
- 1 DFMEA Document

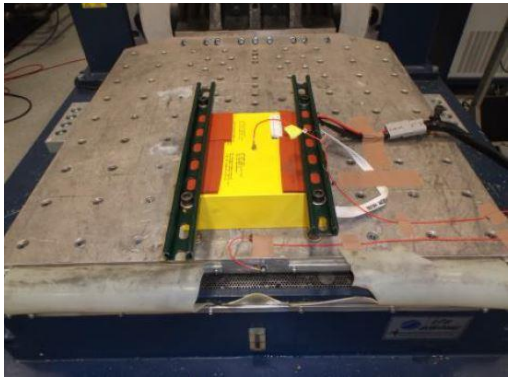
- **Design Verification Test Plan report (DVTP) to verify the DFMEA.**
- 2 BMS Verification Documents
- 4 Battery Module Verification Documents

- **Battery component Risk Analysis document (such as FMEA, HAZID, etc.).**
- 1 DFMEA Document
- 3 BMS and SeaSafe Module Specification Documents

50+ SWE Engineering, Test, and Product Documents Reviewed and Approved by ABS

- **Test reports for the battery module and battery management system, in accordance with 4-9-8/Table 1, as applicable conducted at an independent testing facility and tests listed under 4-9-8/13.1 to be witnessed by an ABS Surveyor.**
- 12 Test plan and test results documents.

- **Test reports for the battery cells in accordance with a recognized standard (eg. UL 1642 etc.) conducted at an independent & competent battery testing facility.**
- 4 Battery Cell Test report and certification documents



- **Unit Certification test reports, in accordance with 4-9-8/Table 2 (witnessed by ABS Surveyor).**
- 1 Document *HS3390641* provides the Unit Certification test report from the ABS surveyor.

- **Battery management system functional test report (witnessed by ABS Surveyor).**
- 1 Document *HS3390641* provides the functional test report witnessed by the ABS surveyor (reference Sc. 5f)

- **Battery technical specifications and Material Safety Data Sheets.**
- **2 Documents:: Battery MSDS Folder**
- **4 Documents:: BMS Folder**
- **5 Documents: SeaSafe Direct Folder**
- **3 Documents:: SeaSafe II Folder**
- **5 Documents: User Documentation Folder**

- **Functional description of the different operating modes of the battery pack.**
- 1 Documents : SeaSafe II and SeaSafe Direct User Manual

- **Control and monitoring system functional description and safety philosophy.**
- 1 Documents : SeaSafe II and SeaSafe Direct User Manual

Multiple Tests Witnessed and Approved by ABS

- **Appropriate service experience and/or history of the usage of the battery.**
- 1 SeaSafe battery user experience report section.

SeaSafe II, SeaSafe Direct
ABS Certified

ABS

TYPE APPROVAL DATABASE

< BACK TO RESULT

Company Name Details

Company Information	
SOUTHWEST ELECTRONIC ENERGY GROUP	
823 BUFFALO RUN	
TX 77489	
United States	
Tel 281.240.4000	
Fax 281.240.6452	
Email: seasafe@swe.com	
Website: https://www.swe.com/	

Certificate Number	Category	Expiry Date

Product	Battery
Model	SeaSafe II, SeaSafe+Direct
Intended Service	Marine and Offshore Applications; Power Supply/Power Distribution
Description	SWE SeaSafe II and SeaSafe+Direct Smart Battery Modules are autonomous (self-sufficient). Each module consists of high performance Li-Polymer cells, a SWE Battery Management System (BMS) with safety protection and current path boosters, a thermally potted enclosure, and connectors for power and communications.
Ratings	SeaSafe II: Voltage: 18 VDC, 22 VDC, 24 VDC, 30 VDC, 33 VDC & 37 VDC; Capacity: 28 Ah, 518 Wh (18 VDC), 622 Wh (22 VDC), 725 Wh (24 VDC), 829 Wh (30 VDC), 932 Wh (33 VDC), 1036 Wh (37 VDC), Operating Current: Discharge - 40A Max (Continuous), 45 A - Max (30 Second Pulse), 52.5 A - Max (30 ms Pulse), & 90 A - Max (60 s Pulse) Charge - 20 A - Max (Continuous), 9 A - Low Temp [0°C - 10°C] (Continuous) Ambient Temperature: 0°C to 45 °C (Charge), -20°C to 60°C (Discharge), -40°C to 60 °C (Storage); Batteries fully potted within flame-retardant urethane enclosure and designed for operation in oil-filled, pressure-compensated enclosure SeaSafe+Direct: Voltage: 18 VDC, 22 VDC, 24 VDC, 30 VDC, 33 VDC & 37 VDC; Capacity: 28 Ah, 518 Wh (18 VDC), 622 Wh (22 VDC), 725 Wh (24 VDC), 829 Wh (30 VDC), 932 Wh (33 VDC), 1036 Wh (37 VDC), Operating Current: Discharge - 10A Max (Continuous), 12 A - Max (30 Second Pulse), 31.5 A - Max (30 ms Pulse), & 54 A - Max (60 s Pulse) Charge - 10 A - Max (Continuous), 9 A - Low Temp [0°C - 10°C] (Continuous) Ambient Temperature: 0°C to 45 °C (Charge), -20°C to 60°C (Discharge), -40°C to 60 °C (Storage); Batteries fully potted within flame-retardant urethane enclosure designed for complete submersion in water

SWE SeaSafe II, SeaSafe Direct
UL, IEC, UN Approvals

National Standard	UL 1642:2012
International Standard	IEC 62619:2017; IEC 61000-4-2:2008; IEC 61000-4-3:2010; IEC 61000-4-6:2013; IEC 61000-4-4:2012; CISPR 16-2:2016; UN 38.3:6th Edition

IEC 62619:2017 Test

Safety Requirements for secondary lithium cells and batteries, for use in industrial applications. Edition 1.0 2017-02

IEC 62619

Edition 1.0 2017-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications

Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs au lithium pour utilisation dans des applications industrielles

SWE Advanced Battery Solutions	IEC 62619:2017 TEST REPORT SEASAFE MODULES		
	Date: 10/30/17	Document Number: Z1469	Revision: 01
	Author: B. Levins	Project: SeaSafe	Page: 1 of 21

FORCED THERMAL RUNAWAY

NO PROPOGATION

IEC 62619:2017 Test Report for SeaSafe Smart Battery Modules (SeaSafe Direct, SeaSafe II)

ABS DESIGN ASSESSED

Figure 2 - Battery Pack Sample

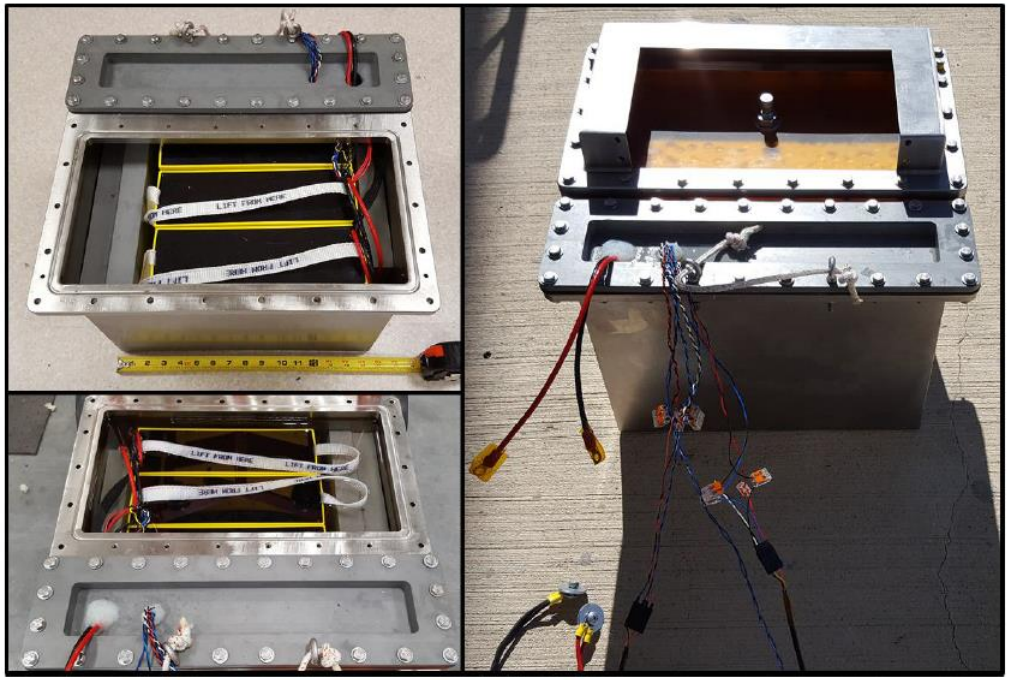
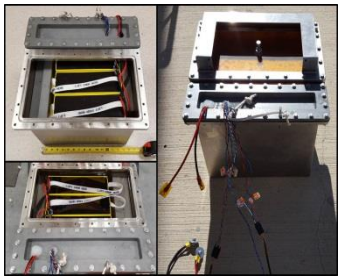


Figure 3 - Battery System Sample
(Top Left – Loaded in Enclosure, Bottom Left – Oil Filled, Right - Assembled)

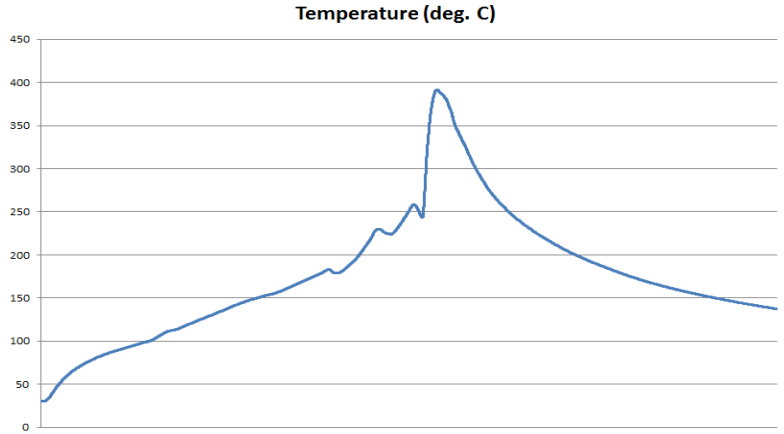
IEC 62619:2017 Test

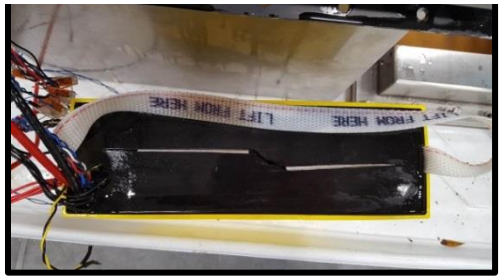
SeaSafe II Module (in System)
Intentional Overcharged Cell (Wired outside of BMS)
Induced Thermal Run-Away: SHOW NO FLAME AND NO PROPOGATION

- A modified 7S, SeaSafe module was manufactured to allow direct overcharging of Cell 4, bypassing outside of the BMS control.
  - All cells were fully charged before test
- 3 SeaSafe modules were placed side-by-side (modified module in the middle), in oil, inside a stainless steel enclosure.
- Cell 4 on the modified module in middle was overcharged directly at 6 V near 150 Amps (bypassing BMS cutoff control).
- After 30 minutes into the intentional overcharge, the cell went into Thermal Runaway and the potting split as designed, which allowed the cell to vent into the oil. (~12 seconds into video)
  - **NO FLAME.**
  - The pressure of the vent pushed oil through the wire feed-through holes on the enclosure.
    - The holes were only filled with RTV for test case (no subsea connectors used.) Normally the vent valve on the enclosure (not installed) would have released the gas.
- The Two adjacent Battery Modules in the case did not show any damage.
  - **NO PROPOGATION of Thermal Runaway**
    - **Module to Module**
- **IEC 62619:2017 TEST PASSED BY SWE SEASAFE !**



IEC 62619:2017 SWE SeaSafe II Test Overcharged Cell in System Video





Vented module with split potting

Agenda

- MUV
- Battery Module
- MUV Battery System using Battery Module
- ABS Type Approval- PDA of Battery Module
- ***Battery Module Tests***
- Summary

UN/DOT 38.3 Certification

Transportation Security Administration

UN38.3 PASSED

Transport Safety Certified

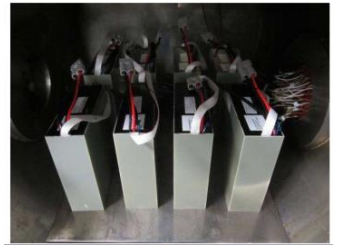
SeaSafe UN DOT 38.3 Testing and Certification

International Shipping Safety Certified - UN Manual of Test and Criteria Section 38.3

RESULT SUMMARY: The tested samples met the test requirements. See below breakout for tests performed.

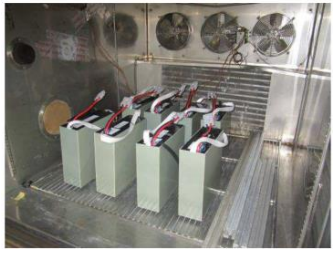
Specification Section	Test Description	Results
T1	Altitude Simulation	Conforms
T2	Thermal Test	Conforms
T3	Vibration	Conforms
T4	Shock	Conforms
T5	External Short Circuit	Conforms
T7	Overcharge	Conforms

T1 – Altitude Simulation Test



T1

T2 – Thermal Test



T2

T5 – External Short Circuit

T5

Intertek

45000 Helm Street
Suite 150
Plymouth Twp., MI 48170

Telephone: 734-582-2600
Facsimile: 734-582-2601
www.intertek.com

TEST VERIFICATION OF CONFORMITY

TEST METHOD: UN-DOT Manual of Tests and Criteria "Recommendations on the Transport of Dangerous Goods," section 38.3 "Lithium Batteries"
Document number ST/SG/AC.10/11/Rev.5, Amend 1
Revision #: 5th Edition, Amendment 1
Effective Date: April 2012

SAMPLE DESCRIPTION: Eight (8) 8S1P29V/918WH Battery Packs

MANUFACTURER: Southwest Electronic Energy Corp.

SPECIFICATION SECTIONS T1 through T6 and T7:
Eight (8) 8S1P29V/918WH Battery Packs, sample numbers:

Battery Packs – 1 Cycle
- SN 1
- SN 2
- SN 3
- SN 4

Battery Packs – 50 Cycles
- SN 5
- SN 6
- SN 7
- SN 8

Condition of Test Sample: Production

DATE RECEIVED: 12/10/2012
DATES TESTED: 12/14/2012 through 02/12/2013

RESULT SUMMARY: The tested samples met the test requirements. See below breakout for tests performed.

Specification Section	Test Description	Results
T1	Altitude Simulation	Conforms
T2	Thermal Test	Conforms
T3	Vibration	Conforms
T4	Shock	Conforms
T5	External Short Circuit	Conforms
T7	Overcharge	Conforms

Nick Diamond
Engineering Supervisor

Michael Wells
Department Manager

February 13,2013
Report No.: 100969626DET-001

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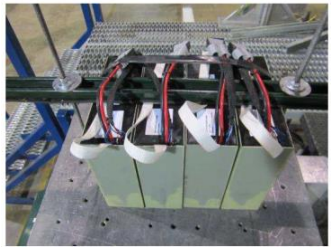
T3 – Vibration Test

T3

T4 – Shock Test

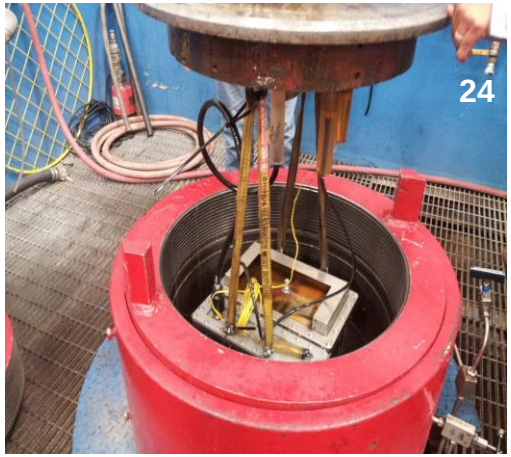


T4

T7 – Overcharge

T7

Extensive SeaSafe II Pressure Testing



- Exhaustive functional testing over 8 years
- Electronics nearing 5 Year Reliability Accelerated Life Testing at 10,000+ psi Pressure in SWE owned pressure vessel
- 200+ Battery Modules pressure tested over years of testing at Southwest Research Institute and WHOI
  - Shown: SeaSafe 316 stainless steel case with four SeaSafe battery modules being lowered into the 30 inch hyperbaric chamber at the Southwest Research Institute
  - 18 complete pressure cycles up to 10,000 psi and back down on a module while performing live charge and discharge cycles
    - 10,000 psi provides for 6000+ meter sea depth
- **ISO9001-2008 Quality Compliant Manufacturing**

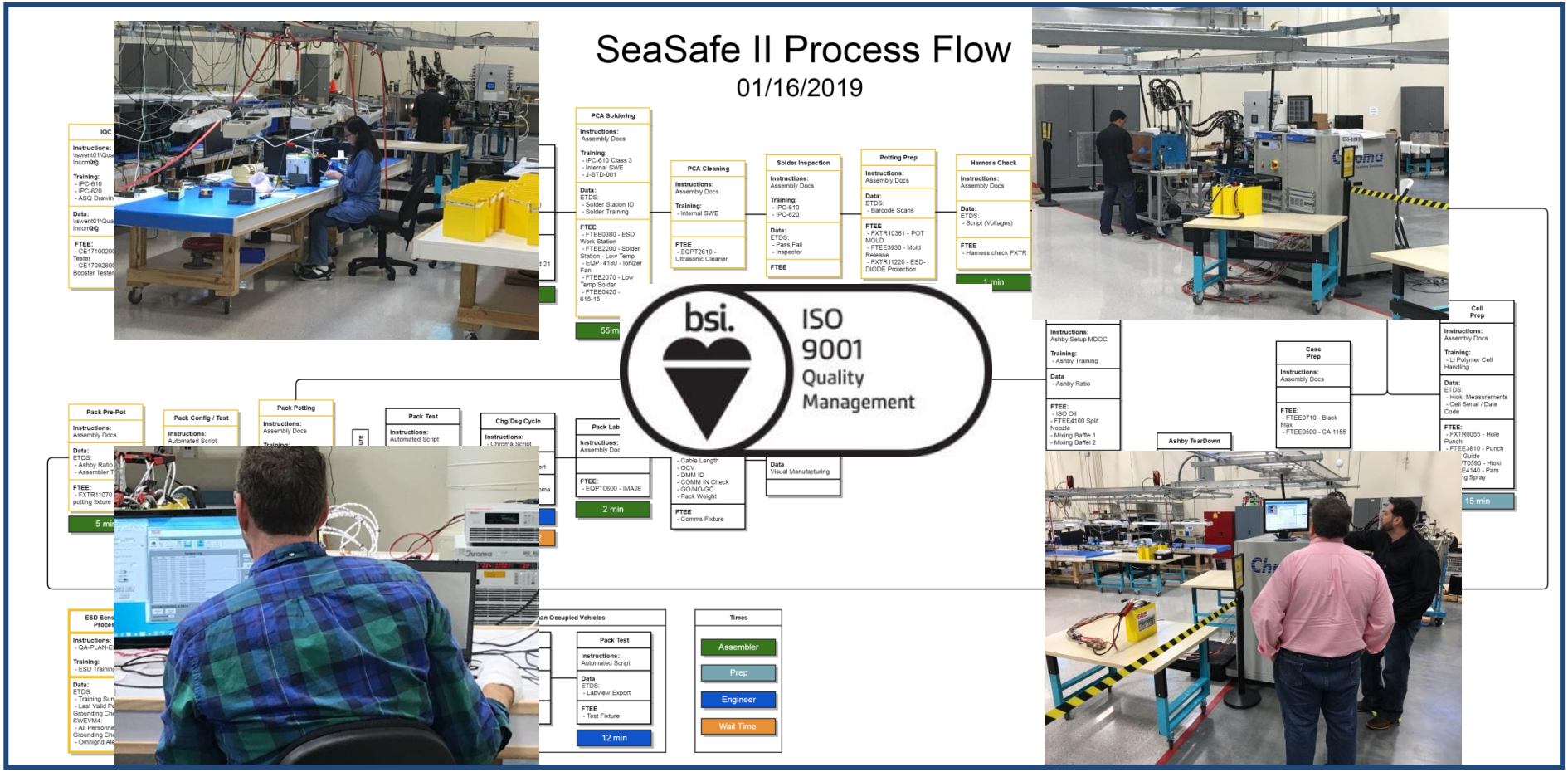
bsi. ISO 9001 Quality Management

SeaSafe Pressure Testing at SWRi

	load	
		
Pressure containment chamber	Batteries on tray support for insertion into pressure containment chamber	Batteries on tray support for insertion into pressure containment chamber
		
Batteries on tray support for insertion into pressure containment chamber	Batteries on tray support inserting into pressure containment chamber	Batteries on tray support inserting into pressure containment chamber
		
Power & COM test connections	Batteries on tray support inserted into pressure containment chamber	Pressure test Guage 20K psig

	
SeaSafe Direct Battery test screen	Pressure test Guage at 10K psig for 6 hours

SWE ISO9001-2015 Quality SeaSafe Manufacturing



Agenda

- MUV
- Battery Module
- MUV Battery System using Battery Module
- ABS Type Approval- PDA of Battery Module
- Battery Module Tests
- ***Summary***

SOUTHWEST ELECTRONIC ENERGY GROUP
Advanced Battery Solutions

Who is SWE?

Advanced Battery Solutions

Industrial, O&G

bsi. ISO 9001 Quality Management

www.SWE.com

SWE named in top 100 of emerging technology companies by *Marine Technology Reporter*

- Since 1964 - Quality supplier to Oil and Gas
- 25 years - Ruggedized Lithium battery experience
  16 years - Lithium Ion battery experience
- 10 patents - Li Ion Battery Management System
- Over 70,000 sq ft - Battery systems R&D and ISO 9001/2008 certified manufacturing
- 300+ customers including many top Oil & Gas Service, Drilling, and Production Companies
- Focus on Service, Quality, and Reliability

SWE Corporate Headquarters
Houston, Texas

Example SWE Customers

ABB
BAKER HUGHES
gyrodata
HALLIBURTON
LEAM Drilling Systems, Inc.
TELEDYNE MARINE Everywhereyoulook™
Transocean
PRODIRECTIONAL
OCEANEERING®
LOCKHEED MARTIN
FMC
NOV
Schlumberger
Shell
SEAMAGINE HYDROSPACE CORPORATION
WOODS HOLE OCEANOGRAPHIC INSTITUTION 1930
Scientific Drilling
U.S. AIR FORCE
Weatherford®
GENERAL DYNAMICS Applied Physical Sciences

SOUTHWEST ELECTRONIC ENERGY GROUP

Advanced Battery Solutions

Thank You!

Come See us Booth 428 at UI2019

Underwater Intervention 2019:

Novel ABS Approved Pressure Tolerant Lithium Ion Battery Modules for MUVs

Leon Adams, VP