Appendix 2

INTERACT GIS – Management Organisation

Status of INTERACT GIS: INTERACT GIS has been developed during INTERACT I and INTERACT II. It now includes the following modules:

- A station catalogue module
- A research project database
- A publication database
- An application module (for application for access to research stations)

Currently, only two stations use the INTERACT GIS application module.

Development plans during INTERACT III: Further development of the system will take place during INTERACT III. According to the INTERACT III Description of Work we have promised to do the following (Subtask 2.0.4 in Workpackage 2):

- Develop INTERACT GIS to make it a leading international platform
- Consolidate the INTERACT GIS Management Organisation
- Ensure an effective operation with an increasing number of stations involved (i.e. stations using the application module)
- Integrate standard station descriptions and science metadata and data in formats developed in cooperation with relevant organisations/networks.
- Integrate thematic maps (climate zones, vegetation, permafrost etc.) in cooperation with relevant organisations/networks

Major challenge during INTERACT III:

- To make the system application module attractive to research stations

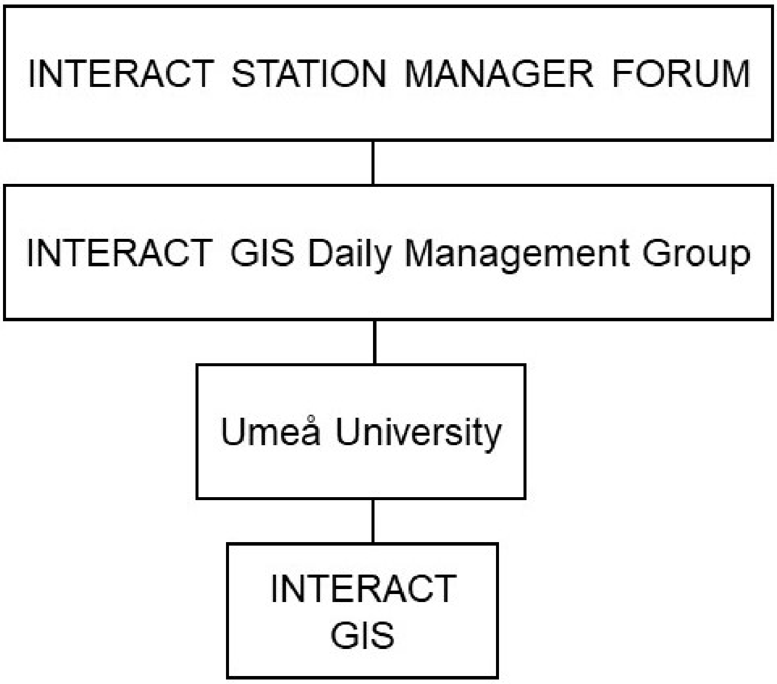
Thoughts about the need for a management organization:

- It is part of the INTERACT II Description of Work to establish an INTERACT GIS management organization with the purpose of securing a continued run of INTERACT GIS after funding from the EU Commission runs out.
- We have not been good enough in making the use of the system application module attractive to stations involved in INTERACT. The application module is a very important part of INTERACT GIS - also because it is one of the feeding systems for the INTERACT GIS project database.
- We now have the chance in INTERACT III to increase the number of stations using the application module and thereby securing that INTERACT GIS will become a leading arctic research project database.
- If we do not succeed with this, it is not considered very probable that INTERACT GIS will have a legacy/life beyond INTERACT III.
- It is therefore suggested that the possible establishment of a more permanent INTERACT GIS Management Organisation is postponed to the last few months of INTERACT III (i.e. the autumn of 2023), when we know whether or not it is probable that INTERACT GIS will have a life after INTERACT.

Suggestions concerning the formal framework for the run and development of INTERACT GIS during INTERACT III:

- INTERACT GIS will be run and further developed in close cooperation between the Station Manager Forum and Umeå University.
- An INTERACT GIS Daily Management Group with Skype meetings once every month and on ad hoc basis (when needed) will be established with participation of two representatives of the Station Manager Forum Secretariat and two representatives of Umeå University.
- Suggestions concerning larger developments of the system will be made by the INTERACT GIS Daily Management Group to be discussed at a Station Manager Forum before system developments are being initiated.
- The Station Manager Forum Secretariat will pay all expenses concerning hosting of the INTERACT GIS during entire INTERACT III.
- The further development of the INTERACT GIS during INTERACT III will take place via funding from INTERACT III to Umeå University.
- The Station Manager Forum Secretariat is obliged to suggest, no later than 30 September 2023, a more permanent management organization to be established when the funding for INTERACT III runs out.
- The Station Manager Forum Secretariat takes responsibility for promoting the system internally in INTERACT to secure that much more stations will find it interesting to use the system in general and specifically the application module.

Suggested management organization:



Discover®

Innovative Battery Solutions

Appendix 3

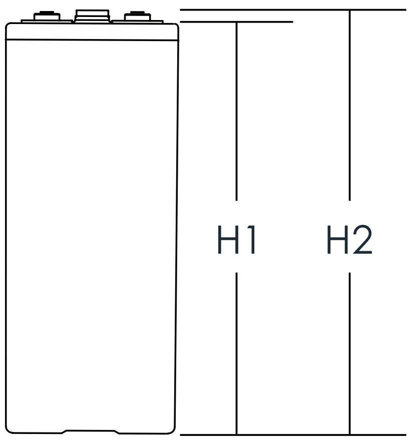
2VRE-4400TG

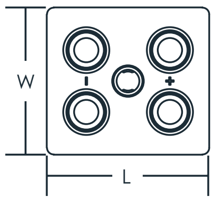
DATASHEET

Tubular Gel OPzV Cell

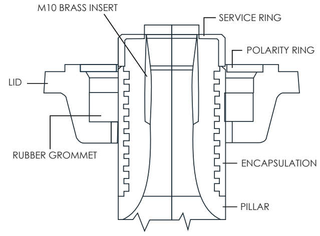
Discover® Tubular Gel OPzV batteries are maintenance-free and provide superior deep cycling performance and reliability for demanding commercial, industrial and residential applications. Providing reliable energy storage for Stationary Backup and Telecom Networks, and Renewable Energy applications with its Advanced Tubular Plate Technology to deliver long service life. Discover® Tubular Gel OPzV batteries provide maximum efficiency per discharge-charge cycle, and proven reliability in remote, high temperature, or unstable power network installations.

MECHANICAL DRAWINGS





Terminal (M10)



MECHANICAL SPECIFICATIONS

Voltage	2	
Industry Reference	Tubular Gel OPzV	
Length (A)	8.3 in	212 mm
Width (B)	10.9 in	277 mm
Height (C)	31.4 in	797 mm
Total Height (D)	32.5 in	825 mm
Weight	247 lbs	112 kgs
Terminal	M10	
Poles	4	
Cell(s)	1	
Container	ABS	

ELECTRICAL SPECIFICATIONS

Reference LVD / I10	**20% DOD**	2.05V
	50% DOD	1.97V
	80% DOD	1.91V
Cycle Life	**20% DOD**	7000 cycles
	50% DOD	2950 cycles
	80% DOD	1900 cycles
Internal Resistance		0.25 mΩ
Short Circuit		8500 A
Self Discharge		2-3% per month
Maximum Operating Temperature		-35°C / -31°F | 50°C / 122°F
Electrolyte		Gel

ELECTRICAL SPECIFICATIONS

240 HR	120 HR	100 HR	20 HR	10 HR	5 HR	3 HR	1 HR
1.85 Volts Per Cell (VPC)			**1.75 Volts Per Cell (VPC)**				
2238 AH	2227 AH	2197 AH	1782 AH	1620 AH	1470 AH	1275 AH	784 AH

NOTE: All Electrical Specifications are based on 20°C / 68°F temperature.

BENEFITS & FEATURES

Long Service Life
Tubular positive plates with non-woven polyester gauntlets are designed to prevent active material plate shedding and provide the highest cycling expectancy amongst lead acid technologies, particularly in PSoC (Partial State of Charge) operation.

High energy density tubular plates in combination with lead calcium alloy reduces self discharge and charge current requirements during float operation and extends battery service life.

Performance and Reliability
Special sliding pole terminals are designed to accommodate natural grid growth occurrence throughout battery lifetime. Battery containers are made of Acrylonitrile Butadiene Styrene(ABS) and Styrene Acrylonitrile (SAN) to endure high impact and heat environments.

Maintenance and Optimization
OPzV Gel batteries are valve-regulated, non-spillable and completely maintenance-free and available with the option to be horizontally mounted.

Safety
All products are tested and certified to multiple international safety standards for use in Photovoltaic and Stationary applications. Flame retardant containers are available upon request.

Lowest Total Cost of Ownership
OPzV Tubular batteries provide the Lowest Total Cost of Ownership (TCO) amongst lead acid technologies. Further savings can be achieved in Hybrid systems through diesel abatement and peak shaving.

CERTIFIED QUALITY

Discover and its manufacturing facilities are fully certified to ISO 9001/14001 and OSHA 18001 standards. OPzS and OPzV Tubular products are also tested in compliance to multiple international standards:

- Eurobat "Long Life" classification
- IEC 60896-21/22 (OPzV) and IEC60896-11 (OPzS) test standard for stationary applications
- IEC 61427 test standard for photovoltaic energy systems
- EN50272-1 and EN50272-2 safety requirements
- DIN 40742 (OPzV) and DIN 40736 (OPzS) standard for stationary tubular plate cells
- UN 2800 (US DOT Compliance)

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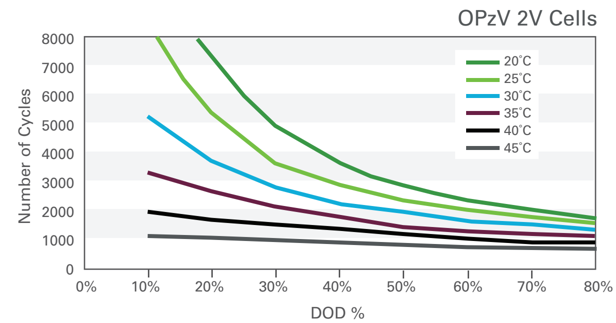
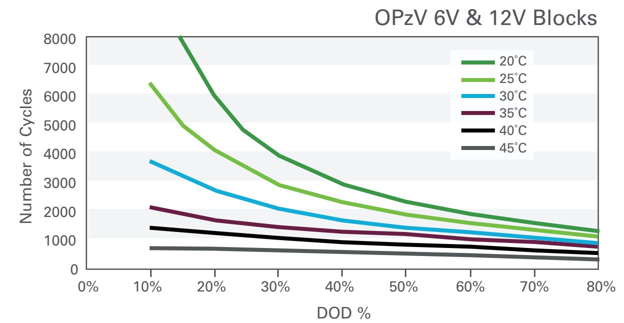
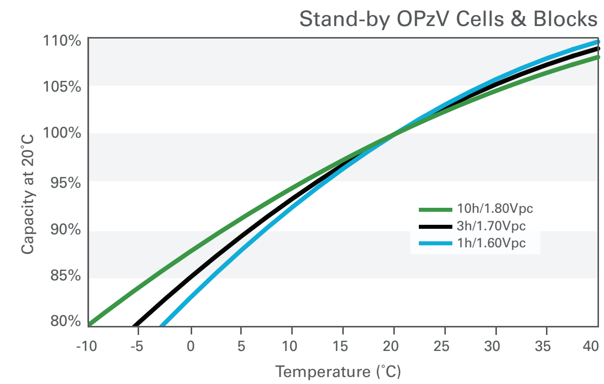
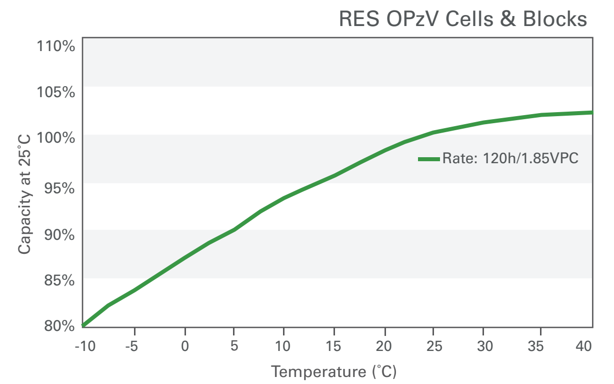
EXPECTED NUMBER OF CYCLES IN RELATION TO THE DEPTH OF DISCHARGE



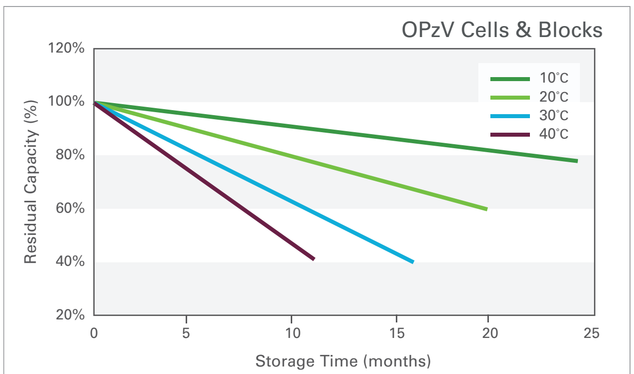


CAPACITY IN RELATION TO THE TEMPERATURE

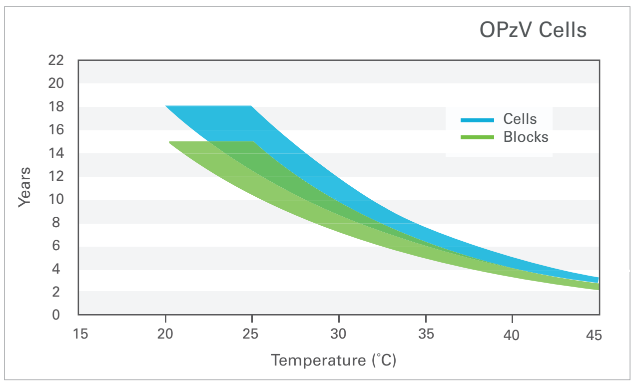




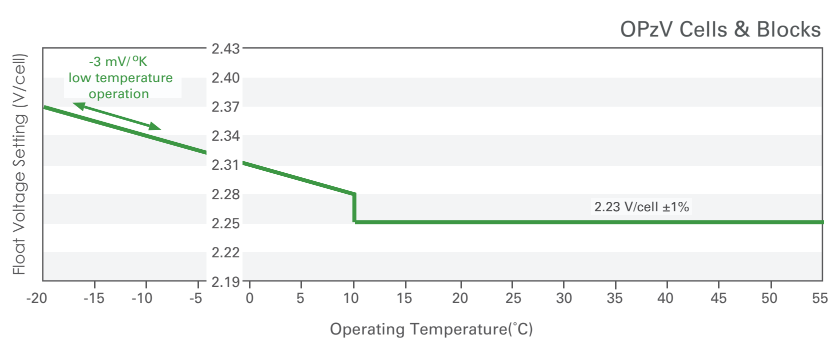
SELF-DISCHARGE CHARACTERISTICS



EXPECTED SERVICE LIFE IN RELATION TO OPERATING TEMPERATURE



Float Voltage Setting in Relation to Operating Temperature



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User Guide

Discover RE Gel Tubular Battery (SOPzV)

Contents

Tubular Gel Battery

1. BATTERY CHARGING

The most common type of charging method can be grouped into three phases: bulk, absorption, and float charge. An additional equalization phase can be performed on a routine maintenance-as-required basis.

The Bulk charge accounts for charging the battery from anywhere between 0% up to 80% state of charge. The absorption phase charges the battery from 80% to nearly 100% state of charge. Lastly, a float charge supplies a controlled voltage and amperage to bring the battery to a complete full charge.

For specific charge programming instructions, please refer to the documents provided by the charger manufacturer.

1.1 CHARGE PARAMETERS

Regular Cycling /PSOC Recovery

Regular Cycling / PSOC Recovery		0°C (32°F)	10°C (50°F)	20°C (68°F)	25°C (77°F)	30°C (86°F)	40°C (104°F)
2V	Bulk & Absorption Charge Voltage	2.49 V	2.44 V	2.39 V	2.37 V	2.34 V	2.29 V
	Float Voltage	2.43 – 2.46 V	2.38 – 2.41 V	2.33 – 2.36 V	2.30 - 2.33 V	2.28 – 2.31 V	2.23 – 2.26 V
12V	Bulk & Absorption Charge Voltage	14.95 V	14.65 V	14.35 V	14.20 V	14.05 V	13.75 V
	Float Voltage	14.55–14.75V	14.25 – 14.45 V	13.95 – 14.15 V	13.80 - 14.00 V	13.65 – 13.85 V	13.35 – 13.55 V
24V	Bulk & Absorption Charge Voltage	29.90 V	29.30 V	28.70 V	28.40 V	28.10 V	27.50 V
	Float Voltage	29.10 – 29.50 V	28.50 – 28.90 V	27.90 – 28.30 V	27.60 - 28.00 V	27.30 – 27.70 V	26.70 – 27.10 V
48V	Bulk & Absorption Charge Voltage	59.80 V	58.60 V	57.40 V	56.80 V	56.20 V	55.00 V
	Float Voltage	58.20 – 59.00 V	57.00 – 57.80 V	55.80 – 56.60 V	55.20 - 56.00 V	54.60 – 55.40 V	53.40 – 54.20 V

TABLE 1 (a): Regular Cycling/Partial State of Charge (PSOC) Recovery

1.2 END AMPS (RETURN AMPS)

End Amps or Return Amps is the current when the battery is fully charged and no longer accepts a charge. When the current reaches the End Amps set point, the charger will turn off. The recommended setting is 2% of the C20 Ah rating. For example, if the battery is 220 Ah at the C20 rate, then the recommended End Amps setting is 4.4 Amps.

2. DEPTH OF DISCHARGE

It is recommended for a system to be sized for no greater than 50% Depth of Discharge (DOD). A deep discharge will provide more capacity to operate loads but exposes the battery to sulphation and reduces the service life. After a deep discharge, it is recommended to charge a battery back to full State of Charge (SOC) as soon as possible to preserve capacity life.

The longer the battery stays at a low Depth of Discharge, the greater the exposure to sulphation and capacity loss. If the battery is left at a low Depth of Discharge for extended periods of time, sulphation damages may become unrecoverable through equalization charges.

2.1 LOW VOLTAGE DISCONNECT

An electromagnetic device may be included into many charging systems which automatically disconnects and reconnects loads to the battery to preserve life based on the Low Voltage Disconnect (LVD) or Low Voltage Cut Off (LVCO) setting. The default setting may be set by the charger manufacturer at 1.8 volts per cell (VPC). To prolong battery cycle life, the recommended LVD setting is between 1.8 VPC to 1.85 VPC.

3. BATTERY MAINTENANCE

3.1 TERMINALS

The battery terminal connections should be regularly inspected, cleaned, and tightened properly with a torque wrench. Loose connections may cause arcing and shorts which will generate excessive heat and damage to the terminals.

Over time, dirt or corrosion may accumulate on the terminals. To clean, the connections should be removed. Using a neutralizing solution such as baking soda and water (100g per litre), wipe the terminals and connections to remove debris and any corrosion. Rinse the terminals and connections with distilled water to remove any remnants of the neutralizing solution. Allow sufficient time to dry, then apply a conductive coating agent such as petroleum jelly which acts as a safeguard against corrosion. Lastly, reconnect the battery terminals using a torque wrench.

3.2 STATE OF CHARGE

12V Block [Volt]	Percentage Charge
13.10V	100%
12.45V	75%
12.15V	50%
11.80V	25%
10.50V	0%

TABLE 2: State of Charge as a Measure Open-Circuit Voltage

3.3 TEMPERATURE

Temperature is important to monitor as it affects the voltage readings. Depending on the battery temperature, the voltage set points may require adjustment. For an accurate temperature measurement, the temperature sensor, if included with the charge equipment, must be properly mounted to the side of the cell casing below the electrolyte. Attaching the sensor to other parts of the battery may provide an inaccurate representation of the battery temperature. Failure to monitor the temperature accurately may cause overcharging or undercharging. The operating temperature should not exceed 50ºC. As a precaution, there should be a charge cut-off to prevent the battery bank from operating at temperatures greater than 50ºC (122ºF).

3.4 STORAGE AND MAINTENANCE

When storing the batteries for a longer period, ensure to check the charge levels periodically as a low state of charge will cause sulphation. At ambient temperature conditions, the self-discharge is 5% per month. To maintain the battery at a high state of charge, the batteries should be recharged every 3 months to prevent sulphation.

If possible, the batteries should be stored at room temperature and in a controlled humidity environment (ie. indoors or sheltered). Depending on the temperature, the electrolyte levels may decrease in a colder environment and increase in a warmer environment. As a result, caution should be taken to monitor and maintain the electrolyte between the indicated minimum and maximum levels as plate exposure will have negative effects towards battery life.

3.5 WINTER STORAGE

The battery should be monitored closely in cold climates. If the electrolyte freezes, it may cause unrepairable damage such as case cracking. A discharged battery is more likely to freeze than a fully charged battery.

A higher specific gravity freezes at a much lower freezing temperature. For example, at a low state of charge, the battery may freeze when stored below -7°C (20°F). When the battery is at a higher state of charge and a higher specific gravity such as at 1.280, the freezing temperature is at -69°C (-92°F).

4. COMMISSIONING AND MAINTENANCE CHECKLIST

4.1 COMMISSIONING

Within the first week of operation, the following parameters should be recorded at full charge (baseline readings):

- Charger voltage and amperage output
- Absorption voltage at battery system terminals
- Measure and record the resting/loaded individual battery voltage
- Ambient temperature

Allow the battery system to discharge until it reaches the Low Voltage Disconnect and record the following parameters:

- Runtime
- Capacity delivered (amp-hours)
- Average DC load (amperes)
- Endpoint voltage at battery system terminals

After discharging, the battery should be fully charged as soon as possible to prevent sulphation.

4.2 SCHEDULED MAINTENANCE

The following should be monitored for the first 6-12 months:

MONTHLY

- Measure and record the resting/loaded individual battery voltage.
- Record ambient temperature where the batteries are installed.
- Inspect cell integrity for corrosion at terminal, connection, racks or cabinets.
- Check battery monitoring equipment to verify operation.

QUARTERLY

- Test Ventilation.
- Check for high resistive connections.
- Check cabling for broken or frayed cables.
- Verify Charge Output, Bulk/Absorption voltage of Inverter/Charge Controller.
- Check Ground connections.

Deep cycle batteries will increase in capacity during the initial break-in period. Adjustments to charging parameters may be necessary during this time. Following these recommendations will ensure the batteries to reach their rated capacity and be maintained in good working order.

5. TROUBLESHOOTING & FREQUENTLY ASKED QUESTIONS

The following is a list of common concerns and questions regarding system setup, battery charging and maintenance procedures. Please refer to these as general guidelines. For further assistance with your specific system setup, please contact your installer.

What causes the Battery Terminal to melt?

Battery terminals melting is most common because of improper connections causing high resistance and heat generation.

- Loose connections
- Over-tightened connections
- Improper sized cables (too small).
- Corroded connections
- Improper use of washers/lock washers.
- Too many connections on the same terminal

Why do the batteries bulge?

Some case bulging is normal from the weight of electrolyte. New battery cases tend to "relax" after filling with electrolyte.

- If case bulging is a concern upon receipt of a new product, please notify your Distributor immediately
- In the case of excessive bulging- your batteries may have been exposed to temperatures of over 50°C (122°F). The high temperature may cause the plates/chassis to swell and expand. If this occurs, the batteries may fail prematurely
- The batteries may have frozen due to excessive exposure to cold temperatures.

What causes a battery to lose capacity?

The capacity loss may be due to sulphation, overheating, or over-discharging. If there is capacity loss, the battery bank may no longer support an increase in load.

- A balance charge may be necessary
- Verify the temperature sensors are properly mounted and the operation settings are adjusted to the appropriate battery temperature

Why is the charging current to the battery bank so low?

The charging current will decrease as the batteries become fully charged. If the charge current is low, the end of charge cycle may have been reached. Verify that the charger is near the end of the Absorption phase or in Float voltage phase. If so, low current is normal at this stage of charging.

- The battery bank self-regulates charge current. The voltage can be controlled and adjusted to a high or low setting, however the amp output to the battery bank cannot be controlled and will drop as the batteries reach a full state of charge.

- When the charge current decreases to 2% of the battery capacity, the charge is essentially complete. (ex. 220 AH battery bank. Charge current is reduced to 4.4 Amps). Check the specific gravity with a hydrometer to confirm.

Why does the voltage rise very quickly causing the charger to shut off when I begin to charge my battery bank?

This is often an indication of sulphated batteries which can be confirmed by completing a load test.

- An increase in Absorption time may be necessary to sufficiently charge the battery to full SOC.
- If the battery bank is heavily sulphated, an equalization charge may be necessary.

Why does the battery bank not reach the Bulk voltage setting when charging?

If the system is not reaching the Bulk voltage, the charger voltage and/or Amp output to the battery bank may be too low. To ensure sufficient charge, the output should be approximately 10%-15% of the Amp Hour capacity of the battery bank. Another cause may be from DC loads running on the system during the charge cycle and reducing the current supplied to the battery bank.

- Verify that the charging settings meet the recommended charging parameters and that the charger output (Amps) is sufficient to meet the capacity requirements of the battery bank.

What do I do if the battery temperatures are very high?

- If at or nearing 50˚C (122˚F), shut off the charger and allow the batteries to cool.
- If a single battery or cell in a string is hot, this may indicate a cell failure or short. Verify the specific gravity for all cells, take the voltage readings from each battery, and perform a load test to identity any cell failures.

What causes the battery cover to crack, shatter and/or dislodge from the case? (Not affecting the positive and negative terminals or connections)

The ignition of hydrogen gas may have caused the battery cover to crack. This sometimes occurs during a charge where a loose connection at the terminal creates a spark and ignites hydrogen gas produced from the cell. If the battery case has split or cracked along the sides, the battery may have frozen in the past.