Appendix E.  Task 1000 Solar Feasibility
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Acknowledgements

In order to develop the material in this report, consultations with many stakeholders were performed. Black & Veatch would like to thank the following contributors for their valuable input:

- Owen Porter, Water Systems Technician, City of Santa Rosa
- Jason Roberts, P.E., Associate Civil Engineer – Asset Management, City of Santa Rosa
- Simon Hood, Senior Water Systems Technician, City of Santa Rosa
Executive Summary

Black & Veatch was engaged by the City of Santa Rosa Water Department (City) to analyze their water supply tanks' communication systems and provide recommendations on possible power back-up solutions. Based on information available to date related to the water supply tanks, Black & Veatch completed the following tasks which are described in this report:

1. Assess power consumption of on-site monitoring and communication equipment.
2. Assess solar energy production at 12 tank sites.
3. Identify solar panel sizing and type to meet on-site energy demands.
4. Identification of charging hardware required and available products.
5. Identification of battery capacity required and available products.
6. Identification of mounting hardware required for functional and reliable system operation.
7. Indicative pricing for engineering, procurement, and construction of solar power generation units.
8. Identification of expected O&M activities for continued system resiliency.

The City is looking to get power back-up on the tank sites to supply power to the Programmable Logic Controller (PLC), during Public Safety Power Shutoff (PSPS) power outages. These power outages can last for up to 5 days (120 hours), and the back-up power systems should have the capability to maintain the full load of PLC system during this period. Solar photovoltaic (PV) and battery system solutions were explored during the study to meet the power demand.

Black & Veatch worked with the City to collect single line diagram of the on-site monitoring and communication systems for the representative sites that capture the types equipment and existing batteries.

Table 2-1 summarizes the sites that were visited and analyzed during this study. Black & Veatch visited the sites to confirm information provided by the City and used satellite imagery for the solar panel siting.

Based on the analysis conducted by Black & Veatch, the following conclusions were reached:

1. A solar PV or battery solution was recommended for each site, based on the solar resource at the tank roof as well as space available in the radio cabinet at each site. The recommended solutions are noted in Table 5-1.
2. For sites where solar PV is the recommended solution, based on the solar resource available at the site, either a ground mounted or a tank mounted solar solution was recommended for the site.
   a. **Ground Mounted solution** – The solar module would be mounted at a 30deg angle, in portrait orientation and at a height of 3 ft.
   b. **Tank mounted solution** - It was determined that the best universal mounting solution would be to mount the module vertically, in landscape mode to the long handrail of the catwalk already attached to the tanks.
3. A common commercial-style, 72-cell, 375-Watt module was chosen for application since they are readily available from local contractors in California.
4. The existing batteries at the site will need to be connected to the solar module via a charge controller including Maximum Power Point Tracking (MPPT). This charge controller can be connected to the battery in parallel with the existing charger system.

5. For sites where an enlarged battery system is the recommended solution, a battery box may need to be added next to the communications cabinet to hold the larger batteries. The batteries will need to be designed to charge using the existing grid-supplied power and provide power back up for at least 120 hours.

Next Steps

This study did not conduct any detailed design analysis or procurement of equipment and installation. The next steps for implementation are:

1. A detailed electrical and structural engineering design should be conducted at each tank site to confirm viability of the recommended solutions.

2. The City should gather any geotechnical details available regarding the site.

3. City should solicit bids for installation of the solar PV and battery solutions, from local photovoltaic solar installers, based on the findings from the detailed engineering analysis.
1.0 Introduction

The City needs to have a back-up power solution during PSPS events to maintain communication with its facilities. The PSPS events could possibly last up to 5 days and the 5-day window also seems to be a reasonable outage for other emergency conditions. In order to maintain PLC communications with tanks located at sites without backup generators (i.e. without a pump station), the City wishes to provide back-up power systems to accommodate 5 days of power usage.

Black & Veatch was asked to conduct an engineering study to evaluate the feasibility of using solar PV panels to generate the needed power to charge back-up batteries and to determine the required facilities and estimated cost and level of effort to install and maintain the facilities.

The team followed a multi-step approach to assess the feasibility of using solar PV panels to supply back-up power during outages for 12 water tank sites. Each section of this report corresponds to a major step in the assessment, and the steps are summarized below.

- **Analysis Overview**: Develop an understanding of the current PLC systems and how it might interconnect with solar PV.

- **Assessment of Power Consumption**: Estimate the daily energy consumption for the on-site monitoring and communication equipment for each site. The estimate was based on the existing batteries which were sized for one day back-up and one-line diagrams provided by the City.

- **Solar Energy Production**: Conduct an energy assessment using the Aurora Solar software to determine solar capacity (number of installed panels) needed at each of the 12 sites; and select panel location considering: avoiding obstruction of access point, shading from trees near tank, and other local infrastructure. The energy production is to be estimated for both ground mount and tank mount solutions.

- **Solution Design**: Develop ground mounting and tank mounting solutions that can be used at the sites. It is assumed that the electrical system will be not vary from site to site due to the uniform nature of the usage. (3 sites are known to have variations involving diesel and existing solar backup). It is assumed that the batteries will be charged under normal conditions by grid power, and the function of the solar PV panels will be to maintain charge during a PSPS event. Steps for the design type/kit development included:
  - Identification of existing battery capacity.
  - Identification of solar panel sizing, type and location required to meet on-site energy demands (11 sites to power programmable logic controllers (PLCs) and 1 site to power PLC and advanced metering infrastructure (AMI)).
  - Identification of charging hardware required and battery connection method.
  - Identification of mounting hardware required for functional and reliable system operation.
  - Identify expected operation and maintenance (O&M) activities for continued system resiliency.

- **Cost Estimate**:
  - Calculate indicative pricing for engineering, procurement, and construction of solar power generation units.
2.0 Analysis Overview

Black & Veatch worked with the City to develop a better understanding of the water tank sites. A series of site visits were conducted with an intent to understand:

- The existing radio communication system;
- The power requirement for the communication system;
- Existing solar PV and/or battery back-up systems at the site;
- Space and solar resource for additional solar PV equipment; and
- Space for additional batteries.

Table 2-1 lists the sites that were visited and related notes.

<table>
<thead>
<tr>
<th>SITE</th>
<th>SOLAR STUDY TYPE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR-1,</td>
<td>PLC</td>
<td>No backup generator at site, solar study to get ready for potential</td>
</tr>
<tr>
<td>AR-2</td>
<td></td>
<td>improvements if tanks are going to go back online</td>
</tr>
<tr>
<td>R2A</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R4A</td>
<td>PLC</td>
<td>No pump station at site. AMI tied to police generator. Limited space</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and very shady. PLC is not tied to generator.</td>
</tr>
<tr>
<td>R6</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R7</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R8</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R9A,</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R9B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R10</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R11</td>
<td>PLC, AMI</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R14</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
<tr>
<td>R17</td>
<td>PLC</td>
<td>No pump station at site</td>
</tr>
</tbody>
</table>

Appendix A summarizes information on each of the sites including pictures of the site and estimated solar production (from ground mount and tank mount solar panel) and load. Appendix B summarizes reference material received from the City.
2.1 OTHER OBSERVATIONS

Although safety was not the focus of this study, Black & Veatch noted that the existing Absorbent Glass Mat (AGM) battery arrangement in the sealed cabinets may pose the following risks:

- Existing batteries may present an explosion hazard, if cabinets are not ventilated.
- Existing batteries are not securely fastened to the cabinet and may present a short circuit and/or explosion hazard during an earthquake, if the positive wiring or battery terminal were to contact the radio cabinet housing and equipment racking.

Figure 2-1 shows an example existing AGM battery at the tank site.
3.0 Assessment of Power Consumption

To properly size the solution for backup power on the tanks, the power load requirements for the PLC communications was assessed. This was assumed to be similar for all tank sites based on the information received from the City.

The load requirements for the tank sites was calculated from the existing batteries, which are sized to supply power back-up for 24 hours. The current 24-hour load from the battery size and a calculation based on equipment load data provided by the City on February 11 in the document in Appendix B, labeled administrator@srcity.org_20200211_160323 and is summarized below:

- **Normal Load**: 1.28 Amps direct current (DC) at 12 Volts. 1.28 Amp x 12 Volts = 15.36 Watts.
- **Daily Load**: 15.36 Watts x 24 hours = 368.64 Watt-hours per day.
- **Monthly Energy Consumption**: 368.64 Watt-hours x 30 days = 11.1 kilowatt-hours (kWh) per month total energy consumption.
- **Required Battery Capacity**:
  - 368.64 Watt-hours / 12 Volts = 30.72 Amp-hours (Ah) (usable) battery capacity required per-day.
  - Existing 35 Ah, 12 V batteries have been sufficient for 24-hour backup, but depth-of-discharge (88%) may exceed recommendations for existing batteries. Since short battery life has not been indicated as a recurring problem, it is believed that the 1.28 Amp load may not be constant and the daily Watt-hour consumption is a conservative estimate. For the basis of subsequent design, the 35 Ah per-day battery capacity and 368.64 Watt-hours energy consumption was considered to be sufficient.
  - A 5-day battery should include a minimum of 175 Ah of capacity, based on 35 Ah x 5 days = 175 Ah.
- **Design Monthly Energy Consumption**:
  - In order to allow for future efficiency degradation of the PV module, a 20% buffer was added to the monthly energy consumption.
  - The required total monthly solar energy production is 13.3 kWh (11.1 X 1.2 = 13.3).
  - The average daily energy production should be enough to keep the existing battery charged during grid outages while 24 hours of backup capacity remain for cloudy or smoky conditions.

The monthly energy requirement (based on the above calculations) for each site is noted in Appendix A.
4.0 Solar Energy Production

Solar panels added to the tanks would need to be large enough to keep the station electronics powered and charge the batteries during the daylight hours. The batteries could keep the station PLC and modem powered during the night time hours. This could be very effective during an earthquake power outage. However, during a fire the panels could be damaged.

A solar feasibility study was performed for each of the tanks to estimate the amount of solar energy that is available considering topography and weather patterns. The solar energy production is also dependent on the relative location of the panel (ground v/s mounted on the tank) and hence both ground and tank mounted solutions were studied separately for the tank locations. The solar panel is then sized to meet the requirements to power the site and charge the batteries.

The battery capacity could be engineered to keep the site powered from 24 – 120 hours on battery only. Considerations for battery capacity include available volume in the cabinet. Battery monitoring equipment can be added and signals for remaining battery capacity or other parameters could be connected to the local PLC.

Aurora Solar is a solar performance modeling software platform which was used to evaluate the tanks site and validate whether the proposed solar PV solutions would meet the power needs of the PLC and provide required power for charging the battery. Aurora Solar includes LIDAR imagery to validate structures and shading conditions to assess the expected energy production of the system, based on electrical characteristics of the proposed hardware and a weather dataset for the City. The energy production reports for these simulations are included for each site in Appendix A.

Based on the modeling, it appears that the solar PV backup solution is promising for most sites, but an enlarged battery solution may be more appropriate and cost effective for the shadier sites. Both ground mount and tank mount solutions would work for most of the sites, except for the sites where the surrounding areas is covered with large trees – only a tank mounted solar PV solution would be possible at these sites. The solar assessment reports in Appendix A include illustrations and graph comparisons showing the expected energy consumption vs. the expected energy production at each site. Ideally, there is plenty of excess production capacity at a site to provide reliability for worst-case bad weather combinations. The sites that are listed as less positive fall slightly short of the required capacity in the shortest winter months.
5.0 Solution Design
Based on discussions with the City, Black & Veatch identified a potential solar PV power solution to provide charging resource to indefinitely extend the function of the current battery backup system. After reviewing a couple of options, which are summarized in Table 5-1, two solutions were identified for the solar PV designs:

- A commercially available ground mount solution, with the PV module tilted at 30° for the sites with space for ground mount equipment. An example of this mounting solution is illustrated in Figure 5-1. The module would be attached to the pre-engineered racking designed to mount to the top of a 3”-4” Schedule 40 Galvanized Steel pole set in a concrete footing. The lower edge of the module should be 36” minimum elevation from the ground. PV source circuit conductors would need to be installed in conduit buried in a trench from the module location to the PLC battery box, crossing landscaping and pavement.

- A universal mounting solution that would mount the PV module vertically in landscape mode to the long rail of the catwalk on the tanks, was selected for sites with limited ground space or reduced solar access. Figure 5-2 shows the proposed installation. Although the vertical mounting is non-traditional, it provided that least interference with access to the tank and can be more securely mounted.

Based on the power needs, a common commercial-style, 72-cell, 375-Watt PV module was chosen. Other options considered for PV modules were more expensive and had a more complicated mounting solution with less power. One example of the recommended PV module is the Mission Solar 375-Watt module (datasheet for this module is included in Appendix C), but this is a common form factor and these modules are currently readily available from 350-400 Watts from various manufacturers and will be easy to procure locally in California. Appendix C includes detailed information on the proposed system components including: the proposed module (or equivalent), charge controller, and mounting components (for ground mount and tank mounting solutions). The existing battery systems on site will need to be connected in parallel to the solar charge controller, to get charged during the day.

Table 5-1  Solar Mounting Alternatives

<table>
<thead>
<tr>
<th>SOLUTION</th>
<th>DESCRIPTION</th>
<th>CONCLUSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount panels on existing utility pole</td>
<td>Intercept grid feed for microgrid</td>
<td></td>
</tr>
<tr>
<td>Mount Mia Sole modules on tank</td>
<td>Top and side in parallel for fire redundancy</td>
<td></td>
</tr>
</tbody>
</table>
| Mount module rack to tank anchor bolts | • City may be able to fabricate mounting plate  
• Most tanks have bolts as a retrofit  
• Possibly use epoxy bolts into foundation to brace mount  
• Possibly 10’ max height for panel servicing  
• Keep panel mount protruding less than overflow pipe or telemetry cabinet | Not a universal solution, several sites would be heavily shaded. |
<table>
<thead>
<tr>
<th>SOLUTION</th>
<th>DESCRIPTION</th>
<th>CONCLUSION</th>
</tr>
</thead>
</table>
| Mount to catwalk railing       | • Mount panels vertically to avoid bird nests, possibly combination of azimuths.  
                               | • Most universal mounting method. Majority of sites have good solar access at catwalk.  
                               | • Catwalks are structurally sound and grounded.                                           | Potential lightning hazard, however Owen Porter mentioned that the tanks are grounded, and catwalks are welded to tanks, making the site safe from lightning. PV module and conduit should be grounded back to charge controller and radio cabinet with an equipment grounding conductor (EGC). |
| Mount panels to cabinet tops   | • City is going to have weather shields installed on every cabinet eventually.  
                               | • Can bolt to weather shield or use existing lifting point holes.                           | Not a universal solution, several sites would be heavily shaded.                                |
| Ground Mount solution          | • Potential maintenance can be completed at ground level.                     | This is the most universal solution and would not require maintenance to be performed at-height.  
                               | • Pre-engineered mounting solutions exist.                                                 | Some sites with heavy shade will still require an enlarged battery system to maintain communications during PSPS events. |
|                                | • Tilt and azimuth can be adjusted to optimize production and account for landscaping changes/growth.  
                               | • Installation cost may be higher than catwalk mount, due to trenching and pavement cutting/repair for conduit back to PLC cabinet.  
                               | • Versatile mounting locations anywhere on-site.                                           |                                                                                               |
|                                | • Low installation height may be subject to significant shade impact from nearby trees. |                                                                                               |                                                                                               |

Figure 5-1 Example Panel Placement Illustration for the Proposed Solar Ground Mounting Solution
For sites with poor solar resource on the ground and tank catwalks, a battery solution is recommended. The replacement battery system needs to be sized to provide at least 120 hours of back-up power, which is equivalent to 175 Ah in battery capacity. This battery system will be charged using grid power. A battery box will need to be added next to the communications cabinet to hold the additional batteries in cases where the battery cabinet is not large enough to hose the larger battery. Two example battery specifications are attached in Appendix C. The example batteries are NiFe, LiFePo and SLA AGM type batteries.

The solar PV solutions would require minimal maintenance once deployed. Because the module will be mounted at 30deg angle for the ground mount solution and vertically for the tank mounted solution, only minimal dirt or debris will stick to the panel and cause reduction in power generation and precipitation will help wash off dirt and debris. If module cleaning is required, the module surface may be wiped with a damp cloth or rinsed clean with a low-pressure hose.

The maintenance for a larger battery system would not be any different than that of existing batteries.

Table 5-2 is a list of battery chemistries that could be considered for the battery solution.
### Table 5-2 Battery Chemistry Options

<table>
<thead>
<tr>
<th>BATTERY CHEMISTRY</th>
<th>DESCRIPTION</th>
<th>PLANNING LEVEL</th>
<th>COST</th>
</tr>
</thead>
</table>
| Ni-Fe, such as those available from Iron Edison [https://ironedison.com/nickel-iron-ni-fe-battery](https://ironedison.com/nickel-iron-ni-fe-battery) | • Long life and durable solution.  
• Large format (59” tall) presents installation challenges. | 200 Ah battery from Iron Edison is listed at $2,406. | |
| LiFePo, Available from multiple manufacturers. | • Long life and durable solution.  
• Requires replacement of the existing battery charger designed for use with LiFePo batteries.  
• Smaller form factor may allow installation in some radio cabinets. | 200 Ah battery from Iron Edison is listed at $2,449. | |
| AGM Lead Acid, Available from multiple manufacturers. | • Durable and proven technology.  
• May fit inside some cabinets, but most would require a dedicated battery box to be mounted adjacent to cabinet. | 200 Ah battery from Renogy listed at $400. | |

Appendix D lists the different solutions that were evaluated at various sites.
6.0 Solution Cost Estimate

Planning level costs are provided below of the recommended equipment in the previous sections. This cost does not include engineering, procurement, permitting or installation. Component costs were obtained from on-line retail prices in July 2020. Labor is estimated to be two people at about one site per day.

**EQUIPMENT FOR TANK MOUNTED SOLUTION**

<table>
<thead>
<tr>
<th>Description</th>
<th>Opinion of Purchase Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 375-Watt solar module</td>
<td>$250-$400</td>
</tr>
<tr>
<td>Tank Mounted Racking hardware (including Ironridge XR mounting rails, 2&quot; ground mount connectors, grounding lug and module clamps)</td>
<td>$250</td>
</tr>
<tr>
<td>The Morningstar ProStar MPPT-25M charge controller</td>
<td>$400</td>
</tr>
<tr>
<td>Balance of System (wiring, connectors, breakers, conduit fittings (using existing spare conduit mounted to catwalk ladder))</td>
<td>&lt;$500</td>
</tr>
<tr>
<td><strong>Total Equipment Cost</strong></td>
<td><strong>$1,400-$1,550</strong></td>
</tr>
</tbody>
</table>

**EQUIPMENT FOR GROUND MOUNTED SOLUTION**

<table>
<thead>
<tr>
<th>Description</th>
<th>Opinion of Purchase Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>The 375-Watt solar module</td>
<td>$250-$400</td>
</tr>
<tr>
<td>Pole Mounted Racking hardware (including Tamarack top of pole mounting system, 4&quot; schedule 40 steel pipe, grounding lug and module clamps)</td>
<td>$500</td>
</tr>
<tr>
<td>The Morningstar ProStar MPPT-25M charge controller</td>
<td>$400</td>
</tr>
<tr>
<td>Balance of System (excluding underground conduit, variable by site)</td>
<td>&lt;$500</td>
</tr>
<tr>
<td><strong>Total Equipment Cost</strong></td>
<td><strong>$1,550-$1,800</strong></td>
</tr>
</tbody>
</table>
7.0 Next Steps

The Solar Feasibility Study evaluated power back-up solutions for the tank PLC communication systems based on:

- The physical space available for solar PV or battery solutions.
- Solar resource at the site.
- Common commercially available solar PV and battery solutions (including the mounting system and casing for the equipment).

The study did not include any structural engineering analysis for the power back-up solutions and has only looked at the possible electrical interconnections at a planning level.

Section 5 of this report identifies alternative solutions that could possibly work for the power back-up requirement. Table 5-1 lists the different site-specific solutions and also notes Black & Veatch recommendations for the sites. A recommended solar mounting solution that would provide a universal solution was discussed with the City and is included in Section 5. The City also expressed a preference towards ground mounted solutions for solar, due to the accessibility challenges of a tank mounted solution. Example equipment specifications that would be included with the recommended solution are attached in Appendix C.

Next steps should include:

- A detailed electrical and structural engineering analysis of each tank site and the viability of the recommended solutions should be confirmed and designed.
- The equipment specifications noted in Section 5 and Appendix C are only examples used for discussion purposes. Detailed investigation and procurement should be done for the equipment as a next step, after detailed engineering design is completed.
- The City should gather any geotechnical details available regarding the site.
- The City should also work on soliciting bids for installation of the solar PV and battery solutions, from local installers, based on the findings from the detailed engineering analysis.
## Appendix A. Tank Site Solar Assessments

<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R11</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>1784 Allan Way, Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.424406, -122.686999</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-West</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>551</td>
</tr>
</tbody>
</table>

![Image of tank site and solar panel location]

### Site Load vs Solar Production

![Bar chart showing site load vs solar production over the months of the year with consumption and production data]
| TANK ID   | R11          |
| ADDRESS  | 1784 Allan Way, Santa Rosa, CA |
| COORDINATES | 38.424406, -122.686999 |
| NUMBER OF TANKS AT THIS LOCATION | 1 |
| MOUNTING SOLUTION | Tank Mount |
| PANEL DIRECTION | West |
| MONTHLY CONSUMPTION (KWH) | 13.5 |
| SOLAR PRODUCTION (KWH) | 274 |

### Site Load vs Solar Production

![Site Load vs Solar Production Chart](chart.png)

- **Consumption (kWh)**
- **Production (kWh)**
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>4762 Woodview Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.422206, -122.648769</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>505</td>
</tr>
</tbody>
</table>

![Panel location](image1.png)

**Site Load vs Solar Production**

![Graph showing site load vs solar production](image2.png)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R10</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>4762 Woodview Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.422206, -122.648769</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>323</td>
</tr>
</tbody>
</table>

Site Load vs Solar Production

- Consumption (kWh)
- Production (kWh)
<table>
<thead>
<tr>
<th><strong>TANK ID</strong></th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDRESS</strong></td>
<td>4796 Annadel Heights Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td><strong>COORDINATES</strong></td>
<td>38.435598, -122.648736</td>
</tr>
<tr>
<td><strong>NUMBER OF TANKS AT THIS LOCATION</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>MOUNTING SOLUTION</strong></td>
<td>Ground Mount</td>
</tr>
<tr>
<td><strong>PANEL DIRECTION</strong></td>
<td>South-West</td>
</tr>
<tr>
<td><strong>MONTHLY CONSUMPTION (KWH)</strong></td>
<td>13.5</td>
</tr>
<tr>
<td><strong>SOLAR PRODUCTION (KWH)</strong></td>
<td>541</td>
</tr>
</tbody>
</table>

**Site Load vs Solar Production**

![Graph showing site load vs solar production for different months]

- Consumption (kWh)
- Production (kWh)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R9</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>4796 Annadel Heights Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.435598, -122.648736</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>2</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-East</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>297</td>
</tr>
</tbody>
</table>

**Site Load vs Solar Production**

![Graph showing Site Load vs Solar Production]

- **Consumption (kWh)**
- **Production (kWh)**

---

**Panel Location**

![Panel Location Image]
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R14</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>1510 White Oak Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.42189, -122.599035</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-West</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>334</td>
</tr>
</tbody>
</table>

**Site Load vs Solar Production**

![Graph](image)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R14</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>1510 White Oak Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.42189, -122.599035</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>305</td>
</tr>
</tbody>
</table>

**Site Load vs Solar Production**

![Graph showing Site Load vs Solar Production]

- **Consumption (kWh)**
- **Production (kWh)**
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R12B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.424079, -122.590691</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-West</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>252</td>
</tr>
</tbody>
</table>

![Site Load vs Solar Production](image)

The site load vs solar production graph illustrates the consumption and production of energy over the course of a year. The bar chart shows the consumption (kWh) in blue and the production (kWh) in green for each month.
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R12B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.424079, -122.590691</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>180</td>
</tr>
</tbody>
</table>

![Panel location](image1)

![Site Load vs Solar Production](image2)
TANK ID | R4
ADDRESS | 4905 Rockridge Ln, Santa Rosa, CA
COORDINATES | 38.469298, -122.686674
NUMBER OF TANKS AT THIS LOCATION | 1
MOUNTING SOLUTION | Tank Mount
PANEL DIRECTION | South-east
MONTHLY CONSUMPTION (KWH) | 13.5
SOLAR PRODUCTION (KWH) | 189

*GROUND MOUNT SOLAR ALTERNATIVE IS NOT RECOMMENDED FOR THIS SITE*
<table>
<thead>
<tr>
<th><strong>TANK ID</strong></th>
<th>R2A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ADDRESS</strong></td>
<td>3899 Parker Hill Road, Santa Rosa, CA</td>
</tr>
<tr>
<td><strong>COORDINATES</strong></td>
<td>38.490498, -122.70526</td>
</tr>
<tr>
<td><strong>NUMBER OF TANKS AT THIS LOCATION</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>MOUNTING SOLUTION</strong></td>
<td>Ground Mount</td>
</tr>
<tr>
<td><strong>PANEL DIRECTION</strong></td>
<td>South-West</td>
</tr>
<tr>
<td><strong>MONTHLY CONSUMPTION (KWH)</strong></td>
<td>13.5</td>
</tr>
<tr>
<td><strong>SOLAR PRODUCTION (KWH)</strong></td>
<td>343</td>
</tr>
</tbody>
</table>

![Panel location](image1)

![Panel location](image2)

### Site Load vs Solar Production

<table>
<thead>
<tr>
<th>Month</th>
<th>Consumption (kWh)</th>
<th>Production (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Feb</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Mar</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Apr</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>May</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>Jun</td>
<td>20</td>
<td>32</td>
</tr>
<tr>
<td>Jul</td>
<td>22</td>
<td>34</td>
</tr>
<tr>
<td>Aug</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Sep</td>
<td>26</td>
<td>38</td>
</tr>
<tr>
<td>Oct</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>Nov</td>
<td>28</td>
<td>40</td>
</tr>
<tr>
<td>Dec</td>
<td>30</td>
<td>42</td>
</tr>
</tbody>
</table>

- **Consumption (kWh)**
- **Production (kWh)**
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R2A</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>3899 Parker Hill Road, Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.490498, -122.70526</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>274</td>
</tr>
</tbody>
</table>

Site Load vs Solar Production

![Site Load vs Solar Production Graph](image)

- Consumption (kWh)
- Production (kWh)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R17</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>2201 Newgate Ct., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.492086, -122.698927</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-East</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>541</td>
</tr>
</tbody>
</table>

**Site Load vs Solar Production**

- **Consumption (kWh)**
- **Production (kWh)**

![Panel Location Image]
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R17</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>2201 Newgate Ct., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.492086, -122.698927</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>340</td>
</tr>
</tbody>
</table>

![Panel location](image)

**Site Load vs Solar Production**

- **Consumption (kWh)**
- **Production (kWh)**

![Bar chart](image)
<table>
<thead>
<tr>
<th>TANK ID</th>
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</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>5035 Harville Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.490147, -122.661831</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-west</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>411</td>
</tr>
</tbody>
</table>

![Site Load vs Solar Production](image-url)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>5035 Harville Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.490147, -122.661831</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>315</td>
</tr>
</tbody>
</table>

Site Load vs Solar Production

![Graph showing Site Load vs Solar Production](image)

- Consumption (kWh)
- Production (kWh)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R7</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>5623 Yerba Buena Rd., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.474455, -122.642669</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-west</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>532</td>
</tr>
</tbody>
</table>

![Panel location](image)

**Site Load vs Solar Production**

- **Consumption (kWh)**
- **Production (kWh)**

![Graph showing site load vs solar production for each month](image)
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R7</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>5623 Yerba Buena Rd., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.474455, -122.642669</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-west</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>280</td>
</tr>
</tbody>
</table>

![Panel Location](image)

**Site Load vs Solar Production**

![Graph showing Site Load vs Solar Production](image)

Legend:
- **Consumption (kWh)**
- **Production (kWh)**
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R8</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>Wrong 6801 Skyhawk Dr, Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.471892, -122.623746</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Ground Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>552</td>
</tr>
</tbody>
</table>

![Panel location](image-url)

### Site Load vs Solar Production

![Site Load vs Solar Production Chart](image-url)

- **Consumption (kWh)**
- **Production (kWh)**
<table>
<thead>
<tr>
<th>TANK ID</th>
<th>R8</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADDRESS</td>
<td>Wrong 6801 Skyhawk Dr., Santa Rosa, CA</td>
</tr>
<tr>
<td>COORDINATES</td>
<td>38.471892, -122.623746</td>
</tr>
<tr>
<td>NUMBER OF TANKS AT THIS LOCATION</td>
<td>1</td>
</tr>
<tr>
<td>MOUNTING SOLUTION</td>
<td>Tank Mount</td>
</tr>
<tr>
<td>PANEL DIRECTION</td>
<td>South-west</td>
</tr>
<tr>
<td>MONTHLY CONSUMPTION (KWH)</td>
<td>13.5</td>
</tr>
<tr>
<td>SOLAR PRODUCTION (KWH)</td>
<td>269</td>
</tr>
</tbody>
</table>

Site Load vs Solar Production

![Site Load vs Solar Production](image)

- Consumption (kWh)
- Production (kWh)
TANK ID | A5  
ADDRESS | 2521 Del Rosa Ave., Santa Rosa, CA  
COORDINATES | 38.4508722, -122.6852055  
NUMBER OF TANKS AT THIS LOCATION | 2  
MOUNTING SOLUTION | Tank Mount  
PANEL DIRECTION | South-west  
MONTHLY CONSUMPTION (KWH) | 13.5  
SOLAR PRODUCTION (KWH) | 237

*SANTA ROSA IS NOT EXPECTED TO NEED A SOLAR SOLUTION AT THIS SITE*
Appendix B. Reference Documents Received from City of Santa Rosa

ADMINISTRATOR@SRCITY.ORG_20200211_160323
## INTERNATIONAL SERIES LINEAR

Power-One produces the industry's broadest selection of linear power supplies with output voltages from 5 volts through 250 volts. Nigel technical and proven designs range to create quiet, highly regulated, dependable DC power.

### FEATURES
- Worldwide AC Input Capabilities 100/120/220/240VAC
- ±0.05% Output Regulation
- Low Output Ripple
- UL, CSA, and TÜV Approvals
- Mean Time Before Failure (MTBF) in Excess of 100,000 Hours
- CE marked to Low Voltage Directive
- 100% Burn-In
- 2 Year Warranty
- Over-temperature Protection (OTP) Standard on 1V Single Outputs, Optional for other outputs under 48V.

### SINGLE OUTPUT MOTORS

<table>
<thead>
<tr>
<th>VOLTAGE</th>
<th>MODEL</th>
<th>VOLTAGE/</th>
<th>CURRENT/</th>
<th>CASE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>9V</td>
<td>R35-1</td>
<td>25V ±1.5A (Note 1)</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-2</td>
<td>25V ±1.5A (Note 2)</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-3</td>
<td>25V ±1.5A (Note 3)</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-4</td>
<td>25V ±1.5A (Note 4)</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-5</td>
<td>25V ±1.5A (Note 5)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-6</td>
<td>25V ±1.5A (Note 6)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>R35-7</td>
<td>25V ±1.5A (Note 7)</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>G4PAF</td>
<td>25V ±1.5A (Note 8)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-1</td>
<td>25V ±1.5A (Note 9)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-2</td>
<td>25V ±1.5A (Note 10)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-3</td>
<td>25V ±1.5A (Note 11)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-4</td>
<td>25V ±1.5A (Note 12)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-5</td>
<td>25V ±1.5A (Note 13)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-6</td>
<td>25V ±1.5A (Note 14)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-7</td>
<td>25V ±1.5A (Note 15)</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIIF-8</td>
<td>25V ±1.5A (Note 16)</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

### SLA Battery Chargers

#### FEATURES
- Electronically regulated - current limited chargers for sealed lead-acid type batteries.
- Wall mount plug-in design for 250, 300, 500, 800 series and 1000A series, counter top design for 24/1000A, 2000, 4000 and 10A series.
- Operating temperature range: 32°F – 104°F (0°C – 40°C).
- Input voltage: 110/120VAC, 60Hz, PSC-1220000A and PSC-2410000A can be switched to accept 220/230VAC, 50Hz.
- Hi-impact resistant thermoplastic housing for 250, 300, 500, and 800 series; metal housing for 1000, 2000, 4000, and 10A series.
- Screw-type terminals for 250 & 500 series, I/O cord with battery connectors for 300, 800, 1000, 2000, 4000, and 10A series chargers.

#### CHARACTERISTICS

- **P** Series: Float chargers are designed to provide optimum life for batteries used in standby applications where charging is continuous. The chargers deliver a constant voltage of 2.25 to 2.30 volts per cell which allow the battery to seek its own current level and maintain itself in a fully charged condition. This series is best suited for burglar and fire alarm equipment, emergency lighting, memory protection, or UPS systems where the battery serves as back-up power to the AC source.

- **A** Series: Automatic dual rate chargers sense battery requirements and automatically switch from the fast charge to float mode, or vice versa. LED’s provide visual indication of the charging mode. Automatic chargers combine the advantages of float and cycle chargers; recharge time is short yet batteries are safe from being overcharged. This charger is ideal for cyclic applications where recharge time is critical and the battery may be left on charge indefinitely. As a result charging is fool-proof.
### Modern 2027

**The heavy-duty, reliable modem for industrial jobs.**

- Supports the Bell 2027 modem standard, a prerequisite for many leased-line applications.
- Operates over point-to-point or multipoint polled systems, full- or half-duplex over 2- or 4-wire circuits.
- Works on indoor and outdoor copper lines that do not meet conventional specifications.
- Perfect for industrial, SCADA, and metering applications.
- Data rates up to 1200 bps over unconditioned lines or 1600 bps over conditioned lines.
- Circuitry prevents data and carrier-detect errors over noisy lines.
- Anti-echoing capability.
- Enables users to verify transmitted and received data via its diagnostic feature.
- AC and DC models available, including a rackmount card.

<table>
<thead>
<tr>
<th>Item</th>
<th>Code</th>
<th>Price (US $)</th>
<th>Qty</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Modern 2027</td>
<td>MD1970A</td>
<td>599.99</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Standalone AC</td>
<td>MD1970A</td>
<td>729.99</td>
<td>0</td>
<td></td>
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<tr>
<td>Standalone DC</td>
<td>MD1970A-DC</td>
<td>545.99</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**These products work with:**
- DB9 Extension Cable (with EMI/RFI Hoods) (EDN12H)
- Click on "Cables" button above. Questions? Contact Tech Support.

The MD1970C also works with:
- Modern Rack (RM21A)
- Click on "Accessories" button above. Questions? Contact Tech Support.

**SPECIFICATIONS**
- Modulation — FSK
- RTS/CTS Delay — 8, 33, 59, or 219 ms
- Connectors — RS-232: (1) DB25 F;
- Telco: (1) RJ-45; 4-wire mode: Pins 4 and 5 for Transmit, Pins 3 and 6 for Receive;

TELEMETRY CABINET T-29635 PRINTS

CITY OF SANTA ROSA
SEISMIC UPGRADES AND TELEMETERING PANELS
T-29635

| 29635-i | DRAWING INDEX |
| 29635-ii | LEGEND SHEET |
| 29635-iii | WIRING INDEX |

TELEMETERING PANELS (TYPICAL OF 29)

| 29635-11 | PANEL ELEVATION |
| 29635-12 | POWER DISTRIBUTION |
| 29635-13 | COMMUNICATIONS DIAGRAM |
| 29635-14 | INPUT/OUTPUT DIAGRAM |
Appendix C. Assumed Equipment Data Sheets

RAIL ATTACHMENT
**SOLAR MODULE SPECIFICATIONS**

**AMERICA'S MODULE COMPANY**
**MSE PERC 72**

**CERTIFIED RELIABILITY**
- Tested to UL1703 & IEC standards
- PID resistant

**ADVANCED TECHNOLOGY**
- PERC and 5 busbar design ≥18% module efficiency
- Ideal for all applications

**EXTREME WEATHER RESILIENCE**
- 5631 Pa front and back load (117 psf) tested to UL1703

**BAA COMPLIANT FOR GOVERNMENT PROJECTS**
- Buy American Act
- American Recovery & Reinvestment Act

**FRAME-TO-FRAME WARRANTY**

**365-375W**
**CLASS LEADING POWER OUTPUT**

18.89%
**MAXIMUM EFFICIENCY**

-0~+3%
**POSITIVE POWER TOLERANCE**

The True American Brand

Mission Solar Energy is headquartered in San Antonio, TX, where we manufacture our modules. We produce American, high-quality solar modules ensuring the highest in class power output and best-in-class reliability to our customers. Our product line is tailored for residential, commercial and utility applications. Every Mission Solar Energy solar module is certified and meets industry standards and regulations, proving excellent performance over the long-term. Demand the best, demand Mission Solar Energy.

www.missionsolarenergy.com | info@missionsolarenergy.com

**PERC 72**

**ELECTRICAL SPECIFICATIONS**

- **Electrical Parameters at Standard Test Conditions (STC)**
  - Module Type: MSE365SS, MSE375SS, MSE375S5S
  - Power Output: 365W, 370W, 375W
  - Module Efficiency: 18.89%, 18.94%, 18.98%
  - Tolerance: 0% to 3%
  - Open-Circuit Voltage: 44.38V, 44.98V, 45.13V
  - Rated Current: 9.325A, 9.322A, 9.322A
  - Rated Voltage: 39.53V, 39.60V, 39.76V
  - Power Rating: 20, 20, 20

**TEMPERATURE COEFFICIENTS**

- Normal Operating Cell Temperature (NOCT): 43.4°C (110°F)
- Temperature Coefficient of Power: -0.39% /°C
- Temperature Coefficient of Voc: -0.63% /°C
- Temperature Coefficient of Isc: 0.045%/°C

**OPERATING CONDITIONS**

- Maximum Power Voltage: 54.29V
- Maximum Power Temperature: 40°C (104°F) to +25°C (77°F)
- Maximum Power Output: 365W
- Fire Safety Classification: Type 1, Class C
- Front & Back Lead (UL standard): 601T Poly (117 psf)
- Tied to UL1703 standard
- Safety Impact Velocity: 25mm at 20 m/s

**MECHANICAL DATA**

- Solar Cells: P-type mono-crystalline silicon (156.75mm)
- Cell Orientation: 72 cells (6x12), 5 busbar
- Module Dimension: 676mm x 1250mm x 35mm (26.6 x 49.2 x 1.4 inches)
- Weight: 21.5 kg (47.4 lbs)
- Front Glass: 2.2mm (0.088 inches) tempered, low-iron, anti-reflective coating
- Frame: Anodized aluminum alloy
- Encapsulant: Ethylene vinyl acetate (EVA)
- J-Box: Protection class IP67 with 3 bypass-diodes
- Cable: PV 1x1.0 mm² (24 AWG), 4x1.4 mm² (12 AWG)
- Connector: MC4 Compatible

**SHIPPING INFORMATION**

- Container: FT: 30' x 53', 40' x 40', 40' x 53', 40' x 60'
- Weight: 325 W
- Size: 325 W
- Height: 1.329W
- Width: 45.9W
- Length: 95.9W

**CLASS LEADING 365-375W**

- **IEC 61215/ 61701/ 61700/ 61700-3/ 8904**

- **370W, 72 CELL SOLAR MODULE**
  - **CURRENT - VOLTAGE CURVE**
  - **BASIC DESIGN:**
  - **UNITS:**

- **MISSION SOLAR ENERGY:**
  - San Antonio, Texas, USA
  - www.missionsolarenergy.com
POLE MOUNTED SOLAR RACKING

The STP-SCR/45R is designed and engineered for a single 60 or 72 cell module that is less than 45° wide. Mounts are manufactured using pre-galvanized steel and heavy-duty corrosion resistant 5000 series aluminum.

- Mounts on a user-supplied 4" schedule 40 steel pipe
- No complex sizing documents or need to send module data sheets when ordering
- Easily installed and adjusted by a single person
- Pre-galvanized finish is standard. No up-charges for environmental challenged areas
- Stainless Steel Hardware
- Tilt angle is easily adjustable in 10° increments from 0° to 60° from horizontal
- IN STOCK for immediate ground shipment
- Total shipping weight is 51 pounds in two boxes
- Certified for up to 150 mph wind speeds and 50 psf snow load at all tilt angles

<table>
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<th>Tilt Angle Degrees</th>
<th>Concrete Footing Size 4&quot; Schedule 40 Steel Pipe</th>
<th>Concrete Footing Size 5&quot; Schedule 40 Steel Pipe</th>
<th>Concrete Footing Size 6&quot; Schedule 40 Steel Pipe</th>
<th>Concrete Footing Size 8&quot; Schedule 40 Steel Pipe</th>
<th>Concrete Footing Size 10&quot; Schedule 40 Steel Pipe</th>
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<td>10°, 20°, 30°, 40°, 50°, 60°</td>
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<td>7.75, 8.40, 8.65, 8.85, 9.05, 8.75</td>
</tr>
</tbody>
</table>

Footprint Diameter (in.)
TANK MOUNTED SOLAR RACKING

**XR Rail Family**

The XR Rail Family offers the strength of a curved rail in three targeted sizes. Each size supports specific design loads, while minimizing material costs. Depending on your location, there is an XR Rail to match.

- **XR15**
  - XR15 is a sleek, low-profile mounting rail, designed for regions with light to no snow. It maximizes space up to 3 feet, while remaining light and economic.
  - 6" spanning capability
  - Moderate load capability
  - Clear & black anodized finish
  - Internal options available

- **XR100**
  - XR100 is the ultimate residential mounting rail. It supports a range of wind and snow conditions, while also maximizing space up to 10 feet.
  - 10" spanning capability
  - Heavy load capability
  - Clear & black anodized finish
  - Internal options available

- **XR1000**
  - XR1000 is a heavy-duty mount, ideal for high snow and wind conditions. It maximizes space up to 12 feet.
  - 12" spanning capability
  - Extreme load capability
  - Clear anodized finish
  - Internal options available

**Rail Selection**

The table below was prepared in compliance with applicable engineering codes and standards. *Values are based on the following criteria: ASCE 7-16, Gable Roof Flush Mount, Roof Zones 1 & 2b, Exposure B, Roof Slope of 8 to 20 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed certification letters.*

<table>
<thead>
<tr>
<th>Load (PSF)</th>
<th>Wind (MPH)</th>
<th>4'</th>
<th>5'-4'</th>
<th>6'</th>
<th>8'</th>
<th>10'</th>
<th>12'</th>
</tr>
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<td>XRX10</td>
<td>XRX100</td>
<td>XRX1000</td>
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<td>0-20</td>
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<tr>
<td>90-120</td>
<td>160</td>
<td><img src="chart.png" alt="" /></td>
<td>XRX1000</td>
<td>XRX1000</td>
<td></td>
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</tbody>
</table>

*This is meant to be a simplified chart for converting general rail capabilities. Use approved certification letters for actual design guidelines.*
CABLE GRIP/HEYCO SOLAR MASTHEAD
CHARGE CONTROLLER

PROSTAR MPPT™ SOLAR CONTROLLER
WITH MAXIMUM POWER POINT TRACKING

- High Reliability
- Maximizes Energy Harvest
- High Efficiency
- Low Noise Design

The ProStar MPPT™ solar controller is an advanced maximum power point tracking (MPPT) battery charger for off-grid photovoltaic (PV) systems up to 1100 watts. All versions have TruSoft™ Technology and include lead control. This controller allows multiple modules in series for 12V and 24V battery systems. Detailed battery programming options allow for advanced battery support for the Metal Luminor, Nickel Cadmium, and Lead Acid battery types.

**KEY FEATURES AND BENEFITS**

- **High Reliability**
  - Conformal coated circuit board and corrosion resistant terminals

- **Maximizes Energy Harvest**
  - Using TruSoft™ Technology to determine and adjust to the true maximum-power point of solar irradiation changes throughout the day

- **High Efficiency**
  - > 99% efficiency at ≥100 W (12V)

- **Data Logging**
  - Up to 256 days of detailed power and load data

- **Low Noise Design**
  - Meets UL Intertek Communications Class B specifications

- **Automatic PV Based Lighting Control**
  - Field adjustable, multi-event load control enables powerful options for PV lighting systems

- **MODBUS Communications**
  - Solar battery standard MODBUS communications protocol allows for easy programming, control, remote data access

- **SUMP (Simple Network Management Protocol)**
  - Provides further flexibility and monitoring of all system data with existing IT management and software

The ProStar design has been proven over two decades of use in the world’s most demanding installations—including Prostar today unless Morningstar’s employee-ownership culture ever “lets us down.” Prostar customers can own both stargate and the latest in a single product.

**Technical Specifications**

**Versions**
- PS-MPPT25
- PS-MPPT25M
- PS-MPPT40
- PS-MPPT40M

**Electrical**
- Max. Battery Current: 25 Amps
- Max. Load Current: 30 Amps
- Nominal Battery Voltage: 12V or 24V

**Environmental**
- Operating Temperature Range: -40°C to +60°C
- Storage Temperature Range: -65°C to +85°C
- Humidity: 100% non-condensing

**Mechanical Specifications**
- Dimensions:
  - Width: 190 mm x 85 mm x 40 mm
  - Weight: 4.1 kg
- Wire Size Range: 10 to 12 AWG

**Electronic Protections**
- Overvoltage without fuse
- Solar Input: overvoltage, short-circuit, high voltage warning, reverse polarity, high temperature, lifeline reverse current
- Load Overload: overvoltage, short-circuit, high voltage, reverse polarity
- Battery: reverse polarity
- Low temperature: “Thermal Lock” (limit overcurrent charging to avoid conditions to protect junctions on other batteries)

**Battery Charging**
- 4-stage charging: Bulk, Absorption, Float, Equalize
- 7 standard battery settings and customization
- Temperature Compensation: 0°C to 50°C

**Accessories**
- 1 NEMA 175, 13’ Power Cord
- 2 NEMA 175, 6’ Power Cord
- 4 NEMA 175, 6’ Power Cord
- 4 NEMA 175, 6’ Power Cord
- 4 NEMA 175, 6’ Power Cord
- 4 NEMA 175, 6’ Power Cord
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- 4 NEMA 175, 6’ Power Cord
GEL BATTERY

RENOGY DEEP CYCLE GEL BATTERY 12 VOLT 200AH

Renogy Off-Grid Deep Cycle Gel Battery is a perfect option for both standby and cyclic use applications under extreme environments owing to its advantages over flooded batteries. Featuring the maintenance-free and leak-proof design, it can reliably supply emergency power to telecommunications systems, security systems, and emergency lighting systems, helping prevent any damage that may be caused by sudden loss of mains power. It is also suitable for RVs, boats, medical equipment, and solar systems, where repeated charge and discharge are highly required, given its long service life and outstanding cycle capacity. Moreover, with its high power-to-weight ratio, it can provide maximum storage for any solar or wind system. With the finest materials, the state-of-the-art production techniques, and the strictest quality control procedures, Renogy Gel batteries aim to provide the most reliable, convenient, and economic rechargeable battery solution.

KEY FEATURES

Maintenance-Free
Renogy Gel battery incorporates gel electrolyte and advanced valve-regulated technology. Renogy Deep Cycle Gel Batteries save you from acid leakage and frequent maintenance.

Extended Service Life
Corrosion-resistant grids enable a design life of up to 6 years in standby applications and more than 500 deep discharge cycles at 68% DOD in cyclic applications.

Long Shelf Life
Made of high-quality materials, Renogy Deep Cycle Gel Batteries reduce the monthly self-discharge rate below 7% at 77°F (25°C), which is 5 times lower than that of lead-acid counterparts.

Deep Discharge Recovery
Proprietary plate composition and patented gel electrolyte ensure excellent recovery capability after excessive deep discharge.

RENOGY.COM  2775 EAST PHILADELPHIA ST. ONTARIO, CA 91764
Specifications

<table>
<thead>
<tr>
<th>Electric Characteristics</th>
<th>Temperature Parameters</th>
<th>Mechanical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage: 12V</td>
<td>Normal Operating Temperature: 57°F (13.8°C)</td>
<td>Nominal: 717W</td>
</tr>
<tr>
<td>Number of Cells: 6</td>
<td>Operating Temperature Range: Discharge: -4°F to 140°F (C-50°C)</td>
<td>Grid Material: ABS</td>
</tr>
<tr>
<td>Capacity @35°F/10°C: 225Ah (1 Hour Rate to 70% DOD)</td>
<td>Storage Temperature Range: -4°F to 140°F (C-50°C)</td>
<td>Weight: 307.6 lbs (139kg)</td>
</tr>
<tr>
<td>Internal Resistance: 2.2 mΩ</td>
<td>Discharge: -4°F to 140°F (C-50°C)</td>
<td>Dimensional (L x W x H): 28.9 x 10.4 x 10.4 (635 x 264 x 264 mm)</td>
</tr>
<tr>
<td>Self-Discharge Rate: 0.5%/day</td>
<td>Charge: 120°F to 140°F (C-50°C)</td>
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</tr>
<tr>
<td>Float Charge Voltage: 13.8V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle Use Voltage: 12V/10.5V</td>
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<td></td>
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<tr>
<td>Max Charge Current: 100A</td>
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<tr>
<td>Max Discharge Current: 92Ah (4 sec)</td>
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Constant Current Discharge Characteristics (177°F/135°C) Unit: WPC

<table>
<thead>
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<th>10000</th>
<th>25000</th>
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<tr>
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<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
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<td>113.2</td>
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<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
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Constant Power Discharge Characteristics (177°F/135°C) Unit: WPC

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<th>200000</th>
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<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
<tr>
<td>2XV</td>
<td>118.6</td>
<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
<tr>
<td>2.5XV</td>
<td>118.6</td>
<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
<tr>
<td>3XV</td>
<td>118.6</td>
<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
<tr>
<td>3.5XV</td>
<td>118.6</td>
<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
<tr>
<td>4XV</td>
<td>118.6</td>
<td>117.6</td>
<td>116.5</td>
<td>115.4</td>
<td>114.3</td>
<td>113.2</td>
<td>112.1</td>
<td>111.0</td>
</tr>
</tbody>
</table>

Discharge Characteristics Curve

Charge Characteristics Curve for Cycle Use

Relationship between Cycle Life and DOD

Temperature Effects on Capacity

Storage Characteristics

Effect of Temperature on Long Term Life

Relationship between OCV and State of Charge
LI-FE BATTERY

LiFePO₄ Instruction Manual
LFP12V50A | LFP12V100A | LFP12V200A
50Ah | 100Ah | 200Ah

Lithium LiFePO₄ Battery 12V
50Ah | 100Ah | 200Ah

AIMS Power’s 12 Volt LiFePO₄ battery product line has a battery for every application. The LiFePO₄ batteries maintain a constant output voltage, providing more efficient power. This allows the cell to deliver virtually full power until it is discharged and it can greatly simplify or even eliminate the need for voltage regulation circuits. The battery has a much longer cycle life capacity and easier to maintain compared to other battery technologies. The LiFePO₄ technology has better thermal and chemical stability, which improves battery safety and packed with power in a small and lightweight footprint. Easily uses the same space as your existing 12V battery and replaces lead acid. AGM or Gel battery applications in RVs, boats, commercial vehicles, off grid back up power and much more. Not intended to replace starting batteries.

FEATURES
- Extremely high number of charge/discharge cycles
- > 10 Year lifespan with proper maintenance
- Bluetooth monitoring
- Wide operating temperature range
- Unsurpassed high temperature performance
- Green energy without metal contaminant
- Low maintenance
- High amp capacity
- Stable output voltage
- Self recovering faults
- BMS safety protection
- Convenient removable carry handle
- Lightweight
50, 100 & 200 Ah models available

SAFETY CHARACTERISTICS
- Short circuit protected
- Physical damage to battery case will not cause fire
- Excessive thermal exposure will not cause a fire
- Able to withstand over-charge/over-discharge without damaging the battery
- Battery Management System (BMS)

BMS FUNCTION
Circuit Protection: The battery includes a BMS (Battery Management System) to protect the battery from overcharging, over-discharging, over drain, and short circuit, resulting in overall longer battery life. The BMS also protects the battery from exploding and catching fire. Includes thermal safety fusing, cell balancing, CID and fault recovery, Bluetooth monitoring available.
## Battery Specifications - Lithium Iron Phosphate

<table>
<thead>
<tr>
<th>Specification</th>
<th>LFP12V50A</th>
<th>LFP12V100A</th>
<th>LFP12V200A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical Specifications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Voltage</td>
<td>12.8V</td>
<td>12.8V</td>
<td>12.8V</td>
</tr>
<tr>
<td>Nominal Capacity (at 35°C, 77°F)</td>
<td>50Ah</td>
<td>100Ah</td>
<td>200Ah</td>
</tr>
<tr>
<td>Minimum Capacity (at 35°C, 77°F)</td>
<td>47.5Ah</td>
<td>95Ah</td>
<td>190Ah</td>
</tr>
<tr>
<td>Expected Cycle Life</td>
<td>&gt;4000 cycles w/1C charge and discharge rate, at 77°F, 80% DOD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operating Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Charge Method</strong></td>
<td>Smart charger, constant current, constant voltage</td>
</tr>
<tr>
<td><strong>Charge Voltage Range (Max 14.6V)</strong></td>
<td>14.4-14.6V</td>
</tr>
<tr>
<td><strong>Continuous Charge Current</strong></td>
<td>50A Max</td>
</tr>
<tr>
<td><strong>Charge Temperature</strong></td>
<td>32°F to 113°F</td>
</tr>
<tr>
<td><strong>Continuous Discharge Current</strong></td>
<td>50A Max</td>
</tr>
<tr>
<td><strong>Peak Instant Discharge Current (150 secs)</strong></td>
<td>100A</td>
</tr>
<tr>
<td><strong>Over Voltage Shutdown</strong></td>
<td>15.5 ± 0.2V</td>
</tr>
<tr>
<td><strong>Discharge Cut-off Voltage</strong></td>
<td>8V ± 0.5V</td>
</tr>
<tr>
<td><strong>Operating/Discharge Temperature</strong></td>
<td>-4°F to 149°F</td>
</tr>
<tr>
<td><strong>Storage Temperature</strong></td>
<td>-4°F to 113°F</td>
</tr>
<tr>
<td><strong>Self-Discharge (stored at 50% SOC)</strong></td>
<td>&lt; 3%/month</td>
</tr>
</tbody>
</table>

**Physical Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery Dimensions</strong></td>
<td>9&quot;L x 5.4&quot;W x 8.2&quot;H</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>17.75 lb</td>
</tr>
<tr>
<td><strong>Shipping Weight</strong></td>
<td>19 lb</td>
</tr>
<tr>
<td><strong>Group Size</strong></td>
<td>1250</td>
</tr>
<tr>
<td><strong>Post to Post Measurement</strong></td>
<td>6.4&quot;</td>
</tr>
<tr>
<td><strong>BMS Operation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Over Charge Protection</strong></td>
<td>Over charge detection voltage: 3.8 ± 0.22V</td>
</tr>
<tr>
<td><strong>Over Discharge Protection</strong></td>
<td>Over charge detection delay time: 1.99 ± 1.4s</td>
</tr>
<tr>
<td><strong>Over Current Protection</strong></td>
<td>Over charge release voltage: 3.6 ± 0.05V</td>
</tr>
<tr>
<td><strong>Polarity Reverse Protection</strong></td>
<td>Yes – see warranty notes</td>
</tr>
<tr>
<td><strong>Short Circuit Protection</strong></td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Warranty** (Limited):
- 5 Year Manufacturer
- 5 Year Manufacturer
- 5 Year Manufacturer

---

## Cell Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>32700</td>
</tr>
<tr>
<td><strong>Standard Capacity</strong></td>
<td>8AH</td>
</tr>
<tr>
<td><strong>Rated Voltage</strong></td>
<td>3.2V</td>
</tr>
<tr>
<td><strong>Max Charge Voltage</strong></td>
<td>3.65V</td>
</tr>
<tr>
<td><strong>Discharge Cut-off Voltage</strong></td>
<td>2.3V</td>
</tr>
<tr>
<td><strong>Peak Instant Discharge Current</strong></td>
<td>30A (10 Secs)</td>
</tr>
<tr>
<td><strong>Dimension (Customized)</strong></td>
<td>32&quot;x70mm</td>
</tr>
<tr>
<td><strong>Weight (Approx.)</strong></td>
<td>About 160g</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-4°F to 149°F</td>
</tr>
<tr>
<td><strong>Built-In Protection Circuit Module</strong></td>
<td>YES</td>
</tr>
<tr>
<td><strong>Cycle Time</strong></td>
<td>4000 times at 1C, 70% DOD</td>
</tr>
<tr>
<td><strong>Nominal Capacity</strong></td>
<td>32700 3.2V 6000mAh</td>
</tr>
<tr>
<td></td>
<td>Diameter: 32.2mm</td>
</tr>
<tr>
<td></td>
<td>Height: 70mm</td>
</tr>
</tbody>
</table>

### Celsius/Fahrenheit

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Celsius</th>
<th>Fahrenheit</th>
<th>Usable Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>140</td>
<td>-advisor</td>
<td>Usable but not recommended</td>
</tr>
<tr>
<td>50</td>
<td>122</td>
<td>-102%</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>104</td>
<td>3100%</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>86</td>
<td>1100%</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>68</td>
<td>257%</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>300%</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>32</td>
<td>125%</td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td>4</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>-20</td>
<td>-4</td>
<td>-125% for 50A/300AH, -267% for 200AH</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix D. Assessment Notes on Potential Mounting Solutions

<table>
<thead>
<tr>
<th>SITE</th>
<th>SITE VISIT NOTES</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
</table>
| R11  | Mount PV to anchor bolts at base or on catwalk railing  
Marginal solar potential | Solar (ground mount) and/or battery solution |
| R10  | Good potential solar mounts:  
• Top of ladder on railing  
• mounted to Unistrut on SE side  
• Mounted to top of Telemetry cabinet | Solar (ground mount) solution |
| R 9A, 9B | Good solar potential  
Two battery cabinets, two batteries, AC-coupled between them  
• No battery space in cabinet R9B, ample space in R9A  
• Mount PV on catwalk railings (vertical preferred on all sites to avoid bird soiling)  
• Look at multiple smaller modules, facing E,S,W combo  
• Mount on pole or anchor bolts, also | Solar (ground mount) solution |
| R14  | Densely wooded  
• Great solar resource on catwalk railing.  Decent resource on anchor bolts  
• Good mounting point for battery box next to cabinet | Solar (ground mount) solution |
| R12a | Going to have backup power provided by pumping station – LB on side of cabinet  
• Good solar resource on catwalk  
• Good solar resource on Cabinet | Solar (ground mount) solution |
| R12b | Marginal solar resource  
Probably only 5% on cabinet.  20% on catwalk | Solar (ground mount) and/or battery solution |
| R6   | Poor solar resource on cabinet  
Good resource on catwalk, no retrofit done for anchor bolts  
Good space inside cabinet for larger battery | Solar (ground mount) solution |
| R7   | Poor Solar resource at cabinet  
Good solar resource at catwalk, Good space for large battery  
• Existing solar only powers the SCADA  
  o 3x Schott 220-Watt panels on Ironridge racking  
  o Batteries were just replaced | Solar (ground mount) solution |
| R8   | Good solar resource on catwalk, poor on cabinet  
Good space inside and next to cabinet for large battery | Solar (ground mount) solution |
| 4A   | Marginal solar resource on cabinet and catwalk.  
Possible 20% solar on bollards on SE side of tank, but they are outside of the fence.  Only a small solar window between the trees.  Good space inside cabinet for large battery. | Solar (tank mounted) and/or battery solution |
<table>
<thead>
<tr>
<th>SITE</th>
<th>SITE VISIT NOTES</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>R17</td>
<td>Excellent solar resource on cabinet. Catwalk is atypical; used for Verizon antenna access. PLC is also on-site with no existing backup, other than batteries. One circuit with one battery and another circuit with two batteries in parallel. May be possible to mount PLC backup solar panels on anchor bolts facing South.</td>
<td>Solar (ground mount) solution</td>
</tr>
<tr>
<td>R2A</td>
<td>Good solar resource on cabinet and excellent resource on catwalk. Plenty of space for larger battery inside cabinet.</td>
<td>Solar (ground mount) solution</td>
</tr>
<tr>
<td>A5</td>
<td>Unlikely to ever be used. Poor solar resource at both cabinets. Good solar resource at catwalks.</td>
<td>N/A</td>
</tr>
</tbody>
</table>