Figure 100: Drum of battery acid obstructing row

Next Steps

Water on the floor needs cleaning up and the deionizer should be checked for leaks. The drum of battery acid needs to be moved out of the way to a safe storage area. The dead cell should be prepared for shipping back to Exide, as a warranty claim can be made for the dead cell.

3.4.5. Battery electrolyte levels

Battery electrolyte levels were visually inspected and battery maintenance was discussed with the operators.

Results

All battery electrolyte levels were close to the maximum line except the new cell, which was slightly lower. Operators reported having topped up the battery electrolyte twice since the system was installed, and checking the electrolyte levels fortnightly. The new cell may need to be topped up earlier than the others.

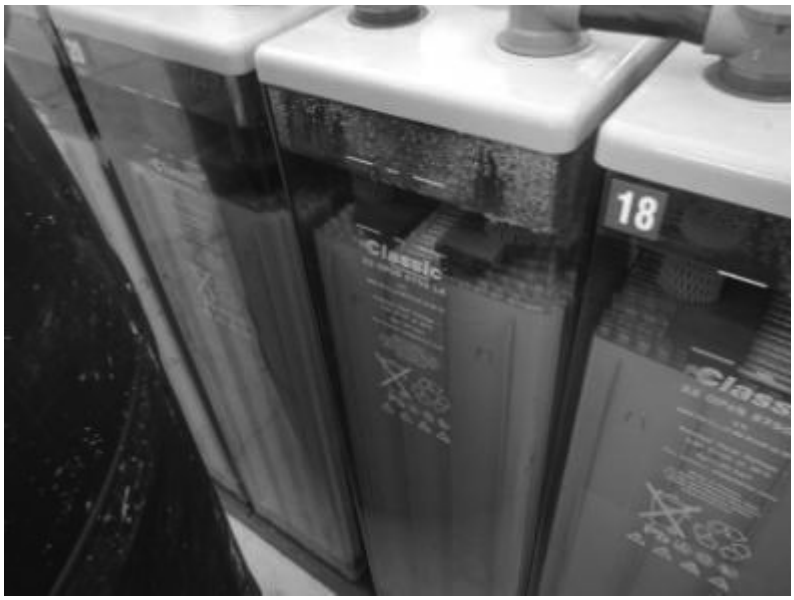

Figure 101: Battery electrolyte levels on old and new cell

Next Steps

The new cell (19, String A Cluster 2) should be checked and monitored. The schedule for checking and topping up batteries appears to be adhered to. Aside from regular checking and topping up of electrolyte no action is required.

3.4.6. Record keeping

Record keeping was discussed with staff to determine whether accurate maintenance records are being kept. The generator room was also checked to determine whether generator logging had continued after the PV system was commissioned.

Results

There were no records of battery testing and maintenance. It did not appear that there were any other maintenance records kept by local operators. We could not locate any generator logs kept since the PV system was installed, though there were logs from before the PV installation.

Next Steps

It is very important that staff are trained to keep records of maintenance work. As well as assisting with trouble shooting, good maintenance records will be important to support warranty claims for any equipment that fails during the warranty period. Staff are accustomed to keeping records for the diesel generator as they had been doing this before the PV system was installed, so it must be emphasised to them that record keeping is equally important for the PV system.

The dead cell in the battery bank occurred within the Exide warranty period, but so far only the one spare battery on site has been used. This leaves no spare batteries available if there is another cell failure. A warranty claim should be made for the faulty battery and a new one requested. The dead cell should be returned to Exide as part of the warranty claim.

3.4.7. Generator maintenance

Generator maintenance was discussed with operators.

Results

The operators reported that one of three generators was operational, though with some errors. The generator room was very untidy with clothes, rubbish and miscellaneous equipment on the floor and on the generators (Figure 102).

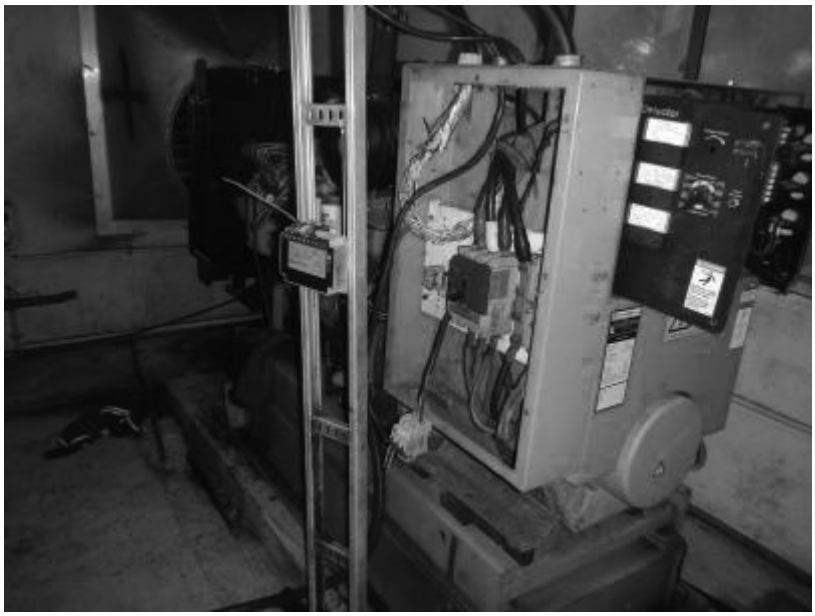

Figure 102: One working generator

Next Steps

The generator room needs to be cleaned up and the generator needs maintenance work. A second generator also needs to be returned to operational status to provide redundancy in the event of a PV system shutdown.

3.4.8. Spares and tools

The site was checked for spares and tools required for ongoing maintenance and replacement of any faulty parts.

Results

The following spare parts and tools were found on site:

- Battery acid (approximately 14 drums stored outdoors under cover)
- Miscellaneous spare conduit and cable
- Tool box
- General power tools and accessories
- 1 pallet spare panels

There are now no spare batteries on site. Of the 6 spare batteries included in the design, 5 were lost during unloading, leaving only one spare on site. That spare has been used and not replaced. The faulty cell identified by Exide should be replaced under warranty, so it is very important that the staff request a new battery so that there is at least one spare on site. The faulty cell should be returned to Exide.

Figure 103: Battery acid drums

Next Steps

Make a warranty claim to Exide for the faulty battery and have a new battery delivered to site to act as a spare. Return the faulty battery to Exide.

3.5. Summary

The system was found to be in good overall condition with no major construction or maintenance issues identified.

However, to ensure the ongoing viability of the system the following items should be addressed:

1. Trees from land north of the array are shading the front row and new trees are growing in the cleared zone. As these trees are on private land, permission to cut them needs to be sought from the land owner. We were advised that compensation is usually provided to landowners if their trees need to be cut down, so this needs to be worked in to the maintenance budget.
2. Check bolts for any spreading of spot rust.
3. Replace galvanized steel screws on locking mechanism for array DC isolator enclosures. These should be provided by Powersmart Solar.
4. The inverter room is too hot and needs to be provided with large extractor fans.
5. Return the inverter room computer to Powersmart Solar for repair or replacement.
6. Put the system diagram on the wall in the inverter.
7. Clean the battery room and store battery acid in a safe place where it does not obstruct access.
8. Ensure there are batteries available for the deionizer.
9. Provide a number for Battery 19, String A, Cluster 2 which has been replaced.
10. Record keeping, particularly for battery and generator maintenance, needs to be improved. This is important both for trouble shooting and also for warranty claims.
11. A new battery should be ordered from Exide under warranty and the faulty battery returned to Exide.
12. Battery SOC should be checked regularly, particularly Battery 19, String A, Cluster 2 which has been replaced.
13. Generator maintenance appears to be lacking and needs to be addressed with the goal of having two operational generators.

4. RECOMMENDATIONS

Ventilation

Nukunonu was the only atoll of the three to have a suitably ventilated inverter room. This was largely due to the location of the room and the fact that it had been purpose-built to maximise natural ventilation. The inverter room site on Nukunonu was situated in an area with a strong, consistent sea breeze that kept the inverter room (relatively) cool.

Fakaofo's inverter room, by contrast, used an existing building and was built inland, next to a swamp surrounded by forest, with very little natural airflow. Fakaofo was the hottest of the three atolls, with inverter room temperatures exceeding 44 degrees. In ITP's opinion it would be extremely difficult to achieve adequate passive cooling at this site due to the lack of natural air flow; forced ventilation is needed. The addition of vents at ground level, to help draw more cool air through the room, may also help. Since the fans are usually needed most during the day when the sun is shining, fans can be set on a timer so that they only run during daylight hours when the PV system is operating. This would reduce the effect on the batteries.

Atafu's inverter room, though purpose built, is also located in an area with very little natural air flow and although passive cooling design elements have been incorporated into the building (in the form of vents above the inverters), these do not appear to be sufficient. In ITP's opinion it would be extremely difficult to achieve adequate passive cooling at this site due to the lack of natural air flow; forced ventilation is needed. The addition of vents at ground level, to help draw more cool air through the room, may also help. Since the fans are usually needed most during the day when the sun is shining, fans can be set on a timer so that they only run during daylight hours when the PV system is operating. This would reduce the effect on the batteries.

Reverse cycle style cooling "air conditioning" is also an option, but is not recommended in Tokelau for various technical and social reasons. Private air conditioners are banned in Tokelau, and while exemptions are usually made for public services and utilities (such as Teletok and hospital clinics) supplying any additional air conditioner to the islands is perceived as setting a bad example; and, in the words of one operator, "everyone would come and sleep in the inverter room once they found out". From a technical perspective, air conditioners are energy intensive and also create an additional point of failure in the system. If an air conditioner is installed, the room needs to be sealed up. This means that if the air conditioner breaks down, the room will very quickly heat up as there is no natural ventilation at all.

The primary passive ventilation option is fixed roof venting to create convection current on still air days. This may not be adequate and the option of (electric) fans may be the only choice that meets all the requirements.

Note that it may be better to run fans 24 hours per day, with two different set points for night-time and daytime. This would allow the cooler night time air to combine with the lower equipment temperature (due to non-operation over night) to pull the thermal mass temperature lower.

Fakaofo

The system was found to be in good overall condition with no major construction or maintenance issues identified.

However, to ensure the ongoing viability of the system the following items should be addressed:

1. Some areas of the foundations on the swampy side of the array need to be reinforced by adding rock or crushed coral under the foundations, as the wood used will decay over time.
2. Check array isolators for wasp nests regularly and remove them to avoid excessive build up.
3. The temperature in the inverter room is excessive and needs to be reduced. Larger, more robust extractor fans are needed. An air conditioner can also be considered, though this would need to be supplemented with fans so that a failure of the air conditioner would not cause the room to overheat.
4. Fault mute switch should be kept in the off position.
5. SD cards were missing from two of the Sunny Webboxes and two of the Sunny Islands. We added new SD cards to the Webboxes. The SD cards may have been taken by power station staff, so this should be investigated by the Acting Director of Energy, particularly if it occurs again.
6. The “change filter” light on the deionizer was flashing. Replace the batteries, check again, and if necessary replace the filter and order another spare.
7. Record keeping, particularly for battery and generator maintenance, needs to be improved as there appeared to be no maintenance records. This is important both for trouble shooting and also for warranty claims.
8. Vegetation around the array was very overgrown and needs to be cut back.

It is desirable, though not crucial, to repair a second diesel generator for redundancy in times of bad weather or when the PV system needs to be shut down for maintenance.

Nukunonu

The system was found to be in good overall condition with no major construction or maintenance issues identified.

After shutting down due to a lightning strike, the system was restored to normal operation within a week after troubleshooting with assistance from Powersmart and SMA. This is good result given

that this was the first outage that the staff needed to deal with since the system was installed, and it indicates that they are capable of troubleshooting with support.

However, to ensure the ongoing viability of the system the following items should be addressed:

1. Check for any signs of erosion around foundations and build up soil if required.
2. Check bolts on array frame for any sign of rust spreading. Tea staining should not spread.
3. Tidy spare parts on in inverter room and put system diagram on wall.
4. Investigate internet connectivity problems with Teletok.
5. Record keeping, particularly for battery and generator maintenance, needs to be improved. This is important both for trouble shooting and also for warranty claims.
6. A new comms board for the spare Sunny Island should be ordered.
7. Monitor battery SOC, as there appear to be some significant deviations between banks.
8. Continue repair work on the second generator for redundancy in times of bad weather or when the PV system needs to be shut down for maintenance.
9. Monitor load, energy requirement and inrush current on the community freezer over a 24 hr period. Unless any problems are identified the freezer should be connected to the grid.

Atafu

The system was found to be in good overall condition with no major construction or maintenance issues identified.

However, to ensure the ongoing viability of the system the following items should be addressed:

1. Trees from land north of the array are shading the front row and new trees are growing in the cleared zone. As these trees are on private land, permission to cut them needs to be sought from the land owner. We were advised that compensation is usually provided to landowners if their trees need to be cut down, so this needs to be worked in to the maintenance budget.
2. Check bolts for any spreading of spot rust.
3. Replace galvanized steel screws on locking mechanism for array DC isolator enclosures. These should be provided by Powersmart Solar.
4. The inverter room is too hot and needs to be provided with large extractor fans.
5. Return the inverter room computer to Powersmart Solar for repair or replacement.
6. Put the system diagram on the wall in the inverter.

7. Clean the battery room and store battery acid in a safe place where it does not obstruct access.
8. Ensure there are batteries available for the deionizer.
9. Provide a number for Battery 19, String A, Cluster 2 which has been replaced.
10. Record keeping, particularly for battery and generator maintenance, needs to be improved. This is important both for trouble shooting and also for warranty claims.
11. A new battery should be ordered from Exide under warranty and the faulty battery returned to Exide.
12. Battery SOC should be checked regularly, particularly Battery 19, String A, Cluster 2 which has been replaced.
13. Generator maintenance appears to be lacking and needs to be addressed with the goal of having two operational generators.

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