PART 2- TECHNICAL REVIEW

1. Fakaofo System Review

1.1. PV Array

1.1.1. Structural Integrity

The PV array frame was visually inspected for damage, loose parts, movement and any signs of corrosion. Nuts and bolts were randomly checked for tightness. Concrete foundations were visually inspected for any signs of cracking or damage that could compromise the structure.

Results

No signs of movement were observed, and none of the bolts randomly checked were loose. Figure 1and Figure 2 show typical array frame details including bolts and general condition of the array frame. No structural problems were observed. Some small red rust patches were found on the aluminium frames (Figure 1). This is not aluminium rust (aluminium rust is whitish in colour, while iron and steel rust is red) so is likely caused by residue from steel strapping used during transportation. This will not cause corrosion of the aluminium and is therefore cosmetic only.

Figure 1: Array frame detail showing typical bolt (left) and residual rust marks from steel strapping (right)

Figure 2: Array frame detail showing general condition of array frame and bolts

Visual inspection of concrete footings revealed no cracking or crumbling of concrete around the array mounting points.

An area of concern at this site is support of the concrete foundations. Half of the array is mounted in swampy ground, so rock, coral and wood have been used to fill in the area under the foundations before pouring the concrete. In some areas, there are preliminary signs of erosion of the soil and rocks supporting the foundations (Figure 3). In other areas, it appears that the foundations are not fully supported by rock underneath – for example, Figure 4 and Figure 5 show parts of the foundation supported by wooden logs that are beginning to rot, and areas where there appears to be no supporting rock under the foundation.

Figure 3: Typical concrete footing detail (left); signs of erosion around foundation (right)

Figure 4: Foundations in swampy ground appear unsupported

Figure 5: Foundations in swampy ground supported by wooden logs

Next Steps

No immediate rectification work is required.

Foundations should be checked regularly for signs of sagging or cracking in areas with minimal support. In particular, wooden logs under the foundation should be replaced with rock support when they have rotted through.

The array structure should be checked periodically by local staff for any signs of movement or loose bolts.

1.1.2. Condition of panels

Panels were visually inspected for damage, hot spots and signs of degradation such as peeling of sealant and membrane, damage to glass, and brown spots on the underside of the panels.

Results

No signs of damage or hot spots were observed. Figure 6 shows typical panel front and back surface appearance. No dark spots, peeling or cracking were observed on any part of the array.

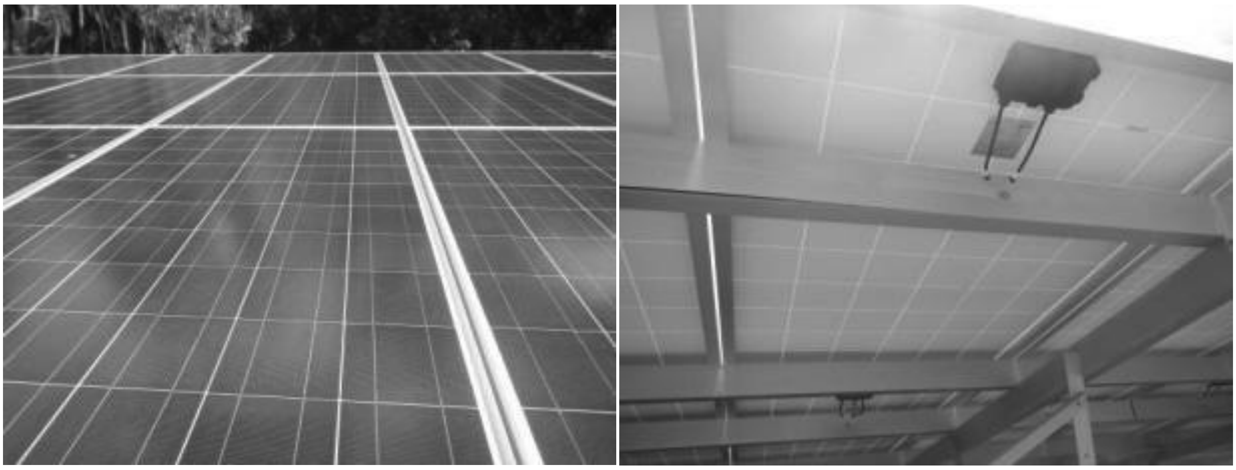

Figure 6: Typical condition of panels

Next Steps

No action is required.

1.1.3. Condition of cables and conduit

Array cables and conduit were visually inspected and physically checked for signs of damage.

The design of the array cable reticulation means that most of the cabling is enclosed within aluminium ducting, leaving only small parts of the cable exposed. Cable entries into the ducting are a possible point of wear so cables at these locations were checked closely for damage.

Results

Exposed conduit (Figure 8) was in good condition and suitably tied up to prevent accidental damage from movement.

Cable entries to ducting have sharp edge and in some cases the cables were pulled up against these edges (Figure 7). Some scratching on the outer insulation of the cables was observed, but no deep cuts in the insulation were found. Wiggling the cables produced very little movement so it is unlikely that they are rubbing against the edges due to movement. Nonetheless these points on the array should be monitored to ensure that the cable insulation is not damaged over time.

Figure 7: Cable entries to ducting – some scratches visible

Figure 8: Conduit detail

Next Steps

No immediate rectification work is required. However, cables entries to the ducting (as shown in Figure 7) should be checked regularly for signs of damage.

1.1.4. Isolator enclosures

Isolator enclosures were visually inspected and physically checked both from the outside and with the covers removed. The condition of all isolators and fuses was checked and cables were checked for loose connections. Enclosures were checked for water ingress and infestation from insects.

Results

1. Labelling and general condition

All labels were checked and none were found to be missing, damaged or incorrect.

Two isolator enclosures were found needing minor repair – one (in row one) had a burred screw while another (in row five) had a small part missing from the latching mechanism on the cover, preventing the cover from closing correctly. Both these issues were rectified immediately by the local operators.

Screw mounts inside the isolators are showing some signs of wear (Figure 9) indicating that they may need replacing after several years of opening and closing the isolators.

Figure 9: Isolator with damaged screw (left) and signs of wear on screw mounts (right)

2. Infestation

A few isolator enclosures had wasps nesting in the screw holes (Figure 10) and one isolator showed signs of previous ant infestation. The infestation was not widespread and wasp nests were easily removed with a screwdriver. There was no evidence that wasp nests would prevent operators being able to open the enclosures if needed. While there is little the operators can do to prevent infestation from wasps or ants, regular removal will prevent excessive build up of debris that could make it difficult to open the enclosures.

Figure 10: Wasp nests in screw holes (left); evidence of ants inside isolator (right)

3. Operational state of isolators and fuses

At the time of the inspection, the system was fully operational and no isolators or fuses were tripped. All isolators operated correctly when switched off and back on again.

4. Water ingress

Isolator enclosures were clean and dry inside. There was no evidence of any previous water ingress. The enclosures are mounted under the array, giving them good protection from rain under most circumstances.

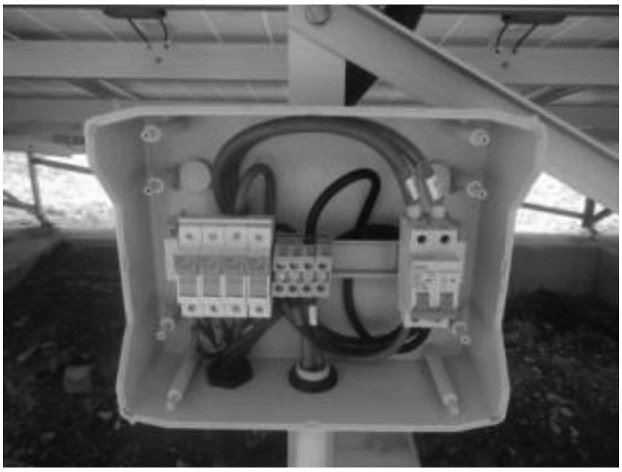

Figure 11: Typical isolator/fuse enclosure showing no sign of water ingress or loose cables

5. Corrosion

No signs of corrosion were found inside the isolator enclosures. Screws used in the enclosures were all stainless steel and showed no signs of corrosion. We were advised by the local operators that the galvanized steel screws that originally came with the enclosures had begun to corrode and had been replaced with stainless steel screws in April 2013.

6. Loose connections

Cable terminations on the isolators were checked for any movement by wiggling them. No loose connections were found and there was no evidence of any cables having moved since installation. Cable terminations were appropriately done with no sign of exposed copper wire inside the enclosures (Figure 11).

Next Steps

No immediate rectification work is required.

Local staff should check for insect infestations regularly to prevent excessive build up of wasp nests that may make it difficult to access the isolators.

Screw mounts are showing some signs of wear and may deteriorate after several years of opening the isolator enclosures. Staff should ensure that spares are available should they be required.

1.2. Inverter room

1.2.1. Temperature

Room temperature was measured using a mercury thermometer at four locations in the inverter room, including areas next to inverters. A measurement was also taken immediately above an inverter heat sink. Measurements were taken between 12:00pm and 12:30pm.

The inverter room contains four ceiling extractor fans for ventilation and these were checked for correct operation.

Results

Temperature measurements ranged from 42°C near the door to 45°C in the middle of the room. A measurement taken above an inverter heat sink read 49°C. Ambient temperature (outside in semi-shade) was 32°C. These temperatures are excessive and indicate that the existing ventilation is not adequate. Inverters will suffer both a performance loss and a shortened lifetime if kept in a consistently hot environment.

Extractor fans appeared dirty (Figure 13) and may be clogged internally. Only two of four fans were operating at the time of the inspection. ITP recommends that significantly larger fans are installed as the current ventilation scheme is inadequate.

Figure 12: Inverter wall and extractor fans visible in ceiling

Figure 13: Extractor fans in the centre of the inverter room

Next Steps

The inverter room temperature is excessive and should be reduced. The existing extractor fans are ineffective and two of four do not appear to be operational. Extractor fans should be replaced with larger fans or an air conditioner.

1.2.2. Operational status

Inverters, Sunny Islands and chargers were visually checked for correct operation by inspecting display screens and cross checking with information displayed on the main computer.

Results

All inverters, Sunny Islands and chargers were operating normally at the time of the inspection. Two Sunny Islands (Cluster 4 Slave 1 and Cluster 6 Slave 2) were missing SD cards. This does not affect data gathering capability as Master 4 and Master 6 were both equipped with SD cards and will collect data from the slaves. Nonetheless, SD cards should be provided for these slave units at the next available opportunity. Three of the chargers (C5A9, C3A10 and C3A9) had indicators lights not functioning but the Sunny Islands indicated that batteries were charging normally. We were advised by the operators that there had been some problems with the indicator lights and that this was being investigated by SMA.

Figure 14: Charger with faulty indicator light (left) and Sunny Island missing SD card (right)

1.2.3. Erroneous tripping of alarms

Frequency of alarm tripping was discussed with the operators on site. The state of system alarms was visually checked. No tripping occurred during the site visit.

Results

Operators reported no erroneous tripping. However, the Sunny Island Fault Mute Switch was in the “ON” position. This may indicate that erroneous tripping has occurred and that the audible alarm has been muted, or that it was switched to “MUTE” during testing and maintenance (which took place in April 2013) and has not been switched back off.

Figure 15: Sunny Island Fault Mute Switch is on

Next Steps

Fault Mute Switch should be kept in the “OFF” position at all times except during testing and maintenance. Leaving the alarm on mute could result in operators missing genuine alarms.

1.2.4. Labelling

Labelling on all inverters, Sunny Islands and Chargers was checked.

Results

All labelling was attached to equipment and was correct.

Figure 16: Labelling on inverters

Next Steps

No action is required.

1.2.5. Surge arrestors

All surge arrestors were checked for operational status by visual inspection.

Results

Figure 17: Lightning arrestors flagged green

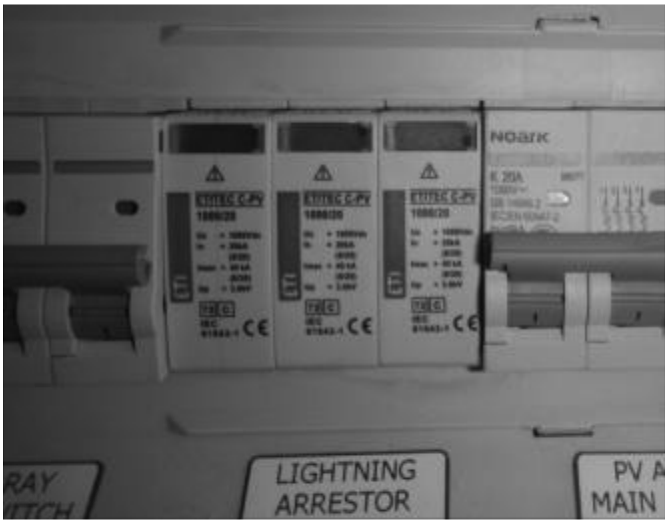

Figure 18: Sunny Boy lightning arrestors intact (red button pops out when tripped)

All Sunny Island lightning arrestors were flagged green indicating they were operating normally and had not tripped.

All Sunny Boy lightning arrestors were intact (for these arrestors a red button pops out when the arrestor is tripped).

Next Steps

No action is required.

1.2.6. Isolator enclosures

Isolator enclosures were opened and the condition and tightness of cables and circuit breaker terminations was checked manually.

Result

All cables were found in good condition and no loose connections were found.

While opening the isolator enclosures we noted that the lids are obstructed by the Sunny Boys next to them (see Figure 19 top right) which prevents them from being fully opened. This makes is slightly difficult to access the screw to remove the isolator lid, so operators will need to take care not to damage the lid when undertaking maintenance.

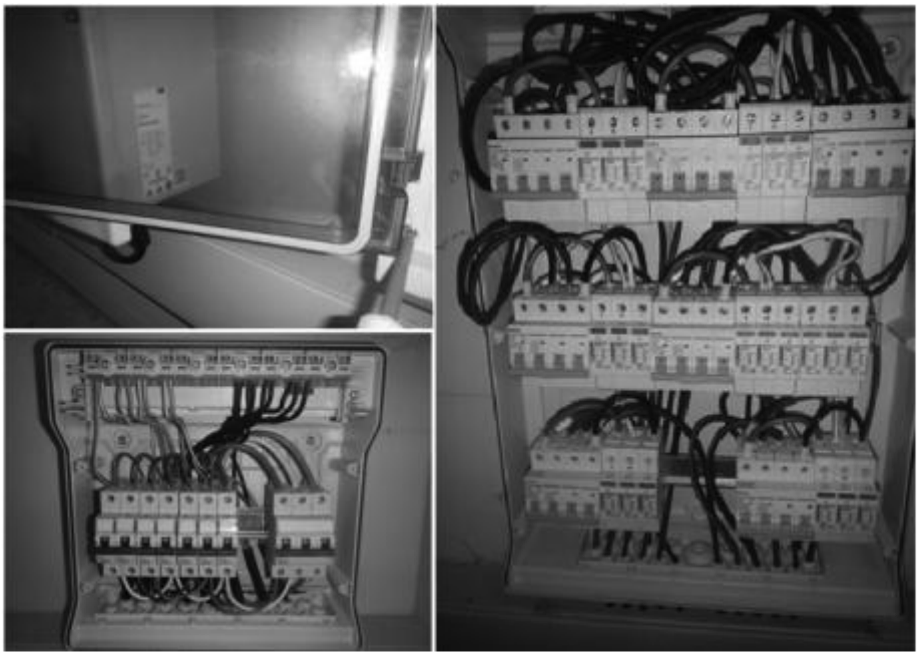

Figure 19: Removing enclosure lid (top left), wiring inside AC enclosure (bottom left) and inside DC enclosure (right)

Next Steps

No action is required.

Note that operators should take care not to damage enclosure lids when opening the enclosures. Ideally, the layout of the equipment should be such that the lids are not obstructed by other equipment such as Sunny Boys.

1.2.7. Webboxes and Internet reliability

Webboxes were checked for operational status. Internet reliability was discussed with system operators. Internet wiring and connections were physically inspected.

Results

At the time of the inspection, all internet wiring was intact and undamaged and the system was online. The Sunny Webboxes indicated that they were online and transmitting data (Figure 20).

Figure 20: Webboxes connected and online

The system operators reported occasional internet outages caused by Teletok (the internet provider) being down. The system reportedly came back online once Teletok restored connectivity. They were not aware of any internet connectivity problems occurring internally.

Two of three Webboxes (top two shown in Figure 20) were missing SD cards and they could not be found anywhere nearby. The SD cards store data regularly and can be used as a backup to access data when the internet connection fails. As the SD cards are missing, there may be data lost for some days when the internet connectivity was down. We had spare SD cards on hand and left new 2GB SD cards in the two Webboxes that were missing cards.

As the system was commissioned with SD cards in all Webboxes, there may be an issue with local operators taking the SD cards for their own use. It is unlikely that an unauthorized person could have taken them, as such a person would be unlikely know where to find the SD cards or have the tools to open the enclosure.

Figure 21: SD cards missing from Webboxes

Next Steps

No remedial work is required. As the SD cards appear to have gone missing, the Director of Energy should investigate the issue of local operators taking SD cards off site.

1.2.8. Manual and array diagrams readily accessible

The inverter room was visually checked for easy access to the manual and array wiring diagrams.

Results

The complete system manual was located at the operator desk in the inverter room. A check of the system manual showed it was complete, though some pages had been re-ordered (to put the battery maintenance procedure at the front). A laminated system diagram was located on the opposite wall.

Shutdown procedure and maintenance schedule were also laminated and mounted on the wall near the operator desk.

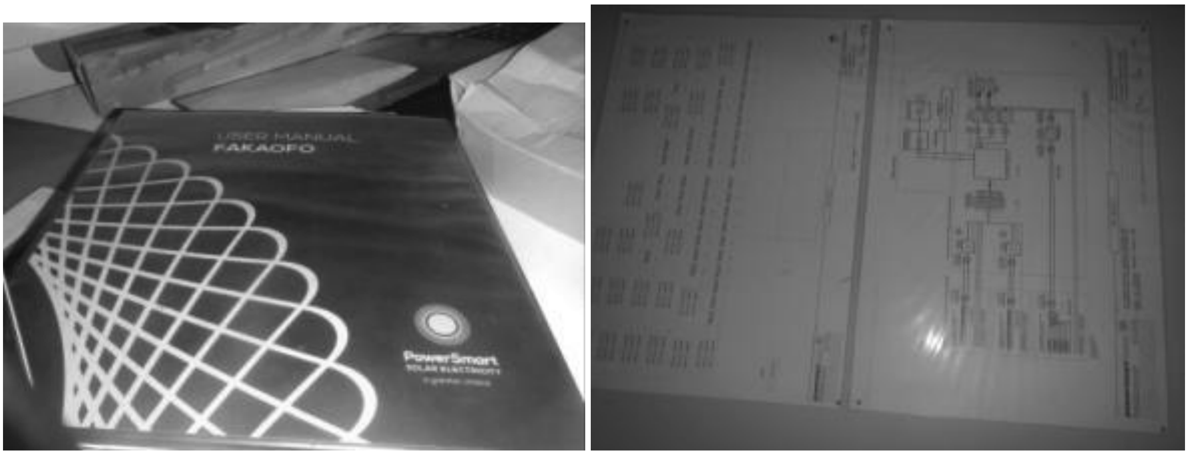

Figure 22: User manual located on operator desk in inverter room and laminated diagrams on wall

Next Steps

No action is required.

1.3. Battery Room

1.3.1. Temperature

Temperature at two locations in the battery room was measured with a mercury thermometer at approximately 13:30.

Results

Temperatures of 32°C were measured at both locations. This was equivalent to ambient temperature so is not a concern.

Next Steps

No action is required.

1.3.2. Source of distilled water

As the system uses flooded lead acid batteries, the battery room was checked for a source of distilled water.

Results

A deionizer was mounted on the wall in the battery room. The deionizer light was flashing (indicating that the filter needs replacing). However, the operators believed that the battery needed changing as the deionizer had only been used twice since system commissioning. They reported that they had a spare filter in the store room but that they would try replacing the batteries first.

Figure 23: Deionizer mounted on wall in battery room

Next Steps

The batteries in the deionizer should be changed and the indicator light should be checked again. If it is still flashing, the filter should be replaced and a spare one ordered.

1.3.3. Battery damage

Batteries were visually inspected for signs of damage such as sulfation on the plates, excessive lead deposits in the bottom of the batteries, low water level, or physical damage.

Results

No signs of sulfation were observed. Battery water levels were all close to the maximum level. Small lead deposits (up to 5mm deep) could be seen in the bottom of the batteries. These were not considered excessive. No signs of physical damage were observed and all terminals were insulated.

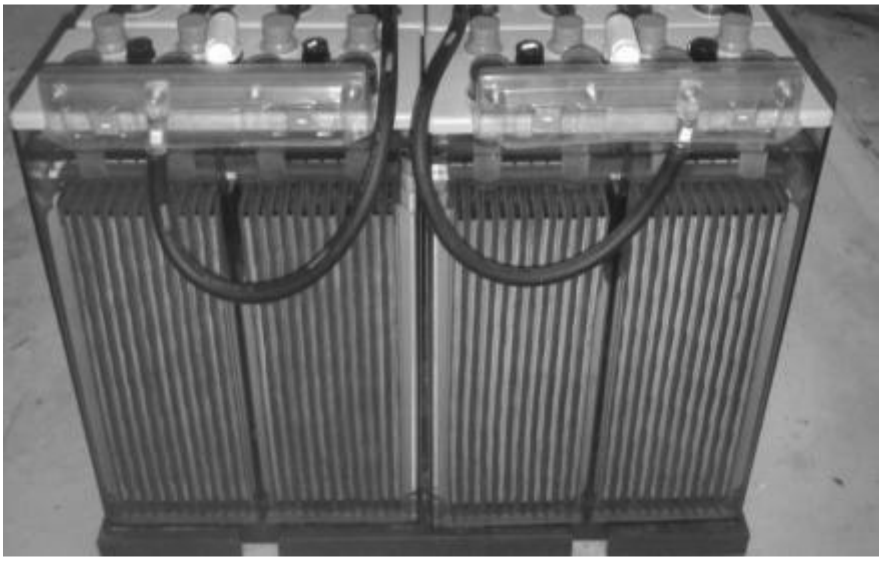

Figure 24: Battery plates and small lead deposits in bottom of batteries

Figure 25: Water level on batteries near maximum line

Next Steps

Other than routine maintenance, no further action is required.

1.3.4. Labelling

The battery room was visually inspected for appropriate warning labels and identifiers on batteries.

Results

Appropriate warning labels were mounted on the walls at both ends of the battery room (Figure 26). Each battery was numbered and the cluster and string number was painted on the wall.

Figure 26: Warning labels at both ends of battery room

Figure 27: Labelling of clusters, strings and batteries

Next Steps

No action is required.

1.3.5. Battery monitoring

State Of Charge (SOC) readings for the batteries were accessible via the monitoring system and on the Sunny Island SD cards. The batteries were tested by Exide during a visit in April 2013 but results of the testing were not available. Operators reported that they were unable to do an equalization charge during the visit as the diesel generator was not available. Battery SOC was checked for consistency across battery banks and battery monitoring was discussed with the operators. Battery SOC data for the day was recorded and compared by cluster using Sunny Island SD card data.

Results

Overall battery bank SOC was at 88% upon arrival at the power house. Operators advised that they switched on the generator manually when the SOC dropped close to 60%.

SOC data from the Sunny Islands was used to compare SOC across individual battery clusters. Each cluster was compared with the average SOC to find the deviation from the average throughout the day. Figure 28 shows the deviation from the average of each cluster. Note that sharp drops noticeable in the graph are a result of the Sunny Island's algorithm and do not reflect sudden actual drops in SOC. Cluster 3 is 1-4% higher throughout the day than the average, while Cluster 5 is 1-3% lower than the average. These deviations are small enough not to be considered problematic. The sudden step changes in SOC caused by the Sunny Island's algorithm may indicate that the method of calculating SOC is not ideal as it may make it more difficult for operators to identify deviations.

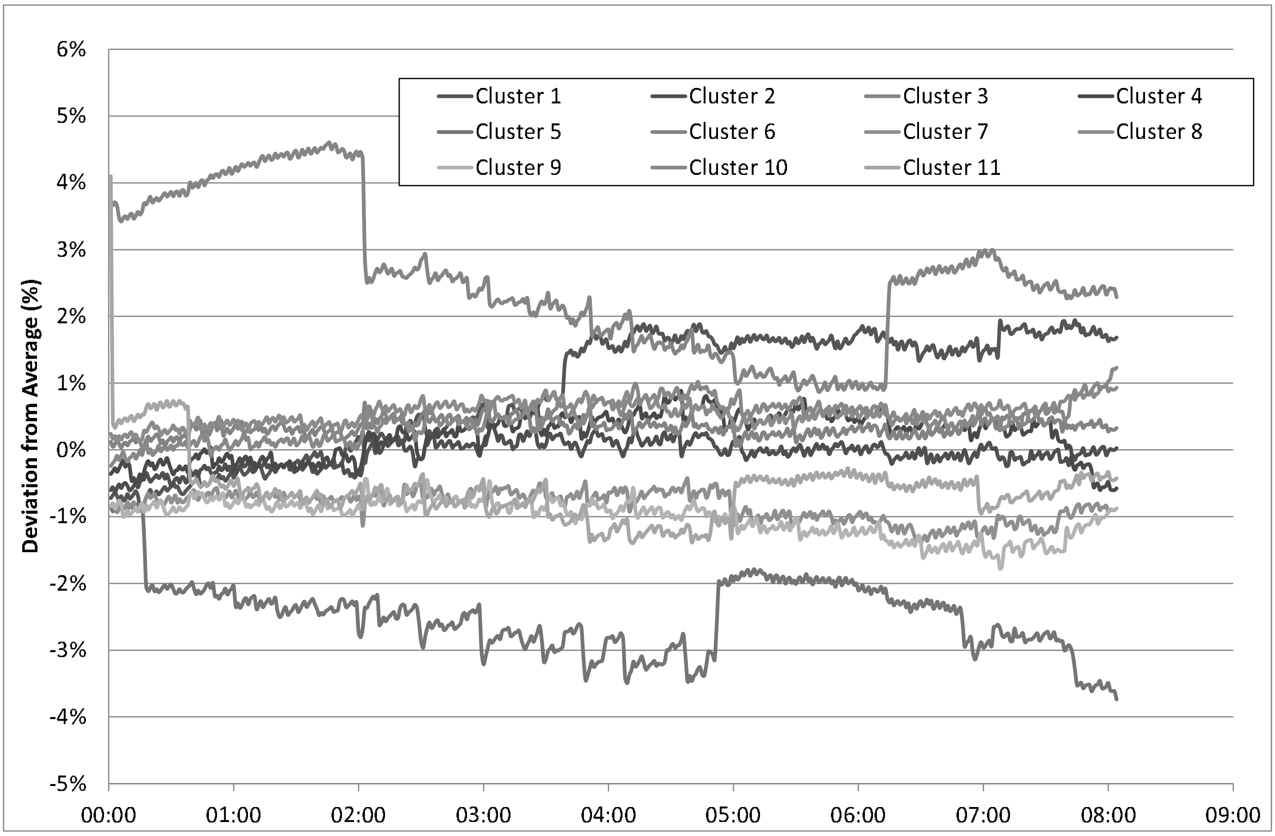

Figure 28: Percentage SOC deviation from average for individual battery clusters (04 June 2013)

Next Steps

There do not appear to be major deviations in the battery SOC across battery banks. However, an equalization charge should be performed soon as the planned equalization could not be done during the Exide visit in April 2013 and there is no evidence of another charge having been performed since. General battery monitoring and testing should continue according to the schedule.

We did not observe any battery monitoring records at the site. It is important that staff adhere to the monitoring and maintenance plan and keep accurate records of all testing and maintenance undertaken.

1.4. Maintenance

1.4.1. Cleaning of panels

Panels were visually inspected for signs of excessive soiling.

Results

Overall the panels were clean and free from any signs of excessive build up of dirt or droppings. There were some bird droppings on the panels but these were not excessively stubborn and appear to wash off in rain storms.

Figure 29: Panels are mostly clean with the exception of some bird droppings

Next Steps

No action is required.

1.4.2. Vegetation around panels

The PV system at Fakaofo is built over swampy ground and vegetation grows very quickly. The system was inspected for general tidiness and any excessive vegetation growth.

Results

There were several large plants growing tall enough to shade the panels (). Vegetation growth was prolific and in some areas, particularly at the swampy end, made it difficult to access the system. This may discourage workers from doing routine maintenance and should be rectified.

In one row at the western end of the array, there were plants grown from cuttings which had been deliberately planted indicating that there was unauthorized access to the site. This likely occurred before the fence was built so is not expected to be an ongoing problem.

Figure 30: Crops planted in front of the array

Figure 31: Plant shading the array. Overgrown vegetation in this area makes it difficult to access the eastern end of the array

Figure 32: Excessive vegetation around array including plants shading panels and creepers on framing

Next Steps

The vegetation around the array needs to be cut back, particularly the plants that are already shading the panels and the thick grass and creepers that make it difficult to access parts of the array. The Acting Director of Energy indicated that this work had been scheduled but was overdue as the workers had not turned up.

1.4.3. Inverter room cleanliness

The inverter room was visually inspected for general cleanliness.

Results

The inverter room was generally kept clean and tidy. There were no trip hazards or water in the room, and the tool box was stored under the operator desk where it could easily be found. The tool box was locked and all tools were present.

Figure 33: Inverter room

Next Steps

None are required.

1.4.4. Battery room cleanliness

The battery room was visually inspected for general cleanliness.

Results

The battery room was generally clean and dry. One drum of battery acid had been left next to the batteries. Because of the size of the room this does not greatly obstruct access, but the drum should nonetheless be moved out of the way.

Figure 34: Battery room

Figure 35 Drum of battery acid next to batteries

Next Steps

Drum of battery acid should be moved to a safe storage place where it does not obstruct any batteries.

1.4.5. 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. Operators reported having topped up the battery electrolyte twice since the system was installed, and checking the electrolyte levels fortnightly.

Figure 36: Battery electrolyte levels close to maximum line

Next Steps

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.

1.4.6. 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

No records of battery maintenance were found and staff believed there were none. However, there were generator logs in the generator room from both before and after the PV system was installed.

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. It is clear that staff are accustomed to keeping records for the diesel generator, so it must be emphasised to them that record keeping is equally important for the PV system.

1.4.7. Generator maintenance

Generator maintenance was discussed with operators and the generator was switched on manually when the battery SOC dropped close to 60%.

Results

The operators reported that one of three generators was working and that they were working on repairing a second generator but required some parts. The generator operated normally when switched on to recharge the batteries.

The operators reported one power outage earlier in the year because all three generators were not working at the time. Since this occurred they appear to have improved their general maintenance and realised the importance of keeping a generator operational at all times. However, we did not observe maintenance records for the generators, although generator running logs were present. There was a substantial supply of diesel in drums adjacent to the powerhouse and there appeared to be no risk of a shortage in bad weather.

Next Steps

Repairs on the second generators should be completed so that there is redundancy in the event of a generator failure.

Record-keeping needs to be improved as maintenance records were not available.

1.4.8. 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 in the store rooms behind the battery room:

- Battery acid (approximately 25 drums)
- Batteries (6 batteries)
- Panels (approx 30 panels observed)
- Miscellaneous spare conduit and cable
- Pallet jack
- Tool box

- General power tools and accessories

This is an appropriate spare parts inventory and there is no immediate risk of power station downtime due to lack of spares. All spare parts were kept indoors in a secure location, although general tidiness of the storage rooms could be improved.

Figure 37: Spare battery acid (left), panels and general tools (right)

Next Steps

No major action is required, although general tidiness of the storage rooms could be improved.

1.5. 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. 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.
9. 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.

2. Nukunonu System Review

2.1. PV Array

2.1.1. Structural Integrity

The PV array frame was visually inspected for damage, loose parts, movement and any signs of corrosion. Nuts and bolts were randomly checked for tightness. Concrete foundations were visually inspected for any signs of cracking or damage that could compromise the structure.

Results

No signs of movement were observed, and none of the bolts randomly checked were loose. Figure 38 and Figure 40 show typical array frame details including bolts and general condition of the array frame. No structural problems were observed. Some small spot rust ("tea staining") was observed on some of the bolts and small rust patches were found on the u-shackles used to support PVC conduit containing cables. Tea staining on stainless steel usually occurs around joins or edges (such as the lettering on the bolt shown) and is mainly a cosmetic issue unlikely to spread. Nonetheless, bolts should be checked regularly for any signs of more extensive rust. Rust spots on the u-shackles should also be checked regularly and these may need to be sprayed with an anti-rusting agent.

Small rusted bolts were also found on the SMA sensor module attached to the array. These screws may need to be replaced. However this is not a structural problem.

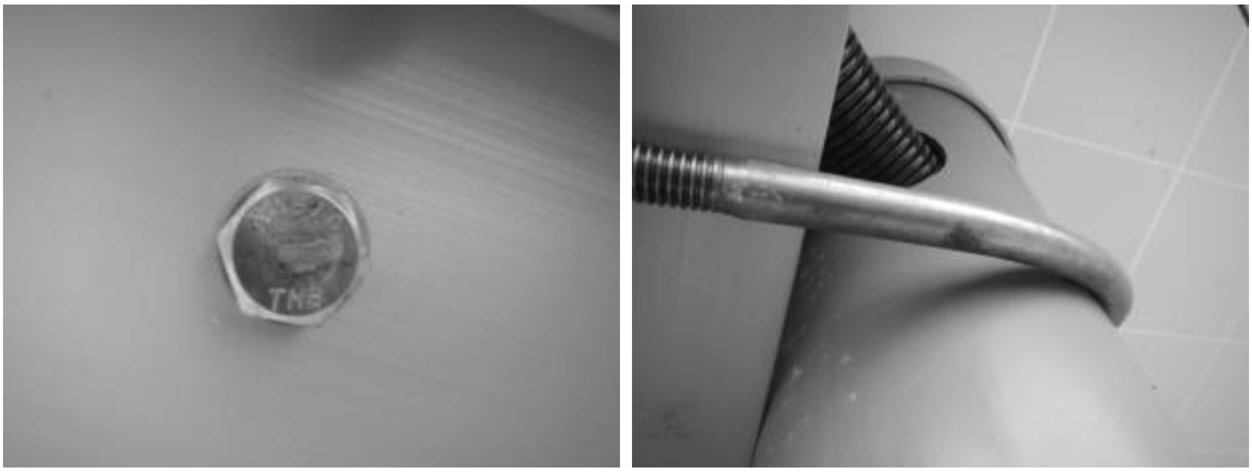

Figure 38: "Tea staining" on bolts (left) and small rust patches on u-shackles

Figure 39: Rusted bolts on SMA sensor module

Figure 40: Array frame detail showing general framing and bolts

Visual inspection of concrete footings revealed no cracking or crumbling of concrete around the array mounting points. There were some preliminary signs of soil erosion around the footings that should be monitored.

Figure 41: Concrete footings showing some preliminary erosion of soil

Next Steps

No immediate rectification work is required.

The array structure should be checked periodically by local staff for any signs of movement or loose bolts or further erosion around the footings.

2.1.2. Condition of panels

Panels were visually inspected for damage, hot spots and signs of degradation such as peeling of sealant and membrane, damage to glass, and brown spots on the underside of the panels.

Results

No signs of damage or hot spots were observed. Figure 42 shows typical panel front and back surface appearance. No dark spots, peeling or cracking were observed on any part of the array.

Figure 42: Typical condition of panels

Next Steps

No action is required.

2.1.3. Condition of cables and conduit

Array cables and conduit were visually inspected and physically checked for signs of damage.

The design of the array cable reticulation means that most of the cabling is enclosed within aluminium ducting, leaving only small parts of the cable exposed. Cable entries into the ducting are a possible point of wear so cables at these locations were checked closely for damage.

Results

Exposed conduit (Figure 44Figure 8) was in good condition and suitably tied up to prevent accidental damage from movement. In two areas (eg Figure 44) the ducting did not sit flush indicating that the cable bend was tight, but this has no significant effect on the conduit.

Cable entries to ducting have sharp edge and in some cases the cables were pulled up against these edges (Figure 43). Some scratching on the outer insulation of the cables was observed, but no deep cuts in the insulation were found. Wiggling the cables produced very little movement so it is unlikely that they are rubbing against the edges due to movement. Nonetheless these points on the array should be monitored to ensure that the cable insulation is not damaged over time.

Figure 43: Cable entries to ducting – some scratches visible

Figure 44 Conduit entry to ducting

Next Steps

No immediate rectification work is required. However, cables entries to the ducting (as shown in Figure 43 and Figure 44) should be checked regularly for signs of damage.

2.1.4. Isolator enclosures

Isolator enclosures were visually inspected and physically checked both from the outside and with the covers removed. The condition of all isolators and fuses was checked and cables were checked for loose connections. Enclosures were checked for water ingress and infestation from insects.

Results

1. Labelling and general condition

All labels were checked and none were found to be missing, damaged or incorrect.

Screw mounts inside the isolators are showing some signs of wear (Figure 45) indicating that they may need replacing after several years of opening and closing the isolators.

Figure 45: Isolator labelling (left) and screw mount (right)

2. Infestation

Very little insect infestation was found in the isolators and insects do not appear to be a problem at this site.

Figure 46: Isolators free from wasp nests

3. Operational state of isolators and fuses

At the time of the inspection, the system was fully operational and no isolators or fuses were tripped. All isolators operated correctly when switched off and back on again.

4. Water ingress

Isolator enclosures were clean and dry inside. There was no evidence of any previous water ingress. The enclosures are mounted under the array, giving them good protection from rain under most circumstances.

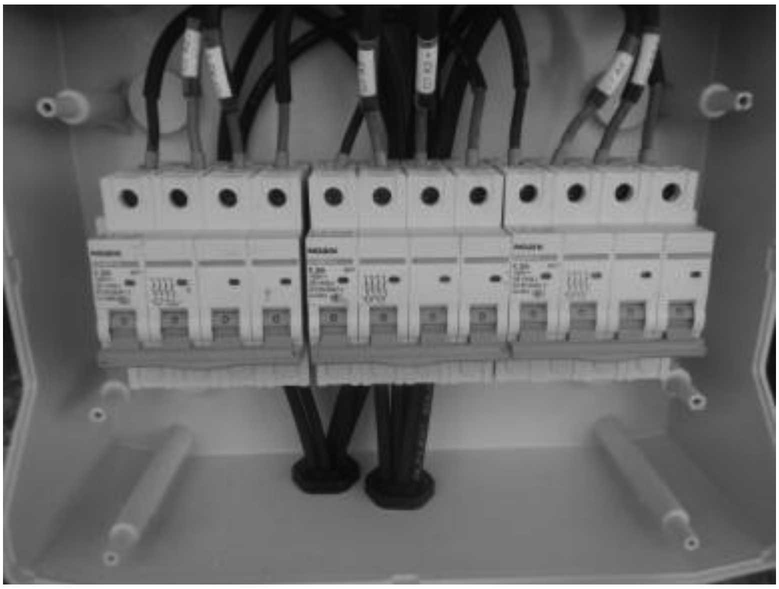

Figure 47: Isolators clean and dry inside with no loose cables

5. Corrosion

No signs of corrosion were found inside the isolator enclosures. Screws used in the enclosures were all stainless steel and showed no signs of corrosion. We were advised by the local operators that the galvanized steel screws that originally came with the enclosures had begun to corrode and had been replaced with stainless steel screws in April 2013.

6. Loose connections

Cable terminations on the isolators were checked for any movement by wiggling them. No loose connections were found and there was no evidence of any cables having moved since installation. Cable terminations were appropriately done with no sign of exposed copper wire inside the enclosures (Figure 47).

Next Steps

No immediate rectification work is required.

Screw mounts are showing some signs of wear and may deteriorate after several years of opening the isolator enclosures. Staff should ensure that spares are available should they be required.

2.2. Inverter room

2.2.1. Temperature

Room temperature was measured using a mercury thermometer at four locations in the inverter room, including areas next to inverters. Measurements were taken between 11:00am and 2:00pm.

The inverter room is naturally ventilated and has no ceiling extractor fans. The room is oriented to take advantage of prevailing winds.

Results

Temperature measurements ranged from 32°C to 33°C throughout the room. A measurement taken above an inverter heat sink read 35°C. Ambient temperature (outside in semi-shade) was 31°C. This indicates that the current ventilation scheme is suitable.

Figure 48: Naturally ventilated inverter room

Next Steps

No action is required.

2.2.2. Operational status

Inverters, Sunny Islands and chargers were visually checked for correct operation by inspecting display screens and cross checking with information displayed on the main computer.

Results

All inverters, Sunny Islands and chargers were operating normally at the time of the inspection.

Approximately a week before the inspection, the system had shut down after a lightning strike. Operators had initially thought that one of the Sunny Islands was damaged, however after troubleshooting with PowerSmart Solar and SMA, it was found that a communications board was damaged in Sunny Island Cluster 5 Slave 2. This was replaced with a new board and the system is fully functional again. All SD cards were present in the Sunny Islands.

Figure 49: Sunny Islands operating normally

Next Steps

None required.

2.2.3. Erroneous tripping of alarms

Frequency of alarm tripping was discussed with the operators on site. The state of system alarms was visually checked. No tripping occurred during the site visit.

Results

Operators reported no erroneous tripping. The Sunny Island Fault Mute Switch was in the "OFF" position.

Figure 50: Alarm mute switch in "OFF" position

Next Steps

None required.

2.2.4. Labelling

Labelling on all inverters, Sunny Islands and Chargers was checked.

Results

All labelling was attached to equipment and was correct.