Solar system 220 Volt - Kamakwie -
September 2011

Manual Breaker (for inverter). Always disconnect the inverter at the end of the work day

Breaker. Just to use to connect/disconnect the 220V power. (One breaker control the Pms & administrator offices and the other control all the other offices)

Manual Breaker (for solar pannels). Disconnect the solar pannel during strong storm to protect the system from lightnings

Inverter MAGNUM MM1012E
1000 Watts

→ According to our estimation, if we use all our equipments at the same time we have a consumption of 9x50=450 Watts (for the laptops), and 3x20=60 Watts (for the printers) , the total consumption is 510 Watts.

The inverter is correctly sized. We must take attention when we use administrator photocopier → the consumption increase a lot and if all the equipments are in use at the same time we can damage the inverter.

It will be good to install a 4 Amps fuse (1000W / 220V = 4,54A) in the negative cable at the exing point of the inverter to protect it from any overload.

Charge controller
TRISTAR TS60
60 Amps

Actually we have 8 solar pannel (x 62 Watts each)
Total Watts: 62x8=682 W

P(W) = U(V) X I(A)

62 W / 12 V = **5,16 Amps (each)**

→ Our solar pannels are in reality 4,5 Amps (manufacture indication); as consequence they produce in reality 4,5Amps x 12 V = 54 Watts (loss of 8 Watts)

→ As the total amperage is 4,5x8=36, the charge controller can potentially hold more solar panels

→ possible improvement 1: to buy the « digital screen » at the solar shop in circular road, Freetown. It will allow to clearly follow the solar charge during the day (and it allow to memorize the datas)

→ possible improvement 2: to buy a MPPT charge controller: best quality to optimize the batteries charge

We know that average sushine period is 6 hours, so we have 6x54x8= 2592 Watts produced per day. It is lightly less than what we need in our estimation. We must be very careful and try to optimize our consumption

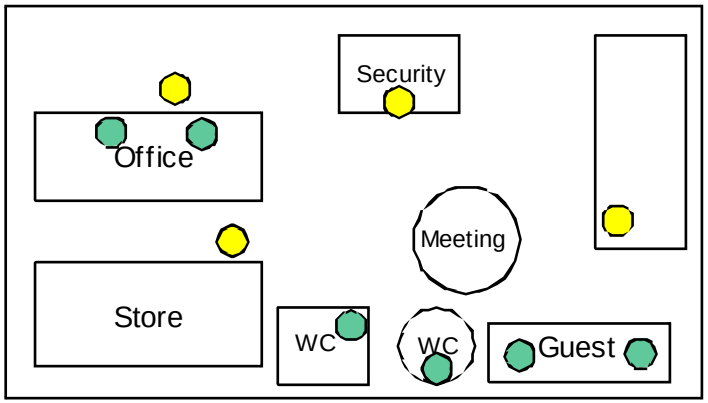
Batteries dry cell (=truck batteries, maintenance free) 12V/200 Amps
Actually we have 4 batteries. As they are not « solar batteries » it is very important not to offload them completely (the solar batteries are more « flexible »: the discharge rate is around 80%. For these batteries the discharge rate is around 40%).This is why it is important to switch off the solar system when the charge controller indicate that the charge is low.

Kamakwie estimation		Wattage	Time in use	Max cons	Total cons	12V DC
	Unit	*W*	*Hours*	*Max W/h*	*Wh/day*	*Amps/h*
9	Lap Top Computers	50	4	450	1800	150
3	Printer	20	3	60	900	75
				510	**2700**	**225**

Necessary needs: 225 Amps/j
Actually: 200x4= 800 Amps/j
If we consider the discharge rate of 40% (that we should respect!), we have 320 Amps available. We have less than half day autonomy (just 320-225=105Amps). As consequence we must use the generator as soon as we have half day without sunshine.

Solar system 12 Volt– Kamakwie -
September 2011

This system was installed to have light during the night (especially to assist the security guard to check the compound). It is a 12 Volts system: just charge regulator as the panel and batteries current is 12 Volts (it is not necessary to invert it into 220 Volts).



Security guard lights (always on by night)

Other lights (occasional use)

Charge controller STECA 10 Amps

It can support 2 solar panels of 4,5 Amps. Actually we have installed just one (largely enough to charge the batteries)

Dry cells batteries 110 Amps. They were installed in the old solar system.

Solar system basic problems & basic solutions

Attention

1.The solar system, after the cars, is the most expensive office equipment: it is really important to identify clearly the person/s in charge. Not all the staff must have access to it!

2.Some equipment of the Kamakwie system are not really adapted to a solar system: we must keep more attention in order to protect the system from any breakdown → the batteries are not "solar"; we must switch off the system as soon as we see that the charge is too low.

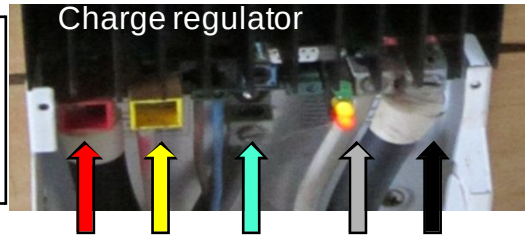
3.Be sure that not "standard" equipment (sellotape repaired charger ...) are connected to the outlets → possible short-circuit

4.Be sure that no extra equipment is connected (some phone charger are acceptable – the consumption is really small -. Too many is a problem!)

5.Never use stabilizer with the solar power: the stabilizer use lot of energy and it is not necessary (the solar current is stable enough).

Solar system dysfunction

a. Not enough charge (red light)
b. Short circuit
c. Damaged equipment



First of all check all the voltage:

The solar panels

They must give between16 and 18 volts (full sunshine) or less (cloudy sky);
- if it is less than 13 the batteries are not really charging:
→not enough sun: *switch off the solar system*
→ short-circuit or disconnection: *check the connection on/under the roof*

The batteries:

-more than 12: charge is ok
-between 10,5 and 12: the batteries are not well charged
→ if possible disconnect some equipment or turn off the solar
-10,5 or less: the batteries charge is very low
→too much consumption: *switch off and wait one or two days... if the batteries are no charging any more, disconnect them and charge them with an external power (generator with enough power for 200Amps batteries)*
→after this step they are just discharging... there is a problem to the solar panels and/or to the charge controller

Electrical tester.

To test the 12 Volt: put the indicator in V= (or VDC) 20
To test the 220 Volt: put the indicator in V≈ (or VAC) 600 (or more than 220) and connect the red cable to positive + and black to negative-.
You can test all the voltage on the charge regulator inputs→ picture

Grounding: be sure that all the solar panel frames are grounded (at least 5 mm cable)
- 220 Volts system: be sure that all the outlets boxes are correctly grounded
- 12 Volts system: ground the negative terminal of the batteries

Solar system 220 Volt – Makeni

September 2011

Steca Solarix 'Modular' Inverter TSW 550W / 12V

→ According to our estimation, if we use all our equipments at the same time we have a consumption of 3x50=150 Watts (for the laptops), 1x20 Watts (for the small printer), 1x250 Watts (for the big printer): the total consuption is 420 Watts.

The inverter is correctly sized. One fuse is yet installed inside the inverter to protect it from any overload. It is better not to use the dewatering pump with the inverter (the consumption is almost 400 Watts – and more than that when it starts).

This inverter is a « pure sinus »: it means it reproduces perfecly the AC current. There will be no problem to use any kind of equipment.

Charge controller STECA 20 Amps

Actually we have 5 solar pannel (x 50 Watts)
Total Watts: 50x5=250 W

P(W) = U(V) X I(A)

50 W / 12 V = **4,16 Amps (each)**

→ Our solar pannels are in reality 3 Amps (manifacture notice); as consequence they produce in reality 3 Amps x 12 V = 36 Watts (loss of 14 Watts)

→ our charge controller is correctly sized: 3Amps x 5 = 15 Amps. It would be possible to install another panel.

We know that the average sushine period is 6 hours, so we have 6x36x5= 1080 produced per day. Compared to the actual needs: 970 Watts/day (yet overestimated) it is clearly enough. It will be possible to add some comsuption in the future.

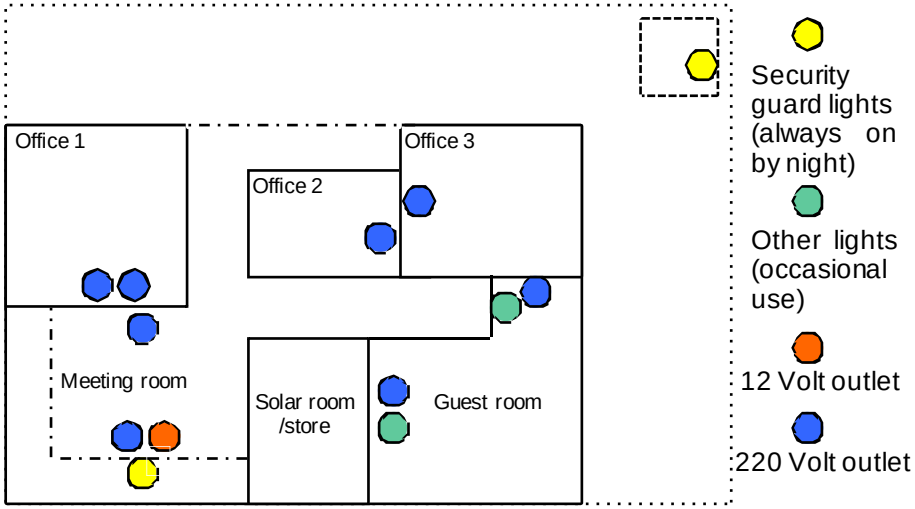
Batteries*: Freedom waterproof* 12V/105 Amps
Actually we have 5 batteries. As they are « solar batteries » they are « deep discharge batteries » (the solar batteries are more « flexible »: the discharge rate is around 80%. For « car batteries » the discharge rate is around 40%). Neverthless it is important to switch off the power – if possible - if the charge controller indicate a low charge (we will insure longer life to the batteries)

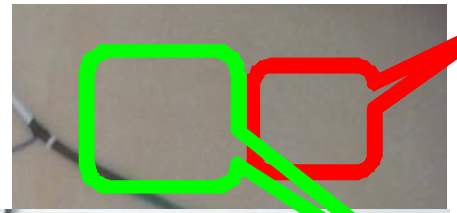
Kamakwie estimation		Wattage	Time in use	Max Unit cons	Total cons	12V DC
	Unit	*W*	*Hours*	*Max W/h*	*Wh/day*	*Amps/h*
3	Lap Top Computers	50	4	150	450	37,5
1	Printer (HP1660)	20	1	20	20	1,6
1	Printer (HP1018)	250	2	250	500	62,5
				420	970	≅100

Needs: 100 Amps/j
Actually: 105x5= 525 Amps/j
If we consider the discharge rate of 80% (that we should respect!), we have 420 Amps available. We have more than two days autonomy (just 420-100=320Amps).

Solar system 12 Volt – Makeni -
September 2011

This system was installed to have light during the night (especially to assist the security guard to check the compound). It is a 12 Volts system: just charge regulator; as the panel and batteries current is 12 Volts (it is not necessary to invert it into 220 Volts).





Main **switcher** for the 12 Volt system. Switch off when you are installing 12 Volt equipment.

Charge Controller
BP Solar GCR - 12v /8A

It can support 2 solar panels of 3 Amps. Actually we have installed just one (largely enough to charge the batteries). This charge controller is yet protected by a 10 Amps fuse

4 Dry cells batteries 110 Amps. They were installed in the old solar system. Largely enough for the lights

Solar system basic problems & basic solutions

Attention

1.The solar system, after the cars, is the most expensive office equipment: it is really important to identify clearly the person/s in charge. Not all staff must have access to it!
2.Be sure that not "standard" equipment (*sellotape repaired charger* …) are connected to the outlets → possible short-circuit
3.Be sure that no extra equipment is connected (some phone charger are acceptable – the consumption is really small - Too many is a problem!)
4.Never use stabilizer with the solar power: the stabilizer use lot of energy and it is not necessary (the solar current is stable enough).

Solar system dysfunction
a. Not enough charge (red light)
b. Short-circuit
c. Damaged equipment

First of all check all the voltage:

The solar must give between16 and 18 volts (full sunshine) or less (cloudy sky);
- if it is less than 13 the batteries are not really charging:
→not enough sun: *switch off the solar system*
→ blow out or disconnection: *check the connection on/under the roof*

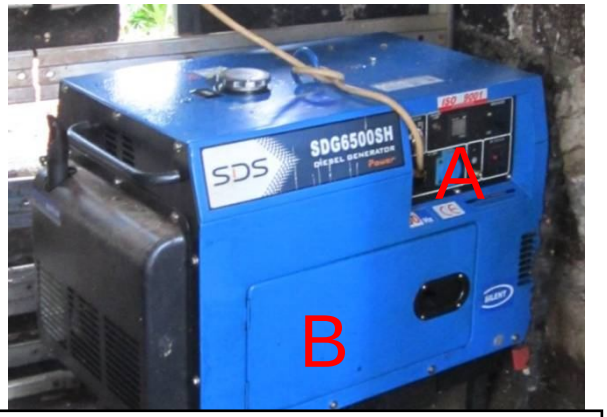
The batteries:
-more than 12: charge is ok
-between 10,5 and 12: the batteries are not well charged
→ *if possible disconnect some equipment or turn off the solar*
-10,5 or less: the batteries charge is very low
→too much consumption: *switch off and wait one or two days… if the batteries are no charging any more, disconnect them and charge them with the generator one by one*
→*after this step they are just discharging… there is a problem to the solar panels and/or to the charge controller*

Electrical tester.
To test the 12 Volt: put the indicator in V= (or VDC) 20
To test the 220 Volt: put the indicator in V≈ (or VAC) 600 (or more than 220) and connect the red cable to positive + and black to negative -.
You can test all the voltage at the charge regulator inputs level.

Grounding: be sure that all the solar panel frames are grounded (at least 5 mm cable)
- 220 Volts system: be sure that all the outlets boxes are correctly grounded
- 12 Volts system: ground the negative terminal of the batteries

Generator system – Kamakwie, Makeni - September 2011

Manual breaker: to connect/disconnect all the generator network before/after the starting *(***Just in Kamakwie)*



Brand: SDS (made in China, accepted in Europe – ISO 9091)
Power: 5 KVA (=5000 Watts)
Consumption: around 1liter diesel / hour

→ According to our estimation, if we use all our equipments at the same time we have a consumption of 510 Watts in Kamakwie and 420 in Makenii (plus the stabilizers consumption).

The generator is largely oversized: 5.000 Watts. We have to use it
1.when the solar power is not available (= when the batteries are discharged at 40%)
2.Kamakwie: When we use the administrator copier/printer – consumption not included on the 510 Watts -. Makeni: when we use the dewatering pump.
3.When we use external equipments/tools: in this case always be sure that the starting need (in Watts) – always more that the using need - is less that 3.500 Watts. *[generators run most efficiently when the load is around 70% of the maximum power, running a larger generator would reduce efficiency and generator life].*
→ Be careful not to use the generator more than 4-5 hours per day (and better not continuously)

Automatic switcher: 1. turn right the key until "ON", 2. wait 10 seconds, 3. turn right to switch on. Switch on/off just when the power switcher is in "OFF" position.

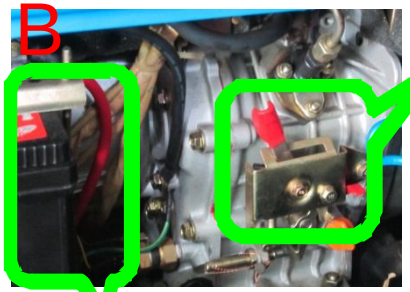
Timing display: it records the generator using time. It is not more working (factory fault): it is important to follow in the generator logbook in order to organize the periodical maintenance (oil filter, oil change, air filter,…) → information available in the generator instructions booklet)

Power switcher: regulate the 220 Volt. It must always be in "OFF" position when we switch on/off the generator. To put in "ON" position just after 10 seconds the generator is on.

DC (12 Volt) charger. One special cable permit to connect this outlet to the batteries terminals. To use this outlet the power switcher must be in "OFF" position.
It is very important to always charge the new car batteries during at least 3 hours before installing.

Ground connection: to connect with a 5 mm cable to the ground (if possible 80 cm deep)

Power output. Originally the power output was divided into 2 (2,5 KVA each). We decided to concentrate all the power in 1 (the right outlet is condemned) - *It is possible to re-set up the original scheme just opening the panel and connect again the left outlet -. *** JUST FOR KAMAKWIE (Makeni mainteined a double outlet)*



Battery. As all the engine battery, it needs to be correctly installed (the terminals must be correctly connected!) and it has a life time → always switch on the generator at least once per week for 2 hours (to maintain the battery)

Fuel regulator. This control stick permit to regulate the engine power.
If we are not able to switch off the generator trough the automatic switcher (this means that we can have a problem to the internal fuse: we must change it) we can cut off here the fuel.

Dysfunction… If the generator cannot start or cannot switch off:
1. Check the battery terminal connection and battery voltage. If everything is ok:
2. Open the panel (6 bolts) and check the fuse. If everything is ok:
3. Good luck to find a good mechanic…

N.B. Always use "stabilizer" between the outlet and the equipment!! → *It protects the equipment from the generator over voltage (frequent).*

Motorbikes – Easy to check…

Fuse. Between the battery (positive cable) and the distribution, one fuse is installed. During electrical reparation and/or battery substitution very frequently the fuse is removed (because it is broken) → this wrong behavior can affect the entire electrical system…

→ The fuse is so cheaper that there is no justification no to replace it with a new one (check the correct amperage).

Spokes. Always check with your hand the wheel spokes. If they are not well tighten the wheel can be easily damaged in a bad dirt patch.

→ If the tools are not available at the office, it is very easy to correctly tight the spokes to a motorbikes (or bicycles) mechanic in town.

Back brake. If the back brake is not correctly working…

→ Before thinking to change it, it is very easy to screw this nut : it will "harden" the back brake.

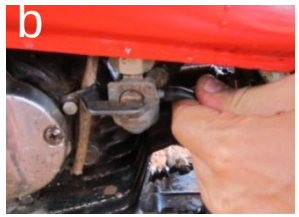
Chain. Always check with your hand if the chain is well tighten. If it is not it will be difficult to climb any hill, to carry any heavy load (second passenger), and the chain can even cut on the road…

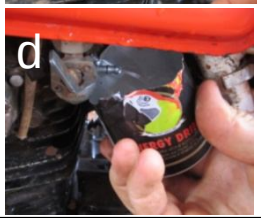
1. lightly unscrew the main nut of the back axle, 2. pull on the back the wheel trough this bolt (picture): unscrewing it we can pull behind the back wheel and so tight the chain. It is important to unscrew these bolts (one in each side of the wheel) exactly the same: to be sure that the wheel is correctly balanced, 3. screw again the main axle nut.

Be sure that the chain is always well greased

→ Lubricant you can use (from the best to the worst) 1. gear box oil, 2. engine oil, 3. old engine oil, 4. general grease (acceptable when there is no dust… just in rainy season)

Be careful to your petrol…

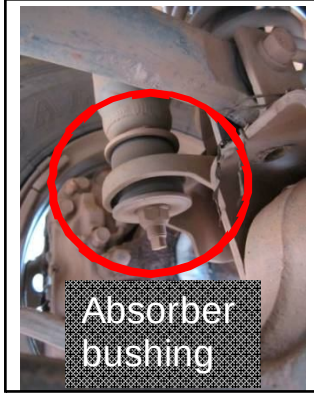




30 second to take 50 cc petrol… It is really important to have a clear follow-up on the motorbikes consumption and on the filling procedures.

Engine oil. It is very important to be sure that there is enough oil. (better when the engine is quite hot but not after a long trip!) 1. put the motorbike vertical, 2. unscrew the oil cap, 3. clean it, 4. insert the cap, without screwing it, 5. check the oil level → it must be between the two treads (but more than half)

Cars – Easy to check…



Bushing. is a type of vibration isolator. It provides an interface between two parts, damping the energy transmitted through the bushing. It separates the faces of two metal objects while allowing a certain amount of movement.

→ It is really important to check frequently if the bushings need to be changed (few examples in the pictures). Do not wait the 5.000 km maintenance! They can be used-up even before!

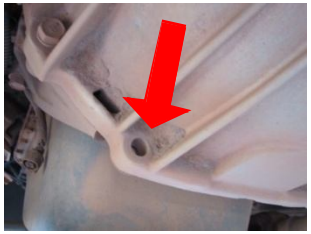
Greasing. there are many lubrication points on the chassis which should not be overlooked. For longevity of moving parts, it's important that all greasable points in the chassis (example in the picture) are regularly checked and pumped with grease.

→ put the car on the pit and add the grease with the "grease gun" trough the "zerk fitting". Depending on severity of use or mud and water encountered, these points should be checked after every vehicle use.

Fuses box. Near the pedals, on the left side there is one fuses box. The fuses are there to protect the electrical system: if any blow out happens the fuses break (or burn).

→ It is very common "to bridge" a broken fuse to make it to work; a bridged fuse is no more functional: it will never break and you will have major breakdown on the system.

The fuse is so cheaper that there is no justification no to replace it with a new one (check the correct amperage).



Bolts and nuts. To check frequently (once per week) the under carrier. Because of the vibration and jerks it is possible to loose some (example in the picture: auxiliary box)

Battery. DC power requires good connections, not grimy, corroded connections

Terminal. Be sure that the terminal is always well connected. If there is no power check the terminal:

→ Remove it and clean it with a iron brush

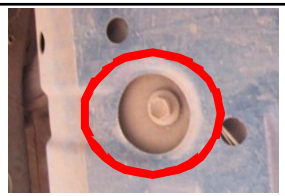
→ Check the nut if it is well tied

→ Change the terminal if it is in bad condition (NEVER HITS IT WITH HAMMER, PLIERS: you can break the battery and the acid will cause lot of problem to the near electrical connection!)

Terminal oxidation. It can affect the connection.

→ Remove the terminal and clean it with an iron brush

→ Apply some grease on the terminals to protect them from air and water.



Be careful to your diesel…

Just one bolt to unscrew under the tank (under carrier) and in few minutes some diesel can disappear!