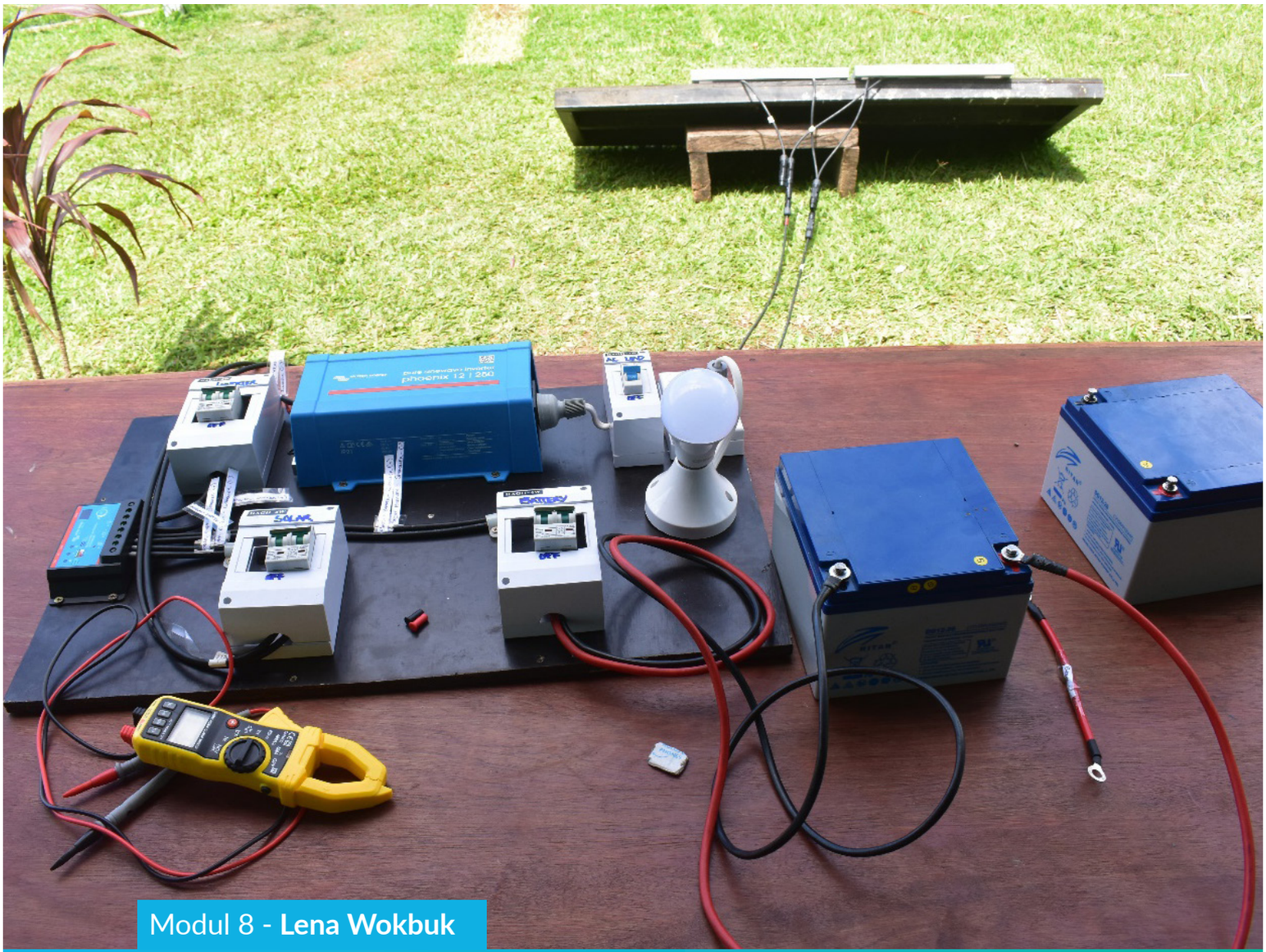

Modul 8 - **Lena Wokbuk**

Sola Operesen mo Mentenens Besik

BISLAMA LANWIS – VANUATU

Kampani we i givim mane from:

KOICA
Korea International Cooperation Agency

Long patnasip wetem:

Pacific Islands Development Forum

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"Sola Operesen mo Mentenens Besik" trening modul ya hemi blong ol teknikol lena we oli wantem save moa long sola instolesen mo mentenens.

Taem yu komplitim kos ya, bambae yu ajivim ol lening aotkam we oli stap daon:

1. Diskraebem ol difdifren taeb blong taeb blong Sola PV Sistem.
2. Mekem lis blong ol komponent we oli yusum long Sola PV Sistem.
3. Eksplenem ol rikwaemen blong ol komponent we oli yusum long sola PV sistem.
4. Aedentifaem ol tul we oli yusum long sola PV sistem instolesen mo mentenens.
5. Diskraebem ol prosija blong instolem mo mentenem sola PV Sistem.
6. Mekem lis blong ol sefti rikwaemen blong sola PV sistem.
7. Aedentifaem mo risolvem ol komom fol long Sola PV Sistem.
8. Demonstretem yus blong wan Sola PV Sistem mentenens jeklis.

TEBOL 1: Lesen Plan

Japta	Lesen Taep
1. Aes Breka – Introdaksen	Teori mo Aktiviti 1
2. Komponent blong Sola Paoa sistem	Teori
	Aktiviti 2
	Aktiviti 3
	Aktiviti 4
3. Komponen Rikwaemen	Teori
	Aktiviti 5
	Aktiviti 6
	Aktiviti 7
	Aktiviti 8
4. Taeb blong Sola PV Sistem	Teori
	Aktiviti 9
	Aktiviti 10
5. Ol tul we oli yusum long Sola PV Sistem	Teori
	Aktiviti 11
6. Instolem Sola PV sistem	Teori
7. Sefti Rikwaemen blong Sola PV Sistem	Teori
	Aktiviti 12
8. Aedentifaem mo Risolvem ol komon fol long sola hom PV sistem	Teori
	Aktiviti 13
9. Sola PV Mentenens jeklis	Teori
	Aktiviti 14

Lena wokbuk ya (LW) i kamaot long koresponding Trena Gaed (TG). Ol Kontent long LW ya oli mekem i kam isi mo samaraesem, wetem fokas long ol daeakram, pija mo ol koresponding aktiviti we i save alaoem man we i lanem blong stap enkej wetem trena long taem blong trening. Sipos yu wantem kasem moa infomesen long eni seksen, plis lukluk i go long koresponding TG.

Pija long kava: Sola demo kit we oli bin yusum long Vanuatu paelot komuniti trening. Sos: GGGI Vanuatu.

GLOSERI

AC- Oltenet Karent hemi taeb blong elektrik we hemi “oltenet” o oltaem hemi jenis, oltaem inveta, jenereta, o bigfala paoa sistem i produsum.

Jaj Kontrola- Komponent we hemi kontrolem batri we i jaj mo i stopem blong ino ovajaj.

Clamp Mita- Devaes we oli yusum blong mesarem karent long wan elektrikol seket, nating we plante oli save mekem ol narafala mesamen

Karent- Elektrik karent hemi wan flo blong elektrik jaj long wan seket o waea.

DC- Daerek karent hemi taeb blong elektrik we hemi konstent mo ol sola panel mo batri nao oli produsum.

Elektrikol paoa- hemi ret we eneji hemi yusum o produsum long wan seket, we oli mesarem lo Watts.

Elektrolyte- Hemi kemikel likwid we oli faenem insaed lead asid batri. Hemi korosiv (rabis) asid tumas mo i denja tumas.

Inveta- Devaes we i konvetem DC elektriki i go long AC elektrik

Lod- Eni samting we i konsumem paoa o yusum elektrik blong operet, olsem ol laet, ol fan, etc.

Maonting- Samting we oli yusum blong helpem wan komponent blong stap. Blong eksampol, komponent mo fiting we oli yusum blong instolem mo protektem sola panel long ruf o long graon.

Multi-Mita- Wan devaes we oli yusum blong mekem ol test mo mesamen long elektrikol seket, olsem mesarem voltej, kontinuiti test, etc.

Ovajaj- Kondisen we wan batri hemi gohed blong jaj nating we hemi jaj fulwan finis. Hemia i save damejem laef blong batri blong i sot nomo.

PV Array- Hemi minim se plante sola panel oli konekt tugeta

Sot seket- Taem ol laev waea blong oposit polariti oli kam long daerek kontak wetem olgeta, oli singaotem sot seket. Eksampol, taem positiv mo neketiv teminol blong wan batri i taj. Sot seket i save damejem komponent blong yu mo kosem faea mo rabis injuri.

Sola Panel- Oli singaotem tu modul’ o PV panel, hemi devaes we i produsum elektrikol eneji taem i ekspos long sanlaet.

Teminol- Elektrikol koneksen post we hemi blong koneksen blong ol waea i go long wan devaes. Blong eksampol, ol batri oli kam wetem positiv mo neketiv teminol blong aloem koneksen blong batri i go long ol seket. Oltaem i gat ol bolt long teminol blong taetem elektrikol koneksen.

Voltej- hemi potensol difrens bitwin tufala poen long wan seket mo wanem hemi kosem karent blong flo long wan seket we i klos.

1

Aes Breka – Introdaksen

AKTIVITI 1

Introdusum yu wan brif nomo long evriwan taem trena i askem yu blong mekem. Bambae oli askem yu blong talem nem blong yum o talemaot save blong yu long sola long komuniti. Mo tu stetem wanem yu stap mekem oltaem mo stetem se yu kamfotebol wetem ples o no.

2

Komponent blong Sola PV Sistem

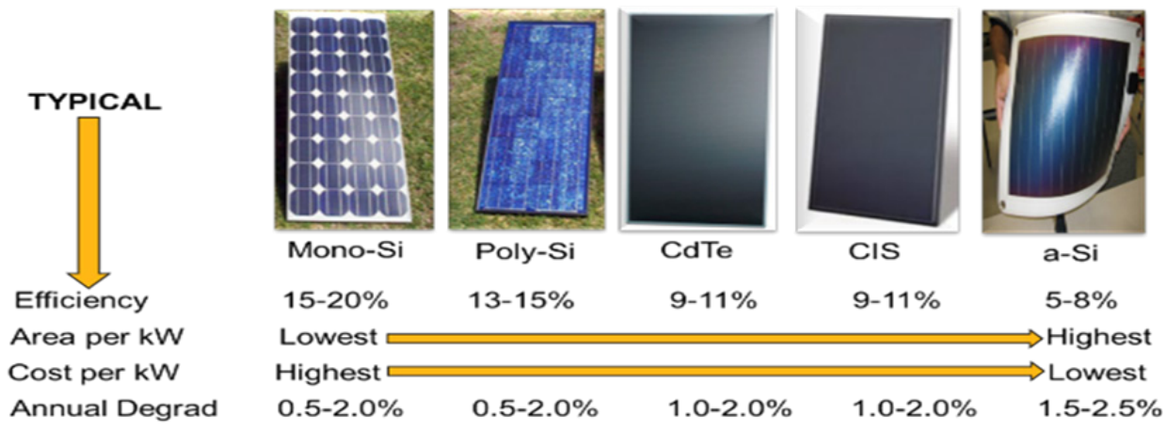
I gat ol difren komponent we oli yusum sola PV sistem. Adisen blong komponent ya oltaem i jenisim karakteristik blong sistem.

2.1. Sola Panel (PV Modul)

Sola PV Modul i produsum elektrik tru konvetem sanlaet i go long eneji. I gat ol difren taeb blong PV modul, mo wanwan long olgeta oli gat ol pefomens mo karakteristik blong olgeta wanwan.

FIKA 1: Sola Panel[1]

FIKA 2: Difren taeb blong Sola Panel (PV Modul)[2]



Ful nem blong ol PV Modul:

1. Mono-Si: Monocrystalline silicon
2. Poly-Si: Polycrystalline silicon
3. CdTe: Cadmium telluride (CdTe). Hemia hemi tin film teknoloji
4. CIS: Copper indium gallium selenide sola sel. Hemia hemi tin film teknoliji
5. A-Si: Amorphous silicon. Hemia hemi tin film teknoloji

2.2. Jaj Kontrola

Jaj kontrola i limitim ret blong taem we elektrik karent i ademap o kamaot long elektrik batri. Hemi priventem ovajaj mo i save protektem agens ovavoltej.

1 Source: Audio Digital, http://www.audio-digital.com/tag-produk/sound/

2 Adapted from the System Components- PV Modules, Arizona State University (VOCTEC), http://voctec.asu.edu

FIKA 3: Difren taeb blong kontrola[3]


Morningstar ProStar controller

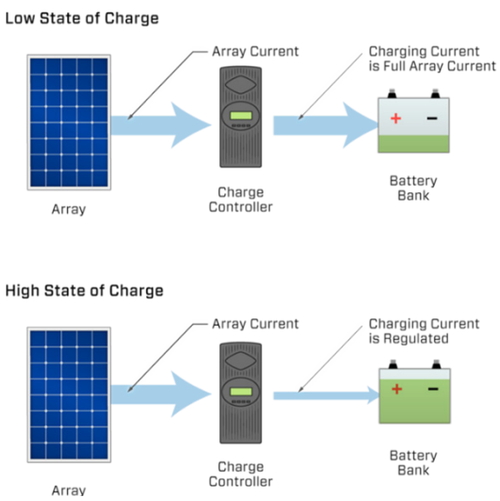

Xantrex C-series controller


Outback MPPT controller


Morningstar TriStar controller


Morningstar lighting controller

FIKA 4: Ova- jaj proteksen[4]



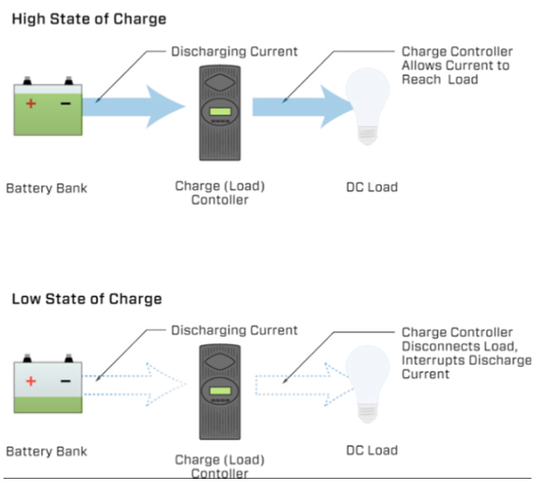
1. Ova-jaj proteksen

Taem batri voltej hemi lo, jaj kontrola i gohed blong konektem PV modul i go long batri blong jajem.
Taem batri voltej i hae, jaj kontrola i otomatikoli diskonektem PV modul long batri blong stopem jaj.

2. Ova-disjaj protektsen

Taem batri voltej hemi hae, jaj kontrola i otomatikoli konektem lod long batri.
Taem batri voltej i kam lo, jaj kontrola i otomatikoli diskonektem lod from batri.

FIKA 5: Ova disjaj proteksen

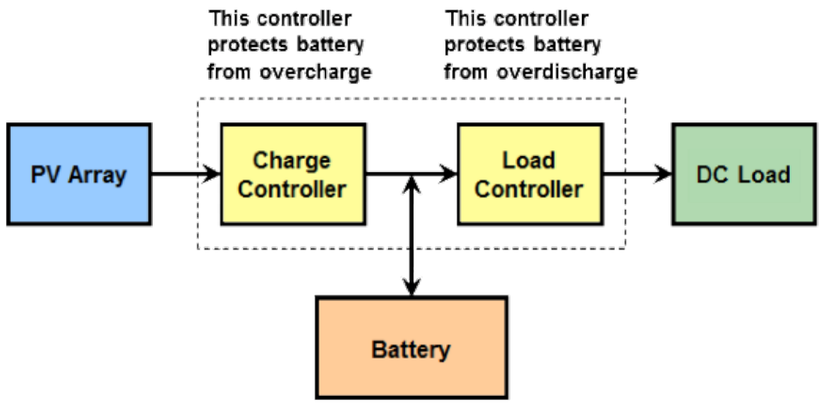


3 Adapted from System Components: Charge Controllers &Inverters, Arizona State University (VOCTEC), http://voctec.asu.edu

4 Photovoltaic Systems, Dunlop,2nd Ed.

3. Seket konfiguresen daon hemi rikomend.

FIKA 6: Rikomend Konfikuresen[5]

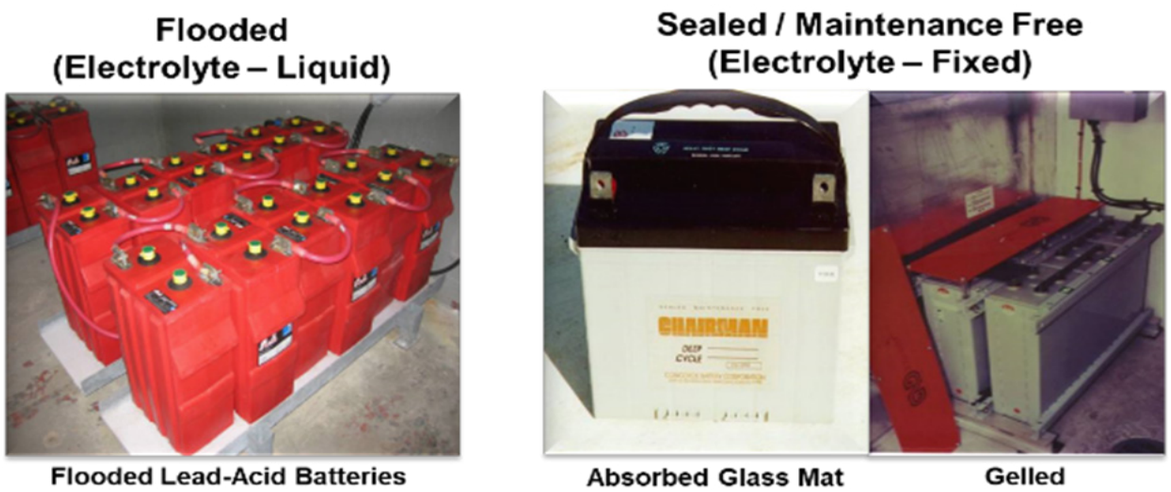


2.3. Batri

Batri hemi wan devaes we hemi save storem elektrikol eneji long fom blong kemikel eneji mo konvetem eneji ya i go long elektrik.

FIKA 7: Batri[6]

FIKA 8: Ol Difren taeb blong batri[7]



5 Source: Jim Dunlop Solar

6 Source: JICA

7 Source: Adapted from "System Components- Batteries", Arizona State University, VOCTEC, http://voctec.asu.edu

Batri Kapasiti:

1. Kapasiti hemi wan mesa blong storem elektrik jaj o storem eneji we wan batri i save dilivarem anda long ol list blong kondisen.
2. Wan ampere-aoa (Ah) hemi unit mesamen blong batri eneji storej kapasiti mo ikwel long transfe wan ampere blong wan aoa.
3. Kapasiti i dipen long batri tempereja, disjaj ret mo kat of voltej.

2.3.1. Flad Batri

Hemia hemi tredisonal enjin stat, trakta, mo dip saekol-stael batri. Likwid elektrolaet hemi fri blong muv long sel kompatmen. Man we i yusum i gat akses long evri wanwan sel mo i save ademap distil wota taem batri i drae. Popula yus blong hem hemi, enjin stat mo dip saekol disaen.

2.3.2. Seal Batri

Toktok ya i save rife long namba blong difren konstraksen, inkludum nomo wan smol jenis long flad stael. Ol popula yus blong hem hemi enjin stat mo limit stat/dip saekol aplikesen.

2.3.3. AGM Batri

Absob Glas Mat i aloem elektrolaet blong saspend blong klosem proksimiti wetem plet aktiv materiel. Popula yus i inkludum hae pefomens enjin stat, paoa spot, dip saekol, sola mo storej batri.

2.3.4. GEL Batri

Gel Sel Batri hemi semak long AGM batri stael from elektrolaet hemi saspend, be I difren from se long teknikol saed lukluk blong AGM batri hemi wan wet set. Nambawan yus blong Gel batri long DIP saekol aplikesen mo i save stap longtaem long hot weta aplikesen.

2.4 Ol Kebol

FIKA 9: Ol Kebol[8]

Elektrikol kebol oli yusum blong konektem 2 o moa devaes, enebolem transfe blong elektrikol siknol o paoa long wan devaes i go long narawan.

2.5 Seket Breka/Aesoleta

Seket breka besik fansen hemi blong intarapt karent flo afta we oli faenemaot wan fol. Aesoleta hemi mekanikol swij devaes we, long open posisen, i alaoem aesolesen blong input mo aotput blong wan devaes.

Breka bambae hemi otomatikoli diskonek sipos amps tru long brek i kasem amps we i spesifae. Blong eksampol, sipos yu yusum 10A brek mo sipos yu bin konektem 12Amps lod, brek bambae i diskonek (olsem yumi kolem se “trip”). Hemia i blong protektem ovakarent long seket from sefti.

FIKA 10: Seket Breka mo Aesoleta[9]

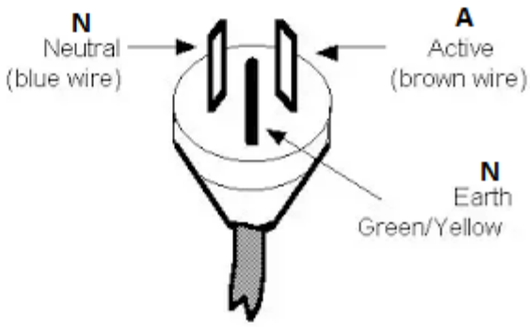
8 Source: Global Market, http://newimg.globalmarket.com/PicLib/group0/5e/73/c477defc613ecc9a0e47b82452f4_l.jpg

9 Source: Wave inverter.co, https://waveinverter.co.nz/shop/solar/solar-connectors/pv-dc-isolator-switch-mc4/ and POSO.com, http://poso.com.vn/wp-content/uploads/2020/04/1-2.png

2.6. Swij mo Paoa Soket

Swij i aesoletem elektrik mo paoa soket yus blong hemi i blong konektem/diskonektem aplaens blong yusum elektrik.

FIKA 11: Swij and Paoa Soket[10]



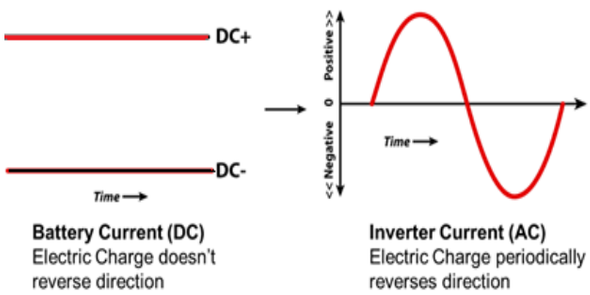
2.7 Inveta

Inveta hemi wan elektronik devaes o seketri we i jenisim daerek karent (DC) i go long olteneting karent (AC). Selektem wan inveta blong stand-alon sistem i bes long ol spesifikesen daon:

- Batri input voltej (12, 24 or 48 V)
- AC aotput voltej (120 or 220V)
- Hae AC paoa i rikwae blong kumuletiv load (long watts)
- Bigfala (Surge) karent (e.g., ol motor) rikwaemen, sipos i gat (long amps)
- Adisonal samtinga (batri jaj, etc.)

FIKA 12: Inveta[11]

FIKA 13: Fansen or wok blong wan Inveta[12]



FIKA 14: Difren taeb blong ol Inveta[13]

	Stand-Alone Inverter	Operate from **batteries** and supply power independent of the utility grid
	Interactive Inverter	Operate from **PV arrays** and supply power in parallel with the utility grid
	Bi-Model Inverter	Transfer PV system operation to a stand-alone mode and provide backup electric power to critical loads when the utility grid is not energized

10 Source: University of Newcastle Australia, "Electrical General-Purpose Outlets", https://www-eng.newcastle.edu.au/eecs/ect/oh&s/Hazards/ElectricalGPOs.html

11 MorningStar, May 2021, https://www.morningstarcorp.com/products/suresine/

12 Adapted from System Components: Charge Controllers &Inverters, Arizona State University (VOCTEC), http://voctec.asu.edu

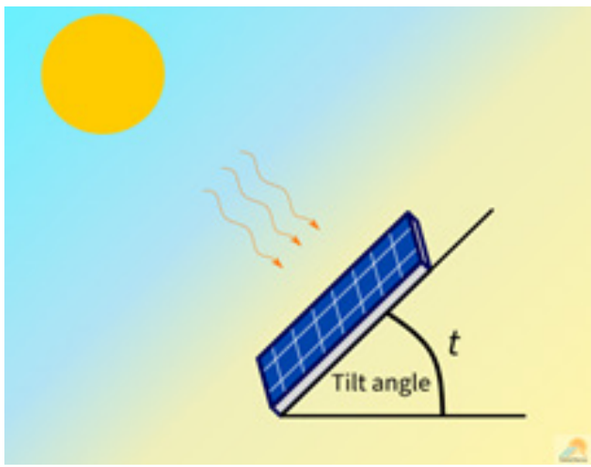
13 Adapted from System Components: Charge Controllers &Inverters, Arizona State University (VOCTEC), http://voctec.asu.edu

2.8 Sola Panel Maonting Sistem

FIKA 15: Ol Maonting braket[14]

Photovoltaik maonting sistem oli yusum blong fiksim sola panel long ol top olsem ruf, foret blong bilding, o graon maonting.

FIKA 16: Sola Panel Orientesen[15]



Long jenerol, blong Vanuatu, evri PV modul oli mas tiltim bitwin 15-20 digris mo fes i go long Not daereksen[16], blong mekemsua maksimam PV paoa jeneresen truaot long yia.

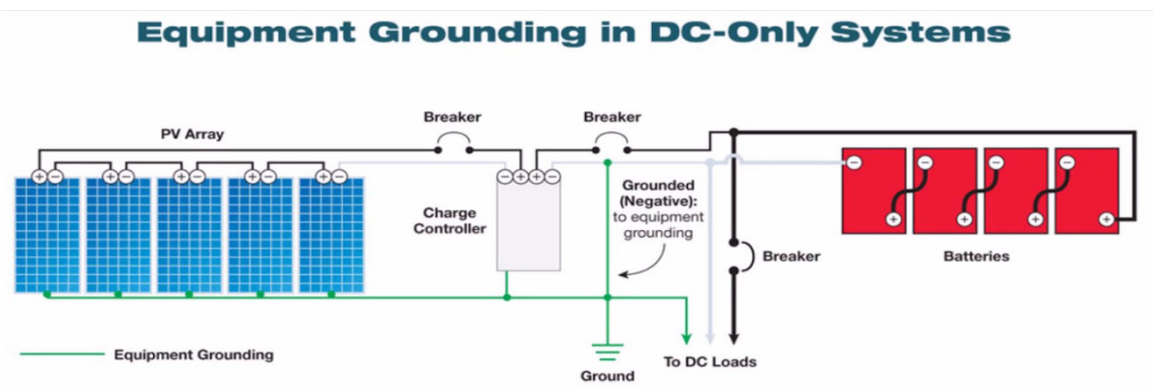
2.9 PV Modul Orientesen

Hemi impoten semak blong tiltim sola panel mo mekem i fes long daereksen we bambae i mekem sua maksimam eneji jeneresen long san. Wan pua orient o sola we i stap long sed bambae i produsum smol sola eneji, mekem bae nogat naf paoa, mo lid i go long isiu blong satdaon mo batri i nogud.

2.10 Et mo Graonding komponent

Hemi rikwae blong graonem evril PV sistem from graon sistem we oli graonem gud bambae i help blong protektem yu long eni janis blong sok mo save gat ded (nating we long taem blong bigfala karent (surge) mo laetning) mo faea we i save kamaot afta long instolesen.

FIKA 17: Olsem wanem blong graondem ikwipmen[17]



14 Source: Shopping.co, https://shopee.co.th/Utilizing%E2%9C%BF%E2%9C%B2-Solar-Panel-Mounting-Bracket-End-Mid-Clamp-Kit-Adjustable-For-19Mm-55Mm-Framed-i.188349769.7409094766

15 Solar Sena, "Optimal Solar Panel Tilt Angle Calculator", May 2021, https://solarsena.com/solar-panel-tilt-angle-calculator

16 Adapted from the Grid- Connected PV Systems (System Installation Guidelines), by PPA and SEIAPI Technical communities, 2019, https://www.ppa.org.fj/wp-content/uploads/2019/08/Grid-Connected-PV-Systems-Installation-Guidelines-V4-250719.pdf

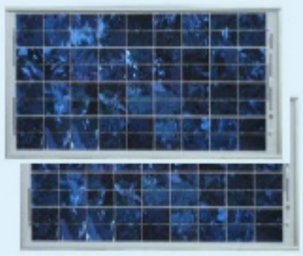
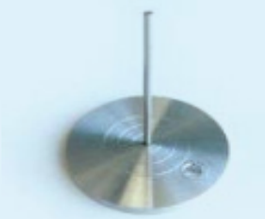
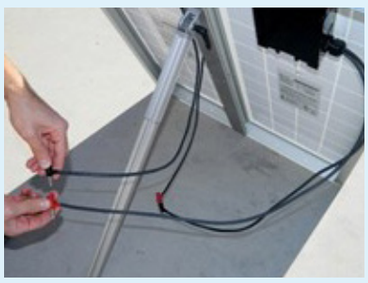
17 Source: Jim Dunlop Solar

FIKA 18: Graonding komponent[18]

18 Brass Universe, "The Ultimate Brass Hub", http://www.brassuniverse.in/brass_earthing_accessories.html

AKTIVITI 2

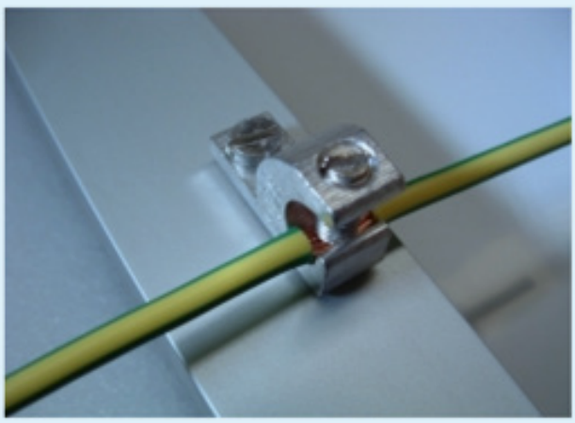
Demonstretem olsem wanem sed i afektem pefomens blong PV Modul. Mesa Voltej (V_{oc}) mo Karent (I_{sc}) anda long difdifren sed paten tru long konektem ol PV modul i go long ol pat mo parallel koneksen.

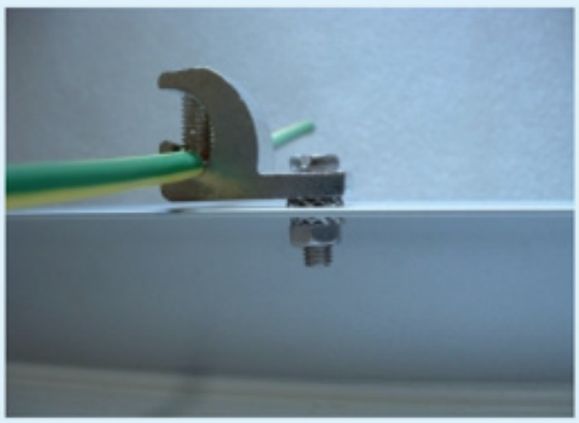
Test Set-ap		
1. PV Modul (2x) 	2. PV Array Maonting Rack 	3. Sundial 
4. Dijitol Maltimita 	5. Kadbod blong sed 	6. Asembol PV Array olsem i diskraebem long MTT Kwik Stat Gaed 
Test Prosidiu: Mesamen blong Voltej		
1. Konektem PV modul long seris 	2. Mesarem Open Seket Voltej (VOC1) without shading 	3. Sedem wan sel blong PV array 

4. Mesarem Open Seket Voltej (VOC2)	5. Sedem wan haf blong PV array	6. Mesarem Open Seket Voltej (VOC3)
		
Wei blong Test: Mesamen blong Karent		
7. Ritim mesamen 2 - 6 blong Sot Seket Karent (I_{SC1})	8. Ritim mesamen 2 - 6 blong Sot Seket Karent (I_{SC2})	9. Ritim mesamen 2 - 6 blong Sot Seket Karent (I_{SC3})
		
Rikod mo Obsevesen blong Voltej mo Karent:		
Array ino sed: Wan sel sed: Haf array sed:	Open Seket Voltej (VOC) VOC1 = 41.1V VOC2 = 41.0V VOC3 = 34.4V **Obsevesen:** VOC3 hemi hitap moa bitim we man i ekspektem 20.5V (Voc blong wan sinkel modul) folem partial laet transmitens tru long kadbod	Sot Seket Karent (ISC) ISC1 = 1.88 ISC2 = 1.84 ISC3 = 0 **Obsevesen:** ISC3 hemi 0 from ol modul ya oli nogat by-pas diodes (module we i gat sed hemi akt olsem wan bigfla resistawe i kosem model blong operet klosap long
Praktisim: Helpem mo alaoem ol patisipen blong mekem setap long tem blong 3 mo rikodem/mesarem ol valiu.		

AKTIVITI 3

From wanem bambae yumi mas etem (earth) sola PV sistem long graon? Mekem wan et koneksen long PV modul.





AKTIVITI 4

Diskasem from wanem yumi mas yusum propa maonting braket mo no livim panel long ruf?

3

Sola PV Komponent Rikwaemen

3.1 PV Modul (Sola Panel)

Hemi impoten tumas blong awea long rikwaemen blong PV Modul. Sam long ol impoten rikwaemen blong awea long hem:

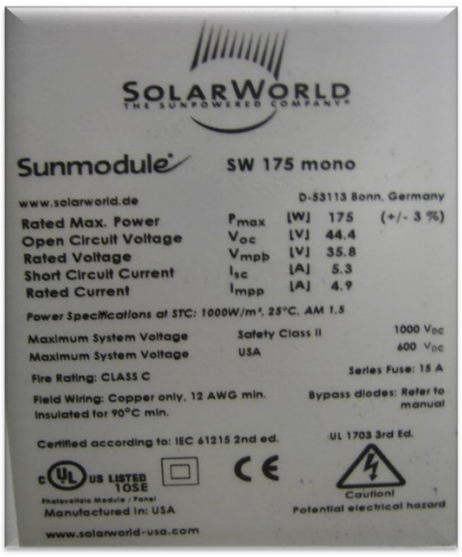
1. Wanem hemi opereting voltej?
2. Wanem hemi maksimam paoa?
3. Wanem hemi opereting karent?

Evri PV modul (panel) oli mas makem wetem ol infomesen daon (sipos no, be maet oli no kam long wan hones sos):

1. Open-seket voltej (Voc)
2. Sot-seket karent (Isc)
3. Opereting voltej (Vmp)
4. Opereting karent (Imp)
5. Maksimam paoa (Pmax)
6. Polariti blong ol teminol
7. Maksimam pemisibol sistem voltej

Yumi mas notem se taem rediens hemi hit moa, aotput blong paoa mo karent i hit moa be voltej blong PV panel hemi klosap konstent bitwin 200-1000 W/m$^{2.}$

FIKA 19: Nemplet data long sola PV modul[19]



3.1.1 Ifek blong Tempereja

Sel tempereja i plei wan kritikol rol long pefomens blong PV modul. Long jenerol, sola panel i kam moa hot, bambae paoa aotput blong hem i kam moa lo. Hemi impoten blong mekemsua gudfala ventilesen blong ol sola panel long taem blong instolesen.

3.2 Jaj Kontrola

Jaj kontrola i mas:

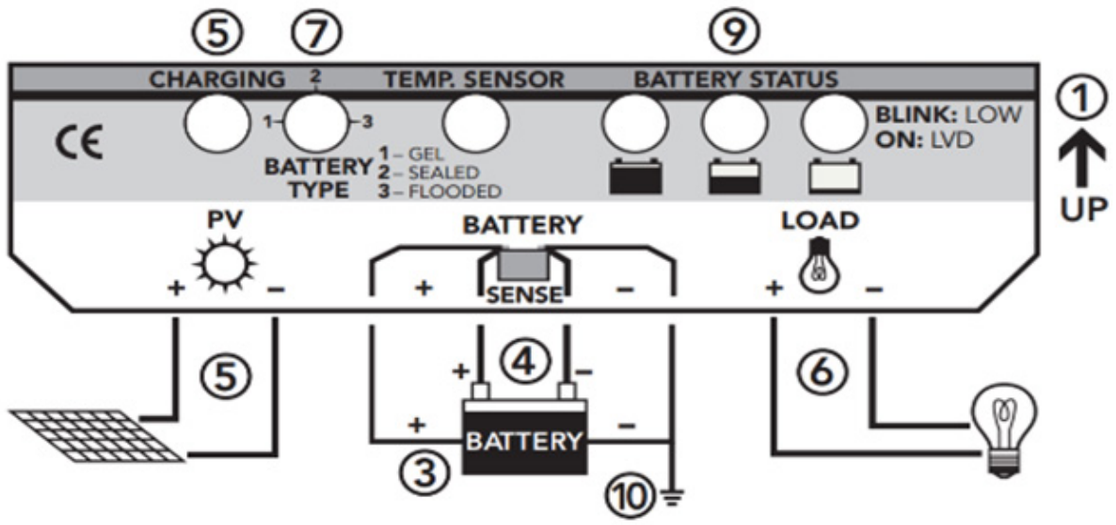
1. Gat wan safisen karent kapasiti blong tugeta jaj (amperes long sola PV) mo blong operetem ol lod (lod karent).
2. accommodate PV input voltej and batri voltej.
3. Gat wan hae DC paoa we i rikwae blong kimuletiv lod.
4. Mas fleksibol blong wok wetem difdifren taeb blong batri (flad o sil lid-asid batri).
5. Mas rilaeabol – simpol kontrola oli moa rilaeabol bitim olgeta we oli kompliket (avoidem. Kompleks ekstra “fija” olsem LCD skrin, maekro-prosesa program kontrol, etc.).

Sam spesifik pat:

1. 3-posisen batri select: gel, sil o fladed.
2. Tempereja kompenset jaj.
3. Ol LED’ blong indiketem batri status mo fols.
4. Rimot batri voltej sens teminol.

19 Adapted from the System Components- PV Modules, Arizona State University (VOCTEC), http://voctec.asu.edu

FIKA 20: Spesifik pat blong Jaj kontrola[20]



3.3 Batri

Batri i storem elektrik nomo mo INO jeneretem elektrik. Batri i gat hae feilia ret blong evri komponent long wan sola paoa sistem.

FIKA 21: Ol batri Spesifikesen[21]

SPECIFICATIONS

Nominal Voltage		12 Volts	
Amp Hour Capacity		115 (C20)	90(C5)
Reserve Capacity Minutes		170 @ 25 Amperes	
Physical Characteristics	Length	13.13"	334 mm
	Width	6.75"	171 mm
	Height	9.38"	238 mm
	Wet Weight	58 Lbs	26.4 Kgs
Terminal Options		BCI Type M	

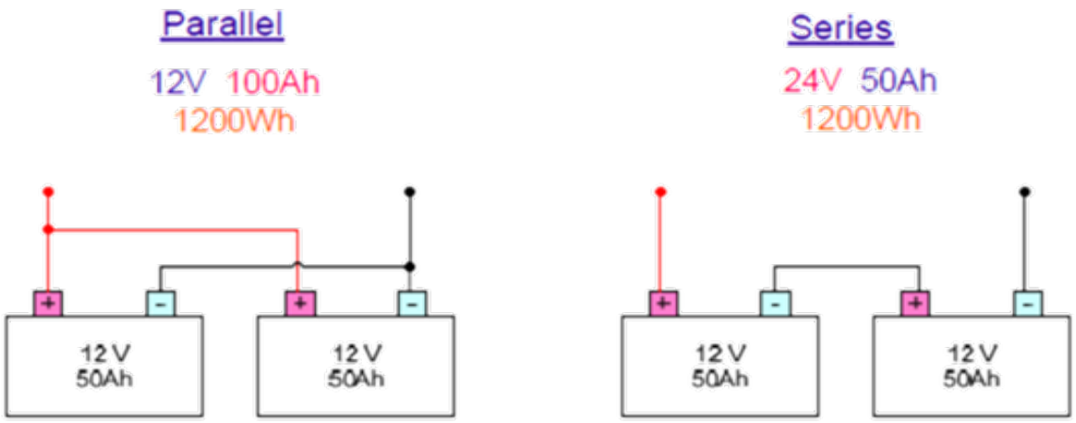
ELECTRICAL SPECIFICATIONS

Amp Hour Capacity	20 Hour Rate	5.75 A	115 Ah
	10 Hour Rate	10.30 A	103 Ah
	5 Hour Rate	18.00 A	90 Ah
	2 Hour Rate	33.50 A	67 Ah
Internal Resistance	80 F	27 C	7.6 mOhm
Capacity affected by Temperature (20 Ah Rate)	104 F	40 C	102%
	80 F	27 C	100%
	32 F	0 C	65%

20 Morning Star, June 2021, https://www.keoghsmarine.com.au/morningstar-prostar-solar-charge-controller-30a-12-or-24v-pwm-4-stage-charging-led-charge-indicators-sr--ps-30

21 Source: Waveinverter, co.nz, https://waveinverter.co.nz/wp-content/uploads/2017/12/products-CR325-1.png

FIKA 22: Taepikol Batri Koneksen[22]



3.3.1 Sam ki poen

1. Paralel koneksen i totolemap kapasiti (Ah).
2. Seris koneksen totolemap voltej (V).
3. Total eneji storej i stap semak (Wh).
4. YU NO majem tugeta moa long wan 4 batri, from hemia i kosem batri blong jaj we ino ikwel mo disjaj, we i save kosem pre-majua batri felia).
5. YU NO miksim ol difren taeb, model, mo yia blong batri, from hemi i save kosem primajua batri felia.
6. Mas maontem batri long wan gudfala ventilet ples mo protektem long san mo ren. Neva putum batri insaed long haos.
7. Batri jaj ikwipmen oli mas waearem strong, yu no mas yusum temporary koneksen.
8. Mas kavremap ol batri teminol blong priventem aksiden sot seket.
9. Mekemsua safisen kliaerens bitwin teminol mo metol wol.

Yusum ol tul we oli protekgud long taem blong eni wok wetem batri.

3.4 Inveta

FIKA 23: Suresin 300W standalon inveta[11]

TEBOL 2: Sampol spesifikesen mo pat blong Inveta

Ol Spesifikesen & Fijas/Pat	
Kontinu Paoa Rating (300 Watts at 25 °C)	Totol Hamonik Distosen (< 4%)
Peak Paoa Ret (600 Watts at 25 °C)	Lo Voltej Diskonekt (LVD) (11.5V o 10.5V)
DC Input Voltej (10.0V – 15.5V)	Lo Voltej Rikonekt (12.6V or 11.6 V)
Wevfom (Pure sine wev)	LVD Woning Treshold (11.8V or 10.8V)
AC Aotput Voltej (220V or 115V +/- 10%)	LVD Dilei Period (4 minutes)
AC Aotput Frikwensi (50 or 60 Hz +/- 10%)	Hae Voltej Diskonekt (15.5V)
Peak Efisiensi (92%)	Hae Voltej Rikonekt (14.5 V)

22 Adapted from "System Components, Batteries", Arizona State University (VOCTEC), http://voctec.asu.edu

Ol Not:

AKTIVITI 5

Wanem nao rikwaemen we yu mas lukluk long hem taem yu selektem wan PV modul? Diskasem wetem narafala man.

Yu save go back long ol not antap blong faenemaot wanem blong lukaotem long Sola PV modul nemplet.

AKTIVITI 6

Karem 2 batri mo konektem long seris mo paralel. Mesarem totol voltej blong wanwan setap.

Batri (x2)	Cables	Multimeter
		

AKTIVITI 7

Diskasem ol Kwesten: Wanem bambae i hapen long PV paoa mo karent sipos tempereja blong ol sel oli inkris?

AKTIVITI 8

Trena blong yu bambae i provaedem ol component we yumi diskasem antap (PV Modul, Kontrola, Batri, Inveta mo 12 DC laet wetem fiksja. Trena blong yu bambae i askem yu blong aedentifaem nemplet data (Spesifikesen & Fija/pat) blong wanwan komponent. Yu ekspektem blong ridim/aedentifaem ol infomesen we oli raetem long komponent folem ol not antap. Diskasem long ol tim blong yu, yu no sem blong askem trena blong yu.

4

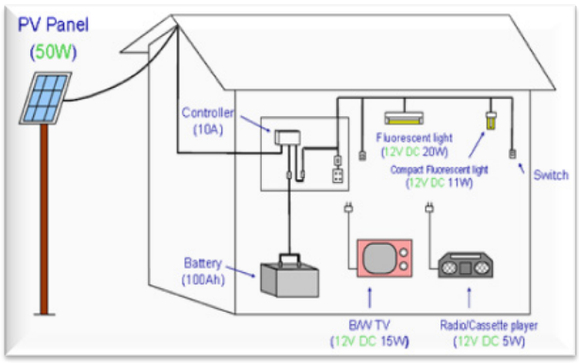
Taeb blong Sola PV Sistem

4.1 Standalon sola (DC) paoa sistem

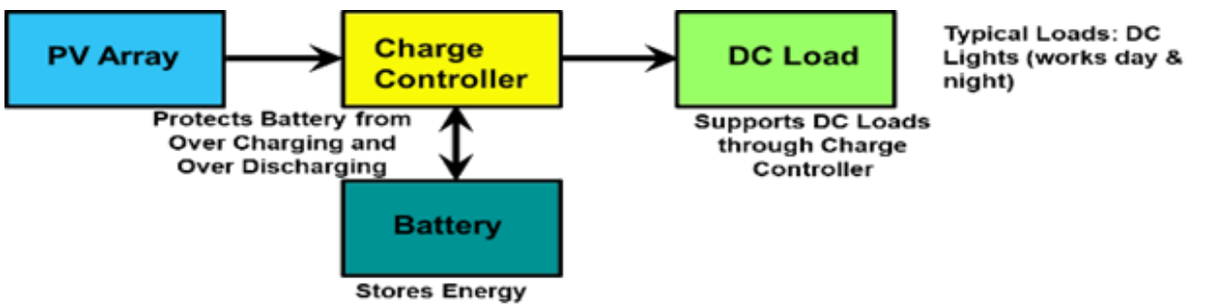
Stand-alon sistem oli no konekt long elektrik grid mo oli instolem long ol rimot eria we i gat limit koneksen long grid, o eria blong lo elektrik dimand.

4.1.1 Standalon sola (DC) paoa sistem

FIKA 24: **Standalon DC paoa sistem**[23]



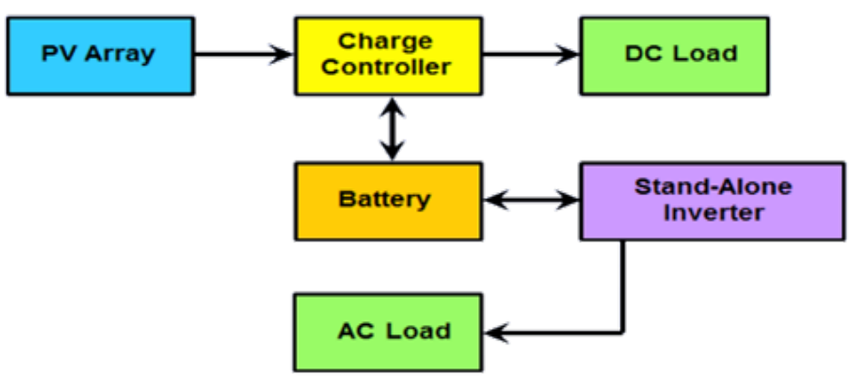
FIKA 25: **Taepikol DC sistem we i nogat batri**[24]



1. I wok Dei mo Naet, folem presens blong batri, taepikoli, i saplaem DC lod, moa nao ol laet.
2. Save gat narafala DC lod olsem fan, mobael fon jaj long USB pot, etc.
3. NO MAS adem ekstra laet o lod long wan SHS sistem, from hemia bae i kosem sistem malfansen, Ovahit, damej o satdaon from eneji difisit.
4. Yus moa nao long ol smol hom we i nidim nom laet mo ol pat blong jajaem fon.

4.1.2 Standalon sola (DC+AC) paoa sistem wetem batri

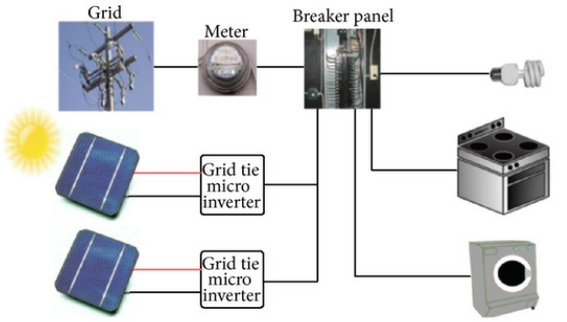
FIKA 26: **Standalon sola (DC+AC) paoa sistem wetem batri**[25]



23 Source: JICA
24 Source: Jim Dunlop Solar
25 Source: Jim Dunlop Solar

1. Semak sistem olsem "DC lod nomo" be i gat ol adisonal inveta blong alaoem paoa blong AC lod tu.
2. NO MAS swapem AC mo DC lod. DC lod i MAS paoa tru long DC saplae NOMO. NEVA PAOA DC LOD WETEM AC SAPLAE. **I gat BIGFALA RISK blong ikwipmen damej, sirias injury o iven ded.**

FIKA 27: **On-grid setap**[26]



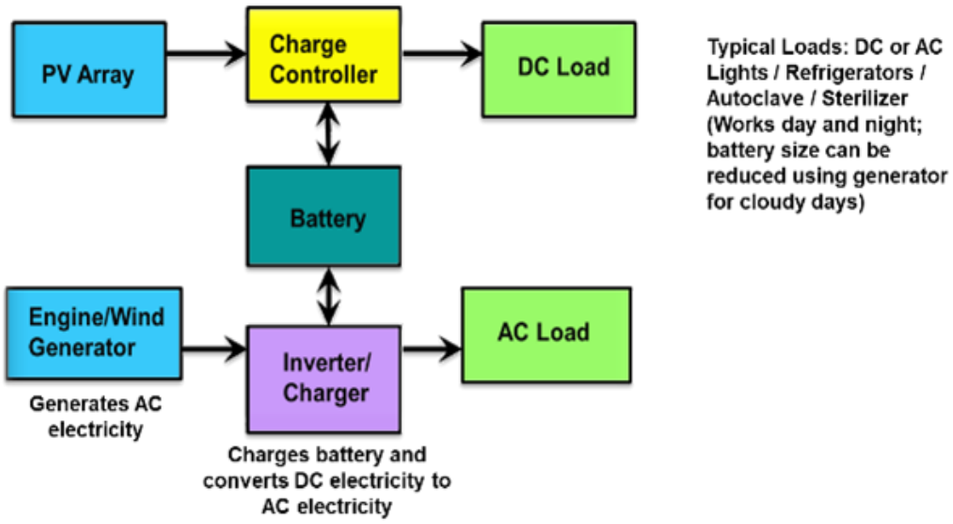
4.2 On-grid sola paoa sistem

Taeb blong sistem i moa komon long eria we i gat grid infrastrakja hemi stret. Inveta i konvetem elektrik we i jeneret tru long sola sistem – we hemi daerek karent (DC) – i go long AC elektrik blong paoa we i jeneret hemi stretgud wetem grid.

4.3 Haebrid sola paoa sistem

Taeb blong sistem ya i stret we i gat atraktiv fid long ol tariff we ol konsuma oli provaedem tru long utiliti kampani.

FIKA 28: **Haebrid setap**[27]

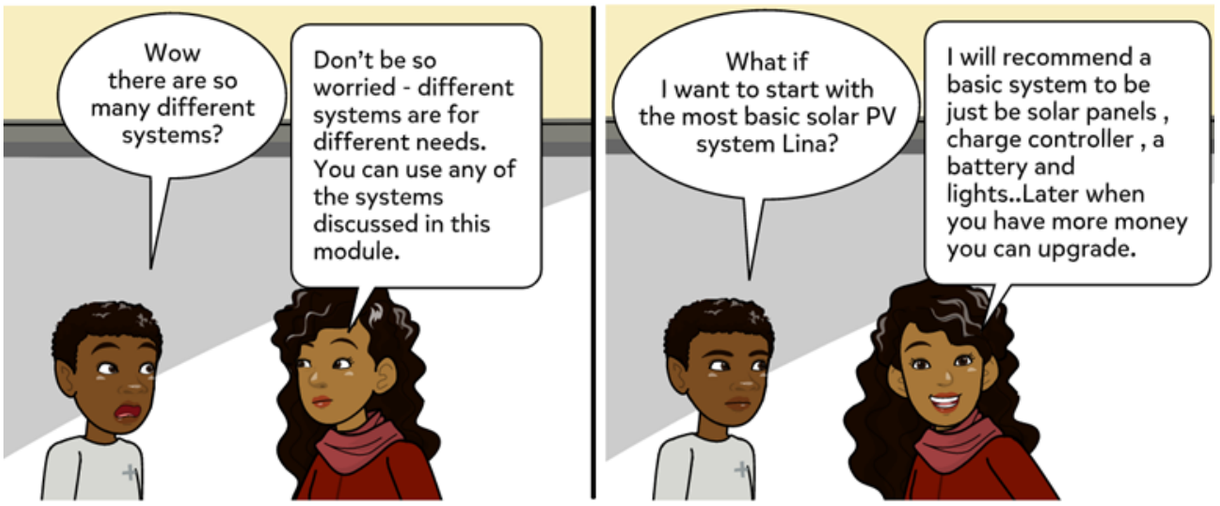


I Wok long Dei mo Long Naet, folem presens blong batri. Yu moa long ol bigfala saes homs we i gat laet, jajem fon mo laksari AC aplaens nid (TV, masin blong was, refrijereta, etc.)

26 Source: Hindawi, "Journal of Renewable Energy", June 2021, https://www.hindawi.com/journals/jre/2013/785636/fig1/

27 Source: Jim Dunlop Solar

Katun Brek



OI Not:

AKTIVITI 9

Droem eni 3 bifgala taeb sola paoa sistem mo lebolem wanwan komponent. Hemi nambawan blong diskasem long grup blong yu bifo yu dro.

AKTIVITI 10

Diskasem long klas wiswan sistem bambae yu prife mo from wanem?

5

Ol Tul we oli yusum long Sola PV Sistem

I gat ol komon tul we oli rikwae long instolesen blong Sola PV sistem.

FIKA 29: Ol Komon tul[28]

5.1 Spesifik Tul mo ol fansen blong hem

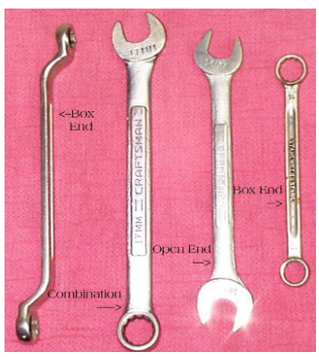
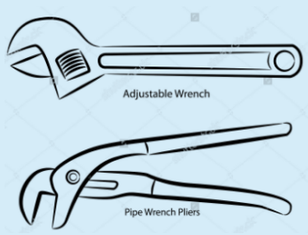
Pija blong ol Tul	Nem blong ol tul	Yus mo fansen blong ol tul
FIKA 30[29] 	Clamp mita	Clamp mita i mesarem eni long ol samting ya: AC karent, AC mo DC voltej, resistens, mekem olgeta oli stretgud blong ol elektrikol wok. Gud blong hae mo isi karent mesamen. Anex B i soem olsem wanem blong yusum wan clamp mita.
FIKA 31[30] 	Maltimita	Wan taepikol Maltimita i save mesarem voltej, karent, mo resistens. Gat hae resolusen. Save mesarem Karent nomo sipos mita i konekt long seris wetem komponent we i mesarem (we ino gat spesel adapta). Anex C i soem olsem wanem blong yusum wan maltimita.
FIKA 32[31A] 	Slot o Flat skrudraeva	Open skru.

28 Quora, "What type of tools and fasteners are required to install a solar panel", https://www.quora.com/What-type-of-tools-and-fasteners-are-required-to-install-a-solar-panel#!n=12

29 Quora, "What type of tools and fasteners are required to install a solar panel", https://www.quora.com/What-type-of-tools-and-fasteners-are-required-to-install-a-solar-panel#!n=12

30 Source: Jim Dunlop Solar

31A Adapted from Amazon.com, https://www.amazon.com/TEKTON-2700-4-Inch-Stubby-Screwdriver/dp/B00DPLNLOS

Pija blong ol Tul	Nem blong ol tul	Yus mo fansen blong ol tul
FIKA 33[31B] 	Philips Skrudraeva	Open skru.
FIKA 34[32] 	Sola Irediens Mita	Mesarem sola intensiti o irediens.
FIKA 35 	Ofset Bokis wrench, Kombinesen wrench, Open en wrench mo Nomol bokis wrench	Hemia ol tul we oli yusum blong provaedem grip mo mekanikol advantej blong aplaem torque blong tanem ol objek—oltaem ol roteri fastena, olsem ol nats mo ol bolt—o kipim olgeta blong oli no tanem.
FIKA 36[33] 	Adjastebol wrench Paep wrench plaes	Hemia ol tul we oli yusum blong provaedem grip mo meknikol advantej aplaem torque blong tanem ol objek—oltaem roteri fastena, olsem ol nat mo ol bolt—o kipim olgeta blong tanem.

31B Source: Conceptdraw.com, "Manufacturing and Maintenance", https://www.conceptdraw.com/examples/diagram-of-screwdriver-and-its-specific-use-in-maintenance
32 Mechanical Engineering, https://mechanical-engg.com/gallery/image/2209-wrench-typesjpg/
33 Source: Pinterest.com, "Different types of wrenches", https://www.pinterest.com/pin/147352219031480866/

Pija blong ol Tul	Nem blong ol tul	Yus mo fansen blong ol tul
FIKA 37[34] 	Laenman Plaea	Laensman plaeas oli ol taeb blong plaeas we ol man blong elektrik mo ol narafala tredsman blong griping, twist, bend mo katem waea mo kebol.
FIKA 38[35] 	Nidel Nos Plaeas	Tugeta plaeas oli blong kat mo holem samting we ol elektrisian oli yusum, mo ol narafala tredsman blong bend, re-posisen mo snip waea.
FIKA 39[36] Flasing 	Flasing oli yusum blong avoidem eni wota lik tru long opening.	
FIKA 40[37] Modul konekta  	Modul konekta oli yusum blong konektem wanwan sola panel long seris wetem narafala sola panel.	

34 Source: AmPro, https://ampro.fr/en/shop/pliers/wire-cutting-pliers/71-2-high-leverage-diagonal-pliers/

35 Source: DORNO, Rubber Grip Long-Nose Pliers, https://www.olo-7.top/products.aspx?cname=rubber+needle+nose+pliers&cid=40

36 Source: Alternergy Solar Pv and Storage solutions, https://www.alternergy.co.uk/dektite-lead-multicable-solar-flashing-tiled-or-slate

37 Source: CED Greentech, https://www.cedgreentech.com/article/pv-connectors-what-you-need-know

I gat ol difren taeb blong skru hed we ol sola teknisian oli save yusum. Wanwan hed i gat spesifik skrudraeva.

Fika 41: **Ol skru wetem ol difren hed**[38]

Handelem mo karem tul hemi vaetal sola PV sistem. Ol metod oli save yusum blong karem ol tul.

FIKA 42: **Wei blong karem ol tul**[39]

I gat trifala (3) taeb blong lada.

1. **Step Lada (Wan-frem):** Ol step lada oli yusful fri-stand lada mo oli disaenem blong yusum long ful 'open' posisen.

FIKA 43: **A-frem lada**[40]

38 Source: UU-99, https://www.hindawi.com/journals/jre/2013/785636/fig1/

39 Source: Pinterest.com, https://www.pinterest.com/bambulancemania/work-apparal/

40 Source: Total Tools, https://www.totaltools.com.au/2-4-4-0m-extension-ladder

2. **Platfom lada**: i semak long step lada be i provaedem sef wok envaeromen. I provaedem wan nambawan platform blong step mo wok long hem. Mo tu hemi gat sam sot blong rel o baria we i provaedem wan smol fol proteksen.

FIKA 44 : **Platfom Lada**[41]

3. **Stret ekstensen lada:** Ekstensen lada oli semak long stret lada mo oli yusum blong kasem long hae eria.

FIKA 45: **Ekstensen lada**[42]

Jusum wan propa lada lengt hemi impoten. Jusum lada lengt bes long kontak poen wea lada i tajem ruf laen o wol.

SAFETY TIP: When selecting a straight or extension ladder, choose a length that extends a minimum of 3 ft above the rung you need to stand on to work from. When using extension and straight ladder the fourth rung from the top is the highest rung to climb to or work from.

SAFETY TIP: Never use a metal ladder near electrical lines or equipment. Always look up prior to raising a ladder to ensure no overhead powerline are present.

Ol Not:

41 Source: Total Tools, https://www.totaltools.com.au/2-4-4-0m-extension-ladder

42 Source: Swallow Tail Inn, http://www.swallowtailinn.com/when-should-replace-your-siding

AKTIVITI 11

1. Wanem hemi bigfala difrens bitwin wan clamp mita mo wan malti-mita?

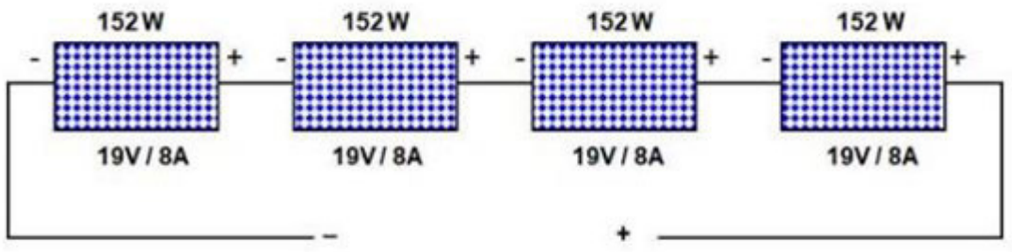
6

Instolem Sola
PV sistem

6.1 Seris Koneksen

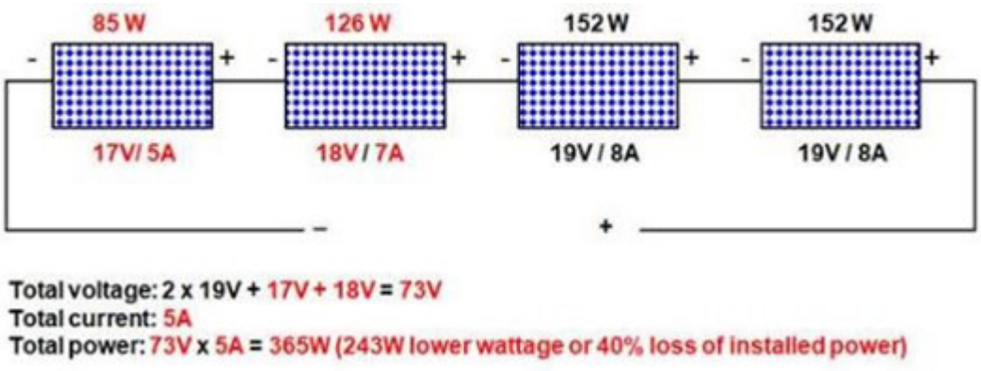
PV modul oli konekt long seris blong ademap voltej aotput (karent aotput i stap semak). Oli mekem ol koneksen long positiv teminol long wan panel i go long neketiv teminol blong ol narafala panel.

FIKA 46: **Seris Koneksen**[43]



Taem oli konektem difren PV panel long seris, karent i adap, be voltej hemi limit tru long lowes karent blong aotput panel long paralel koneksen.

FIKA 47: **Series wetem ol miks praes**[43]

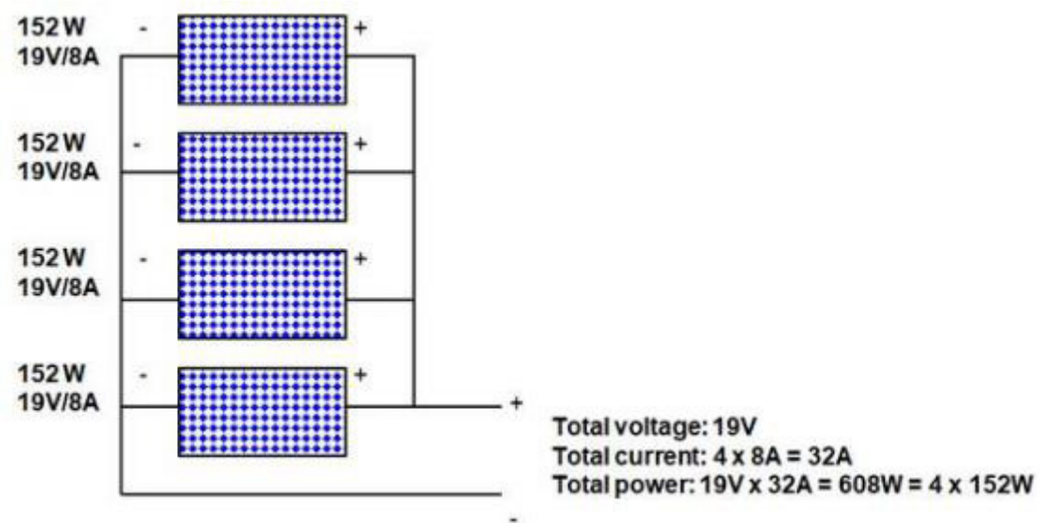


43 Photo credit :https://solarpanelsvenue.com/

6.2 Paralel Koneksen

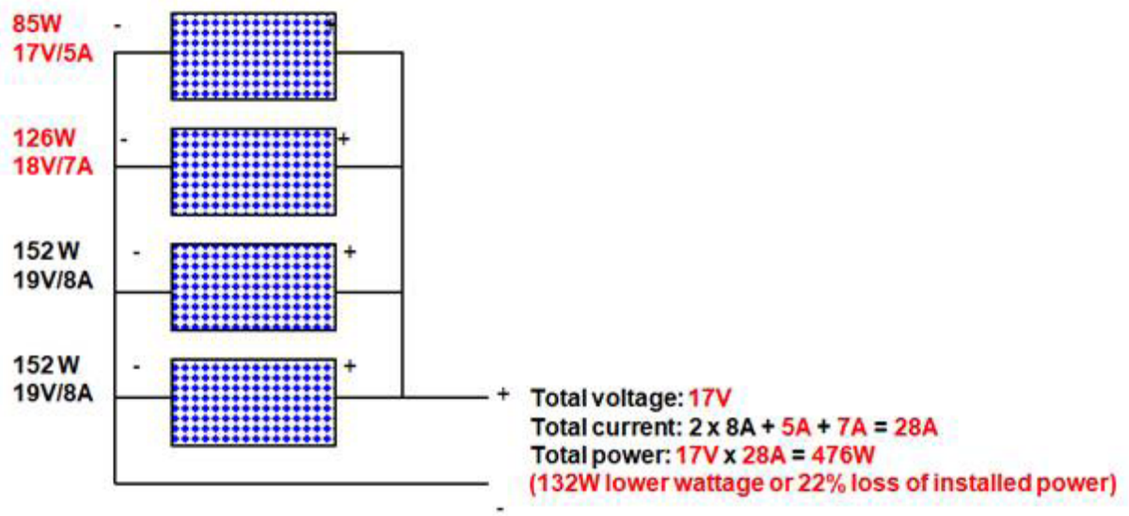
Ol PV modul oli konekt long paralel blong ademap karent aotput (voltej aotput i stap semak). Oli mekem ol koneksen long positiv teminol blong wan modul i go long positiv teminol blong ol narafala panel, mo neketiv terminol blong wan modul long neketiv teminol blong narafala panel.

FIKA 48: **Paralel Koneksen**[43]



Taem difren PV panel oli konekt long paralel, karent i adap, be voltej hemi limit tru long lowes voltej aotput blong panel long paralel koneksen.

FIKA 49: **Paralel wetem ol miks saes**[43]

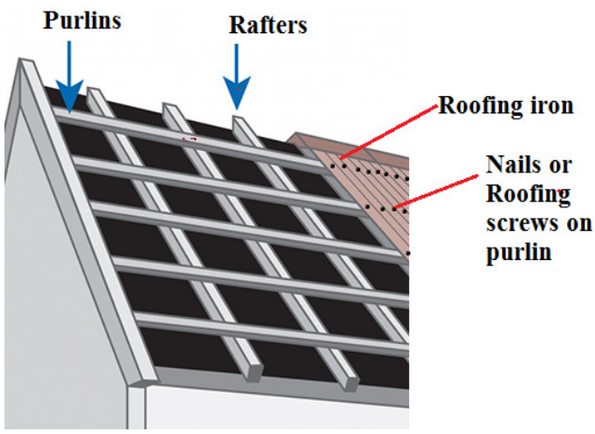


6.3 Mekem rere blong instolesen

Bifo yu statem instolesen, yu mas planem instolesen mo karem evri materiel we i rikwae bifo i prosid. Yu mekemap tingting blong yu klia sipos seris blong paralel koneksen bambae i mekem mo prediktim eni sefti isiu we bambae i raes. Mas ikwip wetem PPE bifo yu statem sola instolesen. Mo tu, maet yu wantem mekemsua korekt saes mo namba blong komponent oli tekem i go long ples blong instolesen.

6.3.1 Ruf maonting PV modul

FIKA 50: Wud strakja long ruf[44]

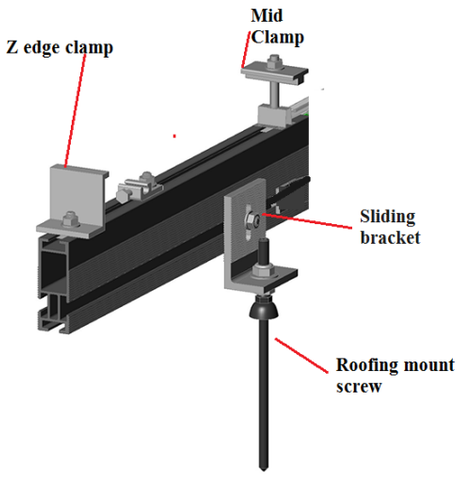


Fesfala samting blong mekem hemi setap wan maonting bes we i fiks i go long ruf purlin yusum semak skru blong ruf. Yu mas tekem kea blong yusum wasa mo seal sipos i rikwae blong priventem lik long ruf. I gat samfala wei blong maontem bes long ruf. Naoia bambae yumi lukim olsem lukluk blong ol panel andanit.

FIKA 51: Sola rel long korukesen[45]

Sola rel oli rikomendem olsem standad praktis taem man i putumap sam ruf sola panel. Nating we blong wan sinkel panel hemi yusful tumas mo alaoem ekstensen isi long fuja. Fika daon i soem ol difren braket long yus long wan aluminum rel. Moa komom wan hemi z-clamp o wan z-braket.

FIKA 52: En mo mid clamp blong sola maonting[46]



Taem oli sekurim ol rel, oli instolem Sola panel mo sekiu long top ol rel oli yusum difren taeb blong ol clamp

FIKA 53: Oli maontem ol Sola panel long ol rel[47]

44 Source: Pinterest.com, March 2021, https://www.pinterest.co.uk/pin/539446861598727570/

45 Source: Sun for Son, http://www.solar-mount.com/solar-mounts/high-quality-tile-roof-aluminum-alloy-pv.html

46 Source: Solar Gain, June 2021, https://www.solargain.ca/product/fast-rack-10-panel-mounting-kit/

47 Source: ClayEnergy, Fiji.

FIKA 54: Maontem sola long Pasifik aelan ruf yusum z clamp mo timba[48]

FIKA 55: Pol maont sola hemi nambawan opsen folem ruf strakja we ino stret[49]

6.3.2 Graon/pol maont PV Modul

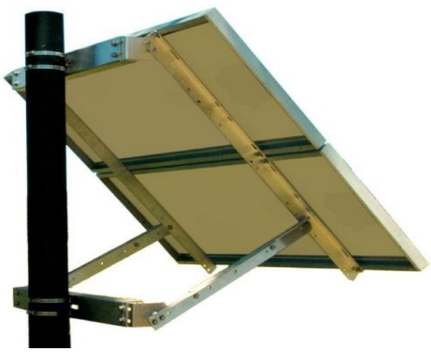
Sipos ruf maont blong sola modul hemi no stret o pisibol, nao graon maont sistem i save ofarem wan gudfala oltenetiv, espeseli blong rural rimot komuniti.

FIKA 56: Eksampol blong pol maont sola PV maonting sistem[50]

Adavantej blong pol maont blong wan o 2 panel instolesen inkludum:

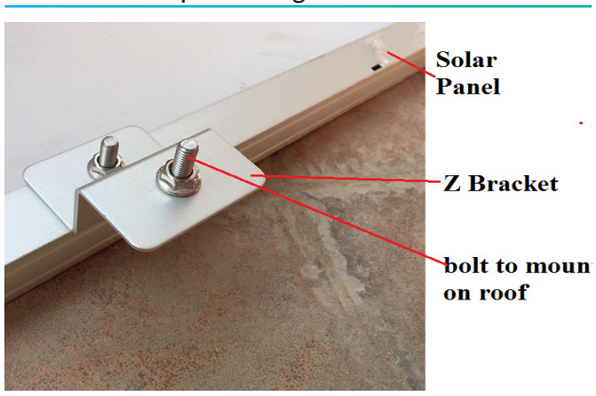
1. Save stap longwe long sed,
2. setem wan propa tilt mo daereksen,
3. kolkol long panel from botom blong panel hemi klia blong ventilesen,
4. no wari from ol liv o doti we i stap bitwin ol panels mo ol ruf,
5. gudfala akses blong mentenens,
6. no problem wetem ol lik long ruf from i gat maonting panel long ol metal ruf.

FIKA 57: Pol maonting oli save mekem long lokol materiel nomo[51]



Long samfala kes, standad slot rel maet ino avelebol. Long kes ya yu nidim blong improvaes mo yusum Z braket. Z bracket oltaem oli yusum blong maontem sola long ol trak blong camp o long ol flat sefes etc. Be i save wok isi long sola instolesen long koruget ruf. Daon hemi wan Z braket we i konekt long baksaed blong sola panel.

FIKA 58: Z clamp maonting ditel[52]

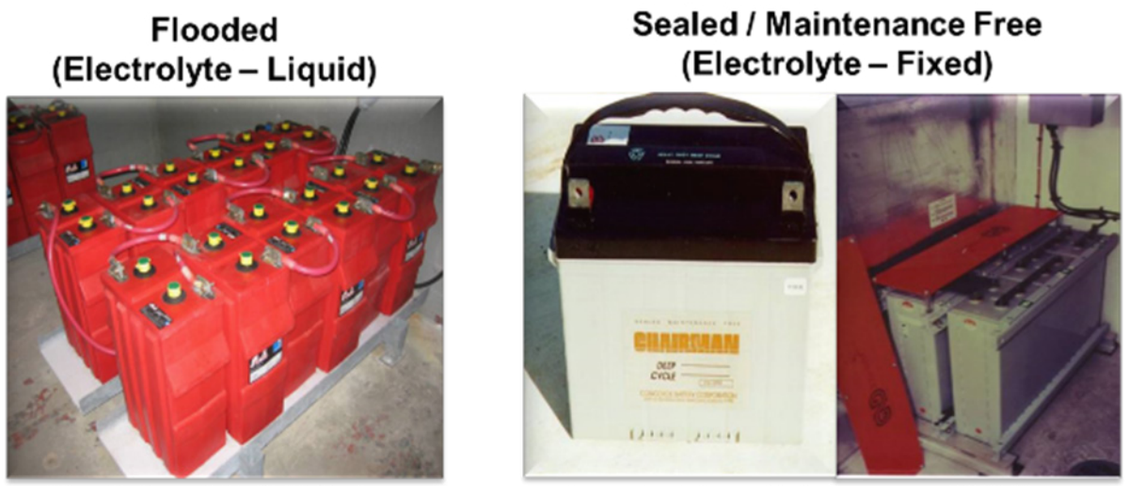


48 Baristar Solar, https://www.bristarsolar.com/solar-metal-roof-mount/solar-panel-metal-roof-mount/solar-panel-mounting-on-metal-roof.html
49 Source: Fiji Department of Energy
50 Source: Mibet Energy, May 2021, https://www.mibetsolar.com/,.
51 Source: https://www.amazon.com/Solar-70-85W-Panels-Supports-15-65deg/dp/B07P13J5C6%20;%20accessed%2028/09/21
52 Source: Engineer Solar, June 2021, http://engineer-solar.com/Products/solar-panel-z-bracket.html

6.3.3 Iinstolem Batri

Oli yusum batri blong storem eneji blong yusum biaen.

FIKA 59: Taeb blong Batri[53]



6.3.4 Instolem Jaj Kontrola mo ol narafala komponent

Ol last komponent blong wan Sola Hom Sistem, olsem jaj kontrola, ol lod, Inveta (sipos sistem hemi AC taeb) mo kebol mo proteksen ikwipmen, oli instolem oltaem long maont bod mo putum long wol olsem yumi luk long pija daon.

FIKA 60: Enjinia i soem wol maont SHS system[54]

Jenerol gaedlaen blong instolesen blong ol komponent oli:

1. Komponent blong instolem folem instraksen blong manufakja.
2. Evri rikwaemen blong wanwan komponen oli mas folem blong alaoem stret kliarens mo vetilesen blong component ya.
3. Instolesen blong jaj kontrola mo inveta (sipos i gat) mas klosap long batri oltaem blong katemdaon longfala lengt blong kebol mo katemdaon voltej drop.
4. No mas instolem ol solar komponents long daerek sanlaet mo mas instolem long wan ples we nogat dast.
5. From komponent, espeseli inveta, i save hevi, hemi impoten blong mekmesua se maonting bod hemi strong inaf blong karem weit.
6. Evri DC (mo AC kebol o inveta sapos i stap) mas stap gud mo i sef. AC kebol masseperetem long DC kebol mo gat mekanikol protektsen blong avoidem eksposa long ol narafala kebol o pesonal.
7. Evri kebol mas yusum bigfala voltej mo karent reting bitim maksimam voltej mo karent we i ekspet long seket ya.
8. Evri proteksen mo swij komponent mas gat stret reting blong operet sef taem i rikwae.

53 Source: Adapted from "System Components- Batteries", Arizona State University, VOCTEC, http://voctec.asu.edu

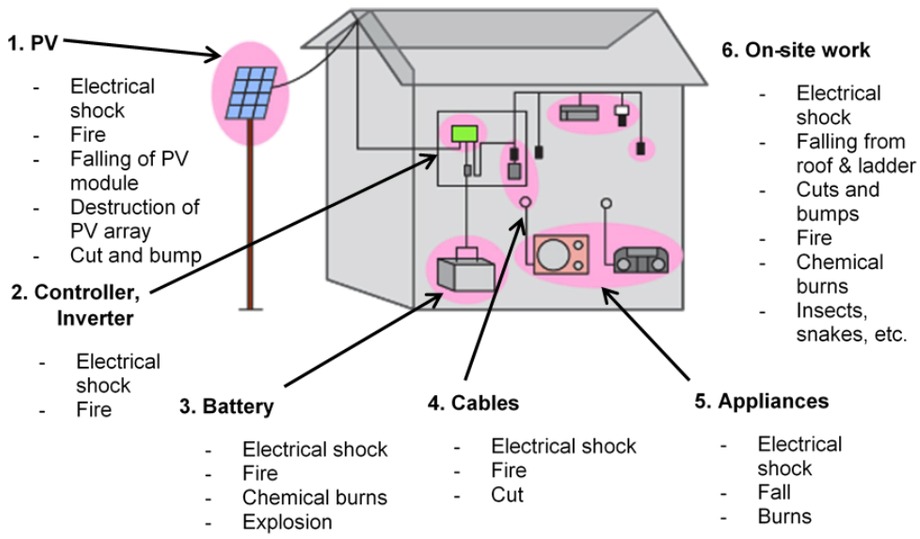
54 CBS Power Solutions, May 2021, https://www.worldbank.org/

7

Sefti Rikwaemen blong Sola PV Sistem

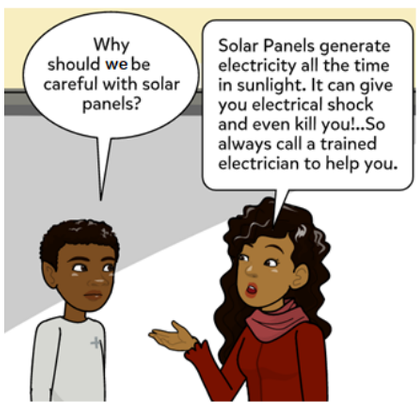
Sefti hemi bigfala impoten samting long Sola PV instolesen o mentenens eksesaes. I gat samfala helt hasad we ino save present long Sola PV Sistem. Sam long ol sefti risk oli haelaetem long fika daon.

FIKA 61: Sos blog aksiden[55]



7.1 Sefti Rul blong folem

FIKA 62: Oltaem tekem help long wan elektrisian o sola teknisian[56]



1. Oltaem yu notifaem ona blong haoshol mo tanem paoa of bifo mekem mo adisonal koneksen o adjasmen. Neva traem blong wok long wan seket we hemi stil aktiv wetem paoa.

FIKA 63: Woning Saen[57]

2. Mekem sua oltaem se yu kondaktem instolesen o ripea long ol seket we yu bin tren from. Yu no traem blong modify sola PV sistem bifo yu andastanem gud ol sistem.

FIKA 64: Werem Insulet glov[58]

55 Source: JICA
56 Source: GGGI,Fiji.
57 Source: AviationPros, https://www.aviationpros.com/tools-equipment/safety-equipment/article/11148860/ground-handling-safety-signs
58 Source: Safety workblog.com, https://safetyworkblog.com/assets/understanding-the-2015-edition-of-nfpa-70e-the-arc-flash-hazard.jpg

3. Oltaem werem PPE (pesonol protektiv ikwipmen) olsem ol insult glove, ae gogel mo sefti futwea. Neva tajem ekspos waea nating we wetem insulet glov.
4. Neva traem blong mekemgud ol folti batri yu wan. Batri i kontenem ol kemikel we i denja tumas we i save kosem bigfala ham.

FIKA 65: Asid Woning[59]

5. Neva storem batri klosap long faea o insaed long siting rum – sam batri oli givimaot ol toksik gas nating we yumi no lukim hemia.

FIKA 66: Fume woning[60]

6. Neva storem batri long smol spes o klosap fuel from oli save kosem faea.. Oltaem putum batri long gudfala eria we bae win save blo.

FIKA 67: Batri Woning[61]

7. Oltaem werem hanes we i konekt long ruf blong haos blong yu taem yu wok long instolem sola PV panel long ruf. Taem yu wok long ruf oltaem wok wetem patna blong yu sipos i posibol.

8. Notem se sefes blong ruf i kam mo klis afta long ren. Blong sefti yumi rikomendem blong wok long drae ruf nomo.

FIKA 68: Konektem harness long ruf oltaem[62]

9. Notem se sola panel i stat blong jeneretem elektrik long eni amaon blong sanlaet. Mekmsua blong no tajem ol waea long enitaem o traem blong aksidentoli konektem ol waea. Mekemsua blong karem ol hevi panel wetem help blong narafala teknisian.

FIKA 69: Tekem plante kea taem yu karem ol panel long hit[63]

59 MSDS online, https://www.msdsonline.com/2014/07/22/sulfuric-acid-safety-tips-sulfuric-acid-msds-information/

60 Source: National Safety Signs, https://nationalsafetysigns.com.au/wp-content/uploads/2020/02/D10332-Toxic-Fumes-sign.png

61 We Need Signs.com, "Ansi Battery Charging Safety Signs", http://www.weneedsigns.com/home.php?cat=403

62 Source: Solar Power World, https://www.solarpowerworldonline.com/2016/01/how-to-stay-safe-on-top-of-metal-roofs-when-installing-solar/

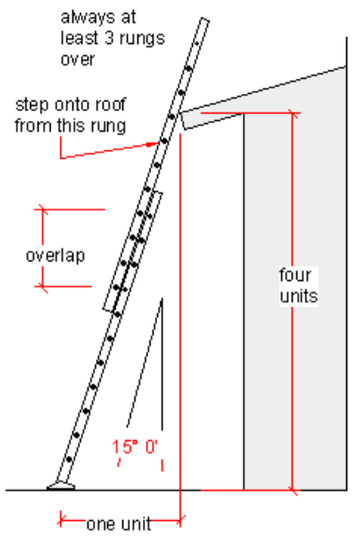
63 Adapted from Barefoot college Annual Report (2016-2017), https://www.barefootcollege.org/wp-content/uploads/2018/10/Barefoot_annualreport_2016-17_v7_online.pdf

10. Sola panel mo ol maont mo iven ruf bambae oli kam hot moa long san, so tekem kea blong werem glov mo ol narafala PPE taem yu handelem hot sefes. Mo tu mekemsua se yu save hao blong yusum elektrikol ikwipmen olsem ol dril etc. blong maont mo werem ae projeksen taem yu yusum dril o hama.

11. Oltaem mekmsua yu praktisim ol lada sefti rul taem yu yusum lada blong kasem ruf blong dil wetem sola PV sistem. Mekemsua lada i gat 75-digri ankle wetem graon. Mekemsua lada hemi stebol long flat graon. Mekemsua wan man i holem lada mo priventem blong i no klis.

FIKA 70: Werem PPE mo konektem hanes long ruf[64]

FIKA 71: Lada blong mekem 75 digri ankel long graon[65]



Ol Not:

64 Source: Pacific Prime Singapore, https://www.pacificprime.sg/blog/covid-19-lockdown-singapores-quarantine-measures-for-foreign-workers/

65 Source: Builder Bill, https://builder-bill.com/diy-help

AKTIVITI 12

Pat A: Diskasen long sefti prekosen

Go long ol grup mo imajinim se yu bin instolem 2 x 50-watt panel wetem 3 x 30Ah batri inkludum 20A jaj kontrola, 2 x Dc laet mo 1 x 100W inveta wetem wan sinkel AC laet bulb olsem wan lod.

Yu rikwae faswan blong diskasem evri safti prekosen we yu nidim blong tekem taem yu mekem instolesen ya. Diskasem long toktok o raetem daon. Mo tu askem olgeta olsem wanem bambae oli instolem sistem. Instolem wan DC mo AC Standalon sistem yusum VOTEC Kit.

Ansa:

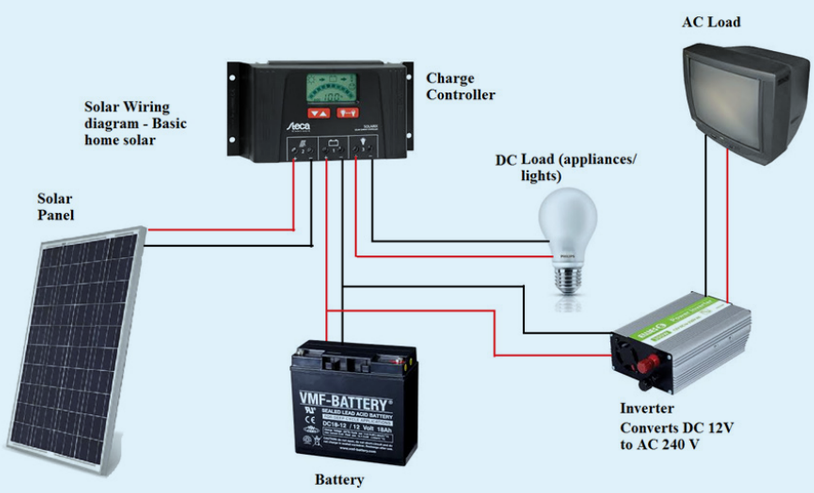
Pat B: Instolesen (Yusum VOTEC Kit blong DC mo AC Setap)

Saplaem sola PV sistem long ol lena we i kontenem ol samting ya daon:

1. Sola panel
2. Batri
3. Jaj kontrola
4. Inveta
5. DC laet balb (klosap 10 W) wetem wan swij olsem AC lod
6. AC laet balb (klosap 10 W) wetem swij
7. Sola Panel mounting kit
8. Elektrikol waea
9. Plaeas, ol skru draeva, malti-mita.
10. PPE – insulet glov, gogol, ol insulet tul, helmet, ruf hanes.
11. Waea konekta mo DC seket breka

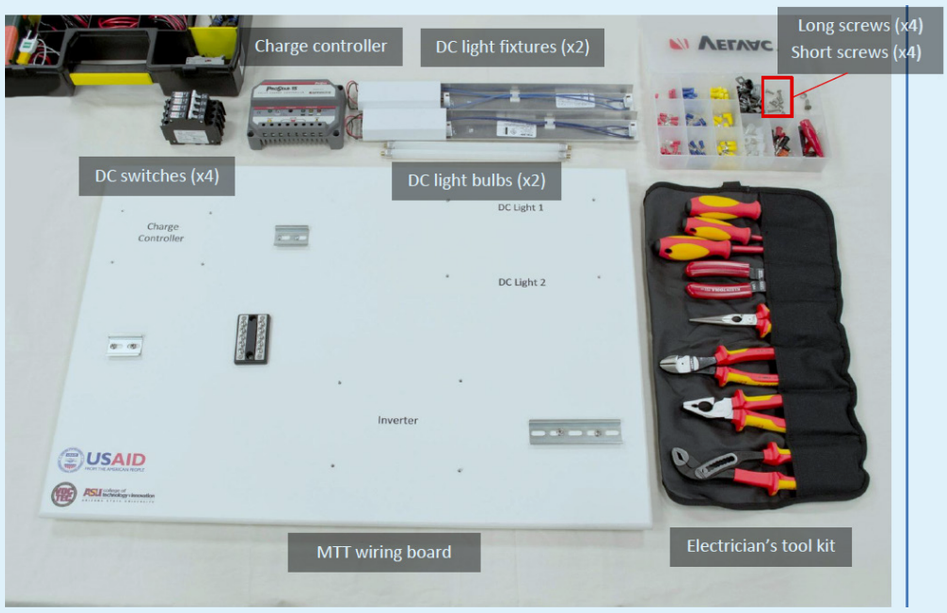
Long aktiviti ya ol lena bambae oli traem blong instolem wan stret sola PV sistem wetem taepikol seket daeagram olsem i stap daon:

FIKA 72: Taepkol AC/DC Sola PV Sistem[66]

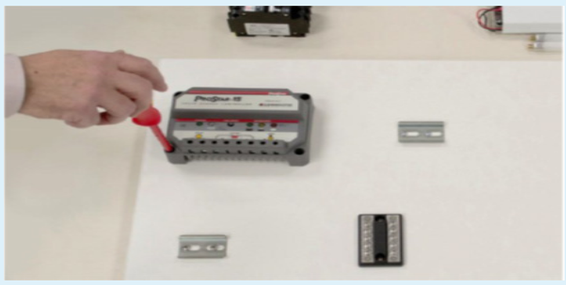


66 USAID-VOCTEC

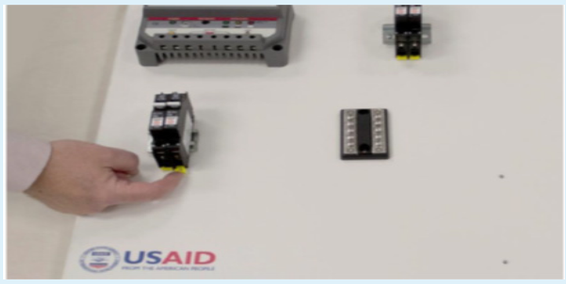
DC SETAP MATERIEL WE YUMI NIDIM



STEP 1

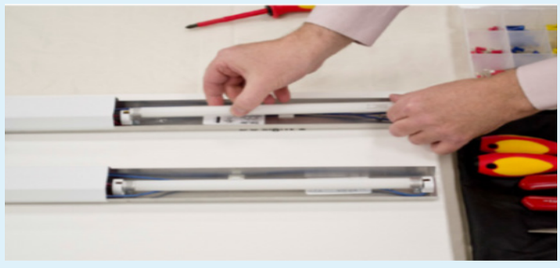


STEP 2



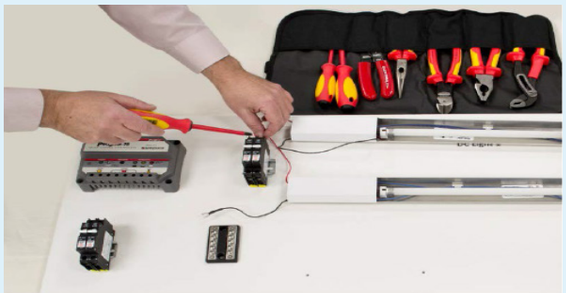
STEP 3

STEP 4



NAOIA YUMI WAEAREM KOMPONENT BLONG DC SISTEM

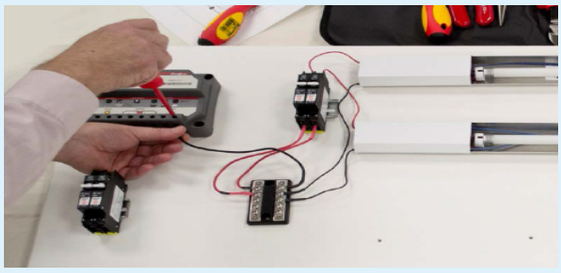
STEP 1



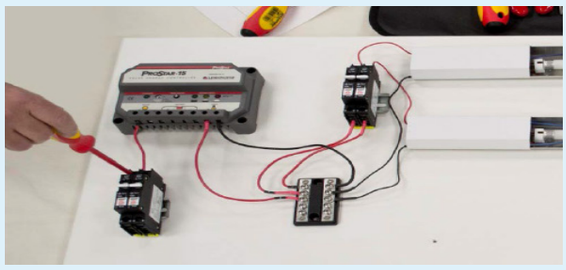
STEP 2

STEP 3

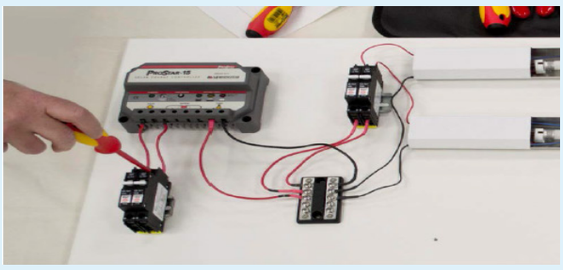
STEP 4



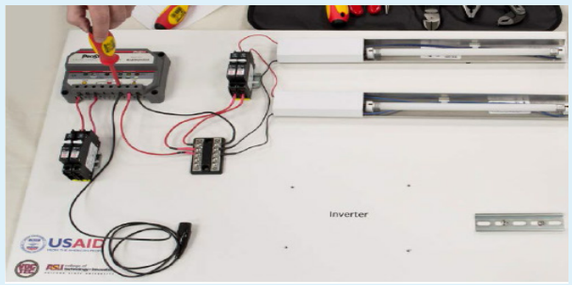
STEP 5



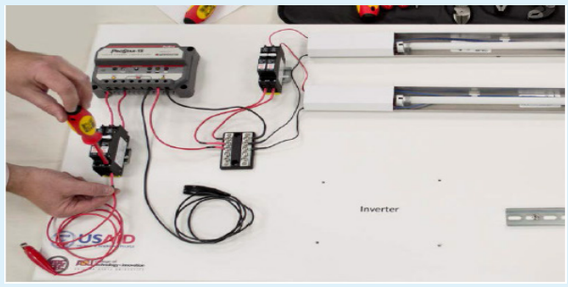
STEP 6



STEP 7

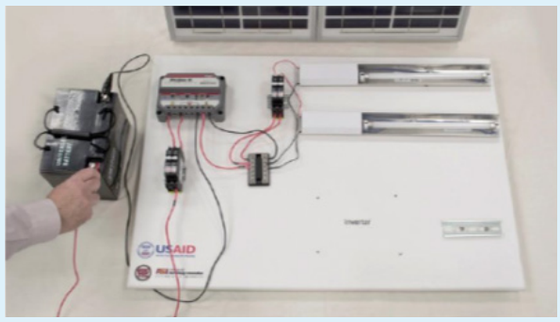


STEP 8

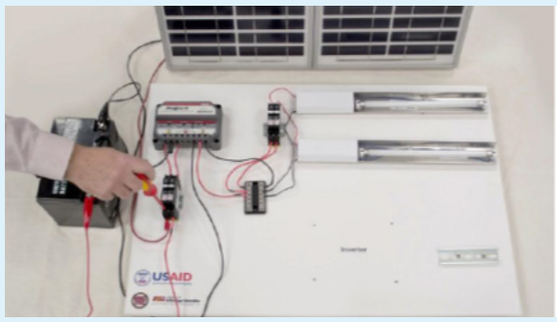


LONG NEKIS STEP YUMI KONEKTEM BATRI MO PANEL

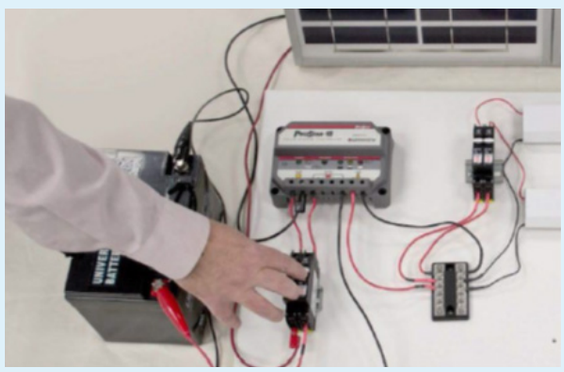
STEP 1



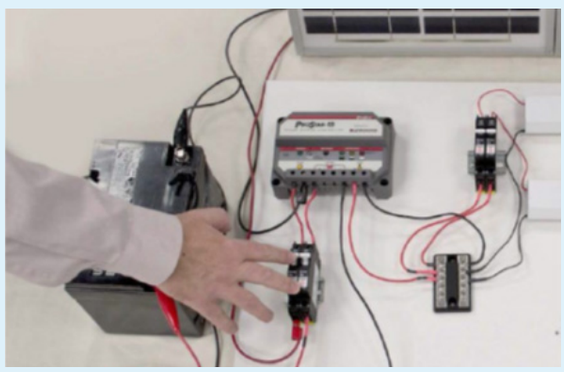
STEP 2

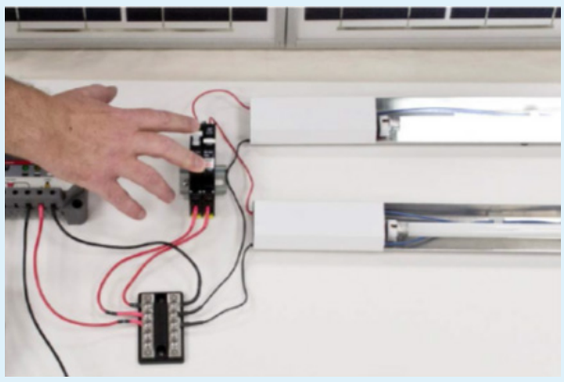
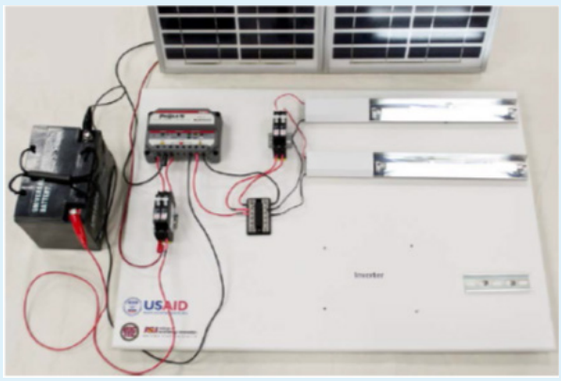


STEP 3



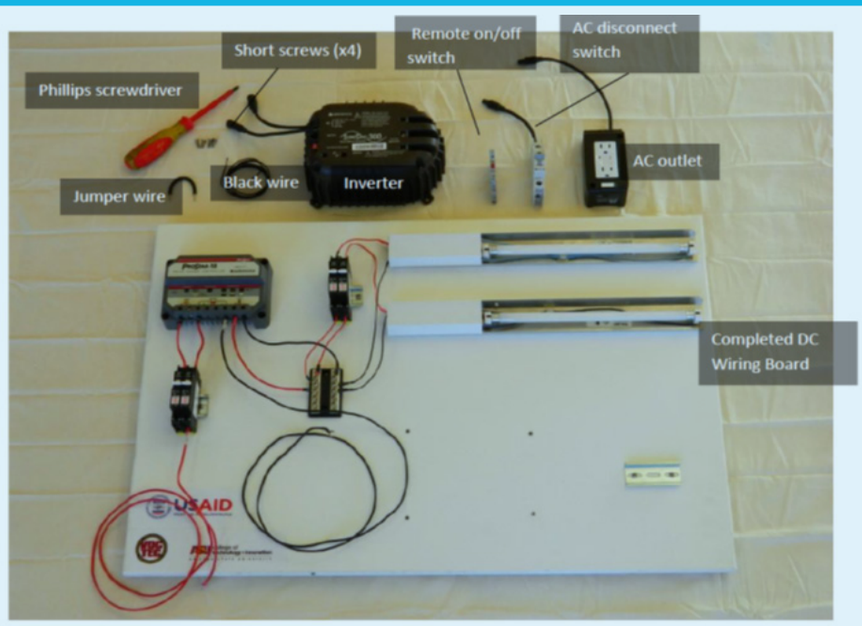
STEP 4



STEP 5	STEP 6
	

Naoia we yumi gat DC sistem finis yumi muv i go long AC sistem. Hemia sam moa komponent we bae yu midim.

NAOIA YUMI INSTOLEM INVETA



NAOIA YUMI INSTOLEM INVETA

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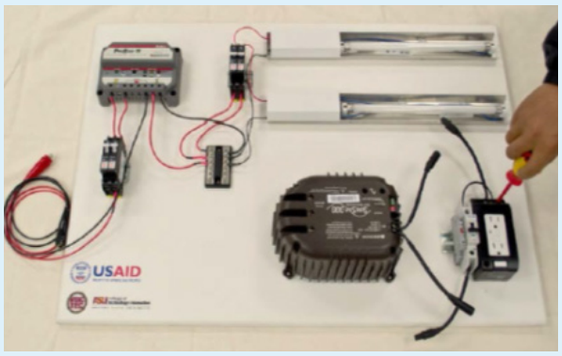
STEP 3



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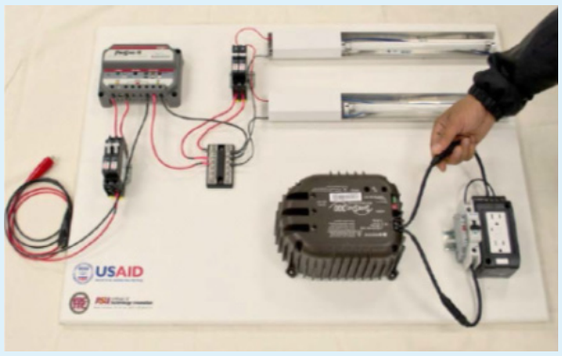

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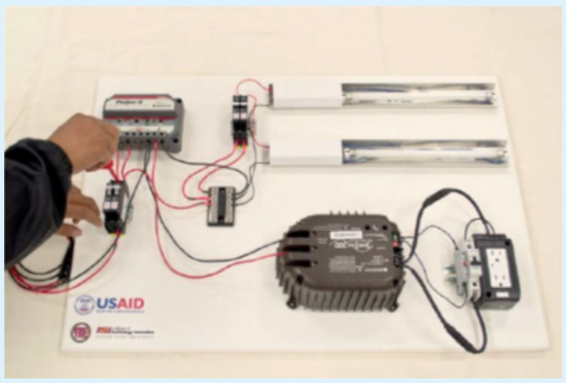

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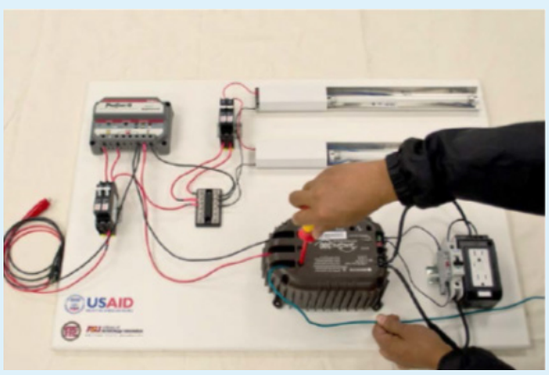

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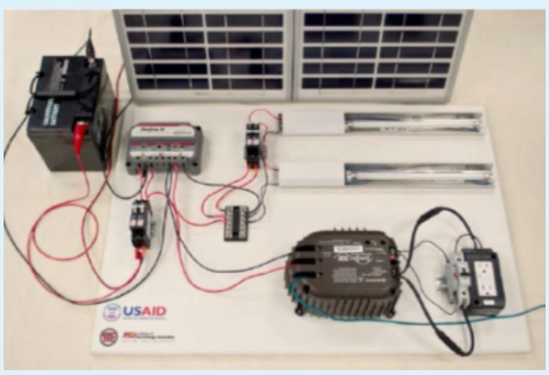

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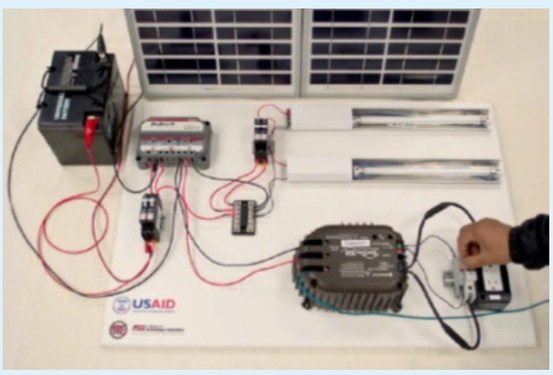

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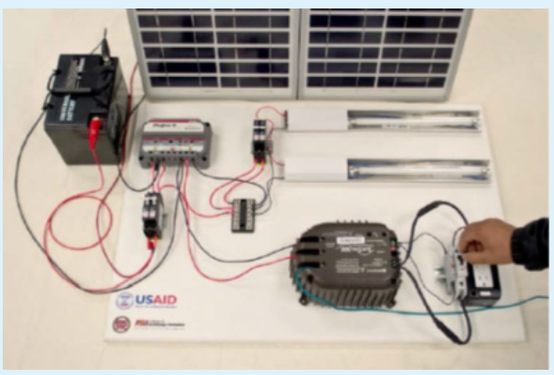
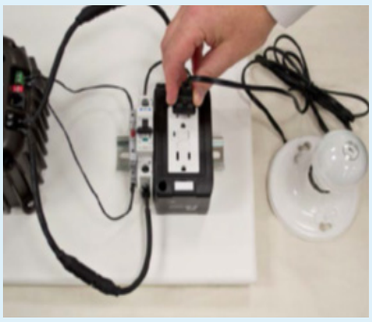


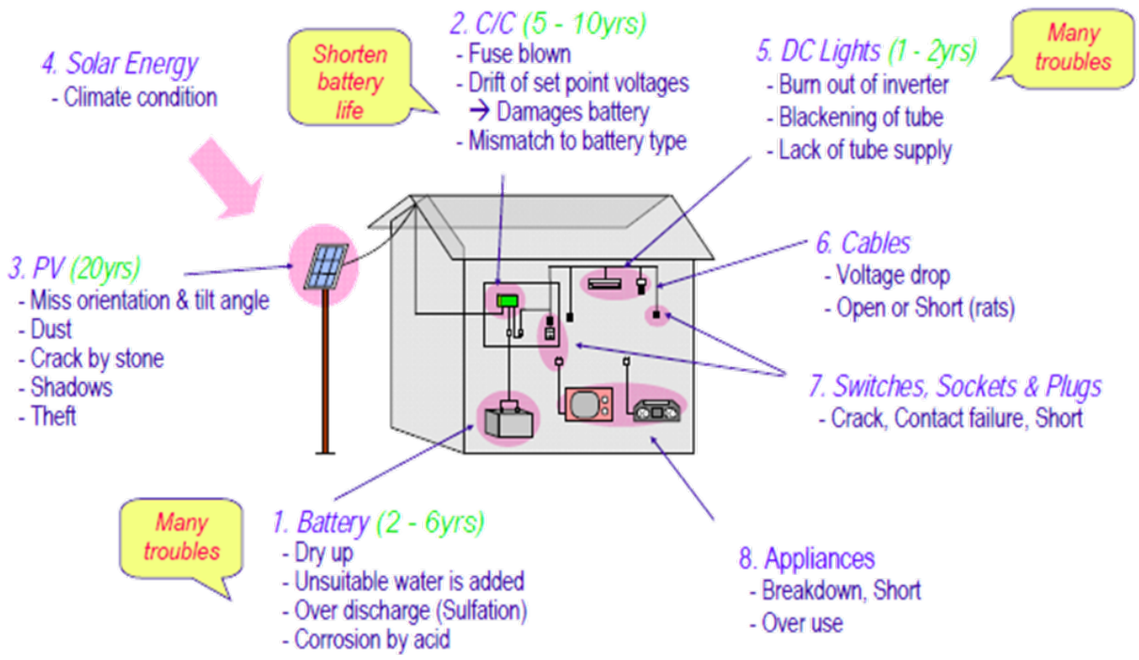
STEP 11	STEP 12	STEP 13
		

8

Aedentifaem mo risolvem ol komon fol long sola hom PV sistem

Fika daon i soem ol komon taeb blong ol fol we yumi save eksperiensem long sola hom sistem, mo ol fol, ol jek mo ol solusen blong sola komponent.

FIKA 73: **Ol Komon kopenent fol**[67]



8.1 Jaj Kontrola Fol

Long sola PV sistem, jaj kontrola hemi bren blong ful sistem, mo hemi fesfala ples we yu save lukluk from ol fol. Hemia samfala komon fol long ol jaj kontrola.

Fol 1: Jaj kontrola i no soem ful stet blong jaj long taem blong wan dei

Rison: Aksidensol Ovayus (klaod, ren, spesel TV program)

Remedi: Katemdaon yus blong lod blong haf dei o blong alaoem batri blong jaj gud

Fol 2: Jaj kontrola i katem aot lod mo ol laet

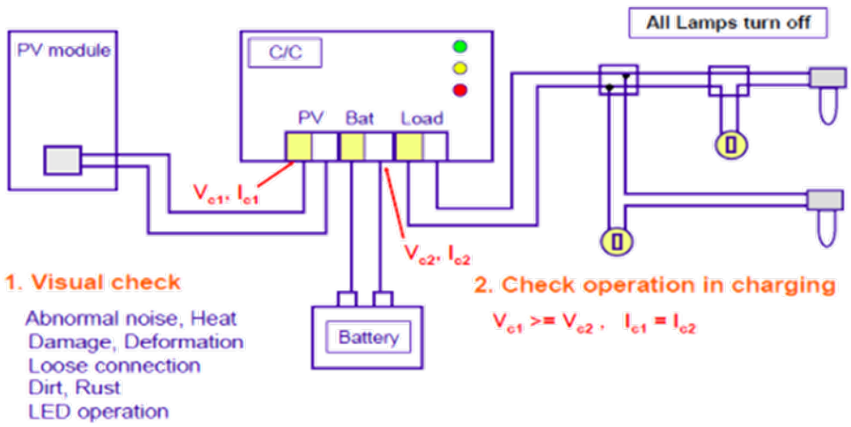
Rison: Yusum ova long evridei (batri hemi empti):

Remedi: Katem daon yus blong haf kasem C/C i soem ful stet (blong wan wik olsem) blong alaoem batri blong jaj gud.

Tufala samting we yumi mensonem oli tufala moa komon fol we bambae yu lukim long jaj kontrola.

67 Source: JICA

FIKA 74: **Faenem fol blong Kontrola**[68]



Fol 3: Nogat karent i flo i go long batri, o i siknol se batri i jaj fulwan nating we batri i jes stat blong jaj o gohed blong jaj taem i fulap.

Ol Rison: Fus i blo, lusum koneksen blong ol waea o malfansen blong intenol kontrola seket.

Remedi: Taetem ol lus koneksen, riplesen fus we i blo fiksim LVD mo HVD seting.

8.2 Sola Panel Fol

Yumi save faenem Sola panel fol espeseli taem i gat lus blong paoa o taem yu mekem mesamen. Displei blong sola panel voltej yumi save lukim long samfala jaj kontrola.

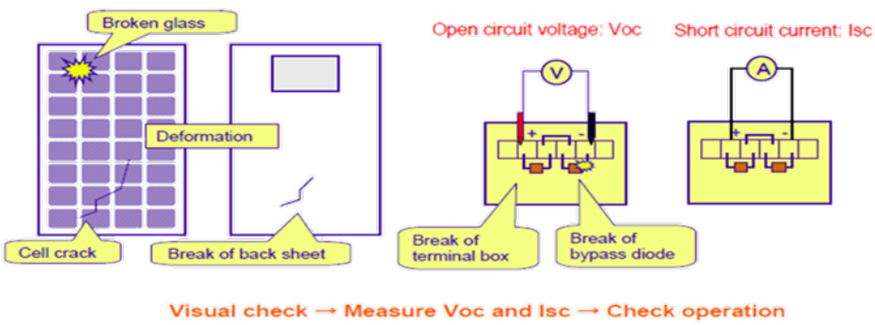
Fol 4: Lo o no paoa aotput long sola panel

Rison: Rong orientesen (rong tilt ankel mo/o daereksen), Akumulesen blong dast, krak long glas laminesen, Sado Ova long panel, pua sunlaet, tumas klaod, sot seket blong bypas diod, Lus o brok waea koneksen, Stilim ol panel.

Remedi:

1. Fiksim orientesen mo tiltelem ankol (tilt ankel bambae i no mas < 10o fesem not)
2. Jekem sipos i gat dast mo krak.
3. Klinim PV wetem wota, detejen sipos i gat nid.
4. Taetem lus koneksen long teminol bokis
5. Rimuvum ol blokej mo priventem sado long PV modul bitwin 9am – 3pm
6. Riplesem Bypas diode

FIKA 75: **Panel Fol**[69]



68 Source: JICA
69 Source: JICA

Narafala komon rison blong lusum paoa:

Delaminesen: hemi i taem we laminet materiel long top blong sola panel i kamaot. Delaminesen i save lid i go long elektrikol sok, mo lid i go long lus blong paoa.

FIKA 76: **Panel Sefes damej**[70]

Sistem i Braon: Hemia i taem we sunlaet mo kemikel riaksen blong panel lea i kosem blong jenisim kala i go yelo o braon. Braon i no save lid long elektrikol sok, be bambae i lid i go long oitic lus blong paoa.

Tugeta Braon mo Delaminesen yumi no save tritim isi oi save rikwae niu mo gudfala kwaliti panel long riplesem.

8.3 Batri Komon Fol

Fol 5: Batri hemi jaj isi mo i no save jaj gud long ol sel we ol voltej oli no maj o ikwel.

Ol Rison: Sulfasen, drae ap batri solusen, stratifikesen (taem elektrolaet long solusen i konsentret long botom), lusum teminol koneksen, hae batri tempereja o likej blong elektrik folem asid long sefes bitwin ol teminol blong batri.

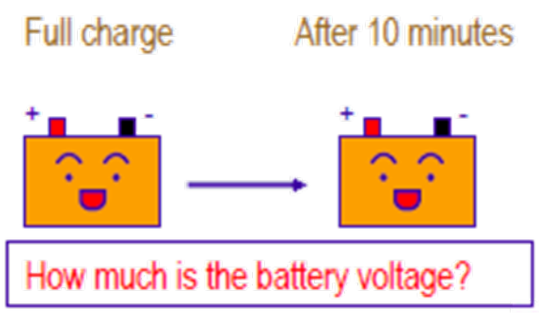
Remedi:

- Lusum koneksen long ol teminol
- Klinim ol teminol wetem stil bras mo aplaem gris (e.g., Vaselin o litium gris).
- Level blong batri elektrolet, top ap taem i stret.
- Yusum stret teminol lug/clamp nomo.
- Tekemaot corosen long ol teminol.
- Sekem batri smol (no > 10 digris long floa laen long saed) blong avoidem stratifikesen.
- Instolesen kondisen, riloketem sipos i nid blong mekem.

8.4 Jekem batri Amp paoa Kapasiti

Hemia samfala adisonal jek we yu save mekem long batri blong yu. Afta batri i jaj fulwan, yusum konsten lod blong pulum elektrik, diskonektem lod long LVD.

FIKA 77: **Batri Jaj**[71]



70 Source: University of the South Pacific & USAID/VOCTEC
71 Source: JICA

8.5 Jenerol Balans blong Ikwipmen Fol

Ol Fol

1. BOS (ol kebol, ol swij, ol laet, etc.).
2. Nogat laet nating we batri i ful jaj.
3. Anda-voltej long en blong lod.
4. Nogat paoa long en blong lod.

Ol Rison:

1. Open o sot seket o graonding.
2. Rong/andasaes kebol (bigfala voltej drop).
3. Bon-aot DC laet tub/inveta.
4. Lusum koneksen long ol teminol.
5. Hae resistens long swij kontak.

Remedi:

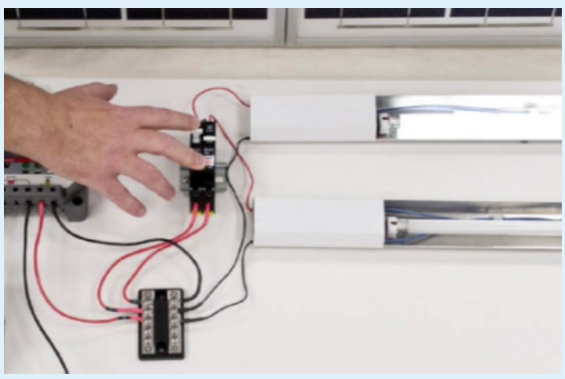
1. Jekem voltej level long los mo voltej drop.
2. Taetem lus koneksen long ol teminol.
3. Jekem saes blong kebol sipos i stret saes, riplesem sipos i nid blong mekem.
4. Gohed blong jekem ol kebol, taem i gat open seket, tresem laen mo konektem open seket.
5. Jekem mo fiksimap sot seket graonding long laen, re-insulet sot seket. Graon laen.
6. Jekem operesen blong swij mo voltej i drop bitwin input mo aotput.

Sam narafala fol mo remedi oli presentem daon.

AKTIVITI 13

Blong aktiviti ya wan folti waea bambae man i konektem bitwin ol batri mo jaj kontrola blong ol lena blong faenemaot mo korekt yus blong test we i kontinu.

Setemap DC Sola PV Sistem mo soem we i wok.



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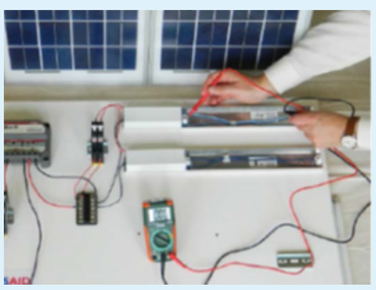

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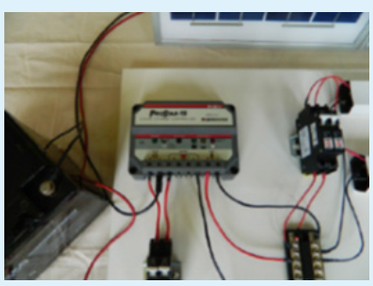

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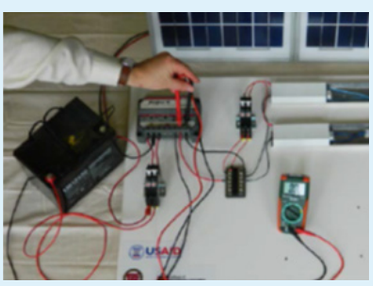

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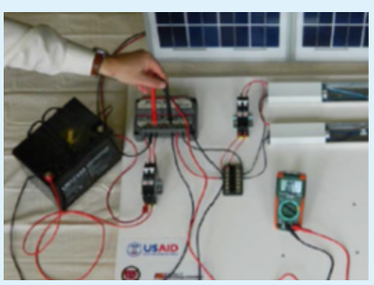

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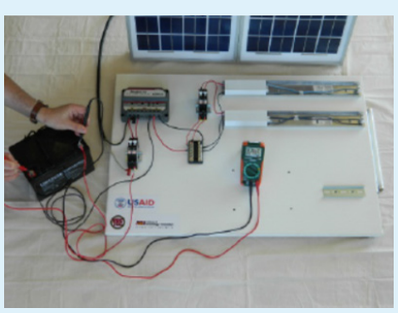

STEP 8

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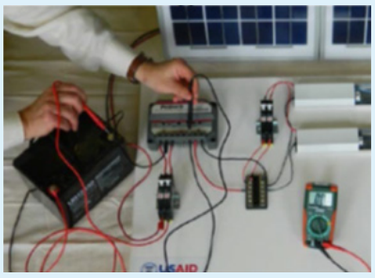
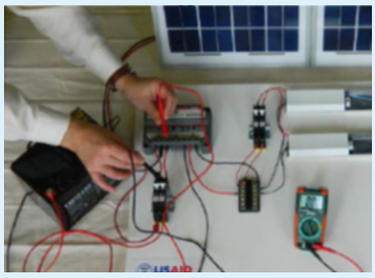
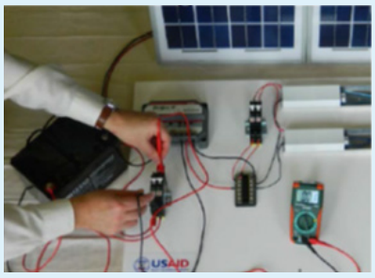
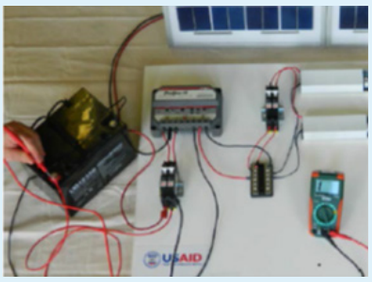
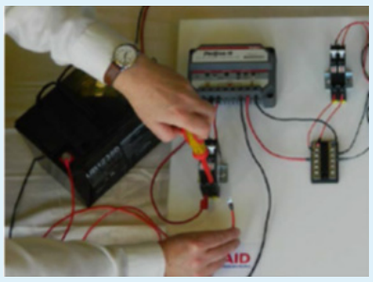
		
STEP 4	**STEP 5**	**STEP 6**
		

9

Sola PV
Mentenens jeklis

9.1 Planing Mentenens

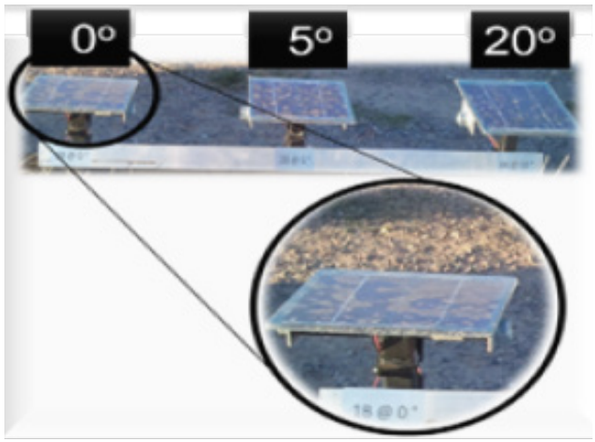
Rutin mentenens hemi nambawan wei blong inkrisim laed blong sola PV sistem blong yu mo ol komponent blong hem.

9.2 Sola Panel Mentenens

1. Inspektem PV array blong eni saen blong fisikol damej, olsem impak o frakja.
2. Sefes i mas kiln, nogat damej, klinim eni doti o rabis.

FIKA 78: Damej Panel[72]

FIKA 79: Ifek blong ol doti panel[73]



9.3 Batri Mentenens

Batri oli mo komon blong no wok gud sipos man i no lukaotem gud. Batri mentenens i involvem difdiren wok i dipen long taeb blong batri mo manufakjara rikwaemen, inkludum:

1. Inspekt mo klinim ol batri rack, kes trei mo teminesen.
2. Inspektem batri diskonekts, Ovakarent devaes mo raeting sistem.
3. Mesarem voltej.
4. Batri lod testing aplae hae disjaj ret tumas blong hamas sekon, taem i mesarem digris long batri voltej.
5. Batri kapasiti test i involvem disjaj blong batri long nominol disjaj ret long wan dept blong disjaj we oli agri long hem.
6. Riplesem pua batri long wan seris string. Pefomens blong wan seris string batri bank bambae i dominetem batri we i pefom pua.
7. Diskarejem Frikwen Ova-disjaj blong Sistem - Ovayus mo Ova-disjaj i katemdaon laef blong batri folem hae dept blong disjaj (DOD).
8. Mesarem spesifik graviti mo ademap wota (blong flad lid-asid batri nomo!).
9. Periodic batri mentenens mas inkludum ol jek blong ol teminol blong korosen mo taetemap gud.
10. Yusum wan stil bras blong klinim aotsaed long ol koneksen. Werem insulesen glov evri taem.

72 Jim Dunlop Solar
73 ASU PV/ Reliability Laboratory

FIKA 80: **Batri kea**[74]



SEFTY TIP: Yusum ol sefti gogol mo raba glov blong sevesem batri. Werem ol olfala klos from se yu save karem asid long olgeta (sipos i gat flad batri)

Kipim wan open bokis blong beking soda mo wan plastik pan blong wota klosap taem yu stap sevesem batri blong yu—lukaot bae i gat spil, yu save sakem beking soda long wota, stiarem, mo yusum miks ya blong netrolaesem eni asid we i spil

Lo voltej hemi no wan sok hasad, be hae karent. Wan twist drop akros long ol teminol i save bonem han blong yu kwiktaem mo i gat janis blong batri i eksplod. Yu mas lukaot!

9.4 Mesarem stet blong batri we i jaj

Stet blong jaj SoC hemi mesa blong helt blong batri potensol. I gat tufala we blong mesarem hemia– tru long wan open seket voltej blong mesarem spesifik graviti (SG) blong elektrolaet.

9.5 Voltej Metod

Batri spesifik graviti (flad batri taeb nomo) mo open-seket voltej oli mesarem long taem blong mentenens blong evaluetem batri helt mo estimetem stet blong jaj. Open-seket voltej i mas mesarem afta we batri i spel blong samfala aoa. Tebol daon i givim stet blong jaj:

FIKA 81: **Stet blong Jaj**[75]

State-of-Charge	Specific Gravity	Open-Circuit Voltage (V)
100%	1.265	12.6
75%	1.225	12.4
50%	1.190	12.2
25%	1.155	12.0
0	1.120	11.8

For typical lead-acid battery at 25°C

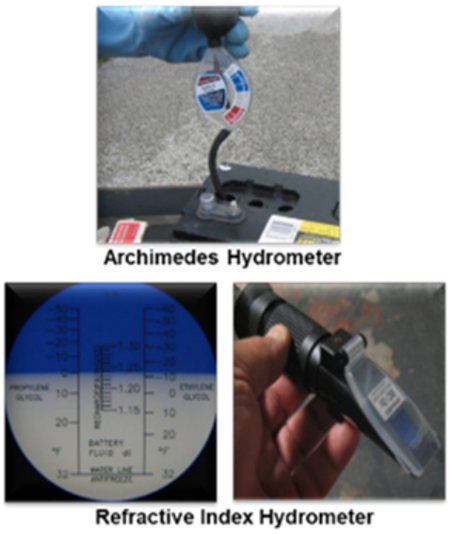
74 Source: ASU PV/ Reliability Laboratory

75 Source, Pinterest.com, https://www.pinterest.com/bambulancemania/work-apparal/

9.6 Haedromita metod (blong flad batri nomo)

Haedromita i mesarem elektrolaet spesifik graviti (SG) tru long ekstraktem elektrolaet long batri sel i go long jemba.

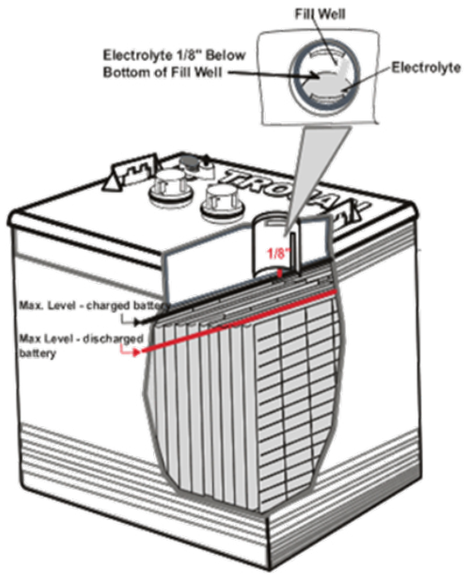
FIKA 82: **Haedromita yusej**[76]



9.7 Adem Distil Wota long Batri (flad batri nomo)

1. Open vent flad batri i lusum wota long elektrolaes mo gas long taem blong jaj.
2. Wota los i inkris wetem tempereja, jaj ret mo yia blong batri.
3. Yusum distil wota blong priventem kontaminesen blong batri mo yu no fulumap i ova.

FIKA 83: **Batri strakja**[77]



Yu save yusum batri mentenens jeklis we i stap daon blong karemaot evridei wok blong jekem batri.

Batri (maet hemi pat blong wan bakap sistem)	
Jekem elektrikol koneksen	Evri wik
Jekem Korosen mo kiln teminol	Evri wik
Jekem wota level mo topap blong lid asid batri	Evri wik
Mekemsua se batri i ful jaj long rikula besis	Evri wik
Riplesem batri bank	Evri 3-5 yia (lid-asid) mo 5-10 yia (sil gel) sipos oli mentenem gud
Manejem ol hasad materiel storej mo disposal risaekol spent batri, manejem elektrolaet spil blong lid asid batri	Olsem i nidim

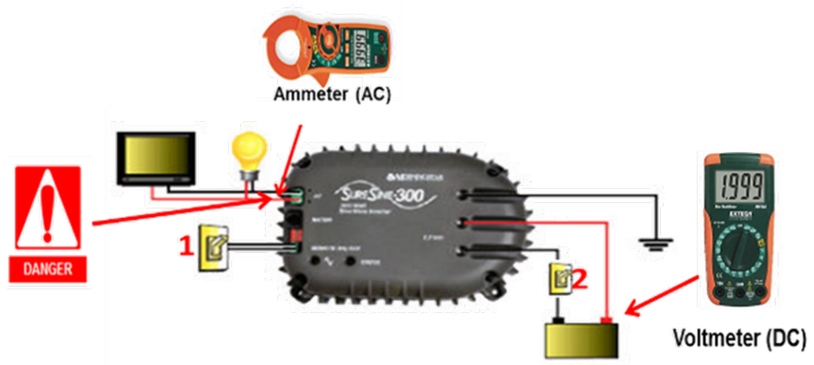
76 Source: Jim Dunlop Solar
77 Source: Jim Dunlop Solar

9.8 Inveta Mentenens

1. Pruvum sipos inveta hemi risivim DC voltej long batri yusum voltej mita set DC voltej mesamen.
2. Pruvum sipos inveta i produsum AC voltej long AC lod yusum voltej mita set blong AC voltej mesamen.

SEFTY TIP: Inveta i jeneretem denja hae AC voltej blong 220-240V. Werem elektrikol insulesen glov mo folem sefti prosija.

FIKA 84: **Inveta waearing**[78]



NO MAS rimuvum eni waea, mekem maonting long sikwens daon:

1. Tanem of evri diskonekt swij 1 mo 2 (lukim pija).
2. Yusum clamp-long amita (AC) long AC saed.
3. Konektem voltmita (INO amita) i go long ol batri teminol (tingbaot: Amita sot seket batri mo fus blo!).
4. Tanem on ol diskonekt swij 1 mo 2.
5. Obsevem sipos voltej mo karent oli flo long lod. Sipos yes, i minim se inveta i wok.

FIKA 85: **Jaj kontrola**[3]

9.9 Jaj kontrola Mentenens

Jaj kontrola oli ol robust mo ino mas givim plante trabol be sipos oli Ovalod nomo.

- Jekem ol lus koneksen.
- Jekem displei voltej mo jekem sipos i gat eni rong mesej.
- Jekem fus blong ino blo/bon.
- Jekem Maont blong kontrola.

9.10 Krietem mo yusum jeklis

Wan eksampol blong masta jeklis blong manis i stap daon, mo yu save ademap moa long hem o rimuvum samfala we oli no aplae.

78 Adapted from "Operations &Maintenance of Stand-Alone PV Systems, Arizona State University, VOCTEC, http://voctec.asu.edu

TEBOL 3: Jeklis

Jeklis aetem	OK	Comment
Jenerol Visualesen Inspeksen		
Inspektem ol PV modul blong ol fol we i save kamaot long fom blong ol bon mak, lusum kala, dilaminesen, o glas i brok.		
Jekem ol modul blong ol hip doti o sisit blong anamol.		
Mekemsua se modul waearing hemi sef mo ino silip long ruf, stap hang nomo mo i isi blong damej, ben i go long rediesen we ino apruvum, o slip antap long ol sap o raf sefes.		
Inspektem PV maonting sistem blong ol fol inkludum rosta, korosen, blong ol difekt inkludum rosta, korosen drop, ol klip mo ol bolt oli lus mo brok.		
Inspektem ol paep blong gudfala sapot, bus mo ol joen oli ekspan, wea i nidim blong mekem.		
Long ruf maon sistem, jekem integriti blong penetresen (taetemap wota).		
Long graon maont sistem, lukaotem ol saen blong korosen sipos i nidim spot.		
Jekem blong mekemsua se eni cabinet (sipos i avelebol) penetresen oli silim gud mo inogat wan saen wota i go insaed.		
Pefomem wan visuel inspeksen blong insaed mo aotsaed long inveta. Lukluk long eni saen blong wota, rodent, o dast intrusen i go long inveta.		
Inveta Jek		
Klinim eni filta.		
Klinim insaed blong kabinet.		
Testem eni fan blong gudfala operesen.		
Jekem ol fus.		
Konfemen se ol lebol oli stap long ples.		
Lukluk long lusum kala from bigfala hit i bildap.		
Gohed blong jekem sistem graon mo ikwipmen graon.		
Jekem mekanikol koneksen blong inveta blong wol o graon.		
Rikodem evri voltej mo karent riding from fran displei panel (sipos i avelebol).		
Jekem ampres/fasin blong klin blong kabinet, ventilesen sistem, mo insulet sefes.		
Jek from korosen/Ovahit long ol teminol mo kebol.		
Taetem ol konekta mo/o bolt sipos i nid blong mekem.		
Rikodem ambient weta kondisen, inkludum tempereja sipos dei hemi gat klaod o san.		
Jekem operesen blong evri sefti devaes (seket breka, sej aresta, etc.).		

Batri Jek		
Sipos batri oli flad taeb, jekem eni saen blong eni elektrolaet long sefti trei (sipos oli provaedem) o long floa, we i talemaot se i gat batri lik o ovafil.		
Jekem kondisen blong batri kontena.		
Jekem batri voltej level - rikodem voltej level.		
Jekem kondisen blong batri teminol – mekemsua inogat korosen, tekemaot sipos i gat.		
Jekem batri elektrolaet level (ino rikwae blong gel/ sil batri).		
Jekem sipso ino gat ol waea oli brok mo kot i kamaot long waea – ripotem eni waea we i brok.		
Mekemsua se evri koneksen oli taet mo kavremap gud.		
Jekem ol waea we oli stap hang.		

Ol Not:

AKTIVITI 14

Putum PPE blong yu mo karemaot ol rutin jek long sola sistem we yu jes setemap long last aktiviti. Yusum jeklis we i stap antap. Wok long ol grup mo karem help long trena blong yu.

Adisonal Rol Plei (opsonal)

Tufala bubu woman blong wan rurol vilej tufala i jes kambak long trening blong Sola O&M Besik mo stap gat konvesesen.

Tima: Mi hapi tumas we mi save atendem trening ya – Mi ting se long yia blong mi, mi nogat wan samting blong lanem – be mi rong.

Anna: Yes, mi filim semak – i gat plante blong lanem, mo mi sapraes long olsem wanem mi save folem trening espeseli wetem andastanding mo teknikol infomesen.

Tima: Maen hemi gud tumas – taem yumi openem ol maen blong yumi blong lanem wan niufala samting – nao yumi save mekem. Mi stap wokem talem long mi wan se mi save mekem mo ol pikinini blong mi mo ol bubu blong mi oli givhan plante long mi long toktok.

Anna: Mi save se mi no bin save olsem wanem blong mekem sipos i nogat sapot long famle blong mi – naoia yumi ol teknisian blong … hahaha.

Tima: Blong mekem yumi sua se yumi tingbaot evri samting; yumi mas mit wan taem long wan wik blong go tru long wanem we yumi lanem. Wanem nao tingting blong yu?

Anna: Yes, Mi agri. Nating we yumi gat kas paoa sistem long EFL plante hom long vilej yusum sola mo hemia nao ples we yumi save help.

Tima: Mo wetem bigfala amaon blong paoa we i aot ino longtaem, mi ting se plante moa famle bambae oli jusum sola sistem. Haebrid sistem ya bae i kam moa popula.

Anna: Yes, yu talem stret. Batri paoa sola sistem bambae i alaoem ol hom blong storem elektrik long taem blong dei from san mo yusum long naet blong givim paoa long ol haos mo ol aplaens.

Tima: Mi glad tumas we yumi save mekem hemia tugeta blong sapotem ol pikinini blong yumi, ol bubu blong yumi mo ful vilej mo tu sapotem envaeromen.

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