Modul 10 - **Wokbuk bilong Sumatin**

Piko-haidro Operesin na Mentenens Beisik

BILONG PAPUA NIUGINI

Halivim i kam long:

KOICA
Korea International Cooperation Agency

Wokbung wantaim:

PAPUA NEW GUINEA

Pacific Islands Development Forum

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"Piko – Haidro Operesen na Mentenens Beisiks" skul modul em bilong ol lain husait i laik skul long teknikol wok na ol i laik save moa long haidro instoleisen na mentenens.

Taim ol dispela lain bai pinisim dispela treinin, bai ol inap gat gutpela save long:

- Tok-klia long ol kaikain hap samting insait long Haidro Pawa Sistem
- Mekim lis bilong ol kain samting ol i yyusim long Haidro Pawa Sistem
- Kliarim ol samting insait long Haidro Pawa Sistem ol i save yyusim bai ol nidim
- Luk-save long ol tul ol i save wok long en long Haidro Pawa Sistem
- Tok-klia long rot ol i save joinim na mentenim Haidro Pawa Sistem
- Mekim lis long wanem samting bai ol i nidim long sefti bilong ol long wok insait long Haidro Pawa Sistem
- Luk-save na stretm ol bagarap i save kamap insait long Haidro Pawa Sistem
- Soim wanem wei bai ol i mas yyusim Haidro Pawa mentenens seklis

Lesen Plen

TEBOL 2: Lesen Plen na ol wok bilong wanwan sesen

Sapta	Wanem kain Lesen
1. Kirapim Tingting – Introdaksen	Skul Ting ting na Wok 1
2. Ol hap bilong Haidro Pawa Sistem	Skul tingting
	Wok 2 (Opsinal)
3. Ol hap samting bai ol nidim	Skul tingting
	Wok 3
	Wok 4 (Opsianl)
4. Luk luk lo ol kain kain Piko-Haidro Sistem i stap	Skul tingting
	Wok 5 (Opsanol)
5. Ol tul ol i save yyusim long Haidro tebain Sistem	Skul tingting
	Activity 6 (Optional) Wok 6 (Opsanol)
6. Instolim ol Haidro tebain sistem	Skul tingting
7. Ol Sefti samtingg ol i nidim long Haidro tebain Sistem	Skul tingting
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8. Luk-save na stretim ol bagarap i save kamap insait long Piko-haidro Sistem	Skul tingting
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9. Haidro tebain Mentenens seklis	Theory Skul tingting
	Wok 9 (Opsanol)

Dispela Wok-buk bilong Sumatin (Learners Workbook (LW) em bin kam long Gaid bilong Tisa (Trainers Guide (TG). Na dispela Wok-buk bilong Sumatin em i wan kain olsem Gaid bilong Tisa.

Ol lesen insait long LW ol i bin mekem kamap isi na tu ol putim het stori tasol, na mekim stronpela tok long daiagrem, ilastrasen na ol kain wok o aktiviti i save stap pas wantaim, na dispela em bai mekim ol sumatin istap pas wantaim tisa long taim bilong skul.

Sapos yu laikim sampela moa tok-save long wanpela hap seksen, plis go long buk TG.

Piksa bilong kava: Piko-Haidro tebain intenal waiarin. Em kam long: Powerspouts, New Zealand.

GLOSERI - Mining bilong ol Toktok i stap insait long dispela wokbuk

AC- Altenating karen em wanpela taip elektrisiti ol bikpela genereita i save kamapim bilong ol bikpela divais olsem TV o wasin masin.

Sas- Bilong konektim ol waia igo long bateri bilong mekim voltes bilong en igo antap. Olgeta taim ol i save konek igo long sola panel long sas.

Sas kontrola- Em samtingg i save kontrolim bateri taim i wok long sas na em tu i save stopim bateri long ova-sas tu.

Klamp mita- em samtingg ol yyusim long mesarim karen bilong pawa.

Karen- Em samting i save ron long waia long givim yyumi pawa wantaim voltes

DC- Dairek Karen em wanpela kain elektrisiti Sola Panel i save kamapim. DC pawa em i ken ronim lait na ol liklik masin

Damp loud- Dispela em loud o masin ol i save konektim bilong pinisim ekstra pawa i stap insait long haidro sistem

Elektrolait- Dispela samting em i luk olsem wara insait long bateri. Em luk olsem wara tasol, em igat bikela poisen.

Fobei- Em hanwara i stap antap long wara we yyumi save kisim wara long en.

Inveta- Em samting i save senisim dc elektrisiti i go long ac elektrisiti.

Loud- Dispela, em wanem samting i save kisim pawa long bateri o sola panel. Em ol kain samting olsem lait, fen o ais bokis. Olgeta samting ol i save yyusim pawa em ol i kolim loud.

Mauntin- Dispela em samting ol i yyusim long holim pas ol hap pats strong long ples bilong ol – kain olsem yyumi yyusim wanpela samting long hangamapim ol foto.

Wankain olsem yyumi save taitim panel gut long kapa antap long ruf wantaim maunten, na win em ino save karim i go.

Malti-Mita- Em samting bilong mesarim strong bilong voltes na ron bilong en. Noken traim long mesarim karen wantaim dispela.

Ova-sas- Sapos bateri i pulap na yu sasim yet- em bai wankain olsem baket i pulap tru long wara na

Em save kapsait wankain tasol dispela bateri em bai bagarap

Penstok- Em paip i save karim wara long hanwara igo long haidro tebain

Pawa- Em strong wanpela i save samting igivim long sampela taim

Sot seket- Em taim pawa em wok long igo tru long waia na wanpela loud olsem lait balb o fen ino bin konek long seket. Sot seket i ken bagarapim ol hap samting istap wantaim. Asua long mekim koneksen long bateri teminal i nap long sot seket na em i ken kamapim bikpela bagarap long yu na bai bagarapim bateri tu.

Teminol- Em hap we yyumi konektim waia. I gat skru i stap long teminol bai ol i mas taitim tru, sapos nogat waia bai slek.

Valf- Em wankain olsem tep bilong pasim o opim wara.

Voltes- Voltes insait long waia i pas wantaim karen bilong givim pawa

1

Introdaksen/ Kirupm Tingting

WOK 1

Mekim liklik tok-klia long yu yet long ol arapela sumatin. Tokim ol long nem bilong yu na yu bilong wanem hap.

Na tokim ol bai yu wokim wanem samting long dispela taim. Tok-klia olsem yu bin gat sampela save long haidro pawa bipo o nogat.

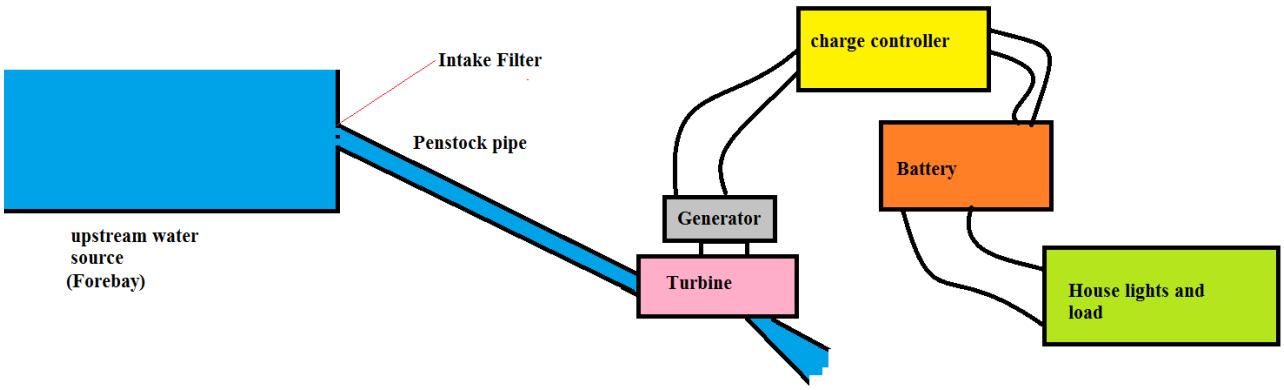
Na tokim ol tingting bilong yu long haidro pawa em wanem. Na tokim tisa wanem samting yu laik lainim long dispela kos.

2

Ol hap pat bilong Piko-Haidro Sistem

Piko- Haidro sistem em wanpela liklik samting bilong bikpela haidro dem tebain na long planti taim igat insait long en ol arapela ekuipmen i wankain olsem em. Dispela piksa daunbilo i soim ol wanwan hap ol i bung long kamapim haidro sistem.

PIKSA 1: Ol wanwan hap i stap insait long wanpela haidro sistem[1]



2.1 Weir – blokim wara mekim bai ron long mak ol i laikim long en

Dispela em ol man yet i wokim na em i go i nap long hapsait wara. Ol i mekim dispela bilong mekim wara bai stap long mak bilong en tasol long larim wara bai i ken ron yet i go tru long hap i save kam insait lo en.

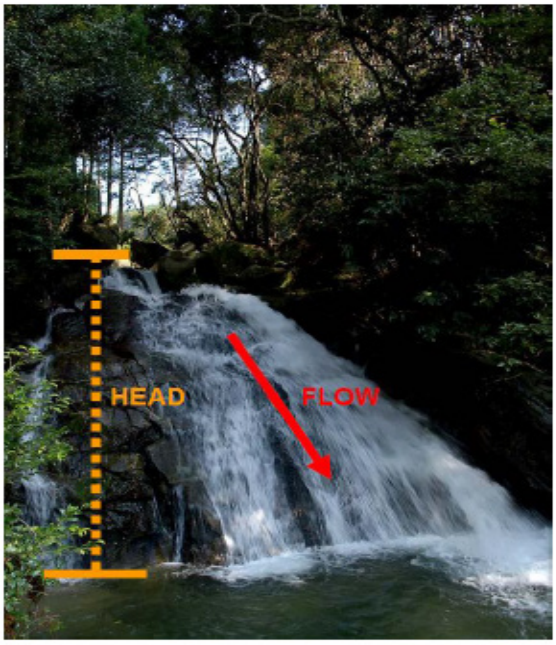
2.2 Inteik

Inteik bilong haidro pawa em ol mekim long stiarim liklik wara tasol bai I ron o bai bikpela wara tru bai ron, na dispela em bai dipen long ol sampela liklik lo ol i bin mekim long stiarim amas wara em bai mas ron. Ol mekim ain ba long banisim inteik na ol dispelaliklik ion ba i save rayusim hap pipia sampelasamtingwara i save karim I gen bagarapim tebain, kain olsem ol gras o hap diwai.

2.3 Fobei- Hanwara i stap long antap i save givim wara

Dispela em liklik hap wara i wok long ron (creek) o hanwara i stap long ples antap moa liklik long tebain i stap long en we wara bai ron kam daun strong tru. Tupela het na ron bilong wara em bikpela samting tru bilong kamapim elektrisiti. Het wara em i stap antap tru na em i save givim wara i kam daun long ples we tebain stap long en.

PIKSA 2: Het na wara kam daun long wara antap[2]



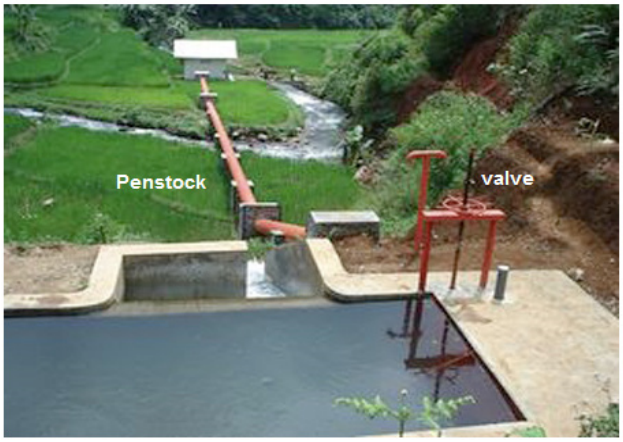
1 Source: GGGI, Fiji.

2 Source: DocPlayer, Manual for Renewable Energy Source, https://docplayer.net/45114164-Manual-per-burimet-e-energjive-te-rinovueshme.html, accessed 21 June 2021.

2.4 Penstok paip na ol valf

Planti ol penstock ol i bin fitim pilta long stat em bilong banisim ol nogut ston na pipia bai ol igo insat long tebain. Ol putim pilta klostu tru long tebain bilong wankain dispela as tasol.

PIKSA 3: Penstok na inlet valf[3]



PIKSA 4: A PVC paip penstock[4]

PIKSA 5: Fleng Bataflai valf[5]

PIKSA 6: Fleng geit valf[6]

Ol save mekim Fleng koneksen planti taim long stil o ain penstok. Em i save larim valf i konek tru long fleng olsem ol soim daunbilo.

2.5 Ol Valf na ol Pilta

Ol i no inap yusim wan kain valf tasol. Bai ol i ken yyusim narapelakain kain valf wanwan taim long kontrolim ron bilong wara.

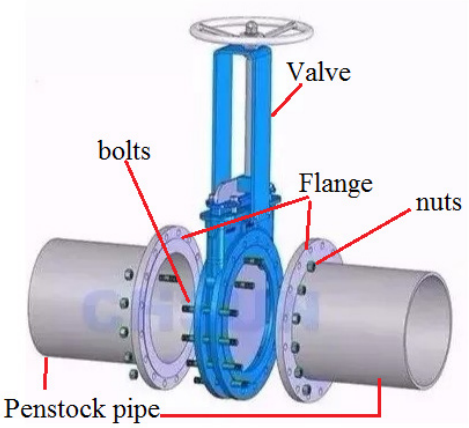
3 Source: Daily Frontier Post, adapted from Energy Central, "Micro Hydro Power Plant inaugurated", https://energycentral.com/sites/default/files/styles/article_body/public/ece/nodes/88088/micro-hydel_power_project.jpg?itok=Q57ENvjU

4 Source: Creative Commons, adapted from Energypedia, https://energypedia.info/wiki/File:Penstock_La_Laguna.JPG

5 Source: Eriks, "Butterfly Valve", https://eriksdigitalcdn.azureedge.net/shop/detail/hlr- system/econosto/sync/01_fotos/publicatie/6333n.jpg

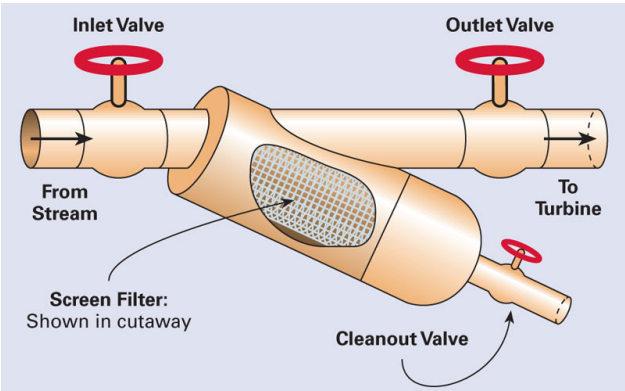
6 Source: Quora.com, https://www.quora.com/What-is-the-difference-between-an-actuated-valve-and-a-gate-valve, accessed 21 June 2021.

PIKSA 7: Fleng ol konektim long geit valf bilong Penstok flo[7]



Sampela penstok ol i gat "Y" taip paiping. Dispela bai larim ol i ken intsolim skrin pilta namel long inlet na autlet. Ol save putim ol klinaut valf long rayusim ol pipia na doti samtingg nogut baistrongpela fos bai mekim na olgeta bai i go daun long dispela paip olsem Piksa 8 i soim.

PIKSA 8: Y taip pilta i stap long penstok lukim kain valf igat[8]



2.6 Ol Tebain

Igat sampelakain kain wara tebain yyumi ken yyusim long makm Piko haidro instelesin, long mekim gutpela tebain em depen long het wara, sais long wara i ron, na i turu olsem ol lokol mentenens mas istap na tu ol mas bringim ikuipmen i kam long dispela ples.

2.6.1 Pelton Tebain

PIKSA 9: Pelton Tebain Rana[9]

PIKSA 10: Piko haidro Pelton tebain[10]

7 Source: Kknews, https://i2.kknews.cc/SIG=2vusqbk/ctp-vzntr/153590072663593s5rs4r3p.jpg, accessed 21 June 2021.

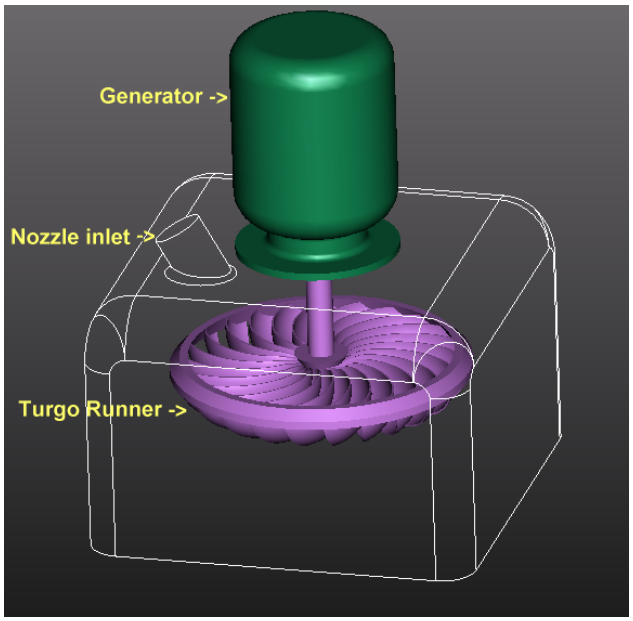
8 Source: Home power, www.homepower.com

9 Source: Techno-science.net, https://www.techno-science.net/illustration/Definition/220px/Pelton-400kW-roue-1.JPG, accessed 21 June 2021.

10 Source: PowerSpout, https://www.powerspout.com/, accessed 21 June 2021.

2.6.2 Tego Tebain

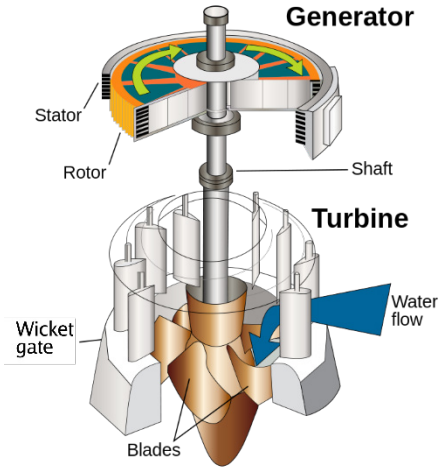
PIKSA 11: Tego Tebain[11]



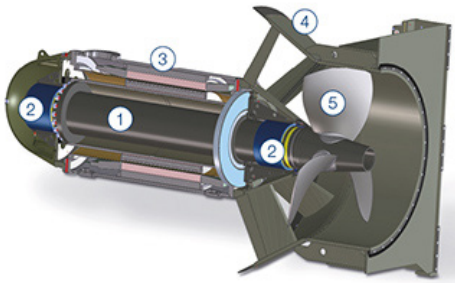
PIKSA 12: Wara paitim baket long engel insait long Tego tebain[12]

2.6.3 Keplen tebain

PIKSA 13: Vetikel eksis Keplen tebain wantaim genereita[13]



PIKSA 14: Balb taip VLH keplen tebain[14]



11 Source: Wikipedia, "Position of nozzle and generator in relation to Turgo blades", https://en.wikipedia.org/wiki/File:Turgo_turbine.png

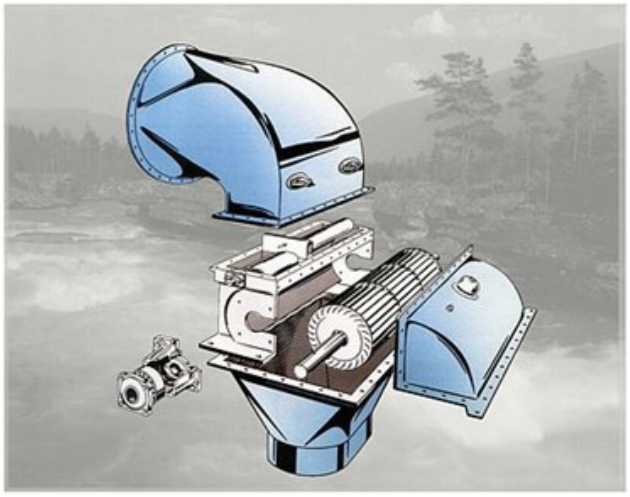
12 Source: SCRIBD, "Impact of jet impulse momentum principle", https://html.scribdassets.com/2k5s3iose83t52ii/images/1-453f23ae7b.jpg

13 Source: green-mechanic.com also adapted from Linquip.com, "Schematic of a Kaplan turbine and its components", https://www.linquip.com/blog/wp-content/uploads/2020/12/parts-of-Kaplan-1.png

14 Source: Voith, "Stream Diver design", https://commscockpitimf.voith.com/im/imf/100_35699/s,x,960/f,j/teaser.jpg

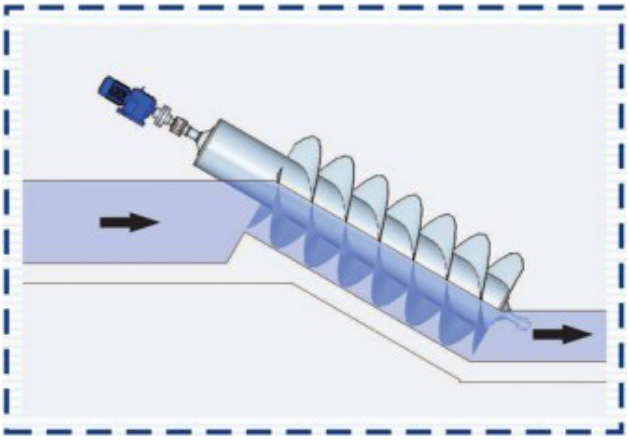
2.6.4 Krosflo Tebain

PIKSA 15: Kros flo o Benki tebain[15]



2.6.5 Skru Tebain

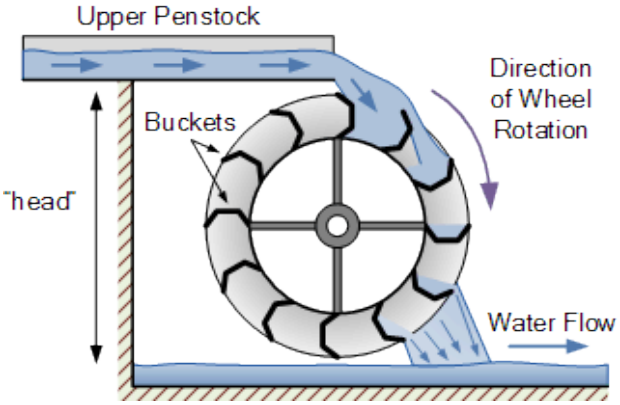
PIKSA 16: Skru taip tebain[16]



2.6.6 Wara Wil Tebain

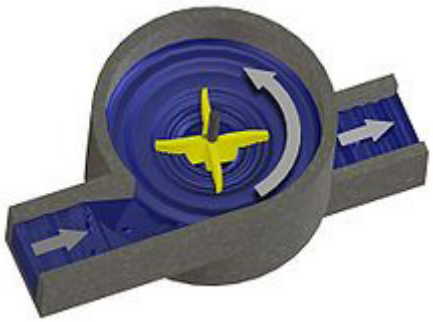
Wara wil em wanpela masin bilong senisim strong bilong wara i ron o senisim wara i pundaun igo long ol kain kain fom blo pawa ol man i ken yyusim, planti taim long waramil.

PIKSA 17: Ovasot wara wil Tebain[17]



2.6.7 Voteks Pawa Plent kamap long Stronpela Fos bilong Wara

PIKSA 18: Wanpela isi voteks tebain kamap long strong bilong wara[18]



2.6.8 Komon Piko Haidro Tebain

Ol liklik Pelton tebain ol i save yyusim planti taim bilong piko skel haidro pawa wantaim propela tebain na kros flo tebain. Na Tego tebain sampela taim.

15 Source: Wikimedia Commons, "Ossberger turbine" , https://upload.wikimedia.org/wikipedia/commons/5/54/Ossberger_turbine.jpg,accessed, 21 June 2021.

16 Source: www.freeflowhydro.co.uk

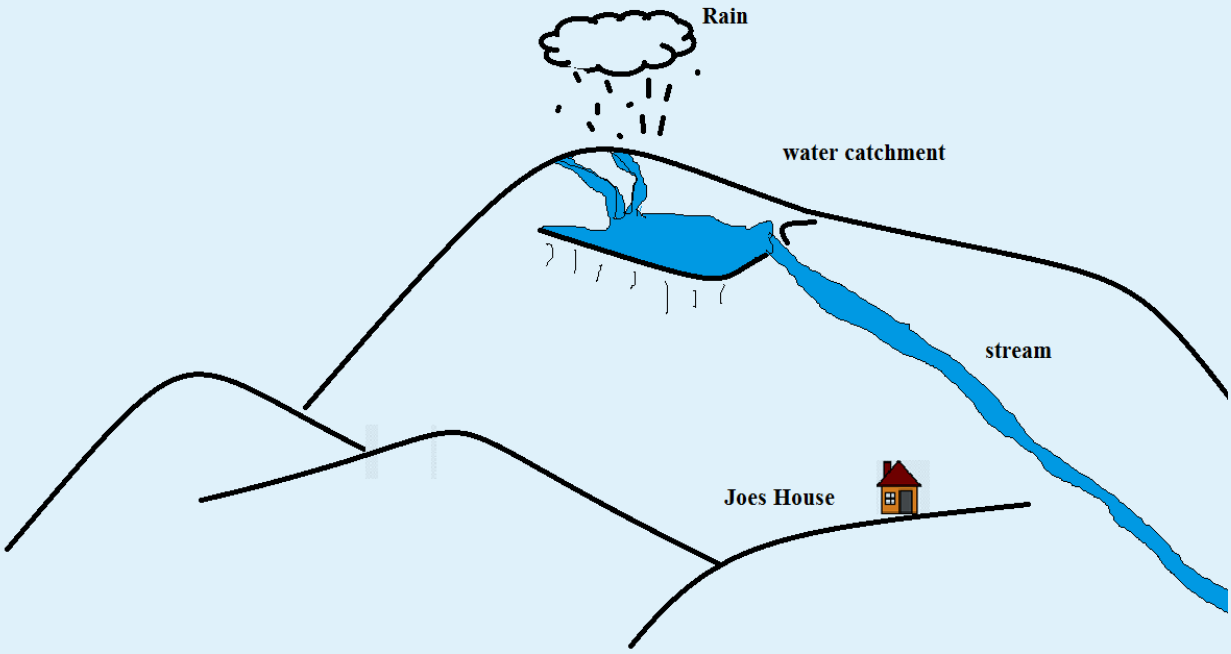
17 Source: Alternative Energy Tutorials, "The Overshot Waterwheel", https://www.alternative-energy-tutorials.com/images/stories/hydro/alt74.gif

18 Source: Wikimedia Commons, "Gravitation water vortex power plant", https://en.wikipedia.org/wiki/File:Wasserwirbelkraftwerk.jpg,accessed, 21 June 2021.

Hap bilong rait:

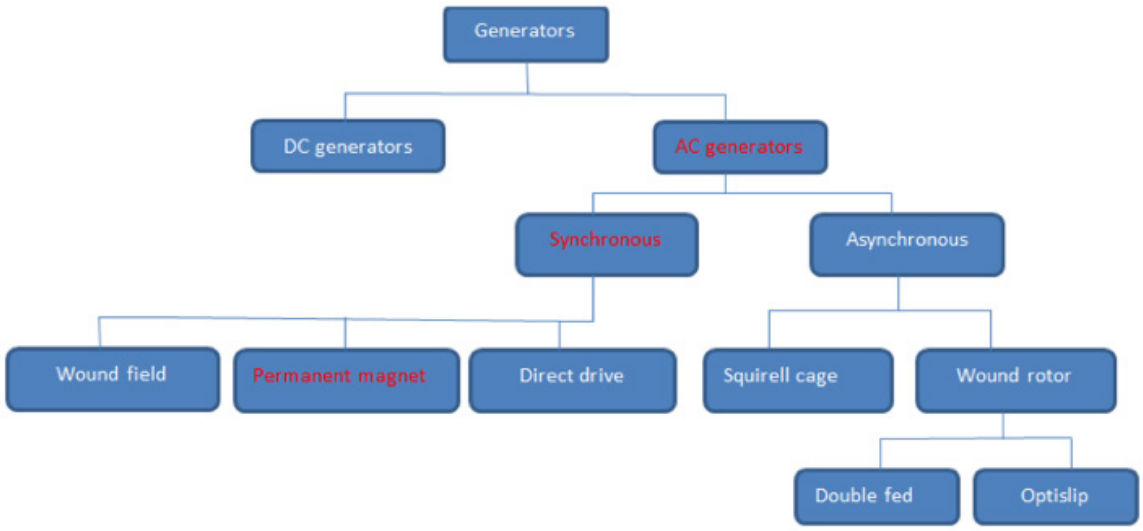
WOK 2

Tingim piksa bilong hanwara long ples antap long hap ples we ol i save kisim wara na haus bilong Joe. Insait long dispela piksa, yu mas droim bai ol i ken putim Piko haidro tebain olsem wanem we Joe bai ken yyusim. Fobei bai ol i putim long wanem hap stret? Penstok bai ol i putim we? Tebain bai stap long wanem hap? Wokim dispela wok long grup. Long dispela seim piksa soim amaspla het i stap pinis bilong tebain.



2.7 Genereita

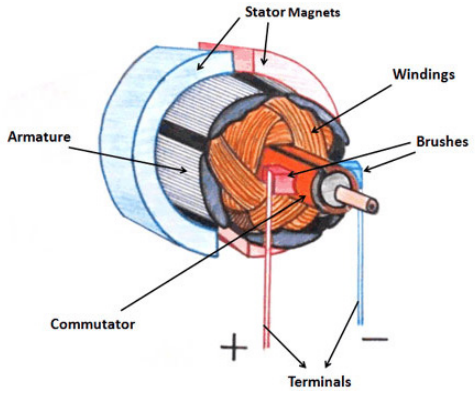
PIKSA 19: Ol kainkain AC Genereita ol i mekim klia moa Genereita[19]



Igat planti Pemenen megnet (PM) genereita ol i save yyusim long maikro haidro pawa aplikesin. Ol dispela genereita em isi long yyusim na em yet em self-eksaitet na igat AC na DC taip.

2.7.1 PM DC genereita (Sinkronus)

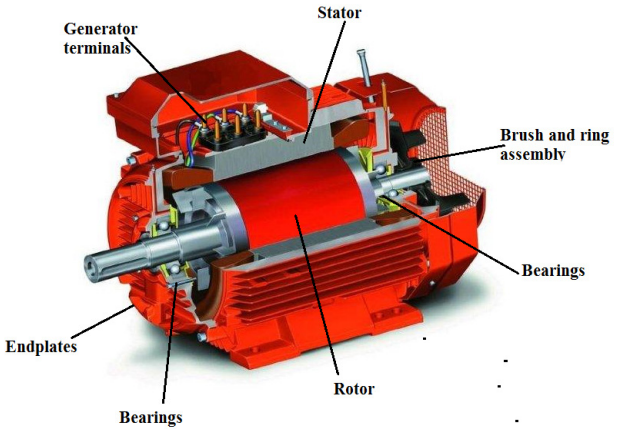
PIKISA 20: PM DC Genereita[20]



2.7.2 Indaksen Genereita

Indaksen genereita em wanpela kain altenetin karen (AC) elektrikol genereita i yyusim ol lo bilong mekim ol moto bilong kamapim elektrik pawa.

PIKSA 21: Ol pat bilong indaksen gerereita[21]



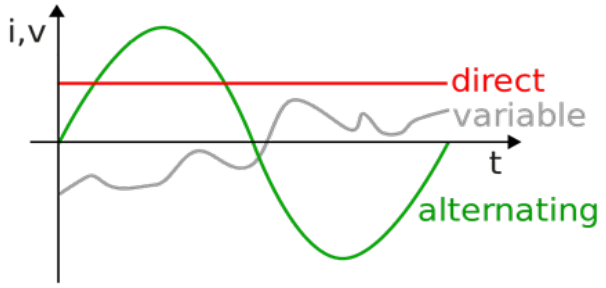
Dispela elektrisiti i save givim igo long grid em i altenetin karen (AC) elekrisiti. Dispela em sinusoidol weif olsem piksa daunbilo i soim.

19 Source: GGGI, Fiji.

20 Source: Linquip.com, "DC Motor Parts", June 2020, https://www.linquip.com/blog/wp-content/uploads/2020/06/DC-motor-parts-2.jpg

21 Source: ePowerMetals.com, "Gate Valve Rising Stem", https://www.epowermetals.com/wp-content/uploads/2019/09/OS-Y-Gate-Valve-Rising-Stem-1024x559.png

PIKSA 22: Dairek veriabol, na altenetin karen[22]



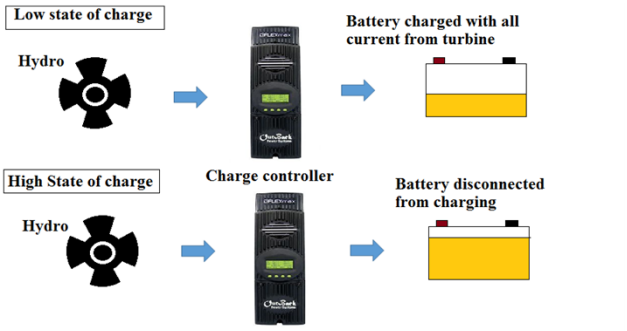
2.8 Sas Kontrola

Sas Kontrola i save daunim sais bilong strong long we elektrik karen i go long en o i save kisim long elektrik bateri. Em i save mekim olsem samting i noken ovasas na banisim samting bai i noken ovavoltes. Piko Haidro sas kontrola i save wok daunbilo long ol stronpela karen tru. Em i winim sola sas kontrola.

PIKSA 23: Haidro-Pawa Sas Kontrola[23]

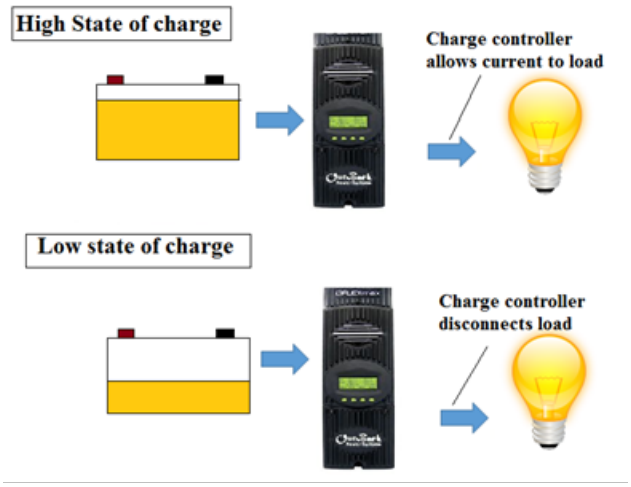
- **Ova-sas proteksen**
  - Taim batri voltes em i save go daun, dispela sas kontrola bai i mekim Haidro tebain stap konek yet long bateri bilong sasim em.
  - Taim bateri voltes i stap strong yet, sas kontrola bai em yet diskonektim Haidro tebain long bateri bilong pasim em bai i noken sas moa.

PIKSA 24: Banis lo ova-sas[24]



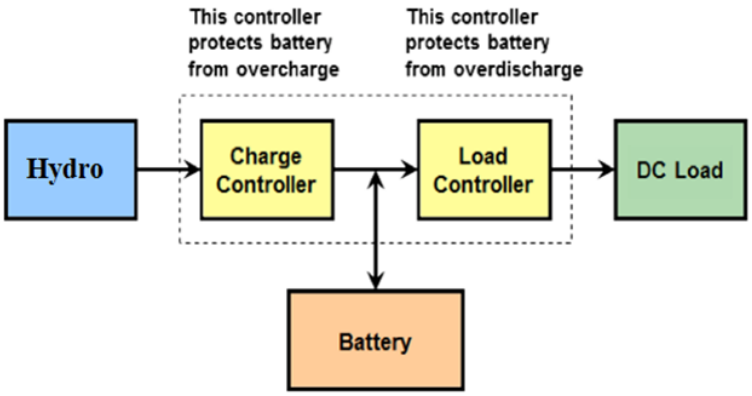
- **Banis lo ova-dis sas**
  - Taim bateri voltes i stap strong yet, sas kontrola em yet bai konektim loud igo long bateri
  - Taim bateri voltes igo daun, sas kontrola em yet bai diskonektim loud long bateri
- Dispela ol setin bilong ron bilong pawa em i gutpela na yu mas mekim

PIKSA 25: Lukaut bilong ova dis-sas[25]



22 Source: PNGWing.com, "Alternating current Direct current Electric current Electricity Electric power", https://www.pngwing.com/en/free-png-czyuz
23 Source: Amazon.ca, "Charge Controller", https://www.amazon.ca/OutBack-Power-FM60-150VDC-FLEXMax-Controller/dp/B00IVC7BYC
24 Source: JICA
25 Source: JICA

PIKSA 26: Rekomended Konfigareisen[26]

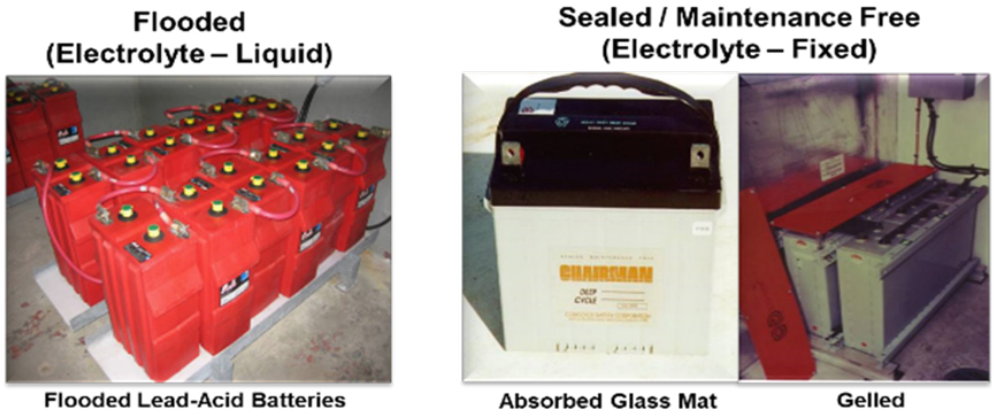


2.9 Bateri

Bateri em samting i save bungim na holim elektrikol eneji insait long samtingfom ol i kolim kemikol eneji na senisim dispela eneji igo long elekrisiti o pawa. Ol i save mesarim sais na strong bilong bateri insait long Amps Aua.

PIKSA 27: Bateri ol Pasim tru long antap[27]

PIKSA 28: Ol narapela kain bateri[28]



- Ol Bateri bilong ol masin sa muv olsem kar dispela ol i no givim tok orait long yyusim long haidro. Ol dispela ol bateri ol I usm lo hairdo m ol i wokim bilong givim bikpela karen tru insait long liklik taim tasol.
- Ol bateri bilong haidro na sola ino wankain. Ol wokim ol we bai ol inap long givim liklik karen igo yet long longpla taim tru.
- Ol bateri ol i silim long en ol igat bikpela voltes i nap long 14.1 V, ol bateri wara karamapim (flooded) ol bai ol inap long sasim igo inap long 14.4 V.
- Bateri Kapasiti bilong Bateri
  - Kapasiti em mak bilong elektrik i stap long bateri ol sasim o strong bilong bateri igat na bai givim igo aut long ol spesifaid kondisen

26 Photovoltaic Systems, Dunlop 2nd Ed.

27 Source: JICA

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

- Ampea-aua (AH) em yunit mesamen bilong bateri eneji storis kapasiti.
- Kapasiti em dipen long tepereitsa bilong bateri, reit bilong tempereitsa na kat-of voltes

- Namel long olgeta komponen insait long DC o AC loud, bateri em igat bikpela pundaun tru

2.9.1 Bateri Wara i karamapim

Dispela em tredisinol enjin stat, ol trakta na dip (deep) saikol-stail bateri. Wara elektrolait em fri lo muv insait long sel kompatmen.

2.9.2 Bateri ol i bin silim

Dispela tok i ken toktok long sampela ol arapela kain konstraksen, em i ken toktok tu long liklik senis tasol ol i bin mekim long fladet batri.

Long dispela as, man i yyusim dispela bateri em i no inap eksesim sel kompatmen, intenel straksa em stap wankain tasol olsem bateri wara i karamapim olgeta.

2.9.3 AGM Bateri

Absob Glas Mat konstraksen larim elektrolait bai i mas pas o saspend klostu long ol plets laif metiriel. Long skul tingting dispela em bai givim moa strong long dis-sas na ri-sas.

Popula yus em save i go wantaim stronpela pefomens enjin stat, pawa spot, dip sikol, haidro na storis bateri.

2.9.4 GEL Bateri

Gel sel bateri em wankain olsem AGM bateri stail as bilong en em olsem bai ol i saspenim elektrolait, tasol em narapela kain bilong wanem teknikoli ol save tok olsem AGM bateri em i wet sel.

2.10 Kebol o pawa rop

PIKSA 29: Kebol o pawa rop[29]

Ol save yyusim Elektrikol keibol long konektim tupela o moa masin, bilong trensferim elektrikol signol o pawa long wanpela masin igo long narapela masin.

2.11 Seket Breka/Aisoleita

Wok bilong seket breika em bilong bagarapim karen flo bihain long ol i painim aut asua. Aisolata i stap long ples klia, em larim aisoleisen bilong input na autput bilong wanpela masin.

PIKSA 30: Seket Breika na Aisolata[30]

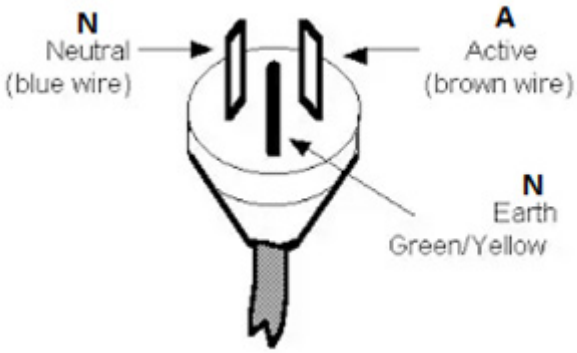
2.12 Swits na Pawa Soket

Swits aisoletim elektrisiti na pawa soket ol yyusim long konek/diskonek elektrik pot. elektrik ketel, elektrik pen e.tc.

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

30 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

PIKSA 31: Swits na Pawa Soket [31]



2.13 Inveta

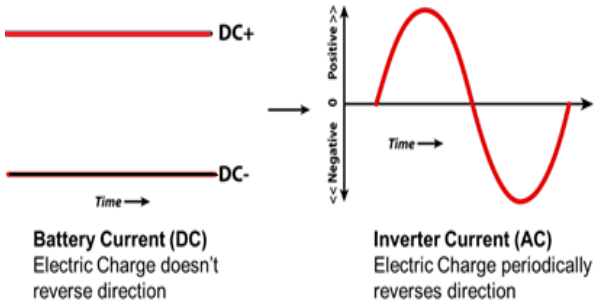
Inveta em wanpela elektronik masin i save senisim dairek karen (DC) igo long altenetin karen (AC).

Igat kainkain taip inveta bilong kainkain wok bilong ol yet. Kisim inveta long laik bilong sten-alon sistem em i stap beis bilong ol dispela samting tasol:

- Bateri input volteis (12, 24 or 48 V)
- Ac autput volteis (120 o 48)
- Strong AC pawa em i save laikim kumuletiv loud (insait long wats)
- Sez Karen (e.g., moto) save kaikim, sapos igat (insait amps)

PIKSA 32: Inveta[32]

PIKSA 33: Wok bilong Inveta[33]



2.14 Divesin loud o Dump loud

Wanem samting i save kamap long ol ekses eneji? YuYumi i no inap lyusim ekses pawa ol i kamapim tasol.

Planti taim bai ol i yyusim daivesen loud long daunim olgeta ekses pawa na bagarap i nonap kamap. Ol i save kolim dispela em resista o damp loud.

PIKSA 34: Damp loud o daivesen loud insait long fom o resista[34]

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

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

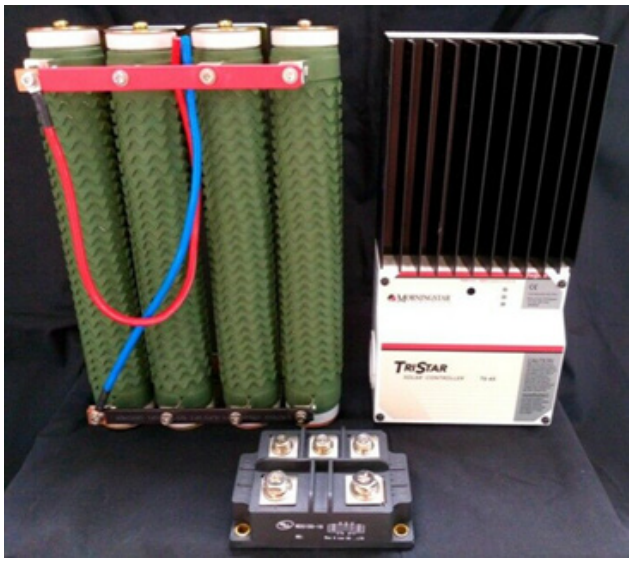
33 Adapted from System Components: Charge Controllers &Inverters, Arizona State University (VOCTEC), http://voctec.asu.edu

34 Source: Michigan Wind and Solar, "Diversion Dump Load Resistor", http://badasstreestands.com/uploads/3/4/2/3/34230874/1320806591.jpg

PIKSA 35: Damp loud wantaim kulin[35]

Ol i ken i nap yyusim dispela daivesin loud em i save daunim elektrisiti wantaim bateri tu long DC sistem taim bateri em i no inap daunim ekses eneji moa.

PIKSA 36: Sampela sas kontrola ol save kam em ol redi bilt na kam wantaim damp loud na skeet[36]



2.15 Elektronik Loud Kontrola

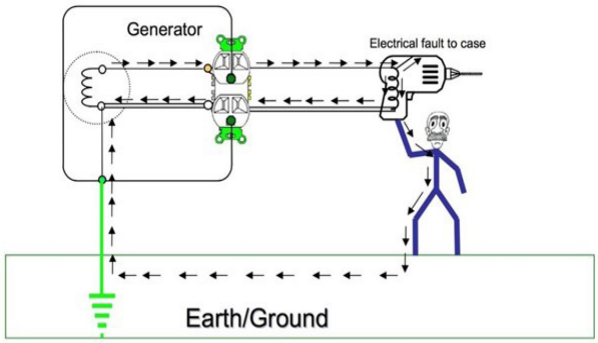
Elektronik Loud Kontrola em samting ol i save yyusim long stretim voltes na frikuensi. Taim mak bilong loud ol kam daun, dispela ELC save stiarim pawa igo long damp loud (lukm het tok antap) na mekim voltes istap wankain.

PIKSA 37: Kain haidro Elektronik Loud Kontrol yunit[37]

2.16 Ples graun na ol hap samting bilong Graundin

Em bikpela samting long bihainim gut tru graundin sistem na konektim ol haidro sistem long graun. Dispela em bai banisim yu bai yu ino ken asua na kisim sok na idai (long taim long sez na laitning.

PIKSA 38: Hau long graun[38]



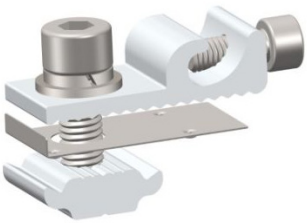
35 Source: Green Energy Star, "Dump Load Interior", http://greenergystar.com/products/wind/dumploadopen%5Bgs%5D.jpg

36 Source: PicClick UK, https://picclick.co.uk/Micro-hydro-turbine-26-kw-with-a-Dump-load-154173045313.html

37 Source: Dhava Mani Technologies, https://1.bp.blogspot.com/-xzLAukzxFa0/V5yP24mX13I/AAAAAAAAAQA/-JbVKYtTl3kHFxXi04uWK8cV7seCBIIEACKgB/s1600/2dumpe-ditmetal.png

38 Source: Portable Power Zone, "The Grounding Process", https://portablepowerzone.com/portable-grounding-generator-steps/

PIKSA 39: Ol samting bilong mekim Graundin[39]



Hap bilong rait:

39 Source: Watch YouTube video, "Earth (electricity) Wikipedia Audio article", Wikipedia tts, 15 June 2019, https://www.youtube.com/watch?v=S10S9cox8vI and

3

SamtingOl Komponen Requiremen

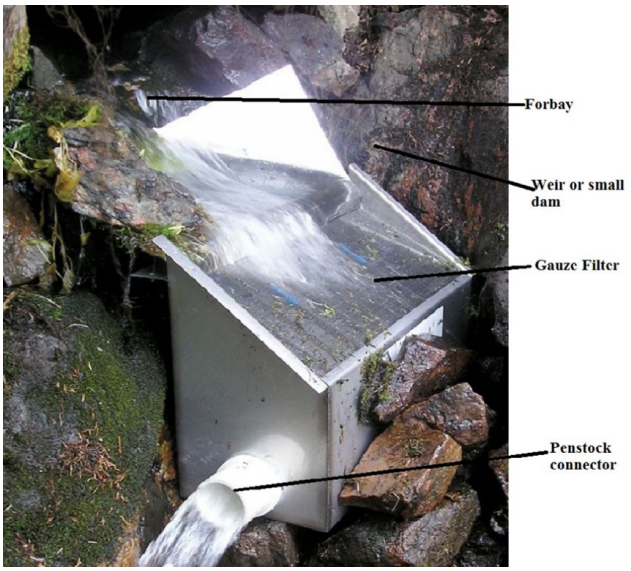
3.1 Fobei Hanwara Ikam Insait

Fobei o hap bilong wara long kam insait em i nidim liklik raun wara ol pasim long ston bilong mekim liklik wara tasol bai i ken go daun long penstok.

Ol narapela samting ol i nidim:

- Yu mas save tru olsem het (vetikal hait long ples tebain stap long en igo antap long wara bilong hanwara antap we wara save kam daun lo en) em dispela seim wan or narapela moa istap nau long tebain ol i tok aut lo en.
- Sekim na save olsem ol slop i stap orait bilong sedimen fobei sek dam.
- Sekim na save olsem em bai isi long go insait long dispela ples

PIKSA 40: Fobei autlet konekta wantaim filta na penstok konekta[40]



3.2 Penstok

Sekim olsem Penstok o ol paip bilong wara i mas PVC presa paip.

PIKSA 41: Presa paip bilong ol kainkain het[41]

Pressure class	PN	Bar	Metres head	MPa	kPa	Psi
A	3	3	30	0.3	300	45
B	6	6	60	0.6	600	90
C	9	9	90	0.9	900	135
D	12	12	120	1.2	1,200	180
E	15	15	150	1.5	1,500	225
F	18	18	180	1.8	1,800	270
No Class defined	10	10	100	1	1,000	150
No Class defined	16	16	160	1.6	1,600	240
No Class defined	20	20	200	2	2,000	300
No Class defined	25	25	250	2.5	2,500	375

40 Source: Pinterest, "Micro hydro intake", https://www.pinterest.com/pin/563020390916765709/

41 Source: Quora.com, "What do PN and PE stand for in a PN6 HDPE pipe", https://www.quora.com/What-do-PN-and-PE-stand-for-in-a-PN6-HDPE-HDPE-pipe

3.3 Tebain na genereita

Long Piko-haidro sistem, ol i save laikim ol tebain het wara i lou i save wok long lou flou-ret. Ol het wara i lou em min olsem bai ol i ken ron wantaim liklik sais wara. Ol i makim olsem mak bilong Lou het em 20m o dambilong. Sampela tebain o balb tebain ol i ken putim stret insai long wara bilong yusim swif karen insait long wara.

3.4 Sas Kontrola

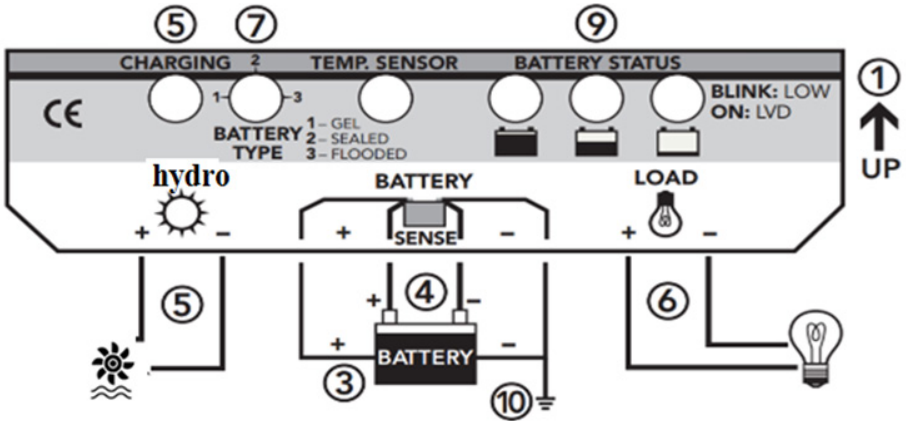
Ol sas kontrola ol i save yyusim long haidro pawa sistem em i save wok wantaim ol bikpela karen tru winim ol sola sas kontrola. Yu mas TAMBU TRU long yyusim ol odinari sola kontrola long Piko-Haidro sistem.

Tupela sola sas kontrola na haidro sas kontrola ol klostru wan kain tasol tupela i save wok wantaim diferen kain sias bilong karen. Bikpela sas kontrola i save inap long wok long karen igo inap long 50A ol i save yyusim long haidro.

Sas kontrola i mas:

- gat inap strong long karen bilong sasim (pawa long haidro tebain) na bilong wok long loud (loud karen).
- Inap long holim haidro voltes ikam insait na bateri voltes
- Emas igat bikpela DC pawa ol nidim bilong mekim moa loud
- igat laik long wok wantaim ol narapela kain bateri (wara i bin karamapim o led-asid bateri ol i bin silim pinis)
- i mas wok gut tru long en – ol kontrola em i no hatpela lo en ol i save wok gut tru ino olsem ol hatpela kontrola (lyusim ol hatpela kontrola igat sampela moa "lukluk"wankain olsem LCG skrin, maikro-prosesa progrem kontrol na moa.

PIKSA 42: Bikpela na isi wei bilong lukim wanpela Saskontrola[42]



42 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

3.5 Bateri

Ol bateri ol i save storim pawa tasol na INO save mekim kamap pawa

- **Yunit sel em 2V**
  - 2V em minim nomal voltes. Strong bilong voltes i save igo inap long mak 1.8SV na igo 2.40v
  - 12V bateri igat 6-yunit sel istap long siris ol i konektim
  - 6V batri igat 3-yunit sel istap long siris ol i konektim

Mak bilong bagarap bilong bateri igo antap tru long haidropawa sistem

PIKSA 43: Pawa na wok bilong Bateri[4344]

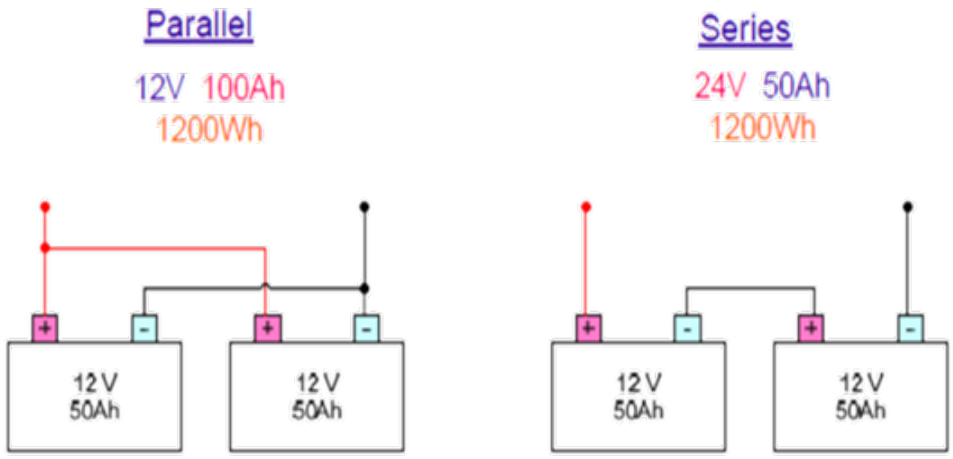
SPECIFICATIONS

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%

PIKSA 44: Kain Bateri Koneksen[44]



3.5.1 Sampela bikpela ki toktok

- Paralel koneksen bungim kapasiti (AH).
- Siris koneksen save bungim voltes (V)
- Olgeta eneji i bung ol i stap wan kain tasol (Wh).
- Noken Putim moa lo 4-pela bateri long paralel em i inap, NOKEN abrusim 4 bateri. Bilong wanem dispela bai mekim em ino sas na dis-sas wankain.
- NOKEN miksim ol narapela kain , modal, na ol bateri i olpela, bilong wanem dispela iken mekim bateri bai bagarap hariap tru.
- Ol mas konektim ol bateri long ol ples win I ron gut na imas stap hait long san na ren,. I tambu tru long putim bateri insait long haus.
- Ol sas ekuipmen bilong bateri ol imas konektim strong bilong istap longpla taim, noken konektim bilong istap sotpla taim tasol.
- Karamapim bateri teminol bilong banisim sot seket inoken kamap nating
- Sekim ol bateri teminol long lukim olsem bateri teminol I stap long wei long ol metol wal nogut bai kamapim birua. wanpela

Yyusim ol raitpela tul taim yu mekim wok long bateri

43 Source: Wave inverter, co.nz, https://waveinverter.co.nz/wp-content/uploads/2017/12/products-CR325-1.png

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

3.6 Inveta

Tebol i soim sampela ki samting na olgeta samting bilong inveta yet. Olgeta taim, ol inveta em ol singol wanpela mak na 3 mak. Lo dispela kos bai yyumi lukluk tasol long singol mak 220-240V, 50Hz autput na 12V input.

TEIBOL 3: Ol Wok na Lukluk bilong wanpela Inveta samting

samting Ol Wok na Lukluk	
Kontiniuos Pawa Mak (300 Wats at 25oC)	Totol Hamonik Distosen (< 4%)
Bikpela Pawa Mak (600 Wats at 25oC)	Lou Voltes Diskonek (LVD) (11.5V or 10.5V)
DC Input Voltes (10.0V – 15.5V)	Lou Voltes Rekonek (12.6V or 11.6 V)
Weivfom (Strongpela sine weiv)	LVD woning Treshol (11.8V or 10.8V)
AC Autput Voltes (220V or 115V +/- 10%)	LVD Dilei Piriot (4 minus)
AC Autput Frikuensi (50 or 60 Hz +/- 10%)	Hai Voltes Diskonekn (15.5V)
Pik Efisiensi (92%)	Hai Voltes Rekonek (14.5V)

PIKSA 45: Wok bilong wanpela Inveta[45]

Item	PS-600JAR
Continuous power	600W
Surge power	1200W
Input voltage range	9.5-16V DC (rated power 12VDC)/ 19-30VDC (rated power 24VDC)
Output voltage	☐ 115V / ☐ 120V / ☐ 220V / ☐ 230V / ☐ 240V ±10% (Be subjected to the rating)
Output frequency	☐ 50Hz ☐ 60Hz
DC input	☐ 12V ☐ 24V
Output wave form	Pure sine wave (THD≤3%)
Efficiency	90 %
USB output	5 VDC Max 2.4A
Input over-voltage shutdown	16VDC±0.5V
Input under-voltage shutdown	9.5VDC±0.5V
Input under-voltage alarm	9.8VDC±0.3V
Over temperature protection	65±5℃
Over-load protection	700W±100W
No Load currents	0.8A
Dimension (L×W×H)	213x140x74mm
Weight	1.67Kg
Working temperature	0~40℃
temperature	-10~45℃
Intelligent cooling	The cooling fan on the product will not run when start up the inverter, it will start running only when the case temperature reaches about 40℃

45 Source: Manual ZZ, Giandel PS-600JAR Power Inverter User Manual, https://manualzz.com/doc/52962368/giandel-ps-600jar-power-inverter-user-manual#:~:text=Item%20PS%2D600JAR%20Continuous%20power,wave%20(THD≤3%25)

Hap bilong rait:

WOK 3

Tisa bilong yupela bai givim tupela bateri. Konektim ol long siris na paralel. Mesarim amas voltes olgeta

Bilong wanwan setap. NOKEN mesarim karen. Noken lus tingting long putim han glav.

Battery (x2)

Cables

Multi-meter

WOK 4

1. Givim sumatin olgeta samting yyumi toktok lo en antap (Haidro tebain, Kontrola, Bateri Inveta na 12DC lait wantaim samting ikam wantaim em, Askim sumatin long luk-save long nem plet data (Wok na ol lukluk bilong en) Istap long wanwan hap bilong en. Sumatin i mas ritim na luk-save olgeta infomeisen ol raitim antap long ol dispela samting wankain olsem nout antap.
2. Bilong nem plet i stap daunbilo pawa autput na het bilong tebain em wanem samting.

Item	PS-600JAR
Continuous power	600W
Surge power	1200W
Input voltage range	9.5-16V DC (rated power 12VDC)/ 19-30VDC (rated power 24VDC)
Output voltage	☐115V / ☐120V / ☐220V / ☐230V / ☐240V ±10% (Be subjected to the rating)
Output frequency	☐50Hz ☐60Hz
DC input	☐12V ☐24V
Output wave form	Pure sine wave (THD≤3%)
Efficiency	90 %
USB output	5 VDC Max 2.4A
Input over-voltage shutdown	16VDC±0.5V
Input under-voltage shutdown	9.5VDC±0.5V
Input under-voltage alarm	9.8VDC±0.3V
Over temperature protection	65±5℃
Over-load protection	700W±100W
No Load currents	0.8A
Dimension (L×W×H)	213x140x74mm
Weight	1.67Kg
Working temperature	0~40℃
temperature	-10~45℃
Intelligent cooling	The cooling fan on the product will not run when start up the inverter, it will start running only when the case temperature reaches about 40℃

4

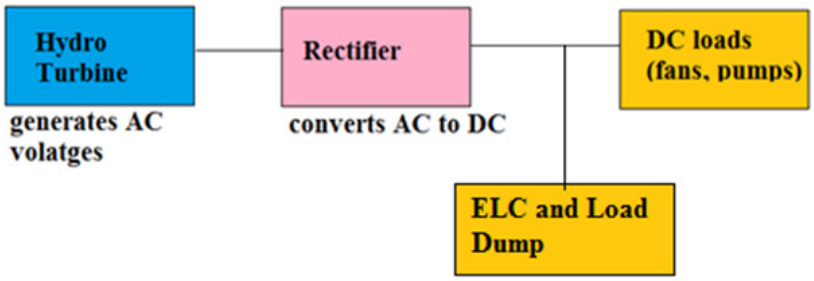
Ol kain Piko-Haidro Sistem

4.1 Piko haidro (DC) pawa sistem we i santap em yet

Ol ino save konektim ol sistem we i save sanap ol yet long pawa lain tasol ol i save putim long ol ples istap long wei we igat liklik koneksen long pawa lain, o ples igat liklik pawa diman.

4.1.1 Piko haidro (DC) pawa sistem save sanap em yet we i nogat bateri bilong en

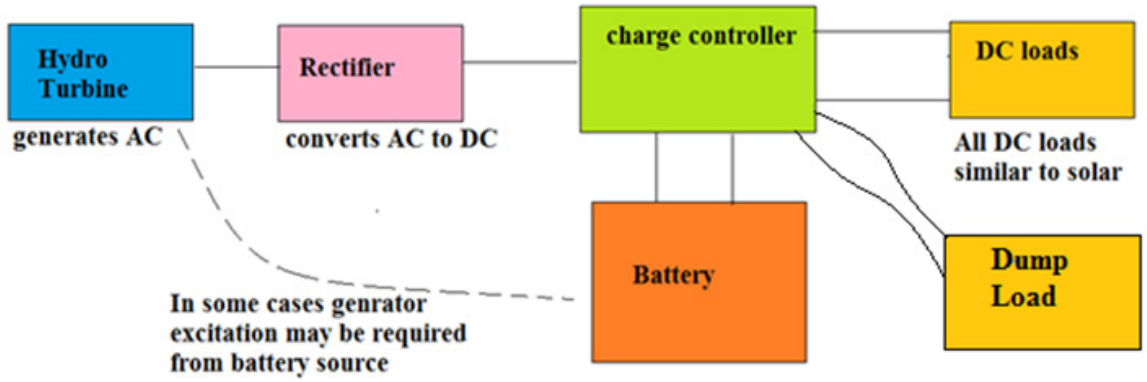
PIKSA 46: Kain DC sistem we inogat bateri bilong en[4647]



- Dispela sistem ol i mekim narapela kain na em bai wok long strong bilong wara i ron long en , tasol haidro sistem i mas mekim kamap sampela pawa yet bilong givim loud.
- ITAMBU long pawarim loud stret ikam long haidro tebain bilong wanem em inap kamapim bagarap long loud. Long dairek loud koneksen yu bai nid lo konek long ELC wantaim damp loud. Damp loud bai halivim long tanim ol eneji igo long hit o narapela samting.

4.1.2 Piko-haidro (DC) pawa sistem save sanap em yet na igat bateri bilong en

PIKSA 47: Kain DC pawa sistem igat bateri na save sanap em yet

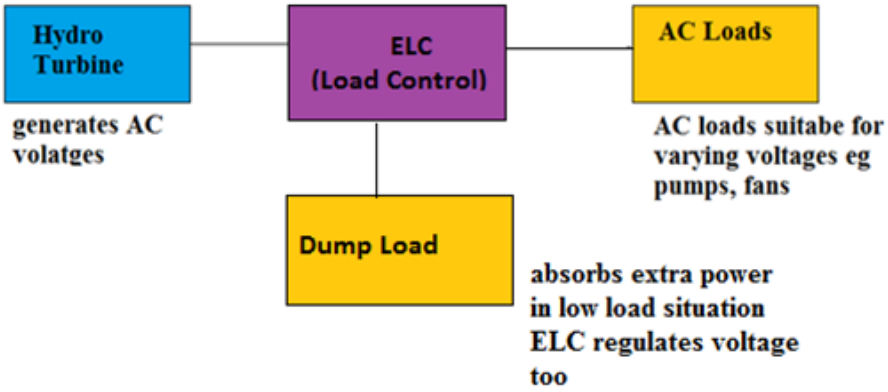


46 Source: VOCTEC
47 Source: VOCTEC

- Em iken gat narapela DC loud olsem DC fen, mobailfon sas long USB pot moa.
- Ol i save yyusim planti long liklik haus long ples we ol i save yyusim lait na samting bilong sasim fon. Ol ino save yyusim ol hevi AC pawamasin samting
- Planti DC genereita igat masin bilong tanim na mekim dairek pawa istap pinis insait long en
- Sampela haidro sas

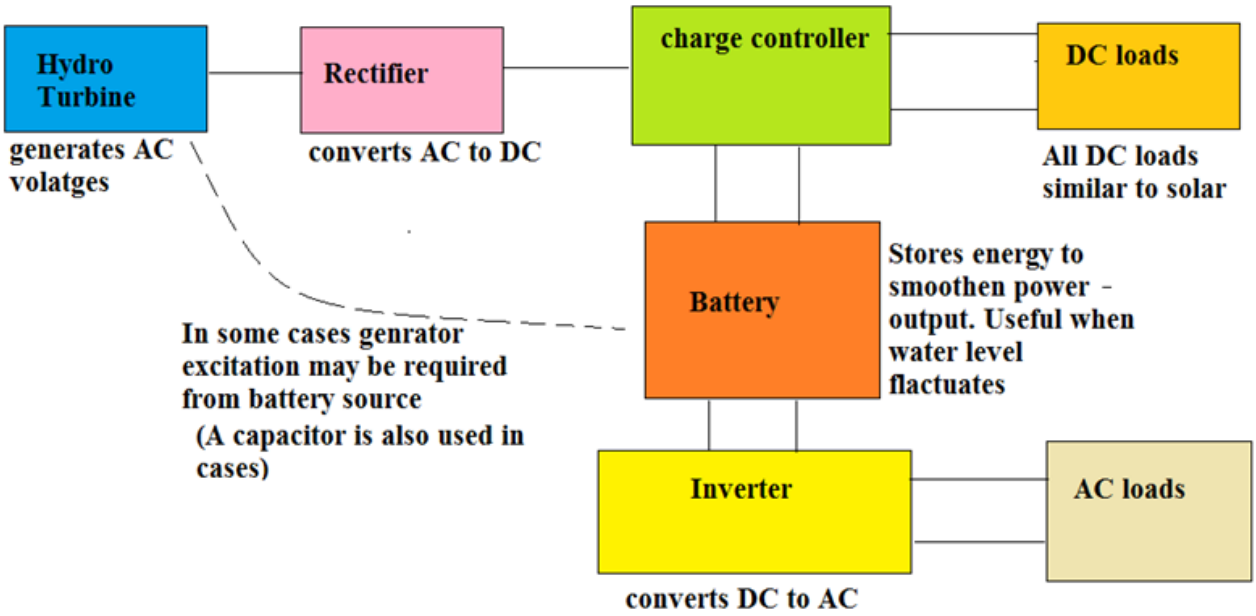
4.1.3 Standalone pico-hydro AC power system – AC Direct system

PIKSA 48: AC sistem we i santap em yet[48]



4.1.4 Haidro (DC+AC) pawa sistem igat wantaim bateri na isave santap em yet

PIKSA 49: Haidro (DC+AC) pawa sistem igat bateri na isave santap em yet[49]

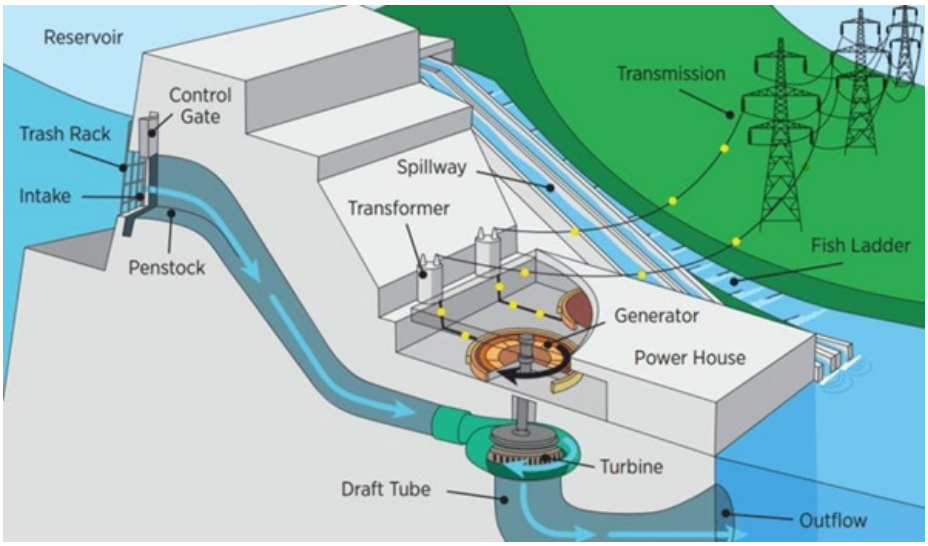


48 Source: VOCTEC
49 Source: VOCTEC

- Gutpela pawa i kamaut yet long taim mak bilong wara igo daun.
- Wankain sistem olsem bilong "DC loud tasol", tasol em igat sampela moa inveta bilong larem bai i givim pawa long AC loud wantaim.
- NOKEN senisim ol AC na DC loud. Ol DC loud i MAS kisim pawa long DC saplai TASOL. I TAMBU TRU LONG AC SAPLAI LONG GIVIM PAWA IGO LONG DC LOUD. **Igat BIKPELA RIS tru long bagarap bilong ikuipmen, man i ken kisim bikpela bagarap na i ken dai tu.**
- Planti taim ol i yyusim bilong namel sais haus igat lait, sasim fon na liklik AC pot, ketel

4.2 Bikpela Pawa Piko haidropawa sistem

PIKSA 50: On-grid or grid koneksen na setap[50]



Saisim Piko-haidro tebain sistem

Dai bilong haidro tebain em isi ino olsem sola. Taim yu tingting long amas pawa sistem bilong yu em bai nidim-yu ken putim 1.5 moa antap long dispela veliu bilong mekim sistem bilong yu igo bikpela liklik. Dispela tokaut bai Haidro tebain kampani bai nidim bilong ol lo salim raitpela kit o sistem ikam long yu. Dispela ino olsem sola panel, haidro tebain ol ino strong long ol stoa bilong yyumi na planti taim ol i save wokim taim ol planti lain laikim tru. Taim ol ino stap antap long self kit tu, ol kampani ol i save mekim dispela bai ol halivim yu long makim ol gutpla wan tru bilong yu.

Hap bilong rait:

50 Source: National Hydropower Association, www.hydro.org

WOK 5

Bung long fopela long wanpela grup o moa na ansarim ol dispela askim:

1. Droim 3 pela bikpela kain haidropawa sistem na putim lebol antap long wanwan lo ol.

2. Toktok long klas wanem sistem em bai yu laikim na long wanem as?

5

Ol tul ol i yyusim long Haidro Tebain Sistem

Dispela em ol tul ol i save wok lo ol olgeta taim na em dispela bai ol i nidim long putim kamap Haidro tebain sistem.

PIKSA 51: Ol Tul ol i save yyusim olgeta taim[51]

5.1 Ol Wanwan Tul na ol wok bilong ol

Piksa bilong ol Tul	Nem bilong ol dispela tul	Ol wok bilong ol dispela tul
 52	Karen bilong flo mita	Ol i yyusim long makim ron bilong wara insait long ol hanwara na ol bikpela wara. (http://www.rainmanweather.com/Flowatch-Flowmeter-Station)
 53	Soket spana	Ol i yyusim long taitim ol join bolt moa,.

51 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

52 Source: RainmanWeather, Flowatch Flowmeter Station, https://www.rainmanweather.com/Flowatch-Flowmeter-Station, accessed 21 June 2021.

53 Source: MITRE10, https://www.mitre10.co.nz/shop/stanley-socket-set-36-piece/p/161418

 54	Paip Rens	Bilong mekim ol playuming wok long penstok na valv na tebain inlet nosel.
 55	Presa geij	Bilong makim presa na het
 56	Speit	Bilong digim na setim wal long sedimen o putim paip bilong penstok.
 57	Klem mita	Ol Klem mita i save makim ol kain samting olsem: AC karen, AC na DC voltes, resistens, mekim ol kamap gutpela tru Bilong elektrikol wok. Em gutpela bilong haia na isi karen mesamen
 58	Malti-mita	Kain malti-mita iken mesarim ol voltes, karen, na resistens Mak bilong lukim ol samtingg em i antap tru. Ol I ken mesarim karen sapos mita ol konektim long siris (na ol ino yyusim spesol adapta)
 59	Tred Silent teip	Em ol i save yusim long putim long ol konekta igat tret bilong pasim wara bai i noken kamaut isi

54 Source: Monotaro.sg, https://www.monotaro.sg/p/57858342.html

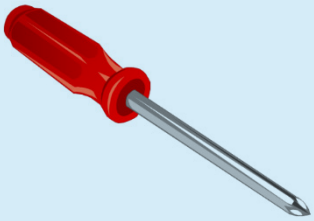
55 Source: Barista Warehouse.com.au, https://baristawarehouse.com.au/products/3m-water-filter-head-pressure-gauge-for-nephead, accessed 21 June 2021.

56 Source: Cashbuild, "Flat spade", https://www.cashbuild.co.za/shop/spade/4460-flat-spade.html

57 Source: Jim Dunlop Solar

58 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

59 Source: The Tool Shed, "Toolshed Thread Seal Tape", https://www.thetoolshed.co.nz/product/15623-toolshed-thread-seal-tape-12mm-x-10m?categoryId=2176

 60	PVC glu o PVC semen	Dispela em ino tul – ol i save yusim long mekim ol join long ol PVC paip.
 61	Klia fleksibol hous	bikpelaOl i save yusim long mesarim het long ol hap ol i stap long en.
 62	Wud so	Bilong katim timba bilong mekim tebain mautin o mekim haus.
 63	Hek So	Bilong katim ol plastik paip na ol konekta
 64	Flet skrudraiva	Opim ol skru
 65	Filips Skrudraiva	Opim ol skru

60 Source: Magpow, "PVC glue", http://www.magicglue.net/UploadFile/prol20108519304880607.jpg

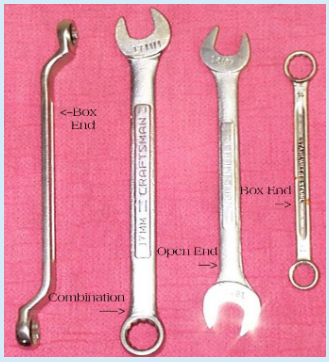
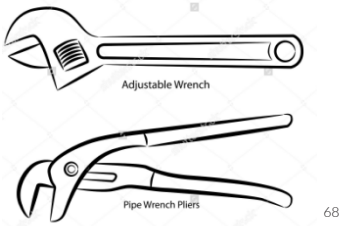
61 Source: Green Chapter, "Air Tube", https://green-chapter-shop.myshopify.com/collections/gush/products/air-tube-per-meter

62 Source: woodworking "Hand saw", https://i.pinimg.com/originals/b6/6b/1f/b66b1feee175c25ebebe05cfd855c520.jp

63 Frakem Blog, "Hacksaw", https://www.frakem.com/blog/wp-content/uploads/2016/06/hacksaw.jpg

64 Source: Galco, www.galco.com

65 Source: Conceptdraw.com, "Manufacturing and Maintenance", https://www.conceptdraw.com/examples/diagram-of-screwdriver-and-its-specific-use-in-maintenance

 66	Ritrektabol 100m teip	Bilong mesarim ol hap – na tu mesamen bilong het i ken ges long en.
 67	Ofset Boks rens, kombaneisen rens, open en rens, na nomol boks rens	Ol dispela tul ol i save yyusim long holim taitim gut na i save halivim tru ol mekanikol wok long tanim samting- oli save taitim ol samting igo raun tasol , kain samting olsem nut na bolt-o kipim ol long tanim
 68	Ajastebol rens Paip rens plaias	Ol dispela tul ol i save yyusim long holim taitim gut na i save halivim tru ol mekanikol wok long tanim samting- ol i save taitim ol samting igo raun tasol , kain samting olsem nut na bolt-o kipim ol long tanim
 69	Lainmen Plaias	Lainsmen plaias em kain plaias ol elektrisens i save yyusim na ol narapela treidsmen bilong yyusim long holim taitim, tanim, kurukutim na katim waia na pawa rop.
 70	Nidol nus plaias	Em plaias ol elektrisen na treidsmen ol i save yyusim bilong katim, yusim kurukutim, narapela na stretim ol waia

66 Source: Amazon.com, “Retractable 100m tape”, https://www.amazon.com/EMI-Body-Tape-Measure-Pieces/dp/B00ELV1QMK?th=1

67 Mechanical Engineering, https://mechanical-engg.com/gallery/image/2209-wrench-typesjpg/

68 Source: Pinterest.com, “Different types of wrenches”, https://www.pinterest.com/pin/147352219031480866/

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

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

Dispela em ol kainkain skru het ol haidro instoleisen teknisen bai ol igat long wok bilong ol. Wanwan het igat spesifik skrudraiva,

PIKSA 52: Ol kainkain skru wantaim ol kainkainhet[71]

Pasin bilong yusim na karim ol tul em bikpela samting insait long Haidro tebain sistem. Pasin bilong karim ol tul yu ken lukim long piksa daunbilo.

PIKSA 53: Ol rot bilong karim ol tul[72]

5.1.1 Ol leda bilong mekim waiarin long haus

Step Leda (A-frem)- Ol step leda em ol fri- sanap leda na ol i ken yyusim long planti wok tu. Ol i mekim ol step leda bilong yyusim long ples i stap op tasol.

PIKSA 54: A-Frem leda[73]

71 Source: Mechanical Booster, "Screwdriver types", https://www.mechanicalbooster.com/wp-content/uploads/2018/05/screwdriver-types.jpg?ezimgfmt=ng:webp/ngcb20

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

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

Pletfom leda – em wankain olsem A-frem step leda tasol man i ken stap seif taim em i yyusim. Em i save mekim man iken sanap antap long en gut na mekim wok.

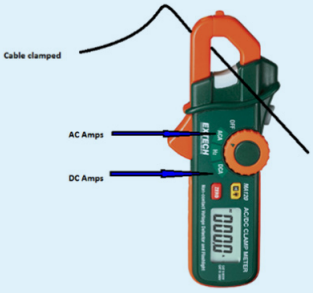
PIKSA 55: **Platfom leda**[74]

WOK 6

Tisa bilong yu em bai givim yu wanpela taim inveta na bateri. Dispela wok em bilong yu long lainim hau bai yu yyusim Inveta long givim pawa long ol dc masin. Yusim inveta na bateri long givim lait igo long balb o mekim fen i ron.

Yusim mita long makim karen insait long pawa rop.

Clamp meter



Battery

Charge Controller

Inverter

AC Light or Fan

- Ensure inverter power is off. You should then connect the inverter to the battery
- Sekim inveta pawa olsem em i of. Bihain yu konektim inveta long

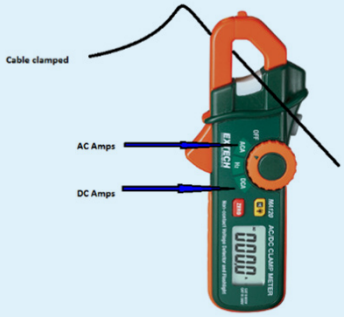
SAFETY: Ensure that AC bulb is connected with lead wire and male-socket plug wired by an electrician.

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

Piksa i soim hau long mekim koneksen

- Nau kisim klem mita na senisim mesarin nob igo long simbol ACA bilong mesarim pawa bilong AC lait o fen. Opim jo bilong klem mita olsem piksa daunbilo i soim. Ridim veliu long skrin. Dispela karen em lait balb i yyusim. Dispela piksa istap daunbilo i soim mesamen istap we na hau bai yu konektim klem.
- Nau rayusim klem na senisim nob igo long DCA bilong mesarim karen i wok long ron long bateri igo lo inveta.

Mak bilong mesarim nob nau istap long ACA



ALTERNATIVELY – YOU CAN ONLY CONNECT BATTERY + INVERTER + AC LIGHT BULB and measure the current consumed by AC light bulb

6

Putim ol Haidro tebain system

6.1 Strtm lo installim

Bipo long yu statim instoleisen, yu mas plenim instoleisen na bungim olgeta samting bai yu nidim pastaim bihainyu go het long ol wok. Yu mas klia gut long wanem kain sistem na koneksen bai yu mekim na tu longlukaut long sampela hevi bai inap kamap long bihain taim.

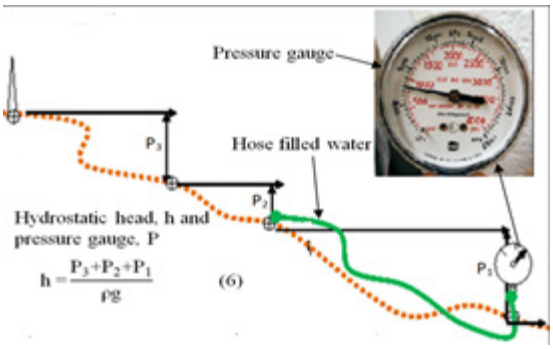
6.2 Retim Fobei na penstok

Namba wan samting, yu mas makim hanwara i stap we. Em i mas stap wankain wantaim het na i mas ron long tebain bilong yu. Mesarim het. Dispelaem ol step bilong mesarim het:

Step 1: Kisim feksibol paip igo antap long hap wara istap long en. Narapela hap en bilong paip i mas stap long ples tebain bai istap long en. Stretim presa geis arere long ples we bai yu putim tebain.

Step 2: Pulmapim hos paip wantaim wara igo inap yu ino inap long pulumapim moa. Ritim geis. Dispela yu ken gesim olsem em het presa.

PIKSA 56: Mesarin het[75]



Step 3: Bai yumi lusim ol kain fomula. Yu kenyusim dispela tebol istap daunbilo na ridim het.

Hait bilong Wara kolumn		Presa			
(m)	(ft)	(kPa)	(bar)	(atm)	(psi)
1	3.28	9.81	0.098	0.097	1.42
2	6.56	19.6	0.196	0.194	2.85
3	9.84	29.4	0.294	0.290	4.27
4	13.1	39.2	0.392	0.387	5.69
5	16.4	49.1	0.491	0.484	7.11
6	19.7	58.9	0.589	0.581	8.54
7	23.0	68.7	0.687	0.678	10.0
8	26.2	78.5	0.785	0.775	11.4
9	29.5	88.3	0.883	0.871	12.8
10	32.8	98.1	0.981	0.968	14.2
12	39.4	118	1.18	1.16	17.1
14	45.9	137	1.37	1.36	19.9
16	52.5	157	1.57	1.55	22.8
18	59.0	177	1.77	1.74	25.6
20	65.6	196	1.96	1.94	28.5

Taim yu painim wanpela ples long hanwara antap we tebain bilong yu bai nidim antap long nemplet, yu ken stat wokim wanpela liklik sais dem bilong bungim liklik pipia na putim filta bilong mekim Fobei

75 Adapted from Water Utility Journal, "Measurement methods for hydropower resources: a review, 2018, http://www.ewra.net/wuj/pdf/WUJ_2018_18_03.pdf

6.3 Forebay

Kliarim dispela ples na yusim ol liklik pipia na ston o hap diwai long wokim niupela liklik dem .

Sapos yu gat samting bilong wokim dem, yu ken yusim simen long mekim fobei dem tu.

PIKSA 57: Fobei ol i mekim long Simen[76]

Bihain long fobei dem, ol i mas instolim geis filta bai iken klinim wara.

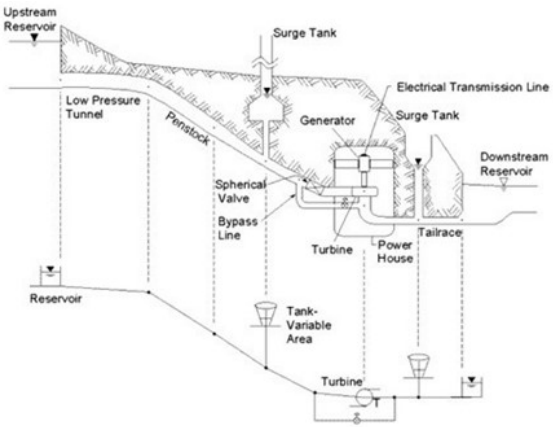
PIKSA 58: Inteik ful skrin filta[77]

PIKSA 59: Ol i instolim filta wantaim penstok autlet long daunbilo[78]

6.4 Penstok

Penstok karim wara ikam long fobei igo long ples we tebain i stap long en.

PIKSA 60: Lukluk bilong ol Penstok valv[79]



76 Source: WISIONS of sustainability, SEPs Energy Projects, https://www.wisions.net/img/pictures/SLP006_2.png

77 Source: Power Spout, www.powerspout.com

78 Source: Waterpower &Dam Construction, "Pico-Hydro", https://www.waterpowermagazine.com/uploads/newsarticle/6798305/images/496422/large/l%20pico%20hydro.jpg

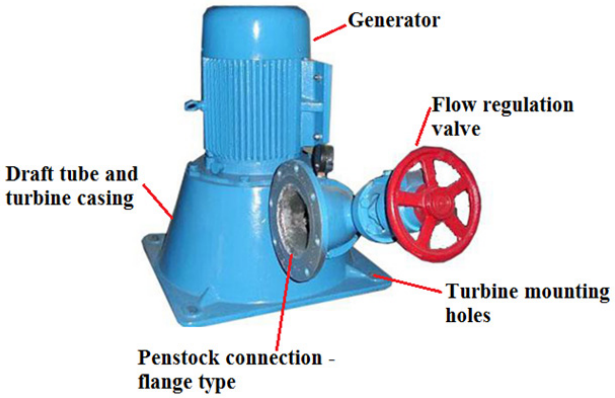
79 Source: Bentley Communities, https://communities.bentley.com/products/hydraulics___hydrology/f/haestad-hydraulics-and-hydrology-forum/171943/modeling-water-hammer-protection-with-a-synchronous-bypass-valve

PIKSA 61: Penstok paip[80]

Tebain na genereita

Planti ol Piko-haidro na olgeta hap samting bilong en wantaim tebain na genereita ol konektim wantaim. Em i isi lo konektim Penstok em rait sais igo stret long tebain keisin . Ol planti tebain ol i save dipen long taip bilong ol yet, dispela bai ol nidim mauntin.

PIKSA 62: Piksa bilong Piko haidro tebain[81]



Long piksa 60 penstok em i igo long inlet flans . Igat kainkain ol konekta bilong kainkain tebain disain. Sampela Piko haidro tebain taip i nid long stap klia daunbilo long ol bilong wara lo igo aut na narapela samting i noken pasim ol.

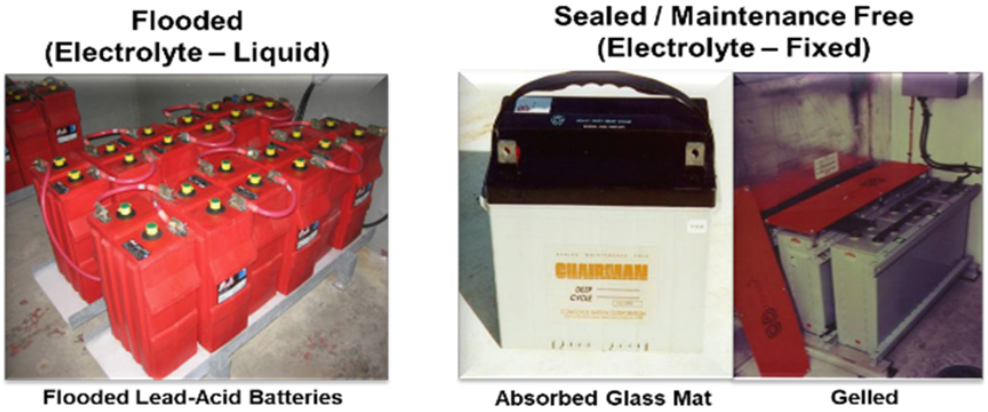
PIKSA 63: Piko haidro tebain ol i putim antap long timba frem [82]

Sapos em inap i gutpla long mekim ol distens bilong pawa rop i sot.

6.5 Bateri

Ol save yusim bateri long storim eneji bilong yusim bihain taim, em long taim we mak bilong hanwara em i no stap long wanpela mak tasol igo antap na i kam daun

PIKSA 64: Ol kain Bateri[28]



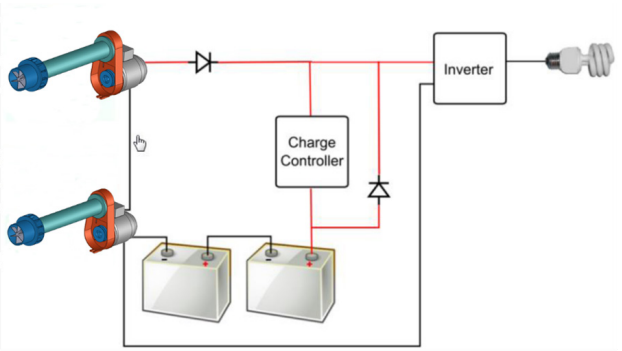
80 Source: https://throughtheluminarylens.wordpress.com/

81 Source: https://www.micro-hydro-power.com

82 Source: Baylor University, adapted from Wikipedia, "Pico Hydro", https://en.wikipedia.org/wiki/Pico_hydro

Nogut ol bai laik long yusim bateri insait long haidropawa sistem, yu mas putim sas kontrola wantaim na dispela bai ken larim karen ikam long genereita. Dispela em ino wankain olsem win na sola haidro pawa em i stap long mak tasol na nogut AC on grid sistem o of grid sistem-ol bateri ol i no save nidim.

PIKSA 65: Soim of grid Piko Haidro koneksen[83]



Hap bilong rait:

83 Source: http://www.unido.or.jp/

7

Ol Sefti Samting bilong Haidro Tebain Sistem

7.1 Ol Sefti rul bilong bihainim

PIKSA 66: Pesonol Protektif Ekuipmen (PPE) ol i save werim olgeta taim[84]

1. I Tambu tru long wok long seket taim pawa emi stap on yet na olgeta taim toksave pastaim bihain putim pawa of.

2. Olgeta taim yu mas putim long tingting bilong yu olsem putim o stretim ol seket yu wokim em samting we yu i bin kisim skul long en na igat save long en. Noken mekim nating.

PIKSA 67: Sefti sain[85]

PIKSA 68: Wanpela teknisen em i wok istap[86]

3. Olgeta taim putim PPE (pesonel protektif ekuipmen) olsem ol glaf bilong han , ai gogol na sefi futwe. Noken holim waia i nogat karamap long en maski yu putim glaf long han bilong yu.

84 Source: 'Personal protection equipment' http://www.mnltap.umn.edu/

85 Source: Aviation Pros, https://www.aviationpros.com/tools-equipment/safety-equipment/article/11148860/ground-handling-safety-signs

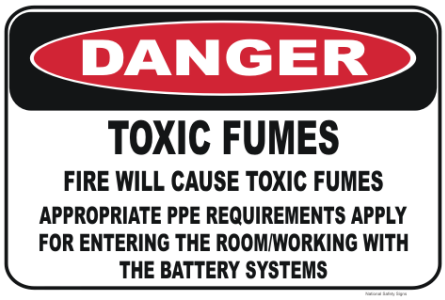
86 Source: Safety workblog.com, https://safetyworkblog.com/assets/understanding-the-2015-edition-of-nfpa-70e-the-arc-flash-hazard.jpg

4. I tambu tru long yu wanpela yet stretim bateri igat asua long en. Ol bateri igat nogut kemikol we ol inap kamapim bikpela bagarap long yu.

PIKSA 69: Sefti sain [87]

5. I tambu long putim bateri klostu long paia o insait long haus we ol man i save sindaun – ol sampela bateri i save autim nogut ges we yumi ino inap long lukim.

PIKSA 70: Sefti sain [88]



6. I tambu tru long putim ol bateri long hap i pulap long planti samting tru o klostu long petrol, kerosin moa., bilong wanem paia i ken kirap long ol sapos liklik ol paia i kamap long en. Olgeta taim putim bateri long ples we win em i ron gut .

PIKSA 71: Sefti Sain[89]

7. Olgeta taim wok wantaim narapela man, taim yu wok long rutin sek bilong yu long haidro tebain penstok na fobei. Ol hanwara i save kamapim pawa long haidro tebain ol i i save ron hariap tru na ol i dip tru long planti ples. Man bai i nap long draun tu.

PIKSA 72: Planti hanwara pasin bilong draun na lus em i stap [90]

8. Yu mas save olsem haidro tebain em i save stat long mekim kamap pawa long taim tebain em i stat ron. I tambu tru long yu holim waia o yu laik long konektim waia taim yu tanim tebain shaf.

PIKSA 73: Sefti sain[91]

9. Noken mekim wok bilong stretim ol samting taim ples em i ren na kisim was long ol bikpela tait wara i save kamap long dispela kain taim olsem.

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

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

89 Source: Wriggles Worth Enterprises, "Lithium-ion batteries", https://www.wrigglesworthenterprises.com/post/lithium-ion-batteries

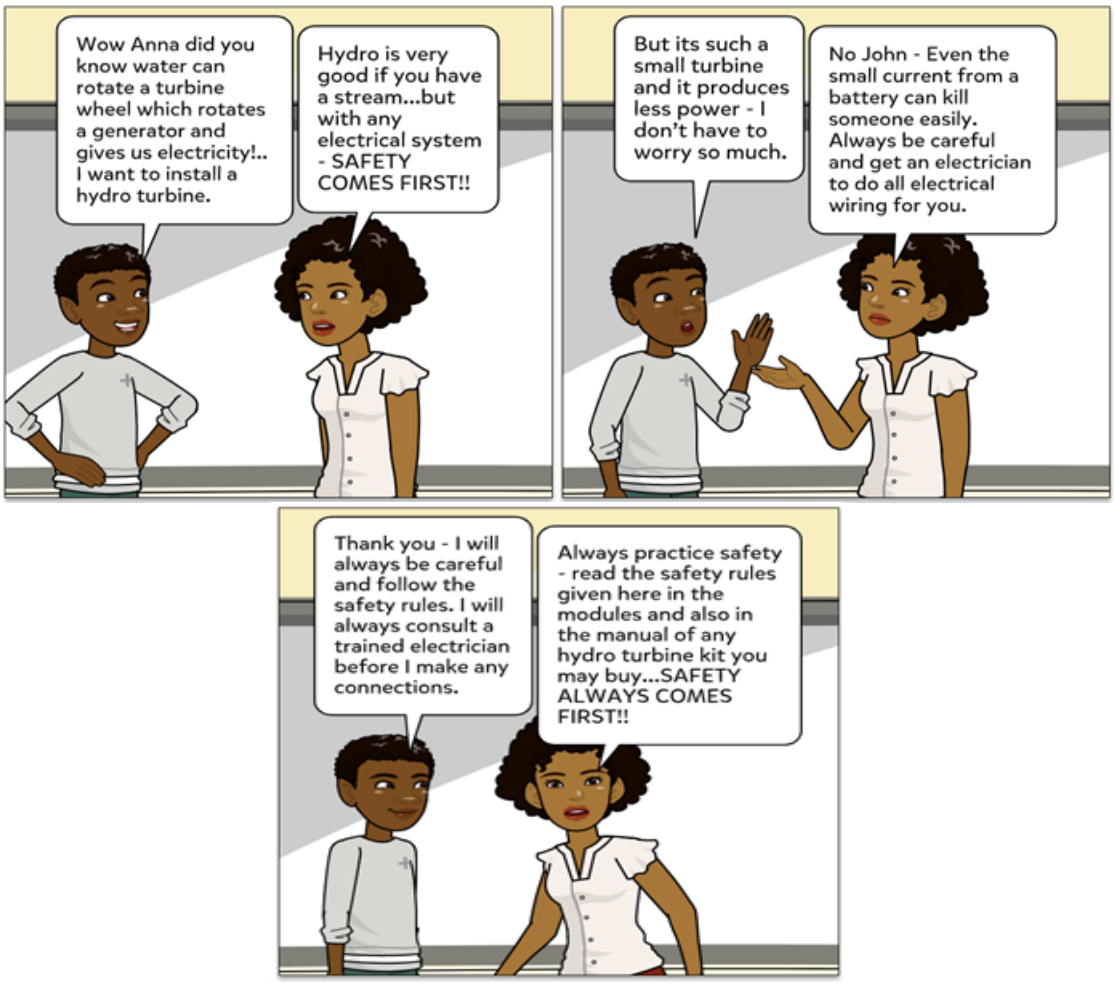
90 Source: Shutterstock, https://image.shutterstock.com/image-photo/stock-vector-beware-of-drowning-sign-isolated-on-white-background-triangle-warning-symbol-simple--flat-vector-450w-1488476456.jpg

91 Source: Seton.co (Signs, Labels & Solutions for a Safer Workplace), https://www.seton.co.uk/danger-death-hazard-warning-signs-with-upgrades.html#HZ150A3DSDH

PIKSA 74: Sefti sain[92]

10. Lukaut gut taim yu apim hevi samting na yu mas yusim olgeta tul ol i soim yu long en, sapos yu no apim samting gut bai yu ken kisim bagarap.

PIKSA 75: Long hapim ol hevi samting, yu mas litimapim ni bilong yu na ino baksait bilong yu[93]



92 WataugaDemocrat.com, "Floodway warning", https://www.wataugademocrat.com/flood-warning-sign/image_caa15320-900a-5e5a-b5aa-c93b53efcdd9.html

93 Source: https://www.espinosafamilychiropractic.com/

WOK 7

Pat A:

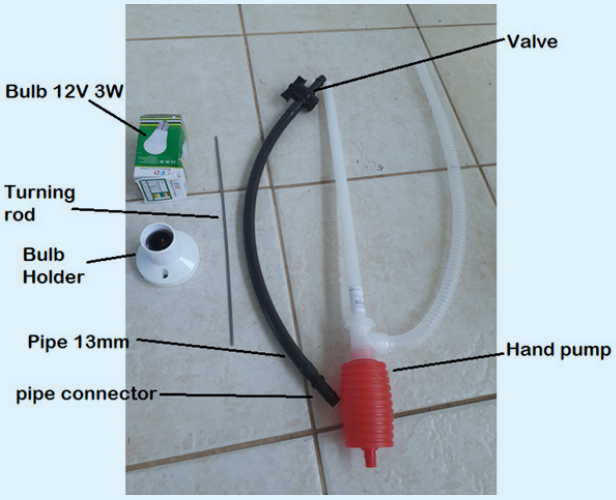
Askim ol sumatin long go long ol grup na mekim ol i tingting olsem ol bai instolim 2 x 600-wat tebain wantaim 3 x 30Ah Bateri wantaim 20A sas kontrola, 2 x DC lait ad 1 x 100W inveta wantaim wanpela AC lait balb olsem loud. (Bai yumi ino inap bildim dispela sistem).

Ol sumatim i mas pastaim toktok long olgeta sefti rot ol i nidim taim ol i mekim dispela wok . Larim ol i toktok o raitim long buk. Na askim ol tu hau bai ol i instolim dispela sistem. (Dispela em i narapela kain long dispela nomol sistem, we bai instolim em ino hat)

Pat B: Instoleisen

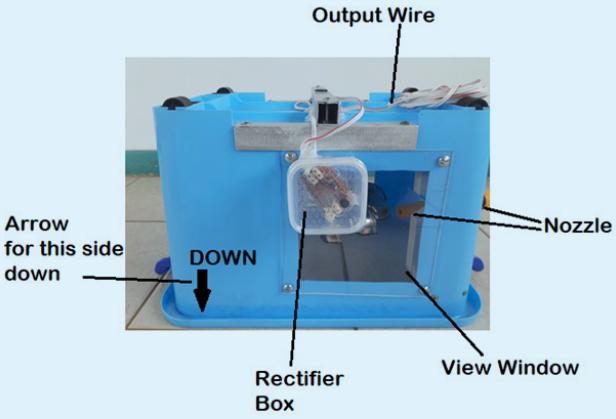
Long dispela seksen sumatin bai ol i soim pastaim na bihain larim ol sumatin bai ronim Togo tebain demo kit.

Ol dispela sapot samting olgeta i kam wantaim demo tebain.



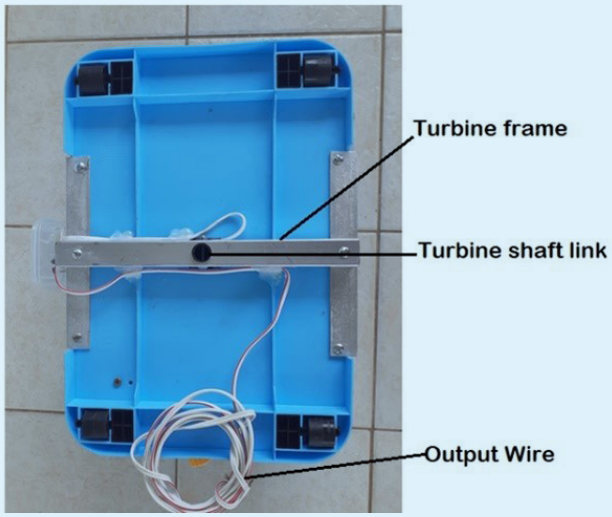
Opim tebain boks na sekim olgeta samting i mas istap insait. Dipen long ol resos bilong wara igat tripela rot long wok long demo tebain kit.

Lukluk bilong Tebain long Fran :

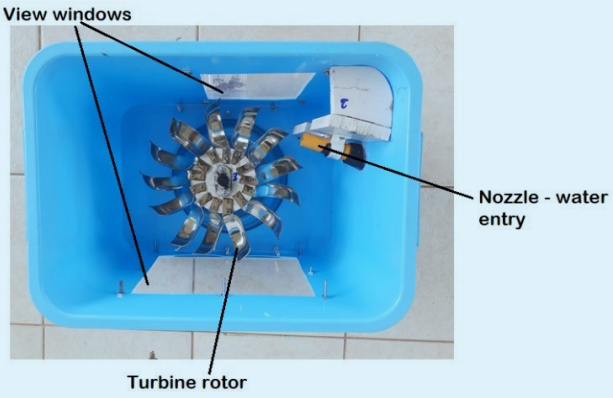


Stretpela rot long kisim gutpela save long tebain

Lukluk bilong Tebain long antap :

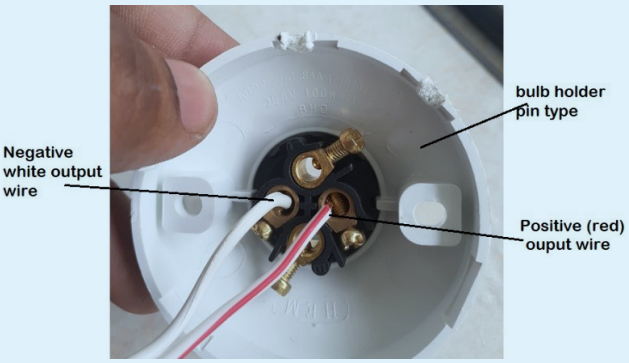


Lukluk bilongTebain long daunbilo:



Konektsen igo long ol autput masin

Longpela bilong autput waia em i olsem 2.5m lo konek igo long sos istap long we tru. Dispela longpela bilong en bai mekim wara bai ino inap go antap long ol elektrikol divais olsem balb ol i konektim long autput. Sapos balb em i no wok - traim na rivesim polariti i.e kisim balb aut na tanim 180 digri pastaim na yu konektim gen.

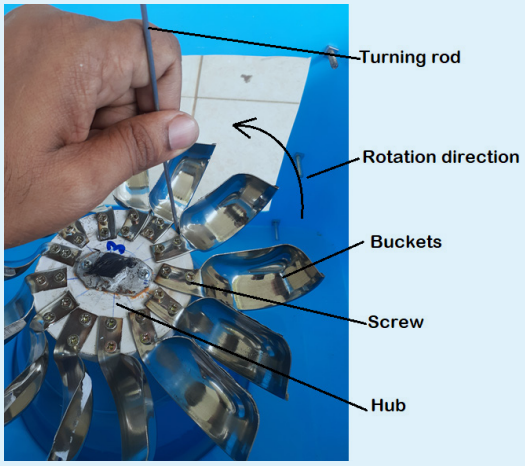


TOKSAVE: NOKEN HOLIM OL KONEKSEN TAIM OL I STAP NATING WANTAIM HAN BILONG YU. Rektifaia bot em i gat kapasita we inap long storim sas sampela taim.

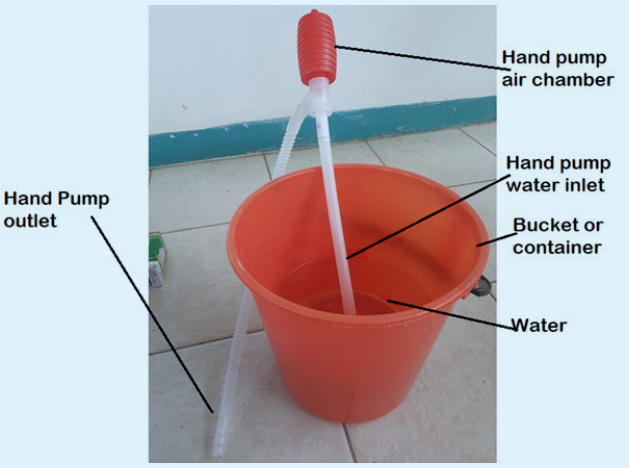
Ronim Tebain lo kamapim pawa

I gat tripela wei we ol rul bilong haidro tebain i ken wok

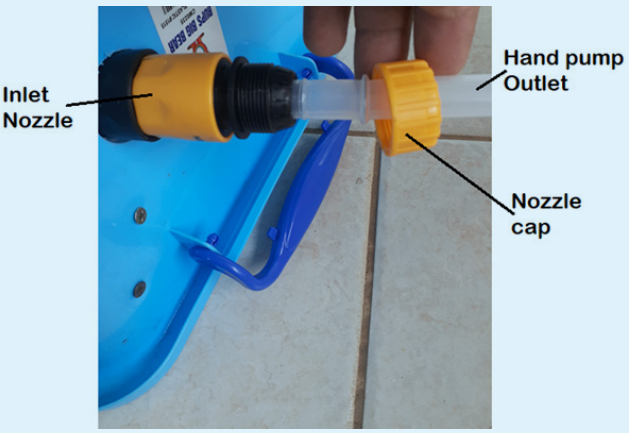
A. **Tanim rota lo mekim kamap pawa long strong:** Yusim tin rod bilong tanim o wanpela skrudriva lo tanim tebain rota. Na dispela tebain imas stap apsait daun. Dispela bai i ken larim ol sumatin i ken lukim hau ol i tanim tebain na kamapim elektrisiti o elektrik pawa. Ol bai i no nidim wara long dispela. Dispela em gutpela tru long ol ples we i nogat wara. NOKEN HOLIM BAKET bilong wanem arere bilong ol i sap tru. Ol sumatin bai i mas lukim ol baket i wok long tanim istap na ol lait balb i wok lo lait ino stap long mak. Yu mas save olsem rektifaia em bai i nonap wok gut wantaim lou RPM olsem na autput em bai i nonap stap long mak long dispela moud inap taim RPM bai igo antap.

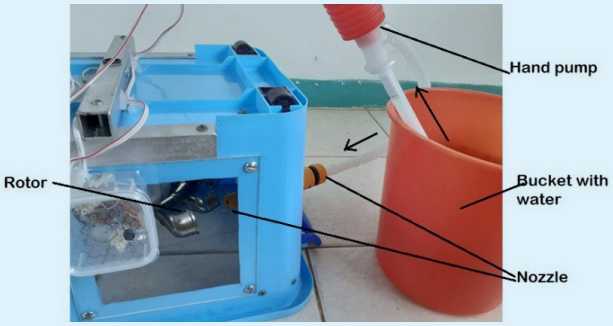


B. **Yusim Han Pam (Hand Pump) lo tanim rota lo kamapim pawa.** Sapos long ples we wara istap, tasol presa bilong wara em ino strong long mekim roteisen long kamap, yu ken yusim han pamp ol i bin givim yupela long bildim presa. Pulmapim kontena lo wara na putim han pam igo insait long kontena olsem piksa daunbilo i soim.



Opim lid bilong Nosel , na putim Han pam inlet insait lo Nosel hap i save go insait long en na taitim ai bilong en gut.





Pusim Han pam win semba na larem ken, mekim olsem planti taim bilong mekem wara igo insait long nosel let na paitim paket bilong tebain. Loms dispela pasim ol sumatin bai lukim wara i save ron olsem wanem na mekim rota i tanim. Balb bai mekim lait ino stap long mak bikos RPM em i lou.

Dispela em soim hau wara bilong kinetik eneji i save tanim tebain na kamapim elektrisiti. Man em soim dispela i mas larim liklik wara tasol bai i mas lus o weist. Wara ol yusim long dispela pasin em mas fri nogut ol hap pipia na liklik pipia bai bagarapim o pasim han pam. Ol rota baket em ol steinles stil na ol samting bilong pam em plastik bai ol i no ken ros. Ol inap long yusim ol narapela han pam sapos ol inap long fitim nosel.

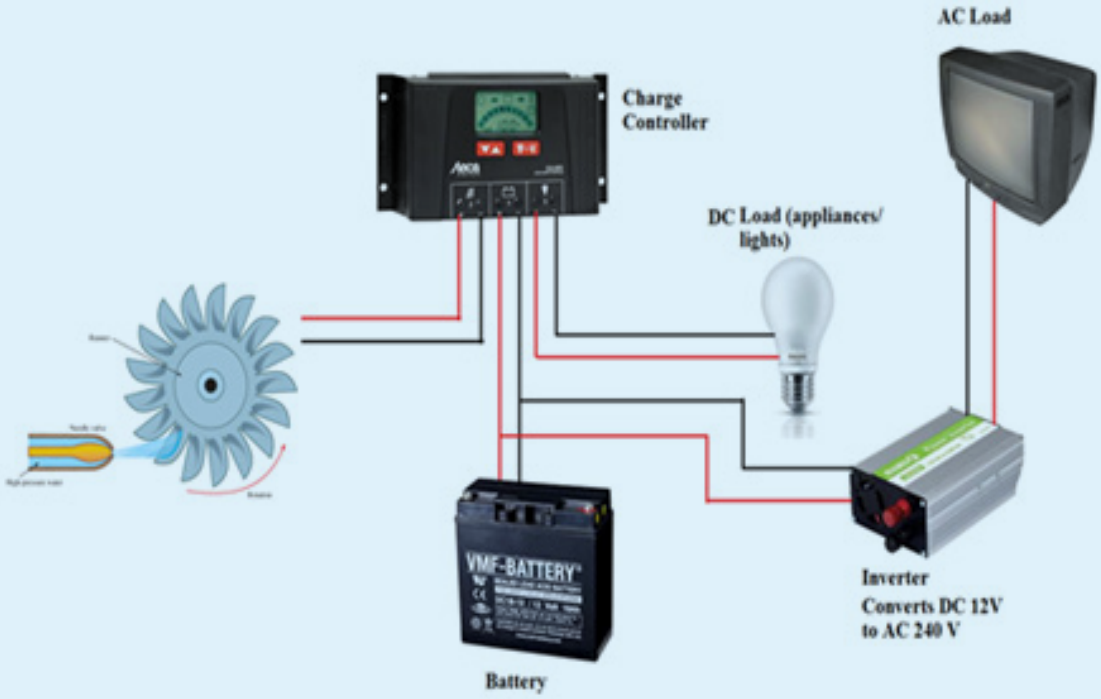
Yusim wara pip lo konek igo long tenk o mein wara saplai: Dispela em gutpela tingting o ol rot bilong soim long man tasol em bai inap nidim presa lo wara bai mas abrusim 1 ba mak. Dispela Presa bilong wara I MAS NOKEN ABRUSIM 4 PELA BAR O ABRUSIM 10 GPM FLO REIT . Dispela demo tebain kit oli givim wantaim narapela valv tu bai oli ken yusim lo kirapim flo. No ken yusim valv long sapos florate em liklik bikos em bai mekim stron presa ikam daun. Konektim paip igo stret long nosel entri na reguleitim long paip tasol, em bai yu no inap makim planti konecsin. Samting bilong Koneksin ol bai givim bilong joinim seksen lo tupela paip – yu bai no nidim bilong dairek koneksen.

Sapos yu mekim koneksin long sos (source) igat bikpela presa tru, i gutpela yu putim valv long namel bilong reguleitim presa i wok lo kam insait

Sapos yu laik mekim dairek koneksin igo long wara bilong tep, we em istap long stendad domestik presa, direk Koneksen em gutpela na
Ol i ken reguleitim stret long tep sapos em stap klos tu. Long dispela moud em gutpela long taitim rosel lid gut bai inonap kam lus ken bikos long bikpela presa.

Ol sumatin ken mesarim gut dispela autput voltes bilong haidro tebain long ol narapela florate. NOKEN MESARIM KAREN wantaim maltimita. Yusim klem mita tasol long mesarim kuren.

Konektim haidro setap igo long inveta olsem piksa soim daunbilo.



8

Luksave na stretim ol asua i save kamap planti taim long Piko haidro

8.1 Sas Kontrola Folts o Asua (faults)

Long haidro sistem, sas kontrola em skru (brain) bilong dispela sistem na em namba wan ples bai yu mas lukim bilong paiim asua. Sampela asua i save kamap planti long sas kontrola em,

Asua 1: Sas kontrola ino save soim olgeta samting bilong off-sas

As bilong en: Aksidentol ova yus (liklik ren, narapela TV progrem)

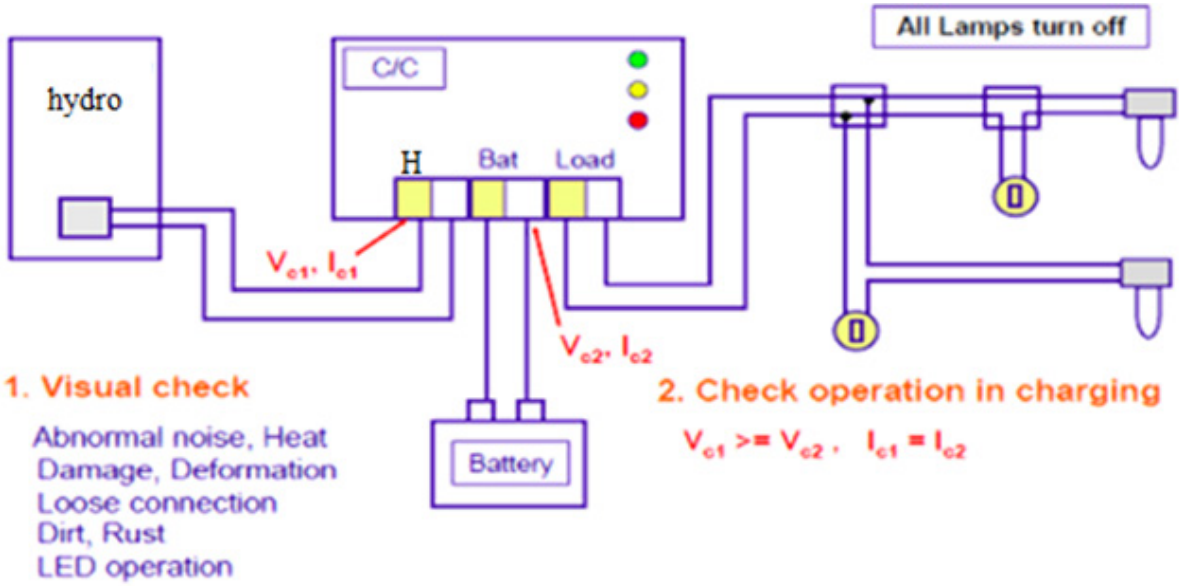
Long Helivim dispela: Daunim yus bilong loud igo long haf bilong wanpela de na larim bateri bai sas gut

Asua 2: Sas Kontrola katim-of loud na lait

As bilong en: Olgeta de ova yus (bateri i pinis)

Planti ol haidro sas kontrola bai kat-off pawa long loudim nogut ol aksidentol sot seket. Sas kontrola bai nid long ri-set gen bihain ol rausim sot seket.

PIKSA 76: **Sas kontrola koneksin**[94]



Asua 3: Karen emi no wok lo flo igo long bateri, o emi mekim signol olsem bateri em ful sas tasol bateri em nau tasol ol putim bilong sas o em wok long sasim bateri yet tasol batri em pulap pinis.

As bilong en: Fus emi bilong pinis, koneksin bilong waia em kam lus o intenol kontrola emino wok gut.

Long Helivim dispela: Taitim dispela koneksi i bin lus, fus i bilong lo en senisim stretim LVD na HVD setin

8.2 Asua Bilong Piko Haidro Tebain

Yu ken painim asua bilong haidro tebain taim ol i wok long l lusim pawa o taim yu mekim ol mesamen. Yu ken lukim Haidro tebain voltes kamap klia long sampela sas kontrola.

Asua 4: Pawa autput i save kam long haidro tebain igo daun o nogat tru

As bilong en: Saplai bilong wara i nogat o em i go lou

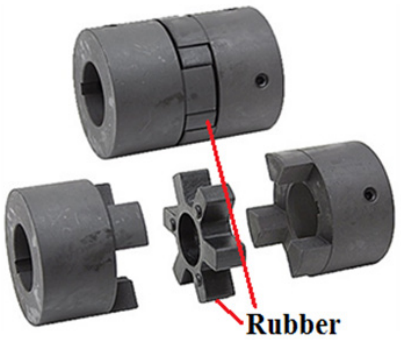
Remedy:

Long Helivim dispela:

- Sekim ol waia ol ron igo long en bilong painim na senisim ol i sot lo en o ol i gat asua long ol.
- Sekim bering na senisim
- Sekim penstok na fobei na kliarim ol hap i pas long en long larim wara i ron
- Sekim ol in lain kuplin bilong ol samting istap antap long raba o burukburuk hap.

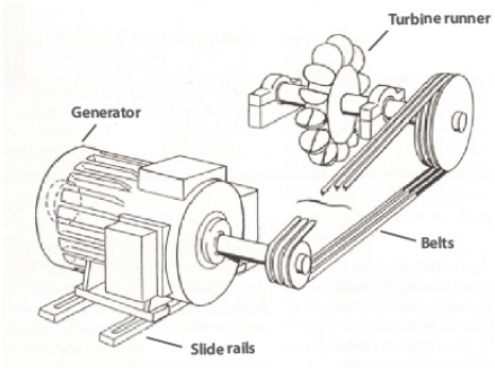
94 Source: JICA

PIKSA 77: Sekim kuplin long we o bagarap[95]



Bilong belt draiv sistem sekim ol V belt i lus o buruk long en. Senisim o taitim ol.

PIKSA 78: Veds belt draiv system[96]



- Sekim gris antap long bering . Senisim sapos gris yu putim em i no wok bikos ol i bin bagarapim bering.

PIKSA 79: Grisim ol bering long saf[97]

Sampela as bilong pawa i save lus planti taim

- Bagarap o lik lo penstok em bai i nonap long saplaim wara wantaim strong igo long tebain

PIKSA 80: Bagarap na penstok em i lik[98]

- Ol pasim valv o i bin bagarap na i wok long pasim wara long ron.

PIKSA 81: Bataflai valv ol save yusim planti[99]

- Ol baket i bin bagarap bai inap daunim strong lo pawa i kam long tebain. Senisim ol baket i bin bagarap.

95 Source: "High quality bearing supplies", https://www.thebigbearingstore.com/
96 Source: Practical Action
97 Source: https://www.priestelectric.com/
98 Source: Nepal Energy Forum, http://www.nepalenergyforum.com/
99 Source: Indiamart.com, "Flanged butterfly valve", https://5.imimg.com/data5/LB/GT/MY-45145264/double-flanged-butterfly-valve-500x500.jpg

PIKSA 82: Ol Pilton bleid i bin bagara[100]

8.3 Planti Asua ol Bateri save painim

Asua 5: Sapos voltas bilong bateri emi no ikul em sel bilong ol bai sas hariap o i nonap sas gut.

As bilong en: Salfasin, bateri solusin emi drai tru, stratifikeisin (taim elektrolaits insait long solusin ol hiphip

Long dambilong), teminol koneksin em i lus (loose), tempereita bilong bateri em go antap tumas o elektrisiti i wok lo lik bikos asid stap antap namel long terminal bilong bateri.

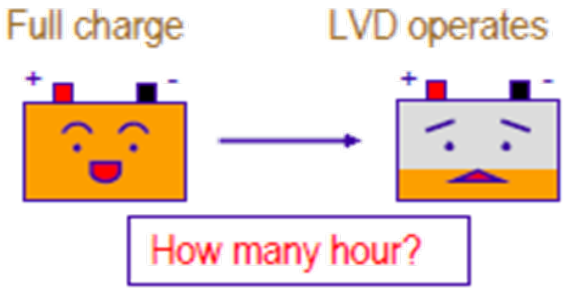
Long Helivim dispela:

- Koneksin long teminol emi lus
- Klinim ol teminol wantaim stil bras na putim gris (e.g., vaselin o litiam gris)
- Level bilong bateri elektrolait, top ap sapos I lou
- Yusim rait teminol lags/klaps tasol
- Rausim ol bagarap istap long teminol
- Seikim bateri liklik (ino > 10 digri long floa (floor) laen lo said) bilong avoidim (avoid) strafikasin
- Kondisin bilong instoleisen, sapos em i orait putim ken lo narapela hap

8.3.1 Sekim bateri AMP Haoa (hour) Kapasity

Igat Sampela samting mo ken bai yu sekim tu long bateri bilong yu. Bihain long bateri i ful sas, yusim loud istap wankain long kisim elektrisiti, rausim loud lo LVD (lou volt diskonek).

PIKSA 83: Hamas aoa bateri i bin kisim bilong kamap lo LVD?[101]

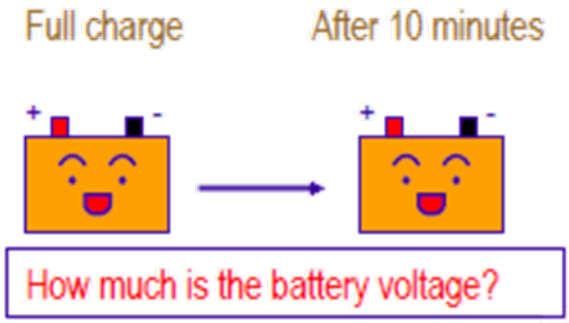


Skelim reit bilong stron bilong amp-aoa wantaim strong bilong amp-aoa ol I bin makim pinis. Sapos mak ol i mesarim amp-aoa em stap daunbilo long 80% mak long stron ol i bin mesarim bipo, em soim olsem bateri em kisim mak we em bai inogat us mo.

8.3.2 Sekim bateri voltes

Bihain lon bateri I ful sas, pasim sasin bihan long 10 minit taim tasol olgeta taim em bai 2 aoa, mesarim bateri voltes. Sapos voltes istap daunbilo long 12.5V, dispela bateri em klostu kamap long arere long mak we bai em inogat us mo. Em bikpela samting lo senisim ol bateri I bagarap tru bai em no ken bagarapim ol narapela bateri.

PIKSA 84: Amas aoa ol bateri i stap sas[101]



100 Source: Dependable Turbines, Ltd, http://www.dtlhydro.com/

101 Source: JICA

8.4 Kain asua kamap long Genrol (general) Balans lo Sistem (BOS)

Ol asua

- BOS (Keibols, suits, laits, etc.)
- Nogat lait taim bateri i bin ful sas tu
- Anda-voltes lo pinish long loud
- Nogat pawa lo pinis long loud

As bilong en:

- Open o sot seket o gaundin
- Ino gutpela/emino keibol (bikpela voltes em i go daun
- Ben-autDC lait tub/inveta
- Koneksin i lus long teminol
- Hai resistens long suits kontek

Long Helivim dispela:

- Sekim voltes level long arere long loud na drop long voltes
- Taitim ol lus koneksin long teminol
- Sekim sais bilong keibol lukim keibol ol i instolim long en em sais bilong en stret o nogat, senisim sapos nogat
- Sekim ol keibol ol igo yet long en, sapos seket i op, bihainim lain na konektim seket
- Sekim na stretim ol sot seket bai kamap long en na graudim long lain, karamapim na pasim ol sot seket/grounded lain
- Sekim ol suits bilong operesin na voltes drop namel input na autput

Hap bilong rait:

WOK 8

Bilong dispela wok sumatin bai nidim lo luksave long ol waia igat asua yusim ol kontiniuti tes.

Long taim bai yupela wok long yusim AC/DC haidropawa sistem setap long las wok tisa bai yu wanpela folt o asua bai yupela i mas stretim.

9

Haidro tebain Maintenens Seklis

9.1 Plenim Mentenens

Mekim rutin mentenens em gutpela rot long mekim laip bilong haidro tebain sistem na ol hap pats bilong en igo longpela moa.

Long mekim rutin mentenens ol i save sekim we ol igat lis bilong samting wanwan pat i nidim bilong makim of. Dispela em sampela samting bilong soim hau bai yu mekim rutin mentenens

9.2 Fobei

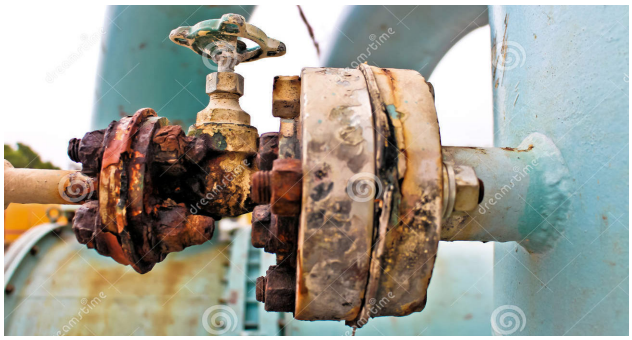
- Olgeta taim sekim godaun bilong fobei na kliarim ol pipia samting i pulap.
- Sekim level bilong wara na klinim ekses igo long fobei
- Sekim fobei geis filta o mes olsem ol i stap gut o ol i bagarap o blok
- Sekim pestok koneksen igat lik o bagarap istap

PIKSA 85: Stop–log freim ol i bildim olsem dem bilong sapotim fobei[102]

9.3 Penstok na ol valv

- Sekim penstok filta na lukim nogut igat sampela baragap
- Sekim igat sampela doti, pipia o bilongk insait long penstok
- Yu mas opim na klinim Y filta bilong rausim hap liklik pipia na doti istap. Wokim dispela planti taim.
- Sekim igat ros long valv na bagarap long valv
- Sekim igat lik o bagarap long penstok paip
- Sekim flans bolt stap tait na sekim tu igat ros long bolt o nogat.

PIKSA 86: Sekim ol valv long ros[103]



9.4 Haidro Tebain Mentenens

Ol i save mekim ol haidro tebain bai oli inap long stap yet long ol ples inogut na bai ol iken stap oli yet. Tasol wankain olgeta mekanikol divais bai ol stil nidim man i mas lukautim ol bai oli ken stap longpla taim na wok gut.

- Sekim samting ol i pasim tebain long en em i nogat bagarap o ol mautin bolt ol i no lus.
- Sekim ol bering ol i no bagarap na putim gris long ol
- Sekim ol inlain istap pas wantaim o belt bilong we
- Sekim ol elektrikol teminol long ol lus koneksen
- Sekim tebain long ol doti na pipia insait – bihain long tait wara
- Sekim baket o tebain bleid long bagarap na nogut em wok long kamap isisi.
- Sekim saf long bagarap o I wok long ajust istap

102 Source: Pond Boss Magazine

103 Source: Dreamtime," Corroded valve", https://thumbs.dreamstime.com/z/corroded-valve-maintenance-industrial-plant-46320348.jpg

PIKSA 87: Lukluk gud long Tebain[104]

9.5 Bateri Mentenens

Planti taim ol Bateri i save feil planti sapos ol i no lukautim ol gut. Long Bateri mentenens igat sampela wok tu, na em bai mas depend long wanem kain bateri na kain requiamen ol lain ol i wokim bateri ol i tok long en, kain olsem:

- Lukluk gut long bateri na klinim ol bateri rek , keis trei na ol temineisen
- Lukluk gut long bateri diskoneksen, ova karen divais na waiarin sistem
- Mesarin voltes
- Bateri loud testin em i bikple dis-sas reit tru long liklik taim , taim yu mesarim digris long bateri voltes. Ol yusim dispela long soim wik na feil (failed) sel taim voltes em i drop olgeta igo daun.
- Long testim stron bilong bateri yu mas dis-sasim bateri long nomol dis-sas reit igo inapim
- arere (depth)-long-dis-sas ol i bin makim. Dispela em lukluk gut tru long kapasiti bilong storim enegi bilong sistem.
- Senisim inogut bateri ikam long siris string. Pua pefomens bateri by givim siris string bateri benk dispela pefomens.
- *Noken larim Frikuen Ova-dis-sasim Sistem – Ova yus na ova-dis-sasin em bai katim laiftaim bilong bateri bikos long bikpela dept long dis—sas (DOD)
- Mesarim spesifik strongpela fos na putim sampela moa wara (bilong fladed led-asid bateri tasol)
- Periodik bateri mentenens i mas igat sek long olgeta teminol long ras na taitim ol skru strong
- Yusim stil bras long klinim ol kain ges istap long koneksen. Putim insuleisen glav olgeta taim.[105]

PIKSA 88: Lukautim Batery[105]

104 Source: Climate Links https://www.climatelinks.org/

105 Source: Jim Dunlop Solar

SAFETY TIP: Use safety goggles and rubber gloves when servicing batteries.

Wear old clothes because you can get acid on them (if flooded batteries)

Keep an open box of baking soda and a plastic pan of water nearby while servicing your batteries—in case of a spill, you can dump the baking soda in the water, stir it, and use the mixture to quickly neutralize any spilled acid

Low voltage isnt a shock hazard, but high current is. A wrench dropped across terminals can quickly burn your hand and possibly explode the battery. Be careful!

9.5.1 Mesarim mak bilong sas bilong bateri (SoC)

Dispela mak long sas SoC em mesarim helt bilong bateri na inapim bilong bateri. Igat tupela rot long mesarim dispela-long seket voltes i op (open-circuit-voltage) na long mesarim spesifik strongpela fos (SG) bilong elektrolit.

9.5.2 Voltes Metod

Bateri spesifik greviti (fladed bateri taip tasol) na seket voltes i op ol i mesarim taim bilong mentenens long lukluk gut long helt bilong bateri na wokim aut steit-bilong-sas. Yu mas mesarim sopen-circuit-voltage behain long bateri i malolo sapla aoa. Tebol daunbilo i soim steit bilong sas.

PIKSA 89: Steit bilong sas[106]

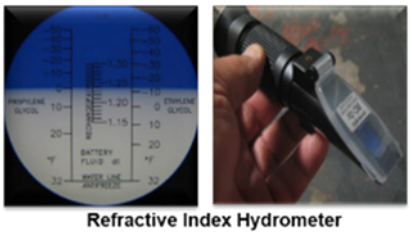
State-of-Charge	Specific Gravity	Open-Circuit Voltage (V)
100%	1.265	12.6
75%	1.225	12.4
50%	1.190	12.2
25%	1.155	12.0
0	1.120	11.8

9.5.3 Haidromita metod (bilong fladed bateri tasol)

Haidromita em save mesarim elektrolit spesifik gravity (SG) long rausim elektrolait long bateri sel igo insait long semba.

PIKSA 90: Use bilong Hydrometer[107]

Archimedes Hydrometer



Refractive Index Hydrometer

Source: Jim Dunlop Solar

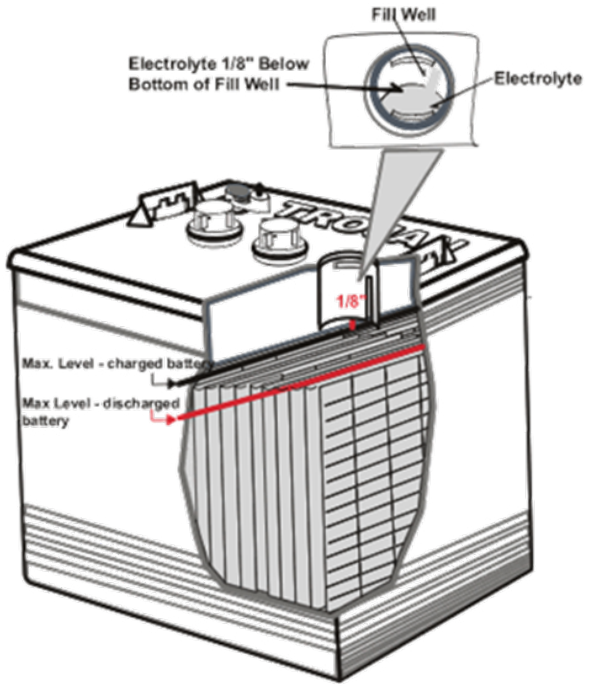
9.5.4 Kapsaitim Distilled wara igo long Bateri (Fladed bateri tasol)

- Open vent fladed bateri lusim wara bikos elektrolaisis na gesin long taim long sas
- Planti moa wara i save lus wantaim tempereitsa, sas reit na bateri i bin stap longpela taim
- Yusim distiled wara long abrusim kontamineisen long bateri na i no ken ovafil

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

107 Source: Jim Dunlop Solar

PIKSA 91: Bateri Strakta[108]



Yu mas yusim bateri mentenens seklist ol i givim long dambilong bilong mekim routin sek bilong bateri.

Bateri (em mas bilong bakap sistem)	
Sekim elektrikol koneksen	Olgtea wik
Sekim ol ras na clinim teminol	Olgtea wik
Sekim wara level na top ap long ol led asid bateri	Olgtea wik
Mas save olsem ol bateri ol ful sas olgeta taim	Olgtea wik
Senisim bateri benk	Olgeta taim, olgeta 3-5 kirismas (led-asid) na 5-10 kirismas (sild gel) sapos ol mentenim gut
Manesimol deseres (dangerous) materiols stores na disposal: resaikl bateri, manes elektrolites spils bilong led-asid bateri	Taim ol i nidim

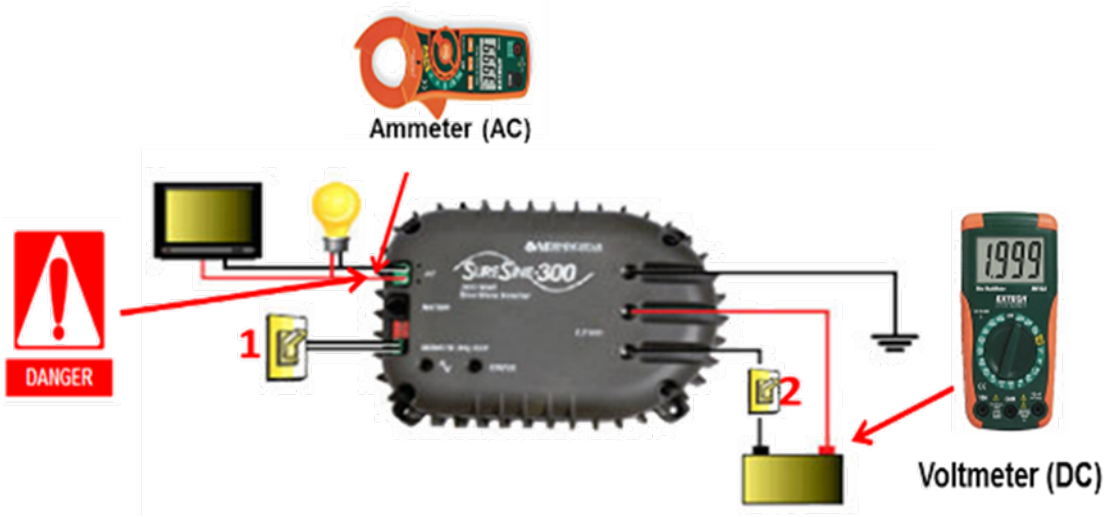
9.6 Inveta Metenens

- Tok stret sapos inveta i wok long kisim DC voltes long bateri i yusim voltes mita set na igo long DC voltes meseimn
- Tok stret sapos inveta i wok long kamapim AC voltes igo long AC loud i yusim mita set na igo long AC oltes meseimnt

SEFTI TIP: Inveta i genereitim bikpela tru AC voltes inap long 220-240V. Putim elektrikol insuleisin glav na bihainim rot bilong sefti.

108 Source: Jim Dunlop Solar

PIKSA 92: Waiarin long Inveta[109]



Yu noken rausim wanpela waia, bihaim dispela oda long taim yu wokim moniterim

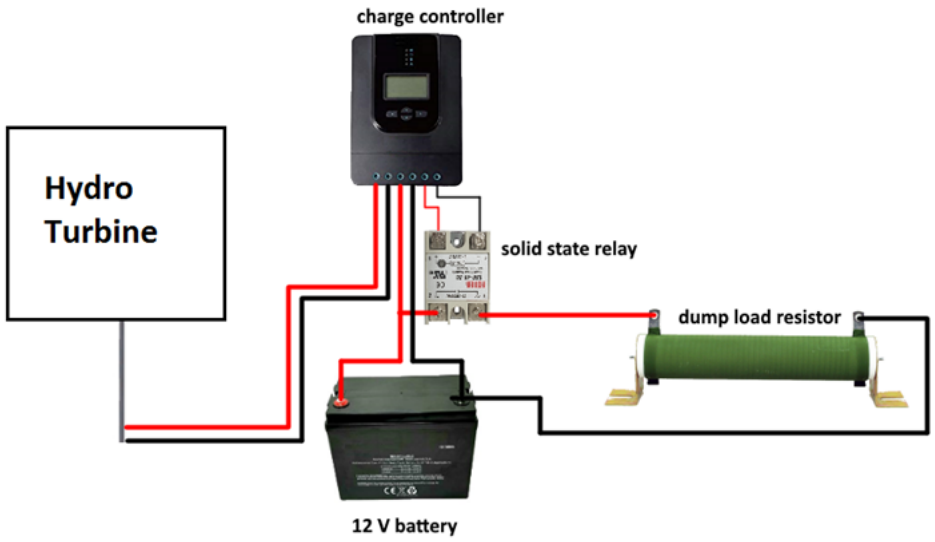
- Putim off diskonesen suis 1 na 2 (lukim piksa daunbilo)
- Yusim klam-on ammita (AC) antap long said bilong AC
- Konektim voltmita (INO AMMITA) igo long bateri teminol (noken lus tingting: Ammita bai iken sot seketim bateri na the fus bai bilong
- Putim on diskonek suis 1 na 2
- Lukim voltes na karen emi flo igo long loud o nogat. Sapos yes, inveta em wok

9.7 Sas kontrola Mentenens

Sas kontrola ol i save robus na em ino ken givim bikpela hevi. Tasol Spos oli ova loud ol i ken givim hevi.

- Sekim ol lus koneksin
- Sekim displei voltes na sekim meseid bilong asua
- Check fuse is not bilongwn
- Sekim fus em i bilong o nogat
- Sekim mauntin bilong kontrola
- Check that diversion load is not worn out or damaged.
- Sekim daivesin loud em i won aut na bagarap o nogat

PIKSA 93: Haidro Sas Kontrola wantaim damp o daivesin loud resista[110]



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

110 Adapted from Resystech.com, "Sizing your Charge Controller and Inverter", https://resystech.com/sizing-your-charge-controller--power-inverter.html

9.8 Mekim na yusim Seklis

Piksa bilong wanwan mun masta seklis istap daunbilo, nay u ken adim sampela mo long en o rausim sampela yu no nidim long en.

TEIBOL 4: Piksa bilongs Masta Seklis

Sekim lis aitem	OK	Stori
Sekim Tebain istelesin ples		
Sekim ras ikamap long ol bagara hap lo karamapim o paip		
Sekim ol sampela plen I gro long dispela hap- klinim sapos oli gro. Hap long igo long fodei na tebain i mas stap klia.		
Sekim ol valv olsem ol i wok gut tasol		
Sekim Y filta na klinim sapos em doti		
Sekim tebain mountin na bateri housin selta		
Sekim tebain autlet em i klia na ol doti na pipia ino blokim		
Banisimdispela hap na putim pedlok long kipim seif – sekim igat bagarap long banis o nogat. Stretim sapos igat.		
Sekim ras long elektrikol teminol long genereita		
Sekim bering wea na putim gris sapos em nidim		
Sekim kuplin raba wea		
Sekim V belt wea		
Genral vissol lukluk		
Lukim gut long inveta/elektrikol ped na sekim em inogat bikpela buruk i kamap o sain bilong wea. Na ol boltim inveta gut long ped long olgeta mountin hap olsem ol lain ol wokim inveta ol i tok ol mas mekim. Em mas depen long sais, ples, na ol man inogat save long tasim dispela sistem, inveta, combaina bokis, na diskonek suis i mas igat tuls o mas gat lok bilong banisim ol man inogat rait long igo na tasim ol dispela ekuipmen.		
Lukaut long wonin plakad wantaim arc flas o PPE rikuiamen bilong go holim ekuimen. Yu mas bihainim ol wonin plakad. Sapos ol ino putim plakad, o sapos plakad em i lus, raitim igo daun na putim bek long taim bai yu kambek visit long mekim mentenens		
Lukim gut ol Haidro tebain nogut sampela asua i kamap bai ol i luk olsem mak bilong samting i kuk, o kala i senis, o sampela hap samting ilus na pundaun, o ras.		
Sekim igat bilongt i lus o i no istap		
Lukim tebain waiarin istap gut na istap long electrikol tub bilong ol.		
Lukluk gut long raking sistem igat sampela asua olsem ras, bagarap, iwok long sink igo daun, samting inosap klips o bolt i buruk.		
Sekim nosel nogut igat samting i blokim.		
Lukluk gut long konduits I nidim sapot, busin, na ekspensin join, sapos igat nid		

Sekim lis aitem	OK	Stori
Sekim strakta bilong tebain housin na maunt.		
Long graun-mounted sistem, lukluk long sain bilong korosin klostu long hap i sapot		
Opim ol kombaina bokis na sekim mak bilong tokui (torkue) long koneksin. Ol mekim mak bilong tokui (torquing) taim ol taitim lag (lug) igo long trutru tokui valiu. Ol i save aplaim ol long taim bilong instelesin, tasol sapos nogat ol teknisen ken makim lag behain long tokui long taim ol kam kenlong mekim mentenens. Mak bilong trupla tokui em ol i save mekim long spesalised tokui pen. Dispela mark em stretpla line igo tru long lug na housing. Spos long sampela taim bai dispela line i separate namel long lag na housing, dispela bai soim olsem lug emi suruk igo no ol imas tokuim ken. Lukaut long ol hap pipia insaid long ol bokis na igat sain long bagarap taim wara I kam insaid. Lukim igat kala isenis o raus long teminol, bod, na ol samting i save holim fus.		
Opim cabinet dua igo long diskonek na lukluk longsain bilong korpsin o bagarap.		
Lukim ol putim gut sil bilong kabinet penetresin na lukim igat sain long wara igo insait. Sekin ol mak bilong tokui long terminal.		
Yu yet yu go na lukim insait na autsait bilong inveta. Lukim igat sain bilong wara, roden, o dusigo insait long inveta. Lukluk lo mak bilong tokui long fild temineisin.		
Sapos weda stesin istap, lukim ol sensa istap long rait ples na long rait tilt na asimut.		
Sekim Inveta		
Raitim na tok klia long ol voltes na prodaksin valu long human-masin intefas isoim em tru		
Recodim las log sistem asua.		
Kilnim ol filta		
Klinim ol insaid long kabinet		
Testim ol fans bai ol i ken wok gut		
Sekim ol fus		
Sekim tokui long ol teminal		
Sekim gaket sil		
Confemim olsem ol lebol bilong wonin istap long ples bilon ol.		
Lukluk long kala i wok long pinis bikos long bik san		
Sekim ol lait i wok gut tasol		
Sekim ol sistem bilong graun na ekuipmen graudin i wok yet		
Sekim mekanikol koneksin bilong ol inveter igo long wol o graun		
Sekim intenol diskonek operesin		
Tok out olsem i tru ol karen sofwe ol instolim		
Kontaktim ol lain i instolim/ o mekim long ol asua yu painim.		
Raitim long pepa olgeta samting yu painim na yu wok bin wokim		

Sekim lis aitem	OK	Stori
Sekim insulated get bi-pola trensista na inveta bod bilong ol kala i lus		
Yusim inspeksin mira sapos yu nidim		
Sekim input dc na ol autput ac kapasita bilong sain long bagarap bikos long ovahitin		
Rekodim ol voltes na karen retin yu mekim long displei bilong fron tebain		
Sekim apiarens/klinlines bilong kabinet, ventileisen sistem, na insulaei safeis		
Sekim korosin/ovahitin on terminal na kebol.		
Ol Tokui teminol, konekta, na bolt na keibol		
Recodim weda istap ol raun dispela hap, wantaim tempretsa long dei i ren o san		
Sekim mak istap long tupela ac na dc surs divais long ol bagarap o mak long waia i kuk		
Sekim wok bilong ol seifti divais (emejensi stop divais, dua suis, graun folt ditekta interapta).		
Lukim (kiln or repleis) ea filta elemen		
Stretim ol ditekted difisensis		
Complete maintenance schedule card. Pinisim mentenens skedul kad		
Pinisim inpeksin ripot yu bin raitim		
Sapos ol lain mekim –skulim ol istap, instol na mekim wanem samting ol i rekomendim engeniarin fild oli modifaim, wantaim softwea apdeit		
Battery Check		
Sekim sainlong elektrolit insait long sefti basket (sapos ol givim) o istap long graun, i soim bateri igat lik o ovafilin;		
Sekim kondisin bilong bateri konteina		
Sekim level bilong bateri voltes		
Sekim kondisin bilong bateri teminol-lukim samting I wok long bagarap istap		
Sekim bateri elektrolit level (ino nidim long gel sil bateries)		
Wires and connection check Sekim waia na koneksin		
Sekim igat buruk long waia na waia ol ino pasim-ripotim sapos igat buruk long waia		
Lukim ol koneksin ol solderin gut na ol karamapim		
Sekim ol lus na waia ol hangamap nating		
Sekim ol waia ol ino karamapim na oli kuk		

Hap bilong rait:

WOK 9

Printim haidro tebain sampl bilong wanwan mun masta seklis. Meik sua yu gat insuloted glav, malti mita, klam mita, gugul bilong ai, na ol sampela tul bai yu nidim long enna PPE. Yu mas train a putimsefti su (shoes) bilong wok.

Puti PPE na kisim seklis igo raun the haidro tebain sistem ol ibin instolim long wok bipo. Yu mas kontinu long bihainimol na ol i mas tikim na mekim koment long ol sek ol wokim. Ol mas kolektim laspela seklis na sekim long toktok long givim fidbak long sampela sek wok.

Diskasin na Askim

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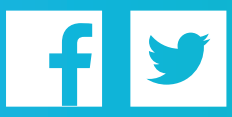

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