



Modul 10 - Lena Wokbuk

Pico-haedro Operesen mo ol Mentenens Besik

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KOICA
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Cooperation Agency

Long patnasip wetem:







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“Pico - Haedro Operesen mo Mentenens Besik” trening modul hemi blong ol teknikol lena we oli wantem blong save moa long haedro instolesen mo mentenens.

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

1. Diskraebem wanwan taeb blong Haedro Paoa Sistem.
2. Mekem lis blong ol komponent we oli yusum long Haedro Paoa Sistem.
3. Eksplenem ol rikwaemen blong komponent we oli yusum long Haedro Paoa Sistem.
4. Aedentifaem ol tul we oli yusum long Haedro Paoa Sistem.
5. Diskraebem ol prosija blong instolem mo mentenem Haedro Paoa Sistem.
6. Mekem lis blong ol sefti rikwaemen blong Haedro Paoa Sistem.
7. Aedentifaem mo risolvem ol komon fol long Haedro Paoa Sistem.
8. Demonstretem yus blong Haedro Paoa mentenens jeklis.

TEBOL 1: Lesen Plan blong wanwan sesen.

Japta	Lesen Taeb
1. Aes Breka – Introdaksen	Teori mo Aktiviti 1
2. Komponent blong Haedro Paoa sistem	Teori
	Aktiviti 2 (Opsonol)
3. Komponent Rikwaemen	Teori
	Aktiviti 3
	Aktiviti 4 (Opsonol)
4. Ol Taep blong Pico-Haedro Sistem	Teori
	Aktiviti 5 (Opsonol)
5. Ol tul we oli yusum long Haedro turbin Sistem	Teori
	Aktiviti 6 (Opsonol)
6. Instolem Haedro turbin sistem	Teori
7. Sefti Rikwaemen blong Haedro turbin Sistem	Teori
	Aktiviti 7
8. Aedentifaem mo Risolvem ol komon fol long Pico haedro sistem	Teori
	Aktiviti 8
9. Haedro turbin Mentenens jeklis	Teori
	Aktiviti 9 (Opsonol)

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: Pico-Haedro turbin intenol waearing. Sos: Powerspouts, New Zealand.

Disklema: Global Green Growth Institute i no save mekem eni jenis/waranti, we maet long ekpres o implae, o asum long eni likol laeabiliti o responsibiliti blong akuresi, komplit, o eni namba 3 pati we i yusum, o risal blong eni kaen yus, blong infomesen, aparatus, prodak, o proses disklos long ol infomesen we i kontenem long plesia o ripresentem se yus blong hem bambae hemi no go ova long praevet raet blong hem

GLOSERI

AC-Olteneting karent hemi wan taep blong elektriksiti we bigfala jenereta oli produsum blong ol bigala devaes olsem TV o masin blong was.

Jaj- Blong konektem ol waea i go long batri blong mekem voltej blong hem i go antap. Oltaem oli konektem long sola panel blong jaj.

Jaj kontrola- Samting we i kontrolem jaj blong batri mo stopem blong ino ovajaj.

Clamp mita- samting we oli yusum blong mesarem karent.

Karent- Hemi wanem we i flo long waea blong givim paoa long yumi tugeta wetem voltej.

DC- Daerek Karent hemi taep blong elektriksiti we Sola Panel i produsum. DC paoa i save ranem laet mo ol smol devaes daerek.

Damp lod- Lod o devaes we oli konektem blong kasem ekstra paoa long haedro sistem.

Elektrolaet- Hemia hemi samting we lukluk blong hem olsem wota long batri blong yu. Hemi luk olsem wota nomo be hemi gat tumas posen.

Fobei- Ples antap long strim o reva we yumi holem o kolektem wota.

Inveta- Samting we i jenisim dc elektriksiti i go long ac elektriksiti.

Lod- eniting we i tekem paoa long batri o sola panel. Maet hemi laet, fan, o frij. Eniting we i yusum elektriksiti hemi lod.

Maonting- Samting we oli yusum blong holem komponent i stap – olsem we yumi yusum wan samting blong hangem ol pija. Semak olsem yumi nidim blong fiksime gud ol panel i go long ruf maonting, blong bambae i no flae aot

Malti- Mita- Samting we yumi yusum blong gohed blong mesarem voltej. Yu no mas traem blong mesarem karent wetem hemia.

Ovajaj- Sipos yu gohed blong jajem batri taem i ful – semak olsem baket we i fulap long wota mo i ovaflo – batri bambae i save damej.

Penstok- Paep we i karem wota long strim i go long haedro turbin

Paoa- Hemi eneji we wan samting i givim ova long wan taem

Sot seket- Taem paoa i go tru long waea we ino gat lod olsem laet balb o fan we i konekt long seket. Sot seket i save damejem komponent. Taem yu mestem yu konektem ol batri teminol i save kosem sot seket mo kosem plante injuri semtaem damejem batri tu.

Teminol – Ples we yumi konektem waea. Oltaem i gat ol skru long teminol we yumi mas taetem sipos no bae waea i slak.

Valv- Olsem wan tap blong stopem o openem flo blong wota

Voltej- Voltej long waea i kombaen wetem karent blong givim paoa long yumi.

A large, white, stylized number '1' is positioned on the left side of the page. The background is a gradient of teal and blue, with a vertical line separating the left side (lighter blue) from the right side (darker teal). The number '1' is composed of two main parts: a vertical stem and a diagonal top bar that extends to the left.

Aes Breka –
Introdaksen

AKTIVITI 1

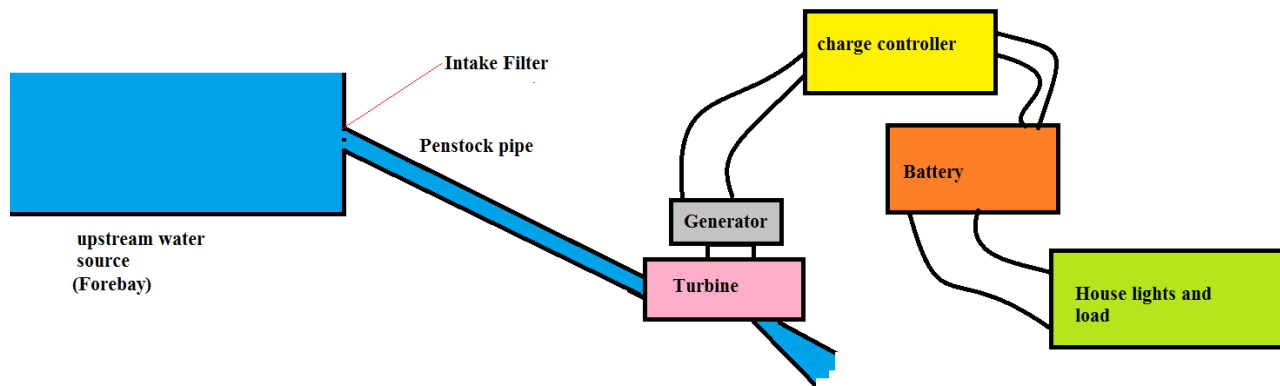
Introdusum yu wan long brif long ol narafala fren long klas. Talem nem blong yu mo yu blong wea. Mo tu talemaot wanem yu stap mekem oltaem long taem olsem. Yu gat eni eksperiens wetem haedro paoa bifo? Wanem nao lukluk blong yu long haedro paoa? Talem long trena wanem yu wantem blong lanem long trening modul ya.

2

**Komponent blong Pico –
Haedro Sistem** —————

Pico-Haedro sistem hemi wan smol vesen blong bigfala haedro dam turbin mo long plante kes i kontenem semak set blong ikwipmen. Fika daon i soem ol difren komponent we i mekemap wan pico- haedro sistem.

FIKA 1: Komponent blong wan Pico Haedro Sistem¹



2.1 Weir/Wol

Hemia wan wol we man i bildim krosem reva blong kipim level blong wota long wan konsten level blong mentenem wan flo we i gohed tru long intek.

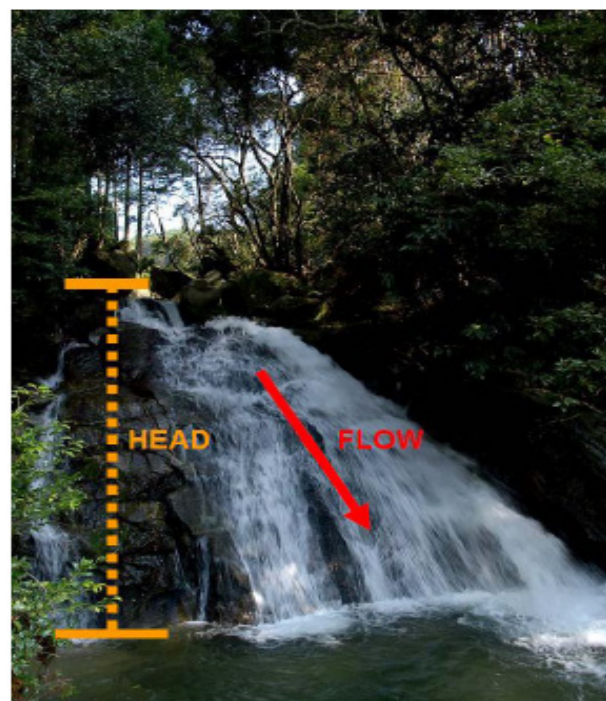
2.2 Intek

Intek blong haedro paoa oli disaenem blong daevetem nomo wan pat blong strim blong flo o komplit flo dipen long ol kondisen blong flo mo rikwaemen.

2.3 Fobei - Apstrim Wota sos

Hemia hemi wan krik o strim we hemi hae lelebet bitim lokesen blong turbin blong wota bambae i kam doan long wan hae flo ret.

FIKA 2: Hed mo Flo blong wota sos²



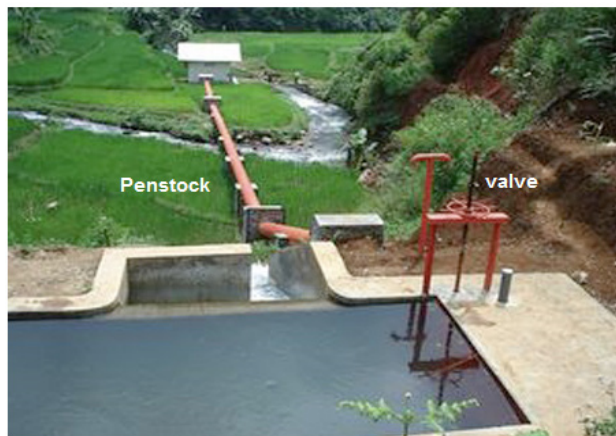
¹ Source: DocPlayer, Manual for Renewable Energy Source, <https://docplayer.net/45114164-Manual-per-burimet-e-energijve-te-rinovueshme.html>, accessed 21 June 2021.

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

2.4 Penstok paep mo valv

Moa penstok oli gat filta we i fit long stat blong priventem ol ston mo hip doti blong go insaed long turbin. Oli plesem ol filta tu jes bifo turbin blong semak pepos tu.

FIKA 3: Penstok mo inlet valv³



FIKA 4: PVC paep penstok⁴



2.5 Valv mo ol filta

Difren taep blong valv we yumi save yusum long Pico Haedro sistem blong kontrolem flo blong wota.

FIKA 5: Flange Bataflae valv⁵



FIKA 6: Flang get valv⁶



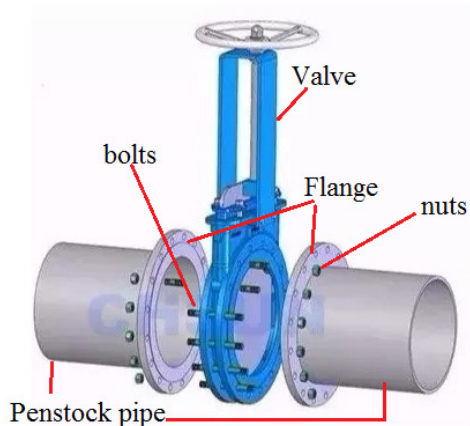
Flange taep koneksen oli komon long stil penstok. Hemi alaoem ol valv blong konekt long ol flanges oslem i soem daon.

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

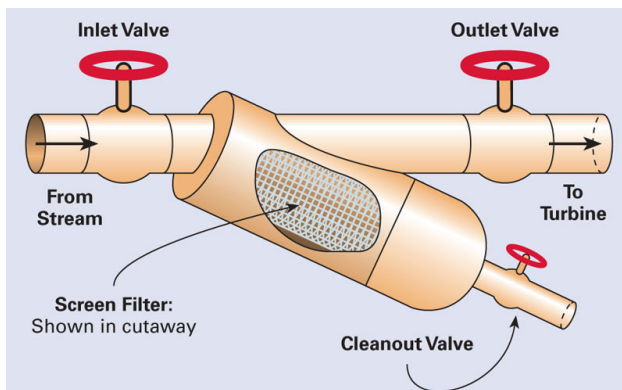
⁴ Source: Creative Commons, adapted from Energypedia, https://energypedia.info/wiki/File:Penstock_La_Laguna.JPG

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

FIKA 7: Flange i konektem valv blong Penstok blong flo rekulesen⁷

Samfala penstok oli gat “Y” taep blong paep we i aloem instolesen blong skrin filta bitwin long inlet mo aotlet. Oli putum ol klinaot valv blong kliaremaot ol rabis mo ol doti we bambae i muv daon long paep folem graviti. setap ya i soem long fika daon:

Fika 8 : Y taep filta long penstok lukim difren valv⁸

2.6 Turbin

Turbin i konvetem enei blong wota we i foldaon long wan haet i go long rotesonal enei. Turbin i konekt long jenereta blong jeneretem elektriksiti.

Samfala taep blong wota turbin i save yusum long Pico haedro instolesen, seleksen i dipen long hed blong wota, volum blong flo, mo ol fakta olsem avelebiliti blong ol lokol mentenens mo transpot blong ikwipmen i go long eria.

2.6.1 Pelton Turbin

Pelton's padel jiometri oli disaenem blong taem rim i ron long haf spid blong wota jet, wota i lego wil wetem smol spid nomo; be, disaen blong hem i ekstraktem moa klosap evri wota impuls enei—we i alaoem blong turbin i operet efisient (80-90%).

FIKA 9: Bigfala Pelton Turbin Rana⁹

2.6.2 Turgo Turbin

FIKA 10: Pico haedro Pelton turbin¹⁰

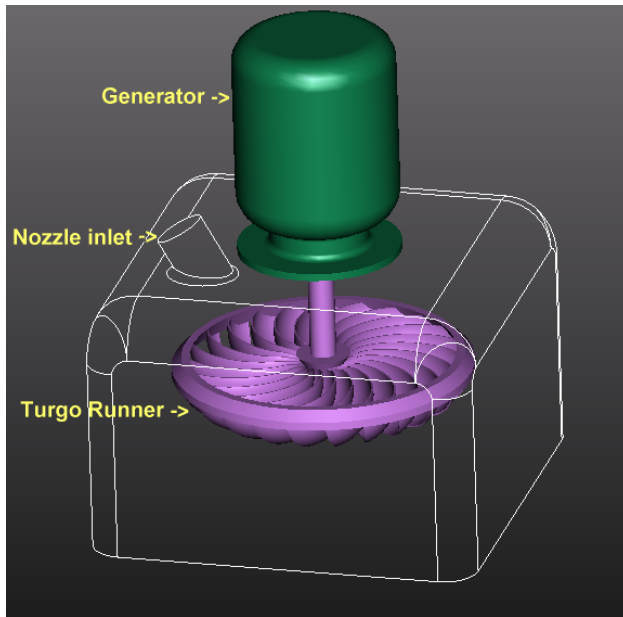
Turgo turbin hemi wan impuls wota turbin we oli disaenem blong medium hed aplikesen. Plante Pico Haedro turbin oli mekem yusum Turgo turbin folem simplisiti blong konstraksen mo isi instolesen

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

8 Source: Home power, www.homepower.com

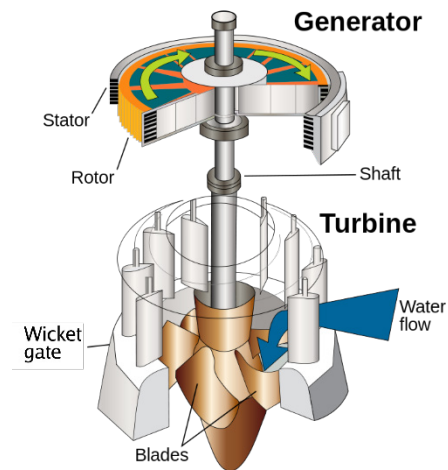
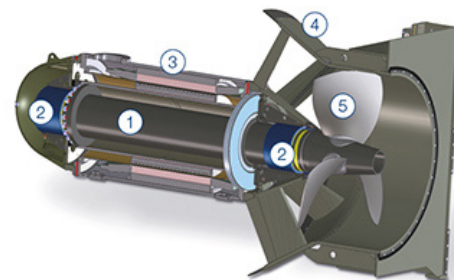
9 Source: Techno-science.net, <https://www.techno-science.net/illustration/Definition/220px/Pelton-400kW-roue-1.JPG>, accessed 21 June 2021

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

FIKA 11: Turgo Turbin¹¹FIKA 12: Wota i hitim baket long wan ankol insaed long Turgo turbin¹²

2.6.3 Kaplan turbin

Wan oltenetiv long tredisional kaplan turbin i bigwan long deamita, slo ten, pemenan magnet, slop open flo (loa hed) VLH turbin wetem efisiensi blong 90%.

Fika 13: Vetikal aksis Kaplan turbin wetem jenereta¹³FIKA 14: Balb taep VLH kaplan turbin¹⁴

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

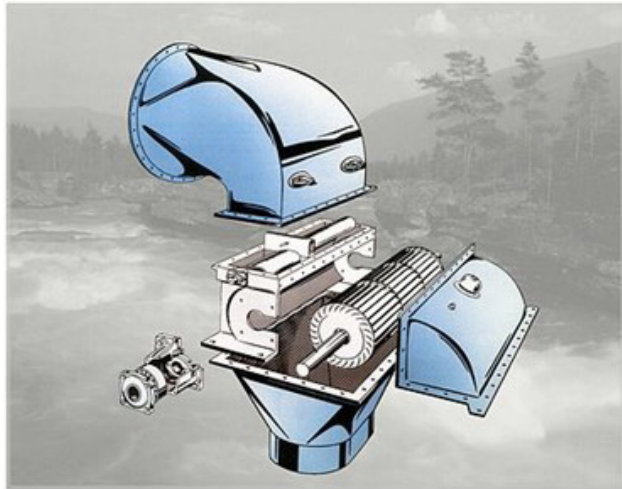
12 Source: SCRIBD, "Impact of jet impulse momentum principle", <https://html.scribdassets.com/2k5s3iose83t52ii/images/1-453f23ae7b.jpg>

13 Source: [green-mechanic.com](https://www.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.i/teaser.jpg

2.6.4 Crosflo Turbin

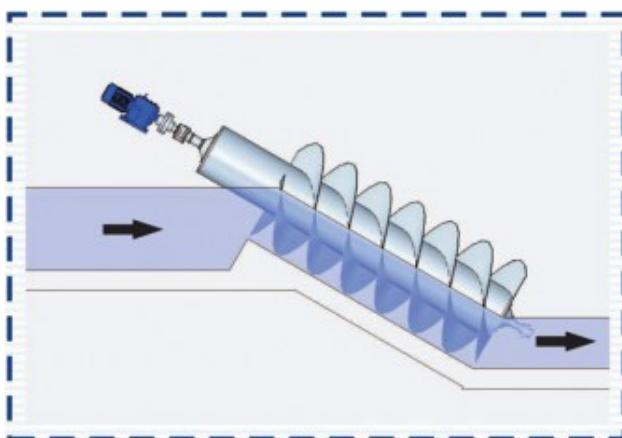
FIKA 15: Crosflo Turbin¹⁵



2.6.5 Skru Turbin

Skru turbin hemi wota turbin we i yusum prinsipol blong Archimedean skru blong konvetem potensol eneji blong wota long wan apstrim level long wok. i save kompea long wota wil.

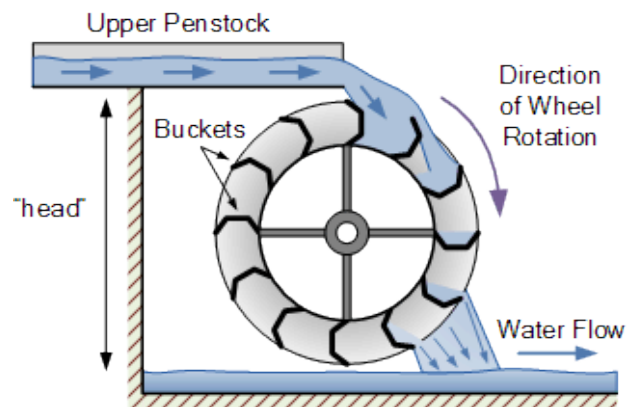
FIKA 16: Skru taep turbin¹⁶



2.6.6 Wota wil

Wota wil hemi wan masin blong konvetem eneji blong wota we i flo o foldaon i go long yusful fom blong paoa, oltaem long wota mil.

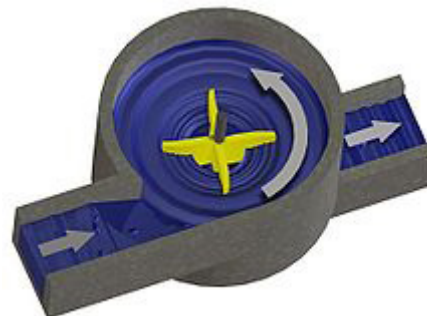
FIKA 17: Ovasot wota wil¹⁷



2.6.7 Gravitesen wota vorteks Paoa Plant

Gravitesen wota vorteks paoa plant hemi wan taep blong macro haedro paoa plant we hemi kepabol blong produsum eneji yusum wan loa hydraulik hed blong 0.7–3 mita (2 ft 4 in–9 ft 10 in).

FIKA 18: Wan simpol gravitesen wota vorteks turbin¹⁸



2.6.8 Komon Pico Haedro Turbin

Smol skel Pelton turbin oli yusum blong wan pico skel haedro paoa wetem propela turbin mo kros flo turbin. Be, sam taem i pas, Turgo turbin oli kamaot long maket blong Pico haedro turbin from se i isi long manufakja mo praes i lo.

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>

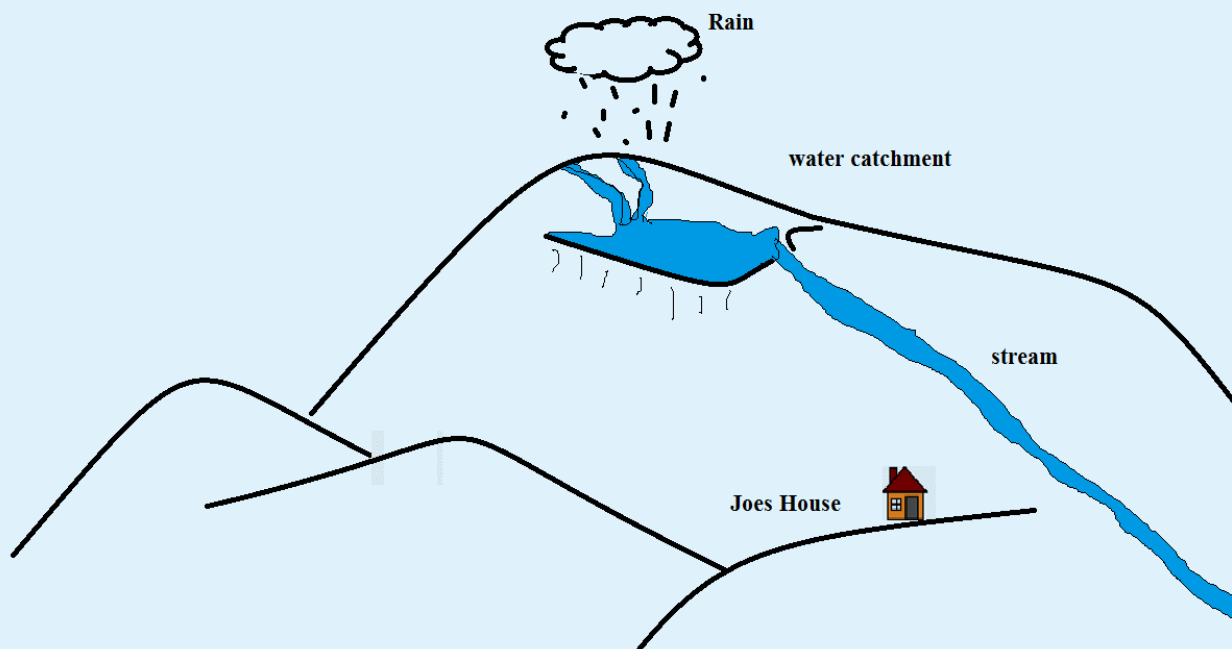
18 Source: Wikimedia Commons, "Gravitation water vortex power plant", <https://en.wikipedia.org/wiki/File:Wasserwirbelkraftwerk.jpg>, accessed 21 June 2021.

OI Not:

AKTIVITI 2

Konsidarem droing blong wan apa strim kajmen eria mo haos blong Joe. Long semak droing, yu rikwae blong mekem wan skej long olsem wanem wan Pico haedro turbin bambae i stap long haos blong Joe blong yusum. Wea nao bambae turbon

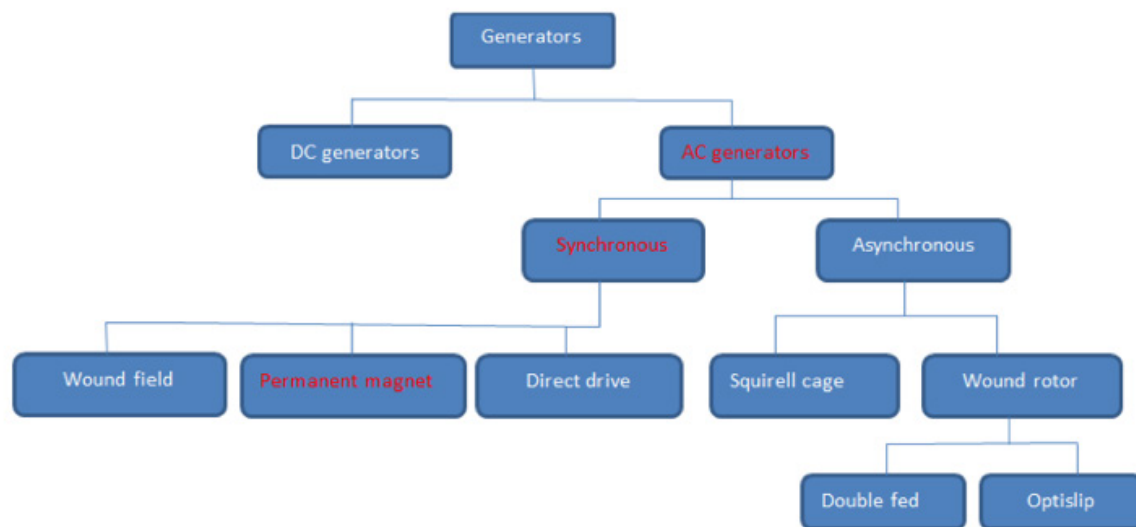
i stap? Weples nao bambae penstock i go? Turbin bambae i stap wea? Oli save mekem long ol tim. Long semak droing mak, total hed we i avelebol long turbin.



2.7 Jenereta

Plante haedro sistem oli kam wetem jenereta we i joen long turbin. Jenereta hemi devaes we i konvetem mekanikol enej i go long to elektrikol enej blong yusum long ekstenol seket.

FIKA 19: Ol taep blong AC Jenereta ekspand¹⁹

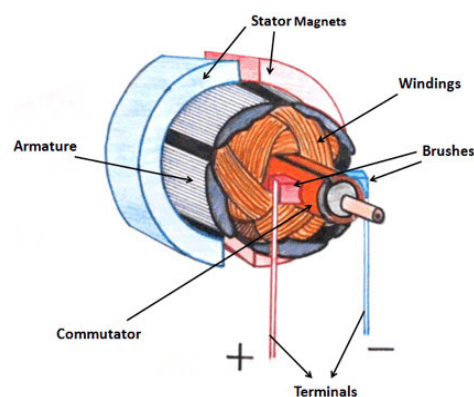


Pemenan magnet (PM) jenereta i komon long macro haedro paoa aplikesen. Hemia ol simpol jenereta we oli gud tumas mo oli kam long AC mo DC taep.

Pemenan magnet synkronas/synchronous jenereta hemi wan jenereta we eksitesen/excitation fil i provaed tru long wan magnet long ples blong wan coil.

2.7.1 PM DC jenereta

FIKA 20: Wan PM DC Jenereta²⁰

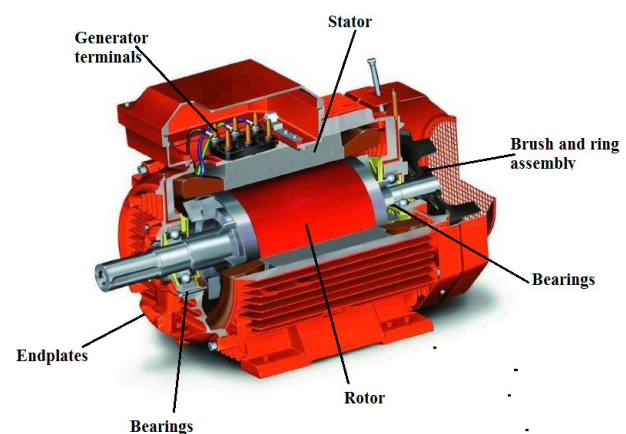


2.7.2 Indaksen Jenereta

Wan indaksen jenereta o asynchronous jenereta hemi wan taep blong olteneting karent (AC) elektrikol jenereta we i yusum prinsipol blong indaksen moto blong produsum elektrik paoa.

Ol taeb blong jenereta ya oli komon long haedro turbin. Olgeta ya oli moa yusful taem haedro turbin oli grid konekt.

FIKA 21: Ol Pat blong wan indaksen jenereta²¹



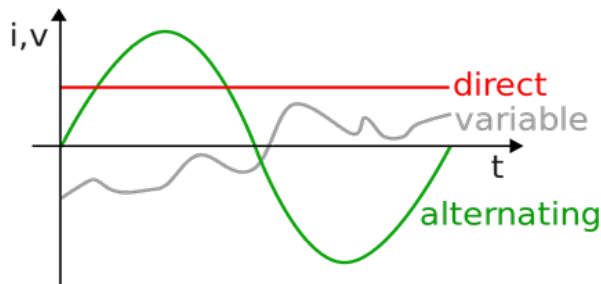
¹⁹ Source: GGGI, Fiji.

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>.

Elektriksiti we i saplae long grid hemi taeb blong olteneting karent (AC) elektriksiti. Hemia hemi wan sinusoidal wev olsem long Fika 22.

FIKA 22: Daerek, variabel, mo olteneting karent²²



2.8 Jaj Kontrola

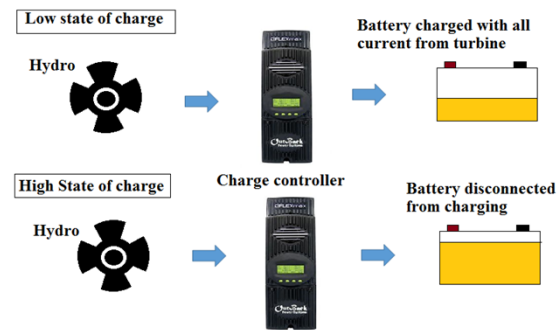
Jaj kontrola i limitim ret long taem we elektrik karent i adap o kamaot long ol elektrik batri. Hemi priventem ovajaj mo i save protektem agens ovavoltej. Pico Haedro Jaj kontrola i operet anda long moa hae karent bitim sola jaj kontrola.

FIKA 23: Haedro-Paoa Jaj Kontrola²³



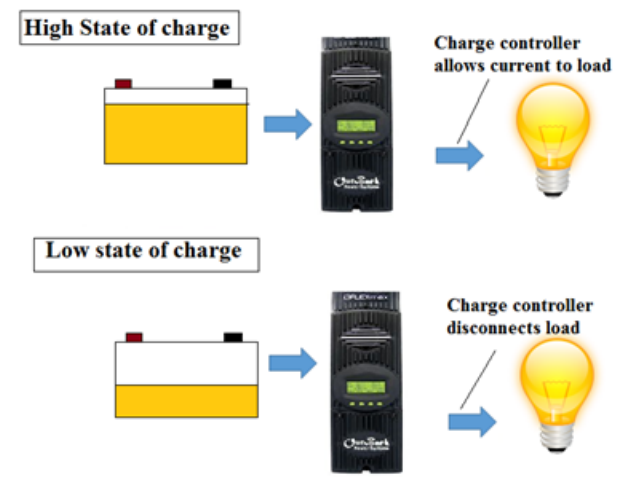
1. Ova-jaj proteksen
2. Taem batri voltej i lo, jaj kontrola i kontinu blong konektem Haedro turbin i go long batri blong jajem.
3. Taem batri voltej hemi hae, jaj kontrola i otomatikoli diskonektem Haedro turbin blong batri blong stop jaj.

FIKA 24: Ova-jaj proteksen²⁴



1. Ova-disjaj proteksen
2. Taem batri voltej i hae, jaj kontrola otomatikoli konektem lod i go long batri.
3. Taem batri voltej i go lo, jaj kontrola otomatikoli diskonektem lod long batri.
4. Seket konfikuresen daon hemi rikomend,

FIKA 25: Ova disjaj proteksen²⁵

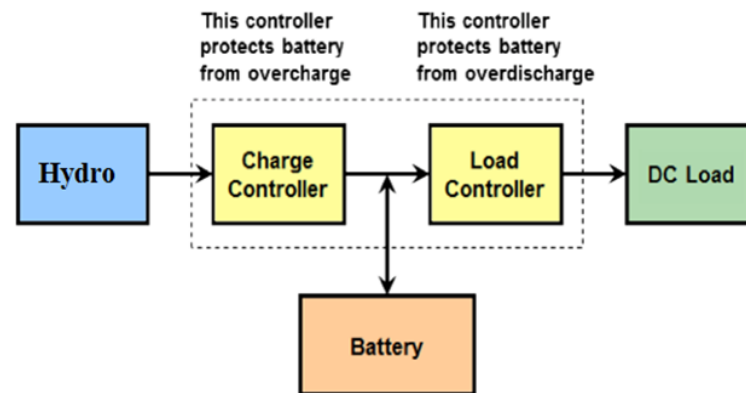


²² Source: PNGWing.com, "Alternating current Direct current Electric current Electricity Electric power", <https://www.pngwing.com/en/free-png-czyuz>

²³ Source: Amazon.ca, "Charge Controller", <https://www.amazon.ca/OutBack-Power-FM60-150VDC-FLEXMax-Controller/dp/B00IVC7BYC>

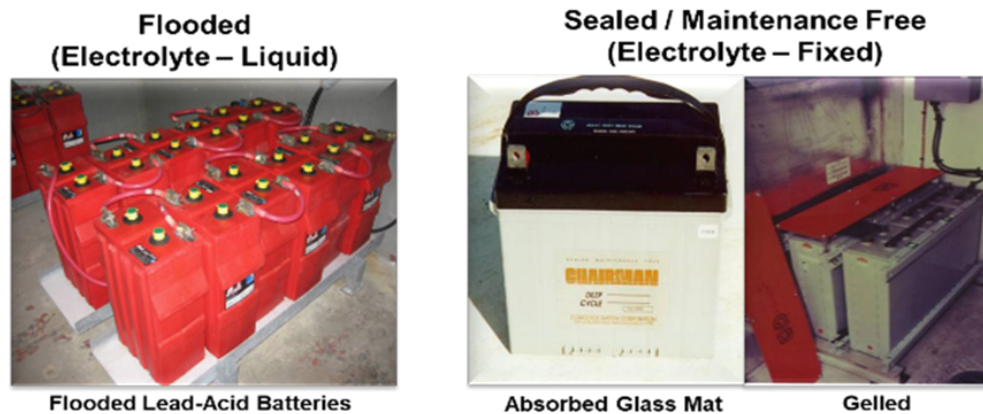
²⁴ Source: JICA

²⁵ Source: JICA

FIKA 26: Rikomend konfigurasi²⁶

2.9 Oli Batri

Batri hemi wan devaes we i save storem elektrikol enoji long fom blong kemikel enoji mo konvetem enoji ya i go long elektriksiti. Hemia semak batri we oli yusum long sola o win paoa sistem. Batri kapasiti hemi mesa long Amps Aoa. Hemia nao oslem wanem plante Amps i save dilivarem long wan aoa.

FIKA 27: Sil Batri²⁷FIKA 28: Difren taep blong batri²⁸

- **Batri Kapasiti:**

1. Kapasiti hemi hemi wan mesa blong elektrik jaj we i storem o enoji we i storem long wan batri i save diliva anda long spesifik kondisen.
2. Ampere-aoa (Ah) hemi unit mesamen blong batri enoji storej kapasiti mo ikwel blong transfe blong wan ampere blong wan aoa.

²⁶ Photovoltaic Systems, Dunlop 2nd Ed

²⁷ Source: JICA

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

2.9.1 Flad Batri

Hemia hemi enjin stat, trakta, mo dip saekol-stael batri. Ol popula yus hemi enjin stat mo dip saekol disaen.

2.9.2 Sil Batri

O popula yus oli enjin stat mo limit stat/dip saekol aplikesen.

2.9.3 Absob Glas Mat Batri (AGM)

Popula yus inkludum hae pefomens enjin stat, paoa spot, dip saekol, haedro, mo storej batri.

2.9.4 GEL Batri

Gel batri oli yusum bes long saekol aplikesen mo i save las long smol long hot weta aplikesen.

2.11 Seket Breka/Aesoleta

Seket breka besik fansen hemi blong intaraptem karent flo afta we oli faenemaot wan fol. Wan aesoleta hemi wan mekanikal swij devaes we, long open posisen, i alaoem aesolesen blong input mo aotput blong wan devaes.

FIKA 30: Seket Breka mo Aesoleta³⁰



2.10 Ol kebol

FIKA 29: Ol Kebol²⁹



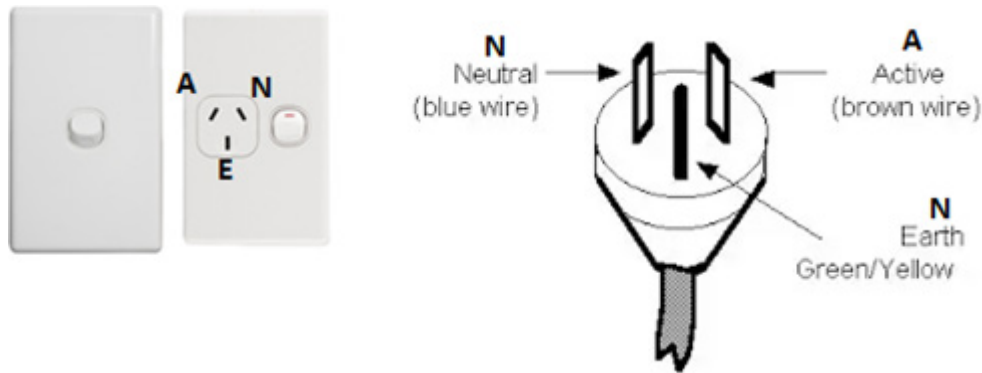
Elektrikol kebol oli yusum blong konektem 2 (tu) o moa devaes, we i save mekem transfe blong elektrikol siknol o paoa long wan devaes i go long narawan.

2.12 Swij mo Paoa Soket

Swij i aesoletem elektriksiti mo paoa soket oli yusum blong konektem/diskonektem aplaens blong yusum elektriksiti

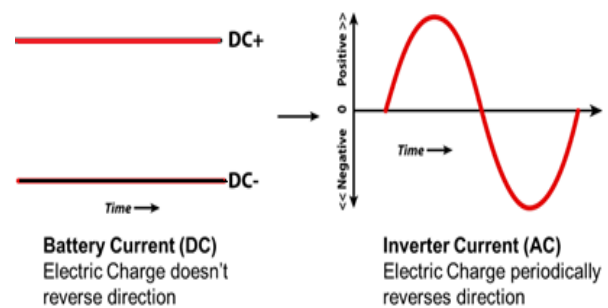
²⁹ Global Market, http://newimg.globalmarket.com/PicLib/group0/5e/73/c477defc613ecc9a0e47b82452f4_l.jpg

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>

FIKA 31: Swij mo Paoa Soket³¹**2.13 Inveta**

Inveta hemi elektronik devaes o seketri we i jenisim daerek karent (DC) i go long olteneting karent (AC). I gat ol difren taep blong inveta blong difren fansen. Blong selektem wan inveta blong standalon sistem hemi bes long ol spesifikesen daon:

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

FIKA 32: Inveta³²**FIKA 33: Fansen blong Inveta³³****2.14 Divesen Lod o Damp lod**

Wanem i hapen long ekses enejji?

Long plant keses, wan divesen lod oli yusum blong absobem evri ekses paoa lo wan sev fasin. Hemia oli kolek tu shunt resista o damp lod.

FIKA 34: Damp lod o divesen lod long fom blong resista³⁴

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://vottec.asu.edu>

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

FIKA 35: Damp lod wetem kuling³⁵

Divesen lod we i absobem elektriksiti i save yusum tu wetem batri long DC sistem taem batri i no save absobem eksese eneji.

FIKA 36: Sam jaj kontrola oli kam redi built wetem damp lod mo seket³⁶

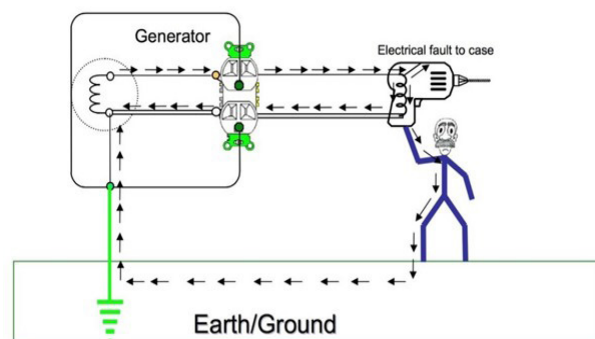
2.15 Elektronik Lod Kontrola

Long moa taem we i jes pas wan devaes oli kolem Elektronik Lod Kontrola (ELC) oli yusum blong rekuletem voltej mo frikwensi. Taem lod hemi ridius ELC i daevetem paoa i go long damp lod (lukim topik antap) blong voltej hemi redi.

FIKA 37: Taep blong haedro Elektronik Lod Kontrol unit³⁷

2.16 Et mo Graonding komponent

I rikwae blong graondem evri haedro sistem from taem yu graondem gud sistem bambae i help blong protektem yu long ol janis blong sok mo posibol ded (nating we long taem blong eni surj mo laetning).

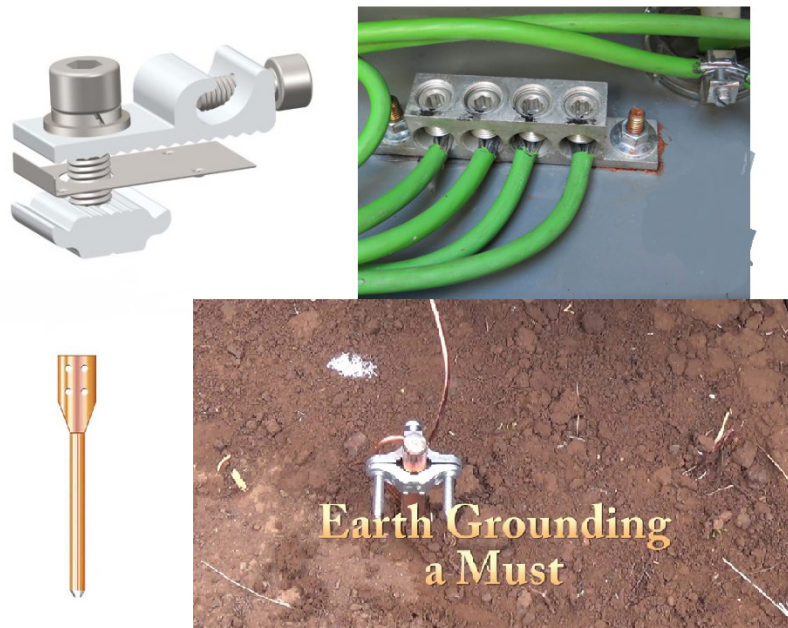
FIKA 38: Olsem wanem blong graon³⁸

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

36 Northern Arizona Wind and Sun, 'Wind and Hydro Charge controller', <https://www.solar-electric.com/midnite-solar-kid-mppt-wind-hydro-charge-controller.html>

37 Source: Dhava Mani Technologies, <https://1.bp.blogspot.com/-xzLAukzxFa0/V5yP24mX13I/AAAAAAAAAQA/-JbVKYtI3kHFxXi04uWK8cV7seCBIIEACKgB/s1600/2dumpe-ditmetal.png>

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

FIKA 39: Graonding komponent³⁹

OI Not:

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

3

Komponent
Rikwaemen

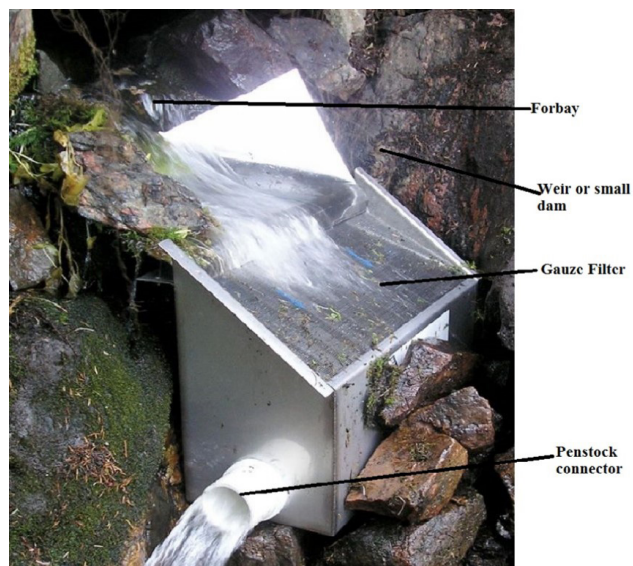
3.1 Fobei Apstrim Inlet

Fobei o apstrim inlet maet i rikwae wan smol wol o dam we oli mekem long ston blong krietem wan pampa blong wota blong flo daon long penstok.

Ol narafala rikwaemen:

1. Mekemsua se hed (vetikol haet long turbin lokesen i go long apstrim wota sos) hemi semak o moa long wanem oli stetem long turbin.
2. Mekemsua ol slop oli stebol blong sedimen fobei jekem ol dam.
3. Mekemsua se eria hemi gat isi akses.

FIKA 40: Fobei wol wetem filta mo penstok konekta⁴⁰



3.2 Penstok

Penstok o diliveri paep i nidim blong fleksibol politilin (Polyethylene) o PVC presa paep.

FIKA 41: Presa paep blong ol difren hed⁴¹

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 Turbin mo jenereta

Blong Pico-haedro sistem, lo hed turbin we i operet long lo flo ret hemi rikwae. Lo hed i minim se oli save ran wetem wan smol haet blong wota. Lo hed hemi klasifae olsem, 20m o daon.

3.4 Jaj Kontrola

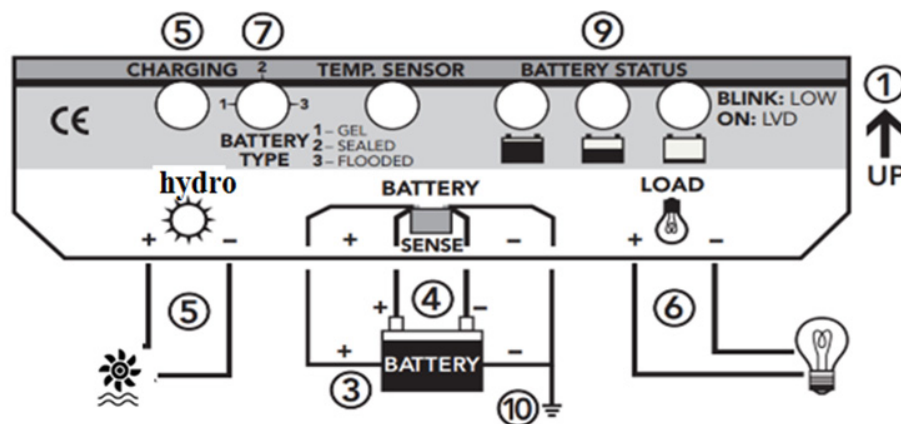
Semak olsem yumi yusum tem jaj kontrola tu long Sola PV sistem, jaj kontrola we oli yusum long haedro paoa sistem i dil wetem moa hae karent kompea long ol sola jaj kontrola. Yu NO MAS yusum nomol sola kontrola long wan Pico-Haedro sistem. Be sola jaj kontrola mo haedro jaj kontrola oli kosap semak – tufala i dil tugeta wetem difren magnitud blong

karent. Ol bigfala jaj kontrola we oli save handelem karent i go antap isi blong 50A i nidim blong yusum.

Jaj kontrola hemi mas:

1. Gat wan stret karent kapasiti blong tugeta jaj (ampere long haedro turbin) mo blong operetem ol lod (lod karent)
2. Akomodetem haedro input voltej mo batri voltej.
3. Gat wan hae DC paoa we i rikwae blong kumuletem lod.
4. Fleksibol blong wok wetem difren tap blong batri (flad o seal lead-asid batri)
5. rilaeabol - simpol kontrola oli moa rilaeabol bitim olgeta we oli had tumas (avoidem kompleks ekstra “strakja” olsem LCD skrin, maekro-prosesa program kontrol, etc.)

FIKA 42: Jeneral skematik blong wan Jaj kontrola⁴²



3.5 Ol Batri

Ol Batri oli strorem elektriksiti mo oli NO jeneretem elektriksiti.

Ol batri oli gat hae ret blong fol long haedro paoa sistem.

FIKA 43: Batri Spesifikesen⁴³

SPECIFICATIONS

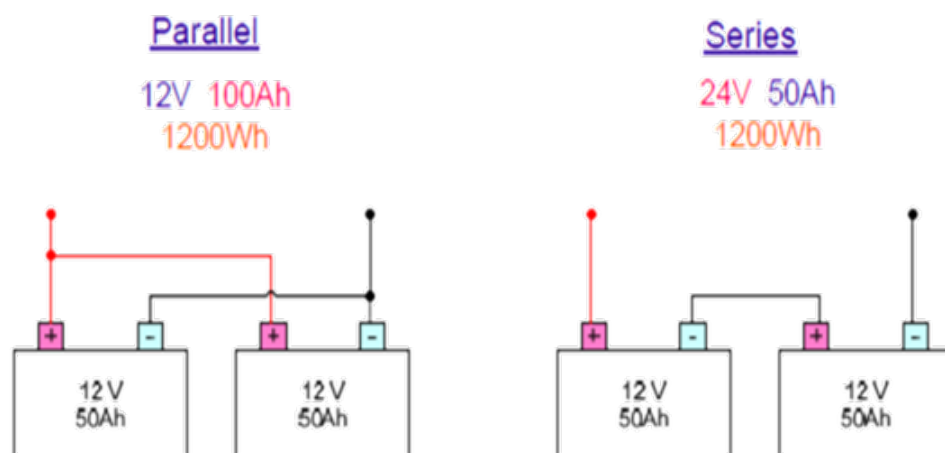
Nominal Voltage		12 Volts	
Amp Hour Capacity		115 (C20)	90(C5)
Reserve Capacity Minutes		170 @ 25 Amperes	
Physical Characteristics	Length	13.13"	334 mm
	Width	6.75"	171 mm
	Height	9.38"	238 mm
	Wet Weight	58 Lbs	26.4 Kgs
Terminal Options		BCI Type M	

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%

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>

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

FIKA 44: Taeb blong Batri Koneksen⁴⁴**3.5.1 Samfala ki poen**

1. Paralel koneksen i totolemap kapasiti (Ah).
2. Seris koneksen i totolemap voltej (V).
3. Total enej storej i stap semak (Wh).
4. NO MAS paralel moa long 4 batri, from hemia i kosem anikwel batri jaj mo disjajing, we hemi save kosem primajua batri feilia).
5. YU NO miksim ol difren taep, model, mo yia blong ol batri, from hemia i save kosem primajua batri feilia.
6. Mas maontem batri long wan gudala ventilet ples mo protektem long san mo ren. Neva putum batri insaed long haos.
7. Batri jaj ikwipmen bae hemi wan we i had blong waearem, yu no mas yusum temporari koneksen.

8. Mas haedem ol teminol blong batri blong priventem janis blong sot seket i hapen.
9. Mekemsua se safisen kliarens bitwin teminol mo metol wol.

Yusum ol insulet tul long taem blong eni wok long batri.

3.6 Inveta

Tebol antap i soem samfala ki strakja mo spesifikesen blong wan inveta.

TEBOL 2: Spesifikesen mo ol fija blong wan Inveta

Spesifikesen & Fija	
Paoa retin i kontinu (300 Watts at 25°C)	Total Hamonik Distosen (< 4%)
Hae Paoa Ret (600 Watts long 25°C)	Lo Voltej Diskoneksen (LVD) (11.5V or 10.5V)
DC Input Voltej (10.0V – 15.5V)	Lo Voltej Rekoneksen (12.6V o 11.6 V)
Wev fom (Pure sine wave)	LVD Woning Treshold (11.8V o 10.8V)
AC Aotput Voltej (220V o 115V +/- 10%)	LVD Dilei Period (4 minit)
AC Aotput Frikwensi (50 o 60 Hz +/- 10%)	Hae Voltej Diskoneksen (15.5V)
Hae Efisiensi (92%)	Haen Voltej Rikoneksen (14.5 V)

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

FIKA 45: Spesifikesen blong wan Inveta⁴⁵

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℃

Ol Not:

[illegible]

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\(THD%E2%89%A43%25\)](https://manualzz.com/doc/52962368/giandel-ps-600jar-power-inverter-user-manual#:~:text=Item%20PS%2D600JAR%20Continuous%20power,wave%20(THD%E2%89%A43%25))

AKTIVITI 3

Instrakta blong yu bambae i provaedem tufala batri long yu. Konektem long seris mo paralel. Mesarem totol voltej blong wanwan setap. NO MAS mesarem karent. Mekemsua blong werem ol insulet glov.

Batri (x2)



Kebol



Multimita



AKTIVITI 4

1. Taem bambae yu provaedem long lena wetem evri komponent we yumi diskasem antap (Haedro turbin, Kontrola, Batri, Inveta mo 12 DC laet wetem fiksja.

Bambae trena i ridim/aedentifaem evri infomesen we oli raetem long komponent folem ol not antap.

2. Blong semak plet daon wanem hemi paoa aotput mo hed blong turbin we i rikwaem.



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 Taep blong Pico-Haedro
Sistem

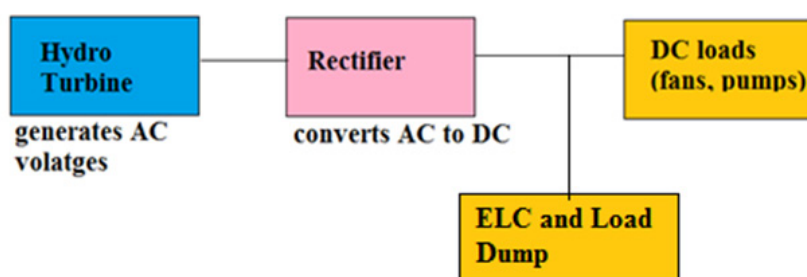
I gat trifala taep blong haedropaoa sistem. On-grid haedropaoa sistem ya; Standalon haedro (AC) paoa sistem; Standalon haedro (DC) paoa sistem mo Hybrid haedropaoa sistem.

4.1 Standalone Pico haedro (DC) paoa sistem

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

4.1.1 Standalon Pico haedro (DC) paoa sistem we i nogat batri

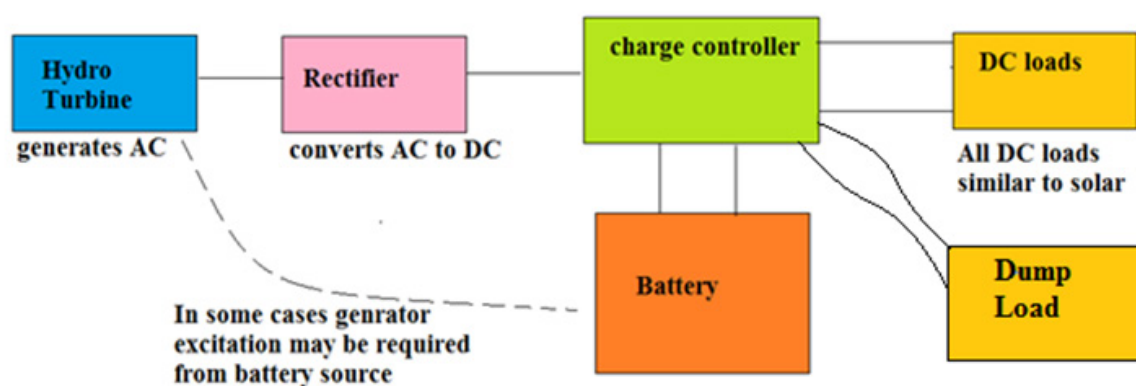
FIKA 46: Taeb blong DC sistem we i nogat batri⁴⁶



1. Sistem ya oli disaenem espeseli blong wok long taem blong hae wota flo, sipos i gat inaf paoa blong jeneretem haedro sistem blong saplae ol lod.
2. NO MAS traem blong paoarem ol lod daerek i go long haedro turbin from i save kosem damej long lod. Blong darek long koneksen maet yu rikwae wan koneksem blong wan ELC tugeta wetem damp lod. Ol damp lod oli mekesua se ekses eneji i konvetem hit o ol narafala fom.

4.1.2 Standalon pico-haedro (DC) paoa sistem wetembatri

FIKA 47: Taep blong standalon DC paoa sistem wetem batri⁴⁷



⁴⁶ Source: VOCTEC

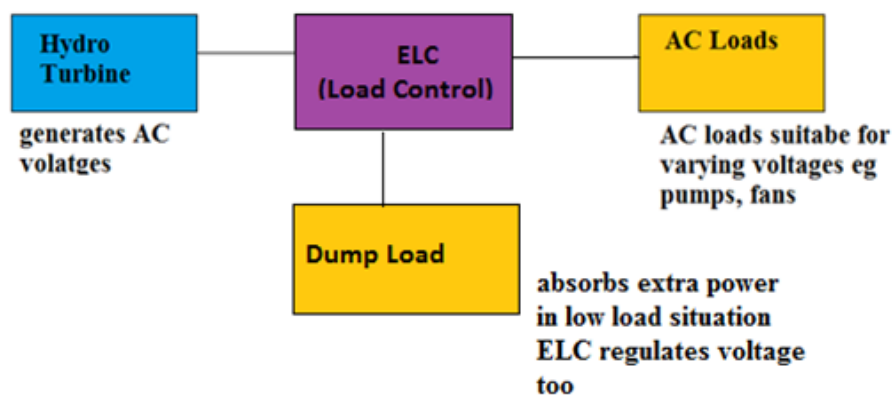
⁴⁷ Source: VOCTEC

1. Save gat ol narafala DC lod olsem DC fan, jajem mobael fon tru long USB port, etc.
2. Oli yusum moa long ol smol hom long rurol eria we i nidim nomo laet mo ol samting blong jajem fon mo ino hevi AC elektrikol aplaens.
3. Plante DC jenereta oli gat bild-in rektifaea.
4. Samfala haedro jaj

4.1.3 Standalon pico-haedro AC paoa sistem – AC Daerek sistem

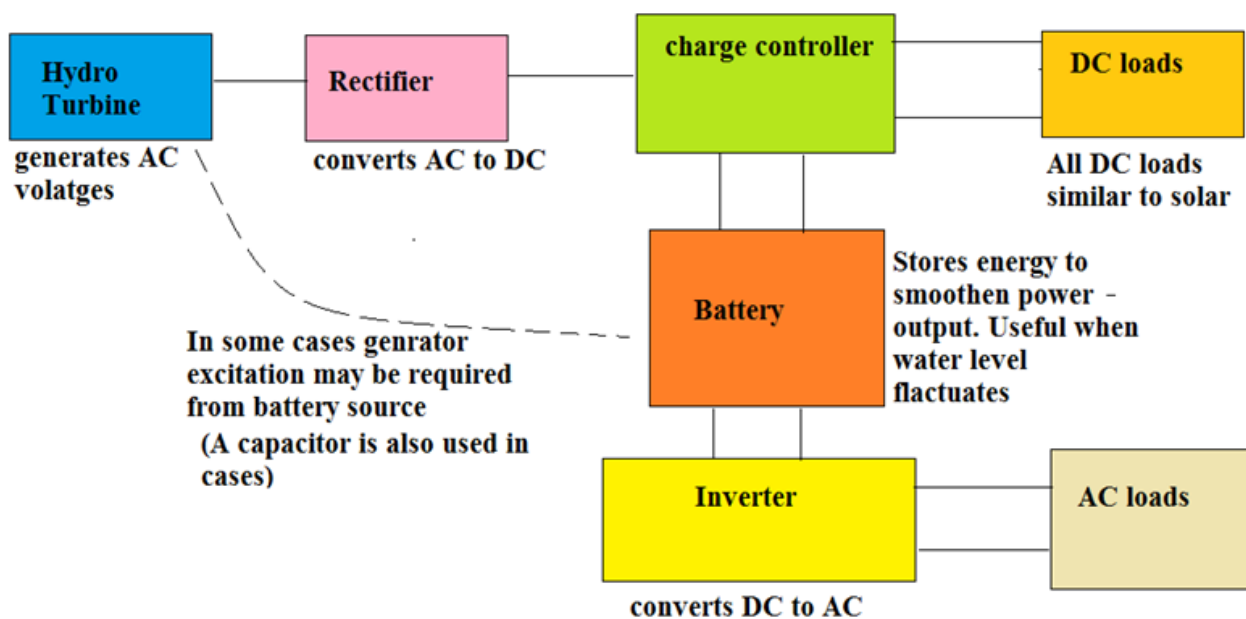
Long standalon AC sistem, aotput blong jenereta hemi AC voltej mo konekt daerek long ol AC lods. Evri jenereta oli developem AC voltej – be i dipen long hed mo flo blong wota, maet voltej aotput i no smut tumas mo i save difren. Hemia hemi simpol sistem

FIKA 48: Standalon AC sistem⁴⁸



4.1.4 Standalon haedro (DC+AC) paoa sistem wetem batri.

FIKA 49: Standalon haedro (DC+AC) paoa sistem wetem batri⁴⁹



48 Source: VOCTEC

49 Source: VOCTEC

1. Smut paoa aotput nating we wota level i lo.
2. Semak sistem olsem “DC lod nomo” be i gat ol adisional inveta blong alaoem paoa blong AC lod tu.
3. NO MAS jenisim AC i go long DC lod. DC lod i MAS paoa tru DC saplae NOMO. NEVA PAOA DC LODS WETEM AC SAPLAE. **I gat BIGFALA RISK blong ikwipmen damej, sirias injuri o iven ded.**
4. Yusum moa long ol medium saes hom we oli gat laet, fon blong jajem mo smol AC aplaens nid.

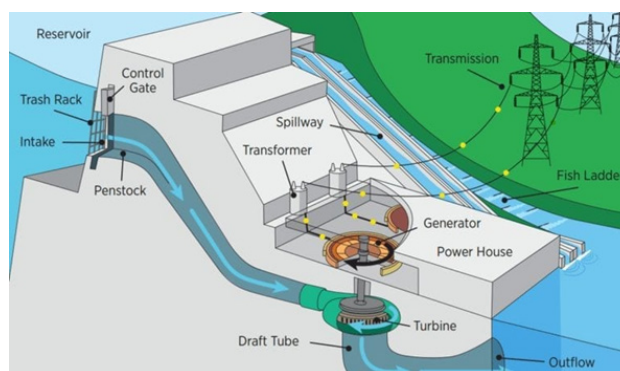
4.2 On-grid Pico haedropaoa sistem

Ol taep blong sistem ya oli moa komon long ol eria we grid infrastrakja hemi stap. Ol haos wetem grid-koneksen oli yusum haedro paoa fastaem bifo oli yusum elektriksiti long grid, taep blong sistem ya oli no yusum long ol rurol komuniti, wea maet grid elektriksiti i no avelebol o blong avoidem kompleksiti mo kipim wan simpol standalon sistem.

Ol Not:

[illegible]

FIKA 50: On-grid o grid koneksi setiap⁵⁰



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

AKTIVITI 5

Go long ol tim blong 4 o moa mo ansarem ol kwesten daon:

Droem eni bigfala taep blong haedropaoa sistem mo lebolem ol wanwan komponent.

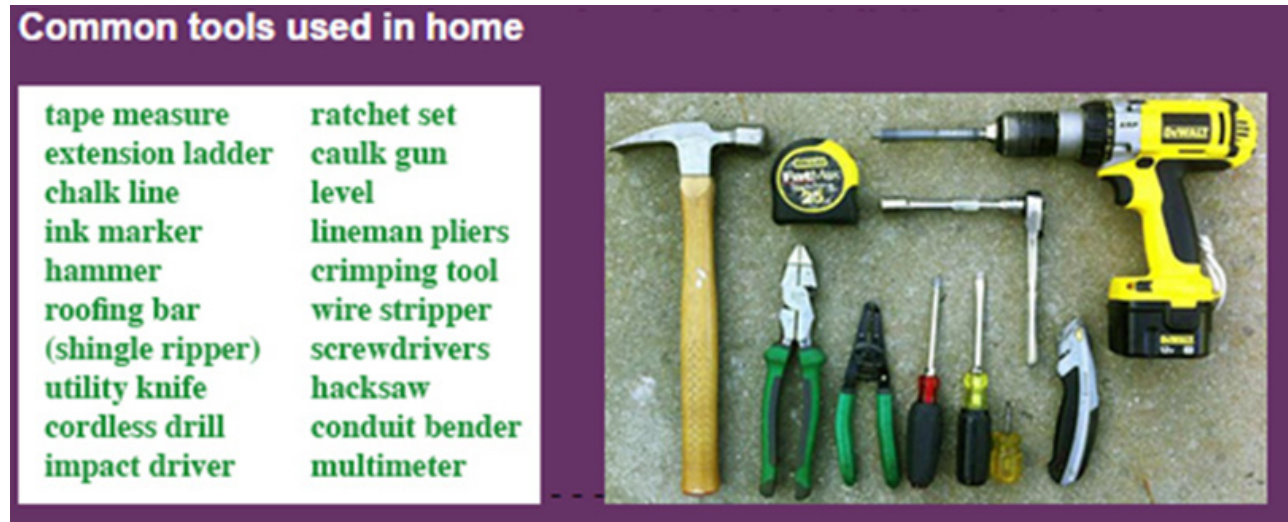
Diskasem long klas wiswan sistem bambae yu jusum mo from wanem?

5

Ol Tul we oli yusum long
Haedro Turbin Sistem —

Hemi ol komon tul we man i nidim long taem blong instolesen blong Haedro turbin sistem.

FIKA 51: Ol Komon tul⁵¹



5.1 Ol Spesifik Tul mo ol fansen blong hem

Pija blong ol Tul	Ol Nem blong ol tul	Yus blong ol tul mo ol wok blong ol tul
 52	Karent blong ol flo mita	Yus blong hem i blong mesarem flo blong wota long ol strim mo ol reva. (http://www.rainmanweather.com/Flowatch-Flowmita-Station)
 53	Soket spana	Yusum blong taetem ol flanj blong bolt etc.

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	Paep Wrenj	Blong mekem wok blong plamping long ol penstok mo valv mo iven turbin inlet nosol.
 55	Presa gauge	Blong mesarem presa mo hed
 56	Sped	Digim mo setemap sediment weir o putum daon blong penstok paep.
 57	Clamp mita	Clamp mita i mesarem eni long ol samting ya: AC karent, AC mo DC voltej, resistens, mekem olgeta i stretgud blong ol elektrikol wok. Gud blong hae mo isi karent mesamen
 58	Multimita	Wan taeb blong Maltimita i save mesraem voltej, karent, mo resistens Gat hae resolusen. I save mesarem karent nomo sipos mita i konekt long seris (no nidblong enispeseladapta)
 59	Tred Sealant tep	Yusful blong aplae konekta we i gat tred blong silim of wota.

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

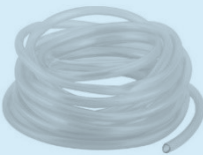
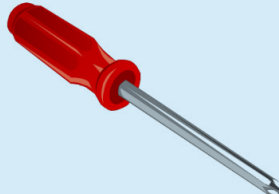
55 Source: Barista Warehouse.com.au, <https://baristawarehouse.com.au/products/3m-water-filter-head-pressure-gauge-for-nephead>, accessed 21 June 2021

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 sement	Hemi ino rili wan tul – be hemi yusful long saed blong ol joens blong PVC paep.
 61	Klia fleksibol hos	Yusful blong mesarem ol hed long ol lokesen
 62	Wud So	Katem timba blong krietem turbin maonting o strakja blong haos.
 63	Hak So	Blong katem ol plastik paep mo konekta
 64	Slot o Flat skrudraeva	Open skru
 65	Philips Skrudraeva	Open skru

60 Source: Magpow, "PVC glue", <http://www.magicglue.net/UploadFile/proj20108519304880607.jpg>.

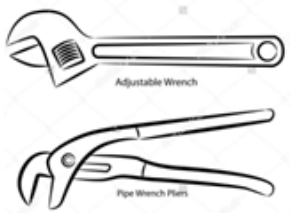
61 Source: Green Chapter, "Air Tube", <https://green-chapter-shop.myshopify.com/collections/gush/products/air-tube-per-meter>

62 Source: ofwoodworking "Hand saw", <https://i.pinimg.com/originals/b6/6b/1f/b66b1feee175c25e8e05cfd855c520.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	Retraktabol 100m tep	Blong mesarem ol lokesen – iven i save mesarem hed.
 67	Ofset Bokis wrenj, Kombinesen wrenj, Open en wrenj mo Nomol bokis wrenj	Hemia ol tul we oli yusum blong provaedem grip mo mekanikol advantej taem yu aplaem torque blong tanem ol objek—oltaem ol rotary fastena, olsem ol nat mo ol bolt—o kipim olgeta strong blong tanem
 68	Adjustebol wrenj Paep renj plaees	Hemia ol tul we oli yusum blong provaedem grip mo mekanikol advantej blong aplaem torque blong tanem objek—oltaem ol rotary fastena, olsem ol nat mo ol bolt—o kipim olgeta blong no tanem
 69	Laenman Plaees	Laensman plaees oli ol taep blong plaees we ol man blong wokem elektrik oli yusum mo ol narafala tredsman blong gripim, twistim, bendem, mo katem waea mo kebol.
 70	Nidil Nos Plaees	Tugeta blong katem mo holem ol samting we ol man blong elektrik oli yusum, mo ol narafala tredsman blong bendem, putum gud samting long posisen, mo snipim waea

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>

Hemi ol difren taep blong skru hed we ol teknisian we oli instolem haedro oli save yusum. Wanwan hed i gat spesifik skrudraeva.

FIKA 52: Ol difren skru wetem ol difren hed⁷¹⁷²⁷³



Handelem mo karem ol tul hemi impoten long haedro turbin sistem. Ol metod daon oli save yusum blong karem ol tul

FIKA 53: Ol Wei blong karem ol tul⁷²



FIKA 54: A-frem lada⁷³



5.1.1 Lada blong mekem waearing long haos

- **Step Lada (A-frem)** - Step lada oli fleksibol fri stand lada we oli disaenem blong yusum long ful 'open posisen'.

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

72 Source: Pinterest.com, <https://www.pinterest.com/bambulancemania/work-apparel/>

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

- **Platfom lada** – i semak long A-frem step lada be hemi provaedem sef wok envaeromen. Hemi provaedem wan gudfala platfom blong step mo wok long hem. Hemi gat tu samfala kaen blong rel o blok blong protekem man blong ino foldaon.

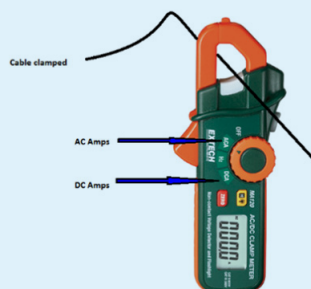
Fika 55: Platfom Lada⁷⁴

AKTIVITI 6

Trena blong yu bambae i saplae yu wetem wan inveta mo batri. Aktiviti ya hemi blong yu lanem oslem wanem yu save yusum wan inveta blong paoarem ol dc devaes. Yusum wan

inveta mo batri blong laetem wan balb o ranem wan fan. Yusum mita blong mesarem karent long wan kebol.

Clamp mita



Batri



Jaj Kontrola



Inveta



AC Laet o Fan



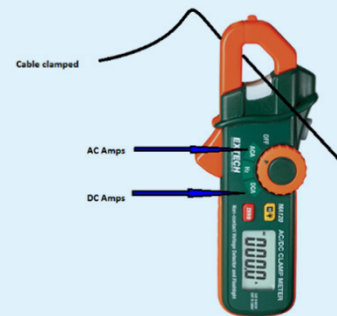
SEFTI: Mekemsua se AC balb i konekt wetem lid waea mo men-soket plak we wan man blong elektrik i waearem.

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

Taep blong diagram blong koneksen



Posisen blong mesarem knob karent long ACA



1. Naoia karem wan clamp mita mo jenisim mesaring knob blong makem ACA blong mesarem paoa blong AC laet o Fan. Openem jaw blong clamp mita oslem i soem daon. Ridim valiu long skrin. Hemia hemi karent we laet balb i yusum. Fika daon i soem mesamen posisen mo olsem wanem nao bae oli konektem clamp.
2. Nao tekemap clamp mo jenisim knob i go long DCA blong mesarem karent flo long Batri i go long Inveta.



**OLTENETIVLI – YU SAVE KONEKTEM BATRI + INVETA
+ AC LAET BALB mo mesarem karent we AC laet balb i
konsumem**

6

Instoalem Haedro
turbin sistem

6.1 Mekemrere blong instolesen

Bifo yu statem instolesen, yu mas planem instolesen mo karem tugeta evri materiel we yu niidm bifo yu stat. Mekemap tingting blong yu klia long taep blong sistem mo koneksen we bambae yu mekem mo tu prediktim eni sefti isiu we i save raes. Mas ikwip wetem PPE we yu rikwaem bifo yu statem wan haedro instolesen.

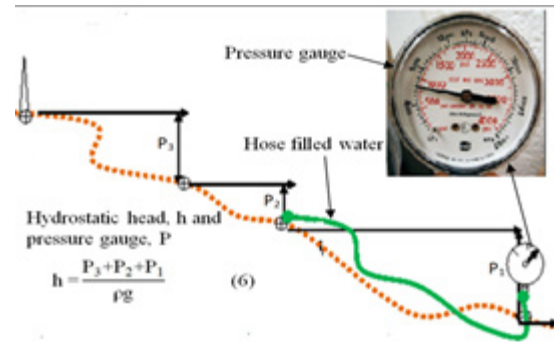
6.1.1 Mekemrere Fobei mo penstok

Faswan, yu niidm blong selektem lokesen blong strim blong majem hed mo flo long turbin blong yu. Mesarem hed. Hemia ol step blong mesarem hed:

Step 1: Tekem wan fleksibol paep i go long apstrim wota lokesen. Narafala en blong paep i mas stap long posibol turbin lokesen. Fiksim wan presa gauge long en wea turbin bambae i stap.

Step 2: Filimap hos paep wetem wota gogo i nomo save fulumap bageken. Ridim gauge. Hemia i save estimetem olsem presa blong hed.

Fika 56: mesarem hed⁷⁵



Step 3: Bambae yumi avoidem eni fomula. Yu save ridim hed yusum tebol daon.

Haet blong Wota Kolom		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

Taem yu faenem wan lokesen apstrim we hemi wanem we turbin i rikwaemen nidim long nemplet, yu save stat bildim wan sediment blok mo plesem filta blong krietem 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

6.1.2 Fobei

Kliarem lokesen mo krietem smol blok o dam yusum ol sediment mo ol rok o wud. Sipos yu gat ol risos, yu save mekem fobei dam long sement tu.

FIKA 57: Konkrit Fobei⁷⁶



From fobei dam, oli mas instolem gauze filta blong bambae wota filta.

FIKA 58: intek ful skrin filta⁷⁷



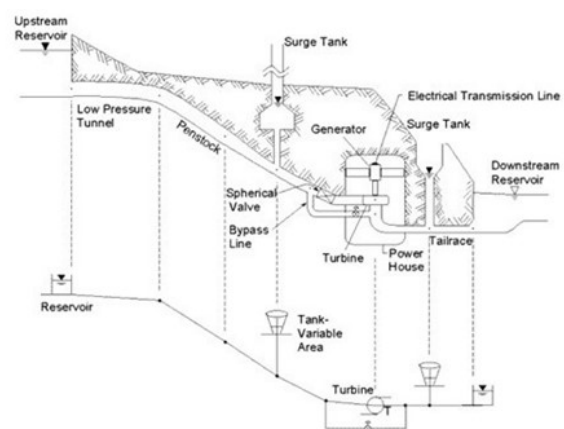
FIKA 59: Filta hemi instol wetem penstok aotlet long botom⁷⁸



6.1.3 Penstok

Penstok i karem wota long fobei i go long turbin lokesen. Konektem penstok long en blong turbin fastaem mo klosem turbin inlet valv. Ranem paep antap kasem fobei filta mo konektem paep i go long fobei. No openem ol valv kasem taem we yu mekem instolesen finis.

FIKA 60: Penstock valv arenjmen⁷⁹



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

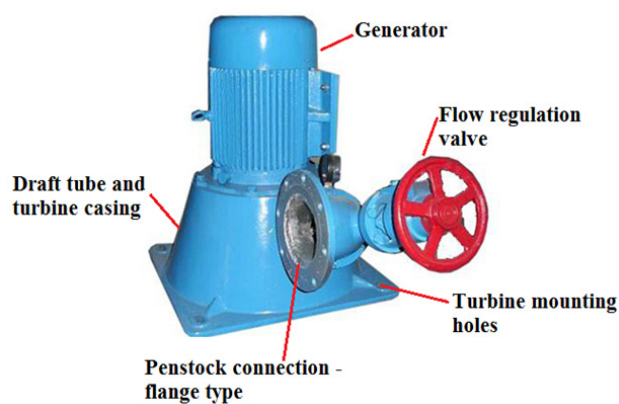
⁷⁷ Source: Power Spout, www.powerspout.com

⁷⁸ Source: Waterpower & Dam Construction, "Pico-Hydro", <https://www.waterpowermagazine.com/uploads/newsarticle/6798305/images/496422/large/1%20pico%20hydro.jpg>

⁷⁹ Energypedia, "Rural Hydropower Civil Engineering", https://energypedia.info/images/9/94/Rural_Hydropower_Civil_Engineering-Training_Handbook-Nigeria_2017.pdf

FIKA 61: Penstok paep⁸⁰

Moa Pico-haedro kit oli kam wetem turbin mo jenereta we i konekt tugeta. Oltaem hemi isi blong konektem raet saes penstok daerek i go long turbin kes. Moa turbin i dipen long ol taep blong olgeta mo bae i nidim wan maonting.

FIKA 62: Sampol blong Pico haedro turbin⁸¹

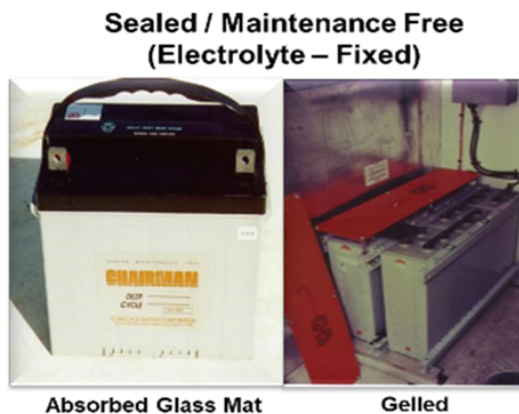
Long fika antap, penstock i konekt i go long inlet flange. I gat ol difren taep blong konekta blong difren disaen blong turbin. Samfala taep blong Pico haedro turbin i nidm kliarens daon blong wota blong kamaot we inogat distebens.

FIKA 63: Pico haedro turbin mounted on timber frames⁸²

Mekemsua se sipos waea we i konekt long jenereta i go long haos i moa long 30m, yu mas eksplenem voltej drop. Hemi gud blong katemdaon distens blong kebol weples i posibol.

6.1.4 Batri

Oli yusum ol batri blong storem eneji blong yusum biae esepeli taem wota level long strim hemi jenis.

FIKA 64: Ol taep blong Batri²⁸

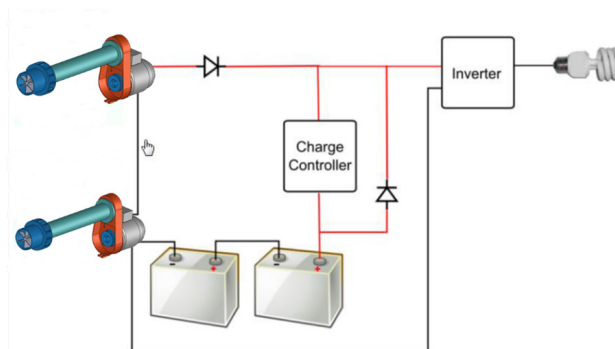
⁸⁰ Source: <https://throughtheluminarylens.wordpress.com/>

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

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

Sipos oli yusum batri long haedro paoa sistem, bambiae yu nidim blong inkludum jaj kontrola we i save provaedem karent we i kamaot long jenereta. Hemia hemi moa kompleks sistem we i nidim wan voltej rekuleta blong mentenem wan stedi voltej bitwin 230-240 VAC.

FIKA 65: Taep blong of grid Pico Haedro koneksen⁸³



Ol Not:

[illegible]

7

Sefti Rikwaemen blong
Haedro Turbin Sistem —

7.1 Ol Sefti Rul blong folem

FIKA 66: Komon Pesonol Protektiv Ikwipmen (PPE)⁸⁴



1. Oltaem talemaot long ona blong haoshol mo tanem paoa of bifo mekem eni niu o adisonal koneksen o adjasmen. Neva traem blong wok long seket we hemi stil aktiv wetem paoa. Amaon blong karent we bambae i flo hemi detamaenem tru long voltej mo resistens long seket.
2. Oltaem mekemsua yu kondaktem instolesen o ripea long ol seket we yu tren long hem. Yu no traem blong modifaem haedro turbin sistem kasem yu andastanem gud sistem.

FIKA 67: Sefti saen⁸⁵



FIKA 68: Wan teknisian long wok⁸⁶



3. Oltaem werem PPE (pesonol protektiv ikwipmen) olsem insult glov, ae gogol mo sefti sus. Neva tajem laev ekspos waea nating we yu werem insulet glov.
4. Neva traem blong mekem gud ol batri we oli nogud yu wan. Ol batri oli kontenem ol kemikel we oli denja tumas we i save kosem sirias ham.

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

⁸⁵ Source: AviationPros, <https://www.aviationpros.com/tools-equipment/safety-equipment/article/11148860/ground-handling-safety-signs>

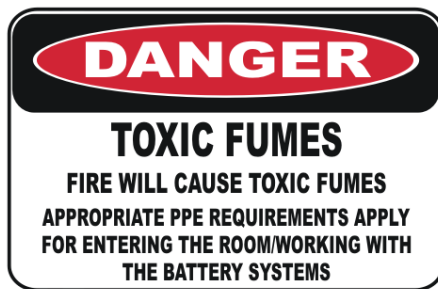
⁸⁶ Source: Safety workblog.com, <https://safetyworkblog.com/assets/understanding-the-2015-edition-of-nfpa-70e-the-arc-flash-hazard.jpg>

FIKA 69: Sefti saen⁸⁷



5. Neva storem ol batri klosap long faea o insaed long siting rum – sam batri oli givimaot ol toksik gas we man i no save luk.

FIKA 70: Sefti saen⁸⁸



6. Neva storem batri long smol spes o klosap long fuel from i save kosem faea from ol spak. Oltaem plesem batri long ol gudfala ventilet eria.

FIKA 71: Sefti saen⁸⁹



7. Oltaem wok long 2, espeseli sipos yu karemaot oltaem jek long haedro turbin penstok mo fobei. Ol strim we i paoarem haedro turbin oli gat kwik flo wota mo oli dip. I gat risk blong man i save draon. Ol slop we oli maontem penstock long hem oli stip mo oli klis mo yu mas mekemsua yu tekem kea taem yu klaem long ol slop espesel taem yu karem ikwipmen.

FIKA 72: Risk blong man i draon i hapen long moa strim⁹⁰



8. Notem se wan haedro turbin i stat jeneretem elektriksiti taem turbin i stat blong rotet. Mekemsua se yu no tajem waea long eni taem o traem blong konektem waea taem yu rotetem turbin.

FIKA 73: Sefti saen⁹¹



9. Ol Haedro turbin oltaem oli putum long ol strim mo klosap long ol strim wea flas flad i save tekem ples long ol sisen blong ren. No mas mekem ripea long taem blong ren mo mas lukoat long ol flas flad.

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

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

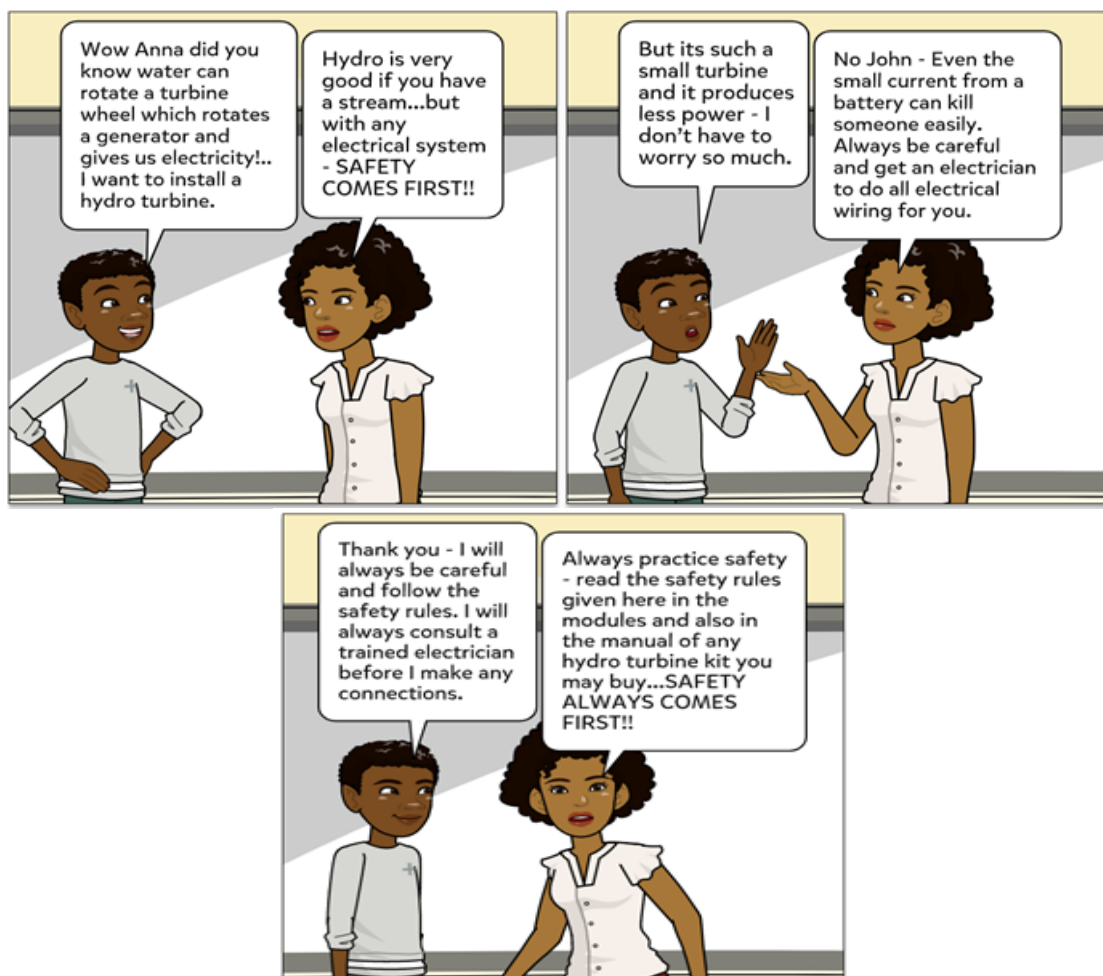
89 Source: Wriggles Worth Enterprises, "Lithium-ion batteries", <https://www.wrigglesworthenterprises.com/post/lithium-ion-batteries>

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>

FIKA 74: Sefti saen⁹²

10. Praktis sefti taem yu stap leftemap ol hevi prodak mo mekemsua yu yusum evri tul olsem we i stap long instraksen. Haedro turbin komponent i save hevi mo sapos yu no leftemap long stret fasin i save kosem injury.

FIKA 75: Mekemsua yu leftemap long ol ni mo ino bak blong yu⁹³

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/>

AKTIVITI 7

Pat A:

Askem ol lena blong go long ol grup mo Imajin se oli bin instolem 12 x 600-watt turbin wetem 3 x 30Ah batri inkludum 20A jaj kontrola, 2 x Dc laet and 1 x 100W inveta wetem wan sinkel AC laet balb olsem wan lod. (Bambae yumi no rili bildim sistem ya).

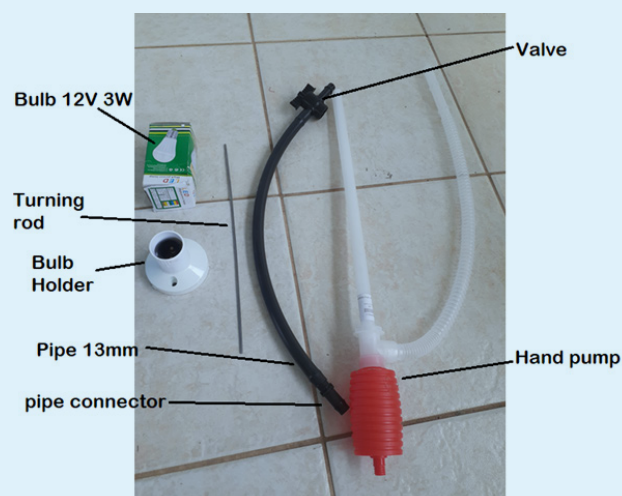
Ol lena oli nid blong fes diskasem evri sefti prekuesen we oli nidim blong tekem taem oli mekem instolesen ya. Letem olgeta blong diskasem long toktok o raetem daon. Askem olketa se bambae oli mekem instolesen sistem olsem wanem. (Hemia i difren biitm stret sistem we bae oli instolem we hemi isi)

Pat B: Instolesen

Long seksen ya ol trena bambae oli mekem wan fas demostresen mo alaoem ol lena blong ranem Turgo turbin demo kit.

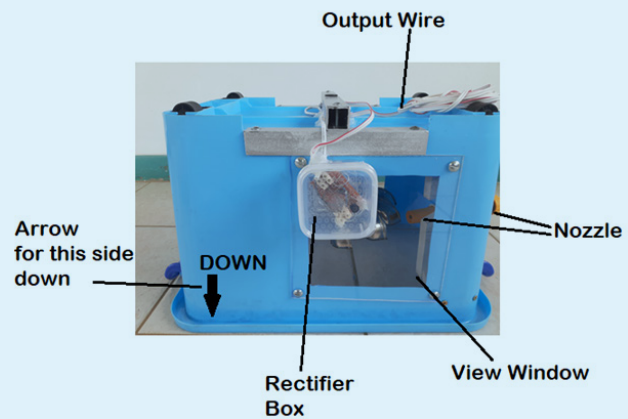
Pat B: Instolesen

Ol asesori daon oli pakem tugeta wetem demo turbin.



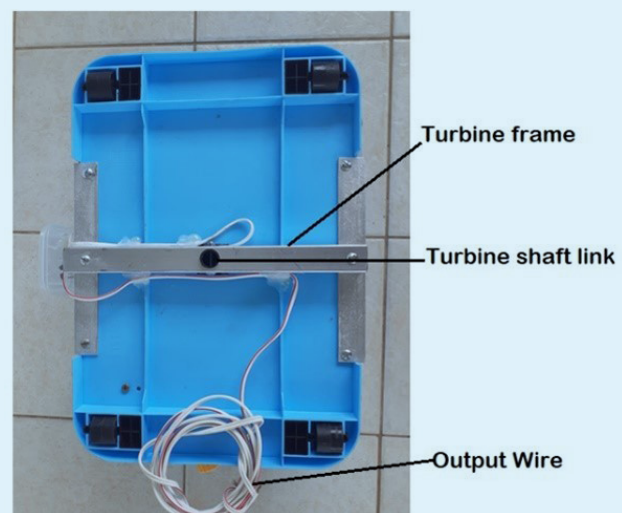
Openem turbin bokis mo jekem sipos evri asesori oli stap. Dipen long ol wota risos i gat trifala wei blong operetem demo turbin kits.

Turbin Fran Viu:

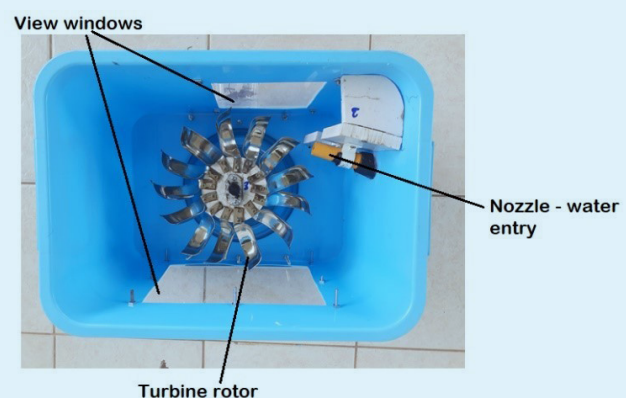


Korekt Orientiesen blong Turbin

Turbin Top Viu:

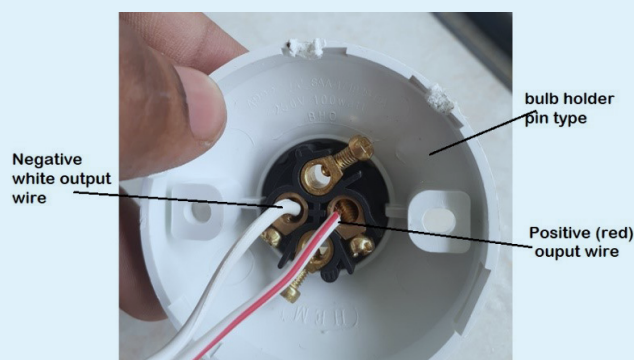


Turbin Botom Viu:



Konektem long aotput devaes

Aotput waea hemi raonabaot 2.5m blong konektem ol sos o lod we oli longwe. Distens hemi mekemsua tu se wota ino splash long ol elektrikol devaes olsem konektem balb long aotput. Sipos balb hemi no wok – traem rivesem polarity i.e tekem balb aot mo rotetem 180 digri bifo rikonektem.

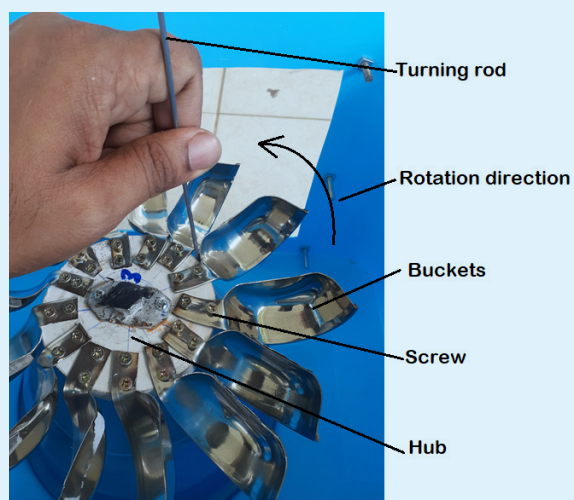


NOT: NEVA TAJEM OL EKSPLOS KONSKESEN WETEM HAN NATING. Rektifaea bod i gat kapasita we hemi save storem jaj long ol taem.

Ranem ol Turbin blong produsum paoa

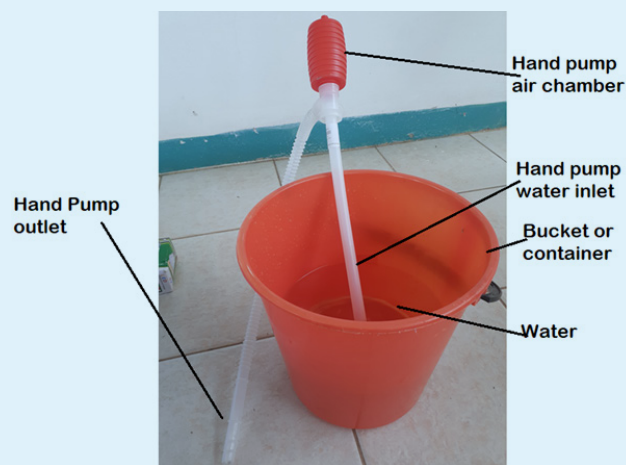
I gat trifala mode we oli save operetem haedro turbin prinsipol long hem

- 1. Tanem rotor manuali blong produsum paoa:** yusum tin tening rod o skrudraeva blong tanem turbin rotor wetem turbin we i tanem apsaed daon. Hemia bae i aloem ol lena blong lukim olsem wanem wan turbin we i rotet i produsum elektriksiti. No nidim wota blong mekem hemia. Hemi i stret long ol ples we wota i nogat tumas wota. YU NO TAJEM BAKET from oli gat ol sap en. O lena oli lukim baket we i rotet mo flem blong laet balb. Yu mas notem se rektifaea bambae ino fansen gud long lo RPM long wan stedi aotput ino posibol long mod ya kasem taem we oli inkrisim RPM.

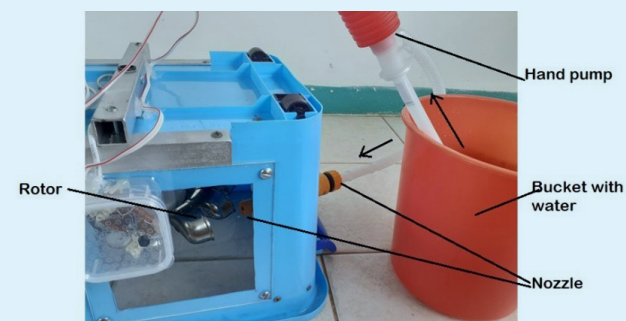
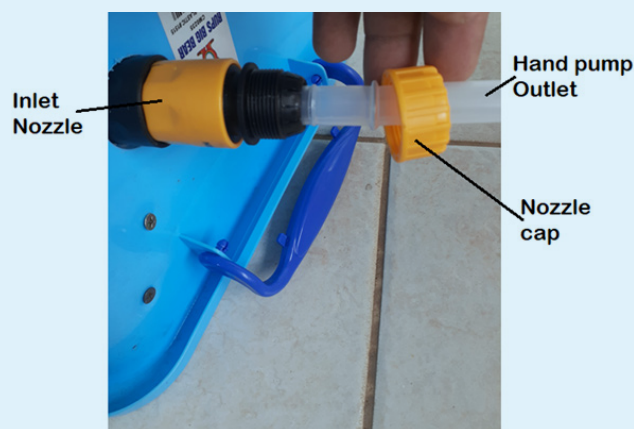


2. Yusum Hand Pump blong tanem roteta blong produsum paoa:

Long ol kes we wota hemi avelebol, be wota presa hemi no avelebol blong kosem rotesen, yu save yusum han pamp saplae blong inkrisim presa. Filimap wota i go long kentena mo plesem han pamp long kontena olsem i soem long pija daon.



Openem Nosel cap, insetem Hand pump inlet i go long Nosol entri mo taetem gud cap.



Skwisim Hand pamp ea jempa mo ripitim rilis blong kosem wota blong flo i go long nosol jet mo hitim turbin baket. Long fasin ya lena bambae i lukim olsem wanem wota i flo mo kosem rotor blong tanem. Balb bambae i flika bakegen folem lo RPM.



Hemia i soem olsem wanem kinetic enej i blong wota i save tanem turbin mo produsum elektriksiti. Demonstreta i mas mekemsua weples hemi posibol blong katemdaon westej blong wota. Wota we oli yusum long mod ya i mas fri long hip doti mo smol patikol we i save damejem o blokem han pamp. Rotor baket oli stainless steel mo pamp materiel oli plastik blong avoidem korosen. Ol narafala han pamp we oli save fitim nosol oli save yusum tu.

1. Yusum wan wota paep we i konekt long tank o men

wota: Hemia hemi stret metod blong demonstretem be hemi nidim wota we presa blong hem i antap long 1 bar. Presa blong wota INO MAS EKSIDIM 4 BAR O FLO RET BLONG 10 GPM. Demo turbin kit oli saplae wetem opsonol valv we oli save yusum blong rikuletem flo. Valv hemi rikomend blong lo floret from bambae i save katemdaon ifektiv presa. Konektem paep daerek i go long nosol entri mo i rikomendem rekulet long tap blong avoidem plante koneksen. Konekta hemi sapale nomo blong joenem ol seksen blong tufala paep – i no niidm blong daerek koneksen.



Taem i konekt long wan hae presa sos, yumi rikomendem se yumi mas putum valv long medel blong rikuletem presa we i kam in



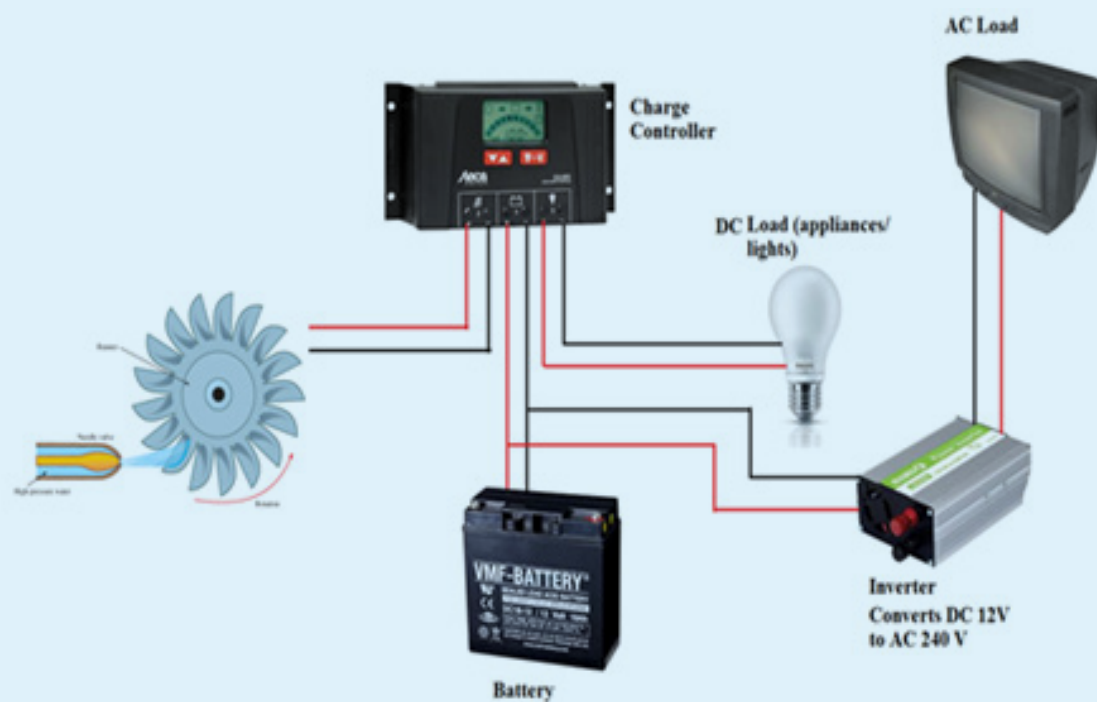
Blong daerek koneksen long tap wota, we hemi standad domestik presa, presa koneksen hemi stret mo i save rikulet daerek long tap sipos hemi stap klosap. Long mod ya hemi impoten blong taetem gud nosol cap blong avoidem diskoneksen folem hae presa.



Ol lena oli save mesarem aotput voltej blong haedro turbin long ol difren floret wetem kea. YU NO MESAREM KARENT wetem wan maltimita. Yusum clamp mita nomo blong mesarem karent.

Konektem haedro setap i go long inveta olsem i stap daon.

1. Konektem batri i go long inveta yusum AC seket breka oltaem.



8

Aedentifaem mo resolvem
ol komon fol long Pico
haedro sistem —————

8.1 Jaj Kontrola Fol

Long haedro turbin sistem, jaj kontrola hemi bren blong ful sistem, mo oli putum faswan yu save lukluk tu from ol fol. Hemia samfala komon fol long jaj kontrolas.

Fol 1: Jaj kontrola ino soem ful stet of jaj.

Rison: Janis blong ova yusum (smol ren, spesel TV program)

Remedi: Katemdaon yus long tem blong lod long haf o ful dei blong alaoem ol batri blong jaj gud

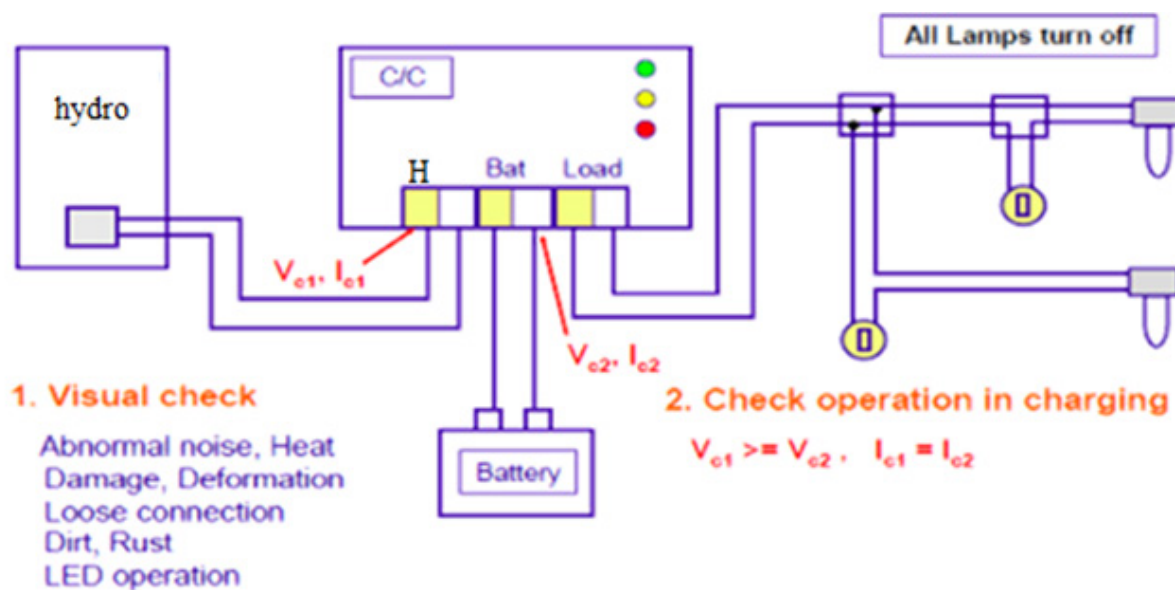
Fol 2: Jaj kontrola i katem of lod mo ol laet

Rison: Ova yusum oltaem (batri hemi empty):

Remedi: Katemdaon yus blong lod long haf kasem C/C i soem ful stet (blong wan wik blong alaoem ol batri blong jaj gud.

Tufala samting we oli talem antap oli moa komon fol we bambae yu lukim long jaj kontrola. Plante haedro jaj kontrola bambae i katem of tu – paoa i go long lod sipos i gat janis blong sot seket i hapen. Kipim jaj kontrola manual oltaem taem trabol sut era mesej.

FIKA 76: Jaj kontrola konektsen⁹⁴



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

Rison: Blown fus, lus koneksen blong waea o malfansen blong intenol kontrola seket.

Remedi: Taetem ol lus koneksen, riplesem blown fus mo jenisem LVD mo HVD seting.

Moa long ol fol oli kwik mo oli save kosem sistem blong sat daon taem samfala fol yumi save faenem long taem blong evridei jek blong yumi

8.2 Pico Haedro Turbin Fol

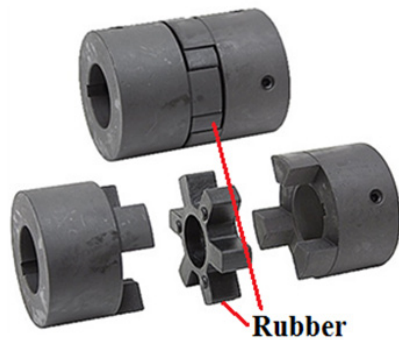
Haedro turbin fol yumi save faenem espeseli taem i gat lus blong paoa o taem yu mekem mesamen. Displei blong haedro turbin voltej yumi save lukim tu long sam jaj kontrola.

Fol 4: Lo o nogat paoa aotput long haedro turbin

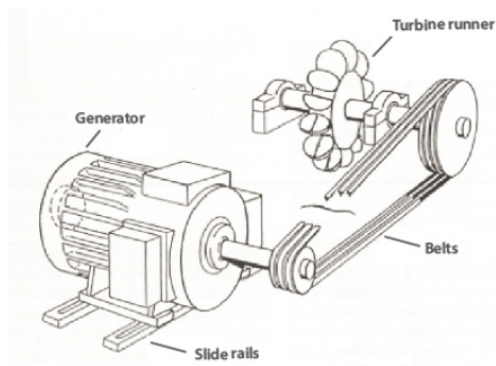
Rison: Nogat o lo wota saplae – penstock i blok. Saf i brok o klaj bearing. Elektrikol sot secut blong waea.

Remedi:

1. Jekem waea blong faenem mo riplesem sot o folti waea.
2. Jekem bearing mo riplesem.
3. Jekem penstok mo fobei mo kliarem blokej blong alaoem wota blong flo.
4. Jekem inlaen joen sipos raba i nogud o i gat krak – riplesem sipos i nid blong mekem.

FIKA 77: Jekem joen blong luk se inogud o damej⁹⁵

5. Blong belt draev sistem jekem eni lus o brok V belt. Riplesem o taetem sipos i nid blong mekem.

FIKA 78: Wej belt draev sistem⁹⁶

Jekem ol gris long bearing – putum gris sipos i nid blong mekem blong priventem klaj bearing. Riplesem sipos gris ino help from maet bearing i damej.

FIKA 79: Grism bearing long saf⁹⁷

Ol narafala komon rison blong lus blong paoa:

1. Damej or lik penstok i no save saplae wota wetem fos i go long turbin

FIKA 80: Damej mo penstok i lik⁹⁸

6. Maet ol valv oli klos o damej mo blokem flo blong wota.

FIKA 81: Bataflae valv we oli yusum oltaem⁹⁹

7. Ol baket we oli damej oli save katemdaon gud paoa we i kam long turbin. Riplesem ol baket we i damej.

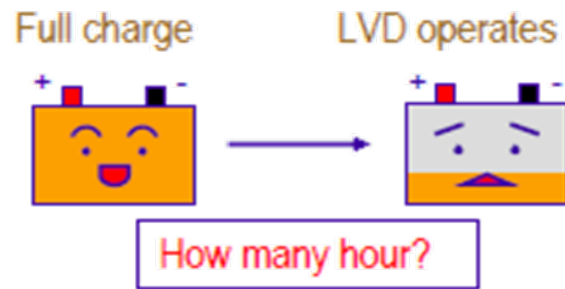
⁹⁵ Source: <https://www.thebigbearingstore.com/>

⁹⁶ Source: Practical Action

⁹⁷ Source: Priest Electric.com, <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>

FIKA 82: Damej Pelton turbin bled¹⁰⁰**FIKA 83:** Hamas taem nao batri i tekem blong kasem LVD?¹⁰¹

Komperem ret blong amp-aoa kapasiti wetem amp-aoa kapasiti we oli mesarem. Sipos amp-aoa we oli mesarem hemi daon bitim 80% blong ret kapasiti, batri klosap i kasem end blong yus blong hem.

8.3 Batri Komom Fol

Fol 5: Batri hemi jaj isi o no save jaj gud from ol sel oli nogat semak voltej.

Rison: Sulfesen, draeap batri solusen, stratifikesen (taem elektrolaet insaedlong solusen i konsentret long botom), lusum teminol koneksen, hae batri tempereja o likej blong elektrik folem asid long sefes bitwin batri teminol.

Remedi:

1. Lus koneksen long ol teminol
2. Klinim teminol wetem stil bras mo aplae gris (e.g., Vaseline o litium gris)
3. Level blong batri elektrolaet, topap taem i nid blong mekem.
4. Yusum apripriet teminol lug/clamp nomo.
5. Rimuvum korosen long ol teminol.
6. Sekem batri smol (no > 10 digri long floa laen long saed) blong avoidem stratifikesen.
7. Instolesen kondisen, riloketem sipos i nid blong mekem.

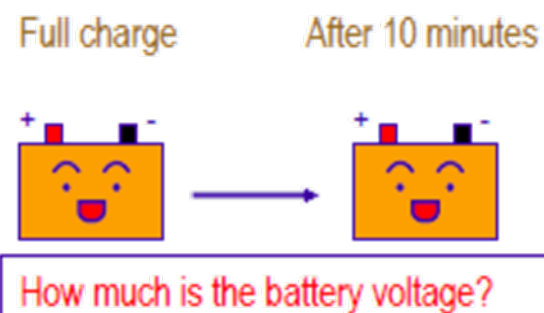
8.3.1 Jekem batri Amp Aoa Kapasiti

Hemia samfala adisonal jek we yu save mekem long batri blong yu. Afta we yu jajem batri fulwan, yusum wan konsten lod blong dro elektrisiti, diskonektem lod long LVD (lo volt diskoneksen).

8.3.2 Jekem batri voltej

Afta ful jaj batri, stopem jaj afta minimam 10 minit o go kasem 2 aoa, mesarem batri voltej. Sipos voltej hemi daon bitim 12.5V, batri klosap i kasem en blong yus blong hem.

Hemi impoten blong riplesem rabis malfansen batri blong avoidem damej long ol narafala.

FIKA 84: Olsem wanem nao batri i holem gud jaj¹⁰²

¹⁰⁰ Source: <http://www.dtlhydro.com/>

¹⁰¹ Source: JICA

¹⁰² Source: JICA

8.4 Jenerol Balans blong Sistem(BOS) Fol

Fol

1. BOS (ol kebol, swij, laet, etc.)
2. Nogat laet nating we batri i ful jaj.
3. Anda-voltej long lod en
4. No paoa long lod en

Ol Rison:

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

Ol Not:

Remedi:

1. Jekem voltej level long en blong lod mo voltej drop.
2. Taetem ol lus koneksen long ol Teminol.
3. Jekem saes blong kebol sipos oli instolem 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 rektifae posibol sot seket mo graonding long laen, re-insulet sot/graond laen.
6. Jekem operesen blong swij mo voltej drop bitwin input mo aotput.

AKTIVITI 8

Blong aktiviti ya bambae oli konektem folti waea bitwin batri mo jaj kontrola blong ol lena blong diteketem mo korektem yusum ol kontinuti test.

9

Haedro turbin
Mentenens jeklis —————

9.1 Planem Mentenens

Rutin mentenens hemi nambawan wei blong inkrisim laef blong haedro turbin sistem mo ol komponent.

9.2 Fobei

1. Jekem oltaem fobei dept mo kliarem ol mad we oli hivap.
2. Jekem wota level mo klinim akses long fobei.
3. Jekem fobei gauze filta o mesh blong damej o blokej.
4. Jekem penstok koneksen blong lik o damej.

FIKA 85: Stop-Log rak arenjmen olsem wan blok o dam blong sapotem fobei¹⁰³



9.3 Penstok mo valv

1. Jekem penstock filta blong eni damej.
2. Jekem eni doti, debris, o obstraksen long penstok.
3. Openem oltaem mo klinim Y filta blong rimuvum ol sofmad mo doti.
4. Jekem korosen long ol valv mo silim ol damej long ol valv.
5. Jekem eni lik o damej long penstock paep.
6. Jekem ol flange bolt blong oli taet mo jekem tu blong ol korosen long ol bolt.

FIKA 86: Jekem blong ol korosen long valv¹⁰⁴



9.4 Haedro Turbin Mentenens

Haedro turbin oli disaen blong last longala long ol raf evaeromen mo ino sud nidim plante atensen. Be i semak long ol mekanikol devaes oli stil nidim blong karemaot blong last longfala mo pefom gud.

1. Jekem turbin kes blong eni damej o lus blong maonting bolt.
2. Jekem bearing blong eni damej mo grisimap.
3. Jekem inlaen joen o belt blong ino mas nogud.
4. Jekem ol elektrikol teminol blong eni lus koneksen.
5. Jekem eni doti o sofmad we i stak long turbin – espeseli afta long flad.
6. Jekem ol baket o bled blong turbin blong damej mo nogud.
7. Jekem saft blong eni damej o alaanmen.

103 Source: Pond Boss Magazine

104 Source: Dreamstime, "Corroded valve", <https://thumbs.dreamstime.com/z/corroded-valve-maintenance-industrial-plant-46320348.jpg>

FIKA 87: Turbin inspeksen¹⁰⁵

9.5 Batri Mentenens

Batri oli moa komon blong fol sipos oli no lukaotem gud. Batri mentenens oli involvem ol difren wok dipen long taep blong batri mo manufaktara rikwaemen, inkludum:

1. Inspektem mo klinim ol batri rak, ol kes blong trei mo teminesen
2. Inspektem diskoneksen, ovakarent devaes mo waearing sistem.
3. Mesaring voltej
4. Batri lod test aplae hae disjaj ret blong hamas seken, taem i mesarem dikris long batri voltej. Hemia oli yusum blong indiketem sel we i wik o i gat fol tru long bigfala drop blong voltej.
5. Batri Kapasiti test i involvem disjaj blong batri long nominol disjaj ret blong preskraeb dept blong disjaj. Hemia i evaluetem avelebol eneji storej kapasiti blong sistem.
6. Riplesem pua batri long wan seris string. Pefomens blong seris string batri bank bambae i dominet tru long pua pefomens blong batri.
7. Diskarejem Ova-disjaj blong Sistem oltaem – Ovayusum mo ova-disjaj i katemdaon batri laef folem hae dept blong disjaj (DOD)
8. Mesarem spesifik graviti mo adem wota (blong flad lid-asid batri nomo!)
9. Periodik batri mentenens mas inkludum ol jek long ol teminol blong korosen mo taetem stret
10. Yusum stil bras blong klinim oatsaed long ol koneksen. Werem insulesen glov evritaem.

FIKA 88: Batri Kea¹⁰⁶

¹⁰⁵ Source: Climate Links, <https://www.climatelinks.org/>

¹⁰⁶ Source: Jim Dunlop Solar



SEFTI TIP: Yusum sefti gogol mo raba glov taem yu sevesem batri. Werem olfala klos from yu save karem asid long olgeta (sipos hemi flad batri)

Kipim wan open bokis blong beking soda mo wan plastik pan blong wota klosap taem yu sevesem batri—sipos i gat spil, yu save sakem beking soda long wota, stiaremap, mo yusum miks ya blong neutralaesem eni spil asid

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

9.5.1 Mesarem batri stet blong jaj (SOC).

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

9.5.2 Voltej Metod

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

FIKA 89: Stet blong Jaj¹⁰⁷

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 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 90: Yus blong Haedromita¹⁰⁸



Archimedes Hydrometer



Refractive Index Hydrometer

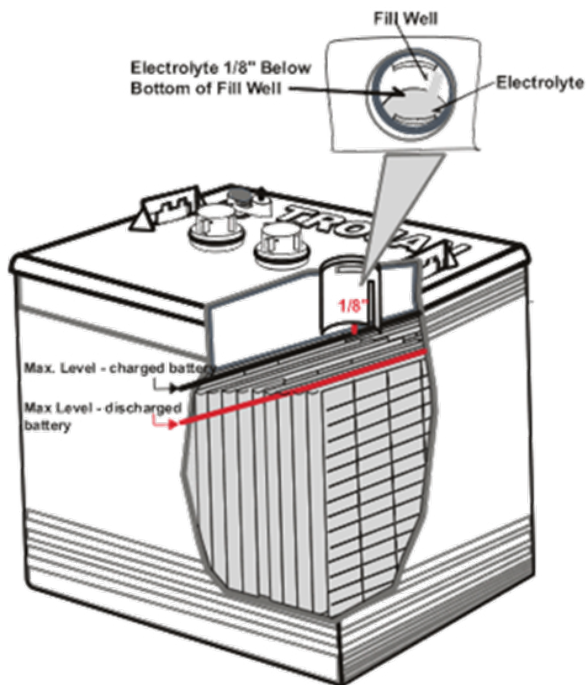
Source: Jim Dunlop Solar

9.5.4 Adem distil wota long Batri (flad batri nomo)

1. Openem vent flad batri i lusum wota folem elektrolaet 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 no fulumap i oval.

107 Source, Pinterest.com, <https://www.pinterest.com/bambulancemania/work-apparal/>

108 Source: Jim Dunlop Solar

FIKA 91: Batri Strakja¹⁰⁹

Yu save yusum batri mentenens jeklis daon blong karemaot ol jek evritaem long batri.

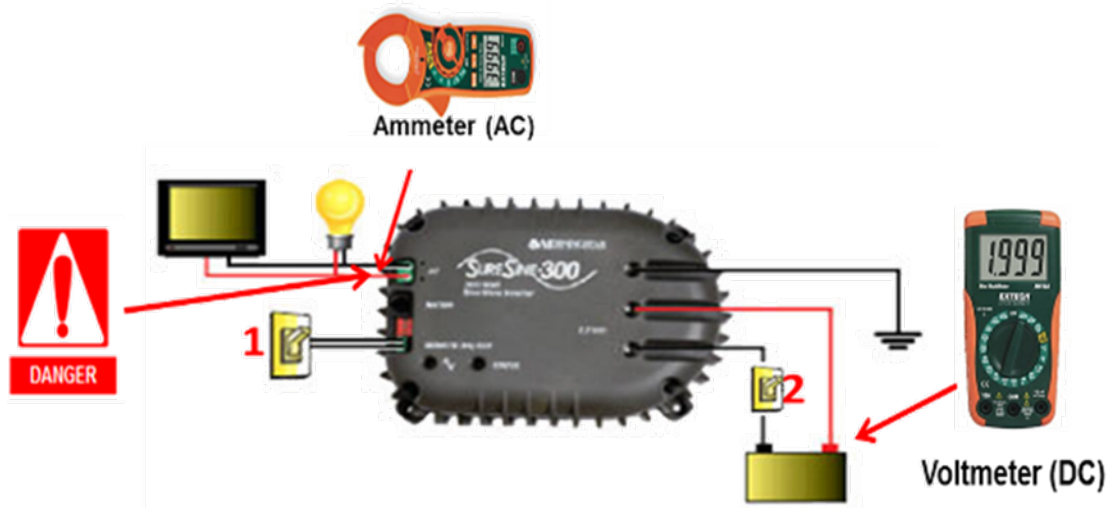
Ol Batri (maet hemi pat blong pakap sistem)	
Jekem elektrikol koneksen	Evri wik
Jekem blong korosen mo klinim ol teminol	Evri wik
Jekem level blong wota mo top ap blong lid asid batri	Evri wik
Mekemsua se batri oli jaj fulwan long rikula besis	Evri wik
Riplesem batri bank	Ol Taep, evri 3-5 yia (lid-asid) 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	Sipos i nid.

9.6 Inveta Mentenens

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



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

FIKA 92: Inveta waearing¹¹⁰

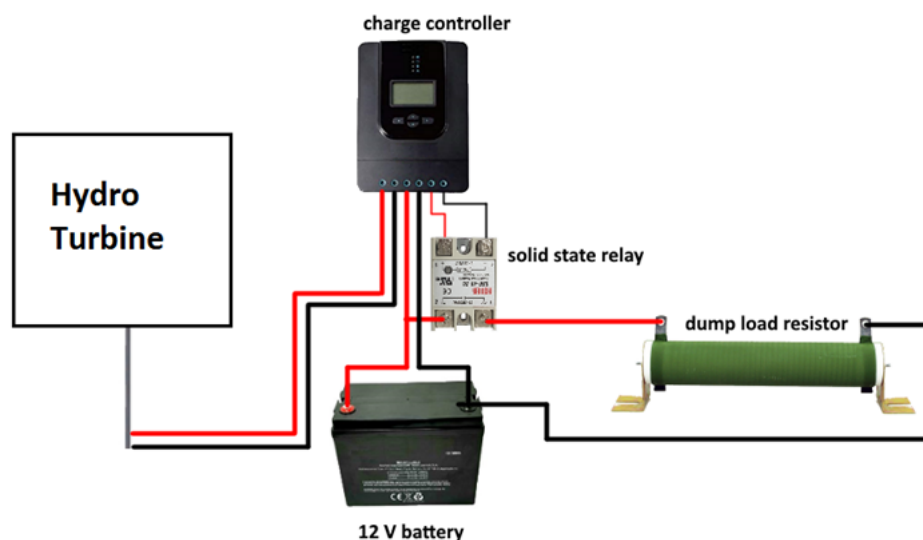
Yu NO rimuvum eni waearing, mekem monitaring long sikwens daon:

1. Tanem of diskoneksen swij 1 mo 2 (lukim imej)
2. Yusum clamp-long amita (AC) long AC saed
3. Konektem voltmita (INO amita) long batri teminol (rimemba: Amita sot seket batri mo fus blow!)
4. Tanem on diskoneksen swij 1 mo 2
5. Obsevem sipos voltej mo karent i flo long lod. Sipos yes, inveta i wok

9.7 Jaj kontrola Mentenens

Jaj kontrola oltaem oli robust mo no mas givim plante trabol sipos oli no ovalod.

1. Jekem lus koneksen.
2. Jekem displei voltej from era mesej.
3. Jekem fus hemi no blown.
4. Jekem maonting blong kontrola.
5. Jekem daevesen lod blong hemi no damej o go nogud.

FIKA 93: Haedro Jaj Kontrola wetem damp o daevesen lod resista¹¹¹

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

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

9.8 Krietem mo yusum jeklis

Wan sampol masta jeklis blong wan manis i stap daon, mo yu save adem moa long hem o rimuvum sam we oli no aplae.

TEBOL 3: Sampol Masta Jeklis blong wan Manis

Jeklis aetem	OK	Komen
Turbin instolesen eria Jek		
Jekem blong ol korosen blong damej blong ol kes o paep.		
Jekem bus we i gro long eria – klinim sipos i nid blong mekem. Kipim akses blong fobei mo turbin lokesen klia.		
Jekem ol valv sipos evriwan i wok gud.		
Jekem Y filta mo klinim sipos i nid blong mekem.		
Jekem turbin maonting mo batri haos selta.		
Jekem se turbin aotlet hemi klia mo no blokem ol doti o sofmad.		
Protektem eria wetem padlock o fens sipos i nid blong mekem – jekem eni damej blong fens.		
Jekem korosen long ol elektrikol teminol o jenereta.		
Jekem bearing sipos i oraet yet mo putum gris sipos i nid blong mekem		
Jekem joen blong raba sipos i go nogud.		
Jekem V belt sipos hemi oraet yet.		
Jenerol Visual Inspeksen		
Inspektem inveta/elektrikol pad blong mekemsua ino soem eksisiv krak o saen blong go nogud. Inveta i mas bolt long pad long evri maonting poen folem manufakja instolesen rikwaemen. Dipen long saes, lokesen, mo aksesibilti blong sistem blong ankwolifae personal, ol inveta, ol kombaen bokis, mo diskoneksen swij mas nidim ol tul o gat ol lok blong priventem ol akses we ino otores long ol ikwipmen.		
Lukluk from ol woning placad inkludum arc flas o PPE rikwaemen blong aksesem ikwipmen. Mekemsua blong komplae wetem ol woning placad. Sipos ino gat placad i stap, o sipos sam placad oli lus, mekem not long hem mo instolem placad we i lus long mentenens visit.		
Inspektem Haedro turbin blong ol difeks we i save kamaot long fom blong ol bon mak, kala i lus, delaminesen, o korosin.		

Jekem ol bolt we i lus o ol pat.		
Mekemsua se turbin waearing hemi sef mo kontenem long elektrikol konduit.		
Inspektem racking sistem blong ol difeks inkludum rust, korosen, saging, mo ol klip mo ol bolt we oli lus.		
Jekem nosol blokej.		
Inspektem konduit blong stret sapot, ol bus, mo ekspansen joen, sipos i gat nid blong mekem.		
Jekem strakja intakriti blong haos blong turbin mo maont.		
Long groan maont sistem, luk blong ol saen blong korosen we oli nidim sapot.		
Open kombaena bokis mo jekem ol twist mak long ol koneksen. Ol twist mak oli hapen taem oli taetem ol lug long stret valiu blong twist. Oli aplaem stret long taem blong instolesen, be sipos no, teknisian i save makem lug afta long twist long taem blong mentenens visit. Wan prapa twist mak oli mekem wetem wan spesalaes twist mak making pen. Mak hemi wan stret laen tru long lug mo haos. Ova long taem sipos laen hemi seperetem bitwin long lug mo haos, i soem se lug i muv mo i nidim blong twistim. Lukluk from ol doti insaed long ol bokis mo eni evidens blong damejem wota intrusen. Lukaotem ples we kala i kamaot long ol teminol, ol bod mo fus holda.		
Openem kabinet doa blong diskoneksen(s) mo lukaot long ol saen blong korosen o damej.		
Jekem blong mekemsua se ol cabinet penetresen oli silim gud mo ino gat evidens blong wota i kamaot. Jekem ol twist mak long ol teminol.		
Pefomen wan visol inspeksen blong insaed mo aotsaed blong inveta. Lukluk long ol saen blong wota, rodent, o dust intrusen i go long inveta. Jekem ol twist mak long fil teminesen.		
Sipos i gat wan weta stesen, mekemsua se ol senso oli stap long korekt lokesen mo korekt tilt mo azimuth.		
Inveta Jek		
Rikodem mo validetem evri voltej mo prodaksen valiu long human- masin intafes (HMI) displei.		
Rikodem last long sistem era.		
Klinim ol filta.		
Klinim insaed blong kabinet.		
Testem fan blong prapa operesen.		
Jekem ol fus.		
Jekem ol twist long teminesen.		
Jekem gasket seal.		
Konfem se ol woning lebol oli stret.		
Lukluk long ol ples we kala i kamaot mo eksisiv hit bildap.		
Jekem intagriti blong laetning aresta.		
Jekem sistem graond mo ikwipmen graonding.		

Jekem mekanikol koneksen blong inveta i go long wol o graon.		
Jekem insaed long diskoneksen operesen.		
Pruvum se karent softwea hemi instol.		
Kontaktem instola mo/o manufakja long eni samting we faenem.		
Dokumen faending blong evri wok we yu pefomem		
Jekem insulet get bi-pola transista mo inveta bod blong diskala.		
Yusum inspeksen mira sipos yu nidim		
Jekem input dc mo aotput ac kapasita blong ol saen blong damej long ovahit.		
Rikodem evri voltej mo karent riding long fran displei turbin.		
Jekem apiarens/klinlines blong kabinet, ventilesen sistem, mo insulet sefes.		
Jekem korosen/ovahit long ol teminol mo kebol.		
Twist teminol, konekta, mo bolt sipos i nidim blong mekem		
Rikodem ambient weta kondisen, inkludum tempereja mo weta dei hemi ren o drae.		
Jekem apiarens blong ac mo dc surge sapresa blong damej o mak blong bon.		
Jekem evri sefti devaes (emejensi stop devaes, doa swij, graond folt ditekta intarapta).		
Inspektem (klinim o riplesem) ea filta element.		
Korektem eni defisiensi we yu ditektem.		
Kompletem mentenens skedul kad.		
Komplitim inspeksen ripot we yu raetem.		
Sipos manufakjara-tren pesonel oli avelebol long eria, instolem mo pefomem eni rikomed enjiniering fild modifikesen, inkludum softwea apgred.		
Batri Jek		
Jekem eni saen blong elektrolaet long sefti trei (sipos i gat) o long floa, indiketem wan posibol batri lik o ovafil.		
Jekm kondisen blong ol batri kontena.		
Jekem batri voltej level – rikodem voltej level.		
Jekem kondisen blong batri teminol – mekemsua ino gat korosen, tekemaot sipos i gat.		
Jekem batri elektrolaet level (ino nidim blong gel sil batri)		
Waea mo koneksen jek		
Jekem eni brek long waea mo nekede waea – ripotem eni brek long waea.		
Mekemsua se evri koneksen oli kavremap gud.		
Jek from eni lus o waea we i hang.		
Jekem blong eni insulet waea we klosap i bon.		

AKTIVITI 9

Printimaot sampol blong haedro turbin masta jeklis evri manis. Mo tu mekem sua yu gat insulet glov, malti mita, clamp mita, ae gogol, mo ol relevan tul mo PPE. Yu mas traem blong werem sefti sus blong ol aktiviti.

Mekemsua evriwan oli putum PPE mo tekem jeklis raon long haedro turbin sistem we oli bin instolem long last aktiviti. Yu

mas kontinu blong obsevem olgeta mo mekemsua yu tikim olgeta mo komen long ol jek we oli mekem. Yu mas kolektem faenol jeklis mo kolektem mo jekem tru long toktok blong givim fidbak long sam jek.

Ol diskasen mo Kwesten.











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