



Lesoni 10 – iVolanivuli

Yavu ni Qaravi Piko-haidro

VOSA VAKAVITI RARABA

Vakailavotaka na:

KOICA
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Ena veitauriliga kei:







CONTENTS

IVolavosa.....	6	5. IYAYA NI CAKACAKA ENA HAIDRO.....	34
1. TOU VEIKILAI MADA	7	5.1 iYaya yadua kei na kedra yaga	35
iVakadre 1	8	IVakadre 6	40
2. GACAGACA NI PIKO-HAIDRO	9	6. VAKADURI HAIDRO	41
2.1 Baniwai.....	10	6.1 Vakarau duri	42
2.2 Gusuniwai	10	6.2 Vakaraautaki ivakaso kei na paipo	42
2.3 iVakaso – ivurevure ni wai mai cake	10	6.3 iVakaso	43
2.4 Paipo ni haidro kei na isogo	10	6.4 Paipo (penstock)	43
2.5 iSogo kei na vulo	11	6.5 iVocevoce kei na jenereita	44
2.6 iVocevoce.....	11	6.6 Bateri	44
IVakadre 2	15	7. IDUSIDUSI NI QAQARAUNI ENA HAIDRO	46
2.7 Jenereita.....	16	7.1 Lawa ni qaqarauni me muri.....	47
2.8 iDoladola (charge controller).....	17	IVakadre 7	50
2.9 Bateri	18	8. KILA NA LEQA KUNE WASOMA ENA PIKO KEI NA	
2.10 Wa	19	KEDRA IWALI.....	56
2.11 iVakariba/Isolator	19	8.1 Leqa ni idoladola (charge controller)	57
2.12 Suiti kei na vunilivaliva.....	20	8.2 Leqa ni ivocevoce ni piko.....	57
2.13 iVuki (inverter)	20	8.3 Leqa kune wasoma ni bateri	59
2.14 iCegucegu (diversion load, dump load).....	21	8.4 iSoqoni ni leqa ni iyaya.....	60
2.15 Electronic Load Controllers	21	IVakadre 8.....	62
2.16 Gacagaca ni sobuiqe.....	21	9. IVOLA NI ITAVI NI QARAVI HAIDRO	63
3. IDUSIDUSI NI GACAGACA.....	23	9.1 Bibi ni kena qaravi	63
3.1 Gusu ni ivakaso.....	24	9.2 iVakaso (forebay)	63
3.2 Paipo (penstock)	24	9.3 Paipo (penstock) kei na isogo (valve)	63
3.3 iVocevoce kei na jenereita	24	9.4 Qaravi ivocevoce	63
3.4 iDoladola.....	24	9.5 Qaravi bateri	64
3.5 Bateri	25	9.6 Qaravi ivuki (inverter)	68
3.6 iVuki (inverter).....	26	9.7 Qaravi idoladola (charge controller)	70
IVakadre 3	28	9.8 Na buli ivolanitavi kei na vakayagataka.....	70
IVakadre 4.....	28	IVakadre 9.....	70
4. MATAQALI PIKO-HAIDRO	29		
4.1 Piko tugalala livaliva dodonu (DC) vakabateri	31		
4.2 Piko-haidro ni lawalevu (grid)	32		
4.3 Kila na ivakarau ni ivocevoce ni piko.....	32		
IVakadre 5.....	33		

LIST OF FIGURES

YALOYALO 1: Gacagaca ni Piko-Haidro	10	YALOYALO 28: Dui mataqali bateri.....	19
YALOYALO 2: Lutu kei na drodro ni wai.....	10	YALOYALO 29: Wa	19
YALOYALO 3: Paipo kei na isogo ni gusuniwai	10	YALOYALO 30: iVakariba kei na Isolator	20
YALOYALO 4: Paipo ni haidro PVC	11	YALOYALO 31: Suiti kei na vunilivaliva.....	20
YALOYALO 5: iSogo 'Flanged Butterfly'	11	YALOYALO 32: iVuki (inverter).....	20
YALOYALO 6: iSogo 'Flanged gate'	11	YALOYALO 33: Cakacaka ni ivuki	21
YALOYALO 7: iSogo vakabatina ni paipo ni haidro	11	YALOYALO 34: iCegucegu, buli mai na idre (resistor)	21
YALOYALO 8: Vulo ni basoga ni paipo, raica na duidui ni isogo....	11	YALOYALO 35: iCegucegu vakaliliwataki	21
YALOYALO 9: Qiqi ni ivocevoce Pelton	12	YALOYALO 36: E so na idoladola e volitaki vata na icegucegu kei na salalivaliva	21
YALOYALO 10: iVocevoce Pelton ni haidro.....	12	YALOYALO 37: Sabolo ni ivotavota (electronic load control unit) ni haidro	21
YALOYALO 11: iVocevoce Turgo	13	YALOYALO 38: iCakacaka ni sobuiquele	22
YALOYALO 12: Na wai e sikava vakatatiki na vokete ni ivocevoce Turgo.....	13	YALOYALO 39: Gacagaca ni sobuiquele.....	22
YALOYALO 13: iVocevoce skru.....	13	YALOYALO 40: Gusu ni ivakaso, vulo kei na isema ni paipo. Na ivakaso e tiko e daku ni baivatu – e laurai ga na gusuna.....	24
YALOYALO 14: iVocevoce Kaplan duri vakadodonu kei na kena jenereita	13	YALOYALO 41: Paipo ni dui lutu.....	24
YALOYALO 15: iVocevoce 'bulb type VLH kaplan'	14	YALOYALO 42: Droini vakacaca ni idoladola (charge controller)	25
YALOYALO 16: iVocevoce 'crossflow'	14	YALOYALO 43: iDusidusi ni bateri	25
YALOYALO 17: Qiqiniwai lutu mai cake (overshot)	14	YALOYALO 44: iTovo ni veisemasemai ni bateri.....	26
YALOYALO 18: iVocevoce 'gravitation water vortex'	14	YALOYALO 45: iDusidusi ni ivuki.....	27
YALOYALO 19: Mataqali jenereita, vakalevu na livaliva dri (AC) ...	16	YALOYALO 46: Sabolo ni haidro livaliva dodonu sega ni vakabateri	30
YALOYALO 20: Jenereita makeneta tudei livaliva dodonu .	16	YALOYALO 47: Sabolo ni haidro tugalala livaliva dodonu vakabateri	30
YALOYALO 21: Gacagaca ni jenereita 'induction'	16	YALOYALO 48: Tugalala livaliva dri.....	31
YALOYALO 22: Livaliva dodonu, veiveisau, kei na dri	17	YALOYALO 49: Hydro tugalala livaliva ruarua (DC+AC) vakabateri	31
YALOYALO 23: iDoladola ni haidro	17	YALOYALO 50: Haidro ni lawalevu (grid)	32
YALOYALO 24: Tarovi na jaji sivia	17	YALOYALO 51: iYaya vakayagataki vakalevu	35
YALOYALO 25: Tarovi na talaci sivia	18		
YALOYALO 26: Salanilivaliva vinaka.....	18		
YALOYALO 27: Bateri sogo.....	18		

YALOYALO 52: Duidui skru kei na dui uluna	38	YALOYALO 74: Notisi ni waluvu	48
YALOYALO 53: iWalewale ni kau iyayas	39	YALOYALO 75: Kua nio kala nio lave, lokia na yavamu qai dodoka	49
YALOYALO 54: iKabakaba yavairua (A-frame)	39	YALOYALO 76: Semai ni idoladola	57
YALOYALO 55: iKabakaba vakavata (platform ladder)	39	YALOYALO 77: Raica na isema ni paipo de yavu se ca	57
YALOYALO 56: Vakaraute lutu	42	YALOYALO 78: Beleti ni ivocevoce (wedge belt)	58
YALOYALO 57: iVakaso simede	43	YALOYALO 79: Qirisitaki na berigi ena tolo ni kaukamea	58
YALOYALO 58: Vulo e gusuniwai	43	YALOYALO 80: Ca na paipo, turu tiko	59
YALOYALO 59: Vulo kei na gusunipaipo e ra	43	YALOYALO 81: Mataqali isogo kune wasoma (butterfly valve)	59
YALOYALO 60: iTuvatuva ni isogo ni paipo	43	YALOYALO 82: Ca na yame ni ivocevoce Pelton	59
YALOYALO 61: Paipo ni haidro	44	YALOYALO 83: Vica na kena dede qai yacova na bateri na LVD? ..	59
YALOYALO 62: Sabolo ni ivocevoce ni piko	44	YALOYALO 84: E maroroi livaliva vakavinaka na bateri?	60
YALOYALO 63: Na piko ena kena vata kauvaro	44	YALOYALO 85: Kauvaro tuva me baniwai ena ivakaso	63
YALOYALO 64: Mataqali bateri	45	YALOYALO 86: Raica de veveka na isogo (valve)	63
YALOYALO 65: Sabolo ni semai ni piko sega ni sema kei na lawalevu	45	YALOYALO 87: Dikevi na ivocevoce	64
YALOYALO 66: iYaya ni tataqomaki (Personal Protective Equipment, PPE)	47	YALOYALO 88: Qaravi bateri	64
YALOYALO 67: Notisi ni qaqarauni	47	YALOYALO 89: iTuvaki ni bateri	65
YALOYALO 68: Cakacaka o kena dau	47	YALOYALO 90: iVakarau ni sosoko	66
YALOYALO 69: Notisi ni waikama	48	YALOYALO 91: iTuvatuva ni bateri	66
YALOYALO 70: Notisi ni kasi gaga	48	YALOYALO 92: Semasemai ni wa ni ivuki	70
YALOYALO 71: Notisi ni qaqarauni ni bateri	48	YALOYALO 93: iDoladola ni haidro kei na idre ni icegecegu (diversion load resistor)	70
YALOYALO 72: Wai kece e rawa nida luvu kina	48		
YALOYALO 73: Notisi ni qaqarauni	48		

LIST OF TABLES

TEVELI 2: iTuvatuva ni Lesoni	5	TEVELI 4: iVolanitavi	70
TEVELI 3: Sabolo ni idusidusi kei na gacagaca ni ivuki	26		

Na leseni “Yavu ni Qaravi Piko-Haidro” e baleti ira na via vulica vakamatailalai na vakaduri haidro kei na kena qaravi.

Ni oti na vuli qo, o na rawata na veika qo:

- Vakamacalataka na veimataqali haidro
- Kila na gacagaca kece ni haidro.
- Tukuna na ka e gadrevi ena gacagaca ni haidro.
- Kila na iyaya e taurivaki ena haidro.
- Tukuna na veitaravi ni vakaduri haidro kei na kena qaravi.
- Tukuna se cava so me qarauni ena haidro.
- Kila na leqa sotavi wasoma ena haidro kei na kedra iwali.
- Vakaraitaka na yaga ni ivola ni itavi ni qaravi haidro.

TEVELI 2: iTuvatuva ni Lesoni

Wase	Mataqali lesoni
1. Tou veikilai mada	Vuli kei na ivakadre 1
2. Gacagaca ni Haidro	Vuli
	iVakadre 2 (Vakatau)
3. iDusidusi ni Gacagaca	Vuli
	iVakadre 3
	iVakadre 4 (Vakatau)
4. Mataqali Haidro	Vuli
	iVakadre 5 (Vakatau)
5. iYaya taurivaki ena Haidro	Vuli
	iVakadre 6 (Vakatau)
6. Vakaduri Haidro	Vuli
7. Qaqarauni ena Haidro	Vuli
	iVakadre 7
8. Kila na leqa kune wasoma ena Piko kei na kedra iwali	Vuli
	iVakadre 8
9. iVola ni iTavi ni Qaravi Haidro	Vuli
	iVakadre 9 (Vakatau)

Na ivolanivuli qo e yavutaki ena kena Salavata nei Qasenivuli (Trainers Guide). Sa vakarawarawataki na lewenivola ka vakalekalekataki, qai vakabibitaki kina na droini, yaloyalo kei na kena ivakadre me ratou veimaliwai vinaka tikoga kina na lewe ni vuli kei qasenivuli ni toso tiko na vuli. Ke o gadreva

na ikuri ni ivakamacala ni wase cava ga, mo raica na Salavata nei Qasenivuli.

Taba e waqanivola: Veisalayaki na waya e loma ni piko. iVurevure: Powerspouts, New Zealand.

Moni Kila: Na Global Green Growth Institute e sega ni yalataka, se yalataka lo madaga, ni donu se taucoko na itukutuku ena ivola qo, se rawa ni veilewaitaki ke cala, ni dua e vakayagataka na vua ni itukutuku se iyaya se cakacaka e volai kina, wili kina ni beci na dodonu ni kena itaukei.

IVOLAVOSA

iCeguCEgu – iYaya livaliva sema kei na haidro me kania na livaliva.

iDoladola – Na gacagaca e lewa na jajitaki ni bateri ka tarova me kua ni jajitaki vakasivia.

Jaji – Sema na kena wa ina bateri me tubu na kena volt. E dau jajitaki vakalevu ena ulunisola.

Jaji sivia – Nida jajitaka tikoga na bateri ni sa tawa – me vaka ni sinai na vokete qai vua tale – ena ca na bateri.

Kui – Ka e drodro ena wa, ni soqoni kei na volt e soli kina na pawa.

Livaliva Dodonu – Mataqali livaliva e dau rawa mai na sola. Na livaliva dodonu e rawa ni waqa kina na cina se yavala na iyaya lalai

Livaliva dri – mataqali livaliva e rawa mai na idini lelevu me baleta na iyaya lelevu me vaka na TV se misini ni savasava

Mita Liga – Ka e vakarautaki kina na voltage kei na vakamuri salalivaliva. Kua ni tovolea mo vakarautaka kina na kui.

Mita iQamu – Gacagaca e vakarautaki kina na kui ni sala livaliva.

Paipo ni haidro - Na paipo ni wai e siro ina ivocevoce

Pawa - Na igu e solia e dua na ka ena gauna yalataki.

iSogo – Gacagaca e sogota se dolava na wai

Shot – Ni drodro lala na livaliva ena wa, sega na kena iusana me vaka na matanicina se irinicagi. Na shot e rawa ni ca kina na gacagaca. Ke rau sema na sucu ni bateri ena shot, e rawa ni veivakamavoataki qai vakacacana na bateri.

Teminala – Vanua e sema kina na wa. Dau vakalevu me skrutaki na teminala me qaqacotaki de taluva na wa.

iTutu – Ka ga e vakadeitaka na iyaya – me vaka na iyaya e lili kina na itaba. E vaka kina na ulunisola me vakadeitaki vinaka e delanivale me kua ni cagina.

iUsana – Ka e vakayagataka na livaliva ni bateri se sola. E rawa ni cina, irinicagi se katoniwaililiwa. Ka ga e vakayagataka livaliva e iusana.

iVakaso – Vanua e soqoni kina na wai me qai lutu ina haidro.

Volt – Na volt ena wa e cokovata kei na kui me soli pawa

iVuki – Ka e vukica na livaliva dodonu me livaliva dri

Waikama – Ka vaka na wai ena bateri. E rairai vaka na wai, ia e gaga sara.



1

Tou veikilai
mada

IVAKADRE 1

Vakamacalataki iko vakalekaleka vei iratou na lewenivuli. Tukuna na yacamu kei na nomu koro. Tukuna talega na ka o dau cakava tiko ena gauna qo. Sa bau sotava oti na haidro?

Cava nomu rai ena haidro? Tukuna vei dauveituberi se cava so o namaka ena vuli qo.



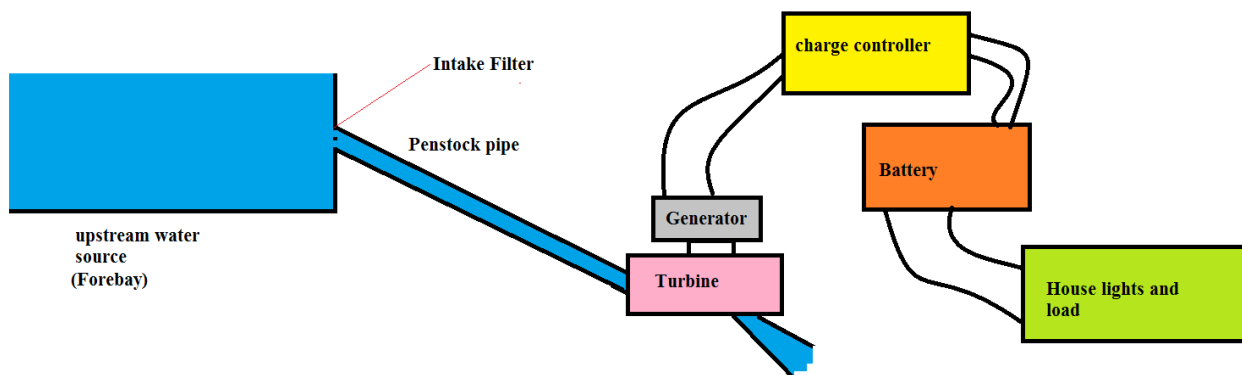
2

Gacagaca ni
Piko-Haidro

Na Piko-haidro e vaka ga na haidro levu vakaivocevoce, kena duidui ga ni ka lailai, ia na kena gacagaca e via tautauvata ga.

Na yaloyalo e ra e laurai kina na gacagaca ni piko.

YALOYALO 1: Gacagaca ni Piko-Haidro¹



2.1 Baniwai

Qo na ba e sogota na wai me tuva vakatautauvata kina me qai curu tuga ina paipo ni haidro.

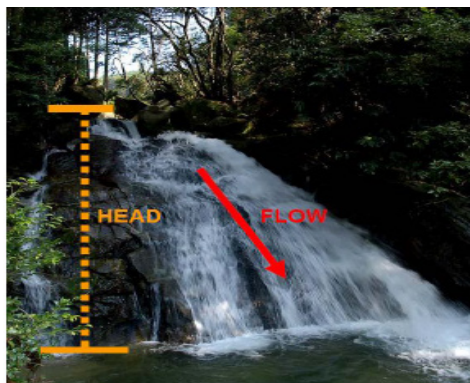
2.2 Gusuniwai

Na inaki ni gusu ni wai ni haidro me curu kina na wai taucoko se vakatikina ga, me vaka e gadrevi. E dau vakalevu me tu na kena vulo kaukamea me tarova na soqosoqo me vaka na co se tolo ni kauvaro.

2.3 iVakaso – ivurevure ni wai mai cake

Qo na wai drodro cava ga e rewaicake, rewaira na ivocevoce, me drodro vinaka kina ni siro tiko mai.

YALOYALO 2: Lutu kei na drodro ni wai²

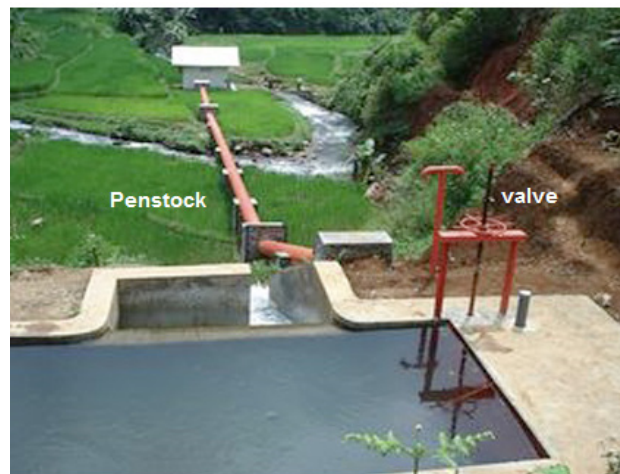


E levu talega na paipo ni haidro e vuloni me tarova na watu kei na soqosoqo de curuma na ivocevoce. E toka talega na vulo ni bera na ivocevoce.

2.4 Paipo ni haidro kei na isogo

Na sala ni wai mai na ivakaso ina ivocevoce na paipo toloilevu (penstock), vakaisogo na muana ruarua.

YALOYALO 3: Paipo kei na isogo ni gusuniwai³



¹ IVurevure: GGGI, Fiji.

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

³ IVurevure: Daily Frontier Post, Yavutaki ena 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=Q57ENvIU

YALOYALO 4: Paipo ni haidro PVC⁴



2.5 iSogo kei na vulo

E vica na mataqali isogo e dau taurivaki ena piko-haidro me lewā na drodro ni wai.

YALOYALO 5: iSogo 'Flanged Butterfly'⁵

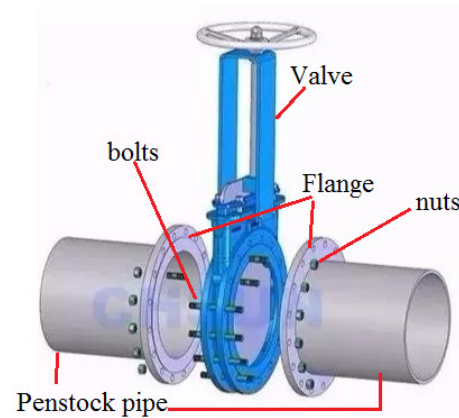


YALOYALO 6: iSogo 'Flanged gate'⁶



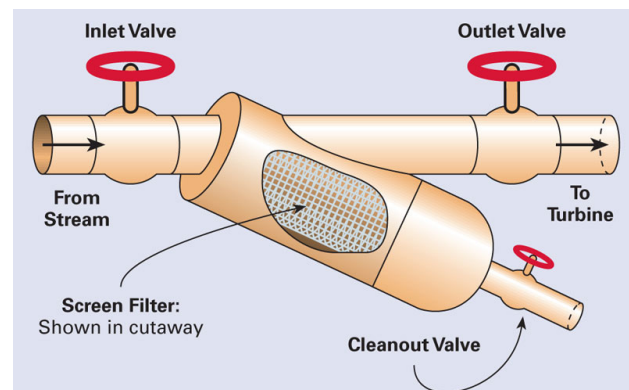
E taurivaki vakalevu na isema vakabatina (flange) ena paipo sitila ni haidro. E sema kina na paipo vakabatina, me vaka e laurai e ra.

YALOYALO 7: iSogo vakabatina ni paipo ni haidro⁷



E so na paipo ni haidro e basoga, me toka kina na vulo ena maliwa ni isogo ruarua. E tiko na isogo ni benu (cleanout valve) me cara kina na soqosoqo kei na duka, me kua ni lutu e loma ni paipo. Qo e laurai ena yaloyalo e ra:

YALOYALO 8: Vulo ni basoga ni paipo, raica na duidui ni isogo⁸



2.6 iVocevoce

Na ivocevoce ni haidro e vukica na igu ni wai lutu mai cake me igu cocowiriwiri. E sema kei na jenereita me qaqi kina na livaliva. Na mataqali ivocevoce na 'impulse', 'reaction', se 'gravity'.

4 IVurevure: Creative Commons, Yavutaki ena Energypedia, https://energypedia.info/wiki/File:Penstock_La_Laguna.JPG

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

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

7 IVurevure: Kknews, <https://i2.kknews.cc/SIG=2vusqbk/ctp-vzntr/1535900726635935rs4r3p.jpg>, accessed 21 June 2021.

8 IVurevure: Home power, www.homepower.com

Mataqali ivocevoce ni haidro

Mataqali ivocevoce			
Lutu (m)	Impulse	Reaction	Gravity
Rewaicake (>50m)	• Pelton • Turgo		
Veimama (10-50m)	• Pelton • Turgo • Multi-jet pelton	• Spiral case Francis	
Rewaira (<10m)	• Crossflow • Undershot waterwheel	• Propeller • Kaplan • Open-flume Francis	• Archimedes screw • Overshot waterwheel

2.6.1 iVocevoce Pelton

Na inaki ni kena buli na ivocevoce Pelton, ni cici tiko ena veimama ni totolo ni wai, ena voleka ni igu taucoko ni wai e vakayagataki kina, ni qai gole tani na wai sa voleka ni oti na kena totolo; kena ibalebale ni mataqali ivocevoce mana sara (80-90%).

YALOYALO 9: Qiqi ni ivocevoce Pelton⁹



YALOYALO 10: iVocevoce Pelton ni haidro¹⁰



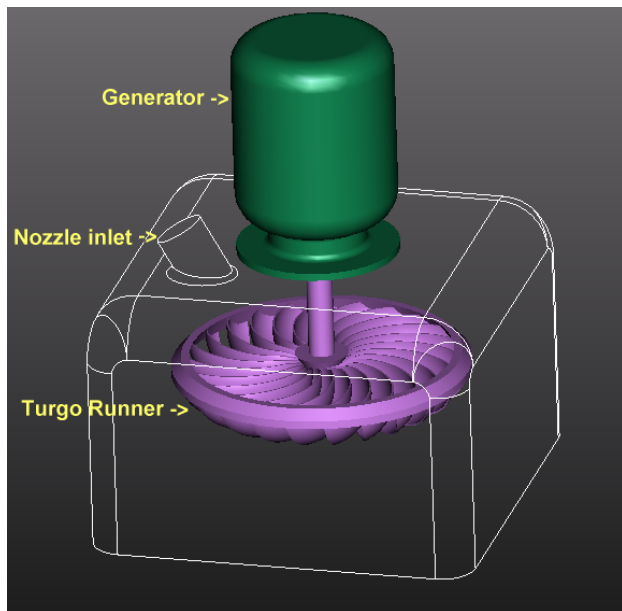
2.6.2 iVocevoce Turgo

E buli na ivocevoce Turgo me ganita na lutu veimama. Kena mana e viavia 87%.

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

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

YALOYALO 11: iVocevoce Turgo¹¹



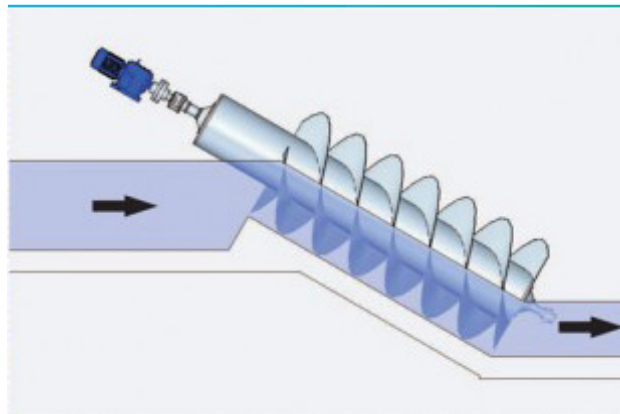
YALOYALO 12: Na wai e sikava vakatatiki na vokete ni iVocevoce Turgo¹²



2.6.3 iVocevoce skru

Na iVocevoce skru e via vaka na iqiva ni wai na 'Archimedean screw' ni vukica na igu ni wai lutu me igu mekeniki. E via vaka na qiqi ni wai (water wheel).

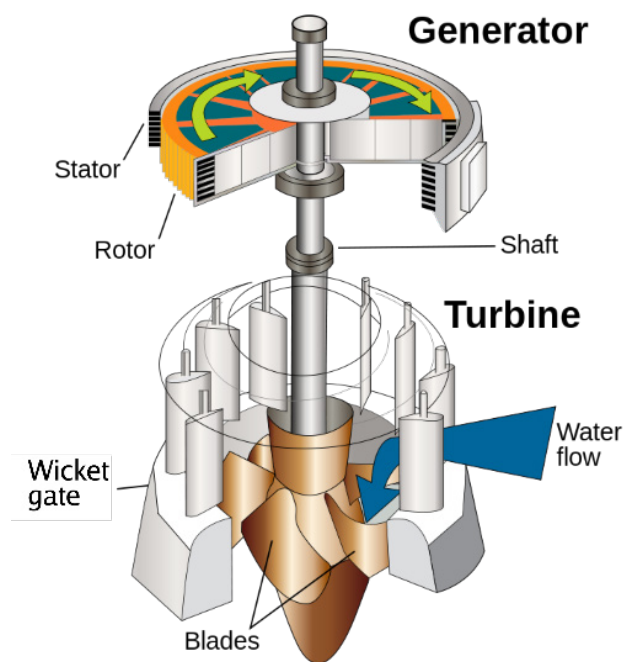
YALOYALO 13: iVocevoce skru¹³



2.6.4 iVocevoce Kaplan

E tiko na iVocevoce kaplan makawa, qai tiko na kena makeneta toloilevu, cowiri malua, 'sloped open flow' (rewaira sara) VLH, kena mana e 90%.

YALOYALO 14: iVocevoce Kaplan duri vakadodonu kei na kena jenereita¹⁴

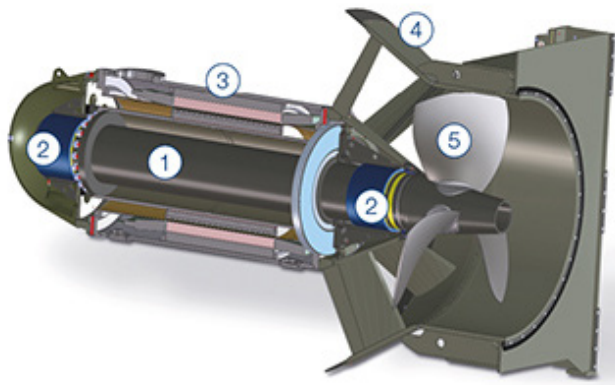


11 IVurevure: Wikipedia, "Position of nozzle and generator in relation to Turgo blades", https://en.wikipedia.org/wiki/File:Turgo_turbine.png

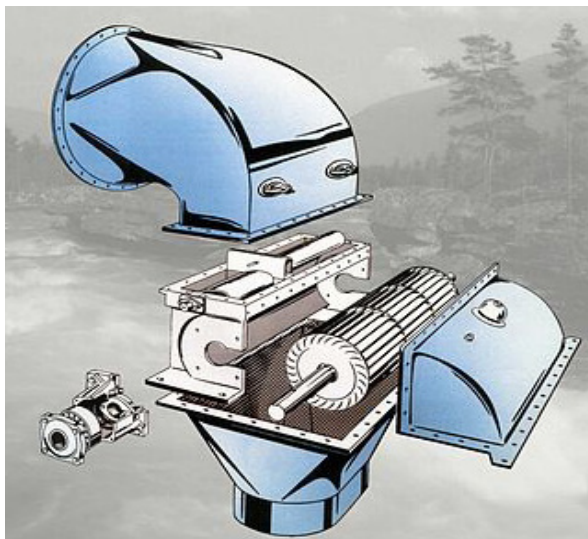
12 IVurevure: SCRIBD, "Impact of jet impulse momentum principle", <https://html.scribdassets.com/2k5s3iose83t52ii/images/1-453f23ae7b.jpg>

13 IVurevure: www.freeflowhydro.co.uk

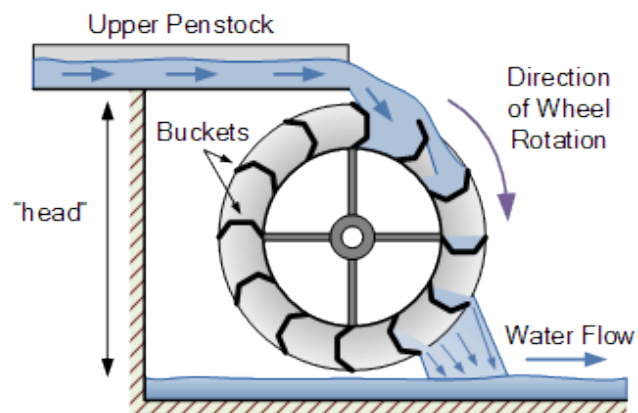
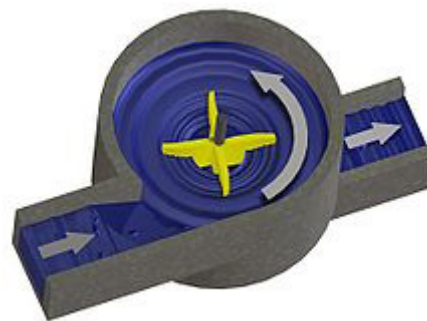
14 IVurevure: green-mechanic.com also Yavutaki ena Linquip.com, "Schematic of a Kaplan turbine and its components", <https://www.linquip.com/blog/wp-content/uploads/2020/12/parts-of-Kaplan-1.png>

YALOYALO 15: iVocevoce 'bulb type VLH kaplan'¹⁵

2.6.5 iVocevoce Crossflow

Na ivocevoce 'crossflow' e vakatokai talega me Banki, Mitchell se Ossberger. E laurai ni sereki tu ena yaloyalo 15. Na tolona e buli vakadramu, na yamena e kakalovelove, kena kaukamea e davo vakadodonu. Na wai e sikava na tolona taucoko me cowiri kina.

YALOYALO 16: iVocevoce 'crossflow'¹⁶

2.6.6 Qiqiniwai

Na qiqiniwai (water wheel) na misini e vukica na igu ni wai drodro se lutu me igu yaga, vakalevu ena iqaqi.

YALOYALO 17: Qiqiniwai lutu mai cake (overshot)¹⁷

2.6.7 iQaqi ni livaliva ni wai lutu (gravitation water vortex power plant)
YALOYALO 18: iVocevoce 'gravitation water vortex'¹⁸

2.6.8 iVocevoce taurivaki vakalevu ena piko

E dau taurivaki vakalevu ena piko na ivocevoce Pelton lalai, na ivocevoce 'propeller' kei na ivocevoce 'crossflow'.

¹⁵ Ivurevure: Voith, "Stream Diver design", https://commscockpitimf.voith.com/im/imf/100_35699/s.x.960/f.j/teaser.jpg

¹⁶ Ivurevure: Wikimedia Commons, "Ossberger turbine", https://upload.wikimedia.org/wikipedia/commons/5/54/Ossberger_turbine.jpg, accessed 21 June 2021.

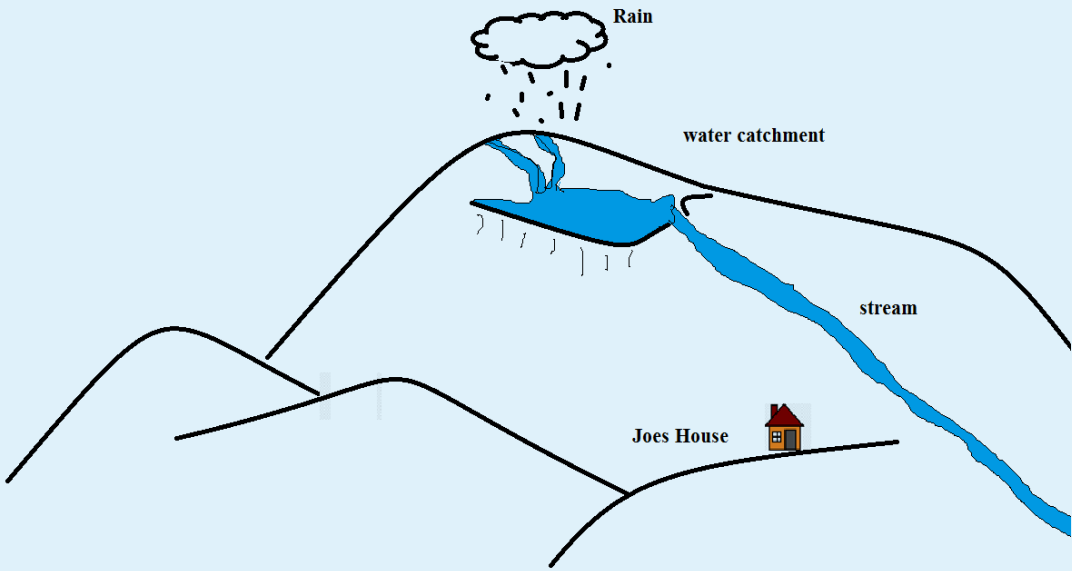
¹⁷ Ivurevure: Alternative Energy Tutorials, "The Overshot Waterwheel", <https://www.alternative-energy-tutorials.com/images/stories/hydro/alt74.gif>

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

Volavola:

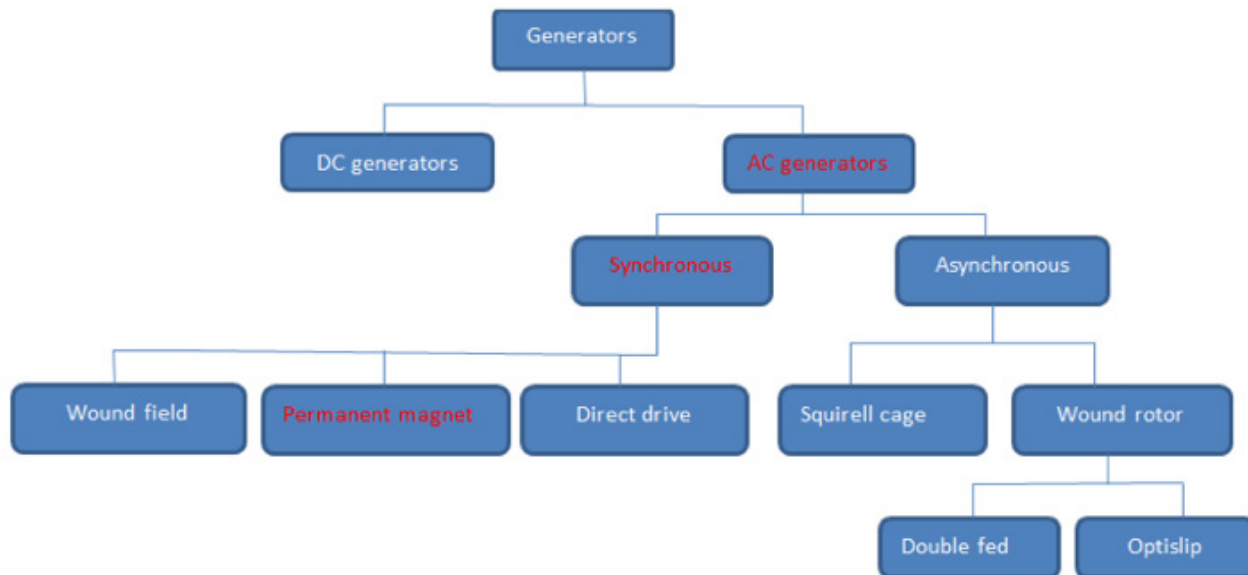
IVAKADRE 2

Raica na droini qori, na uluniwai kei na vale nei Joe. Mo droinitaka kina se me toka e vei na piko me yaga vei Joe. E vei na ivakaso? E vei na kena paipo? E vei na ivocevoce? E rawa ni caka vakaiwasewase. Vola talega kina se vica taucoko na lutu ni wai.



2.7 Jenereita

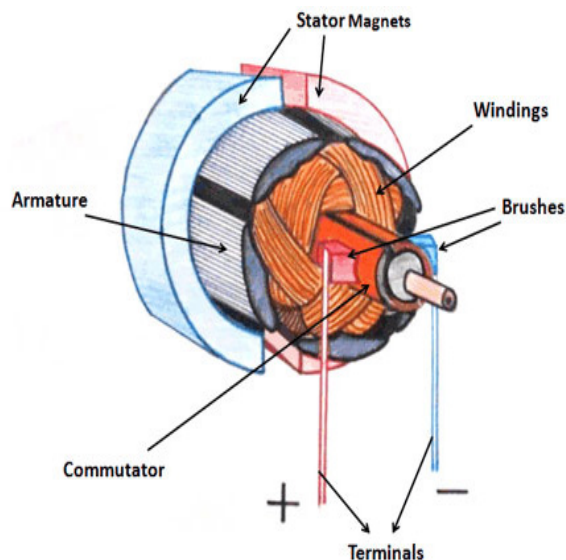
YALOYALO 19: Mataqali jenereita, vakalevu na livaliva dri (AC)¹⁹



Na jenereita makeneta tudei (permanent magnet, PM) e kune vakalevu ena maikro-haidro. Qo na mataqali jenereita rawarawa yavala vakataki koya, tiko ruarua na livaliva dri (AC) kei na livaliva dodonu (DC).

2.7.1 Jenereita makeneta tudei livaliva dodonu (synchronous)

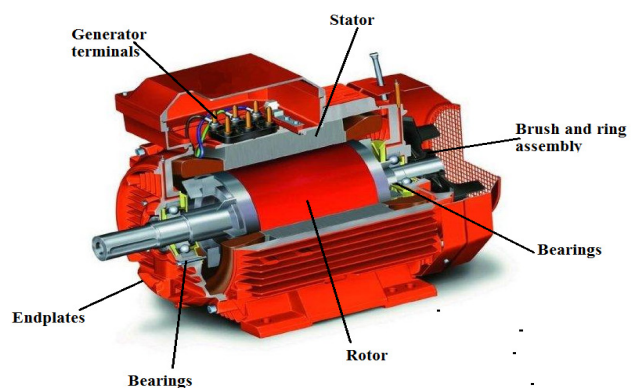
YALOYALO 20: Jenereita makeneta tudei livaliva dodonu²⁰



2.7.2 Jenereita 'induction'

Na jenereita 'induction' (se 'asynchronous') na mataqali jenereita livaliva dri e qaqi livaliva ena icakacaka ni moto na 'induction motor'.

YALOYALO 21: Gacagaca ni jenereita 'induction'²¹

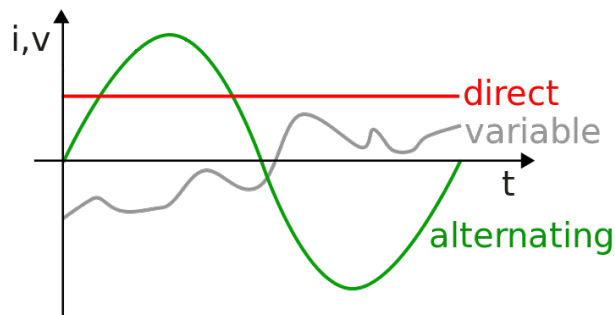


¹⁹ Ivurevure: Linquip.com, "DC Motor Parts", June 2020, <https://www.linquip.com/blog/wp-content/uploads/2020/06/DC-motor-parts-2.jpg>

²⁰ Ivurevure: GGGL, Fiji.

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

YALOYALO 22: Livaliva dodonu, veiveisau, kei na dri²²



2.8 iDoladola (charge controller)

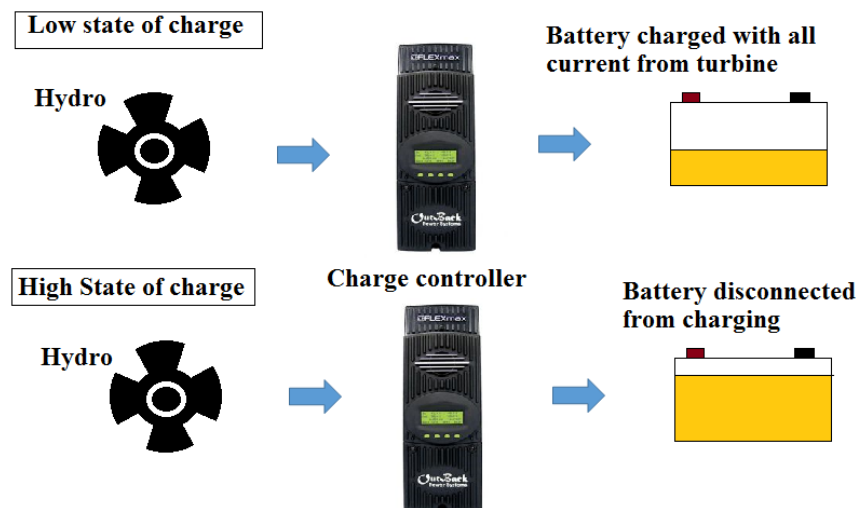
Na idoladola e yalana na kiu ni livaliva e curuma na bateri. E tarova kena jajitaki sivia se kena sivia beka na volt. Na idoladola ni piko e levu cake sara kena kui mai na ka ni sola.

YALOYALO 23: iDoladola ni haidro²³



- Tarovi na jaji sivia
 - Ni lailai na volt ni bateri, na idoladola ena dolava tikoga kena isema kei na ivocevoce ni haidro me jajitaki kina.
 - Ni levu na kena volt, na idoladola ena sogota na kena isema kei na ivocevoce ni haidro me cegu kina kena jajitaki.

YALOYALO 24: Tarovi na jaji sivia²⁴

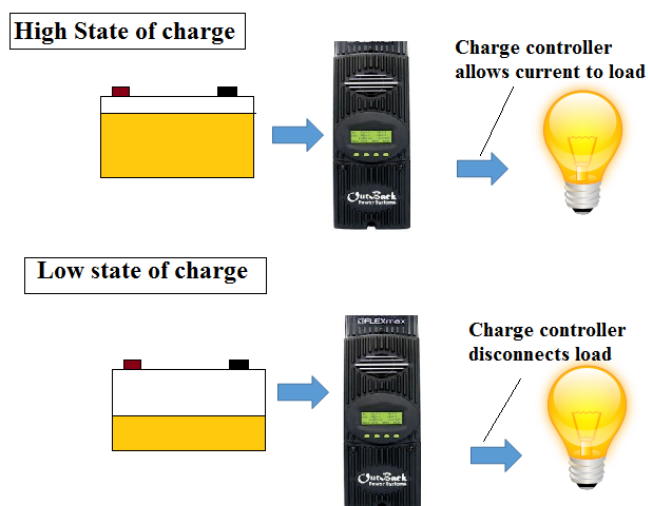


- Tarovi na talaci sivia
 - Ni levu na volt ni bateri, na idoladola ena sema na bateri kei na kena iusana
 - Ni lailai na volt ni bateri, na idoladola ena luvata na iusana mai na bateri

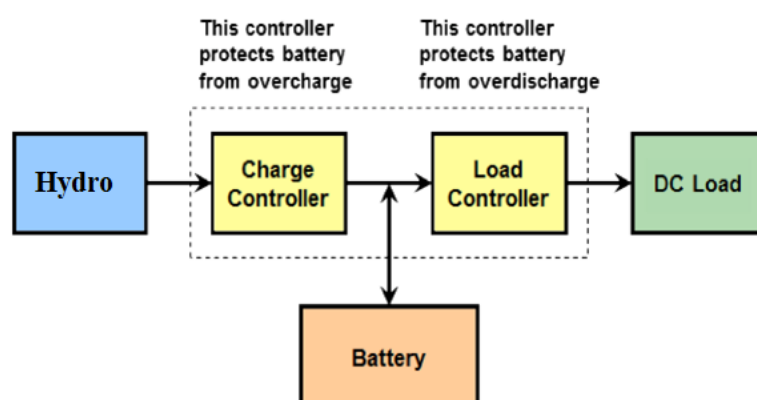
²² Ivurevure: PNGWing.com, "Alternating current Direct current Electric current Electricity Electric power", <https://www.pngwing.com/en/free-png-czyuz>

²³ Ivurevure: Amazon.ca, "Charge Controller", <https://www.amazon.ca/OutBack-Power-FM60-150VDC-FLEXMax-Controller/dp/B001VC7BYC>

²⁴ Ivurevure: JICA

YALOYALO 25: Tarovi na talaci sivia²⁵


- E vinaka na salanilivaliva qo

YALOYALO 26: Salanilivaliva vinaka²⁶


2.9 Bateri

Na bateri na iyaya e maroroya na igu livaliva ena igu kemiki qai vukica me livaliva. Qo na bateri vata ga e taurivaki ena sola kei na ivocevoce ni cagi. Na gumatua ni bateri e vakarautaki ena 'amps hour', ya na levu ni amp e rawa ni solia ena dua na awa.

YALOYALO 27: Bateri sogo²⁷


²⁵ Ivurevure: JICA

²⁶ Photovoltaic Systems, Dunlop 2nd Ed.

²⁷ Ivurevure: JICA

YALOYALO 28: Dui mataqali bateri²⁸

**Flooded
(Electrolyte – Liquid)**



Flooded Lead-Acid Batteries

**Sealed / Maintenance Free
(Electrolyte – Fixed)**



Absorbed Glass Mat

Gelled

- Na bateri ni lori e sega ni ganita na haidro, ni dau solia na kui levu ena gauna lekaleka.
- Na bateri ni haidro se sola e kena veibasai, ni dau solia na kui lailai ena gauna balavu.
- Na volt ni bateri sogo e yacova na 14.1 V, bateri vakawai e yacova na 14.4V
- Gumatua ni bateri:
 - Na gumatua (capacity) na levu ni livaliva e rawa ni solia na bateri ena vanua yalataki
 - Na ampere-hour (Ah) na ivakarau ni igu e rawa ni maroroya na bateri, tautauvata kei na dua na ampere dua na awa
 - Na gumatua ni bateri e vakatau ena kena katakata, totolo ni talatalaci, kei na volt e sogo kina (cut-off voltage)
- Vei ira kece na gacagaca ni iyaya livaliva, dodonu se dri, e dau leqa vakalevu na bateri
- Na waikama ni bateri vakawai (lead-acid) e veitosoyaki e loma, na ka ni bateri sogo e tu vakadua

2.9.1 Bateri vakawai

Qo na mataqali bateri dau yavalata na idini ni lori, kei na 'deep cycle-style'. E yavavala na waikama e lomana.

2.9.2 Bateri sogo (sealed battery)

Qo e rawa ni cavuti ena vica na mataqali bateri, wili kina e dua e via tautauvata ga kei na bateri vakawai. Na lomana e voleka ni tautauvata, kena duidui ga ni sega ni rawa ni dola.

2.9.3 Bateri AGM

Ena bateri AGM (Absorbed Glass Mat) na waikama e curu tu ena 'glass mat' volekata na veleti ni bateri, me mana kina na kena jaji kei na kena talaci. Na mataqali bateri kilai levu e wili kina na 'high performance engine starting', 'power sports', 'deep cycle', haidro, kei na 'storage'.

2.9.4 Bateri Gel

Na bateri gel e vaka na bateri AGM, baleta ni dei tu na waikama, ia e wili me duatani baleta na bateri AGM e wili tiko me sela suasua.

2.10 Wa

YALOYALO 29: Wa²⁹



Na wa ni livaliva e dau sema kina na iyaya, me dewa kina na itukutuku se na igu livaliva.

2.11 iVakariba/Isolator

Na itavi levu ni ivakariba me tarova na drodro ni livaliva ni kune na leqa. Na isolator e latia na livaliva ni curuma se biuta na iyaya.

²⁸ Ivurevure: Yavutaki ena "System Components- Batteries", Arizona State University, VOCTEC, <http://voctec.asu.edu>

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

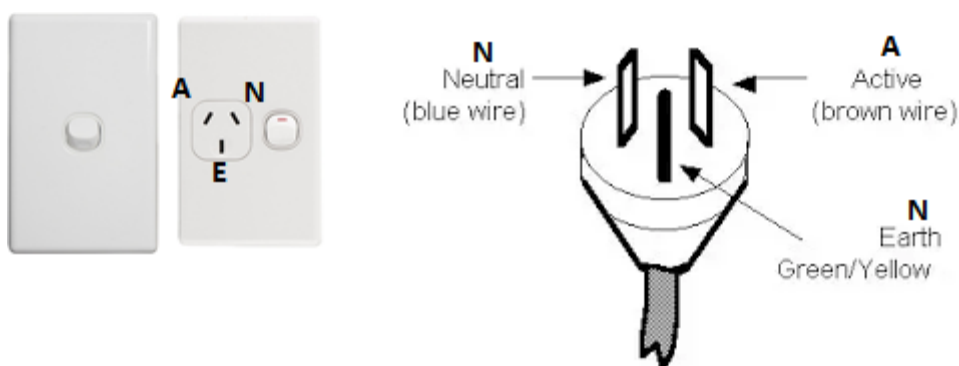
YALOYALO 30: iVakariba kei na Isolator³⁰



2.12 Suiti kei na vunilivaliva

Na suiti e sogota na livaliva, na vunilivaliva (power socket) e sema kei na iyaya livaliva me yavala kina

YALOYALO 31: Suiti kei na vunilivaliva³¹



2.13 iVuki (inverter)

Na ivuki na iyaya se salanilivaliva e vukica na livaliva dodonu (direct current, DC) me livaliva dri (alternating current, AC). E vica na mataqali ivuki, duidui na kedra yaga. Qo na veika me nanumi nida digitaka na ivuki ni haidro tugalala:

- Volt mai na bateri (12, 24 se 48 V)
- Volt livaliva dri e solia (120 se 220V)
- Gadrevi me levu na livaliva dri me colata na iusana lelevu (ena watt)
- Kui (surge current), mv ena moto, ke dua (ena amp)
- Veika tale eso (jaja ni bateri &s)

YALOYALO 32: iVuki (inverter)³²

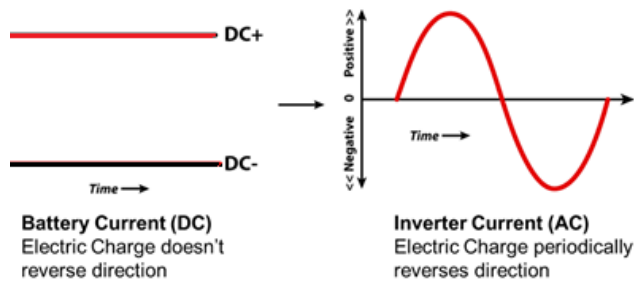


³⁰ IVuevure: Wave inverter.co, <https://waveinverter.co.nz/shop/solar/solar-connectors/pv-dc-isolator-switch-mc4/> and POSO.com, <http://poso.com.vn/wp-content/uploads/2020/04/1-2.png>

³¹ IVuevure: 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/>

YALOYALO 33: Cakacaka ni ivuki³³



2.14 iCeguCEgu (diversion load, dump load)

Qai vakacava na igu e vo tu? E sega ni rawa ni biu ga na igu e qaqi qai sega ni vakayagataki. E dau vakayagataki vakalevu na iceguCEgu (diversion load, dump load, shunt resistor) me kania na vo ni livaliva.

YALOYALO 34: iCeguCEgu, buli mai na idre (resistor)³⁴

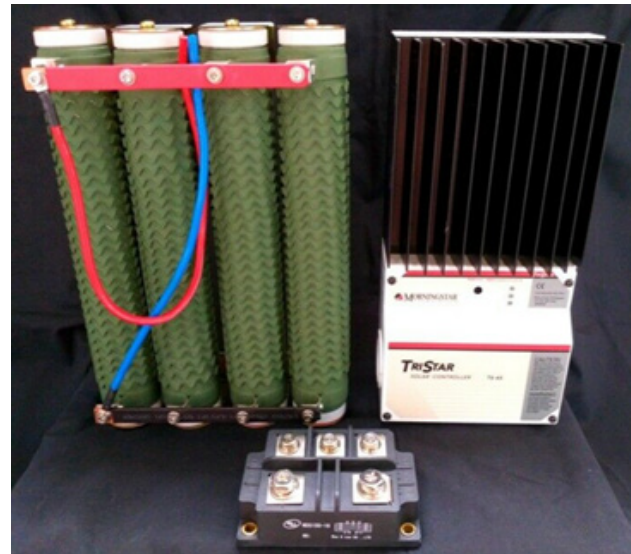


YALOYALO 35: iCeguCEgu vakaliliwataki³⁵



Na mataqali iceguCEgu vata ga e rawa ni yaga ena bateri ni livaliva dodonu, ni sa sega ni ceguva rawa na bateri na igu sa qaqi.

YALOYALO 36: E so na idoladola e volitaki vata na iceguCEgu kei na salalivaliva³⁶



2.15 Electronic Load Controllers

Sa mai taurivaki vakalevu ena gauna qo na ivotavota (Electronic Load Controller, ELC) me lewa na volt kei na 'frequency'. Ni dau lutu na iusana, na ivotavota e votā na livaliva ina iceguCEgu (raica na ulutaga e cake).

YALOYALO 37: Sabolo ni ivotavota (electronic load control unit) ni haidro³⁷



³³ Yavutaki ena System Components: Charge Controllers & Inverters, Arizona State University (VOCTEC), <http://vottec.asu.edu>

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

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

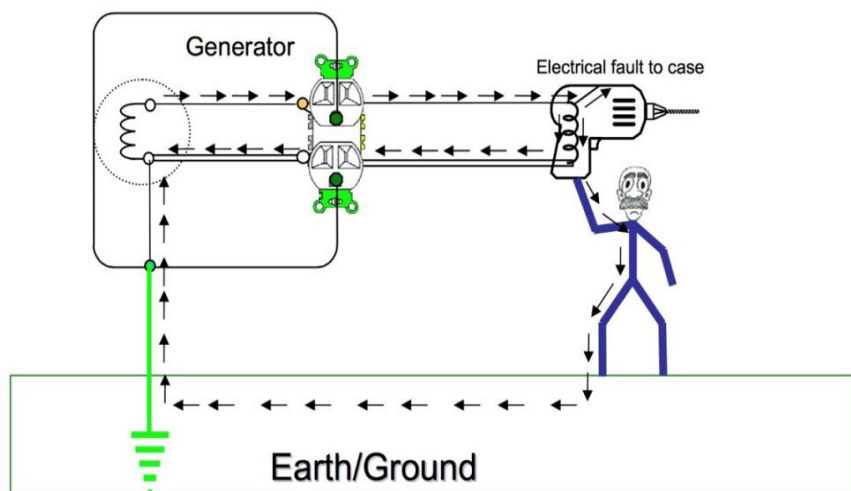
³⁶ Ivurevure: PicClick UK, <https://picclick.co.uk/Micro-hydro-turbine-26-kw-with-a-Dump-load-154173045313.html>

³⁷ Ivurevure: Dhava Mani Technologies, <https://1.bp.blogspot.com/-xzLAukzxFa0/V5yP24mX13I/AAAAAAAAAQA/-JbVKYtI3kHFxXi04uWK8cV7seCBIIeACKgB/s1600/2dum-peditmetal.png>

2.16 Gacagaca ni sobuiqele

E lavaki me sobuiqele (ground, earth) na haidro kece, me tarova na shok se mate (veitalia mada ni loka na livaliva (surge) se lidi na yaseyase).

YALOYALO 38: iCakacaka ni sobuiqele³⁸



YALOYALO 39: Gacagaca ni sobuiqele³⁹



Volavola:

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

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



3

iDusidusi ni
gacagaca

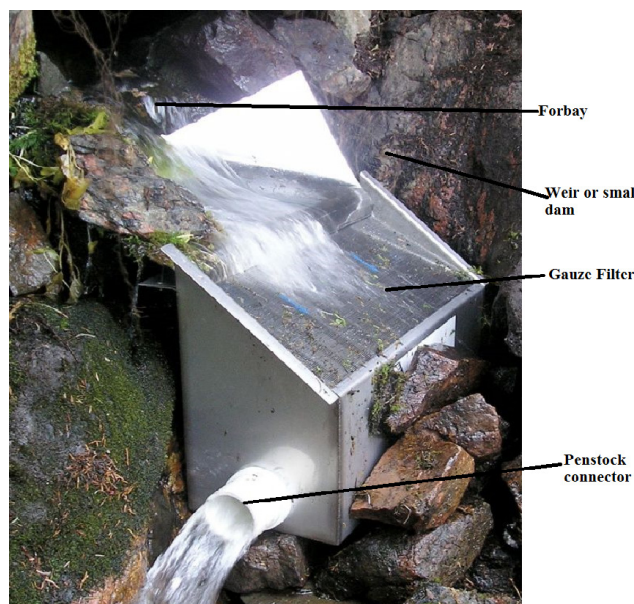
3.1 Gusu ni ivakaso

De na vinakati me vakabai vatu lailai na ivakaso (forebay), me tuva kina na wai qai drodro sobu ena kena paipo (penstock).

iDusidusi tale eso:

- Qarauna me tautauvata na lutu (veiyawaki ni ivakaso kei na ivocevoce ni lutu sobu) e tautauvata kei na kena e volai tu ena ivocevoce, se sivia.
- Qarauna me dei vinaka tu na baba e bati ni ivakaso de sisi.
- Qarauna me lakovi rawarawa na vanua e tu kina na ivakaso.

YALOYALO 40: Gusu ni ivakaso, vulo kei na isema ni paipo. Na ivakaso e tiko e daku ni baivatu – e laurai ga na gusuna.⁴⁰



3.2 Paipo (penstock)

Na paipo me taku lovelove (polyethylene) se paipo kaukaua (pressure pipe) PVC.

YALOYALO 41: Paipo ni dui lutu⁴¹

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

3.3 iVocevoce kei na jenereita

Na piko e yavala ena ivocevoce ni lutu rewaira, me 20m se lailai.

3.4 iDoladola

E dina ni taurivaki na idoladola (charge controller) ena sola, ia na ka ni haidro e ganita na kui levu sara. Mo KUA SARA ni taurivaka na idoladola ni sola ena piko.

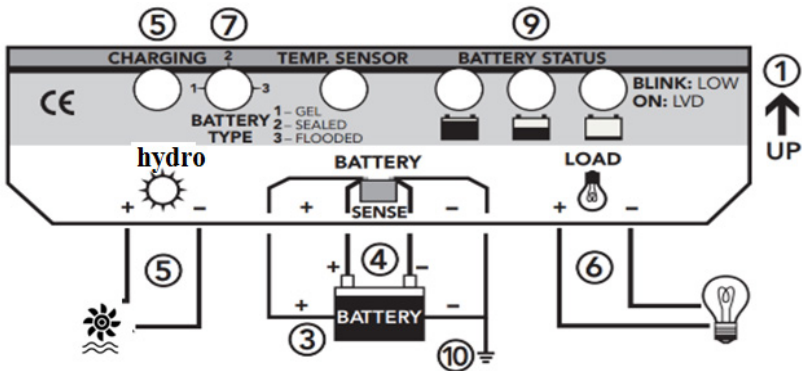
⁴⁰ Ivurevure: Pinterest, "Micro hydro intake", <https://www.pinterest.com/pin/563020390916765709/>

⁴¹ Ivurevure: 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>

Na idoladola e dodonu me:

- veirauti na kui e rawa ni colata kei na jaji (amp mai na ulunisola) kei na usausa (kui ni iusana)
- rawata na volt mai na hydro kei na volt ni bateri
- rawata na pawa ni livaliva dodonu me colata e levu na iusana
- rawa ni vakayagataki kina na veimataqali bateri (vakawai se sogo)
- nuitaki – e nuitaki vakalevu na idoladola rawarawa, sega so na ka vereverea (kua ni rawai ena kena fensi (“extra “features”) mv LCD screen, micro-processor programmed control &s)

YALOYALO 42: Droini vakacaca ni idoladola (charge controller)⁴²



3.5 Bateri

Na bateri e maroroya ga na livaliva e SEGA ni bulia.

YALOYALO 43: iDusidusi ni bateri⁴³

SPECIFICATIONS

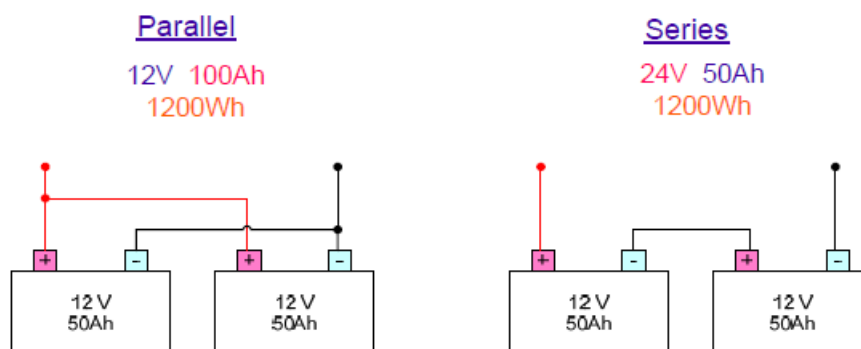
Nominal Voltage		12 Volts	
Amp Hour Capacity		115 (C20)	90(C5)
Reserve Capacity Minutes		170 @ 25 Amperes	
Physical Characteristics	Length	13.13"	334 mm
	Width	6.75"	171 mm
	Height	9.38"	238 mm
	Wet Weight	58 Lbs	26.4 Kgs
Terminal Options		BCI Type M	

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

YALOYALO 44: iTovo ni veisemasemai ni bateri⁴⁴**3.5.1 Me nanumi dei**

- Duisala (in parallel) soqoni na gumatua (Ah).
- Salavata soqoni na volt (V).
- Soqoni ni igu maroroi e tautauvata (Wh).
- Vinaka cake me KUA ni duisala e sivia na 2 na bateri (de qai vakavuna me duidui na jajitaki bateri se kena talatalaci, qai leqa koso kina na bateri; e levu na kabani ni bateri ena sega ni rokova na yalayala (warranty) ke duisala e sivia na rua na bateri).
- KUA ni duisala e sivia na 4 na bateri, de qai vakavuna me duidui na jajitaki bateri se kena talatalaci, qai leqa koso kina na bateri.

- KUA ni vakayagataki vata na bateri dui kabani, mataqali se yabaki, de qai leqa koso kina.
- Na bateri me vakadeitaki ena vanua cagicagi, vakarurugi mai na siga kei na uca. Tabu sara ni tokari e loma ni vale.
- Na iyaya ni jajitaki bateri me dei na kena wa (hard-wired), kua ni caka ga me rawa.
- Na sucu ni bateri me ubi ena isulu me kua kina ni shot.
- Qarauna me rau veiyawaki na sucunibateri kei na lalaga kava.

Cakacaka kece ni bateri me vakayagataki na iyaya vakarava (insulated tools).

3.6 iVuki (inverter)

Na teveli e vakaraitaki kina na idusidusi kei na gacagaca lelevu ni ivuki.

TEVELI 3: Sabolo ni idusidusi kei na gacagaca ni ivuki

iDusidusi & Gacagaca	
Continuous Power Rating (300 Watts at 25°C)	Total Harmonic Distortion (< 4%)
Peak Power Rating (600 Watts at 25°C)	Low Voltage Disconnect (LVD) (11.5V se 10.5V)
DC Input Voltage (10.0V – 15.5V)	Low Voltage Reconnect (12.6V se 11.6 V)
Waveform (Pure sine wave)	LVD Warning Threshold (11.8V se 10.8V)
AC Output Voltage (220V se 115V +/- 10%)	LVD Delay Period (4 miniti)
AC Output Frequency (50 se 60 Hz +/- 10%)	High Voltage Disconnect (15.5V)
Peak Efficiency (92%)	High Voltage Reconnect (14.5 V)

44 Yavutaki ena "System Components, Batteries", Arizona State University (VOCTEC), <http://voctec.asu.edu>

YALOYALO 45: iDusidusi ni ivuki⁴⁵

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℃

Volavola:

45 Ivurevure: 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))

IVAKADRE 3

Ena solia o dauveituberi e rua na bateri. Semai rau me salavata kei na daisala. Vakaraotaka na levu ni volt ena sala ruarua. KUA ni vakaraotaka na kui. Qarauna mo vaqaniliga rava.

Bateri (x2)



Wa



IVAKADRE 4

1. O dauveituberi me solia na ka kece cavuti e cake (ivocevoce, idoladola, bateri, ivuki kei na matanicina livaliva dodonu 12V kei na kena itutu) mo wilika na itukutuku ena ivolakabi (idusidusi & gacagaca) ni iyaya kece qai vakamacalataka, me vaka ena ivola e cake.
2. Ena ivolakabi e ra, cava na igu e rawa kei na lutu lavaki ni ivocevoce?





4

Mataqali piko-
haidro

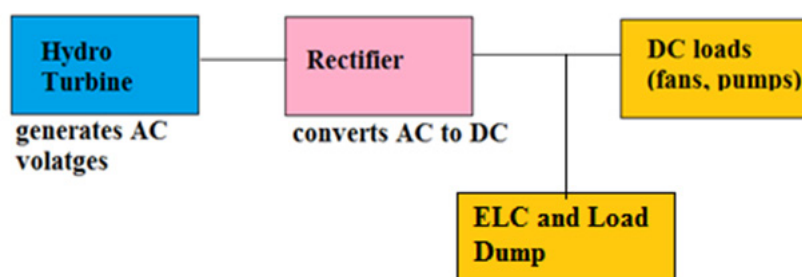
E va na mataqali haidro: na haidro ni lawalevu (on-grid); haidro tugalala (standalone) livaliva dri (AC); haidro tugalala livaliva dodonu (DC), kei na haidro veiwaki (hybrid).

4.1 Piko tugalala livaliva dodonu (DC)

Na haidro tugalala e sega ni sema kei na lawalevu (grid), e vakadurī vakalevu ena vanua yawa sega ni sema kei na lawalevu, se na vanua e sega ni gadrevi vakalevu kina na livaliva.

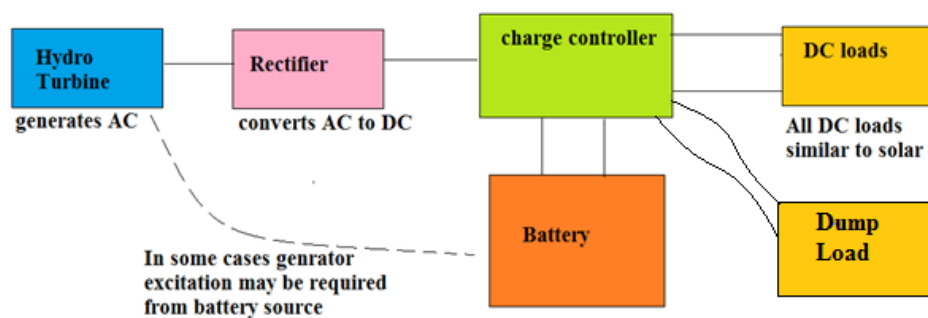
4.1.1 Piko tugalala livaliva dodonu (DC) sega ni vakabateri

YALOYALO 46: Sabolo ni haidro livaliva dodonu sega ni vakabateri⁴⁶



4.1.2 Piko tugalala livaliva dodonu (DC) vakabateri

YALOYALO 47: Sabolo ni haidro tugalala livaliva dodonu vakabateri⁴⁷



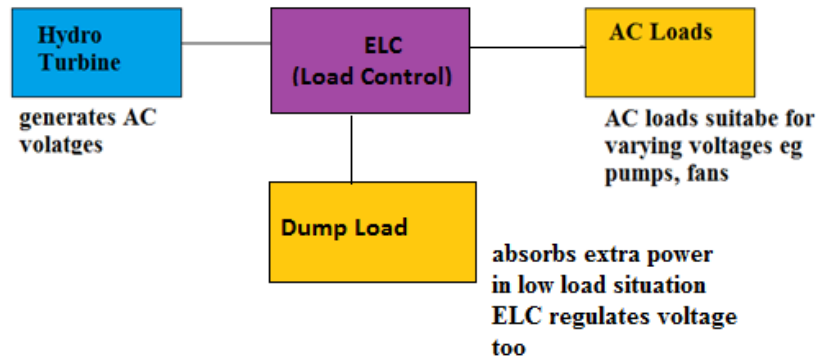
- Rawa ni cici kina na iyaya livaliva dodonu mv irinicagi, jajitaki talevoni ena vuniliti (USB port).
- Taurivaki vakalevu ena vale sega so ni levu mai vanua yawa, gadrevi ga na cina kei na jajitaki talevoni, sega ni iyaya livaliva dri lelevu.
- Na jenereita livaliva dodonu (DC) e dau vakalevu me tu kina na ivakadodonu (rectifier).

⁴⁶ Ivurevure: VOCTEC

⁴⁷ Ivurevure: VOCTEC

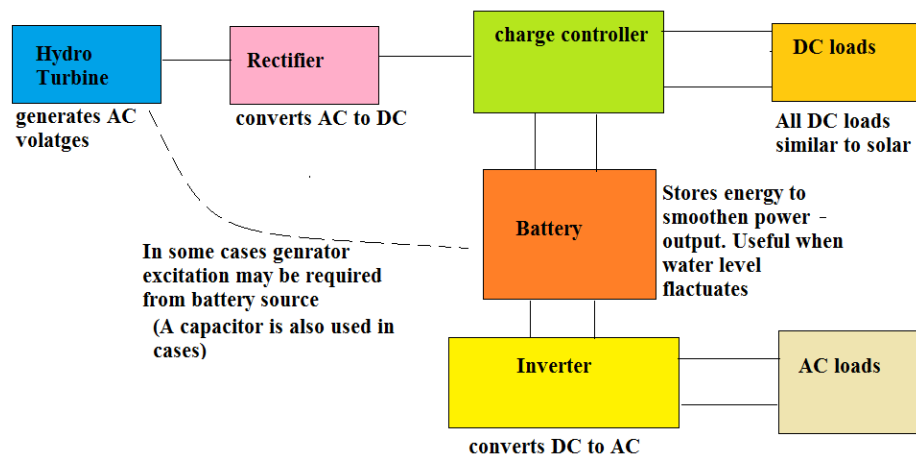
4.1.3 Piko tugalala livaliva dri

YALOYALO 48: Tugalala livaliva dri⁴⁸



4.1.4 Haidro tugalala livaliva ruarua (DC+AC) vakabateri

YALOYALO 49: Hydro tugalala livaliva ruarua (DC+AC) vakabateri⁴⁹



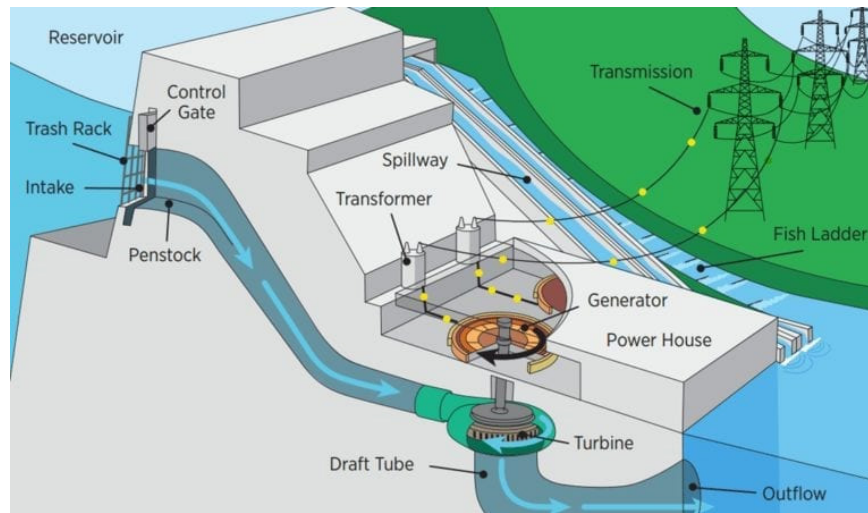
- Dei vinaka na livaliva e soli, veitalia ni lailai na wai.
- Tautauvata kei na “livaliva dodonu ga”, qai vakaivuki me cici talega kina na iyaya livaliva dri.
- KUA SARA ni veisautaka na iyaya livaliva dri kei na livaliva dodonu. Na iyaya livaliva dodonu me cici ga ena livaliva dodonu. KUA SARA NI SEMA NA IYAYA LIVALIVA DODONU INA LIVALIVA DRI. E RAWA SARAGA ni ca na iyaya, se o mavoia se mate sara.
- Vakayagataki vakalevu ena vale levu toka ni gadrevi kina na cina, jajitaki talevoni kei na iyaya livaliva lalai.

48 Iurevure: VOCTEC

49 Iurevure: VOCTEC

4.2 Piko-haidro ni lawalevu (grid)

YALOYALO 50: Haidro ni lawalevu (grid)⁵⁰



4.3 Kila na ivakarau ni ivocevoce ni piko

E bau rawarawa na kila na saisi ni ivocevoce ni haidro, dredre na sola, baleta e levu na kabani e rawa ni bulia na ivocevoce me ganiti kemudou, vakatau ena levu ni iusana, oya se vica

na pawa dou gadreva vakavuvale se vakoro. Ni sa soqoni oti ga qori – mo vakalevutaka ena 1.5 me bau veirauti sivia kina. Qo eratou na via kila na kabani ni ivocevoce, me donu na kena eratou na volitaka. Na ulunisola e volitaki ga ena sitoa, na ivocevoce ni haidro e sega, e otataki ga. Kevaka madaga sa tu rawa ena sitoa, o na kila se saisi cava e rauti kemudou.

Volavola:

IVAKADRE 5

Wasewase leleya 4 se sivia mo dou sauma qo:

1. Droinitaka e 3 na mataqali haidro kune wasoma, vola na yaca ni gacagaca yadua. Veivosakitaka vakalasi se mataqali cava e vinaka vei iko, kei na vuna.

2. Veivosakitaka vakalasi se haidro cava dou vinakata, kei na vuna.

5

iYaya ni cakacaka
ena haidro

Qo na iyaya e dau vakayagataki vakalevu ena vakaduri haidro.

YALOYALO 51: iYaya vakayagataki vakalevu⁵¹



5.1 iYaya yadua kei na kedra yaga

Kena yaloyalo	Yacana	Kena yaga
 52	iVakarau ni kui	Vakaraautaki kina na kui ni wai.
 53	Spana (socket spanner)	Vaqaqacotaki kina na bolu ni bati ni paipo &s.
 54	Spana ni paipo	Cakacaka vakapalama ena paipo ni haidro kei na kena isogo, bau kina na gusuniwai ena ivocevoce.

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 Ivurevure: RainmanWeather, Flowatch Flowmeter Station, <https://www.rainmanweather.com/Flowatch-Flowmeter-Station>, accessed 21 June 2021.

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

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

 55	Mita ni bi (pressure gauge)	Vakarautaki kina na bi kei na lutu.
 56	iSivi	Kelivaki baniwai se paipo.
 57	Mita iqamu (clamp meter)	Na mita iqamu e vakarautaka na kui ni livaliva dri, volt ni livaliva ruarua, kei na idre (resistance), koya e ganita vinaka kina na cakacaka ni livaliva. Rawarawa qai ganita na vakarautaki kui lelevu.
 58	Mita liga (multimeter)	Na mita liga e dau vakarautaka vakalevu na volt, kui, kei na idre (resistance). E ivakarau matailalai. Rawa ga ni vakarautaki na kui ni salavata kei na iyaya e vakarautaki (vakavo ni tiko na kena 'adapter').
 59	Tepi ni paipo (thread sealant tape)	Tepitaki kina na isema vakauaua (thread) me tarova na wai.
 60	Drega ni paipo (PVC glue)	Yaga ni sema na paipo rava (PVC).

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

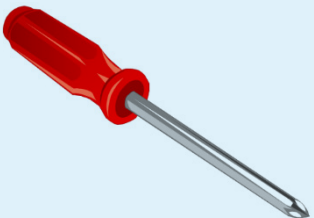
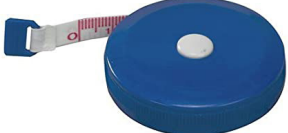
56 Ivurevure: Cashbuild, "Flat spade", <https://www.cashbuild.co.za/shop/spade/4460-flat-spade.html>

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

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

 61	Osipaipo iloiloa	Vakarautaki kina na lutu
 62	iVaro	Varo kau ni itutu ni ivocevoce se kena vale.
 63	iVaro ni paipo (hacksaw)	Varo paipo kei na isema taku
 64	Skrudraiva	Wirica na skru
 65	Skrudraiva sta (Philips screwdriver)	Wirica na skru
 66	iVakarau cibini 100m	Vakavakarau mai vanua – rawa ni kilai vakacaca kina na levu ni lutu.
 67	So na mataqali spana, mv spana mama takelo (offset ring spanner), spana duimua (combination spanner), spana tadola (open-ended spanner), spana mama (ring spanner).	Qo na iyaya e vesuka matua e dua na ka meda wirica, vb nati se bolu, se me kua ni cowiri.

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

62 Ivurevure: ofwoodworking "Hand saw", <https://i.pinimg.com/originals/b6/6b/1f/b66b1fee175c25e8e05cfd855c520.jp>

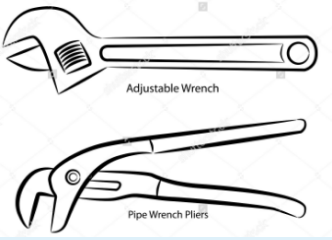
63 Ivurevure: Frakem Blog, "Hacksaw", <https://www.frakem.com/blog/wp-content/uploads/2016/06/hacksaw.jpg>

64 Ivurevure: Galco, www.galco.com

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

66 Ivurevure: 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/>

 Adjustable Wrench Pipe Wrench Pliers 68	Shifta (adjustable spanner) Spana ni paipo (multigrip pliers)	Qo na iyaya e vesuka matua e dua na ka meda wirica, vb nati se bolu, se me kua ni cowiri.
 69	Plais (lineman pliers)	Qo na mataqali plais ra vakayagataka vakalevu na daunilivaliva me qamuta, wirica, loveca se kotiva na wanilivaliva.
 70	Plais ucumomoto (needle-nose pliers)	Mataqali plais vb ni daunilivaliva me loveca, tokia se kotiva na wanilivaliva.

E levu na mataqali ulu ni skru eda sotakaya ena vakaduri haidro, qai dui tu na kena skrudraiva.

YALOYALO 52: Duidui skru kei na dui uluna⁷¹



68 Ivurevure: Pinterest.com, "Different types of wrenches", <https://www.pinterest.com/pin/147352219031480866/>

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

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

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

E ka bibi meda kauta voli vakamaqosa na iyaya vakamatai nida caka haidro tiko. Qo e vica na kena icakacaka:

YALOYALO 53: iWalewale ni kau iyayas⁷²



5.1.1 iKabakaba ni vakawataki vale

YALOYALO 54: iKabakaba yavairua (A-frame)⁷³



YALOYALO 55: iKabakaba vakavata (platform ladder)⁷⁴



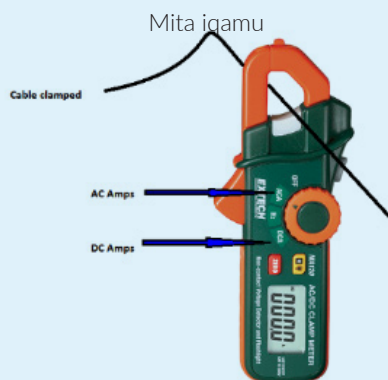
⁷² Ivurevure: Pinterest.com, <https://www.pinterest.com/bambulancemania/work-apparel/>

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

⁷⁴ Ivurevure: Bunnings.com, "Bailey Ladders", https://www.bunnings.com.au/bailey-0-9m-150kg-fibreglass-platform-ladder_p0860918

IVAKADRE 6

O dauveituberi me soli ivuki kei na bateri. Na ivakadre qo mo vulica kina na yaga ni ivuki me yavala kina na iyaya livaliva dodonu. Vakayagataka na ivuki kei na bateri me waqa kina na cina se yavala na irinicagi. Na mita me vakarautaki kina na kui ena wa.



iVuki



Bateri



iDoladola



Matanicina se irinicagi
livaliva dri



- Qarauna me boko na ivuki. Oti me rau sema na ivuki kei na bateri

- Luvata na mita, dusia na DCA me vakarautaki kina na kui mai na bateri ina ivuki.

QAQARAUNI

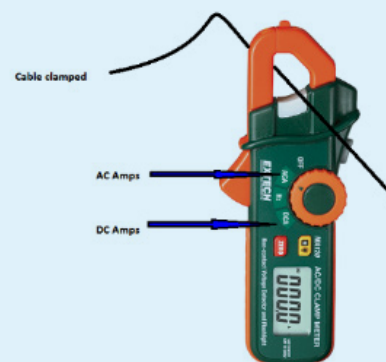
Na matanicina livaliva dri me sema na kena wa kei na palaka sa vakawataka na daunilivaliva.



Droini ni semasemai

- Dusia na ACA ena mita iqamu me vakarau kina na livaliva ni cina se irinicagi livaliva dri. Dolava na gusu ni mita me vaka e laurai e ra. Wilika na mita. Qo na kui ni matanicina. Na yaloyalo e ra e laurai kina na icakacaka ni vakavakarau kei na semai ni mita.

Dusia tiko na ACA



SE KA - MO SEMAGA NA BATERI + IVUKI + MATANICINA
qai vakarautaka na kui e kania na matanicina livaliva dri.

6

Vakaduri haidro

—————

6.1 Vakarau duri

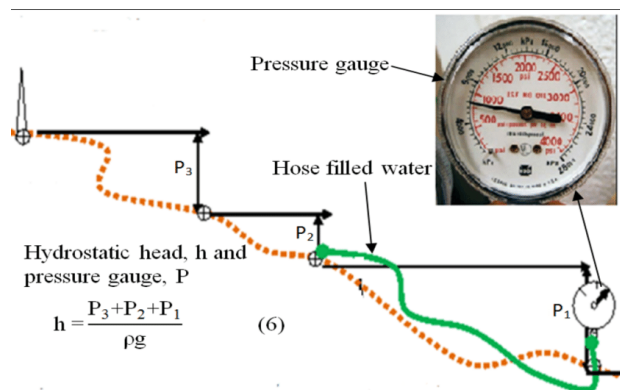
Ni se bera ni tekivu vakadurī, me tuvanaki rawa e lomamu qai vakarautaki rawa na iyaya kece ena gadrevi kina.

6.2 Vakarautaki ivakaso kei na paipo

Matai, me digitaki na wai me sotava na lutu kei na kui e gadrevi ena ivocevoce. Vakarautaka na lutu. Qo na kena veitaravi:

1. Me dua na mua ni paipo lovelove ena ivakaso. Muana kadua me tiko ena vanua e nanumi me duri kina na ivocevoce. Na muana qori me dua na kena ivakarau ni bi (pressure gauge).
2. Tawana na wai ena paipo me yacova ni sinai. Wilika na ivakarau ni bi. Qori vakacaca na bi ni lutu (head pressure).

YALOYALO 56: Vakarautaki lutu⁷⁵



3. Sa kua na fika vereverea. Wilika ga na lutu ena teveli e ra.

Lutu		Bi			
(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

Nio sa kunea ga na vanua mai uluniwai e sota kei na gagadre ni ivocevoce ena kena ivolakabi, sa rawa ni tuva na baniwai qai toka na vulo me taucoko kina na ivakaso.

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

6.3 iVakaso

Samaka na vanua mai uluniwai, tuva e dua na baniwai lailai vatu se kau. Ke tiko na kena ikolo, e rawa ni simede.

YALOYALO 57: iVakaso simede⁷⁶



Tarava na baniwai na vulo lawalawa matailalai me vuloni kina na wai.

YALOYALO 58: Vulo e gusuniwai⁷⁷



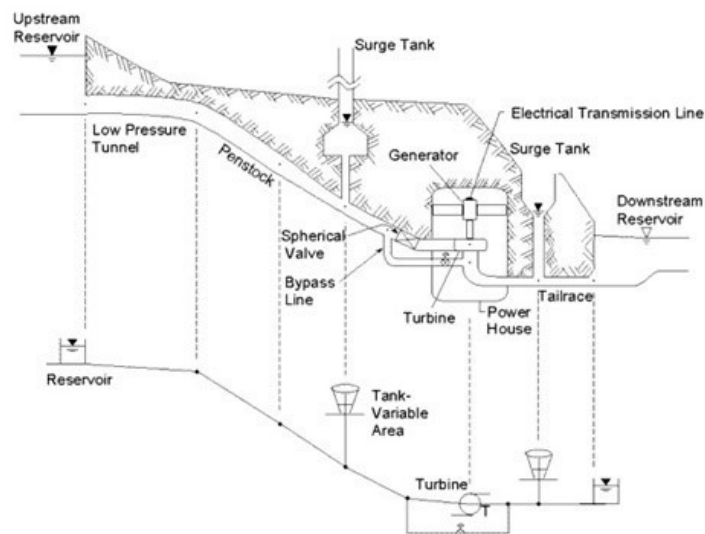
YALOYALO 59: Vulo kei na gusunipaipo e ra⁷⁸



6.4 Paipo (penstock)

Na paipo na sala ni wai mai na ivakaso ina ivocevoce.

YALOYALO 60: iTuvatuva ni isogo ni paipo⁷⁹



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

⁷⁷ Ivurevure: Power Spout, www.powerspout.com

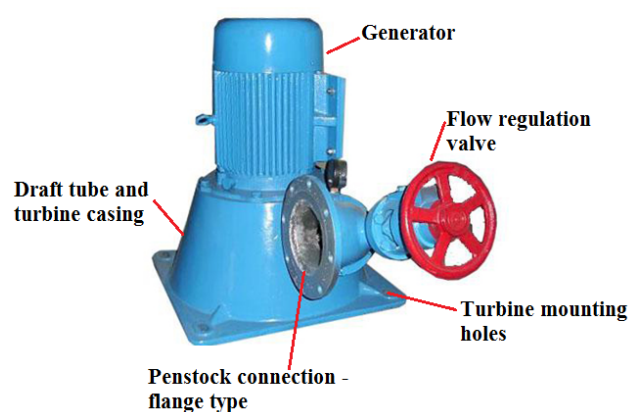
⁷⁸ Ivurevure: Waterpower & Dam Construction, "Pico-Hydro", <https://www.waterpowermagazine.com/uploads/newsarticle/6798305/images/496422/large/l%20pico%20hydro.jpg>

⁷⁹ Ivurevure: 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

YALOYALO 61: Paipo ni haidro⁸⁰

6.5 iVocevoce kei na jenereita

Nida voli piko, e dau vakalevu me rau sema rawa na ivocevoce kei na jenereita. E rawarawa na sema na paipo kei na qa ni ivocevoce. E levu na ivocevoce e vinakati me vakavata.

YALOYALO 62: Sabolo ni ivocevoce ni piko⁸¹


Ena yaloyalo e cake, e sema na paipo kei na gusu ni qa ni ivocevoce vakabatina. Na mataqali isema e duidui ena veimataqali ivocevoce. E so na mataqali ivocevoce piko e gadrevi me galala na rukuna me drodro tani kina na wai.

YALOYALO 63: Na piko ena kena vata kauvaro⁸²


Na wa mai na jenereita ina vale ke sivia e 30m, mo nanuma ni na lutu kina na volt. Na lekaleka ni wa na kena vinaka.

6.6 Bateri

Na bateri e maroroi kina na igu me vakayagataki malua, vakabibi ni dau veitubuyaki na kui ni wai.

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

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

⁸² Ivurevure: Baylor University, Yavutaki ena Wikipedia, "Pico Hydro", https://en.wikipedia.org/wiki/Pico_hydro

YALOYALO 64: Mataqali bateri²⁸

Flooded
(Electrolyte – Liquid)



Flooded Lead-Acid Batteries

Sealed / Maintenance Free
(Electrolyte – Fixed)



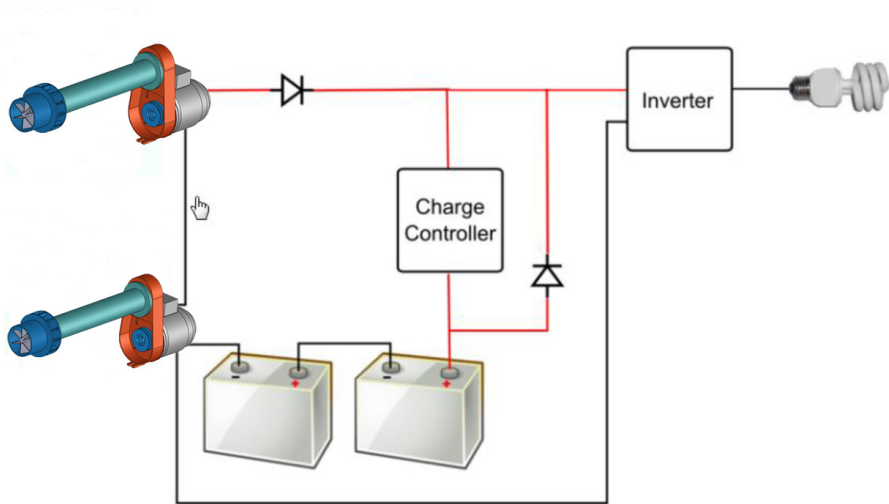
Absorbed Glass Mat

Gelled

Ni vakabateri na haidro, e vinakati talega na idoladola (charge controller) baleta na livaliva mai na jenereita. Na haidro e dei tu, sega ni veitubuyaki vaka na cagi se sola, e sega gona

ni gadrevi na bateri ena haidro livaliva dri, se sema kei na lawalevu (grid) se sega.

YALOYALO 65: Sabolo ni semai ni piko sega ni sema kei na lawalevu⁸³



Volavola:

83 I vurevure: <http://www.unido.or.jp/>



7

iDusidusi ni Qaqarauni
ena haidro

7.1 Lawa ni qaqarauni me muri

YALOYALO 66: iYaya ni tataqomaki (Personal Protective Equipment, PPE)⁸⁴



1. Nio vakarau semā se moica na livaliva ni vale, mo dau tukuna vei iratou na itaukei ni vale qai bokoca na livaliva. Kua sara ni tovolea mo cakacaka ena salanilivaliva e bula tiko. Na levu ni kena kui ena vakatau ena volt kei na idre (resistance) ni salanilivaliva.

2. Mo dau tuvā se ripeataka ga na salanilivaliva o sa vulica oti. Kua ni tovolea mo veisautaka na icakacaka ni ivocevoce ni haidro, vakavo nio kila vinaka sara.

YALOYALO 68: Cakacaka o kena dau⁸⁶

YALOYALO 67: Notisi ni qaqarauni⁸⁵



⁸⁴ Ivurevure: "Personal protection equipment", <http://www.mnltap.umn.edu/>

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

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

3. Mo dau vakaiyaya ni tataqomaki (PPE, personal protective equipment) mv qaniliga rava, matailoilo ni tataqomaki kei na ivava kaukua. Tabu na tarā na waya ni livaliva, veitalia nio vaqaniliga.
4. Kua ni tovolea mo ripeataka duadua na bateri. Na bateri e tu kina na kemiki rerevaki e rawa nida mavoa bibi kina.

YALOYALO 69: Notisi ni waikama⁸⁷



5. Kua ni tokara na bateri volekata na matadravu se e loma ni rumu ni gade – e so na bateri e dau kuvuraki kasi kama se kasi gaga, dina ni sega ni laurai.

YALOYALO 70: Notisi ni kasi gaga⁸⁸



6. E tabu ni maroroi na bateri e vanua qiqo se veitikivi kei na benisini se karasini, de qai lidika qai caudre. Na bateri me dau maroroi e vanua cagicagi.

YALOYALO 71: Notisi ni qaqarauni ni bateri⁸⁹



7. Cakacaka taurua, vakabibi nida lai raica na ivocevoce, kena paipo se na ivakaso. E dau kui sara na uluniwai ni haidro, e so na tikina e titobu sara. De dua e luvu. Na baba e toka kina na paipo e so e siro sara qai sisisi, mo dau qaqarauni nio cabe tiko e baba, vakabibi nio cola iyaya tiko.

YALOYALO 72: Wai kece e rawa nida luvu kina⁹⁰



8. Nanuma tiko ni ivocevoce ni haidro e tekivu cowiri ga, sa qaqi livaliva sara tiko. Kua sara ni tarā se semā na kena wa ni cowiri tiko na ivocevoce.

YALOYALO 73: Notisi ni qaqarauni⁹¹



9. Na ivocevoce ni haidro e dau toka vakalevu ena wai se yasa ni wai e dau dobui ni taubi na uca. Kua ni ripeataka ni tau na uca, qai namaka tiko ga na dobui.

YALOYALO 74: Notisi ni waluvu⁹²



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

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

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

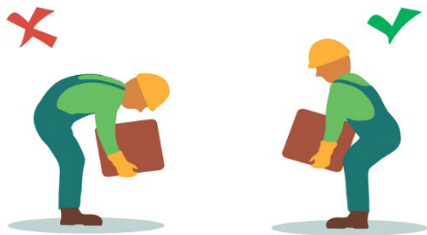
⁹⁰ Ivurevure: Seton.co (Signs, Labels & Solutions for a Safer Workplace), <https://www.seton.co.uk/danger-death-hazard-warning-signs-with-upgrades.html#HZ150A3DSDH>

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

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

10. Qaqarauni nio lave ka bi, qai muria kece na idusidusi ni iyaya nio vakayagataka tiko. E so na gacagaca ni ivocevoce era ka bibi sara, da laveta vakaca e rawa nida mavoa.

YALOYALO 75: Kua nio kala nio lave, lokia na yavamu qai dodoka⁹³



Volavola:

93 Iivurevure: <https://www.espinosafamilychiropractic.com/>

IVAKADRE 7

Wase A:

Me ratou wasewase na lewenivuli. Tukuna me ratou vakaduria e 2 na ivocevoce ya 600-watt, e 3 na bateri ya 30Ah kei na idoladola (charge controller) 20A, 2 na matanicina livaliva dodonu (DC) kei na 1 na ivuki 100W, kena iusana e dua na matanicina livaliva dri. (Tou na sega ni tuvā dina).

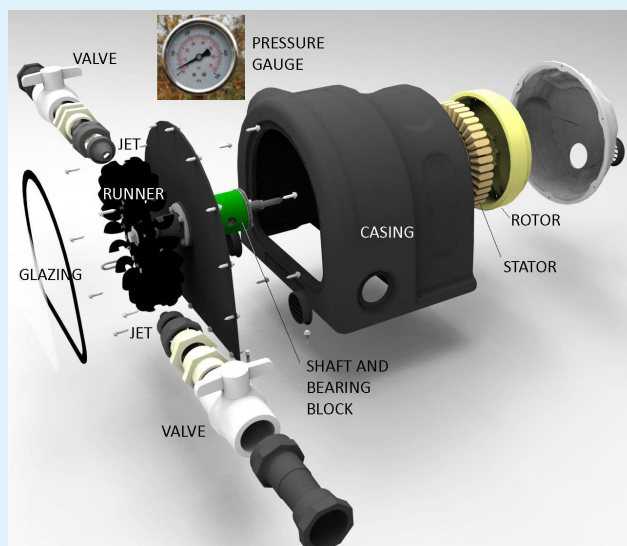
Me ratou veivosakitaka mada na itovo kece ni qaqarauni ena vinakati ena cakacaka qo. Veivosakitaka ga se volā sara. Tarogi iratou se ratou na vakaduria vakacava. Oti vukei iratou me ratou vakaduria na ka tugalala livaliva ruarua (DC, AC) me vaka sa vakarautaka na VOCTEC.

Wase B: Vakaduri

Me tekivu na ivakadre ena iyaya qo.

- 1 Jet kei na 1 isogo (valve) (2" BSP standard - NPT optional)
- iVakarau ni bi waiwai vinaka toka (oil filled pressure gauge)
- 'Manual grease fitting' me vaka e lavaki
- 2m na waya PV 4mm2 'tinned +/-earth'
- 2 x MC4 isema ni wa (cable connector)
- 4 x Tek 'screw fixing kit'
- 4 'jet insert' tu vakawawa
- Curu talega na 'rotor packing set kit' ke nanumi ni na vinakati

E laurai e ra ni vaka e sereki na ivocevoce PS PLT o na tuvā vakatovotovo.



Laurai ni sereki na ivocevoce PS PLT

Ni bera ni tekivu nomu vakaduria, mo nanuma tiko na itovo ni qaqarauni qo:

- E so na ivocevoce e rawa ni veivakamatei na livaliva ena levu ni kena volt, vakabibi ni totolo sivia, mo kua gona ni tarā se bau volekata na kena wa.
- Nio vakarau semā na ivocevoce kei na idoladola se ivuki mo vakadeitaka na kena volt ena sala dola, de qai ca kina na iyaya livaliva.
- Na cakacaka qo me qaravi e matai dua na kena dau vakaivola, koya sa qaseta talega na vakaduri iyaya livaliva kei na jenereita lalai.
- Na volt livaliva dodonu (DC) ni ivocevoce e dau veitubuyaki, e so mada na gauna e rawa ni vakatolutaki na kena e kilai vakaivola. Na idoladola kei na ivuki e tiko kina na 'capacitor' e rawa ni maroroi kina na livaliva veivakamatei ena kena waya.
- Ni sema vakaca na waya e rawa ni lade na livaliva, qai vakavu kama. Me vaqacacotaki matua kece na isema vakalivaliva e loma ni ivocevoce ni vakaduri tiko.
- Na ivocevoce PLT e tiko na kena isogo dola rawarawa (quick release toggle latch), baleta me moici kina e loma ni se bera ni yavala. Ni sa oti qori, me vakaisogo tudei, mera kua kina ni curuma na gone qai mavoa ena cowiri ni ivocevoce. Na yame ni ivocevoce Pelton e gagata, e rawa ni mavoa vakaca kina na ligada.

Sema ni Paipo

1. Sema na muana ena isogo (valve)

Na isogo e dau yalani kina na drodro ni wai ina ivocevoce. Na ivakarau ni bi (pressure gauge) me toka e yasa ni isogo, me vaka e laurai i kerī. Ena vinakati e dua na mataqali isema (reducing bush) me semai rau na paipo kei na isogo.



2. Sema na paipo levu kei na paipo ni isogo

E soli e dua na isema ni paipo (camlock) me sema totolo kina e dua na tolo ni osipaipo 50mm mai na paipo levu ina gusu ni ivocevoce. Raica na kena droini e ra. E laurai kina na veitaravi

ni isema mai na paipo levu (penstock) ina ivocevoce. E rawa ni vakayagataki na 'pipe saddle' me vakauaua kina na gusu ni paipo levu, qai toka kina na isogo, tarava na isema-osipaipo-isema, qai tini ena ivana (jet sleeve) ena ivocevoce.



3. Sema ni 'jet' kei na ivocevoce

Na droini e ra e laurai kina na veitaravi ni isema ena muana ina ivana (jet sleeve). Qo e sema kei na gusu ni ivocevoce. Qirisitaki vinaka na uaua (thread). Vaqacotaka ena spana na isogo se isema (camlock) ena mua ni ivana, me kua ga ni qaqaco sara de lutu na mama (O-ring seal). Na gusu ni ivana (jet cap) me vaqacotaki ga e liga, me dei kina na kena itokatoka (jet insert). Qarauna ga me kua ni lutu qai kuitaki.

CUTTING AND MEASURING A JET INSERT

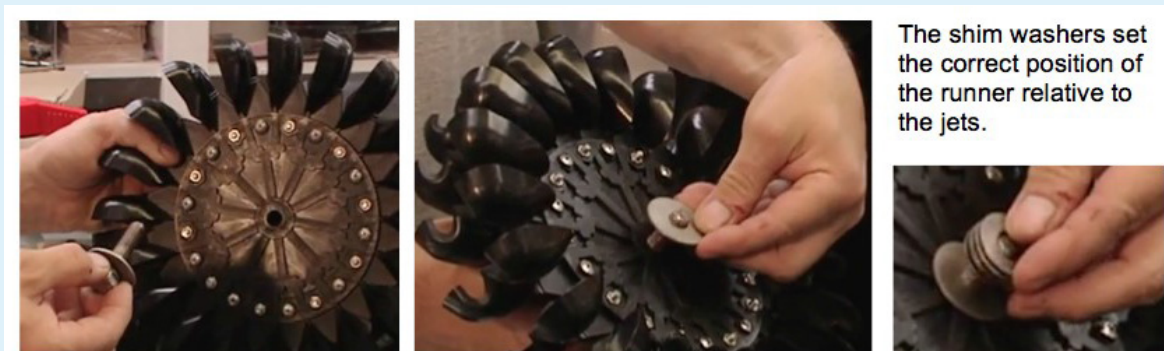


4. Vakarauteki na qara ni ivana

Qo eda na vakatovolea me tava na gusu ni ivana (nozzle opening of jet insert) me yacova ni donu na vanataki ni wai. E va tiko na ivana, tou na vakayagataka ga e dua. Qarauna nio tavatava tiko.

5. Vakaduri iqaqi ni ivocevoce

Na ivocevoce dina (runner) e toka ena mua ni tolo ni kaukamea e donuya na wai. Qarauna ni toka donu na ivocevoce me cowiri vakaliganikaloko, me vaka sa laurai qori. Toka na wasa (spring washer) kei na dua na wasa levu (flange washer) ena bolu M12 qai vakacuruma. Toka na ikarua ni wasa levu (flange washer) kei na so na wasa lalai (shim washers) sa vakarauteki yani e muri. Vaqacotaki na bolu me 50 Nm 'torque' se qa sara. Ke sisi e rawa ni mavoia kina na ivocevoce.



The shim washers set the correct position of the runner relative to the jets.

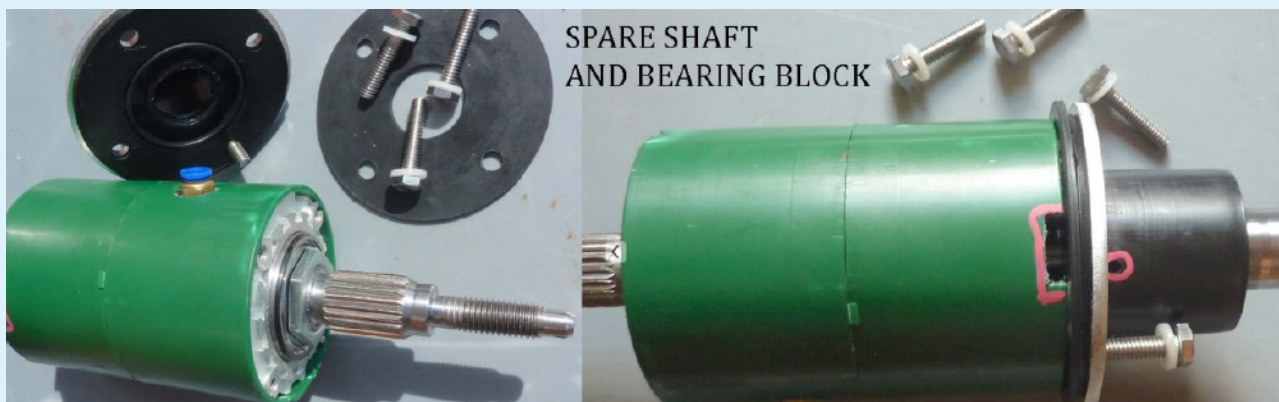
6. Toka na ivocevoce

E rawa nio irova na ivocevoce Pelton ena ivana, me vaka e laurai qori. Na wai vanataki me lauta donu na loma ni yamena (spoon splitter). Ke cala, vakayagataka na wasa lalai qori me ivakasoso ni vu ni ivocevoce.



7. Sema na tolo ni kaukamea kei na berigi

E vinakati me luva na tolo ni kaukamea (shaft) kei na qa ni berigi qai toka tale me veisau kina na berigi. Tou raica mada na itokatoka ni qa ni berigi.



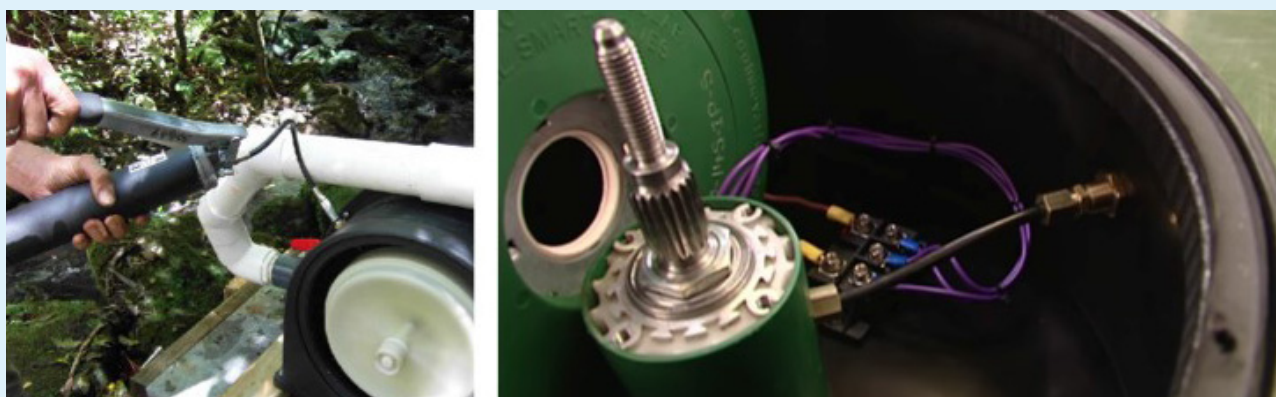
Tekivu mai na muana 'mamaca', biliga na tolo ni kaukamea me curuma na qara ni ilati (bulkhead). Qarauna me toka e ra na qara ni wai (drainage notch, wirini piqi e cake). Toka na kena

rava (rubber gasket) kei na isala (top hat assembly) ena mua ni tolo ni kaukamea, ni qirisitaki vinaka na rava kei na 'seal'.



Wirica na isala me toka talega e ra na qara (drain hole). Taurivaka na skrudraiva me sotasota kece na qara, qai coba na imatai ni skru ¼ idi. Coba tale na skru e tolu, vaqacotaka vakatautauvata ena spana cowiri (socket spanner) 7/16"

se 11mm, me yacova na 5Nm (4 ftlb). Kua ni qa vakasivia, de mavoa kina na rava qai turu. Semā na osipaipo (grease hose) kei na qa ni berigi. E ka bibi me qirisitaki na berigi me bula balavu.



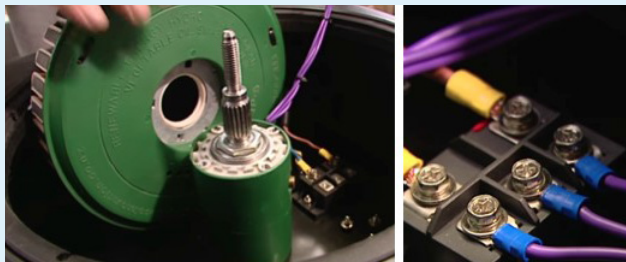
Na berigi sogo (sealed) e vinaka me qirisitaki tale, baleta na ivocevoce ni haidro e cici tuga siga kei na bogi, qai cowiri sara vakatotolo. Na PowerSpout e tiko na sucuna (re-greasing nipple) me qirisitaki kina. Qo me caka ni cowiri tiko na tolo ni kaukamea (ena igu ga ni wai se na iqiva sega ni vakawa me dua na matana (attachment) 19mm).



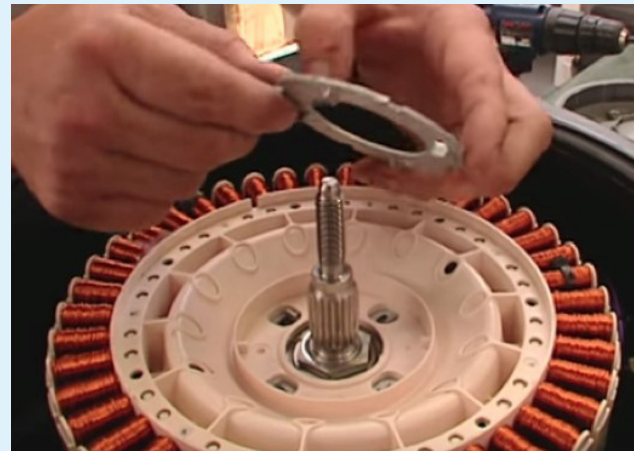
Pamutaka i loma ni qa ni berigi e rauta ni 40 ml na qirisi ni se qai tekivu (raica na yaloyalo e cake). Qo e viavia pamutaki vaka40-60 na ipamu ni qirisi ni vale. Na berigi me qirisitaki ni luva na makeneta (magnetic rotor). Nio raica ga na qirisi ena qanikuvu (dust shield) sa rauta. (Ke o via kila na volt e soli, vakarautaka rawa, baleta na qirisi ena vakaberā na kena talaci (maximum off-load speed).)

8. Vakaduri jenereita

Ni bera ni toka na qa ni jenereita ena ivocevoce PLT, me sema na wa e tolu ina ivakadodonu (rectifier) ka toka ena ilati e dakuna. (Me sema talega na osipaipo ni qirisi ena qa ni berigi.)



Tokara na 'stator' ena mua na qa ni berigi 'mamaca'. Na wasa levu (galvanized) me toka e cake (me qara sobu na batibatina). Wirica na 'stator' ena qa ni berigi, me tavivi kina na wa, me kua ga ni teru me tarā na ivocevoce. Vaqacotaka na skru e va e vakadeitaki kina ena spana cowiri 11mm se 7/16".

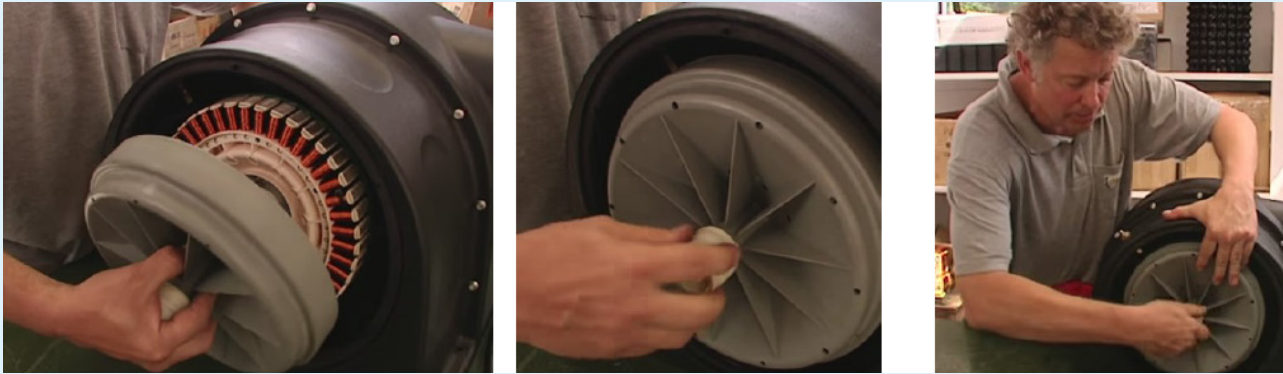


9. Toka na 'extractor knob' kei na 'rotor'

Na 'extractor knob' me biligi matua me coba ina qara ena makeneta (magnetic rotor) ni se bera ni semasema kece. Kena inaki me rawarawa kena tokari na makeneta ena tolo ni kaukamea kei na kena lvua, me vorata na idre ni makeneta kei na 'stator'.



Qirisitaki na bati ni qiqi (mating splines). Na makeneta (rotor) me toka ena mua ni tolo ni kaukamea 'mamaca', o qai wirica vakamalua nio taura tiko na ivocevoce mai muana 'suasua' me yacova ni sota na batibatina qai dei.



Wirica vakaliganikaloko na itautauri me toka na makeneta, me yacova ni tu vakadua. E rawa ni vaqacacotaki ga e liga.

Nida via luvata na makeneta (rotor) cakava ga na kena veibasai, wirica na itautauri ina imawi, se ka taura matua na itautauri qai wirica na makeneta ina imatau qai dre me lako tani mai. Wirica na makeneta se cowiri vakavinaka. E dau gi toka qai vakamalua me yacova ni tu vakadua ni oti e vica na sekodi.

10. Sema na ivakadodonu

Na ivakadodonu (rectifier) e loma ni PowerSpout e vukica na livaliva dri (3-Phase AC) mai na PMA me livaliva dodonu (DC) me dewa ina veibateri se na ivuki sema ena lawalevu. Le levu ra vakabauta cala ni rawarawa ni cici na livaliva dri (AC) ena wa, na kena dina ke tautauvata na volt kei na levu ni tolo ni wa, e rawarawa ni cici na livaliva dodonu (DC).

RECTIFIER



EMC FILTER

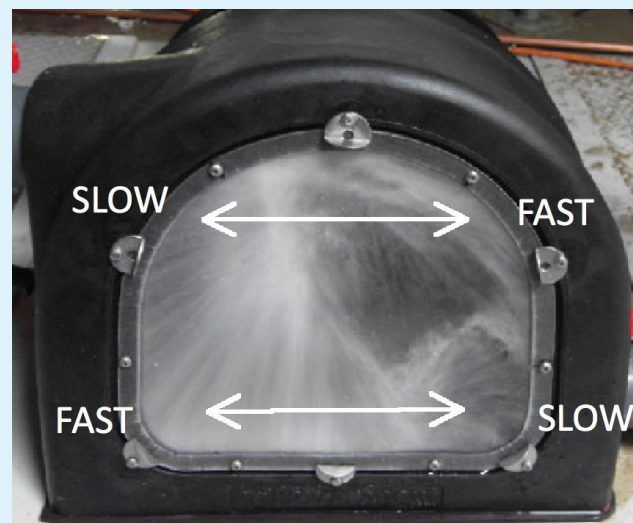


Qarauna:

Kua ni yavalata na ivocevoce ni sema kei na idoladola MPPT se ivuki sema kei na lawalevu, me laurai rawa na kena volt ni sala dola (open circuit voltage (Voc)). Ke sivia na volt ena ca vakadua na idoladola se ivuki.

11. Yavale na ivocevoce, sema na livaliva e rawa

Ni dola levu tu na isogo (valve), volā na bi ni wai kei na kui ni livaliva. Ke o taurivaka tiko na paipo love love ni paipo babasogasoga (manifold), moica na itutu ni paipo me donu vinaka na itokatoka ni ivana, me totolo se kaukauwa sara. Na kui ni livaliva e dau tautauvata kei na kena e tabaki ena ivolakabi, se sivia. De vinaka me vakavinakataki mada na totolo ni cowiri (RPM). Dikeva na we ni sika ni wai ena palasitika, de sika na wai mai na ivocevoce i yasana imawi se imatau. Qo e macala kina ni rui totolo se berabera kena cowiri. Na itaba e ra e laurai kina na isikasika ni wai – ke berabera, e tau tale volekata na ivana, ke totolo e tau yawa mai na ivana.



E rawa ni kilai vakacaca na kui ni livaliva ena teveli qori. Qarauna me sema na livaliva mai na ivocevoce ina idoladola kei na bateri, oti qai cici kina na iyaya, de loka (surge) na livaliva.

Head range	Operating rpm	Runaway rpm	Comment
0-25 m	0-800 rpm	0-1600 rpm	Can be allowed to run unloaded without excessive wear or noise.
25 - 60 m	800 - 1250	1600-2500	Safe to run unloaded but will reduce life of parts.
60 - 130 m	1250 - 1900	2500 - 3800	Do not run unloaded, apart from testing Voc.
above 130 m	above 1900	above 3800	Consult with PowerSpout.

12. Veisau na totolo ni ivocevoce

Qo na vakatovotovo ga, ia ena yaga kina na vakadidike ni sika ni wai me vaka sa vakamacalataki e cake. Nio tosoya na

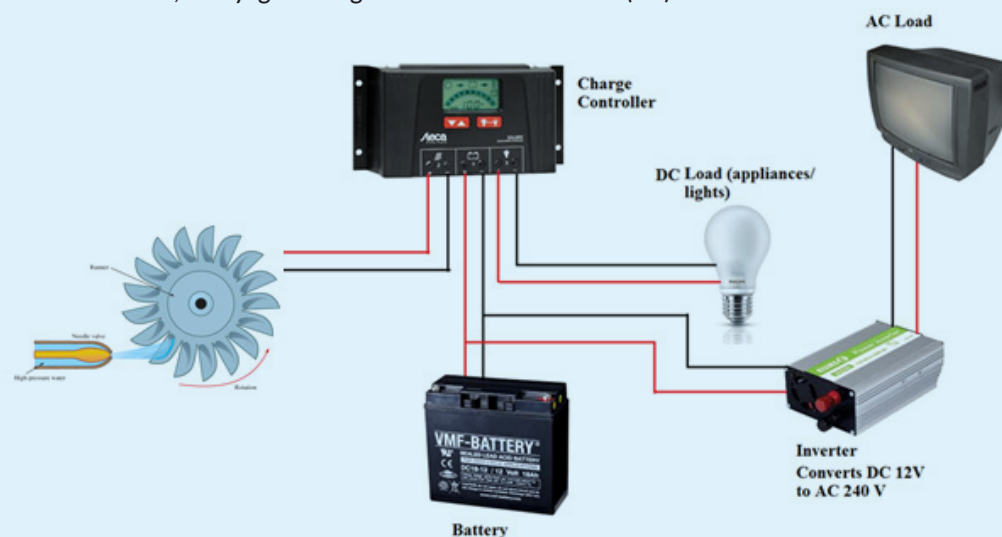
makeneta cowiri i sau, me yawaka na 'stator' ena totolo, nio tosoya i loma, me volekata na 'stator', ena berabera.



Taura matua mada na itautauri, wirica vakasukasuka. Nanuma se cowiri vakavica. Eda vakatovolea tiko, yavala na ivocevoce, raica na kui ni livaliva, tu vakadua na ivocevoce, wirica na itautauri ena makeneta, yavala tale, tovolea tale. Ni sa macala

na itokatoka donu ni makeneta, me daramaki kina na wasa me toka dei kina. Kua ni qaqaco sivia na nati taku. Na wasa vakarautaki yani e ya 1.75 mm kena vavaku, ni wirici vakadua na itautauri sa 1.6mm. Na wasa damudamu (ke soli) me liu.

13. Sema na bateri kei na ivuki, vakayagataki tuga na ivakariba livaliva dri (AC)





8

Kila na leqa kune
wasoma ena piko kei
na kedra iwali

8.1 Leqa ni idoladola (charge controller)

Na idoladola e vaka me 'mona' ni haidro taucoko, qai bau leqaleqa vakalevu. Qo e so na leqa kune wasoma ena idoladola.

Leqa 1: Na idoladola e sega ni vakaraitaka ni jajitaki taucoko

Vuna: Vakayagataki vakasivia vakacalaka (lailai na uca, sivia na sara TV)

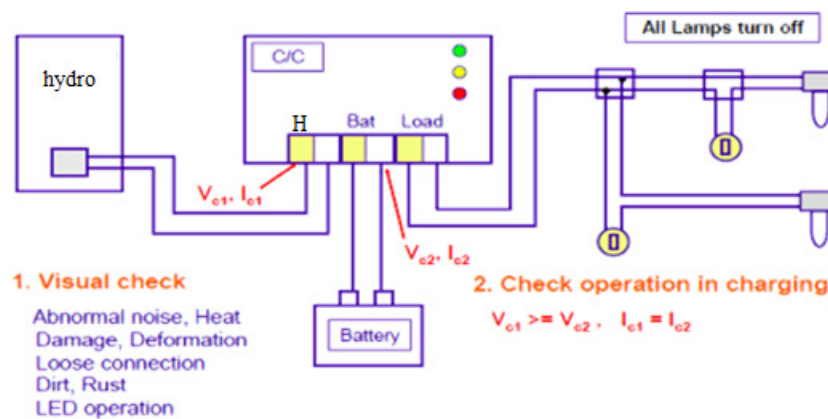
iWali: Musurua kena vakayagataki ena dua na siga me jaji tale vakavinaka na bateri

Leqa 2: Na idoladola e bokoca na cina kei na iusana

Vuna: Vakayagataki vakasivia e veisiga (maca na bateri):

iWali: Musurua kena vakayagataki me jaji vinaka na bateri me yacova ni vakaraitaki ni sinai (macawa dua se sivia).

YALOYALO 76: Semai ni idoladola⁹⁴



Leqa 3: Sega ni tawa tiko na bateri, se tukuni ni sinai na bateri ni se qai tekivu jaji, se jaji tikoga ni sa sinai.

Vuna: Kama na fius, sema vakaca na wa se ca na salanilivaliva ni idoladola.

iWali: Vakadre na isema, dua na fius vou, vakadodonutaka na setting ni LVD kei na HVD.

iWali:

- Vakamuri wa, koya sa shot se ca me sosomitaki.
- Sosomitaka na berigi ca
- Ke tasogo na paipo se ivakaso, carata.
- Raica na isema ni paipo de yavu na rava se kaca qai sosomitaka.

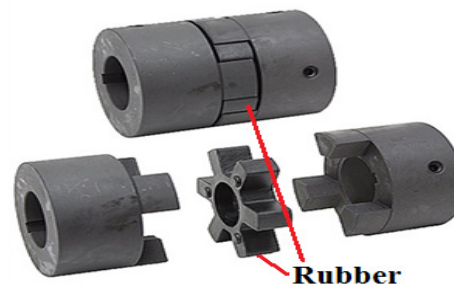
8.2 Leqa ni ivocevoce ni piko

E kune vakalevu na leqa ni ivocevoce ni sega na livaliva se nida vakarautaka tiko. Na levu ni volt ni ivocevoce e laurai talega ena so na idoladola.

Leqa 4: Sega se lailai na livaliva mai na piko

Vuna: Sega se lailai na wai – tasogo na paipo. Kamusu na tolo ni kaukamea se ca na berigi. Shot na wa.

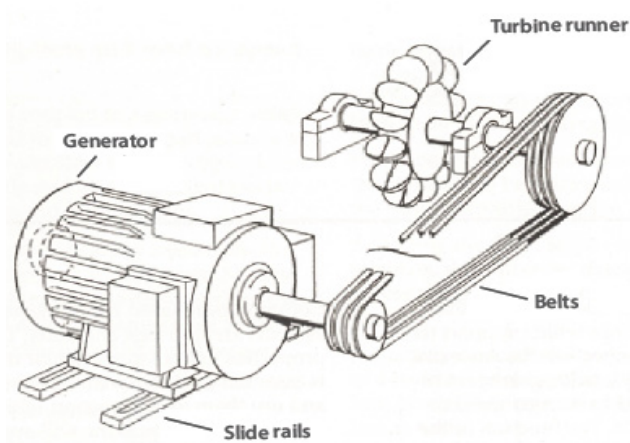
YALOYALO 77: Raica na isema ni paipo de yavu se ca⁹⁵



- Ke vakabeleti, raica de yavavala se cavuka na beleti, qai vaqacacotaka se sosomitaka.

⁹⁴ Ivurevure: JICA

⁹⁵ Ivurevure: "High quality bearing supplies", <https://www.thebigbearingstore.com/>

YALOYALO 78: Beleti ni ivocevoce (wedge belt)⁹⁶


- Raica na qirisi ni berigi – ke sega, na berigi sa na tu vakadua. Ke qirisitaki qai leqa tikoga, sa ca na berigi, me sosomitaki.

YALOYALO 79: Qirisitaki na berigi ena tolo ni kaukamea⁹⁷


E so tale na vuna e dau lutu kina na livaliva:

- Ca se turu na paipo, lailai kina na igu ni wai ina ivocevoce

YALOYALO 80: Ca na paipo, turu tiko⁹⁸


- Tao na wai ena isogo (valve) ni ca se sogo tu.

YALOYALO 81: Mataqali isogo kune wasoma (butterfly valve)⁹⁹


- Ni mavoia na yame ni ivocevoce ena lailai na livaliva. Me sosomitaki.

YALOYALO 82: Ca na yame ni ivocevoce Pelton¹⁰⁰


⁹⁶ Ivurevure: Practical Action

⁹⁷ Ivurevure: Priest Electric.com <https://www.priestelectric.com/>

⁹⁸ Ivurevure: Nepal Energy Forum, <http://www.nepalenergyforum.com/>

⁹⁹ Ivurevure: Indiamart.com, "Flanged butterfly valve", <https://5.imimg.com/data5/LB/GT/MY-45145264/double-flanged-butterfly-valve-500x500.jpg>

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

8.3 Leqa kune wasoma ni bateri

Leqa 5: Jajitaki vakatotolo na bateri, se sega ni rawa ni jajitaki vakavinaka ni duidui na volt ni bateri yadua.

Vuna: Vakasulifure (vuki kemiki ni uma (electrode)), drekea na waikama, veitaqataqai (ni lutu e ra na waikama sosoko), luluqa na isema ni sucuna, katakata na bateri se cila na livaliva baleta na waikama e dela ni bateri e maliwa ni sucuna.

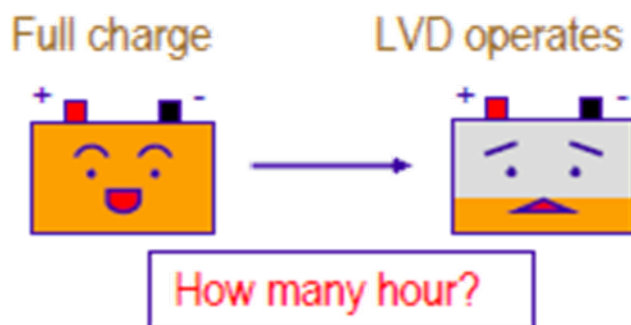
iWali:

- Luvata na wa e sucuna
- Qua na sucuna ena barasi sitila, vaqirisi (mv Vasilini se 'lithium grease')
- Drekea na waikama ni bateri, tuvuca
- Vakayagataka ga na kena iqamu (lug/clamp) dina
- Qua na sucuna me kau tani na veveka
- Kurea vakamalua na bateri (kua ni sivia e 10 na dikiri kena kala) me kua na veitaqataqai
- E toka vakaca, tokia ke gadrevi

8.3.1 Raica na Amp Hour Capacity ni bateri

Qo e vica tale na cakacaka me tovolei kina na bateri. Ni sa jajitaki vakaoti, me dua na iusana dei me kana livaliva kina, qai luvata ni sa yacova na LVD (low volt disconnect).

YALOYALO 83: Vica na kena dede qai yacova na bateri na LVD?¹⁰¹



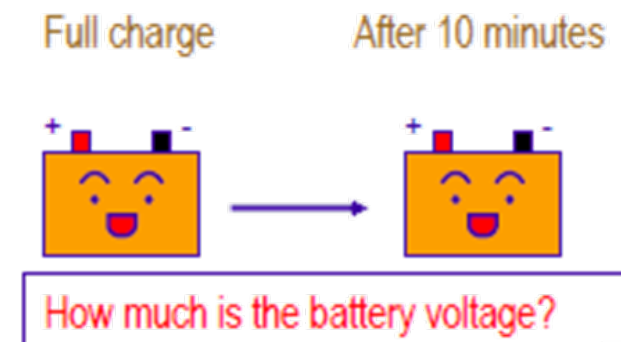
Me dikevi na amp-hour capacity sa kune qo kei na kena e tu vakaivola. Kevaka e sega ni yacova na 80% ni kena e tu vakaivola, na bateri sa voleka ni oti vua.

8.3.2 Dikevi na volt ni bateri

Jajitaki oti na bateri, cegu, qai oti e 10 miniti se sivia, vinaka me 2 awa, vakarau na kena volt. Kevaka e sega ni yacova na 12.5V, na bateri sa voleka ni oti vua.

E ka bibi me sosomitaki na bateri ca de qai ca tale na bateri eratou sema tiko.

YALOYALO 84: E maroroi livaliva vakavinaka na bateri?¹⁰²



8.4 iSoqoni ni leqa ni iyaya

Leqa

- Wa, suiti, matanicina &s
- Sinai na bateri, boko ga na cina
- Lutu na volt ena mua ni wa (iusana)
- Segga na livaliva ena mua ni wa (iusana)

Vuna:

- Dola se shot na salanilivaliva, se sobuiqeile
- Veicalati se lalai na wa (lutu sara na volt)
- Kama na matanicina livaliva dodonu se ivuki
- Sema vakaca e sucuna
- Levu na idre (resistance) ena wa ni suiti

iWali:

- Raica se vica na volt ena mua ni wa (iusana) kei na kena lutu ni waqa na cina.
- Vaqacacotaka na isema ena sucuna
- Raica me donu na tolo ni wa, ke segga veisau
- Raica na wa, ni sala dola, vakamuri wa qai vakadodonutaka na sala dola
- Raica de shot se sobuiqeile vakaca qai vakadodonutaka, vakarava tale (re-insulate)
- Raica se vinaka na suiti, kei na lutu ni volt mai na vunilivaliva ina iusana

101 iVurevure: JICA

102 iVurevure: JICA

Volavola:

IVAKADRE 8

Ena iVakadre qo, e dodo e dua na wa ca ena maliwa ni bateri
kei na idoladola, qai nodratou itavi na lewenivuli na vakamuri
sala (continuity test) me kune na wa ca qai vakavinakataki.

9

iVola ni itavi ni
qaravi haidro

9.1 Bibi ni kena qaravi

Ni qaravi wasoma ena bula balavu na haidro kei na kena gacagaca.

9.2 iVakaso (forebay)

- Dau raica na titobu ni ivakaso, caramaka na soqosoqo kei na deniwaluvu.
- Raica na levu ni wai kei na savasavā ni bati ni ivakaso.
- Raica na vulo lawalawa de kabasu se tauvi duka.
- Raica na isema ni paipo de turu se ca.

YALOYALO 85: Kauvaro tuva me baniwai ena ivakaso¹⁰³



9.3 Paipo (penstock) kei na isogo (valve)

- Raica na vulo ni paipo de ca.
- Raica de curuma na paipo na duka, soqosoqo se itatao.
- Dau dolava na vulo Y (Y filter) qai samaka me kau tani na gele kei na duka.
- Raica na isogo (valve) de veveka se ca na kena sila (seal).
- Raica na paipo de turu se ca.
- Raica na bolu ni bati ni paipo (flange) de yavavala se veveka.

YALOYALO 86: Raica de veveka na isogo (valve)¹⁰⁴



103 Ivurevure: Pond Boss Magazine

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

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

9.4 Qaravi ivocevoce

Na ivocevoce ni haidro e buli me vorata na veika dredre ena donuya, e sega gona ni dau leqa vakalevu. Ia me vaka na iyaya kece, e vinaka me dau qaravi me colata na itavi qai balavu na kena bula.

- Raica na qa ni ivocevoce de ca se yavavala na kena bolu.
- Raica me qirisitaki vinaka na berigi qai sega ni ca.
- Raica na isema se beleti de yavu.
- Raica na teminala de sema vakaca.
- Raica de tauvi duka se soqosoqo na ivocevoce – vakabibi ni oti na dobui.
- Raica na yame ni ivocevoce de ca se yavu.
- Raica na tolo ni kaukamea de ca se toka cala.

YALOYALO 87: Dikevi na ivocevoce¹⁰⁵



9.5 Qaravi bateri

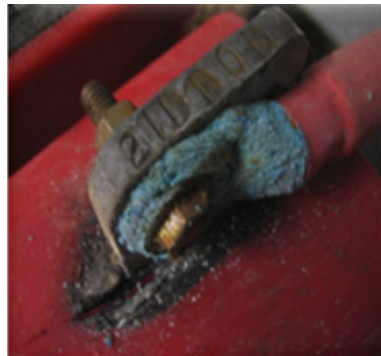
Na bateri na imatai ni iyaya me leqa ke sega ni qaravi vakavinaka. Na qaravi bateri e levu na kena itavi, vakatau se mataqali bateri cava, kei na ivoladusidusi ni kabani a bulia, me vaka:

- Dikeva ka samaka kena vata se cava e toka kina
- Dikeva na kena 'disconnect', tarovi ni kui sivia kei na veidodoyaki ni wa
- Vakaraautaki volt
- Tovolei iusana ni bateri (load testing) e talaci vakalevu me vica na sekodi, ni vakarautaki na lutu ni volt ni bateri.
- Tovolei gumatua ni bateri (capacity testing) e talaci

vakalailai na bateri me yacova na levu ni talaci e gadrevi (prescribed depth-of-discharge). Qo e macala kina na gumatua ni bateri ena maroroi livaliva.

- Ni saladua e vica na bateri qai dua e ca, me sosomitaki. Ena sega ni solia nona igu taucoko ni ca e dua.
- Kua so ni talaci vakasivia (over-discharge) – ni sivia na kena vakayagataki kei na kena talaci (depth of discharge, DOD) ena lekaleka na kena bula.
- Vakarautaki sosoko (specific gravity) ni waikama, ni drekea me tuvuci ena wainiua (distilled water) (bateri vakawai ga!)
- Ni dau qaravi na bateri me laurai na sucuna kece se veveka se luluqa
- Na barasi sitila me qusi tani kina na veveka ena isema. Vaqaniliga rava tuga.

YALOYALO 88: Qaravi bateri¹⁰⁶



Qaqarauni: E daumaka mo vakamatailoilo ni tataqomaki kei na qaniliga rava ni o qaravi bateri. Nio qarava na bateri luvu (vakawai), mo vakaisuai, de sikavi iko na waikama. Me dua na kava ivakatubu dola rawa kei na taku wai, ke mani tasova na waikama me sova na ivakatubu i loma ni wai, ulia, qai sui sara kina na waikama me kua ni vakamai keda.

Na volt lailai e sega ni veivakamatei, na kui levu e rawa. Qarauna me kua ni lutu na iyaya e dela ni bateri, de qai kama na ligamu se kacabote na bateri. Qarauna!



9.5.1 Vakarautaki ituvaki ni bateri (state of charge, SoC)

9.5.2 Vakarautaki volt

E dau vakarautaki na sosoko (specific gravity) ni waikama (ena bateri vakawai ga) kei na volt ni sala dola (open circuit) ni qaravi na bateri me kilai kina kena bulabula kei na kena ituvaki. Na volt me vakarautaki ga ni sa vica na awa kena vakacegu tu na bateri. Kena ituvaki e kune ena teveli e ra:

YALOYALO 89: iTuvaki ni bateri¹⁰⁷

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

For typical lead-acid battery at 25°C

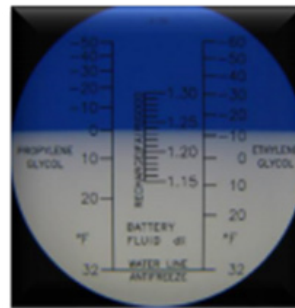
9.5.3 iVakarau ni sosoko (hydrometer (bateri vakawai ga)

Na iyaya qo (hydrometer) e vakarautaki kina na sosoko (specific gravity, SG) ni waikama, ni domici na waikama mai na bateri me dikevi. Ena 'Archimedes hydrometer' e vakarautaki na 'vude' me macala kina na sosoko.

YALOYALO 90: iVakarau ni sosoko¹⁰⁸



Archimedes Hydrometer



Refractive Index Hydrometer

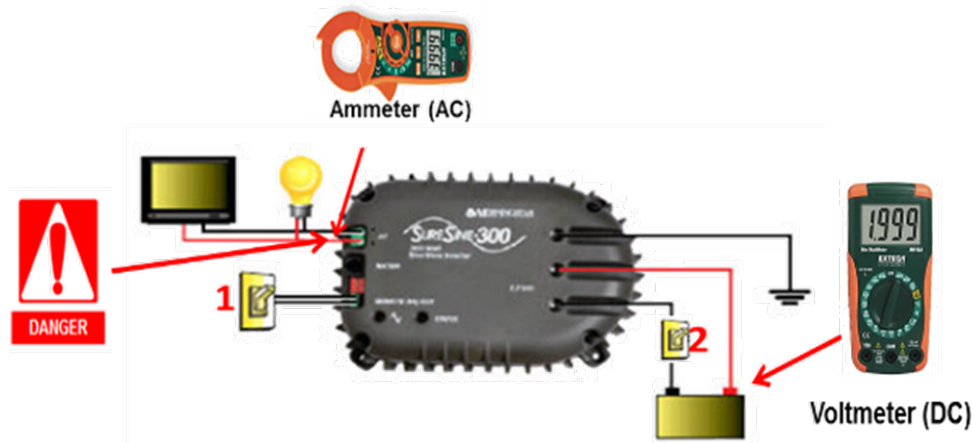
Source: Jim Dunlop Solar

9.5.4 Tuvuci na wainiuca (distilled water) ena bateri (bateri vakawai ga)

- Na bateri vakawai tadola (open vent) e dau maca mai na wai baleta na kena vakalivalivataki (electrolysis) kei na kena vuki me kasi ni jajitaki tiko
- E maca mai baleta na kena katakata, totolo ni jajitaki kei na kena makawa
- Vakayagataka na wainiuca (distilled water) me kua ni tauvi duka na bateri, me kua ni vua

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

¹⁰⁸ IVurevure: Jim Dunlop Solar

YALOYALO 92: Semasemai ni wa ni ivuki¹¹⁰


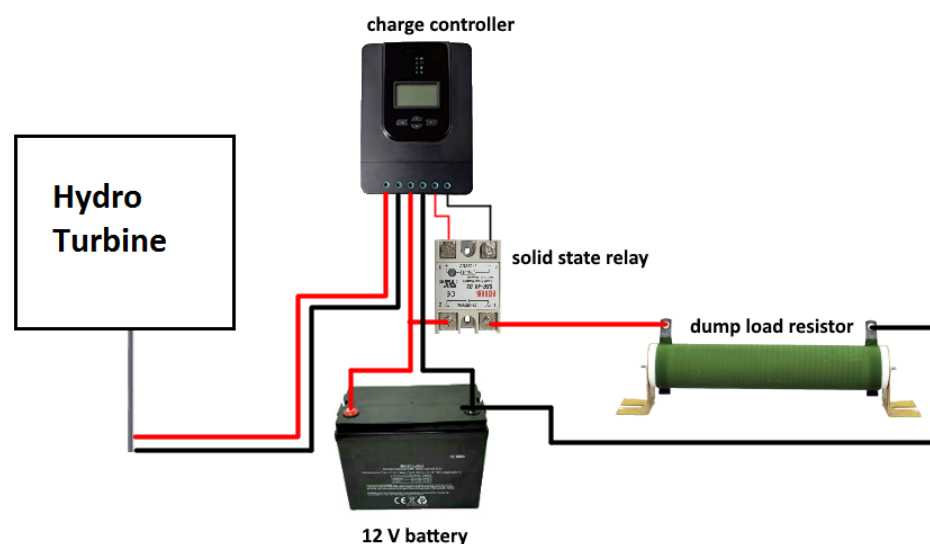
KUA ni luvata e dua na wa, muria na veitaravi qo:

- Bokoca na suiti 1 kei na 2 (raica na yaloyalo)
- Vakayagataki na mita iqamu ni vakarau kui (ammeter) ena yasana e solia na livaliva dri
- Semā na mita ni volt (KUA ni mita ni kui, ammeter) kei na sucu ni bateri (nanuma: ke vakayagataki na mita ni kui ena shot na bateri qai kama na fusi ni mita!)
- Waqaca na suiti 1 kei na 2
- Raica se tiko na volt, qai drodro na kui ina iusana. Ke dina, e vinaka tu na ivuki

9.7 Qaravi idoladola (charge controller)

Na idoladola e dau vakalevu me iyaya momoqaga, ena rawa ga ni leqa ke usabi.

- Raica me dei na isema
- Raica na volt e vakaraitaki kei na itukutuku ni cala (error message).
- Raica ni sega ni kama na fusi
- Raica na itutu ni idoladola
- Raica de yavu se ca na icegucegu (diversion load)

YALOYALO 93: iDoladola ni haidro kei na idre ni icegucegu (diversion load resistor)¹¹¹


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

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

9.8 Na buli ivolanitavi kei na vakayagataka

E dua na sabolo ni ivolanitavi levu vakavula sa tabaki e ra, e rawa nio vakuria se musuka me vaka e ganita.

TEVELI 4: iVolanitavi

Cava	Donu	Cava tale
Vakadidike ni ivocevoce		
Raica na paipo se waqana de veveka se ca		
Raica de tubua na vanua – wereca. Me dau galala na sala ina ivakaso kei na ivocevoce.		
Raica se vinaka kece tu na isogo (valves)		
Raica na vulo basoga (Y filter) samaka ke duka		
Raica na itutu ni ivocevoce kei na vata ni bateri		
Raica me galala na gusu ni ivocevoce, sega ni tasogo ena duka se soqosoqo se deniwaluvu		
Vakabaitaka na vanua qai vakaloka ke ganita – raica de ca na bai		
Raica de veveka na isema ni livaliva ni jenereita		
Raica de yavu na berigi, qirisitaka ke ganita		
Raica de yavu na rava ni isema (coupling)		
Raica de yavu na beleti (V belt)		
Vakadidike raraba		
Dikeva na ivuki (se electrical pad) de kakaca se yavu. Na ivuki e dodonu me bolutaki ina kena idabedabe (pad) ena tikina kece e dusimaki ena kena ivoladusidusi. E vakatau ena levu ni haidro, na vanua e tiko kina kei na kena rawa ni lakovi vakaveitalia, ia na ivuki, na combiner box kei na disconnect switch e dodonu me taqomaki, me lokataki se tiko na kena iyaya me dola kina, me kua ni tarai vakaveitalia.		
Raica na notisi ni qaqarauni, wili kina na lade ni livaliva se na iyaya ni tataqomaki (PPE) ni lavaki nida torova na iyaya. Mo muria kece na notisi ni qaqarauni. Ke sega na notisi, se yali beka, me vakadurī tale nio na lai qaravi haidro tale.		
Dikeva na ivocevoce de kune kina na ivakatakilakila ni leqa me vaka na we ni kama, roka tani, tacega na palasitika se veveka.		
Raica de yali na bolu se gacagaca tale eso.		
Qarauna me dei vinaka tu na wa livaliva ni ivocevoce, qai tawa kece ena kena iubi (conduits).		

Dikeva na vata (racking system) de veveka, kakana, damele, se yali se kamusu na pini (clip) se bolu.		
Raica na gusuniwai de tasogo.		
Dikeva na iubi ni wa (conduit, bushing) me tokoni vinaka, kei na kena gacagaca, ni ganita.		
Raica ni tiko vinaka na vale kei na itutu ni ivocevoce.		
Ni vakaduru, raica de veveka se vuca na kena duru.		
Dolava na combiner box qai raica na we ni torque ena kena isema. Na we ni torque e caka ni sa vaqacotaki oti vakavinaka na nati (lug). Dodonu me caka ni se qai vakadurī vou, ke sega o daunihaidro e rawa ni qai cakava ni lai qarava tiko. E tiko na kena maka. Na we ni torque na laini dodonu e vakababataka na nati kei na kena itokatoka. Ni toso tiko na gauna, kevaka rau sa veitalatala na laini ena nati kei na kena ena itokatoka, sa kilai kina ni sa toso na nati, vinaka me wirici tale me qa. Raica na loma ni box de curumi wai. Raica na teminala, baba kei na itutu ni fuis de roka tani.		
Dolava na kovate (cabinet) ni disconnect de veveka se ca.		
Vakadeitaka ni sogo vakavinaka na cabinet penetrations, qai sega ni curumi wai. Raica na we ni torque ena teminala.		
Dikeva na ivuki, e loma e sau, de curuma na wai, kalavo se kuvu. Raica na we ni torque ena field termination.		
Ke tiko na siteseni ni draki, qarauna me toka donu na kena sensor qai donu talega na kedra kala kei na azimuth.		
Vakadidike ni ivuki		
Volā ka vakadeitaka na volt kei na ivakarau (production value) ena matana (human-machine interface, HMI).		
Volā na iotioti ni leqa (logged system error).		
Samaka na vulo (filter).		
Samaka na loma ni kovate.		
Tovolea na irinicagi se vinaka tu.		
Raica na fuis.		
Raica na torque ena termination.		
Raica na gasket seal.		
Vakadeitaka ni kabi na notisi ni qaqarauni.		
Raica de roka tani ni sivia na katakata.		
Raica se tu vinaka na bainilivaliva (lightning arrestor).		
Vakadeitaka ni vinaka na sobuiqele kece.		
Raica se vesu vinaka ena lalaga se fuloa.		
Raica na internal disconnect operation.		

Vakadeitaka ni sa tu kina na software vou.		
Ke kune na leqa, tukutuku vei koya a bulia se vakaduria.		
Vakaivolataka na macala kece ni vakadidike ni cakacaka.		
Raica na insulated gate bi-polar transistor kei na baba ni ivuki de roka tani.		
Taurivaka na kena iloilo (inspection mirror) ke gadrevi.		
Raica na capacitor input dc kei na output ac de vakacacani ena katakata sivia.		
Volā kece na ivakarau ni volt kei na kui ena mata ni ivocevoce.		
Raica me rairairinaka/savasavā na kovate, sala ni cagi kei na tikina e vakarava (insulated).		
Raica de veveka/katakata sivia na sucuna se wa.		
Vaqaqacotaka na isema kei/se bolu ni ganita.		
Vola na itukutuku ni draki, wili kina na katakata ni siga kei na rugurugua ni vanua se sega.		
Raica na surge suppressor ruarua (AC, DC) de ca se tu kina na we ni kama.		
Raica me vinaka na iyaya kece ni qaqarauni (emergency stop device, door switch, ground fault detector interrupter).		
Samaka se veisautaka na gacagaca ni vulo ni cagi (air filter).		
Ni kune ga na leqa, vakavinakataka.		
Vakalewena na ivola ni qaravi haidro.		
Volā na itukutuku ni vakadidike.		
Ke bau tiko na kena dau e vakaivola ni kabani a bulia, cakacaka kece vakaidinia e rawa ni caka sara, wili kina kina toroi cake na software.		
Vakadidike ni bateri		
Ni bateri vakawai, raica se to na waikama ena kena terē (ke tiko) se ena fuloa, de turu na bateri se vua.		
Raica se vinaka na itawatawa ni bateri		
Raica na volt ni bateri - volā.		
Raica na sucuna de veveka, ke kune kau tani.		
Raica na levu ni waikama (bateri sogo/gel e sega)		
Raica na wa kei na isema.		
Raica de cavuka se tavoci na wa – ripotetaka		
Raica me dei vinaka na isema kece qai ubi vinaka.		
Raica de teru se lili wale na wa		
Raica de veivolekati na waya se wa kama.		

Volavola:

IVAKADRE 9

Me tabaki mai na ivolanitavi vakavula ni haidro e cake. Vakawilika na ivola, me tiko na iyaya ni cakacaka kei na iyaya ni tataqomaki (PPE), qai veivosakitaka na nomu nanuma baleta na veika e volai tu ena ivolanitavi.

Ke levu na gauna, veitalanoataka vakaiwasewase na ka dou sa vulica, dou qai bucina e dua na ituvatuva ni sasaga me cuqeni kina na haidro ena nomudou koro se itikotiko. Vakalewena na teveli qori:

Leqa kune baleta na piko	Cava so na kena iwali?
1.	
2.	
3.	







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