SAARC ENERGY CENTRE
Energy for Peace & Prosperity

Online training of SAARC Professionals on Small, Mini and Micro Hydro Power Generation (Sept 13 - 17, 2021)

SMMHP Operations, Monitoring and Control

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List of Contents

- Operation of the small hydro projects both community as well as commercial
- Typical daily data report sheets
- Safety and precautions to be taken in plant operation
- Illustration through photographs of Hydro Power plants in operation

Learning objective of Presentation

- To apprise the process of operation and various steps.
- To Prepare plant reports and plant data sheets

Operation of Micro Hydro Project (up to 100KW Unit)

- Operation of plants vary from site to site
- water supply to the machine should be checked
- Inspect the channel, regulating valves, desilting tank, fore bay tank and trash racks, to see that they are clean and the required amount of water is flowing in the channel.
- Rotate the shaft by hand if possible to see whether it is free to rotate and check the bearing, belts, nuts and bolts, etc,
- If the plant has an Electronic Load Controller then the water supply to the ballast tank should also be checked.
- The pressure gauge on the turbine should indicate the maximum static value.
- The turbine should be started gradually and brought up to speed. The operator should observe the pressure gauge and the revolution meter as the turbine comes up to speed.
- If the pressure drops below its normal running value it is possible that there is not enough water or there is something blocking the penstock.

- If the speed exceeds the rated value then it may be that the governor is not working properly.
- At rated speed the voltage also should reach the nominal value (eg 415V) and in some cases it may be set at a higher or lower value, which should be in the range of +3%.
- Once the turbine is operating at its rated speed and voltage it is possible to load the Machine
- Select the required load and connect it onto the hydro.
- Periodically the turbine should be inspected. Bearing and alternator temperatures should be checked. If they rise to a high value, the meters should be examined to see if the machine is overloaded, if not then the machine should be stopped and checked.
- The following could be taken as guidance for starting and stopping a micro-hydro plant.

Starting Reduce

1. Visual inspection of all equipment
2. Clean trash rack and silt tank if necessary
3. Turn on water at intake as required.
4. Inspect oil levels
5. Check pressure gauge
6. Check that all switches are in the OFF position
7. Inform consumers or villagers that plant is to be started
8. If a bypass valve is installed, open it
9. Gradually let water into turbine and observe the pressure gauge, rpm meter, and the volt meter
10. Listen to machine as it runs; if there is any abnormal noise or vibration, stop turbine and check
11. Continue to increase water flow gradually and observe pressure gauge; do not allow the pressure gauge to fluctuate rapidly
12. Once machine/turbine speed and voltage come to the normal value, increase water as required
13. Switch ON loads by connecting hydro onto switchboard.
14. Observe machine and meters, check bearings; if load is too much, increase water or change part of load back to other source of power.

Stopping

1. Inform consumers or village of stopping turbine
2. Switch OFF all loads connected to hydro power scheme
3. Reduce water gradually and observe pressure gauge do not allow pressure to fluctuate rapidly
4. Allow turbine to stop and check bearing temperature
5. Stop water at intake in necessary

Operations of Small Hydropower Project

- **Intake Gate Opening**

  i. Check Intake gate supply

  ii. Check hosting system

  iii. Give raising command

  iv. Check gate possition in raised condition

- **Inlet Valve Opening**

  i. Put oil pumps on 'auto' mode

  ii. Open bye pass valve manually or

  iii. Give opening command to bypass auto valve

  iv. Check water pressure on spiral side

  v. Give opening command to inlet valve on equalized pressure

  vi. Check closing of valve in auto and on emergency command

  vii. Check opening of inlet valve in auto operation

Turbine Operation

- Put oil pumps on auto mode to maintain required pressure in pressure accumulator
- Check availability of Nitrogen cylinder and check pressure of the same
- Check air pressure for maintaining proper oil level in pressure accumulator (if provided)
- Open cooling water for bearings
- Open shaft seal water
- Put brake on auto mode
- Unlock guide vane lock
- Put machine on auto mode

Generator Operation

- Select AVR Auto/Manual mode as required
- Keep fire fighting system operative(where provided)
- Switch on D.C. supply for excitation flashing
- At 30% of generator voltage D.C. supply from battery cuts off
- At 90% speed switch on generator excitation, if not on auto
- Start machine on Auto or Manual mode as required
- Check for abnormal sound & vibration.
- Check stabilization of bearing temperatures.

Synchronization

- Check grid voltage & frequency
- Check generator voltage & frequency
- Reduce or increase generator voltage & frequency to match with line voltage & frequency
- Put synchro scope in ON position needle will start moving and lamps will start glowing. Needle on 12 O'clock position and lamps in dark position indicate that voltages and frequencies of grid and generator respectively are matching.
- At equal grid & generator voltage and frequency, close generator breaker at approaching 12 O'clock position
- Now generator is synchronized with grid.
- Take minimum prescribed load immediately

Checks after synchronizing and taking load

- Unit control board supply is changed to Unit Aux. Transformers.
- Change excitation from Manual to Auto mode.
- Transformer "Motor for oil pump, if OFW cooling water system is provided" started.
- All parameters in control room are matching and correct.
- General check up of machine and other unit auxiliaries at all floors.

Plant Reports and Records

A vast amount of information is generated by the power station on every aspect of generation.

Most of this data is generally compiled on daily basis at the Power Station level and at HQ level for generation of Management Information Reports.

Generally following reports, logs, reading sheets are required to be prepared at different levels of management structure:

Typical Plant Data Sheets:-

- Hourly panel meter readings
- Station event log book
- Defect register Energy meter readings
- Daily generation report
- Hydraulic data sheet
- Monthly generation & aux. consumption report
- Monthly water utilization & runoff report
- Tripping report / tripping analysis
- Special event report (eg. landslide, fire etc.)
- Accident report (involving human being, animals)
- Quarterly safety & fire drill, training imparted at plant
- Instruction register
- Communication register
- History register
- Plant register
- Periodic test run of DG set register, if provided
- Visitors book

Safety manual

- Every power plant shall have safety manual, copies of which shall be given to every employee. The safety manual shall contain:
  - Safety policy of the organization
  - Safety during work
  - Outage procedure with safety tags.
- The management shall conduct safety training for operation and maintenance staff on regular basis.
- The safety equipment such as helmet, welding goggles, hand gloves, insulated T&P for electrical works, earthing chains /earthing rod, safety belt, rain coat, gum boot etc. shall be kept at the location where these can easily be accessed.
- The arrangement to supervise safety tags shall be made at each P.S. The list of tags for every equipment outage must be finalized and given in safety manual.

- Guidelines for safety in working are to be given in detail in safety manual.
- Fundamentals on Safety : Prevention of accidents requires whole-hearted co-operation of all members of the organization. A capable, mentally alert and trained employee will avoid accidents. However an unsafe person is a liability. He is danger to himself, his fellow workers and to equipment and organization.
- Unsafe acts which may cause accidents:
  - Operations of equipment without authorization.
  - Making safety devices in operative.
  - Using defective equipment or its improper use.
  - Working nearby dangerous or live electrical equipment which could conveniently be de-energized.
- Unsafe conditions which may cause accidents:
  - Ungrounded equipment.
  - Defective or non standard material or equipment or T & P.
  - Improper illumination.
  - Non-standard design or construction.

Photographs

Rukti-II (5MW)
Aleo-II (4.8MW)
Aleo (3MW)

Himachal Pradesh INDIA

Rukti-II 1.

Trench Weir

Rukti-II 2.

ontrol Gates

Rukti-II 3.

Desilting Tank (DT)

Rukti-II 4.

Cleaning of DT

Rukti-II 5.

Cleaned DT

Rukti-II 6.

Snowing (DT)

Rukti-II 7.

Surge Shaft

Power Pipe

Rukti-II 8. Machine Hall

Rukti-II 9.

Switch Yard

earthing & fire safty

Aleo-II 1.
Trench Intake

Aleo-II 2.

Trench Gate
Penstok Gate
And Penstok


Aleo-II 3.
Surge Shaft
Power house

Aleo-II 4.
Machine Hall

Aleo-II 5. Tailrace Pond And Gates

Aleo-II 6. Switchyard

Aleo

Power house
Switchyard

Aleo 2.
Switchyard

Aleo 3.
Control Room

ALEO-II HEP

DAILY DATA REPORT

			Dated	2-Sep-2021	
UNIT-I	**MAXIMUM**	**CHANNEL NUMBER**	**TIME (HRS)**	**LOAD (KW)**	**Ambient T (°C)**
Winding Temperature (°C) Max 110	74.3	4	22:00	2924	19.6
Bearing Temperature (°C) Max 70	54.6	8	18:00	1832	22.8
Generator Voltage (KV)	6.39		07:00	2002	18.6
Generator Current (A) Max 300	268.5		20:00	2910	20.8
Line Voltage (KV)	34.48		02:00	1846	20.1
Load (KW) Max 3120 KW	2945		23:00	2945	19.3
Average Load (KW)	1833.33				
	MINIMUM		**TIME**	**LOAD**	
Generator Voltage (KV)	6.25		12:00	1663	22.9
Load (KW)	1603		13:00	1603	23.8
	MAXIMUM	**MINIMUM**			
Ambient Temp.(°C)	25.1	18.6			

UNIT-II	**MAXIMUM**	**CHANNEL NUMBER**	**TIME (HRS)**	**LOAD (KW)**	**Ambient T (°C)**
Same as Unit 1					
	MAXIMUM	**MINIMUM**			
Ambient Temp.(°C)	25.1	18.6			

			Clear	**Cloudy**
			Rain	**Snow**

	UNIT-I	**UNIT-II**	**Total**
PRODUCTION (KWH)	**44,000**	**45,000**	**89,000**
UNIT- I (Hrs Opr)	**21.03**		**2901:28:00**
UNIT- II (Hrs Opr)	**20.50**		**2835:30:00**
Auxillary Consumption			
139 kwh			

	OT Max-90	**WT Max-90**	**Operational Camera**	**Non-Operational Camera**
Transformer- I (°C) Max-80	37	48	All	None
Transformer- II (°C) Max-80	50	48		

	MAXIMUM	**MINIMUM**
OPU- I (°C) Max-60	32	25
OPU- II (°C) Max-60	34	26
GLOP- I (°C) Max-55	34	30
GLOP- II (°C) Max-55	36	32

Remarks:- M/C stopped at 02:00 AM due to non avalability of water. Sync at 4:30 AM
On leave:- Bhag Chand, Naresh Kumar

Prepared by:-Narender Kumar

Detail of tripping (UNIT-I)

Time of Tripping	**Grid Resume Time**	**Total Grid Outage**	**M/C Syn. Time**	**Plant Outage**	**Reason For Outage/Remarks**
0:54:00	**0:55:00**	**0:01:00**	**1:00:00**	**0:06:00**	**Due to grid fail**
2:15:00			**5:06:00**	**2:51:00**	**Due to A.D shut down.**
			Total Outage	2:57:00	

Thank you