



# THE MICRO-HYDRO PLUG-AND-PLAY EXPERIENCE

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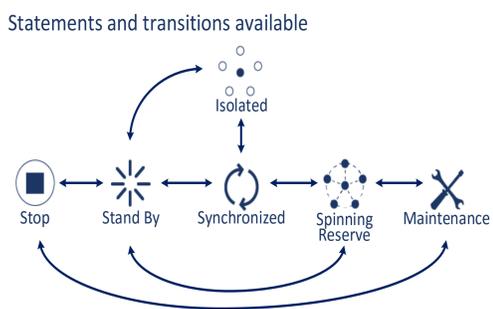


CENTRO DE ENERGÍA

## MOTIVATION

The present poster presents the experience of the Energy Center of the University of Chile in the use of micro-hydro power plants as distributed generation. Specifically, the micro-hydro power station designed by the members of the Center is presented as well as its applications and control modes. In this case, small waterways are used to provide energy to an isolated settlement that has or has not access to a main grid. The main advantage of small hydro-power stations is the low impact they have in the surrounding environment.

## OPERATION MODES



**Stop:** There is no water flow and the electrical system is disconnected.

**Stand by:** the unit is operating in nominal conditions but is disconnected from the system.

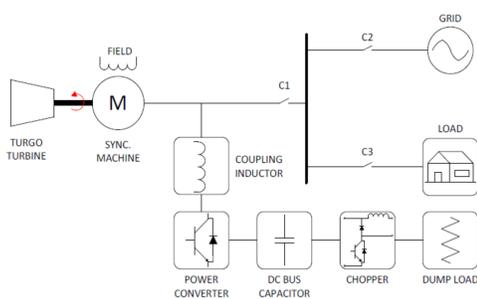
**Isolated:** The generator of the micro-hydro plant is able to feed local consumption, but it is isolated from the network.

**Synchronized:** The electrical system is supplying the local load and at the same time is synchronized to the network.

**Spinning reserve:** The unit is operating in nominal conditions but is disconnected from the load and the grid. Also the load is supplied by the grid.

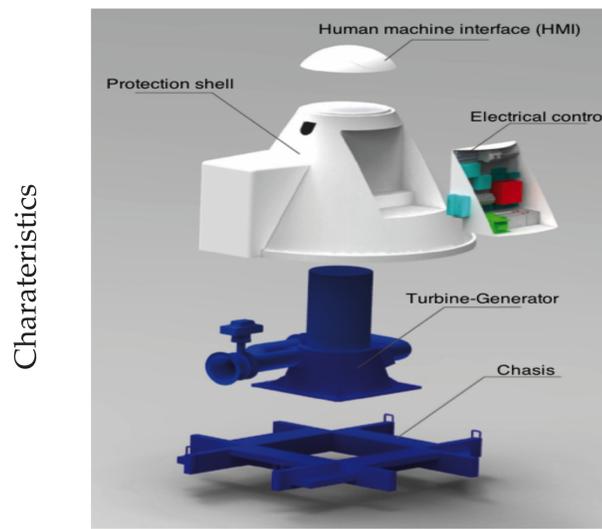
**Maintenance:** The unit is off, no water flow and all consumptions are fed by network.

## APPLICATIONS



This application uses a power converter in order to dispose of the excess of energy in a dump load. This converter consists of a three leg bridge plus breaker. Where the bridges are used to maintain the dc voltage of the bus. The breaker is used to limit the amount of energy dumped, while the system is not synchronized to the grid. The control of this converter is done by the central control unit, which also take care of the field current and the disconnectors. This controller takes measurements from the generator, the grid and the power converter. It is also capable of taking decisions such as when a fault has occurred, when to synchronize to the grid, transitions between operation modes, etc.

## MICRO-HYDRO CHARACTERISTICS



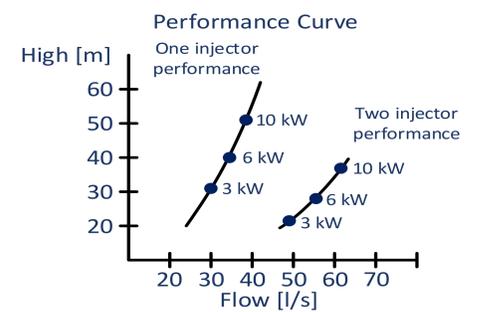
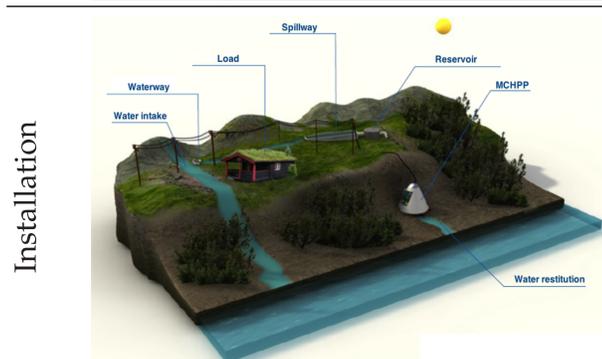
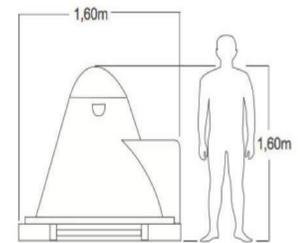
### Specifications

- Unit weight: 700 [kg]
- Turbine: Turgo
- Swing speed: 1500 [rpm]
- Generator: AC wound rotor synchronous

### Electrical specifications

- Peak power: 10 [kVA]
- Voltage: 380 [V]
- Nominal current: 26.3[A]
- Operating frequency: 50 [Hz]
- Number of phases: 3

### Dimensions



## LABORATORY TEST RESULTS

Start up

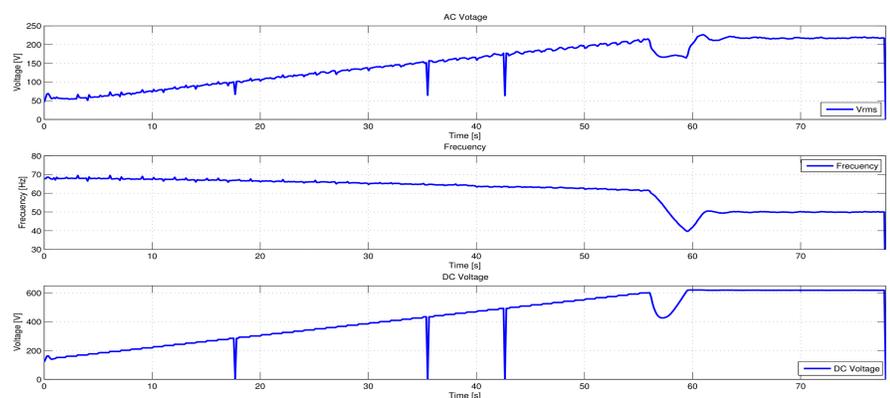


Figure 1: It shows the Start up of micro-hydro

Load connection

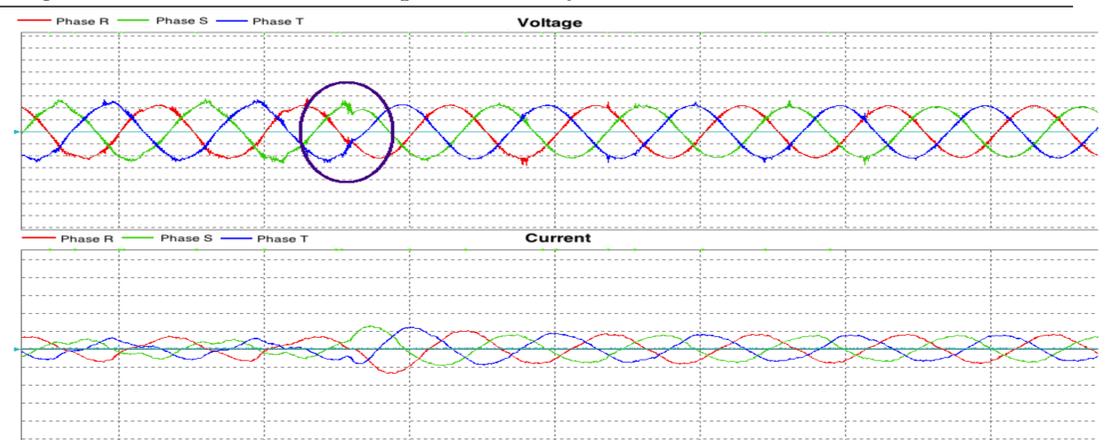


Figure 2: It shows the connection of loads, in island mode

Figure 1, shows a transition from stop to the stand by mode, where the voltage AC and DC increases to their nominal values 220 [V] Vrms and 600 [V], when this condition is reach the frequency control is activated, allowing the rate to stabilize at 50 [ Hz ] . In figure 2, shows a transition to island mode from standby, during this transition the sistem checks for nominal conditions and then connects a local load.