Sample applications
- Joint control
- Water control
- Water flow control of a turbine
- Turbine control
- Excitation system

Note: These are simple examples only! ... to demonstrate the approach

Logical structure of a hydro power plant
- Different devices handle active and reactive power control:
  - The turbine governor provides the active power control by regulating the water flow through the turbine and thus the pole angle between the rotating magnetic flux and the rotor.
  - The excitation system provides the reactive power control by regulating the voltage of the generator. The magnetic flux must correspond to the shaft torque to keep the generator synchronised to the grid.
  - The next figure shows an example of an arrangement including a joint control function. The set-points will be issued from a dispatch centre and could be one of three optional values.
  - The second figure is a typical example of water control functions of a dam. The overall water control of a hydropower plant will also include the water running through turbines.

Principles for the joint control function
**Water control functions**

- Upper water level
- Calculated water flow
- Level / opening relation curve
- Water flow set-point
- Water level set-point
- Overflow protection
- Dam gate position controller
- Water control
- Calculated water flow / opening relation curve
- To Joint Control

**Example of water flow control of a turbine**

- Intake gate
- Water level at intake
- Turbine water flow control
- Guide vane control
- Tailrace
- Under-pressure penstock
- Turbine
- Water flow control
- Net head calculation
- Guide vane position controller
- Guide vane position
- Governor control
- High pressure oil system
- Runner blade position controller
- Runner blade position
- Setting curves
- Combinator
- Setting curves
- Position indicator
- Calculated net head
- HWCL
- HLVL
- HGTE
- HLTP
- HGPI
- HDAM
- HDLS
- GCLV
- HNTP
- HGPT
- HNTE

**Typical turbine control system**

- W_FPID
- W_FSPT
- W_FCSD
- Spd_FPID
- Spd_FSPT
- Governor control
- Active power set-point
- Spd set-point
- Frequency set-point
- Governor control
- Opening limitation
- Tank
- Runner blade position controller
- Runner blade position
- Combinator
- Setting curves
- Position indicator
- Calculated net head
- HWCL
- HLVL
- HGTE
- HLTP
- HGPI
- HDAM
- HDLS
- GCLV
- HNTP
- HGPT
- HNTE

Logical Nodes
Excitation system

Logical node examples
- Turbine - generator shaft bearing
- Water level indicator
- Water control

Turbine - generator shaft bearing
Logical Node HBRG shall be used to represent the physical device bearing. It can be used to represent both thrust and guide bearings. One instance shall be used per bearing.