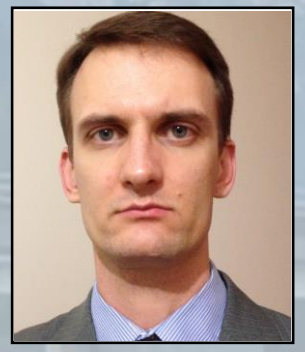

Challenges during the Control System retrofit in a 900 MW HPP with Double Pelton Turbine that operates as a Synchronous Condenser

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SUMMARY

- Contextualization
  - Henry Borden HPP
  - Double Pelton Turbine
  - Synchronous Condenser operation mode
- Modernization
  - Governor
  - Automation and Subsystems
- Comissioning Results
- Conclusions

Henry Borden HPP - External Powerhouse

External View

Internal View

Penstocks

CONTEXTUALIZATION

Henry Borden HPP - Underground Powerhouse

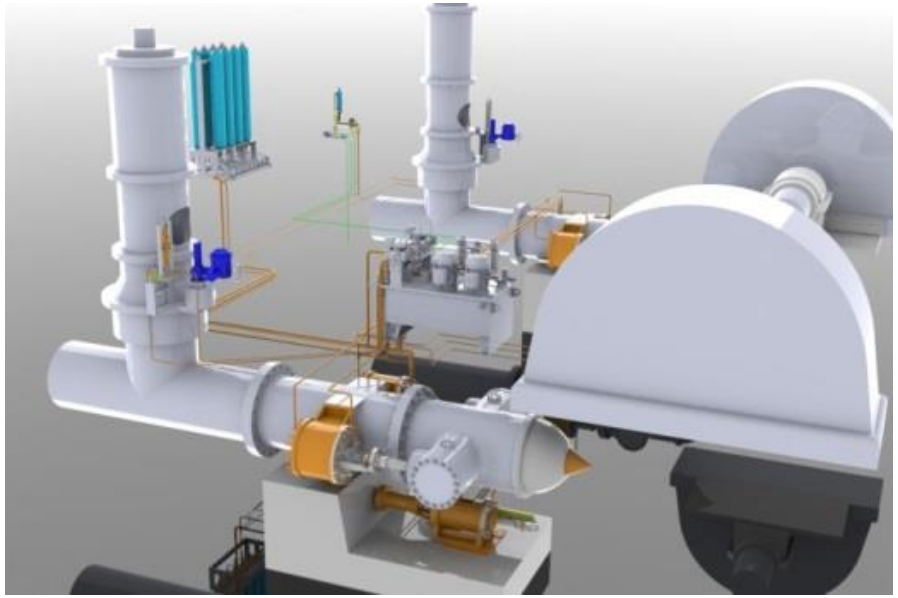
Generators

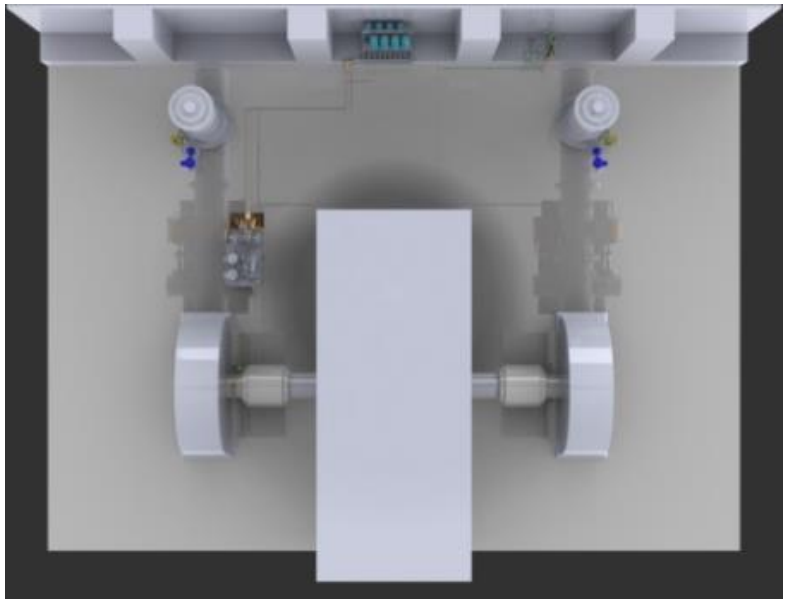
Butterfly Valves

CONTEXTUALIZATION

Double Pelton Turbine

Pelton turbine





Isometric Drawings – Perspective and Upper views

CONTEXTUALIZATION

Synchronous Condenser operation mode

MODERNIZATION

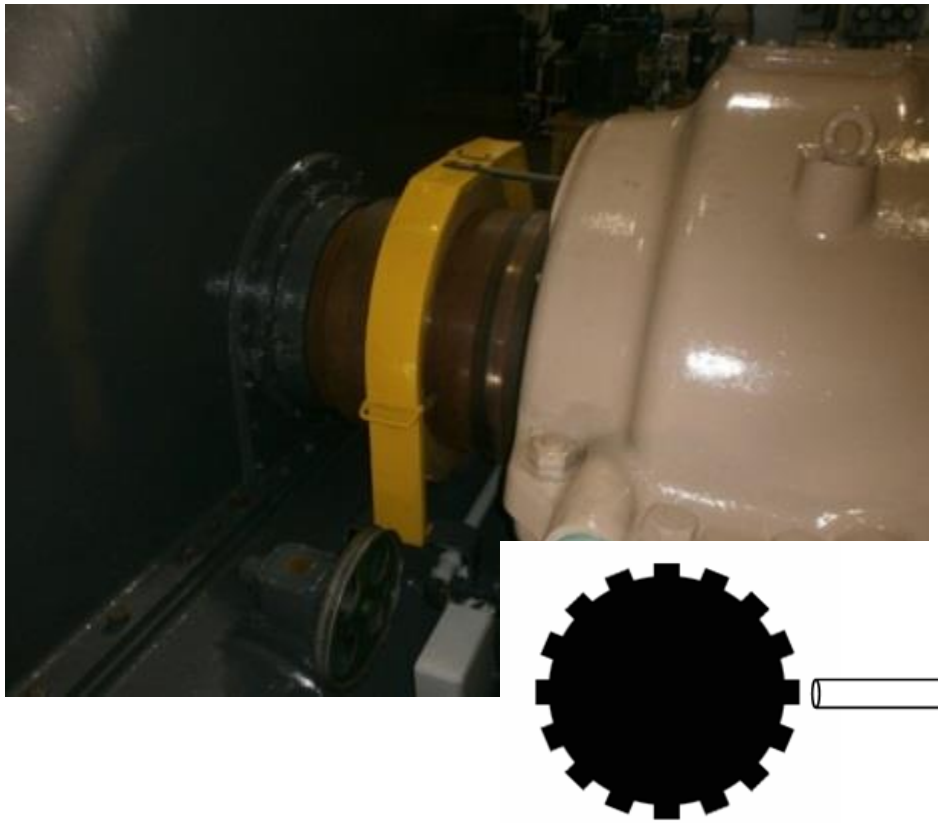
Governor – Hydraulic Systems

Original Systems

New Systems

MODERNIZATION
Governor – Sensors

Original Systems



New Systems

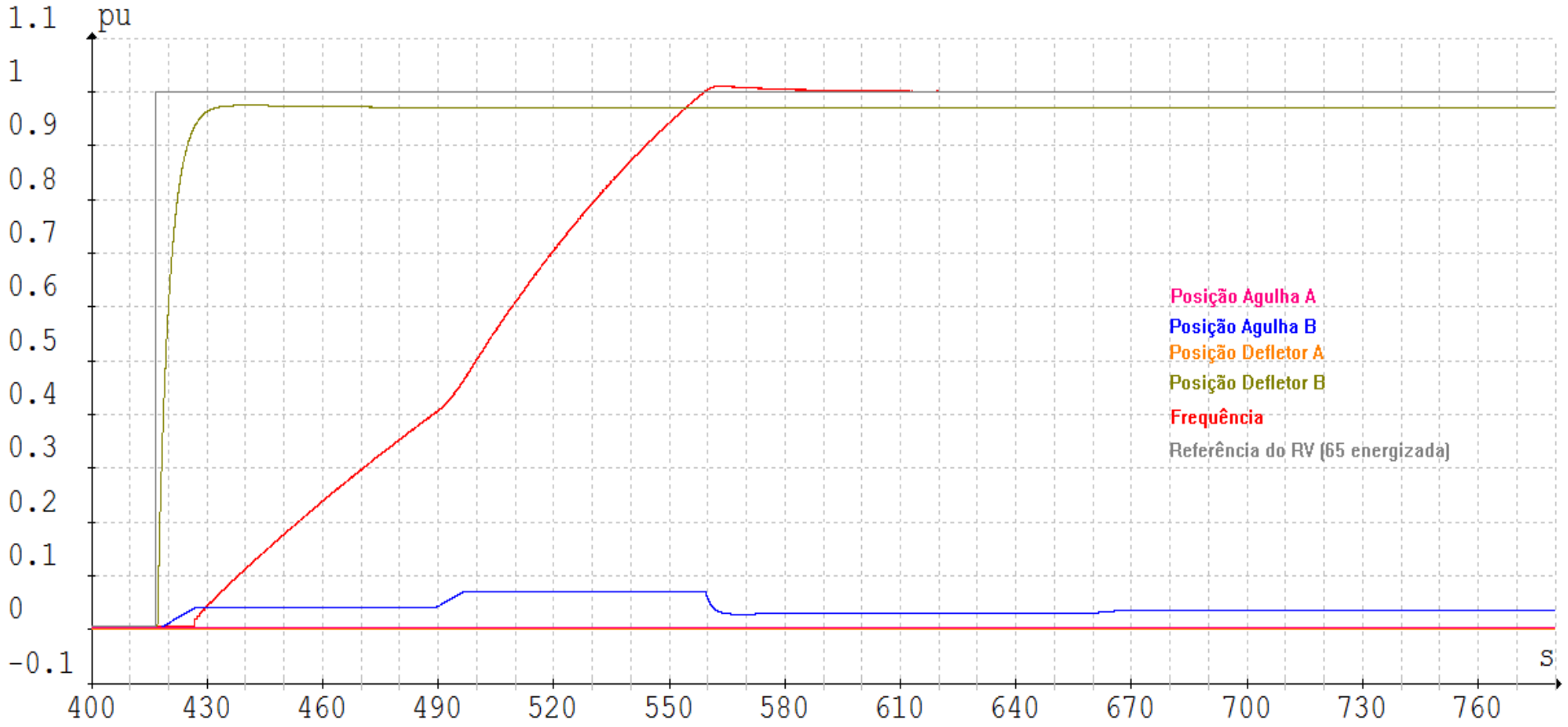
MODERNIZATION
Governor – Digital Control

New Governor – Control Cabinet
External View and Internal View

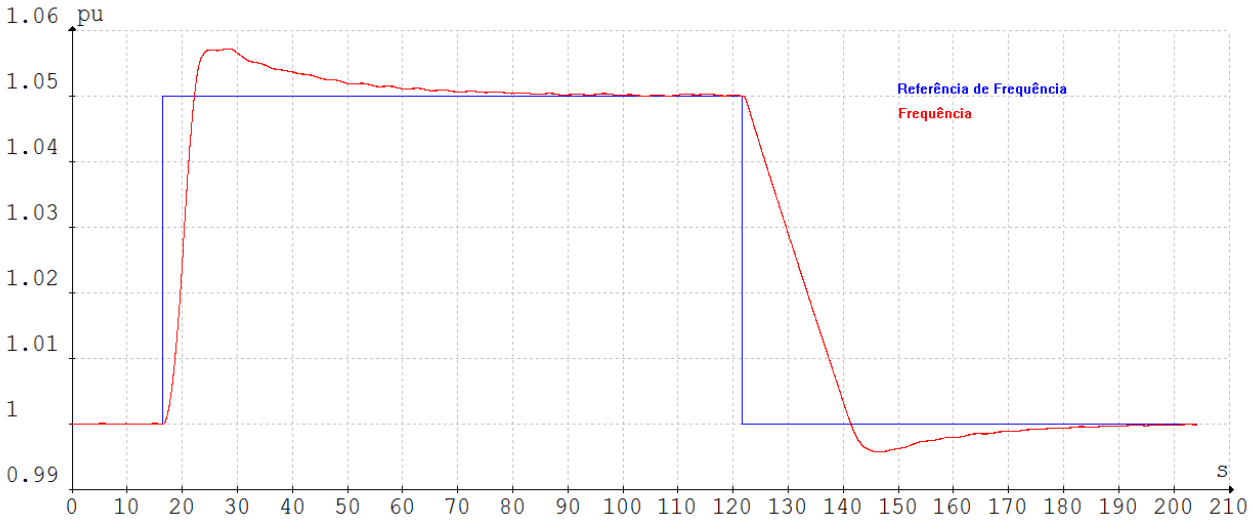
MODERNIZATION
Automation System

Operation Room
Control panels
Governor Remote
HMI

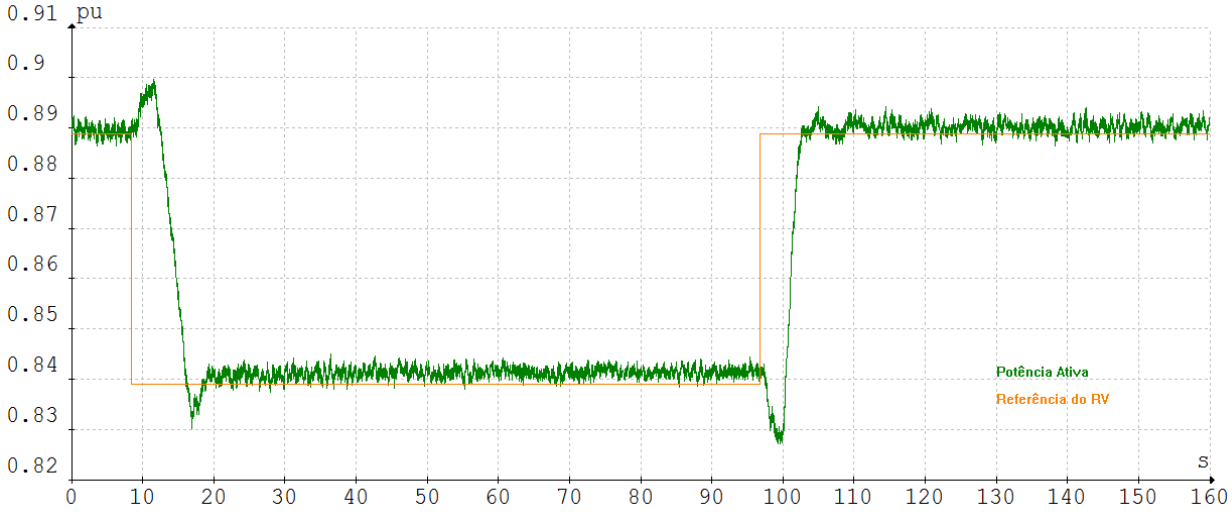
Automatic Start



Tuning the Control Loops



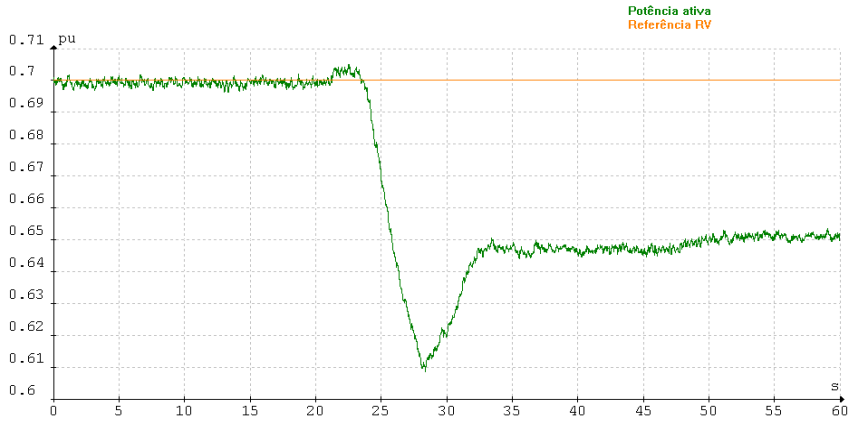
Frecuency step response



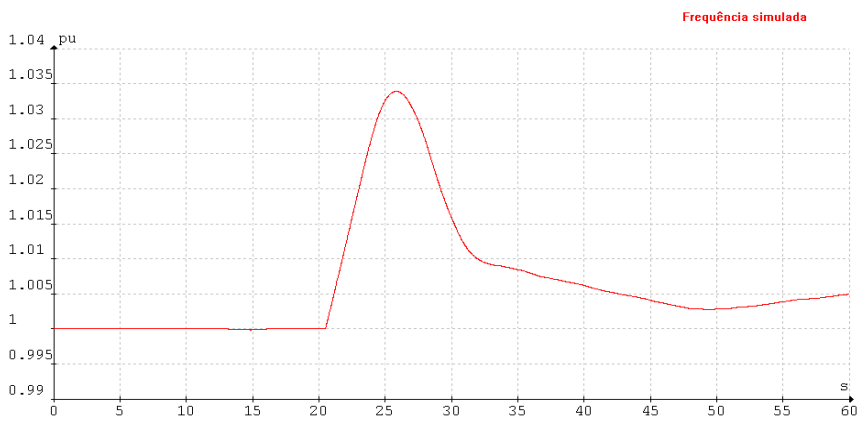
Active power step response

Tuning the Control Loops – Isolated testing

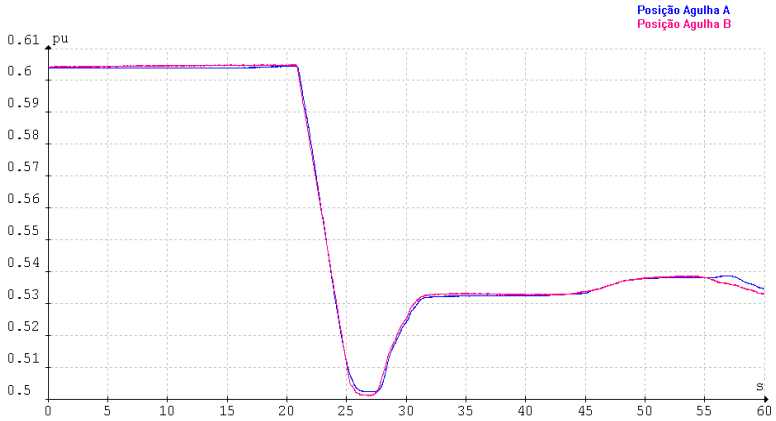
IEC60308 / IEEE1207



Reference and Active Power



Simulated frequency



Nozzles

CONCLUSIONS

- Maintenance: New diagnostic and testing tools
- Operation: New way – visibility of all process + centralized commands
- Versatility: Synchronous condenser mode
- Better performance: Isolated Simulation
- Reliability Increased
- Costs reduction

REIVAX

Thank you!

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