

Over Pumping Protection
Systems
Recommended Design Criteria

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Objectives

- Prevent over pumping of upper reservoir at pumped storage projects.

Upper Reservoir Instrumentation Systems

- Water Level Monitoring/Control System.
- Over Pumping Protection System.
- These two systems perform different functions.
- Focus on over pumping protection systems.

Design Criteria Goals

- Fail Safe Design
- Independent of Water Level/Control Systems
- Direct Action Pump Shutdown
- Redundancy
- Ease of Testing and Calibration

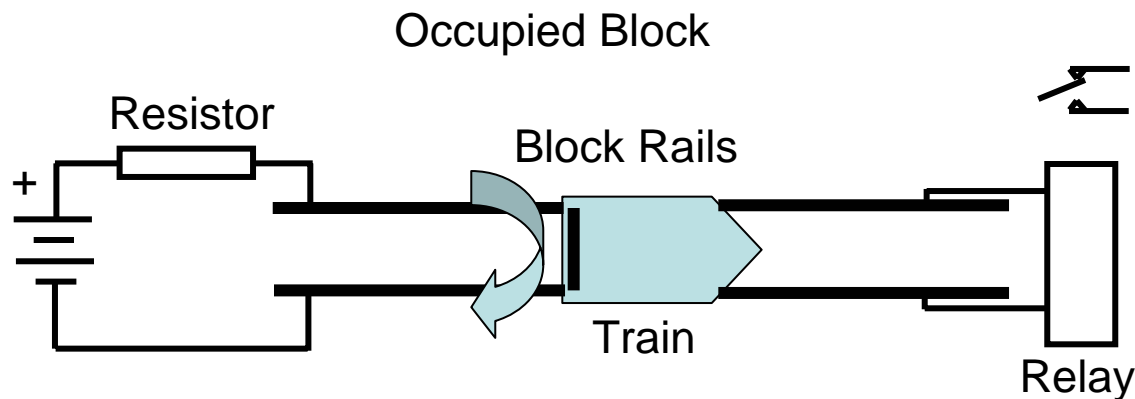
Fail Safe Design (1)

- Failure of any component results in predictable safe output condition.
- In our case, the pump/turbines are shutdown.

Fail Safe Design (2)

- Example of fail safe design.

Railroad Detection Circuit



Relay at one end of block is normally energized by battery and resistor at other end of block.
Locomotive or rolling stock axle in block shorts out current to relay to indicate block occupancy.

Independent of Water Level Monitoring/Control Systems

- Overpumping protection is dam safety feature.
- Consequence of failure is more severe than water level/control system failure.
- Should have more stringent requirements than water level/control system.

Direct Action Pump Shutdown

- Based on philosophy used for typical hydro generator protective devices where any sensor operation will release an “86” shutdown relay.
- Shutdown signal is not routed through computers, PLC’s or timers.

Hydro Plant Electrical Systems

by Dave Clemens

“Emergency Shutdown Controls

Although computer and PLC systems improve plant operation by providing greater flexibility in control, alarming, and sequence of events recoding, the essential emergency shutdown controls should remain hardwired. This will guarantee that a safe and orderly shutdown of the plant can be accomplished in an emergency situation during which the computer/PLC has failed.”

Redundancy

- Enhances reliability of over pumping protection system.
- Not a substitute for fail safe design.
- Taum Sauk had three redundant water level sensors but shared a common support system that failed.
- Can give false sense of security if not a truly redundant design.

Ease of Testing and Calibration

- System should be easy to test and validate correct operation.
- Should require periodic testing.
- Should be included in Part 12 Safety Reports.

Recommendation

- FERC should establish minimum standards/guidelines for over pumping protection systems.
- Water level/control system design should be at the discretion of project owners.