Island Detection in Microgrids

A Case Study

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Introduction

- Oil refinery with cogeneration plant
  - Refinery uses electricity and steam from cogeneration

- Refinery-wide outage potential
  - Generators could not stay online in the event the refinery electrical system was islanded from the utility
System One-Line
Generator Control Systems

• **Normal Condition:** Generators operate in parallel with the utility
  - Generator control systems take their frequency reference from the utility (droop mode of operation)

• **Islanded Condition:** Frequency reference is lost
  - The control system of one generator needs to become the new frequency reference for the other generators (Isochronous mode of operation)
Quantum Detection Goals

- **Detect** an island condition and change generator control mode to keep refinery loads online
  - Must be fast, otherwise generator frequency may drift and trip offline on under or over frequency conditions depending on the generation to load mismatch at the moment of islanding

- **Leverage** greater use of existing cogeneration to provide system reliability
Island Detection Development Process

- Create Functional Specification
  - Describes how the system is supposed to operate
- Develop island detection logic
  - Breaker statuses provided to Logic Processor by IEDs via IEC 61850 messages
- Develop IEC 61850 configuration
- Develop settings for Logic Controller
- Bench Test Logic Controller settings
- Field Commission and Test System
Application to Other Microgrids

- Island detection applies to other microgrid generation types/control systems
  - Inverter-based generation (PV, BESS, wind turbine)
  - Synchronous generators (Gas turbines, reciprocating machines, steam turbines, hydro)
- Depending on the mix of generation control types, all of these control systems may benefit from being told the system is islanded
- Can be used to trigger load shedding
Questions?