A Peek Inside Electric Utilities to Understand Organizational Theory

D'Angelo R. Woods | October 20, 2014 | Special Topics: Computers & Critical System Safety

Background

- Organization Theory and Accidents
  - There has yet to be a single accidental nuclear detonation
  - Need to understand how or why this has been the case
  - Issue of safety and reliability in complex technological systems
  - Two schools of thought: High Reliability Theory and Normal Accidents Theory
  - We will take a peek inside the electric utility, a more familiar complex technological system and organization

Theory #1

High Reliability

Serious accidents with hazardous technologies can be prevented through intelligent organizational design and management.

Scholarly Works

University of California at Berkeley	Joseph Marone and Edward Woodhouse's *Averting Catastrophe: Strategies for Regulating Risky Technologies*	Aaron Wildavsky's *Searching for Safet*
"Serious accidents with hazardous technologies can be prevented through **intelligent organizational design and management.**	"A systematic product of human actions – the result of a **deliberate process** by which risks are monitored, evaluated, and reduced"	"Major focus is on examining the cost and benefits of …'**anticipation'** (efforts to predict and prevent potential dangers from arising before they have ever occurred) and '**resilience'**(efforts to cope with dangers once they have ever occurred)

Four Critical Factors

- Prioritization of safety and reliability as a goal by political elites and the organization's leadership
- High levels of redundancy in personnel and technical safety measures
- Development of a "high reliability culture" in decentralized and continually practiced operations
- Sophisticated forms of trial and error organizational learning

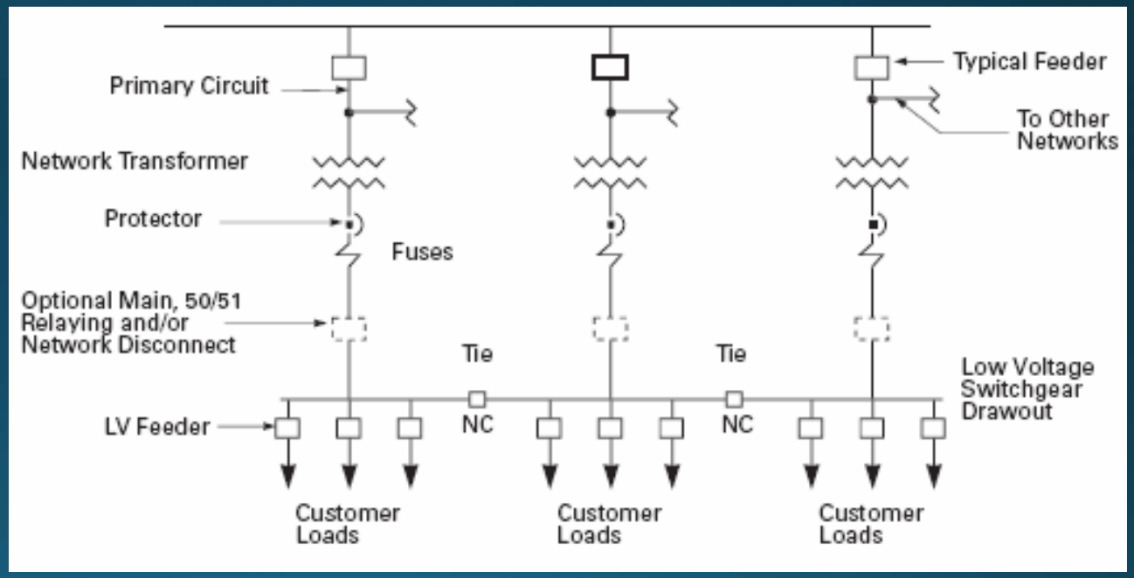
Safety as a Goal

- OSHA Requirements
- NERC Compliance
- Office Safety Audits
- Field Safety Inspections
- Flame-Retardant Clothing
- Contingency Analyses

High Levels of Redundancy in Technical Safety and Reliability

Underground Network Transformer

https://www.gedigitalenergy.com/HVMV_Equipment/catalog/network_transformers.htm#nettrans1



Spot Network

http://www.nrel.gov/docs/fy05osti/38079.pdf

Development of High Reliability Culture

- Utilities around the country are investing millions into tree trimming to cut down on the number of tree-related outages
- Reliability established as priority through financial investment and continually-practiced operations

Sophisticated Trial and Error

- Implementing lessons from past mistakes in order to improve processes and procedures
- We'll see an example of this later…

Theory #2

Normal Accidents

Serious accidents are inevitable.

Scholarly Works

Charles Perrow
Normal Accidents: Living with High-Risk Technologies

Interactive complexity and tight coupling

Northeast Blackout of 2003

- Unlikely problems: tree branches and software bugs
- Cited Causes
  - Failure to ensure operation within secure limits
  - Inadequate vegetation management
  - Inadequate operator training
  - Failure to identify emergency conditions and communicate that status to neighboring systems
- Tightly coupled systems: time-dependent processes, redundancy limited to original design, not easily-recovered (resilience)
- Interactive complexity: many moving parts

NOMA Outages of 2011

A Personal Account

When it Comes to Electric Utilities…

Are you a High Reliability Theorist or a Normal Accidents Theorist?