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# Assessing Electric and Gas Utility Infrastructure

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# Overview

- General
- Maps and Construction Standards
- Electric Distribution Systems and Substations
- Natural Gas Distribution Systems
- Key System Components
- Tools and Resources

# Utility Systems

- Purpose
  - Designed and maintained to provide for the safe, reliable, efficient delivery of electricity or natural gas
  - NEC and/or NESC - electric
    - Local regulatory oversight
    - NESC for utility companies
  - 49 CFR 191 and 192 - gas
    - Transportation of natural gas, design and safety requirements
    - US DOT and local authorities

# Safe, Reliable and Efficient

- NEC and federal regulations generally cover safety and certain installation standards
- Local regulatory agencies and industry standards address safety and reliability
- Economics drive efficiency
- “Rules” under the NESC vs. NEC are different for wire size, conduit sizing, transformer sizing, hot work

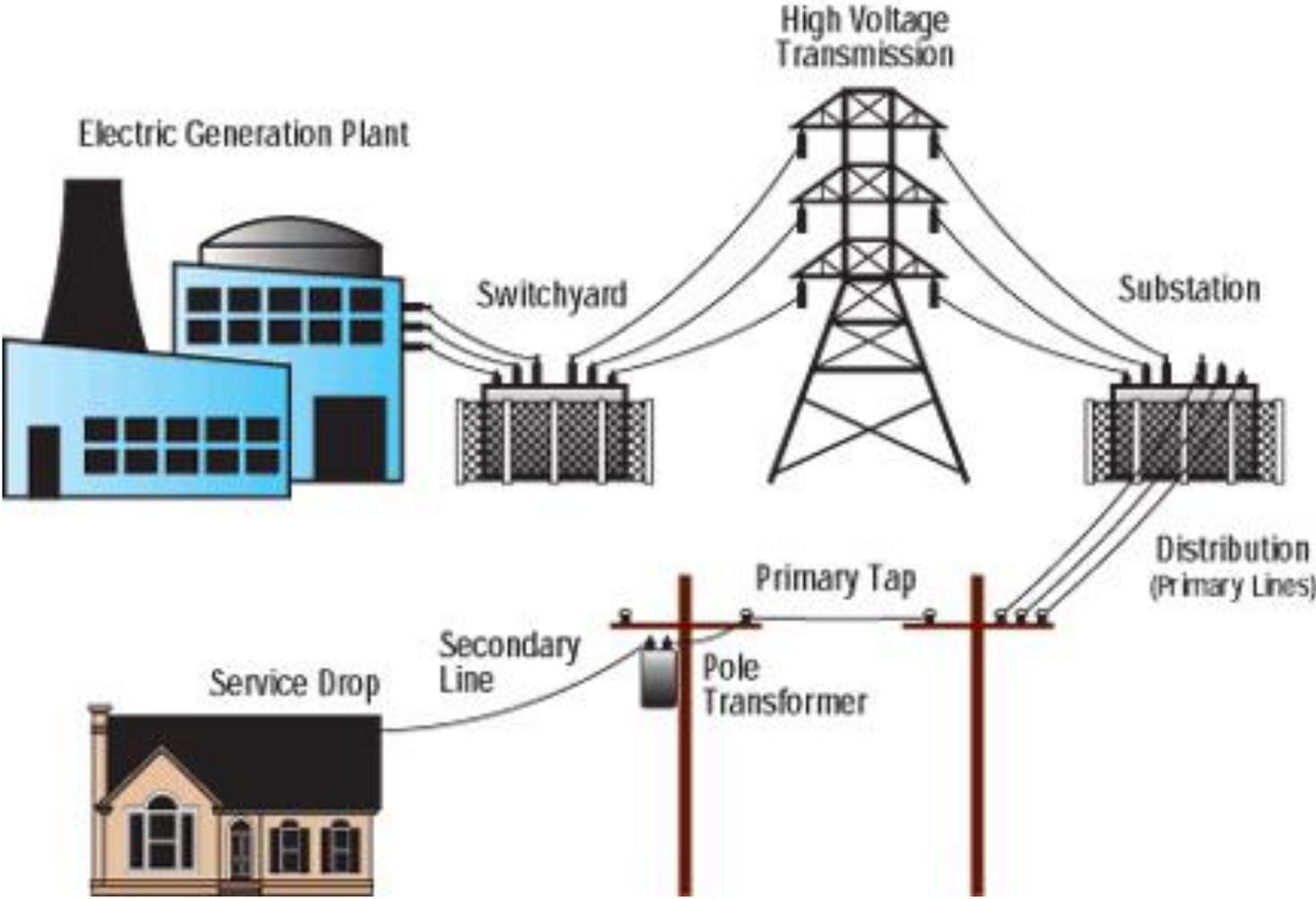
# System Assessment

- Safety - use NEC or Title 49 as the guideline
- Reliability – system design, condition of equipment
- Efficiency – design and operation of the system
  
- Work hand in hand

# Maps and Construction Standards

- Provide all essential information
- Equipment location, construction style, type, size, height, width, connection points, age, phase loading, wire size, pressure, flow, etc.
- Critical during a system event and when making system modifications
- If construction standards are followed and maps are accurate everything is easy

# Electric Systems



# Substation



# Substation



# Transmission / Distribution System



# Assessing the System

- Bus Work
- Breakers
- Insulators
- Foundations
- Poles
- Crossarms
- Attached Equipment
- Guys
- Transformers
- Grounding
- UG Equipment
- Conductors
- Clearances
- House keeping
- Construction Standards

# Bus Work, Breakers, Insulators and Foundations

- Condition
- Leaking
- Corrosion
- Cracks
- Loose connections
  - IR scan

# Poles and Crossarms

- Dig and test for integrity
- Birthmark
- Holes
- Splitting
- Rot
- Leaning
- Loading

# Attached Equipment

- Brackets, lightning arrestor, capacitor bank, insulator, switch, lighting, meter, etc.
- Non-electric utility system equipment – cable, phone, TV, fiber optic, etc.
- Corrosion
- Condition of attachment
- Loose connections
- Clearance

# Guys

- Guard
- Loose
- Split
- Firmly anchored
- Guy passing through the primary

# Transformers

- PCB
- Age
- Corrosion
- Leaking
- Connections
- Properly marked
- Pad mount
  - Locked
  - Level
  - Not flooded
  - Ants
  - Bushings
  - Clearance

# Grounding

- Condition of wire
- Ground clamp
- 25 ohms or less

# Underground Equipment

- Hand holes
  - Accessible, flooded, mud filled
- Risers
  - primary – 42” minimum
  - Secondary – 30” minimum
- Trenching

# Conductors

- Pitting, attachment at insulators, squeeze-ons, splices, clamps, etc.
- Sag and tension – original design, field test
- Clearance
- Hi pot the UG
- Wire size vs. transformer capacity

# Clearance

- Vertical and horizontal
- From adjacent conductors on same circuit, under build circuits, guy wires and other equipment
- From buildings, trees, bridges, water and signs
- Rail crossings and boat landings
- Truck vs. non-truck traffic areas

# House keeping

- Nothing stored in substation
- Nothing stored on or around transformers
- Pole attachments

# Natural Gas Systems

- Less complicated, fewer parts but harder to assess
- Regulations rely on record keeping
- Certified designer, certified materials, installed by certified installers and maintained by individuals with proper certification
- Leak survey reports
- Initial MAOP
- Records must be keep for the life of the system

# Assessing the System

- Pressure regulating station
- Regulator
- Meter
- Pipe
- Valve, valve box
- Tracer wire
- Cathodic protection
- Pipe markers
- Other attached equipment or systems
- Leak survey

# Regulating Station, Meters and Regulators

- Corrosion
- Leaks
- Size
- Orientation
- Location of meters
  - Not in enclosed spaces or “pools”

# Pipe

- Size
- Type
  - Steel, plastic
- Fusion joints
- Location
- Depth

# Valves and Valve Boxes

- Locate and operate
- Lubricate
- Clean the boxes

# Tracer Wire, Cathodic Protection and Pipe Markers

- Locate and check
- Markers in place

# Attached Equipment

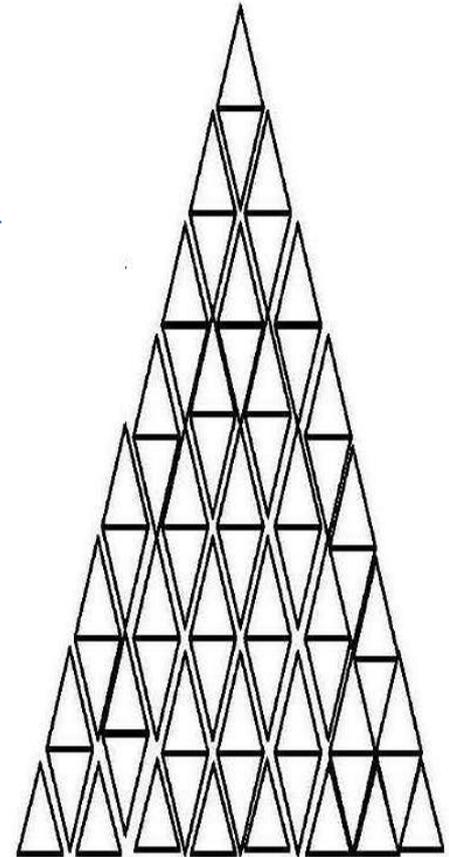
- Propane Air System
- Heavier than air
  - Equipment located in basements
  - Meter locations
    - Enclosed porches, “pools”

# Leak Survey

- Grade 1
  - Existing or probable hazard
  - Requires immediate repair
- Grade 2
  - Non-hazardous at time of detection
  - Requires near term repair
- Grade 3
  - Non-hazardous and not expected to get worse

# Key Components

- Largest to smallest
- Substation - Regulating Station
- Feeder Breaker
- Circuit - Main
- Branch Circuit - Laterals
- Service Line - Services
- Service Transformer - Regulators



# Tools and Resources

- Consultants
- Contractors
- Local utility
  - Training facilities available to customers
  - Construction standards for local conditions
- Software tools
  - Load studies, phase balancing, fault current analysis, fusing, system coordination, sag, tension

# System Operation and Maintenance

- Trained construction and maintenance personnel
- Construction Standards
- Accurate maps
  
- Complex systems that require proper engineering, construction, maintenance and capital replacement