

Campus Utility System

Preparedness Planning

RMA Webinar
Feb 28, 2013



ARCHITECTS & ENGINEERS, INC

Presenters:

Henry Johnstone PE
Director Mechanical Engineering



Ted Moeller PE
Director Electrical Engineering



John McGann PE
Director Civil Engineering



Our Experience

Campus Utility Systems

- Troubleshooting
- Planning
- Design
- Commissioning

Higher Education

- UA, NAU, ASU, UNM, NMSU, UW, UAF.....
- Utility Development Plans
- Plant and Distribution Design
- System Commissioning

Health Care

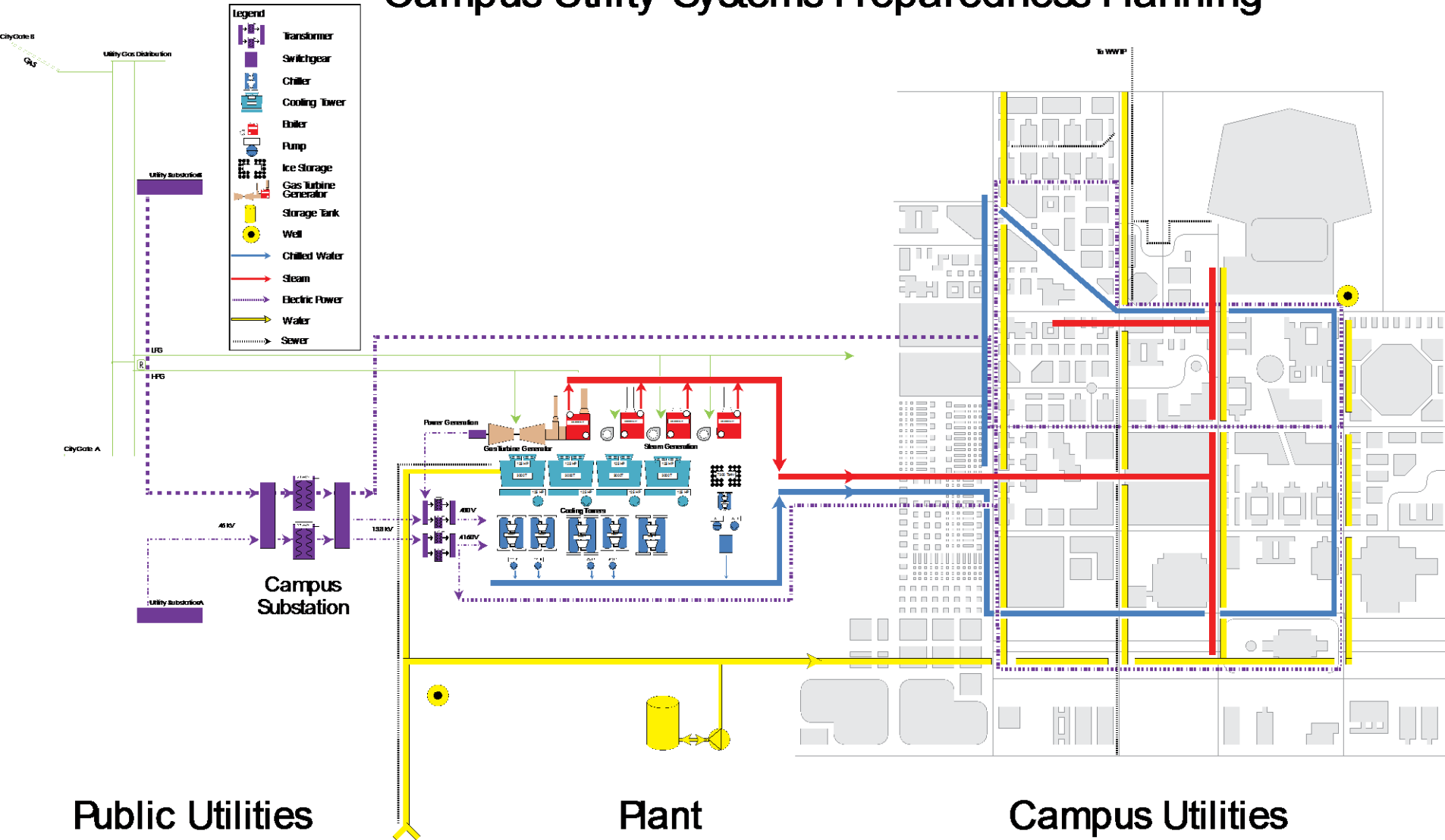
- Department of Veterans Affairs
- Facility Condition Assessment
- Hurricane Preparedness Evaluation
- Physical Security Design Manual
- Critical Operations Electrical Analyses

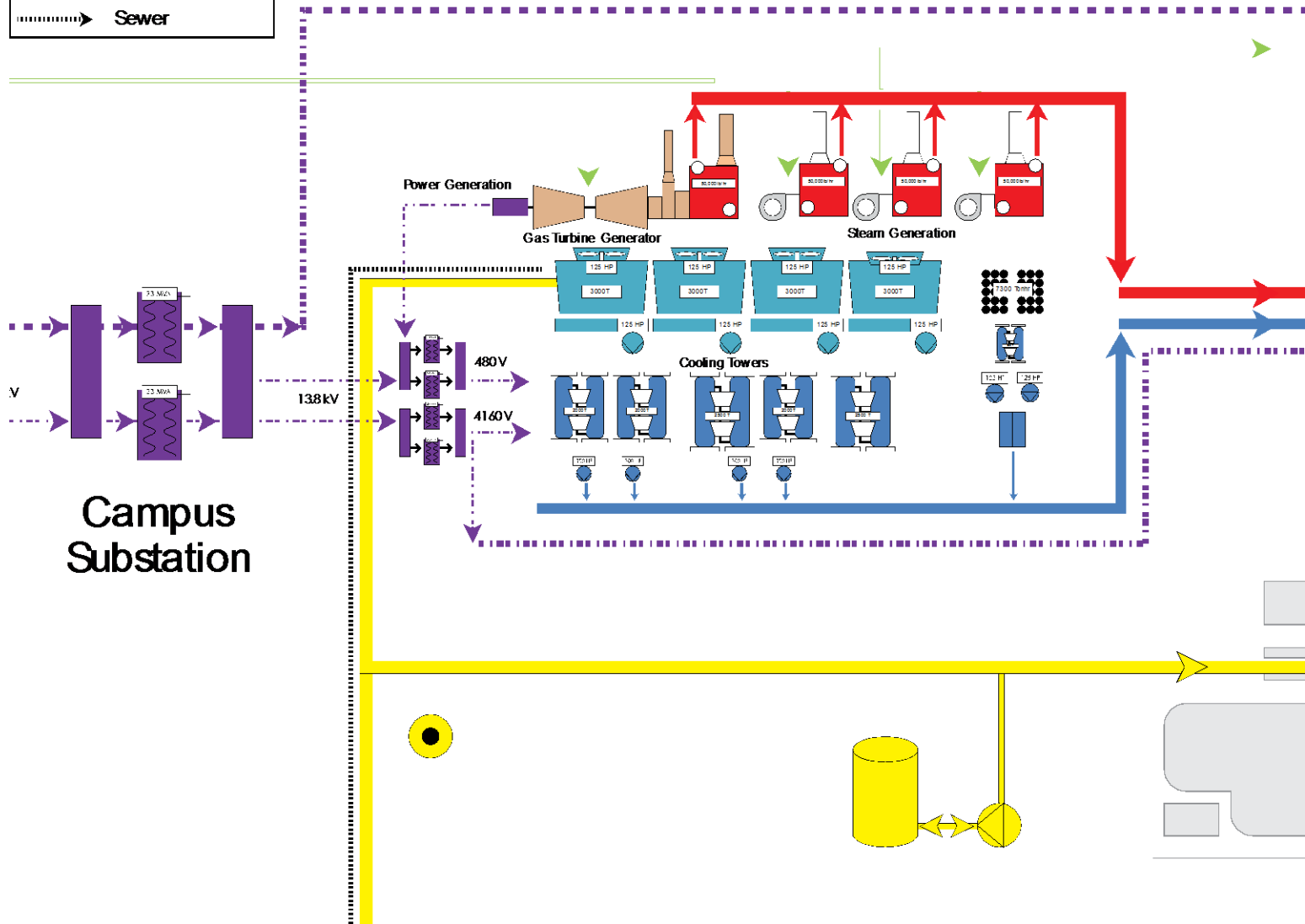


Campus Utility System Preparedness Planning

- Review characteristics of campus systems and interfaces with external utilities
- Consider vulnerabilities that could lead to major unplanned campus utility outages
- Review campus utility system reliability metrics
- Discuss campus utility system reliability enhancements
- Learning Objectives
 - Gain an understanding of campus utility system reliability from an engineering perspective
 - Gain insight and tools that can be applied to your specific campus situation

Campus Utility Systems Preparedness Planning





Campus Utilities Mission

- Establish & maintain plant, infrastructure and services for a safe, healthy, and productive campus environment
- Maintain services to on-campus residence community
- Support special requirements of funded research
- Meet medical and patient care environmental standards

Subject to capital and operating cost constraints (enterprise mentality)







Preparedness

- A set of contingency plans or processes that enable ongoing operation of utilities through unplanned system disruption
- Internal
- External
- Forces of Nature



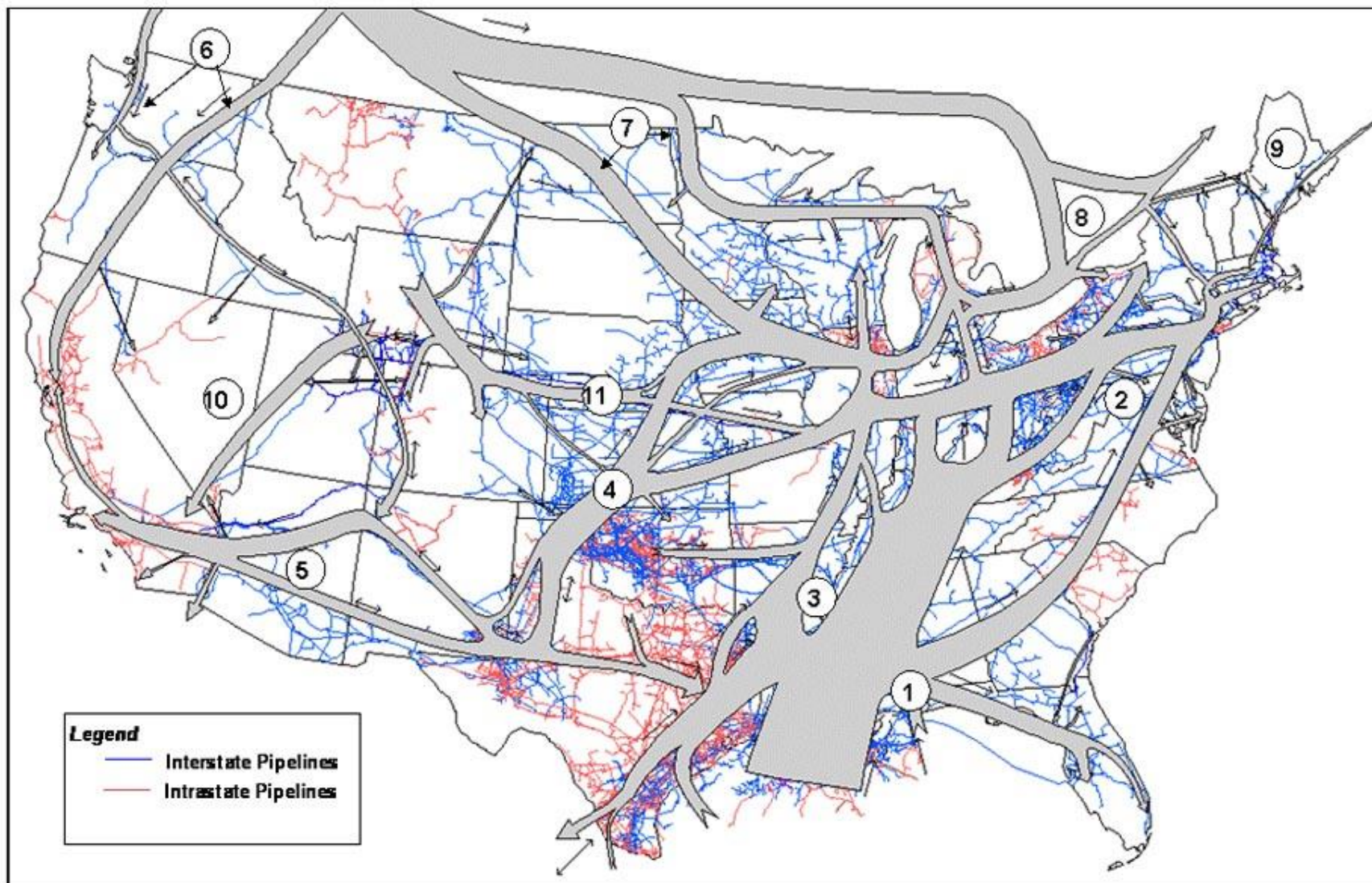
Internal Disruptions

- Distribution Pipe Breaks
- Electrical Breaker Trips
- Prime Equipment Failures
- Unexpected Consequences:
Cascading, Compounding Failures



External Disruptions

- **Utility Outages**
 - Water Line Break
 - Electrical Substation Failure
 - Natural Gas Outage



Source: Energy Information Administration, Office of Oil and Gas, Natural Gas Division, GasTran Gas Transportation Information System.

The EIA has determined that the informational map displays here do not raise security concerns, based on the application of the Federal Geographic Data Committee's *Guidelines for Providing Appropriate Access to Geospatial Data in Response to Security Concerns*.



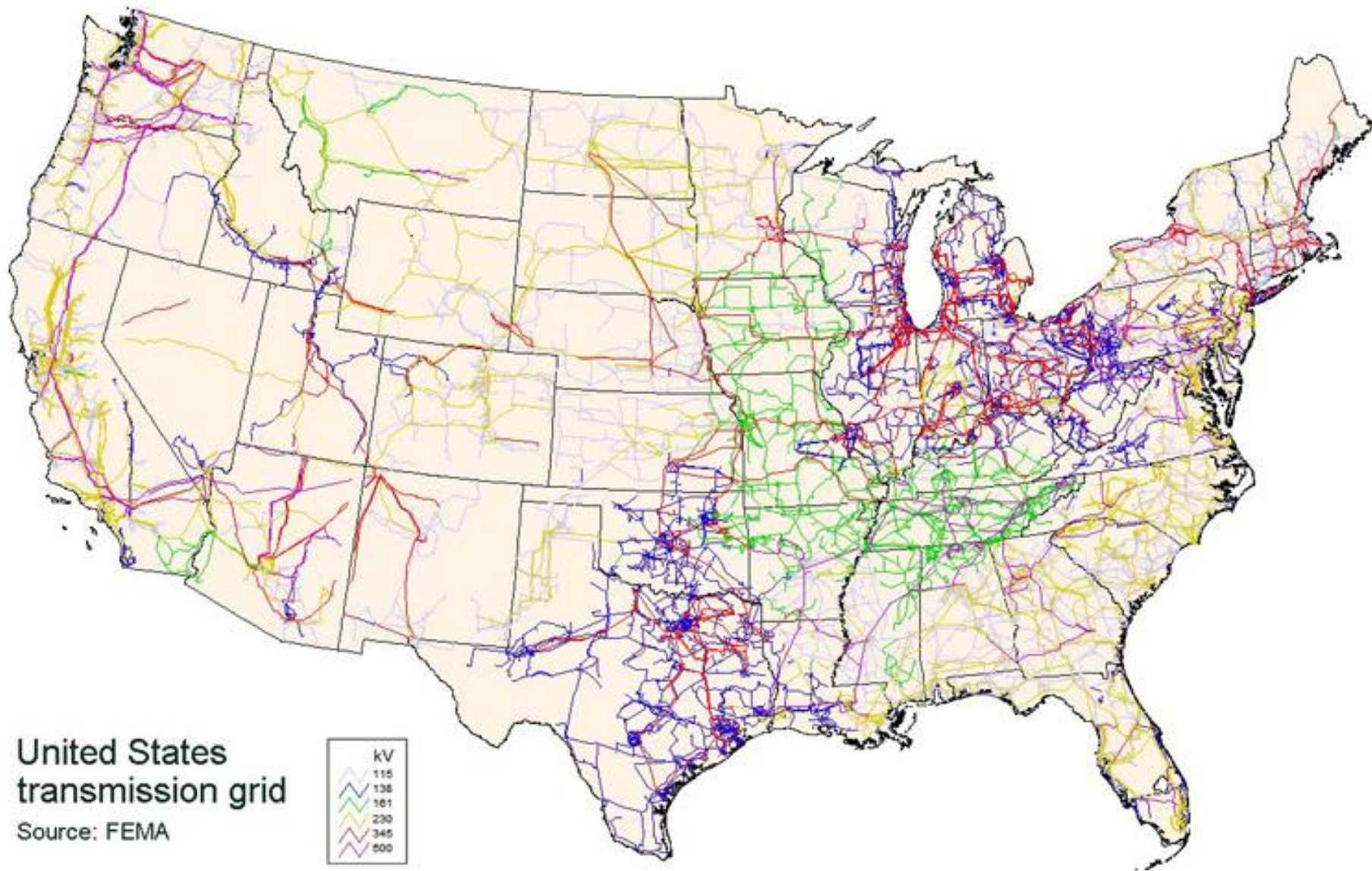


Acts of Nature

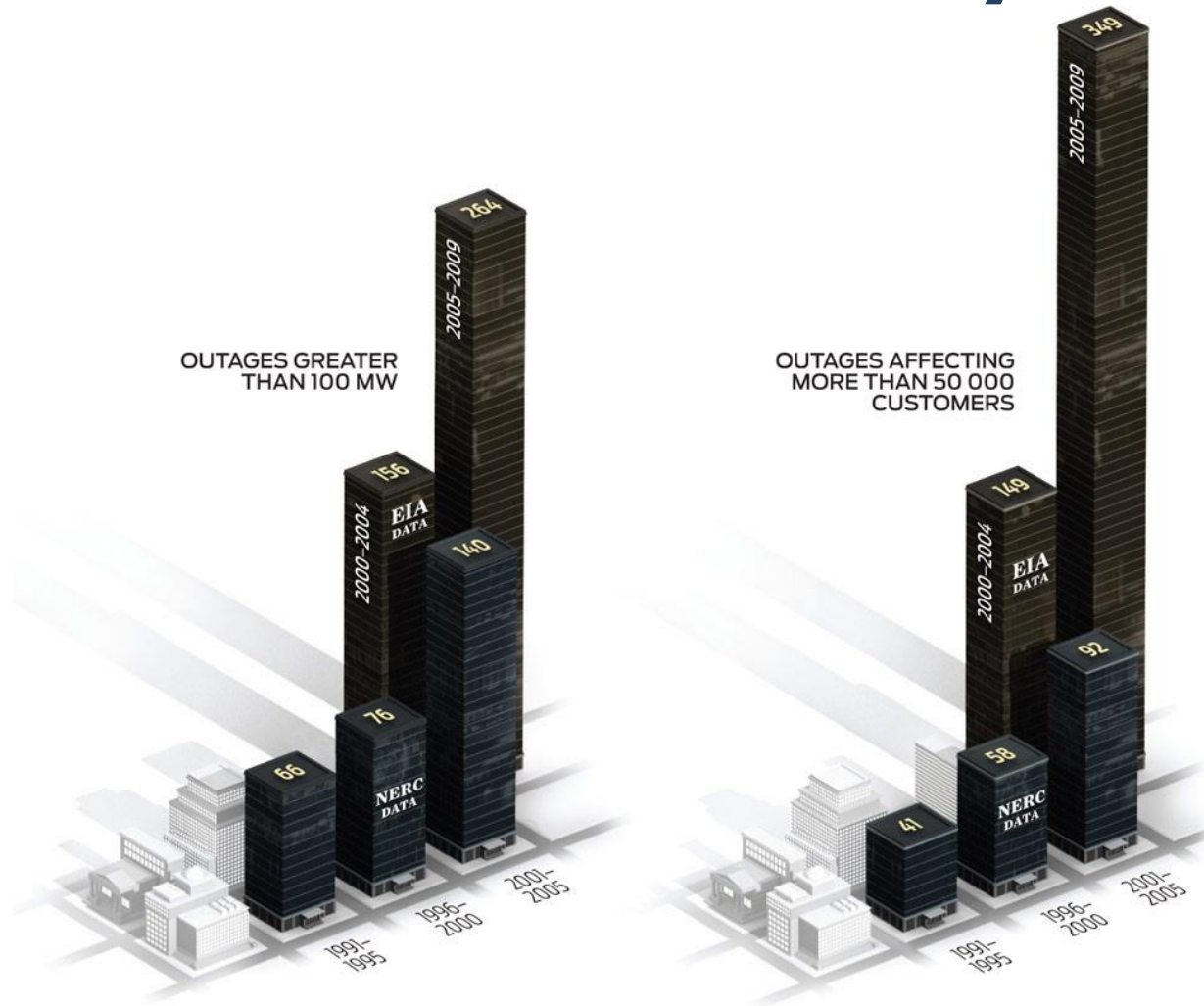
- Fire
- Flood
- Earthquake
- Extreme Temperature

geographically remote causes





Grid Reliability



Other External Vulnerabilities

- Water System Contamination
- Electric Grid Instability
- Vandalism
- Cyber Attack – web access

Geographically Remote Causes



Hurricane Sandy doubled Internet outages

USC (US) — During Hurricane Sandy, almost twice as much of the Internet was down in the US than usual, say scientists who track outages throughout the world.

6

8

Tweet

Like

0

+1



Murphy's Law

**Everything that can fail,
shall fail**

- What could go wrong with the system or process?
- How badly might it go wrong?
- What needs to be done to prevent (or accommodate) failures

Failure Mode and Effects Analysis

- FMEA : a systematic analysis of the system to whatever level of detail required to demonstrate that no single failure will cause an undesired event

Failure Mode and Effect Analysis

Simple Approach

- Risk Priority Number
- $\text{Severity} \times \text{Occurrence} \times \text{Detection} = \text{RPN}$
 - Severity
 - Rates the severity of the potential effect of the failure.
 - Occurrence
 - Rates the likelihood that the failure will occur.
 - Detection
 - Rates the likelihood that the problem will be detected before it reaches the end-user/customer.
 - RPN rating scales range from 1 to 5 or from 1 to 10, with the higher number representing the higher seriousness or risk.

RPN Considerations

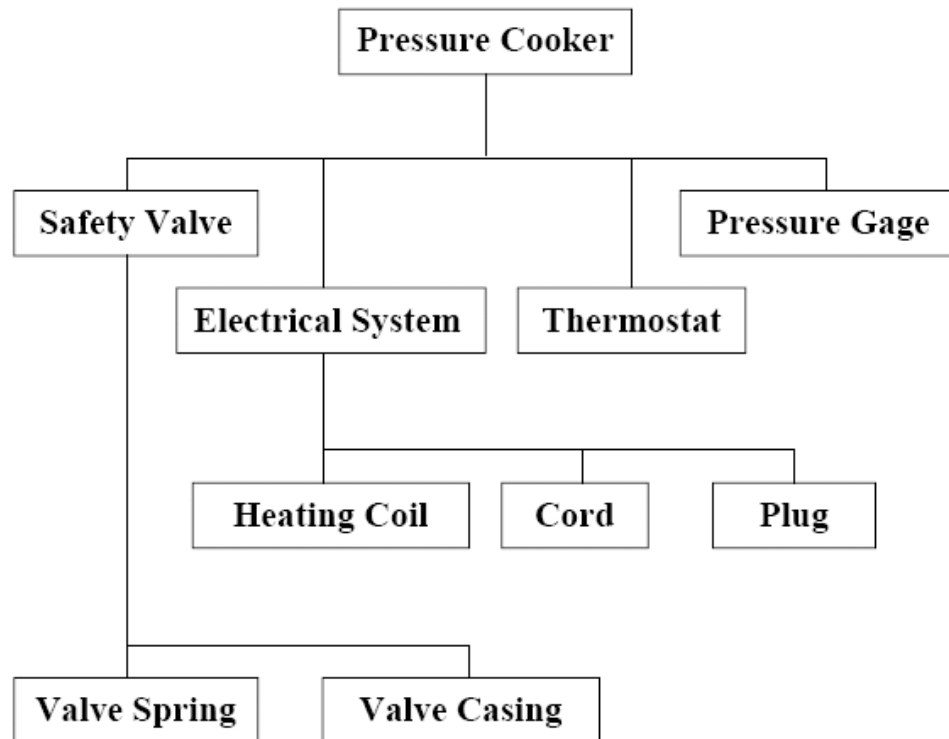
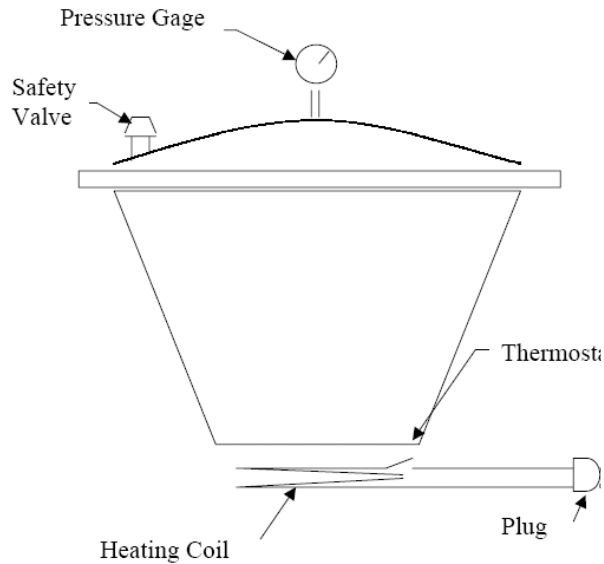
- Rating scale example:
 - Severity = 10 indicates that the effect is very serious and is “worse” than Severity = 1.
 - Occurrence = 10 indicates that the likelihood of occurrence is very high and is “worse” than Occurrence = 1.
 - Detection = 10 indicates that the failure is not likely to be detected before it reaches the end user and is “worse” than Detection = 1.

1

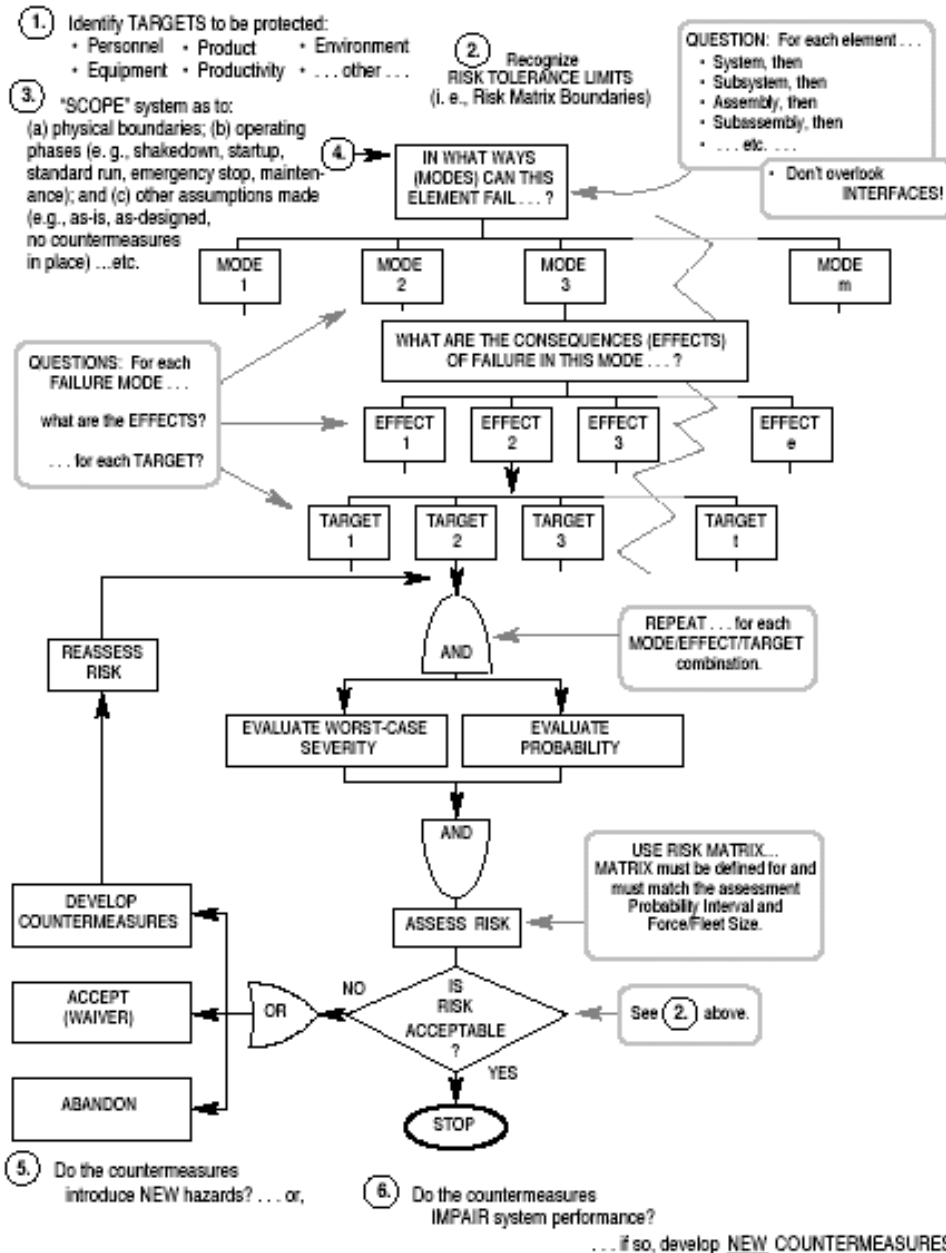
5

10

Block Diagram



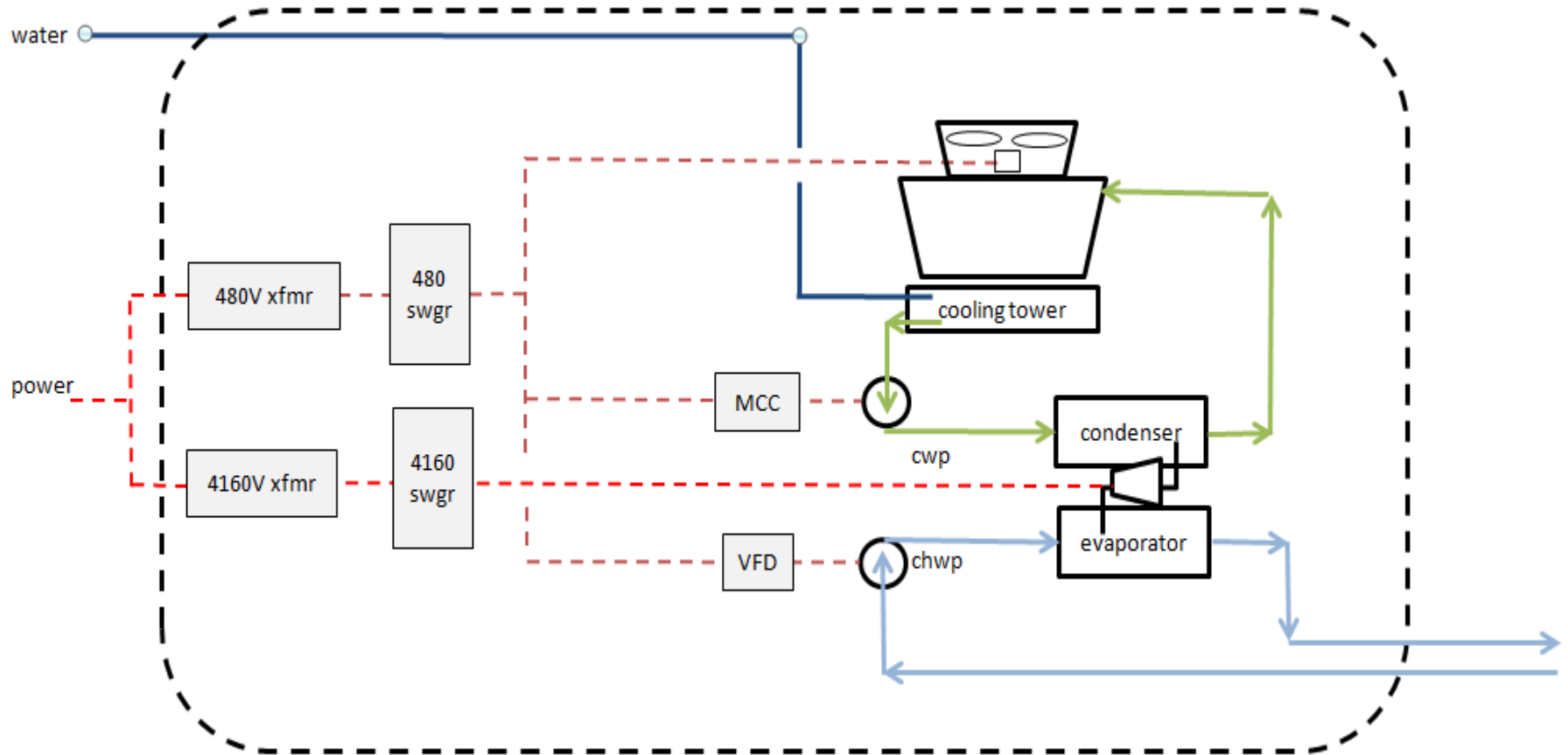
FMEA Process Flow



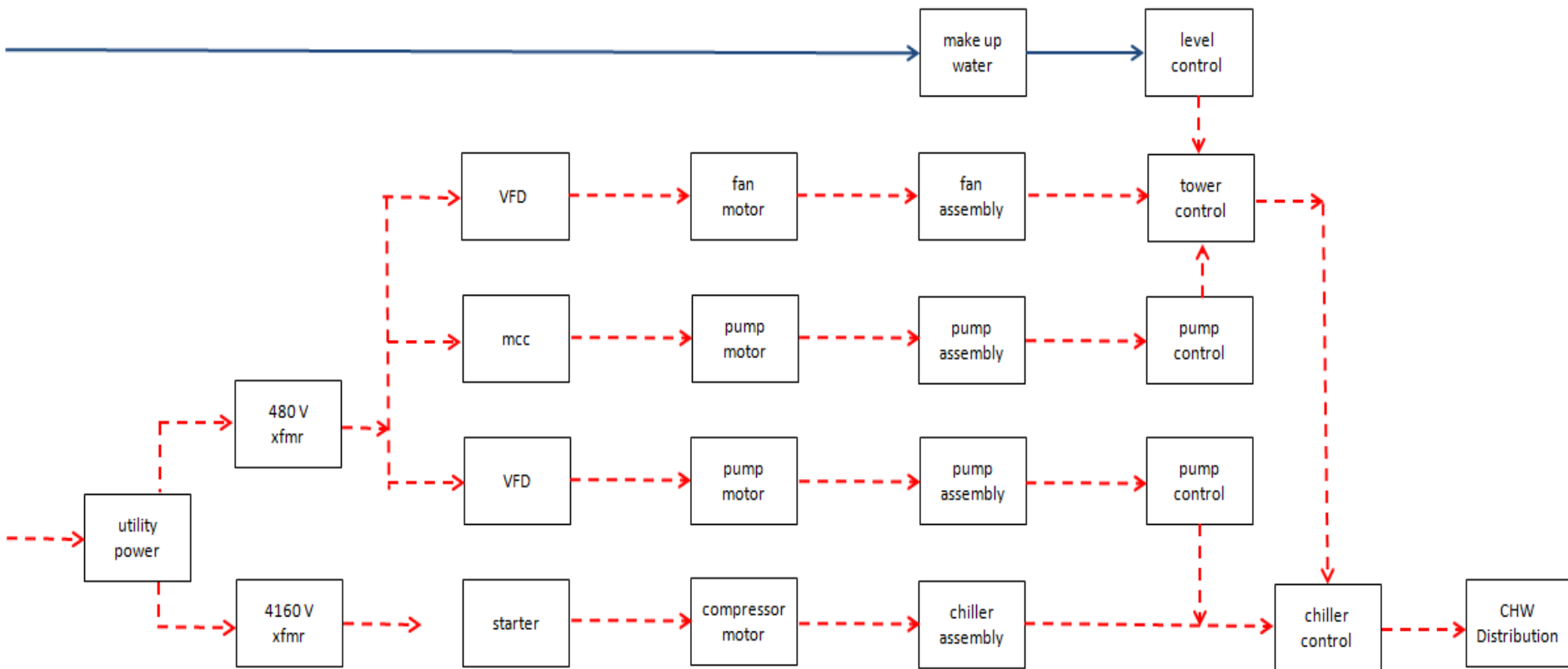




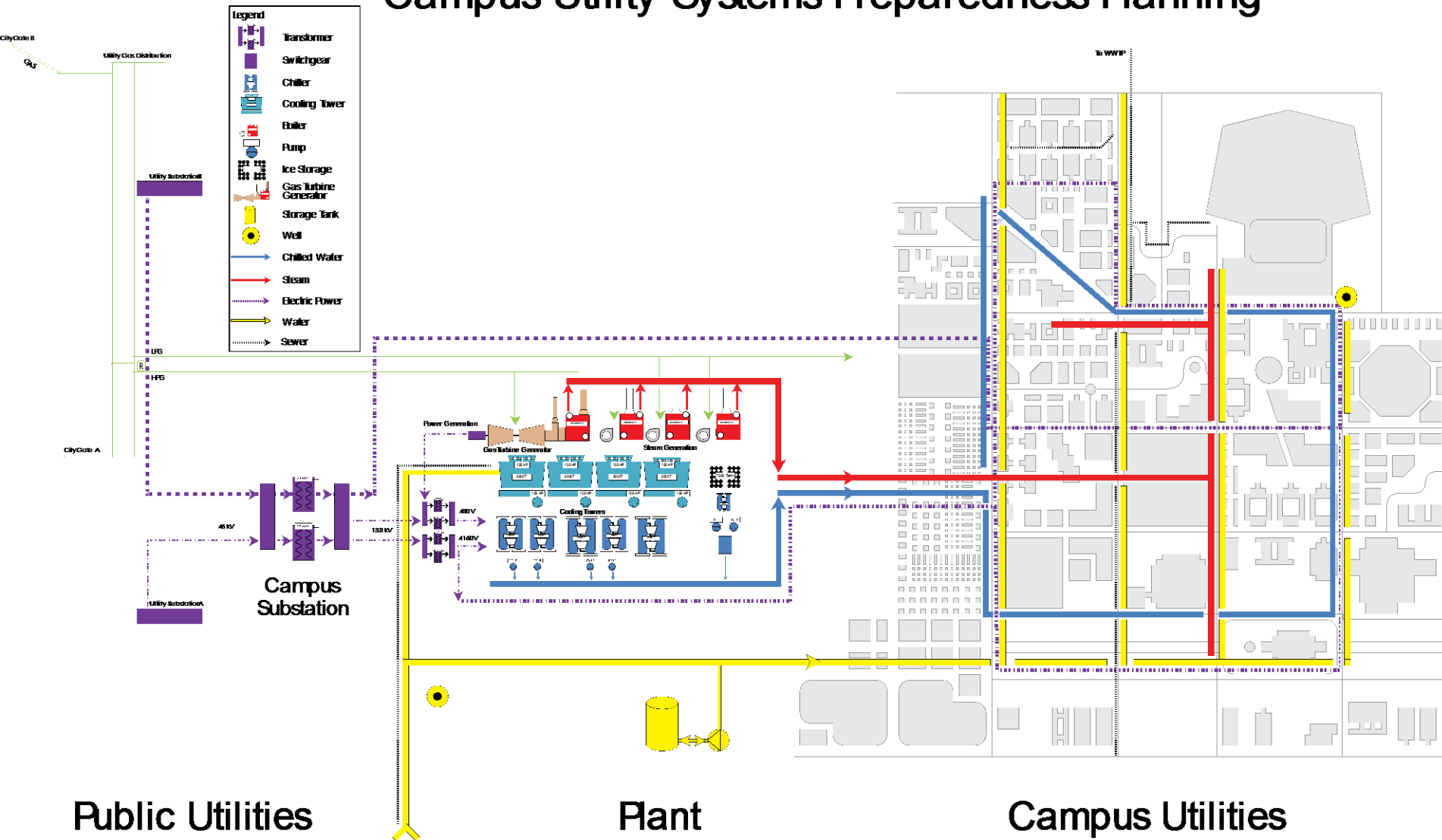
Single Chiller Plant Example



Single Chiller Plant Example



Campus Utility Systems Preparedness Planning

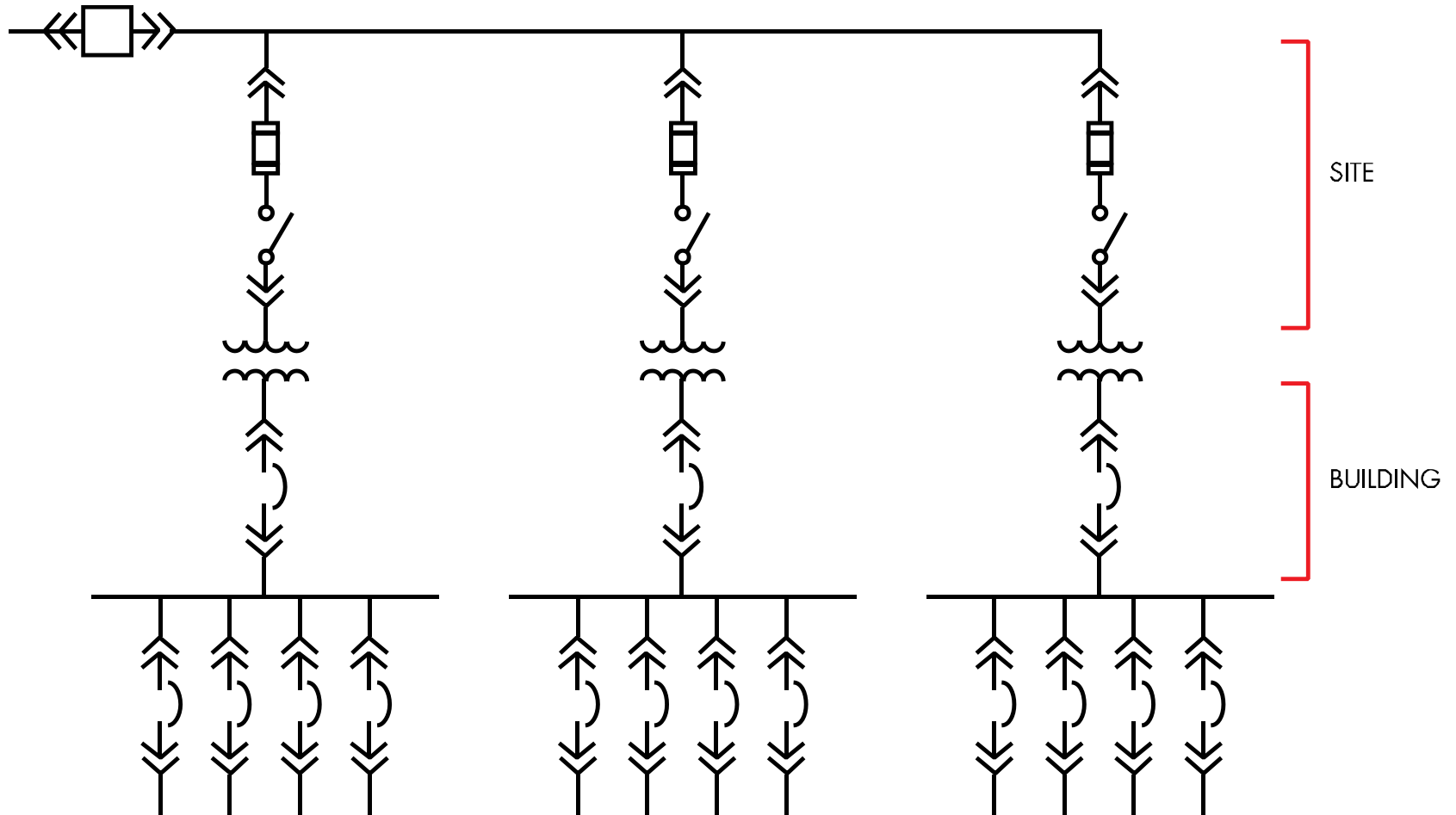


Campus Utility Preparedness

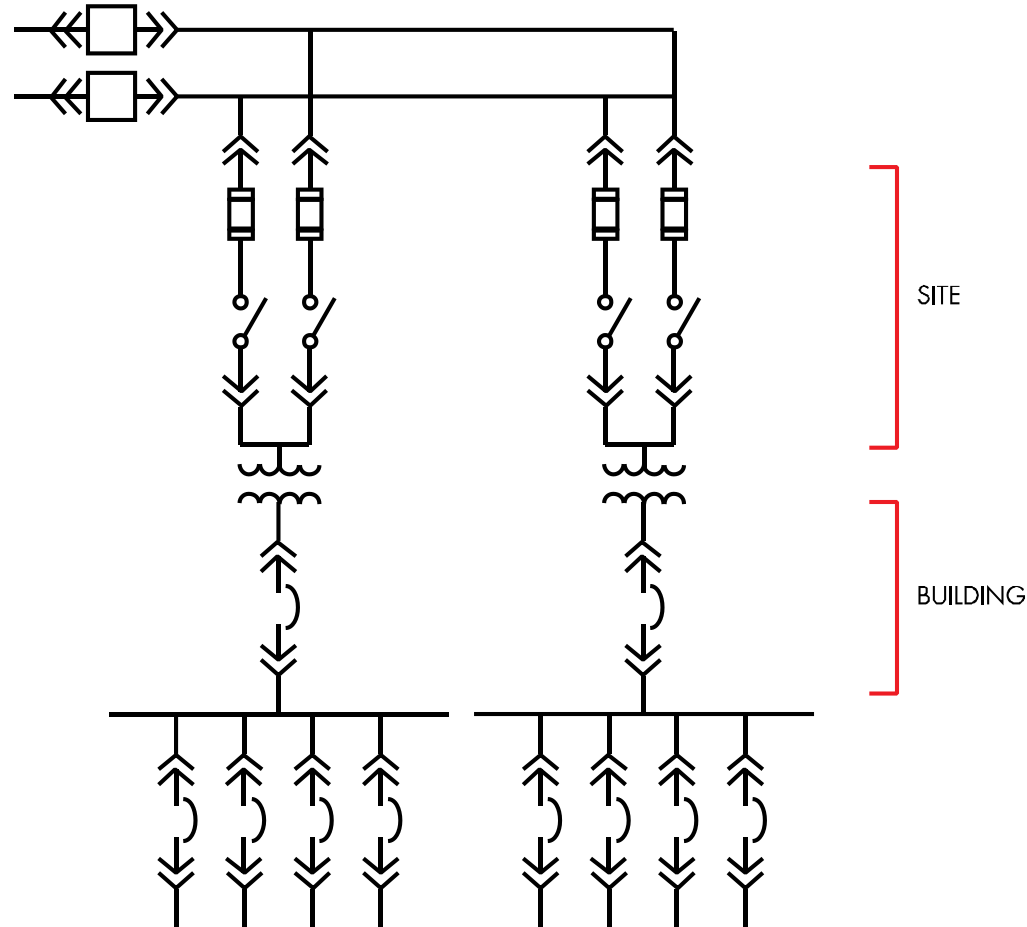
Electrical Concepts

- System Drawings
- Operational Knowledge
- Know Your Loads
 - Load priorities
 - Metering
- Spare Parts
 - Breakers
 - Electronic components
- Standby Generation

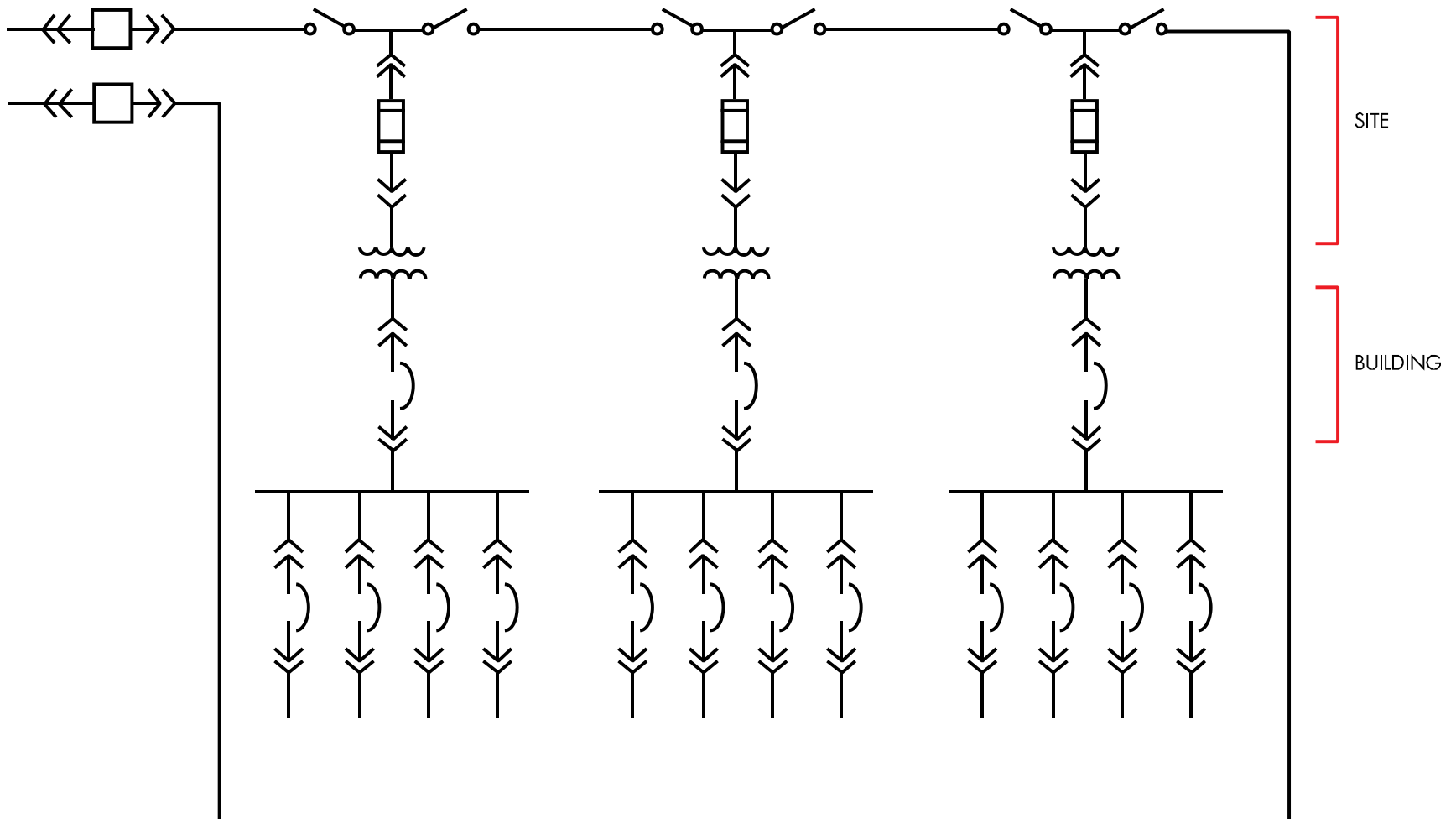
Radial System



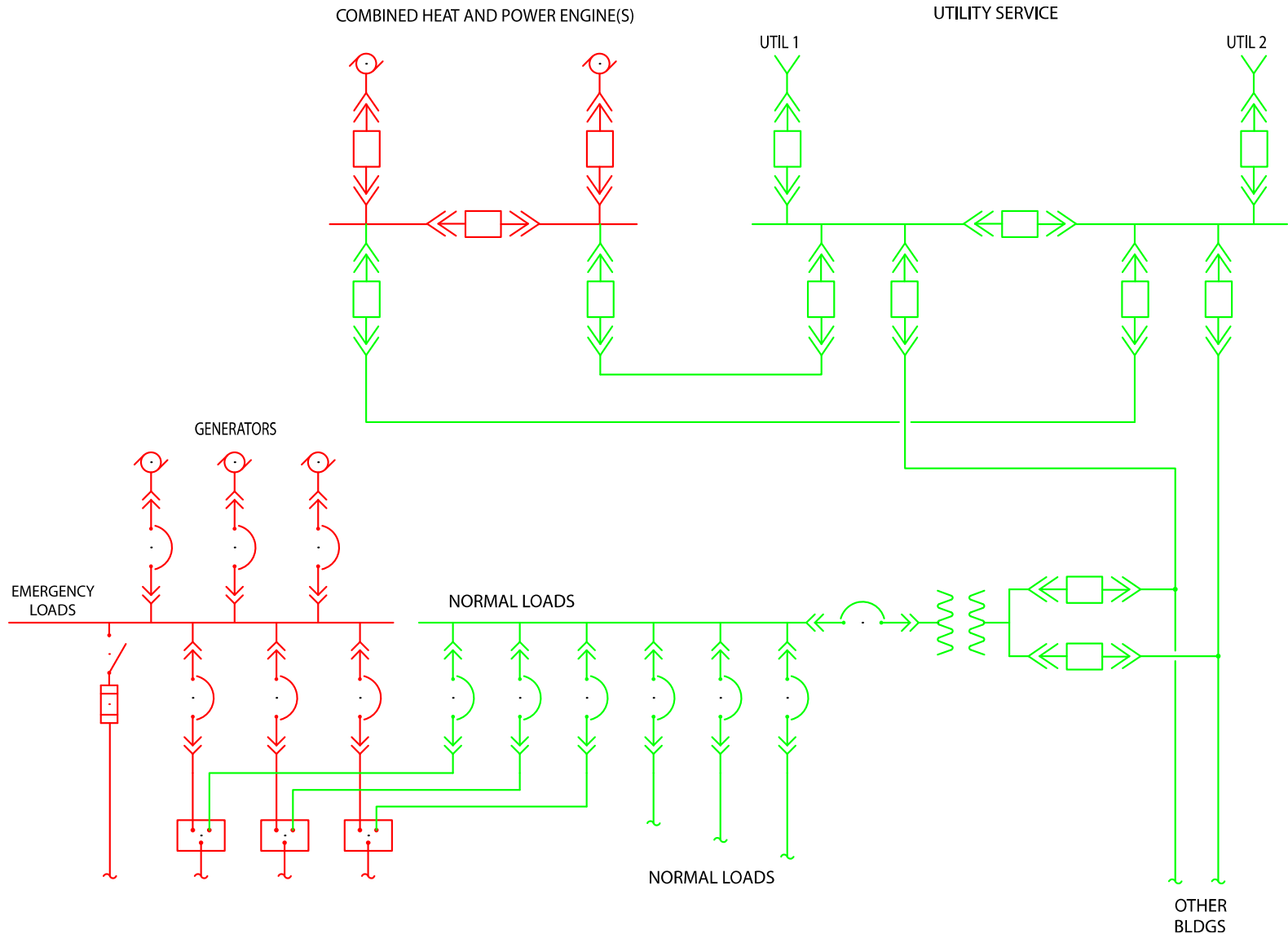
Primary Selective System



Primary Loop System



Campus Power Concept



Central Water and Sewer Concepts

Campus Utility Systems Preparedness Planning

Multiple Municipal Feeds

Networked Distribution

On-Site Production

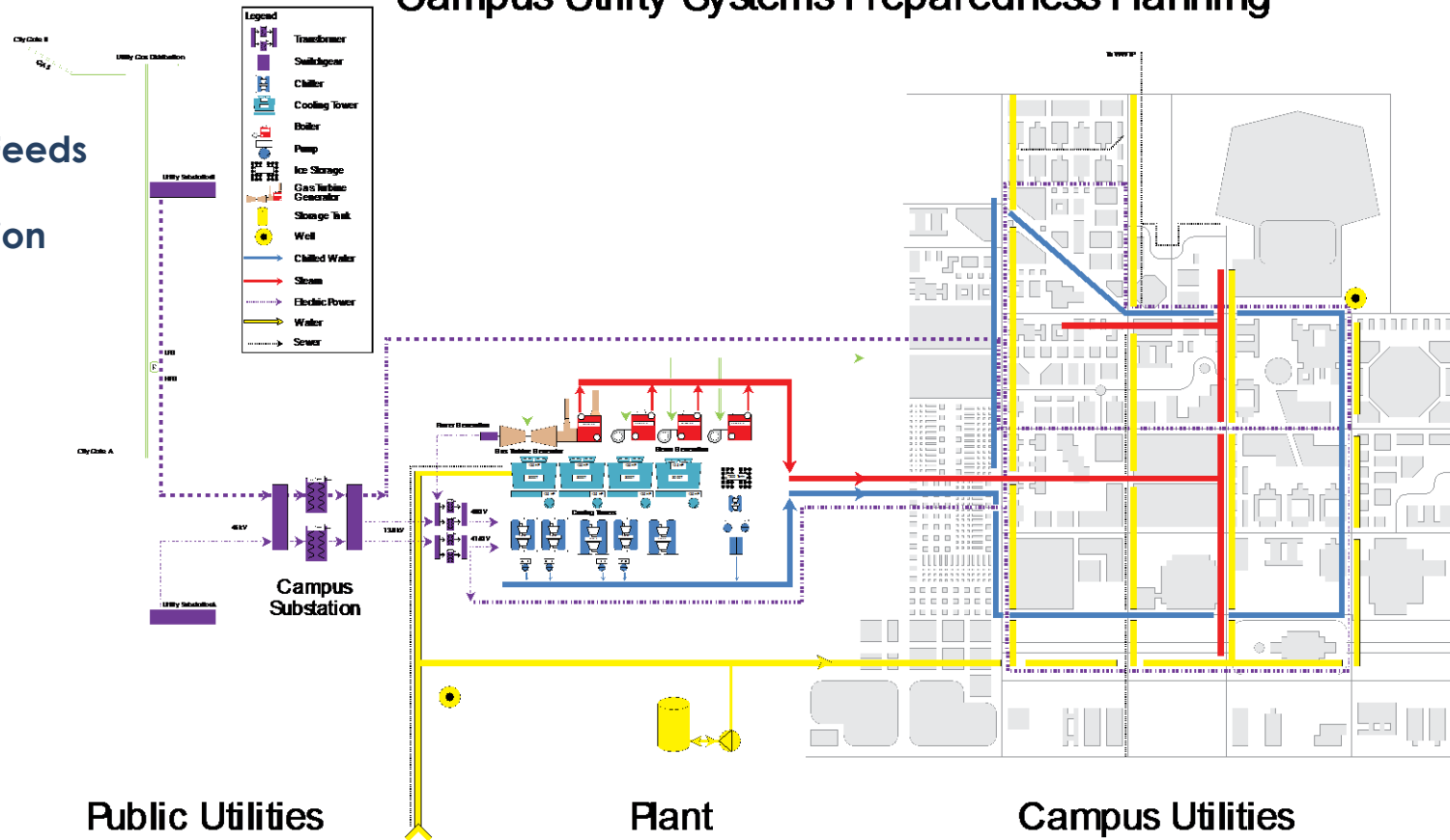
On-Site Storage

Lift Stations

Back Up Power

Bypass Pumping

EPA Table Top Tools



Central Heating and Cooling Concepts

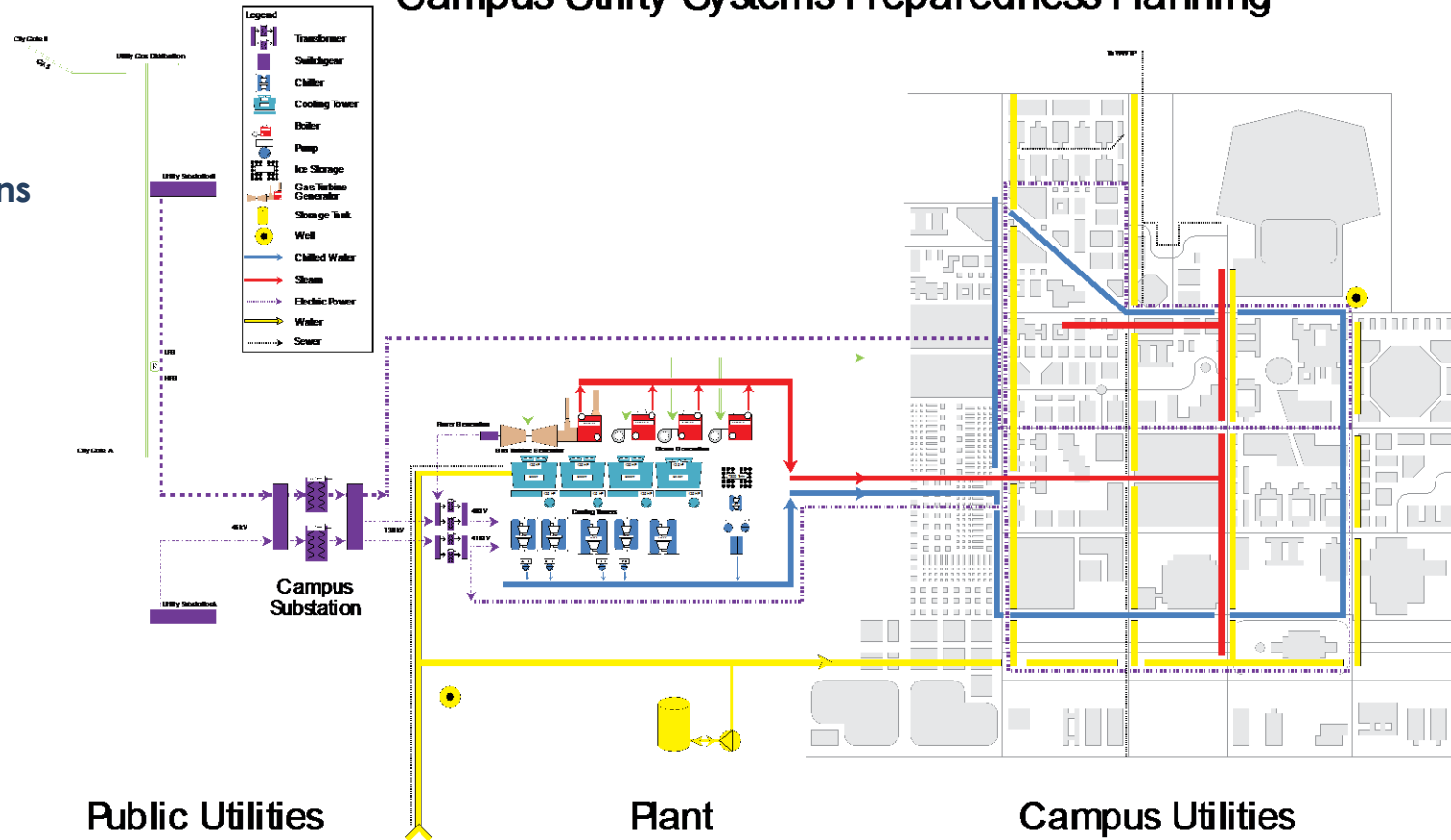
Campus Utility Systems Preparedness Planning

Parallel Process Trains

Looped Distribution

Satellite Plants

Dual Fuel Sources



Central Heating and Cooling Concepts

Parallel Process Trains

Looped Distribution

Satellite Plants

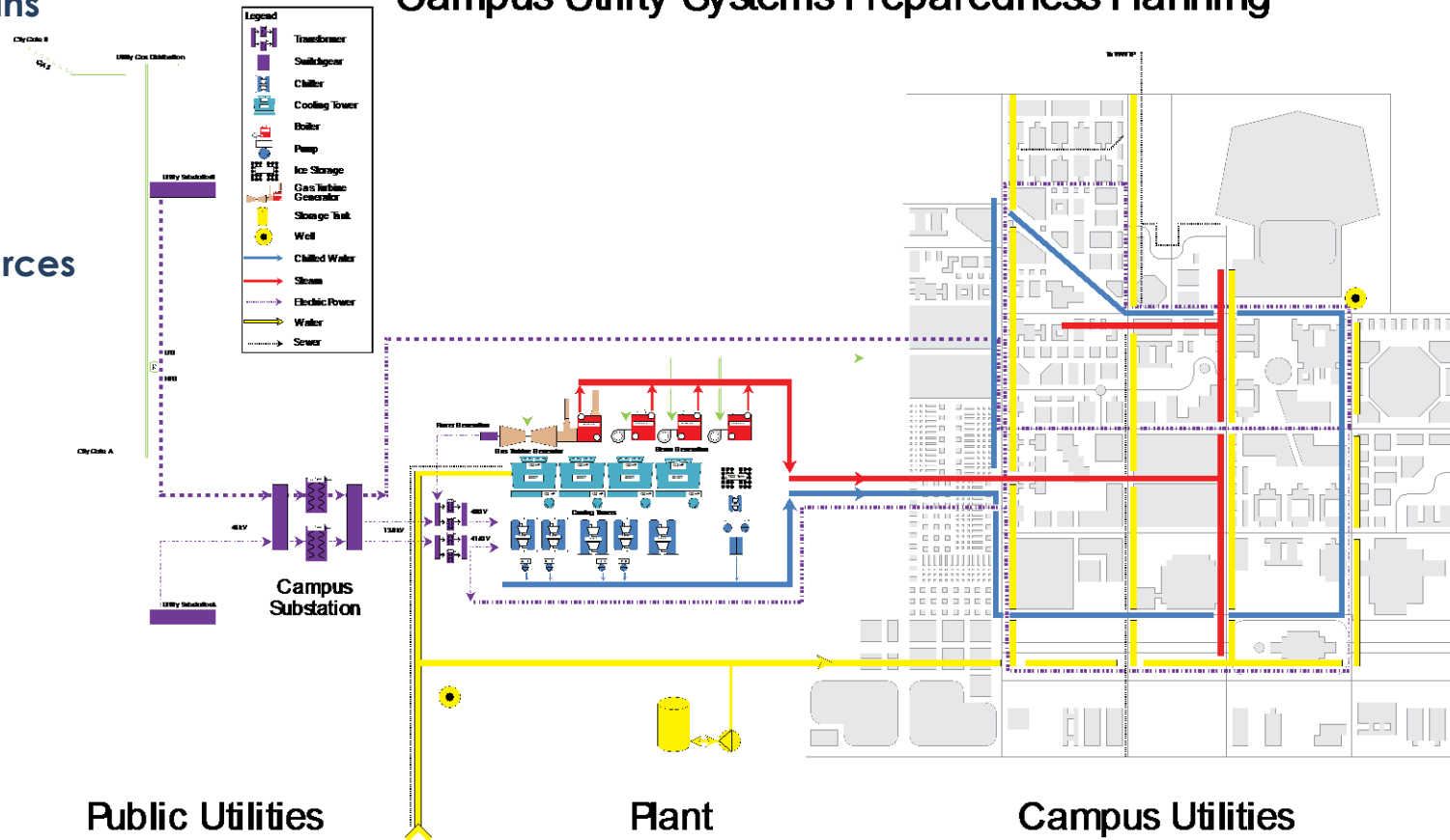
Dual Boiler Fuel Sources

Thermal Storage

Standby Water

Standby Power

Campus Utility Systems Preparedness Planning



Combined Heat and Power Concepts

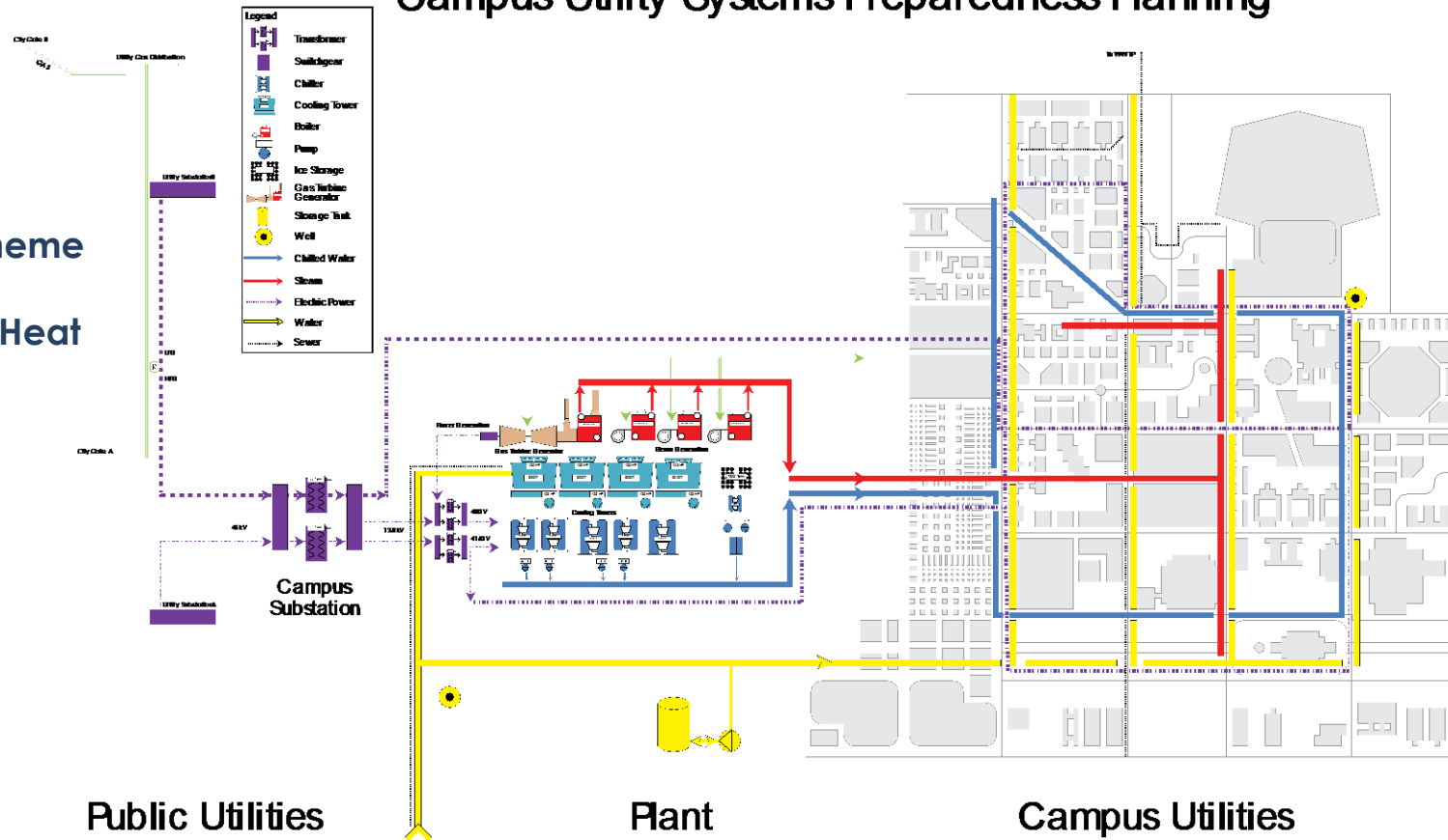
Campus Utility Systems Preparedness Planning

Island from Utility

Load Shedding Scheme

Generate Power & Heat

Dual Fuel Sources





Hurricane Sandy

Princeton University

- 4 day Public utility outage
- Load switching strategy
- Campus CHP provides 15 MW power and heat to campus
- Campus utility meets its mission
 - Establishes emergency response center
 - Offers food and shelter
 - Provides cell phone charging site



Questions?





BE PREPARED



ARCHITECTS & ENGINEERS, INC