Station Service Generators

Southwestern Federal Hydropower Council

Dewey Short Visitor Center

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US Army Corps of Engineers
BUILDING STRONG®

Outline

- Station Service System Definition
- Components of a Station Service System
- System Design Criteria
- Typical Station Service Configurations
- Station Service Generators
  - Benefits
  - Potential Rehab Items
- Alternative Sources
- Summary

Station Service System

- A station service system …
  - Is the electrical distribution system within the power plant
  - Provides power to run the plant
  - Is essential to plant operation
  - Includes a variety of components

Station Service Components

- Power Supplies
  - Internal – Main generator, Station Service generator, Diesel Generator
  - External – Transmission system
- Power distribution equipment
  - Transformers
  - Switchgear
  - Motor control centers
  - Cable, bus, and wire
  - Controls and relays

Station Service Loads

- Powerhouse Loads
  - Unit Auxiliary Equipment
    - Pump motors – governor, bearing oil, cooling water, unwatering, etc.
  - Loads common to all units
    - Battery chargers, HVAC, cranes, hoists, elevators, air compressors, lights and power, security and controls systems, etc.
- Non-powerhouse loads:
  - Switchyard, spillway, navigation locks, recreational facilities, visitor centers

SS Generator and Governor

SS Transformer & Switchgear

Station Service Diesel Generator

SS Motor Control Centers

Station Service Design Criteria

- Primary Design Goals:
  - High Reliability
    - Multiple independent sources
    - No single point of failure
  - Adequate Capacity
  - Redundant service for critical loads, including automatic switching

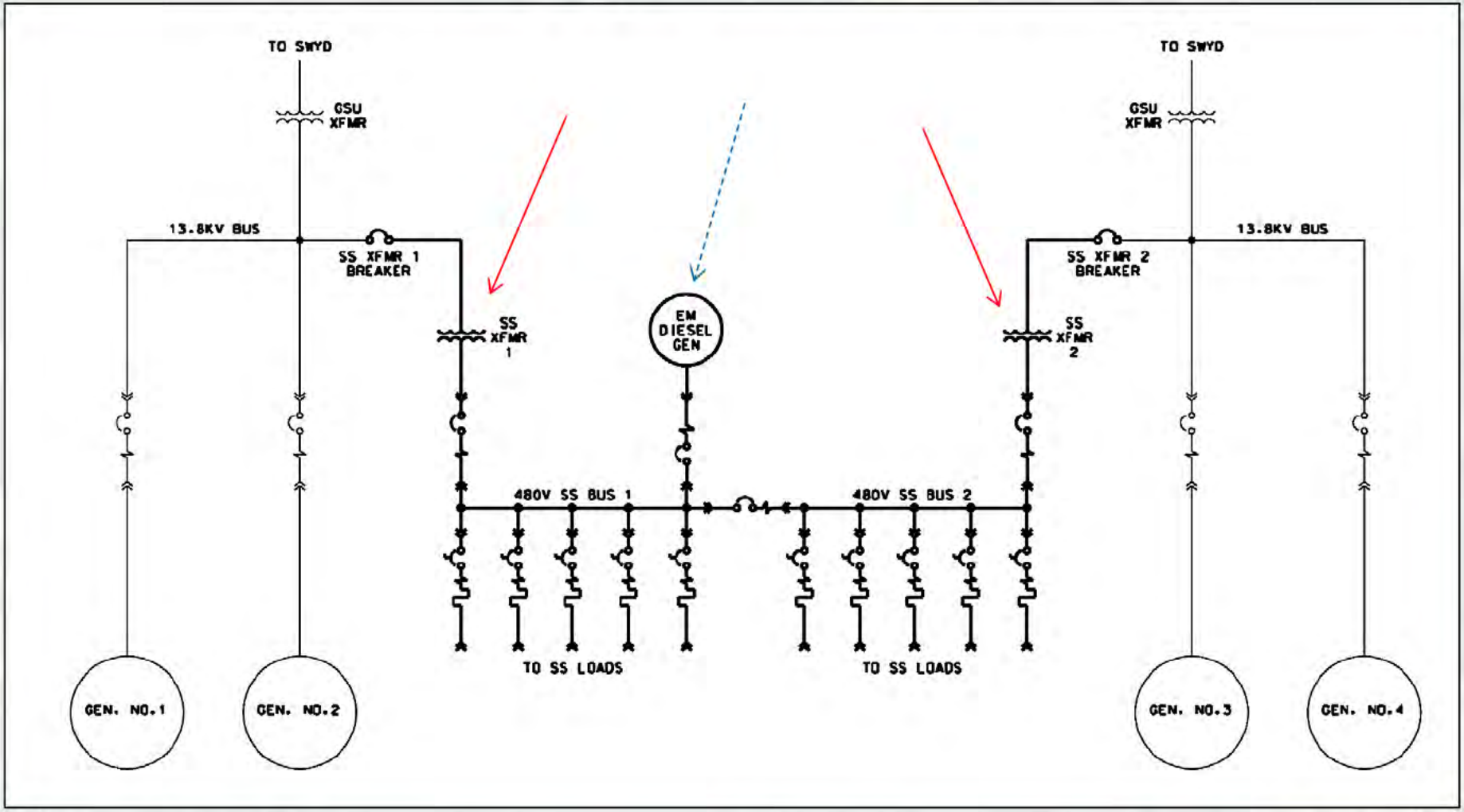
Application of Design Criteria

- Large Plant – 3 full capacity sources
  - Line-fed SS Transformer
  - Main Unit fed SS Transformer
  - SS Generator(s)
  - Diesel Generator (usually not designed for continuous duty, may not be full capacity)
- Smaller Plants – 2 full capacity sources with 1 reduced capacity source

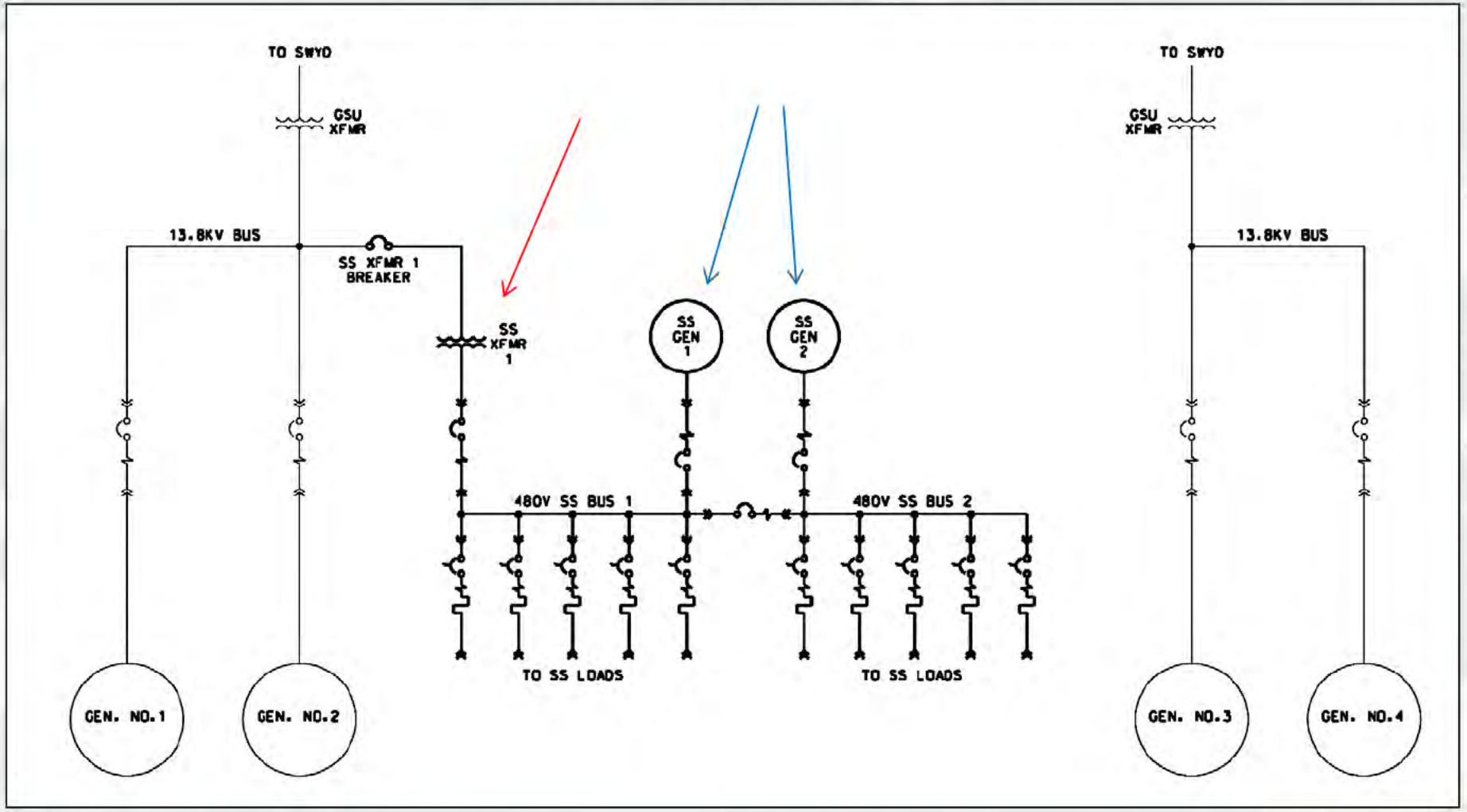
Typical Configurations

- Two station service transformers and back-up diesel generator
- One station service transformer and two SS generators
- One station service transformer with selectable supplies and one SS generator
- One station service transformer and one back-up diesel generator

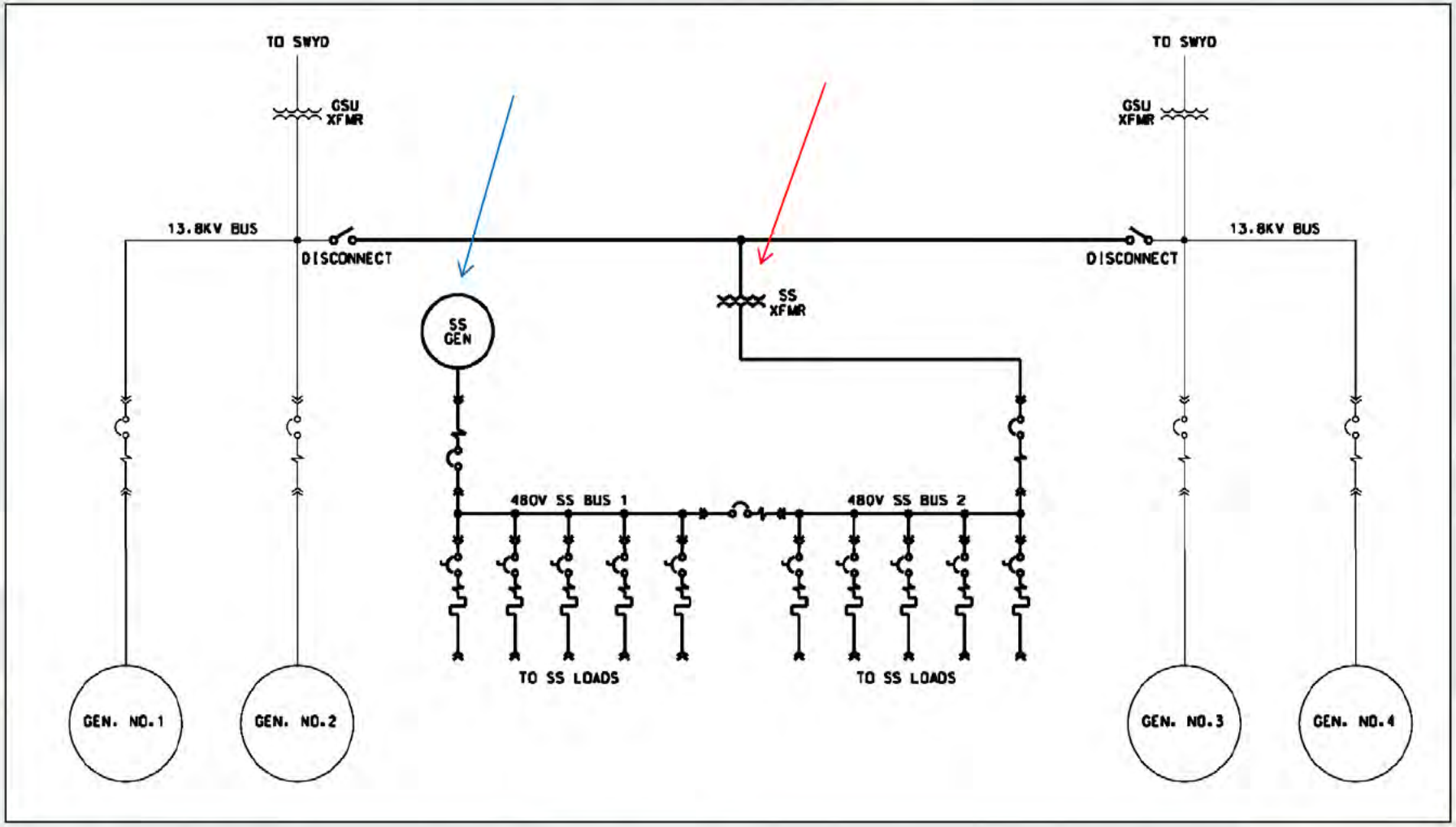
Two SS Transformers and One Back-up Diesel Generator



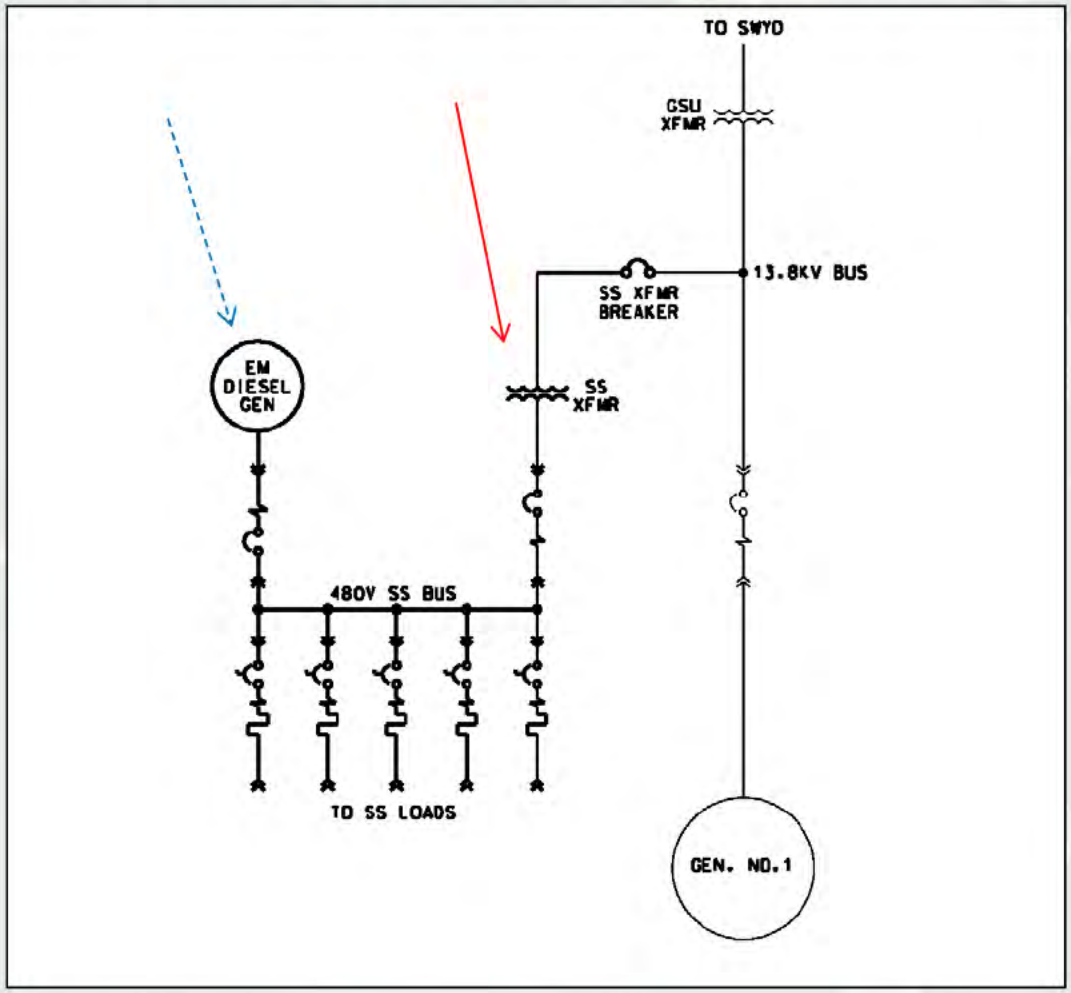
One SS Transformer and Two SS Generators



One SS Transformer and One SS Generator



One SS Transformer and One Back-up Diesel Generator



Station Service Generator

- Complete small hydro-electric generator
- Operates independently of
  - Main units
  - External power system
- Benefits of main unit in a smaller package
  - Good load control
  - Good voltage/reactive power control
  - Can operate continuously
  - “Free” fuel
  - Better able to operate with small loads

Benefits of SS Generator

- Provides flexibility in station service operation
  - Operation not dependent on external power system - does not need to be on the grid
    - Black start capable
  - Able to carry all of the station service load
  - Typically on-line and carrying load,
    - if not, starting reliability higher than other choices
  - Renewable energy source

Rehabilitation of SS Turbine-Generator

- Possible items for a SS generator rehab
  - Turbine runner, wicket gates, stay vanes, and water passages
  - Thrust and guide bearings
  - Mechanical portions of governor
  - Rewind the generator
  - Replace excitation system
  - Installation of digital governor controls
  - Replace generator bus and switchgear

Rehabilitation of SS Generator

SS Generator Output Cables

Scroll case and wicket gates

Alternatives to SS Generator

- Back-up diesel generator
- Another SS transformer
- Considerations
  - Operational concerns
    - equivalent reliability, availability, and capacity
    - continuity of service to load
  - Physical space for installing equipment
  - Electrical Connectivity
  - Maintenance
  - Environmental

Considerations for Converting to Back-up Diesel Generator

- Location for installing diesel generator
  - Outdoors, physical protection
- Routing of feeders
  - Parallel runs of large conductors
- Maintenance
  - Monthly testing (need load bank)
- Environmental
  - Spill containment for fuel tank
- Operational
  - Inherent interruption in power supply

Considerations for Converting to Back-up Diesel Generator

Considerations for Adding Another SS Transformer

- Real estate for additional equipment
  - SS Transformer and oil containment
  - Generator bus tap, current limiting reactor, disconnects and/or switchgear
- Routing of additional bus/cables
- High initial cost
- Availability depends on connectivity
  - Unit vs. transmission system

Considerations for Adding Another SS Transformer

Summary

- Importance of Station Service
  - Power plant operations and dam safety
- Station Service Design Philosophy
  - Multiple reliable sources
- Typical Station Service Configurations
  - Value of SS Generators
- SS Generator Rehab Scope
  - Magnitude depends on condition of unit
- Alternatives to SS Generator
  - Many considerations in addition to actual power source