Oconee Nuclear Station

Pre-Application Meeting - October 13, 2015

LAR to Support Keowee Stator Replacement

DUKE ENERGY®

Duke Participants

- Doug Phelps, Critical Systems Engineering Director, Oconee Nuclear Station
- Chris Wasik, Regulatory Affairs Manager, Oconee Nuclear Station
- Darla King, Keowee Electrical System Lead Engineer, Oconee Nuclear Station
- Boyd Shingleton, Licensing Lead Engineer for Stator LAR, Oconee Nuclear Station

Agenda

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Introduction

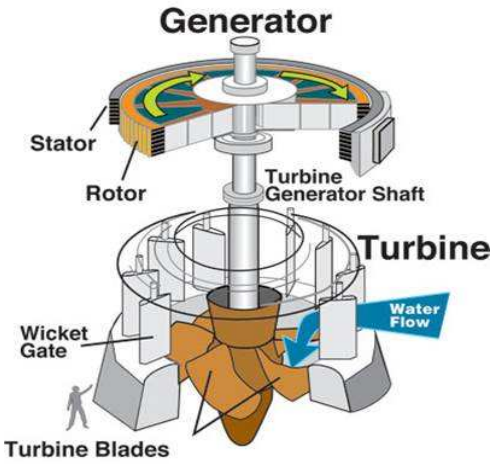
Chris Wasik

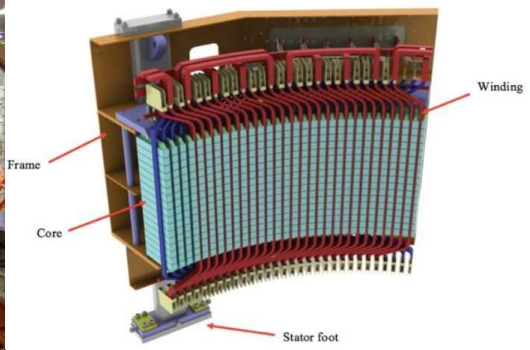
Regulatory Affairs Manager, Oconee Nuclear Station

Keowee Generator Stator Project

- Keowee Hydro Station commissioned in 1971
- 2008 - 2009 preventative maintenance inspections identified aging mechanisms in rotor pole assemblies
- 2009 Duke Energy started planning efforts to refurbish/overhaul both Keowee generators
- First phase refurbished/replaced all 56 generator field poles on each KHU
  - KHU-2 performed January 2014
  - KHU-1 performed July 2014
- Second phase is to replace stator for each KHU
  - KHU-1 scheduled January 2018
  - KHU-2 scheduled January 2019

Keowee Generator Stator Project





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Licensing Background

- NRC approved LAR for one-time extended TS Completion Time to allow KHU rotor pole rewind work on January 8, 2014
- ONS plans to request a one-time extended TS Completion Time to allow stator on each KHU to be replaced
- Similar justification will be provided for stator LAR

Proposed Technical Specification Change

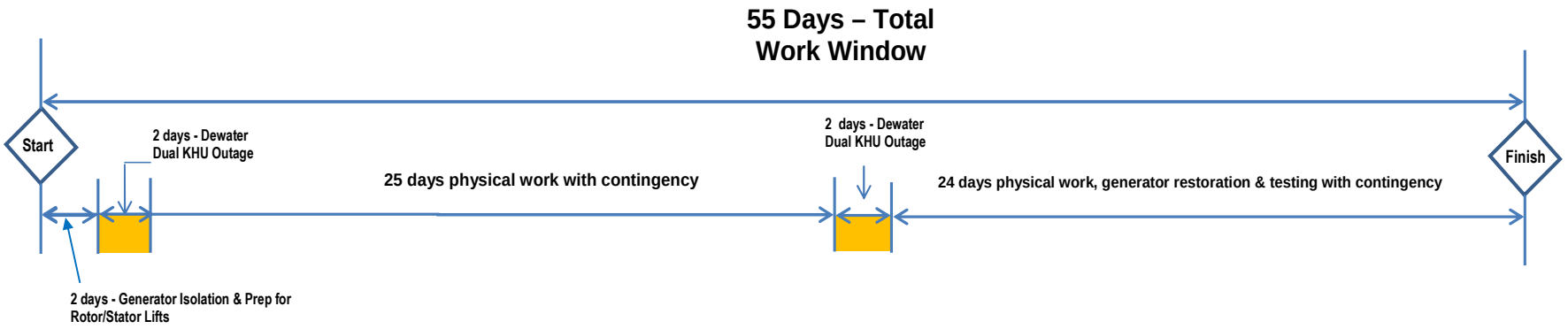
- Current TS 3.8.1 C – KHU aligned to the overhead path inoperable
  - Cumulative 45 day Completion Time to restore inoperable KHU over a 3 year period
- The License Amendment Request (LAR) will request a one-time 55 day Completion Time for each KHU to allow stator replacement

Doug Phelps

Critical Systems Engineering Director
Oconee Nuclear Station

- Implementation Strategy
  - Original strategy was a standard rewind, estimated to require a 100-120 day Technical Specification (TS) Allowed Outage Time (AOT)
  - Alternate strategy was developed based on benchmark trip
  - Benchmark plant strategy was to pre-build stator remote to unit
  - Feasibility study was conducted to determine if a pre-build strategy was viable for Keowee
  - Study concluded pre-build stator strategy was feasible and reduces the required TS AOT by ~50%
  - ONS selected option to pre-build the stator in an assembly building to minimize required TS AOT
  - As a result, the scope of the project expanded to include:
    - New Frames
    - Stator Assembly Building
    - Powerhouse Modifications
    - Heavy hauling from the assembly facility to the powerhouse and haul path evaluation

Keowee Generator Stator Outage Timeline



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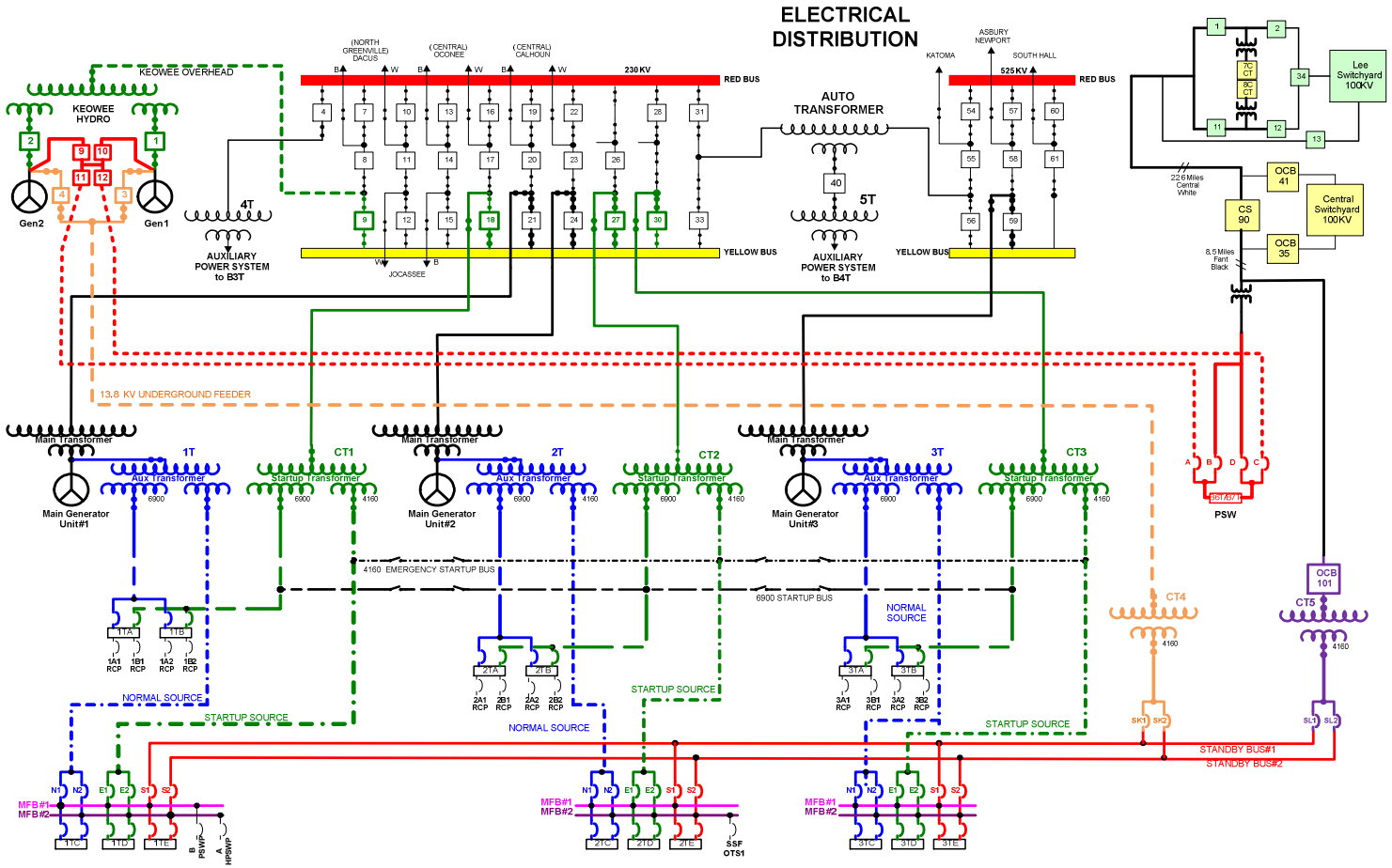
ONS Electrical Distribution System



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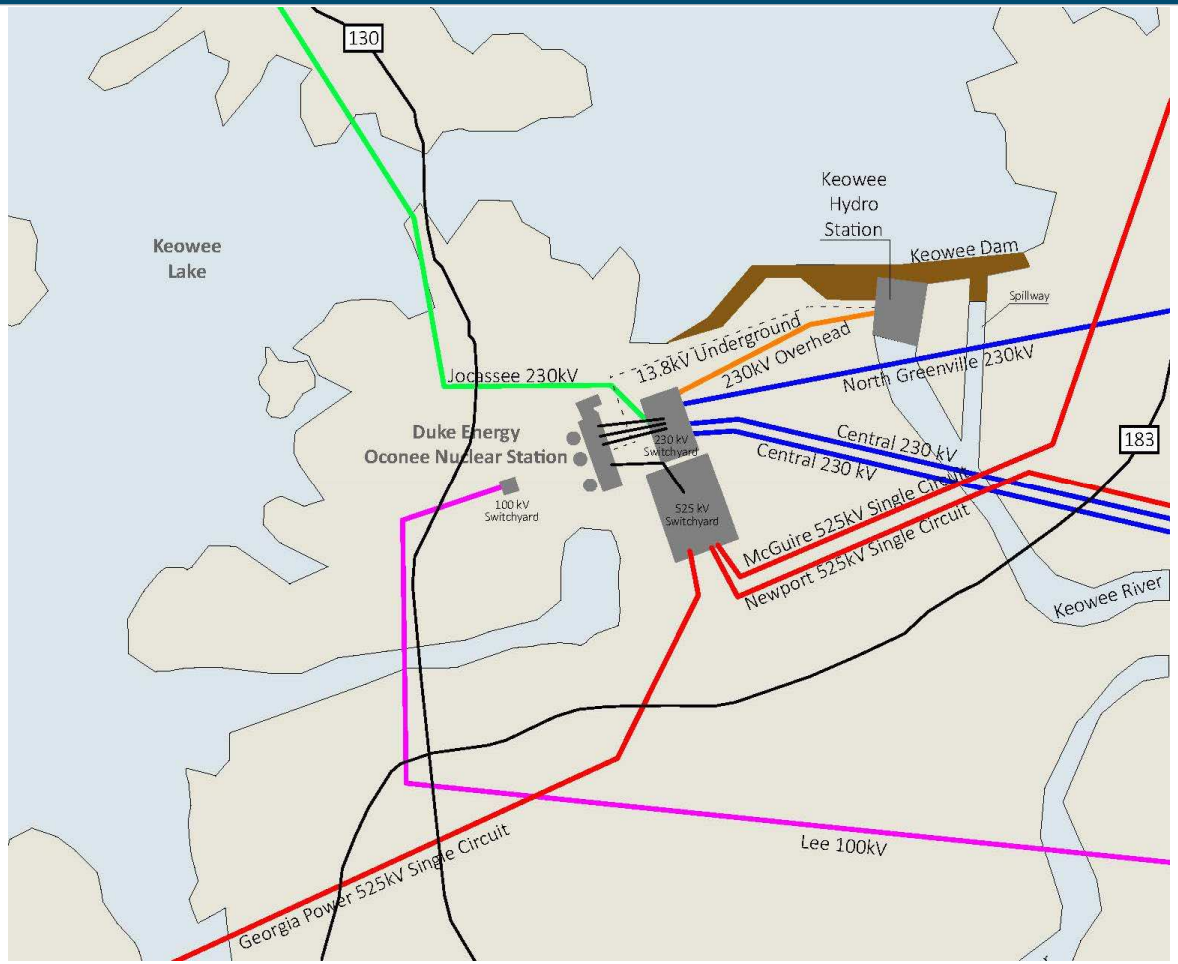
ONS Transmission Lines



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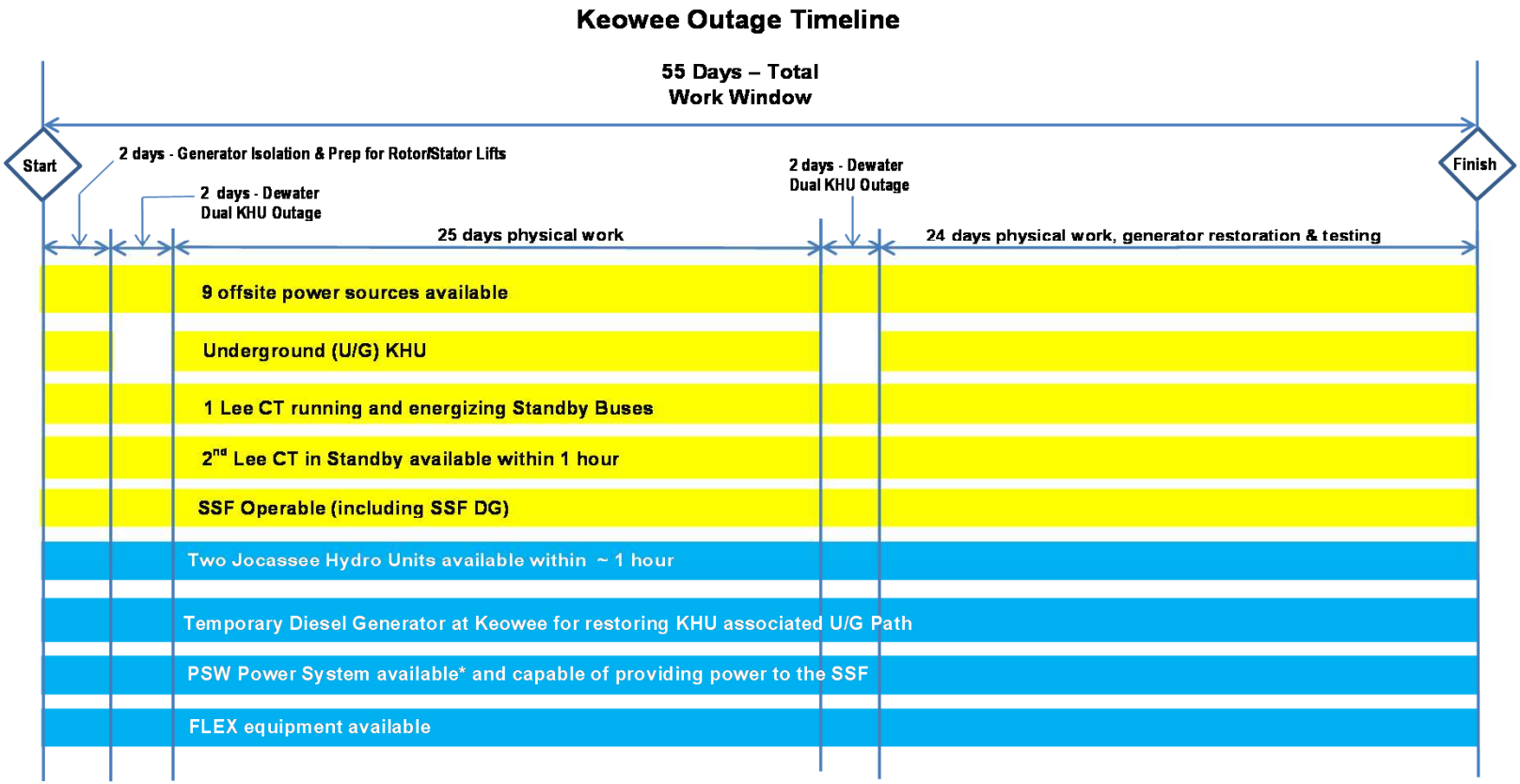
Defense-in-Depth – Multiple Diverse Backup Power Sources



*commercial power feed during dual KHU outage, Keowee or commercial power feed during single KHU outage

existing additional

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Backup Power for Emergency Power System

- Proposed LAR will credit the following backup power sources:
  - Underground Keowee Hydro Unit
  - Dedicated Lee Combustion Turbine energizing both Standby Buses during extended completion time
  - Remaining LCT available and capable of energizing the Standby Buses within one hour
  - Required offsite power sources available
  - SSF capable of mitigating SBO for at least 72 hours
  - Two dedicated Jocassee Hydro Units available either of which has capacity of powering ONS shutdown loads in approximately one hour
  - Temporary diesel generator at Keowee capable of restoring unwatered Underground KHU within 4 hours
  - PSW power system capable of powering SSF
  - FLEX equipment available

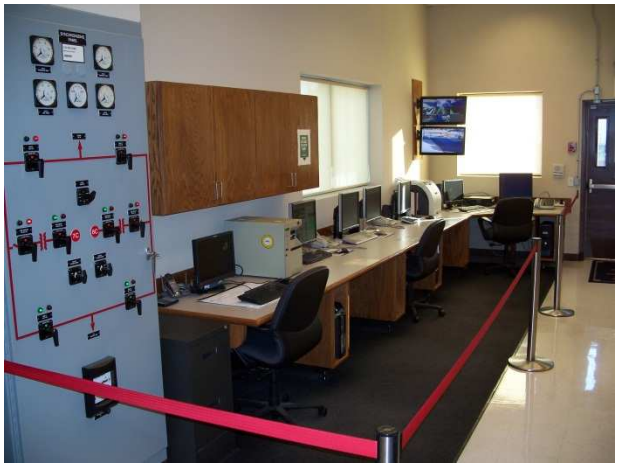
Alternate Methods of Maintaining Safe Shutdown

- The following systems/equipment can be used to maintain all three Oconee units in a safe shutdown condition:
  - SSF operable and capable of providing alternate shutdown capability
  - PSW System operable and capable of providing alternate shutdown capability
  - Turbine Driven Emergency Feedwater Pump capable of feeding steam generators
  - FLEX equipment available
- One or more of the following power sources can be used to place all three Oconee units in cold shutdown:
  - One LCT energizing ONS standby buses prior to outage start
  - Underground KHU
  - A second LCT can be started and aligned to the standby buses within one hour
  - Two Jocassee Hydro Units available, either of which can be aligned to the Oconee 230kV Yellow Bus in approximately one hour
  - Any of multiple offsite power sources

Lee Combustion Turbines

- Two LCTs (7C, 8C) available to power Oconee standby buses
- Dedicated line electrically separated from the system grid and offsite loads
- Capacity to supply ONS shutdown loads
- Routinely operated/tested, demonstrating reliability
- Black start capable, tested annually
- Included in the ONS Normal and Emergency Operating Procedures
- Verified available each shift
- Staffed continuously

Lee Combustion Turbines



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Jocassee Hydro Station

- Two of the four Jocassee Hydro Units can be separated from the grid and dedicated to ONS in approximately one hour
- Each Jocassee Hydro Station unit is rated at 195 MVA
- Two transmission lines, north of ONS, directly connect the Jocassee 230 kV switchyard to the Oconee 230 kV switchyard
- Capacity to supply ONS shutdown loads
- Routinely operated/tested, demonstrating reliability
- Black start capable, tested annually
- Included in the ONS Emergency Operating Procedures
- Verified available each shift
- Staffed continuously

Jocassee Hydro Station

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Temporary DG located at Keowee for restoring U/G KHU

- Onsite DG supplies backup power to KHS during dual KHU outage when unwatered
- Adequate capacity to restore the underground KHU
- Allows for rapid restoration of the underground KHU during loss of all power (≤ 4 hours)
- Black start capable
- Use approved Keowee operating procedures
- Operated and tested prior to outage
- Verified available each shift
- Keowee Hydro Station continuously staffed

Standby Shutdown Facility and Protected Service Water System

Standby Shutdown Facility

- Provides an alternate means to achieve and maintain the ONS units in safe shutdown conditions
- Provides additional defense in depth protection by serving as a backup to existing safety systems
- Includes a dedicated power system including a diesel generator
- Credited to mitigate Station Blackout, and other non design basis events
- Mission time is 72 hours
- Staffed continuously during dual KHU outages

Protected Service Water

- Provides an alternate means to achieve and maintain the ONS units in safe shutdown conditions
- Provides additional defense in depth protection by serving as a backup to existing safety systems
- Alternate power path to connect the SSF switchgear, with sufficient capacity to operate SSF equipment in the event of a failure of the SSF diesel generator

Risk Reduction Measures - Regulatory Commitments

Duke Energy will commit to the following:

- ONS will not start the extended single KHU outage or a dual KHU outage if severe weather conditions are forecast within the next two days.
- ONS will contact the system load dispatcher once per day to ensure no significant grid perturbations (high grid loading not able to withstand a single contingency of line or generation outage) are expected during extended TS completion time.
- ONS will avoid component testing or maintenance of safety systems and important non safety equipment in the offsite power systems that can increase the likelihood of a plant transient (unit trip) or LOOP. In addition, no discretionary switchyard maintenance will be performed.
- ONS will verify that TS required systems, subsystems, trains, components, and devices that depend on the remaining power sources are operable and preclude subsequent nondiscretionary testing or maintenance activities on these systems, subsystems, trains, components, and devices during the extended TS completion time.
- ONS will control the steam-driven emergency feedwater pump(s) as “protected” equipment during the extended TS completion time.
- ONS will continuously staff the SSF during the dual KHU outages in which the intake is de-watered.

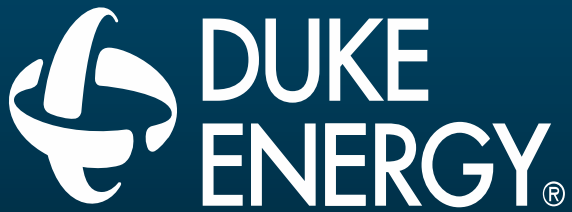
Other Risk Reduction Measures

Critical Activity Plan, approved by the Plant Operations Review Committee prior to implementation, used for risk management. Plan will include the following risk reduction measures:

- LCT and Central Switchyard protected
- 2nd LCT protected and available within one hour
- Two Jocassee Hydro Units available either of which can be aligned to the Oconee 230kV Yellow Bus in approximately one hour
- Temporary DG located at Keowee Hydro Station with capability to restore available KHU unit to operable status within 4 hours from dual KHU outage
- Reduced RCS Inventory not permitted during dual KHU outage
- PSW available to backup SSF
- FLEX equipment available

Summary

- Stator replacement is needed and will improve equipment reliability for emergency power system
  - Stator replacement outages scheduled for January 2018 and January 2019
- Additional diverse backup power sources result in electrical system defense-in-depth that provides level of protection equivalent with Branch Technical Position guidelines
- Additional risk reduction measures will be implemented and managed by critical activity plan
- Staff approval of LAR is essential to allow Duke Energy to implement KHU reliability improvements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