



# Summary of AP1000 Licensees' Response to Bulletin 2012-01

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# NRC Bulletin 2012-01: Background

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- NRC issued Bulletin 2012-01 July, 2012, in response to Byron and other industry events
- SCE&G and SNC submitted bulletin responses to NRC October 2012
- Follow-up RAI to SCE&G January 2014
- SCE&G and SNC submitted RAI responses February 2014
- All Responses developed jointly with SCE&G, SNC and Consortium



# NRC Bulletin 2012-01: AP1000 Design and Licensing

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- Offsite power has no safety-related functions and is not required for safe shutdown due to passive safety features
- Partial exemption granted to GDC-17 (only one credited offsite power circuit required)
- No Technical Specifications for offsite power availability
- Safety Related, Class 1E DC power isolated from offsite power by qualified isolation devices (battery chargers)
- Onsite AC power connected to the offsite source, including diesel backed standby power is Non-1E, or non-safety



# NRC Bulletin 2012-01: AP1000 Design and Licensing

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- Design changes enhanced detection of unacceptable voltage on Non-1E Medium Voltage buses
- Diesel backed, 'defense-in-depth,' AC busses have detection, alarm and isolation for unacceptable voltages present on any phase
- Due to design enhancements and no Tech Specs on offsite power, the design vulnerabilities from Bulletin 2012-01 have been addressed for the AP1000 design
- Several solutions are in development or new to the market (EPRI, Exelon, PCS2000, etc.)





# AP1000 GDC-17 Compliance Discussion

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- *“An onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety.”*
  - The capability of supporting safety-related structure, system, and components (SSC's) is provided through the use of the 1E DC power (IDS) without reliance upon the main ac power system (ECS).
  - Although provided by the design, availability of the ECS is not required to achieve or maintain safe shutdown.
  - The only safety-related components of the ECS are the RCP (reactor coolant pump) trip circuit breakers.
    - The safety related trip function is powered from IDS via the Protection and Monitoring System (PMS).
    - The AC power to the RCPs is not safety related.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- *“Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable.”*

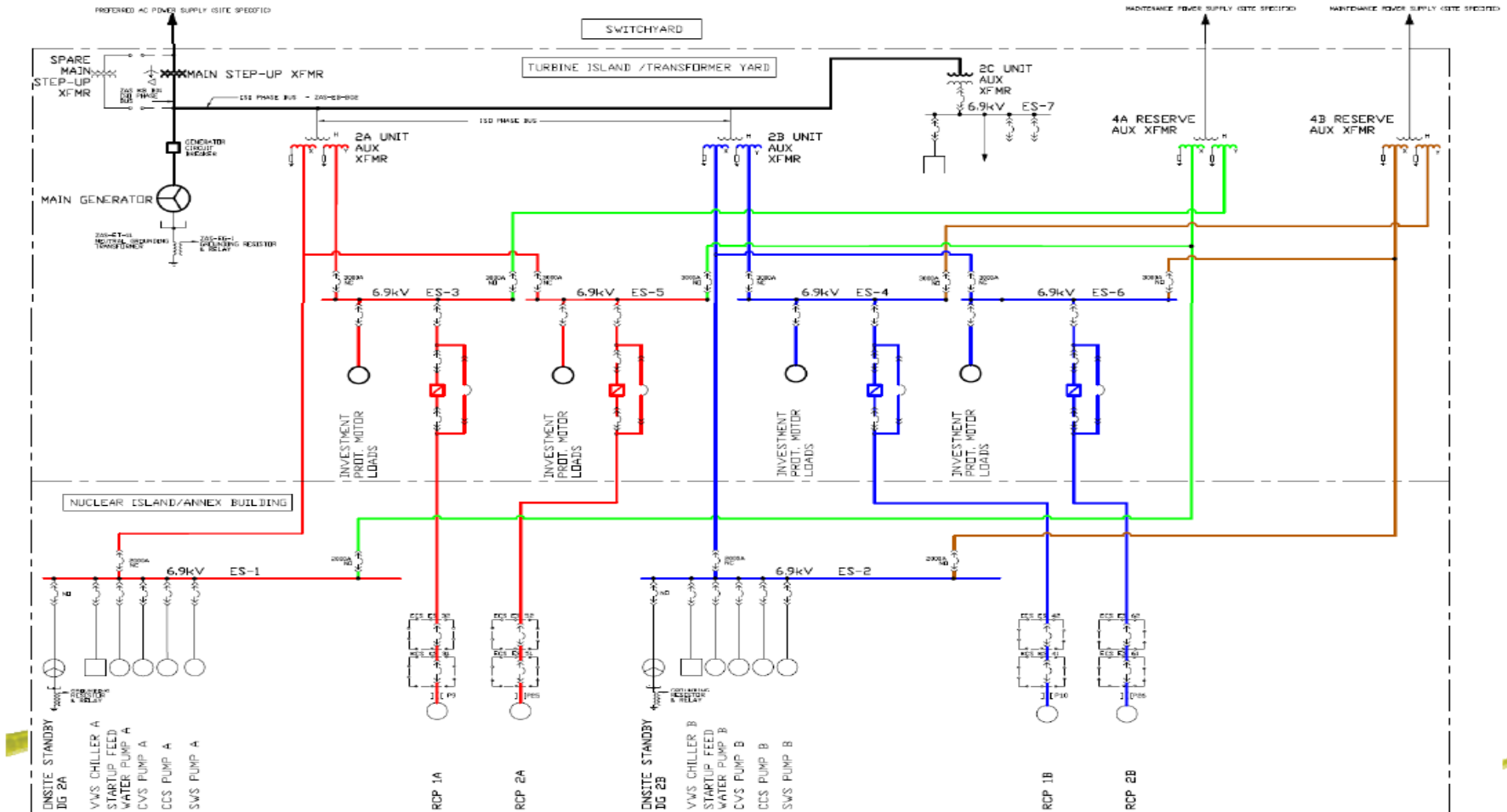
-The AP1000 design supports a partial exemption from GDC-17 for AC Offsite Power sources due to passive safety features of the AP1000 design that do not rely on power from offsite power system to accomplish safety-related functions.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

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AC POWER STATION SIMPLIFIED ONE LINE DIAGRAM





# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- *“Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies [and the other offsite electric power circuit], to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded.”*
  - The AP1000 Chapter 15 safety analysis assumes that the grid will remain stable for at least three (3) seconds following a turbine trip, assuming no electrical faults. This is demonstrated through the grid stability analysis.
  - GDC-17 preferred source does not provide safety related power.
  - Credited power for safety related SSCs is through the Class 1E DC Power System (IDS).

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- ***“One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.”***
  - The AP1000 design meets these criteria. The single offsite circuit is normally available within a few seconds.
  - The AP1000 design includes two offsite circuits; however, because only one circuit is required, the circuit does not and is not required to meet a single failure criterion or similar level of fault tolerance.
  - If all offsite circuits are lost due to a single failure, there is no impact to credited core cooling, containment integrity, and vital safety-related functions while a circuit is restored assuming a coping time of 72 hours to provide alternate PCS cooling means.
  - Additionally, provisions are included in the design to repower the PCS system pumps and PAMS cabinets plus MCR lighting and temporary cooling from the Ancillary ac diesel generators after 72 hours if power cannot be restored from an offsite circuit or from the onsite standby diesel generators.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- *“Provisions shall be included to minimize the probability of losing electric power from [any of the remaining] supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.”*
  - Grid stability shows for various scenarios that grid remains stable to meet 3 second RCP requirement (this assumes no electrical system faults, such as OPC) and that offsite power meets AP1000 interface requirements.
  - Loss of phase would be local to circuit that connects plant to the switchyard (through Generator Step Up Transformer GSU or Reserve Auxiliary Transformer RAT), not a credible fault for entire transmission network.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- Continued
  - In response to operating experience and lessons learned since the Byron event, a design modification was made to supplant existing open-delta undervoltage detection scheme with 2-out-of-2 logic, with a phase-to-ground undervoltage detection scheme.
  - ES-1 and ES-2 buses uses 3 PT's (potential transformers) on each phase.
  - An alarm is annunciated in the MCR (Main Control Room) in the event unacceptable voltage is sensed 1 out of 3 PT's on any phase.
  - Automatic electrical protection action occurs in the event unacceptable voltage is sensed by 2 out of 3 on any phase.
  - 1 PT on each phase, phase to ground detection, for buses ES-3 through ES-7.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

- Continued
  - Enhancements to onsite power design mitigate the vulnerability described in the bulletin (addition of PTs for abnormal voltage detection on all MV busses).
  - During operations, OPC would likely result in plant trip and loss of normal power supply (from generator), but detection schemes are in place to detect condition on non 1E AC system, unlike the Byron event, due to enhanced MV detection.
  - Light loading of GSU (preferred source) increases difficulty of detection, only expected during shutdown conditions. No impact on safety related equipment.

# NRC Bulletin 2012-01: AP1000 Compliance to GDC-17 Requirements

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- Continued
  - STAC requires that onsite (from at least 1 of 2 DG) and offsite power availability (UAT or RAT) is confirmed prior to entering Modes 5 and 6, and that actions are taken if one offsite power and one onsite power supply is unavailable and cannot be restored within 12 hours.
  - Licensee is required to have procedures in place to verify STAC for these conditions. No additional regulatory controls are needed to address these concerns.
  - Enhanced Open phase detection does not provide protection or reduce the probability that a failure will occur. For lightly loaded conditions where offsite power performs an investment protection function, STACs are in place to verify power source availability.

## Questions

