# Comanche Peak EDG Exciter Replacement Project Brief

February 4, 2004

# Purpose of the Meeting

- Brief NRC Staff on CPSES Safety Related EDG Exciter Replacement Project
- Discuss Digital Portions of the design and approach, including 50.59 Evaluation
- Overall Conclusions
- Questions/Answers

# Topics

- Modification Overview
  - Current System Design
  - New System Design
- New Digital Components
  - Safety-related Automatic Voltage Regulator
  - SIPROTEC Multifunctional Relay
- Approach to Digital Design and Qualification

# Modification Overview

- Current System Design
  - Portec, Static Exciter Voltage Regulator (SEVR)
    - Portec components became obsolete in 1998.
    - History of repetitive failures challenging the operability of the Diesel Generators.
    - Existing spare components are being depleted.
    - Analog system.
      - Extensive maintenance is required to maintain reliability.
      - No fault recording or diagnostic capabilities.
      - Troubleshooting is very time consuming.

# Modification Overview

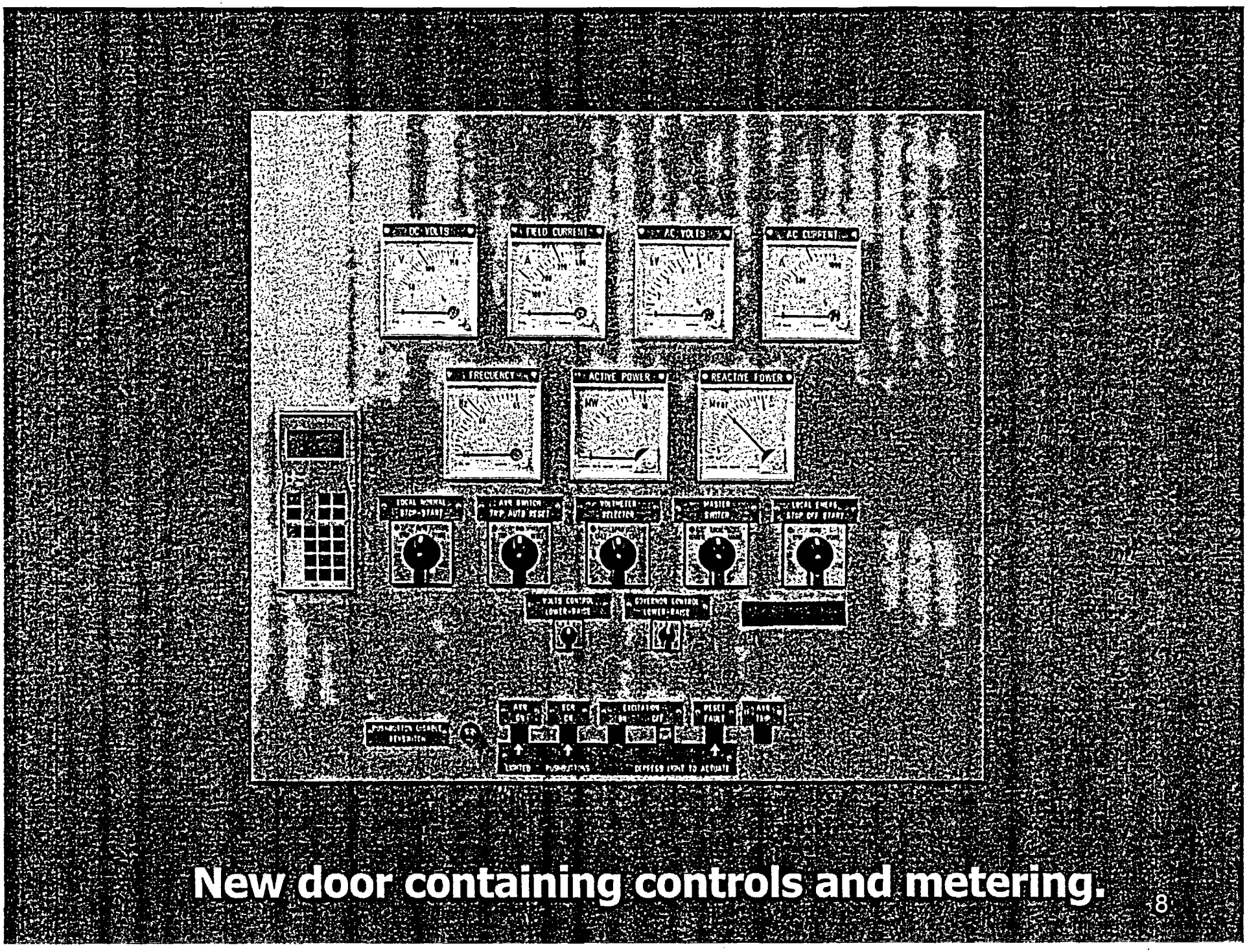
- Current System Design (cont.)
  - The current magnetics associated with the Portec SEVR system supply more power (5% to +15%) than is required therefore it is necessary to shunt away the excess power.
  - This is accomplished by SCR's controlled by the Voltage Regulator cards.
  - A characteristic of a shunt SCR system is that for most failures excitation will go extremely high resulting in a trip of the DG.

# Modification Overview

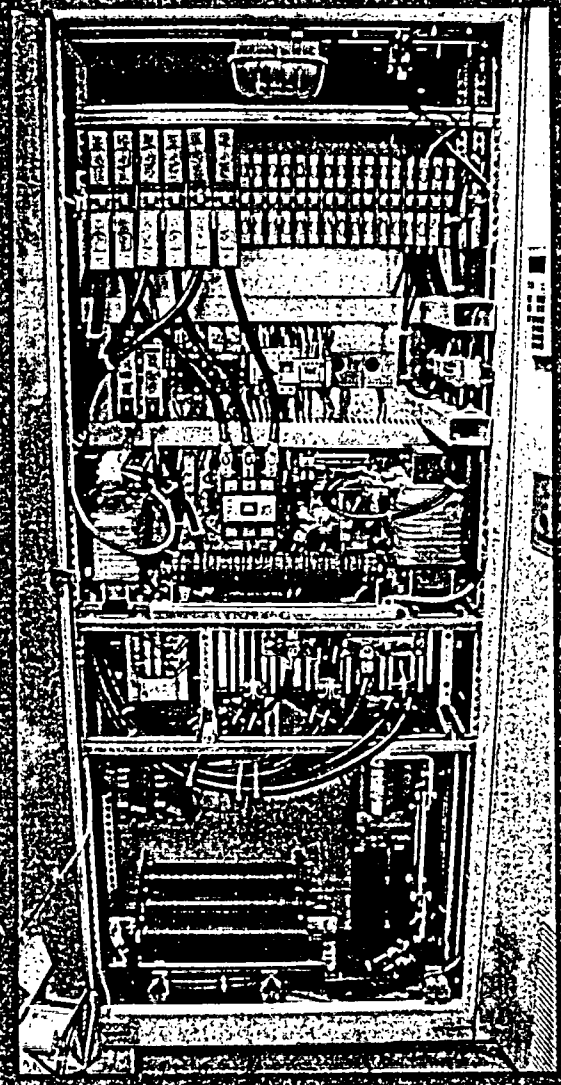
- New System Design
  - Siemens Thyripart, static compound excitation system
    - Component and engineering support through the life of the plant
    - Proven reliability
    - Digital system
      - Fail safe analog back-up via magnetic portion of system
      - Self diagnostics and fault recording
      - SIPROTEC Multifunctional relay bypassed in Emergency Mode

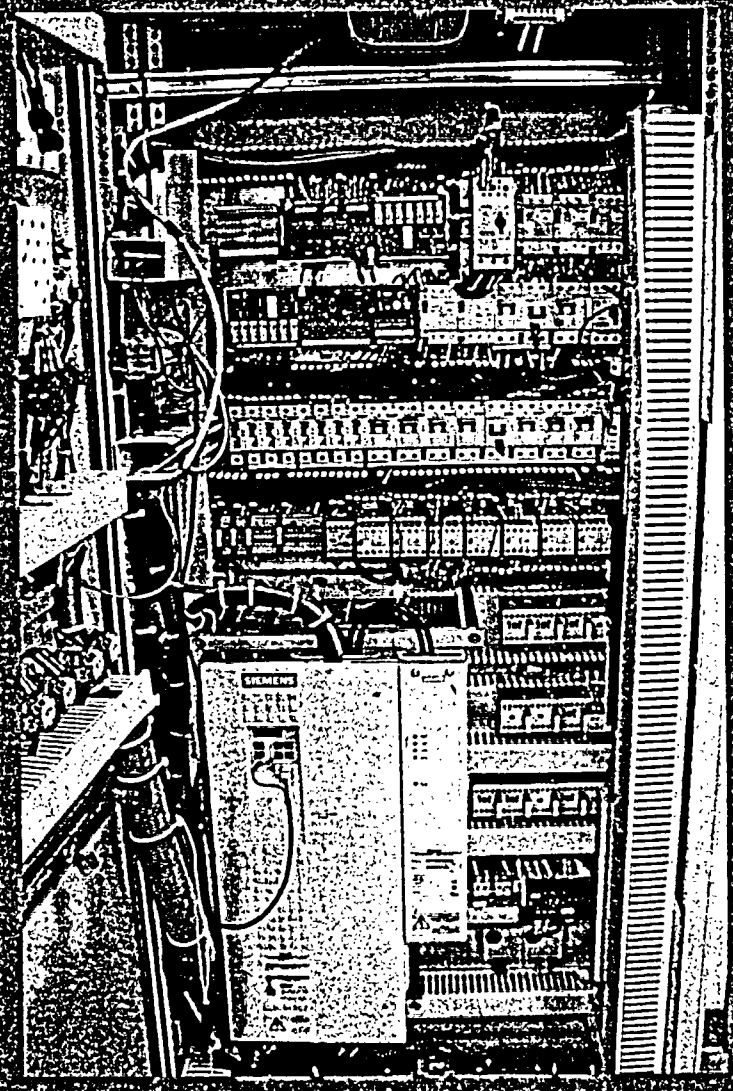
# Modification Overview

- New System Design (cont.)
  - Voltage precision achieved by the magnetics portion is approx. ± 5%.
    - Within Technical Specification requirements of >6480V and <7150V.
  - Masterdrive 'tunes' the generator voltage regulation to within ± 0.5%.
    - Boost (increase excitation)
    - Buck (decrease excitation)
  - Masterdrive output monitored with over voltage and under voltage relays to trip the Masterdrive if undesired voltage levels are sensed.

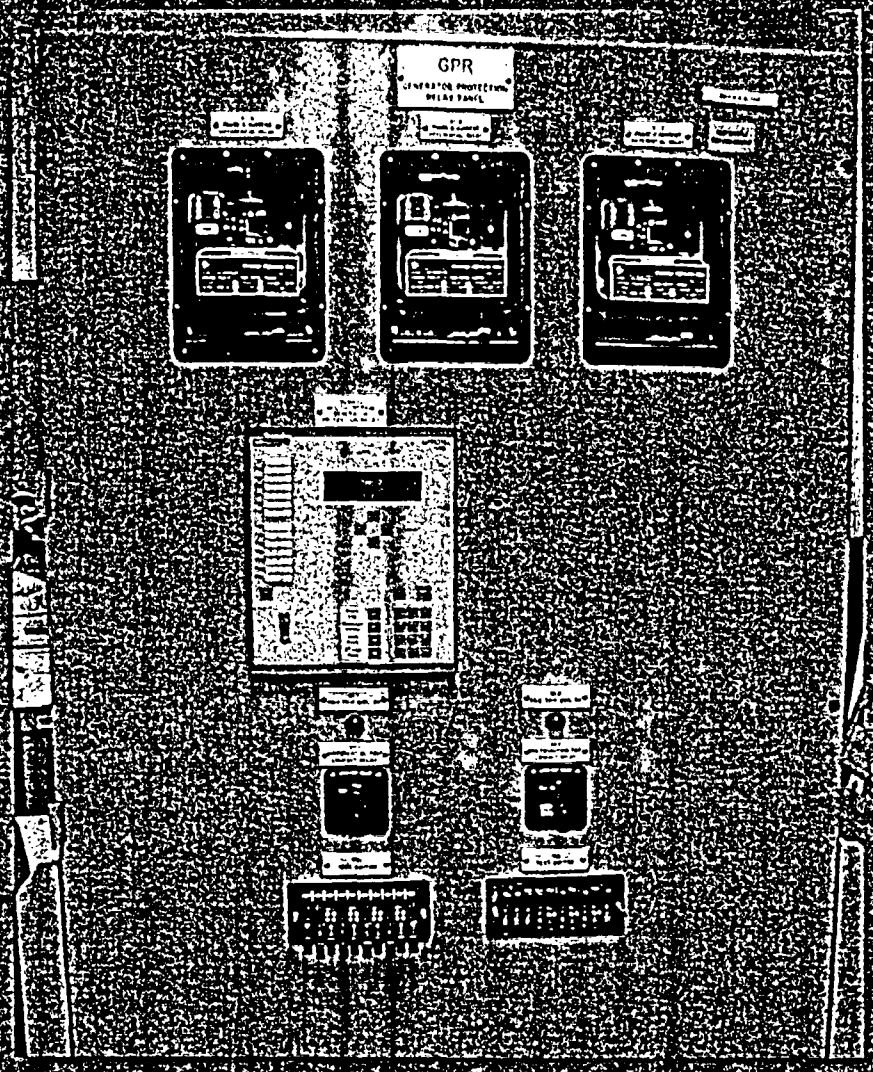



New door containing controls and metering.






# Exciter and Voltage Regulator Racks




# New Protective Relay Door.

# CGD Process for Digital AVR

- CGD of AVR part of the overall dedication of the EDG Exciter System
- Digital AVR CGD meets the requirements of IEEE 7-4.3.2 and EPRI COTS CGD Guidelines for use in Safety Related Applications
  - Commercial Grade Survey
  - Critical Characteristics
  - Qualification (seismic/environmental/EMI-RFI)
  - Unused/Unintended Functions
  - Common Mode Software Failures
  - V&V in accordance with Reg Guide 1.168 (IEEE 1012)
  - Functional Testing
  - Cyber Security Considerations
  - Design Control/Configuration Control
- Traceability matrix developed and used
- Comprehensive CGD plan, procedures and report
- Life Cycle Management Plan
  - FANP Appendix B Vendor
  - Part 21 Reporting

# Environmental & Seismic Testing

- Environmental Testing
  - Operational testing conducted under 130°F ambient temperature conditions for a period of 7 days demonstrated that equipment remained fully operable under worst-case environmental conditions.
- Seismic Testing
  - Operational test was conducted at the Trentec laboratory using the CPSES seismic spectra for the Diesel Generator Building to demonstrate that equipment remained fully operable under worst-case seismic event conditions.

# EMI/RFI Testing

- Operational EMI testing assessed equipment for emissions and susceptibility, including:
  - *low and high frequency conducted and radiated emissions*
  - *low and high frequency conducted and radiated susceptibility*
  - *Electrical Fast Transients*
  - *Surge Withstand Capability*
  - *Electro Static Discharge*
- Testing demonstrated that equipment fully met requirements of the new NRC Reg Guide 1.180; DG 1119 and EPRI TR-102323, R.1 guidelines.
- Testing demonstrated that equipment operation will not be affected by EMI/RFI; nor will equipment emit EMI/RFI which will interfere with other plant equipment operation.

# Failure Analysis

- Overall Conclusions
  - System meets single failure criterion and system reliability is at an acceptable level
  - FMEA documented
  - EDG Exciter system capable of providing excitation to the EDG under all known hardware failure condition and modes

# Failure Analysis (conti.)

- Common Mode Software Failure
  - Analysis concludes that SWCMF does not impair the Thyripart safety function and there is adequate diversity and independence for the event analyzed.
  - Diverse equipment not impaired by postulated SWCMF is available to affect the needed Reactor Trip and ESFAS Response
  - IEEE 7-4.3.2-1993, Annex F on Abnormal Conditions and Events was reviewed. The ACEs that could affect the safety functions were identified, analyzed and results documented. All postulated ACEs have been eliminated by design, or do not have any impact on system performance. No impact on safety and safety functions.

# Verification & Validation

- V&V Approach
  - V&V Plan in conformance with reg Guide 1.168 (IEEE 1012)
  - Process
    - Software Critical Functional Requirements Document
    - Software Requirements Matrix
    - Validation Test Plan/Procedure
    - Validation Tests
    - Discrepancy reporting/resolution
  - Results
    - Validation Test Reports
    - Final V&V Reports
- Summary Conclusions
  - The software meets stated requirements and does not perform any unintended functions
  - The requirements and coding documents are adequate and current

# Cyber Security Considerations

- EDG Exciter system has no external connectivity to LAN or modem, self contained system located in a vital area.
  - Strict design control, configuration control and change control process in place
  - All direct paths and indirect pathways have been analyzed
  - Password protection for parameter change functions via front panel display or via lap top connectivity
  - Communication ports for access are key locked
- FANP & Siemens Cyber Security program addresses virus checks, malicious code, user authorization, access control and network security
- Lap-top access is administratively controlled

# Design Control/Configuration Control

- Software under FANP configuration Control
  - Appendix B vendor with Part 21 responsibilities
  - Software Archiving and release per approved procedures
  - Software changes subjected to the same dedication process as original software
  - Life Cycle Mgmt for dedicated software in place
- End user functions limited to parameter changes using Station procedures

# 10CFR50.59 Evaluation

- 10CFR50.59 screening limited evaluation scope to digital design only.
- Evaluation done in accordance with NEI 01-01 ***Guideline on Licensing Digital Upgrades***.
- Evaluation addresses the 8 criteria in 50.59(c)(2)
  - No new accidents, failure modes, or malfunctions are created.
  - Prior NRC approval is not required.

# Overall Conclusions

- The dedicated commercial equipment, including the digital controller used in the Safety Related application 'CPSES EDG Exciter System Upgrade' is safe, reliable and fault tolerant. The design and qualified equipment meets regulatory requirements set forth for use of this equipment in a safety significant application.