UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

January 26, 2007

James M. Levine, Executive Vice
President, Generation
Arizona Public Service Company
P.O. Box 52034
Phoenix, AZ 85072-2034

SUBJECT: MEETING SUMMARY FOR REGULATORY ENFORCEMENT CONFERENCE

Dear Mr. Levine:

This refers to the Regulatory Conference public meeting conducted at the U.S. Nuclear Regulatory Commission (NRC) Region IV Office, Arlington, Texas, on January 16, 2007. This meeting was conducted to discuss the significance, cause, and corrective actions associated with two apparent violations involving the failure of an Emergency Diesel Generator K-1 Relay. The apparent violations can be found in NRC Inspection Report 0500258/2006012; 05000529/2006012; 05000530/2006012 (ADAMS ML0634005611). The meeting attendance list and a copy of the presentations are included as Enclosures 1 and 2. No commitments were made by the licensee during the conference.

In accordance with 10 CRR 2.390 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter and its enclosures will be available electronically for public inspection in the NRC's Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this matter, we will be pleased to discuss them with you.

Sincerely,

J. Clark

for Troy W. Pruett, Chief
Project Branch D
Division of Reactor Projects

Dockets: 50-528
50-529
50-530

Licenses: NPF-41
NPF-51
NPF -74

Enclosures:
1. Attendance Lists
2. Presentation

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Regulatory Conference	
LICENSEE/FACILITY	Arizona Public Service Company, PVNGS
DATE/TIME	January 16, 2007, 12 noon - 5 p.m. (CST)
CONFERENCE LOCATION	NRC Region IV, Training Conference Room, Arlington Tx
EA NUMBER	06-298

LICENSEE REPRESENTATIVES		
NAME (PLEASE PRINT)	ORGANIZATION	TITLE
Scott Bauer	APS-Regulatory Aff.	Dept Leader
Dwayne Carnes	APS-Nuc. Assurance	Director
Randy Edington	V	Visitor
Jim Levine	APS	Exec. VP, Gen.
Cliff Eubanks	APS	VP, Nuclear Operations
MARK HYPSE	APS	SL ENG DEPT
Gerald Sowers	APS	SL PRA

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PUBLIC

NAME (PLEASE PRINT)	ORGANIZATION	TITLE
VICTOR DRICKS	NRC	PUBLIC AFFAIRS
Gregory Werner	NRC	Senior Project Eng.
Geoff Cook	Southern Calif Edison	Project Manager
William B. Jones	NRC	Chief, Engineering Branch 1
Mark Sitek	NRC	TSS Team leader
MARK HAIRE	NRC	ACES ENFORC. SPEC.
BRIAN CORRELL	NRC	DRS
Scott Rutenkroger	NRC	Reactor Inspector
Eduardo Uribe	NRC	Reactor Inspector
Matthew R. Young	NRC	Reactor Inspector
Mike Chambers	NRC	Proj. Eng.

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LICENSEE REPRESENTATIVES

NAME (PLEASE PRINT)	ORGANIZATION	TITLE
Brian Ramey	Palo Verde NGS - Engr	Maint Engr Dept Ldr.
GEORGE ANDREWS	PALO VERDE NGS – ENG'G	SYSTEM ENG'G DEPT LDR.
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Doug Withers	Palo Verde - ENG	Sr MAINT. ENG
Harvey Leake	Palo Verde - Eng	Sr Consulting Eng.
MARK HILEST	PALO VERDE – PRA	SR PRA ENGR
Bianca West	Palo Verde - Eng	Engineer I

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NRC REPRESENTATIVES

NAME (PLEASE PRINT)	ORGANIZATION	TITLE
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Art Howell	NRC RIV	DIRECTOR, DRP
TROY PRUETT	RIV	Branch Chief, DRP
BRUCE MALLETT	RIV	RA
Mike Hay	RIV	DRP/BC
Greg Warnick	RIV	DRP/SRI PV
Michael Runyan	RIV	SRA
John Holmes	APS	Section Leader
Michael Bloodgood	NRC	DRP/Reactor Engineer

PALO VERDE REGULATORY CONFERENCE

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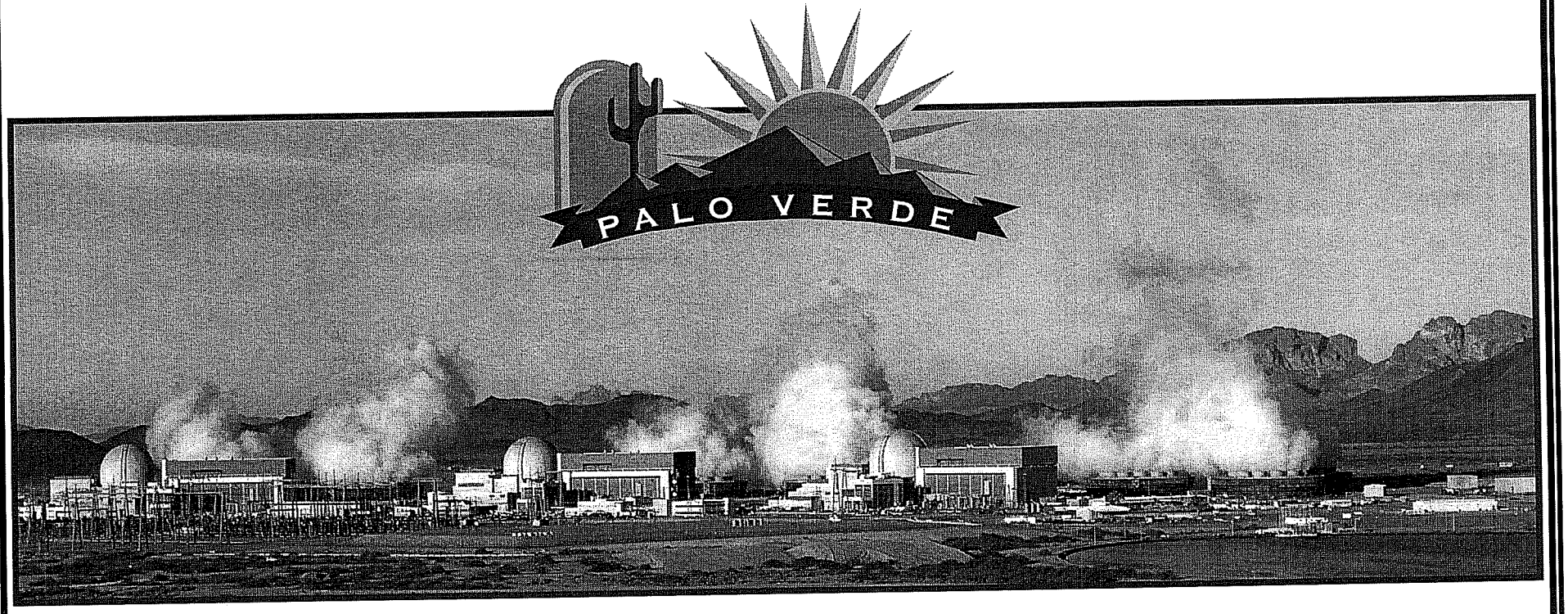
Cynthia			

Attention: Michael Bloodgood

FROM: Mike Markley

SUBJECT: Headquarters Attendees

Enclosure 2



NRC Regulatory Conference
January 16, 2007

Assessment Of
PVNGS Emergency Diesel Generator 3A
K1 Relay Failure

Introduction

David Mauldin

Vice President,

Nuclear Engineering

Agenda

♦ Introduction	David Mauldin
♦ Demonstration	John Holmes
♦ EDG 3A K1 Relay Failure Risk Significance	Gerald Sowers
♦ Battery Capacity for September 2006	Mark Hypse
♦ Organization and Programmatic Assessment	George Andrews Brian Ramey
♦ Closing Remarks	David Mauldin

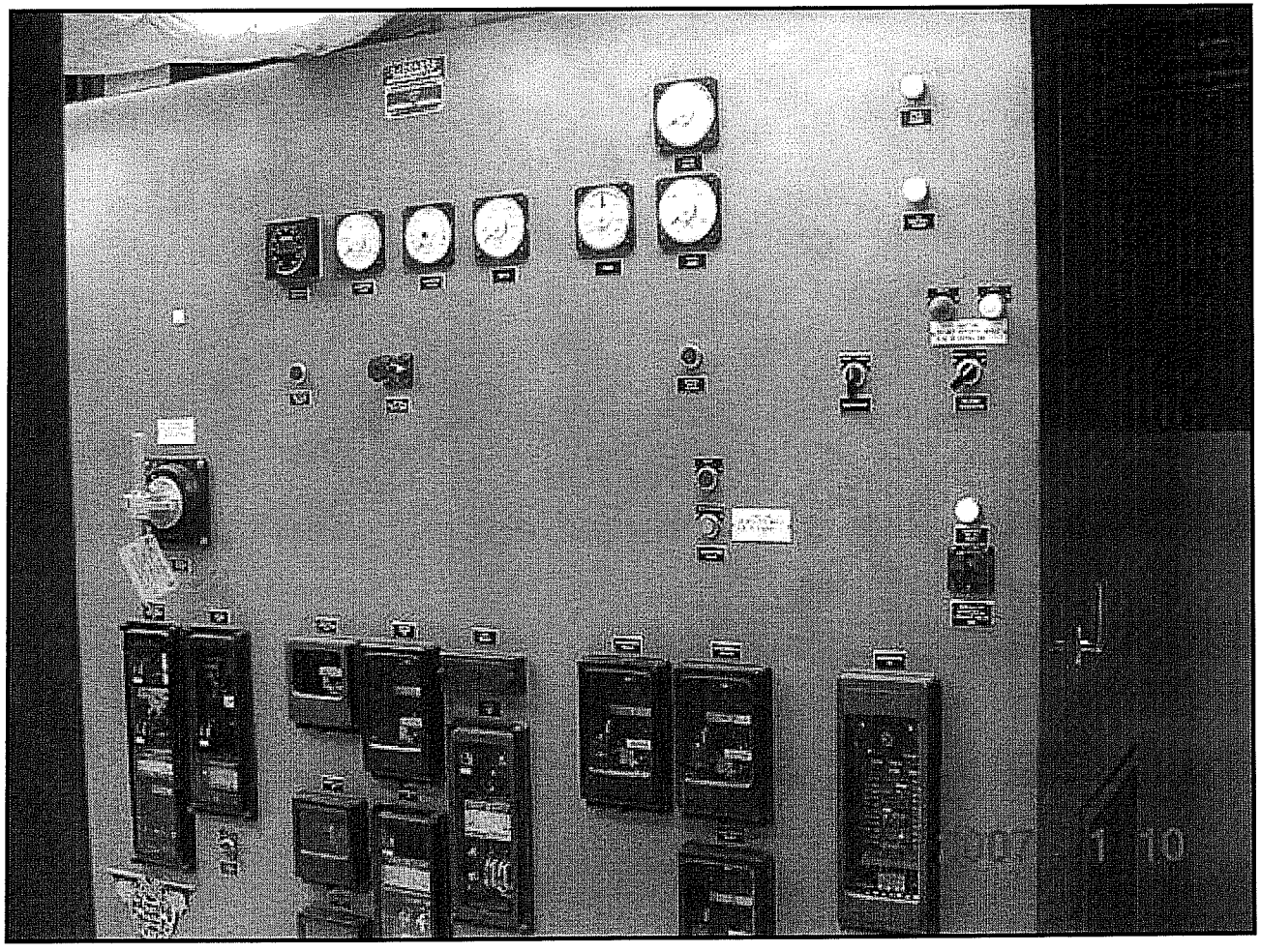
EDG K1 Field Shorting Relay Functional Demonstration

John J. Holmes, P.E.

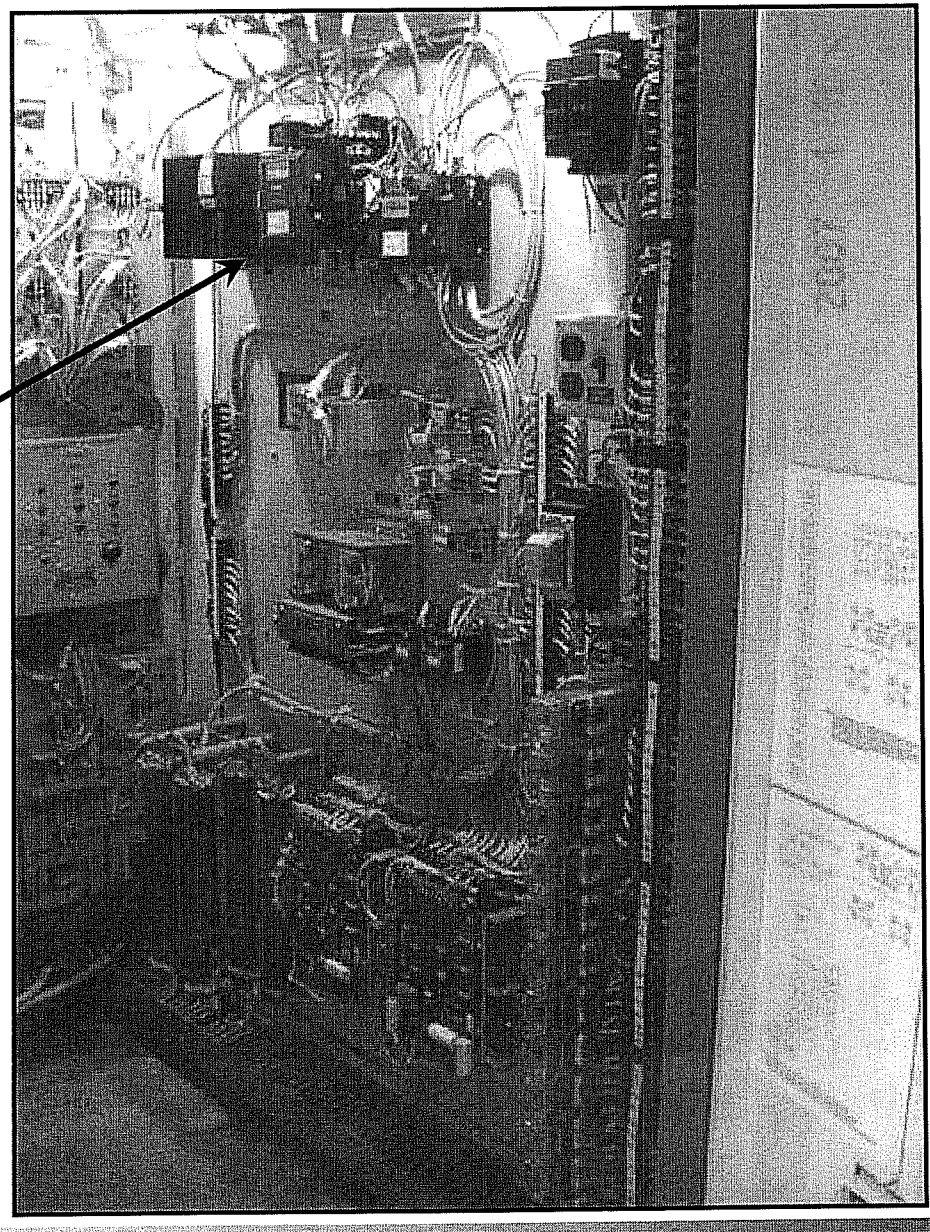
Section Leader,

Maintenance Engineering

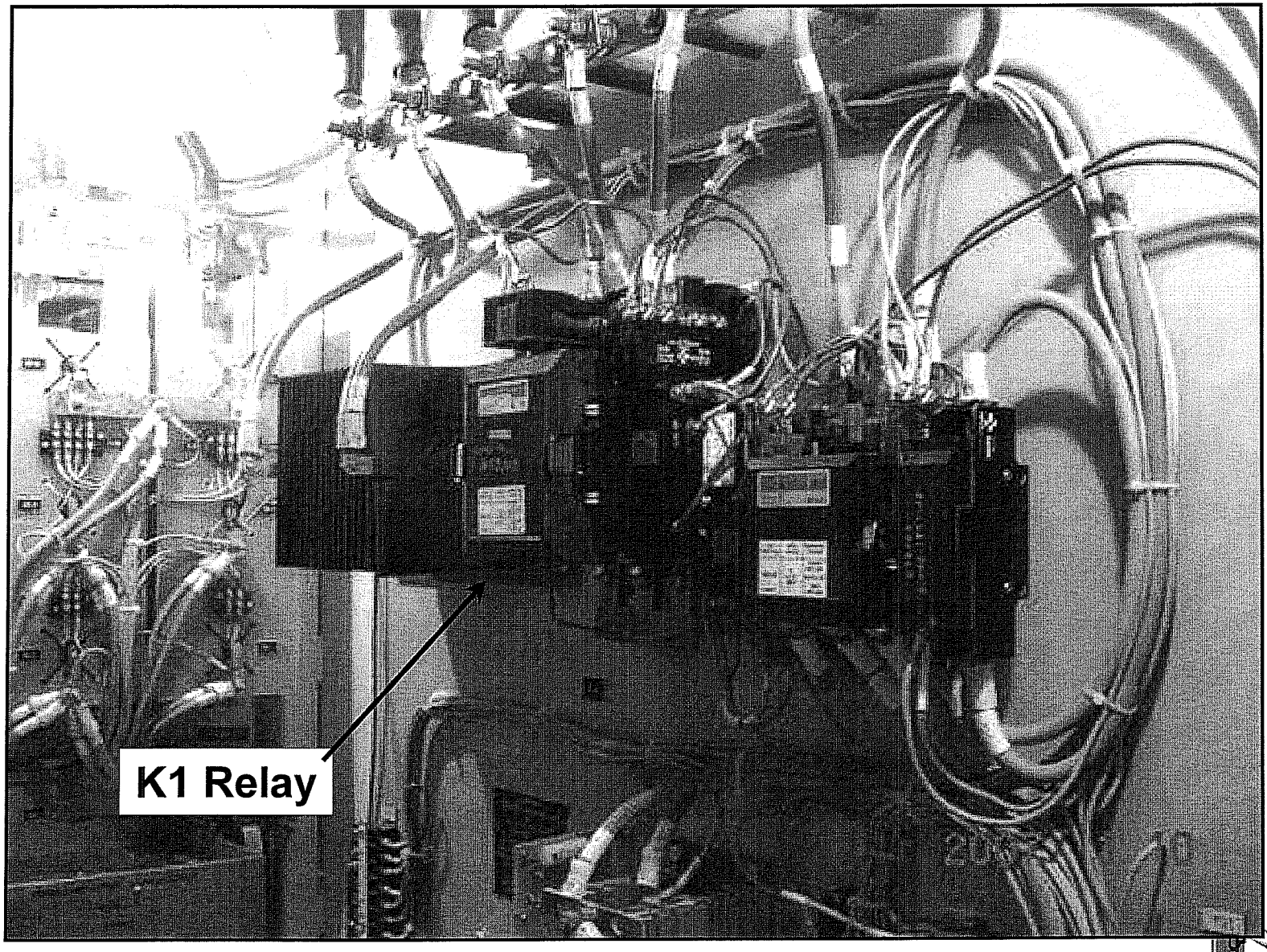
EDG 3A Control Cabinet



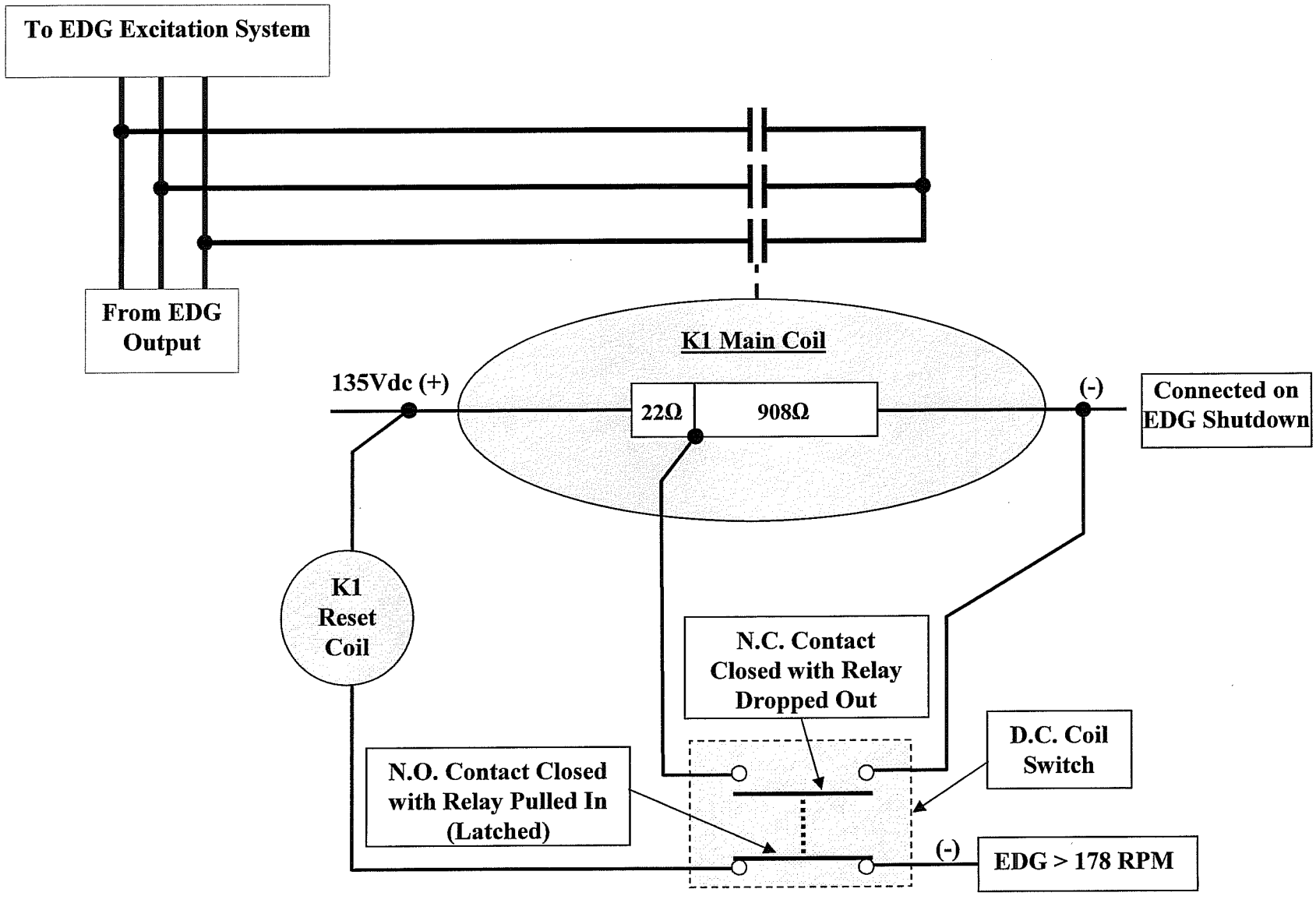
EDG 3A Control Cabinet Interior



K1 Relay



Simplified K1 Relay Control Circuit



EDG 3A
K1 Relay Failure
Risk Significance

Gerald Sowers

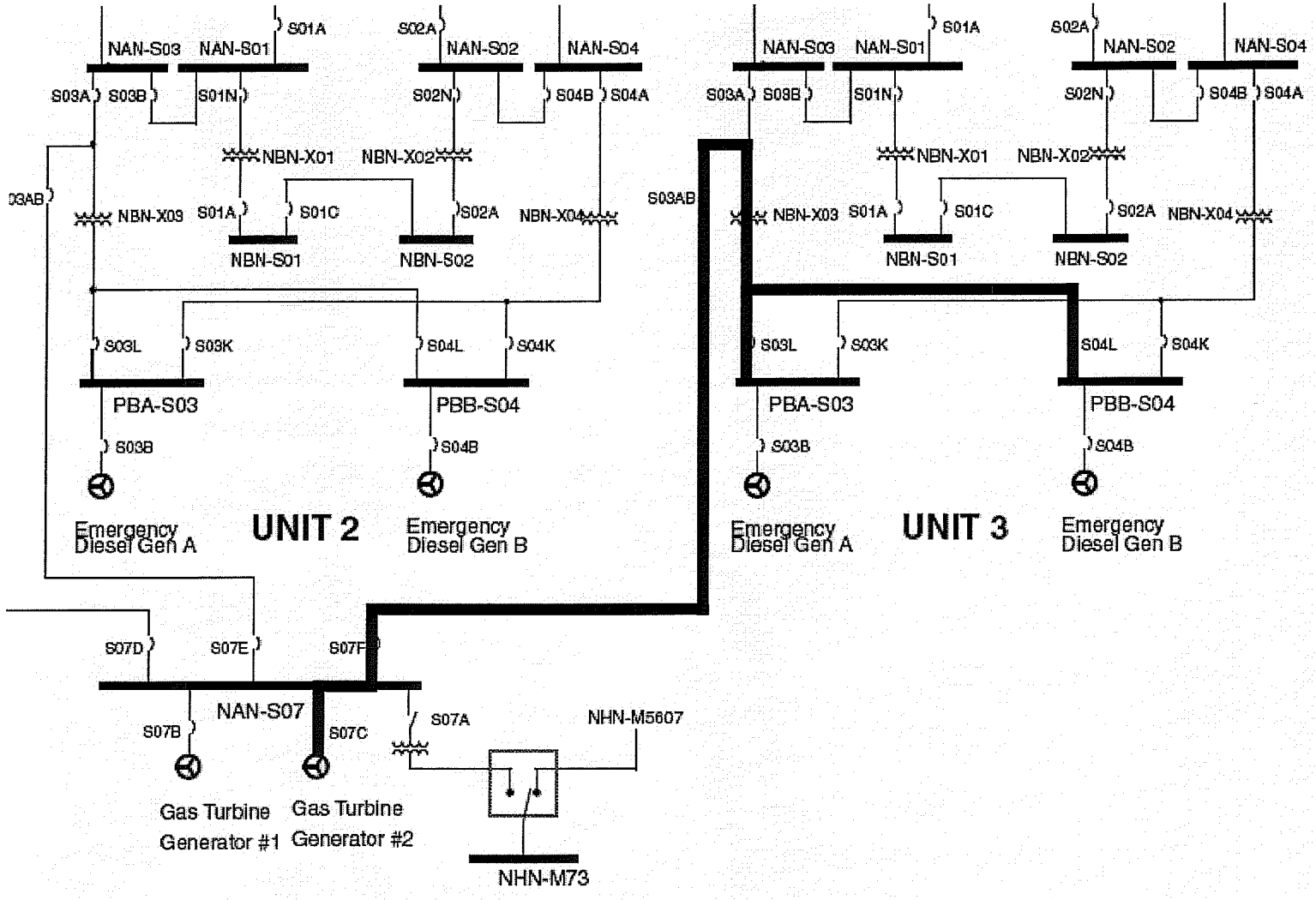
Section Leader,

Probability Risk Assessment

Significance Determination
Risk Impact - Agenda

- Electrical Distribution System Description
- Affected Initiating Events
- Exposure Time
- Analysis Inputs
- Risk Significance Results

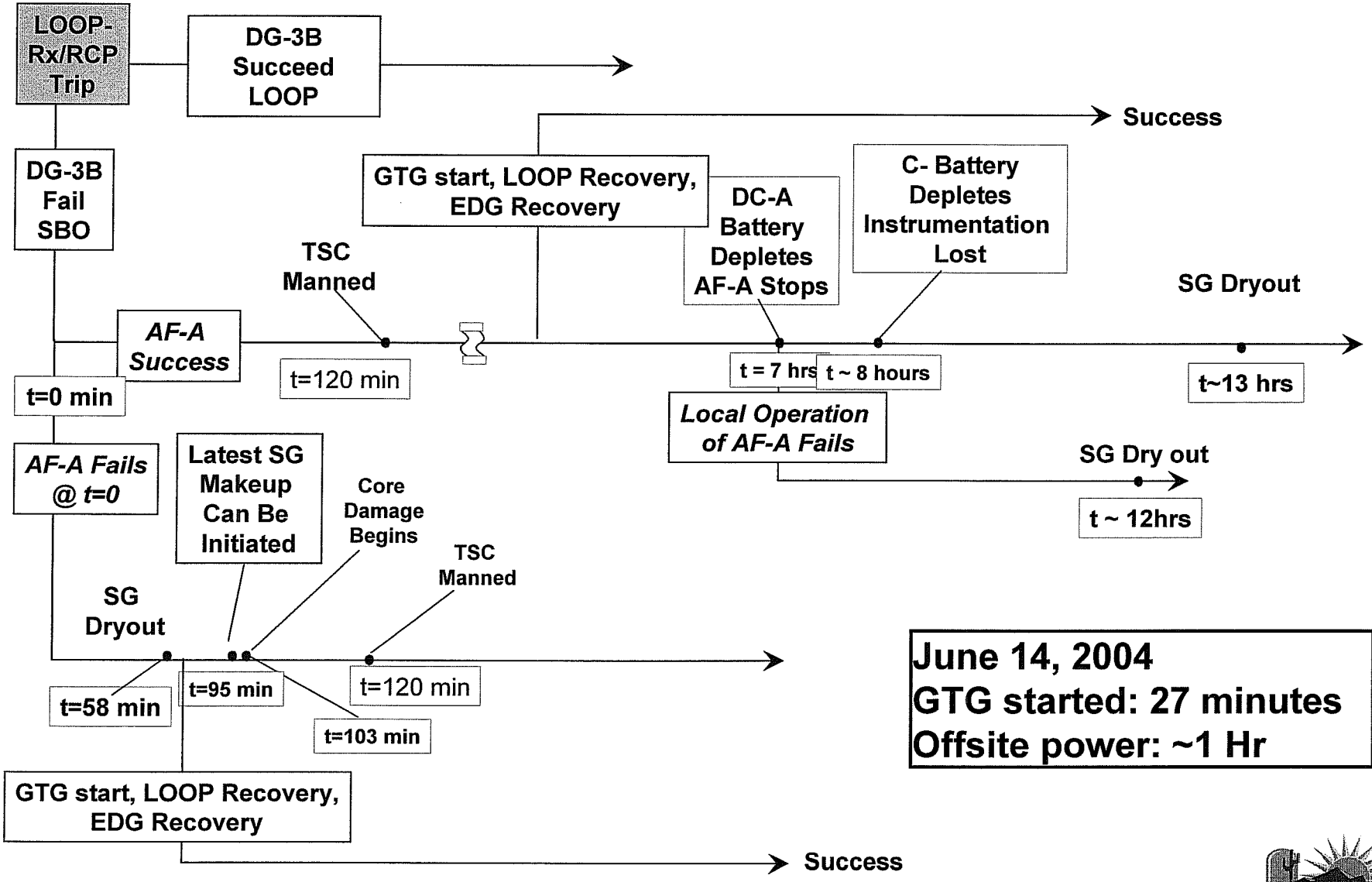
Electrical Distribution System



Affected Initiating Events

Initiating Event	% ΔCDF
Loss of offsite power (LOOP)	45%
Fire (offsite power sources, B-Switchgear)	22%
Miscellaneous Trips	11%
Turbine Trip	6%
Seismic	5%
Loss of Non-Class 13.8Kv	5%
Loss of Class 4Kv	2%
All Others	4%

Event Timelines for Station Blackout @ t=0



June 14, 2004
GTG started: 27 minutes
Offsite power: ~1 Hr

Exposure Time

- The relay root cause of failure indicates the failure is best characterized as an out of service condition for 18 days, 9/4 – 9/22. (Deterministic option in the inspection report)
  - if relay aux contacts successfully close on DG shutdown, they stay closed
- Using out of service time to estimate unreliability is more conservative than using failure history to determine unreliability

Important Analysis Inputs

- The probability that the operator fails to successfully start and align gas turbine generators (GTGs)
- The probability of failure to recover the K1 relay failure
- LOOP initiating event frequency and non-recovery probability
- Battery life – Mark Hypse

Important Analysis Inputs

- The probability that the operator fails to successfully start and align GTGs
  - Different values depending on turbine driven AF pump status and time
    - 1 hour given AF failure
      - PVNGS value: 0.16
      - SPAR/Inspection Report value: 0.1
    - 7 hours given AF success (battery life)
      - PVNGS value: 0.004 (SBO sequences)
      - SPAR/Inspection Report: 0.1 (assumed 2 hour battery life)

Important Analysis Inputs

- The probability of failure to recover the K1 relay failure
  - K1 relay failure is easily recoverable
    - July 25 event was recoverable 15-30 minutes after failure
    - September 22 event was recovered in 18 minutes
  - Three Probability Values Used (1hr, 7hr)
    - Two values for Recovery - Human Reliability Analysis
      - SPAR-H Methodology (0.14, 0.05)
      - EPRI HRA calculator Methodology (0.45, 0.09)
    - One value for EPS Repair - NUREG 6890 (0.77, 0.33)

Important Analysis Inputs

- **LOOP Initiating Event Frequency & Non-Recovery Probability**
  - **LOOP Initiating Event Frequency – used 3 values**
    - **LOOP frequency (mean=2.13e-02, 95%=3.77e-02) is a plant specific calculated value based on western US regional grid reliability data and PVNGS experience, including 2004 event**
      - **Plant Centered LOOPs modeled with Fault Trees**
      - **Consequential LOOPs modeled in individual Event Trees**
    - **NUREG 6890 (mean=5.68e-02, does not include the plant centered contribution which is modeled explicitly with a fault tree, does include consequential LOOP)**
  - **LOOP Non-Recovery Probability**
    - **Used NUREG 6890 for this analysis**

PALO VERDE

PVNGS Unit 3
Battery Capacity
for September 2006

Mark Hypse

Section Leader,

Electrical Design Engineering

Objective

- To determine the capability of the batteries to provide a minimum of seven hours of capacity in September 2006 for station blackout.

Batteries Credited for Station Blackout

- ‘A’ — Turbine AF pump & valves Instrumentation / ADVs
- ‘C’ — AFW Valves / instrumentation / ADVs
- ‘E’ & ‘F’ — Offsite power breaker controls

Input from Design Calculations

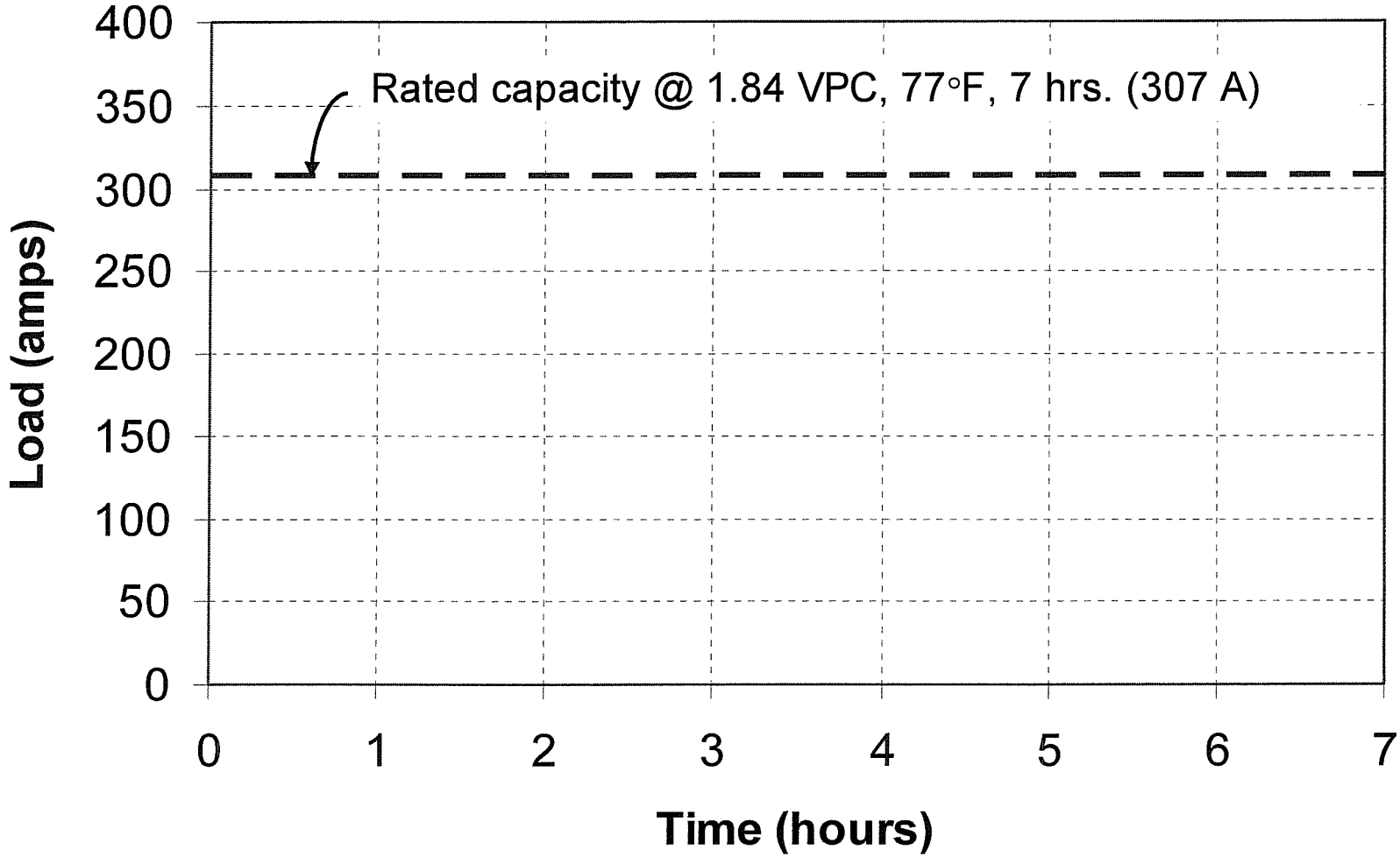
- **Calculations**
  - Batteries 'A' and 'C': 02-EC-PK-0207
  - Batteries 'E' and 'F': 13-EC-NK-0200
- **Data Used**
  - Battery loading during critical switching steps
  - Minimum voltage to satisfy downstream loads

Differences from Design Calculations

- Temperature
  - Increased temperature increases capacity
  - Higher temperatures expected during SBO due to loss of HVAC
  - Used actual cell temperature data from Fall 2006 battery testing

Manufacturer's Design Capacity

Batteries 'A' and 'C'



Differences from Design Calculations

- Aging
  - Analysis does not use 25% derating factor for end of life
  - Capacity initially goes above 100%, then degrades to 80% at end of life

    'A' & 'C' installed in April 2000

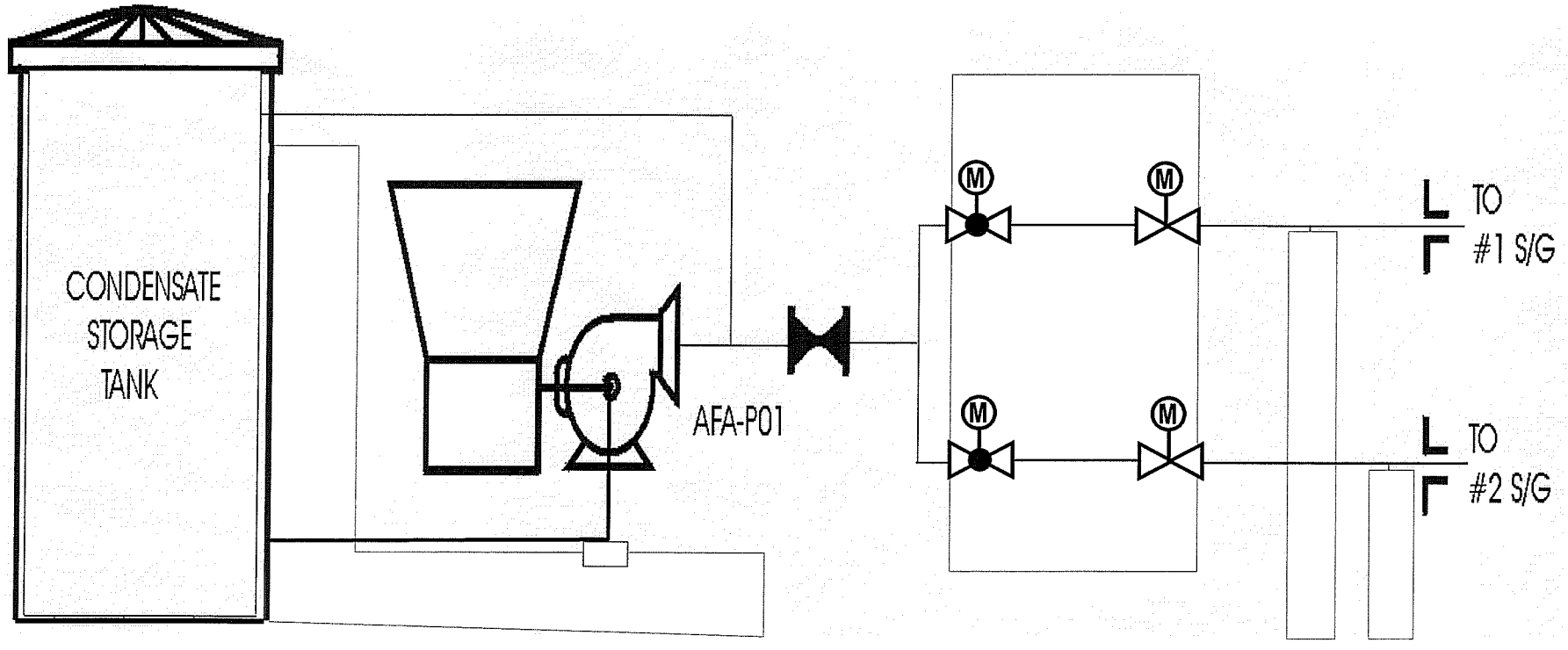
    'E' installed in April 2006

    'F' installed in April 1995

Differences from Design Calculation

- **Auxiliary Feedwater Valves**
  - Calculation models automatic control mode
    - Four AF valves stroke on demand
  - This study models manual control mode
    - In accordance with Emergency Operating Procedures
    - Two isolation valves remain open
    - Two control valves throttled
      - Conservatively modeled at continuous locked rotor condition

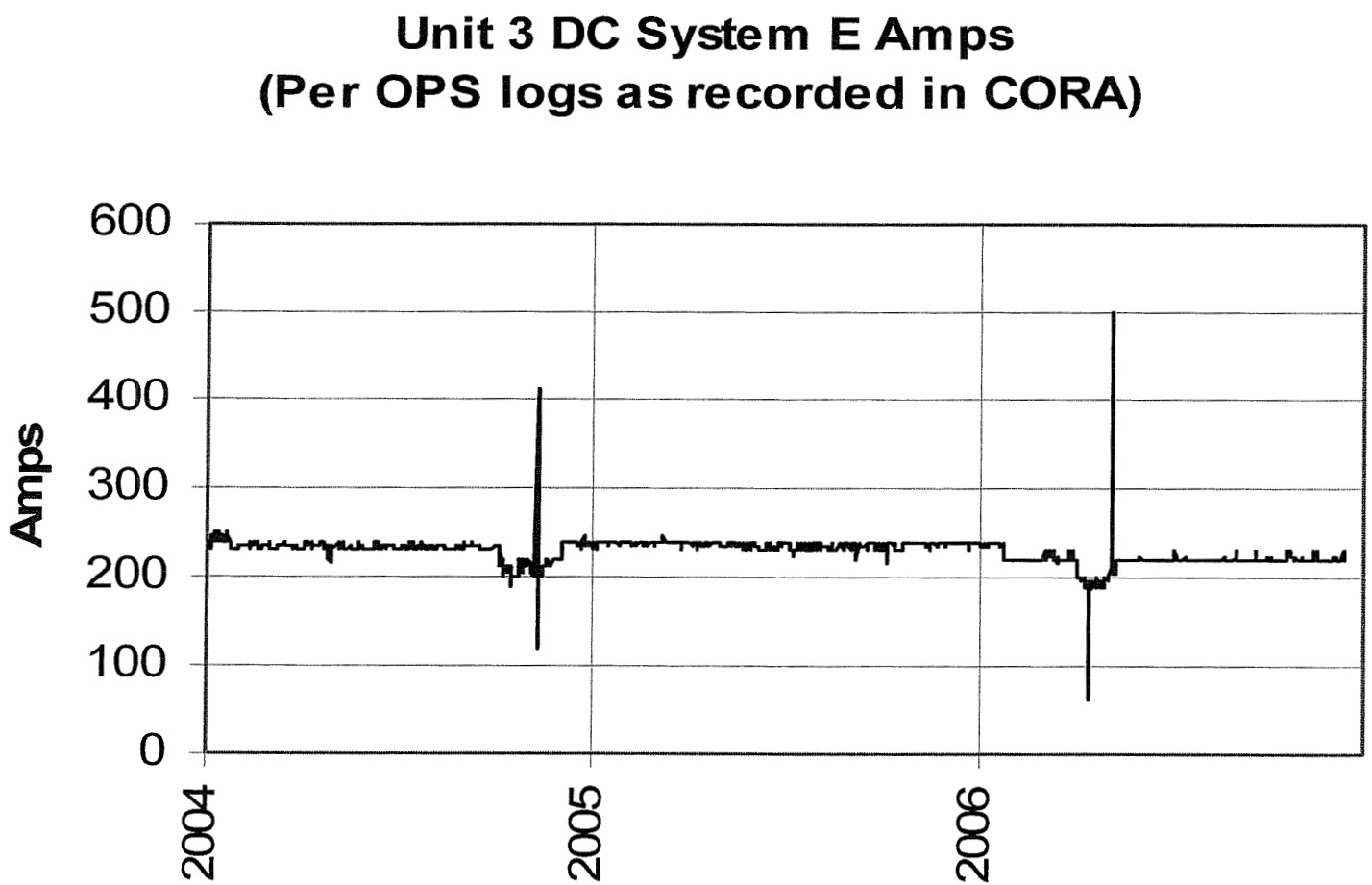
Auxiliary Feedwater Valve Arrangement



Differences from Design Calculations

- **Battery 'E' Steady-State Load**
  - Calculation postulates 450 amps
  - Actual current is 230-250 amps
    - Based on past three years of metered data
  - 250 amps used for this analysis

Empirical Data 'E' Battery



IEEE 485 Sizing Methodology

BATTERY A

(1) Period	(2) Load (amperes)	(3) Change in Load (amperes)	(4) Duration of Period (minutes)	(5) Time to End of Section (minutes)	(6) Capacity at T Min Rate (amperes)	(7) Req'd # of Positive Plates
First Period						
1	374	374	1	1	1240	4.83
					Total	4.83
First 2 Periods						
1	374	374	1	14	1240	4.83
2	161	-213	13	13	1240	-2.75
					Total	2.08
First 3 Periods						
1	374	374	1	15	1240	4.83
2	161	-213	13	14	1240	-2.75
3	490	329	1	1	1240	4.25
					Total	6.32
First 4 Periods						
1	374	374	1	420	307	19.49
2	161	-213	13	419	308	-11.06
3	490	329	1	406	316	16.66
4	220	-270	405	405	317	-13.63
					Total	11.46

Maximum Size Required = 11.46 Positive Plates Per Cell
x 1.04 (temperature correction factor)
= 11.92 Positive Plates Per Cell to 1.84 Volts per Cell

Margin Analysis Methodology

- **Fraction of Design Capacity Needed =**

  Number of positive plates required/actual number of plates

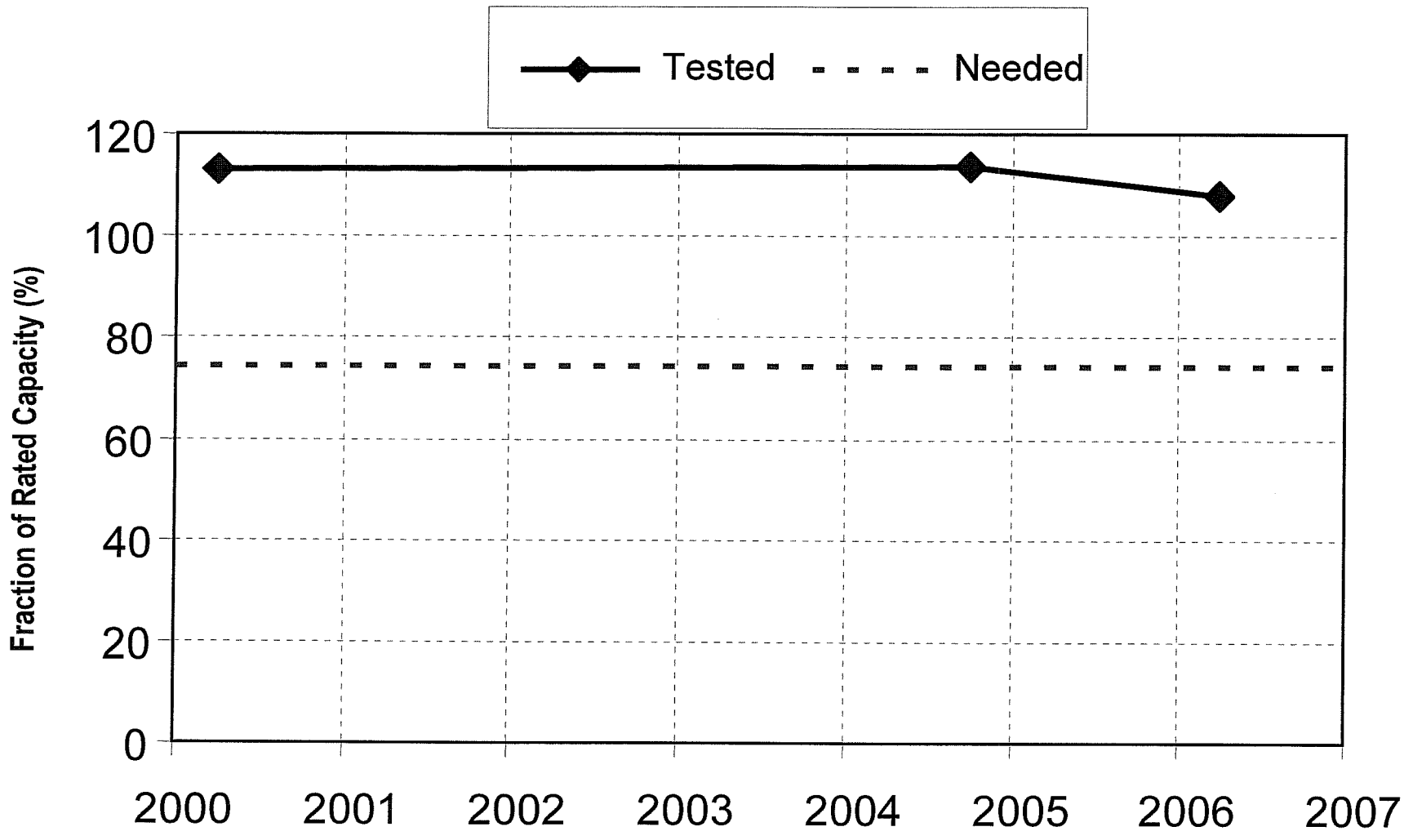
- **Example for Battery 'A'**

  11.92/16= 75% (of manufacturer's rated capacity)

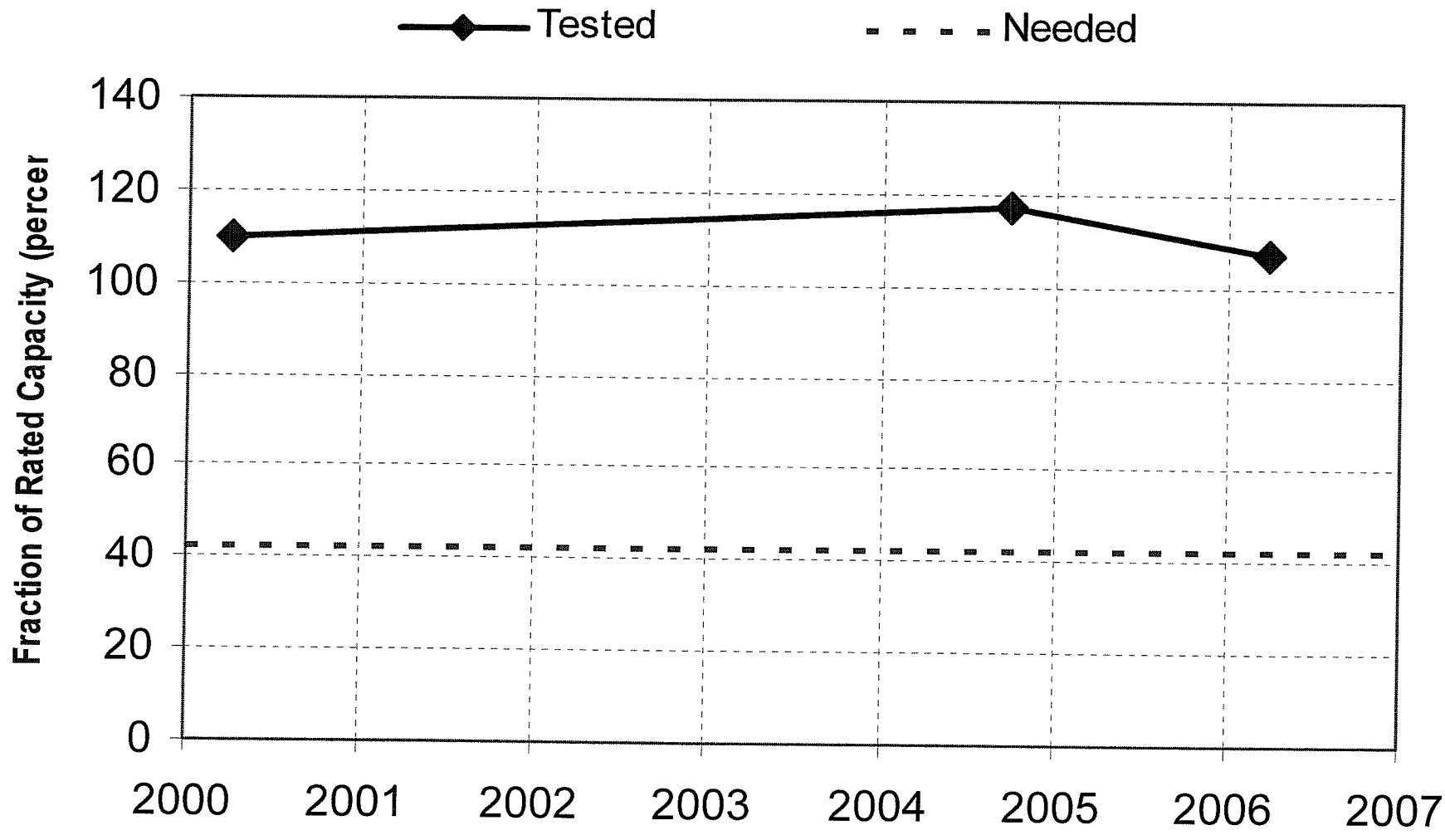
Margin Analysis Results

7 Hour Station Blackout Service Profile				
Battery	Margin based on Positive Plates Required			
	Fraction of Design Capacity Needed	Most Recently Tested Capacity	Fraction of Tested Capacity Needed	Margin
A (3EPKAF11)	75%	108%	70%	30%
C (3EPKCF13)	42%	107%	40%	60%
E (3ENKNF17)	93%	111%	84%	16%
F (3ENKNF18)	69%	104%	67%	33%

Battery 'A' Test Results



Battery 'C' Test Results



Battery Capacity Loss

- No physical signs of significant degradation
  - Plates look good
  - Individual cell voltages consistent through discharge
- Reviewed Operating Experience
- Independent review
- Large amount of capacity margin in batteries

Battery Capacity Loss

- Battery 'C' has entered Tech Spec Surveillance 3.8.4.8, which requires a performance test prior to April 2007
- Plan is to test the batteries in the near term

Conclusion

All four batteries Class 1E ('A' & 'C') and Non-Class 1E ('E' & 'F') are capable of providing seven hours of capacity with margin.

Results

- Selection of Analysis Inputs
- ΔCDF
- Sensitivity Results

Results

- **Analysis Inputs**
  - 7 hour Battery Life
    - Affects GTG Operator Failure value
    - Affects Offsite Power Recovery Probability
    - Affects EDG Recovery Probability
  - EDG Restoration using Recovery HRA vs. the NUREG 6890 Model
  - Plant Specific LOOP Frequency based on US Western Regional Grid data and PV experience
- **ΔCDF=3.1e-07**

Sensitivity Results
7 Hour Battery Life
ΔCDF

	LOOP Frequency		
EDG Restoration (1hr, 7hr)	PVNGS Mean (2.13e-02)	PVNGS 95% (3.77e-02)	NUREG 6890 (5.68e-02)
Recovery			
SPAR-H (0.14, 0.05)	1.1e-7	1.3e-7	1.6e-7
HRA Calc (0.45, 0.09)	3.1e-7	4.0e-7	4.6e-7
Repair			
NUREG 6890 (0.77, 0.33)	6.2e-7	7.5e-7	9.3e-7

Conclusions

- The most likely risk impact is in the range of 3e-7 to 5e-7, mid-green
- A clearly bounding value is 9e-7, still in the green range

Organization and Programmatic Assessment

George Andrews
Department Leader,
System Engineering

Brian Ramey,
Department Leader,
Maintenance Engineering

Closing Remarks

David Mauldin

Vice President,

Nuclear Engineering