Infrastructures: Electrical

C-AD

RHIC Retreat 2009

J. Sandberg

July 2009

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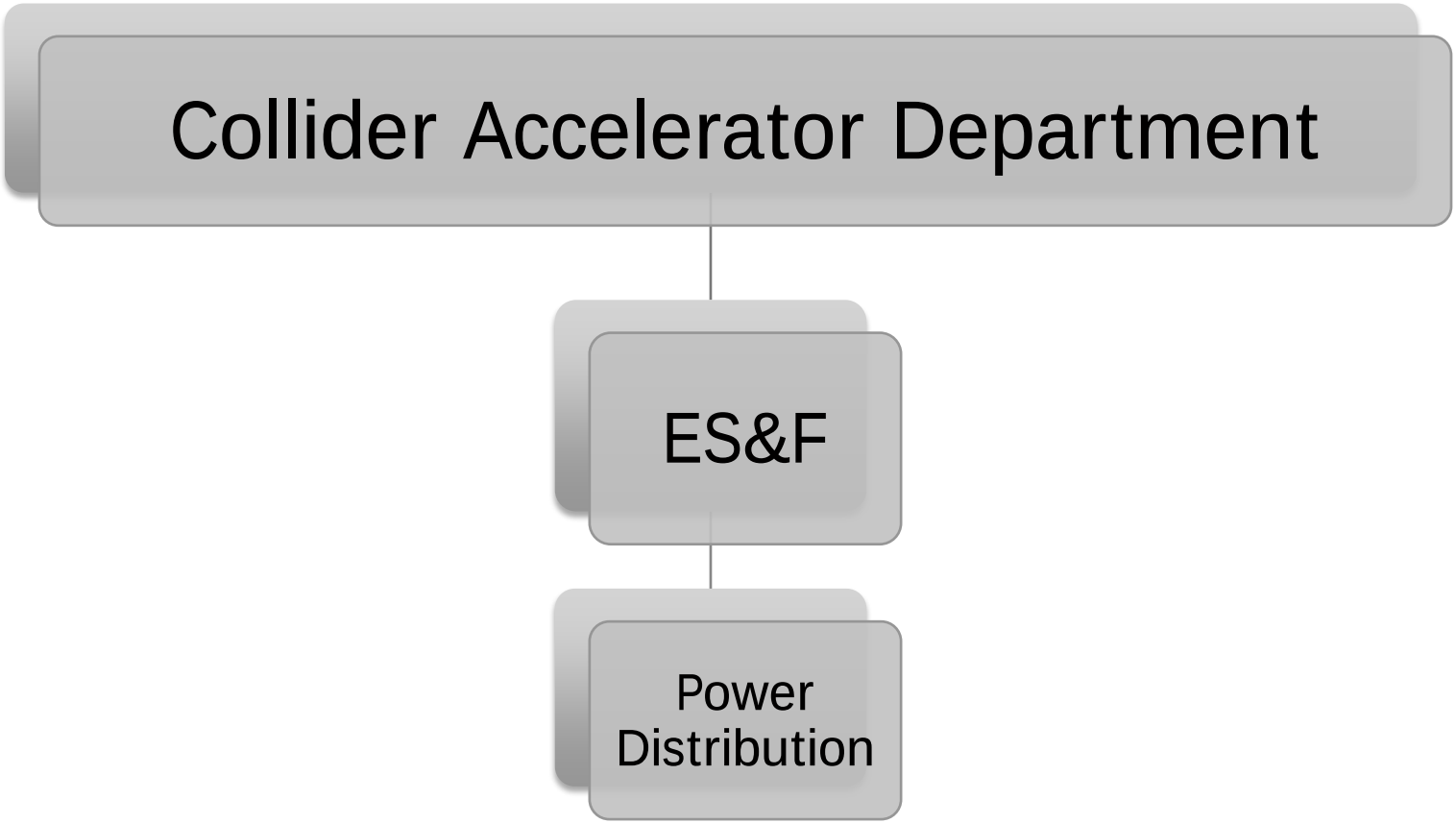
Electrical Systems

C-AD



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Electrical Systems

C-AD

Power Distribution

(J. Sandberg)

PK Feng

D. Donaldson

(R. Lockey)

D. Bastedo

C. Wade

8 to 12 Electricians

Electrical Systems

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- 124 Buildings
- 60 Substations
- 6000 high power switches at the 480 volt level
- Much of this equipment is between thirty and fifty years old

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Electrical Systems

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- Require One additional Engineer
- Will receive $500 K to $1000 K per year for the next 6 years to replace deteriorating infrastructure
- The major bottlenecks are the disturbances power outages cause and the lack of in house Engineering Supervision and support

Electrical Systems

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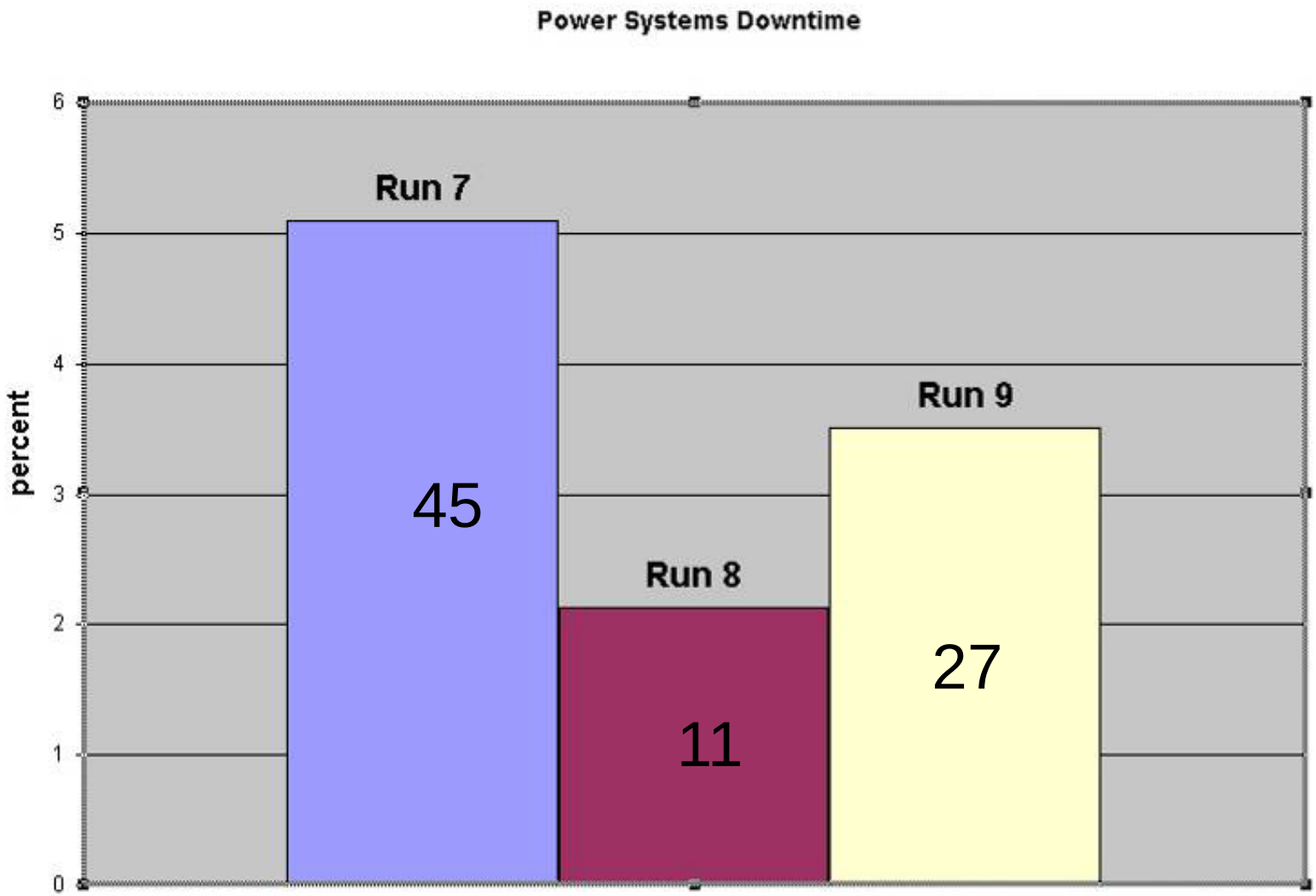

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- The most significant development affecting the C-AD power system is the understanding and mitigation of the dangers associated with Electrical Arc Flash

- This danger was not properly recognized by the industry until the beginning of this decade.

- It is estimated that arcing faults will send more than 2,000 workers to burn centers this year.

Impact of Arc Flash Study

- Detailed equipment parameters must be known
- Protective devices must be well maintained and tested
- Documentation must be correct and well controlled
- Equipment analysis has uncovered other hidden concerns such as over-dutied equipment, unmarked equipment, and undocumented engineering decisions.

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•A conservative estimate is that C-AD has spent $900,000 and 5 man-years on the Arc Flash program over the last two years. The Laboratory has more than doubled this amount.

• There is estimated to be another years work at C-AD to complete this project.

•This is an ongoing process that must be constantly revisited as even small changes can have significant consequences.

Electrical Systems

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- We have identified and labeled over 1500 devices at RHIC and 2500 devices at the remainder of C-AD

- It is estimated that there are an additional 1500 devices remaining to be labeled. Many of these devices were not in the original study so there must be data collection, calculations and documentation done.

Electrical Systems

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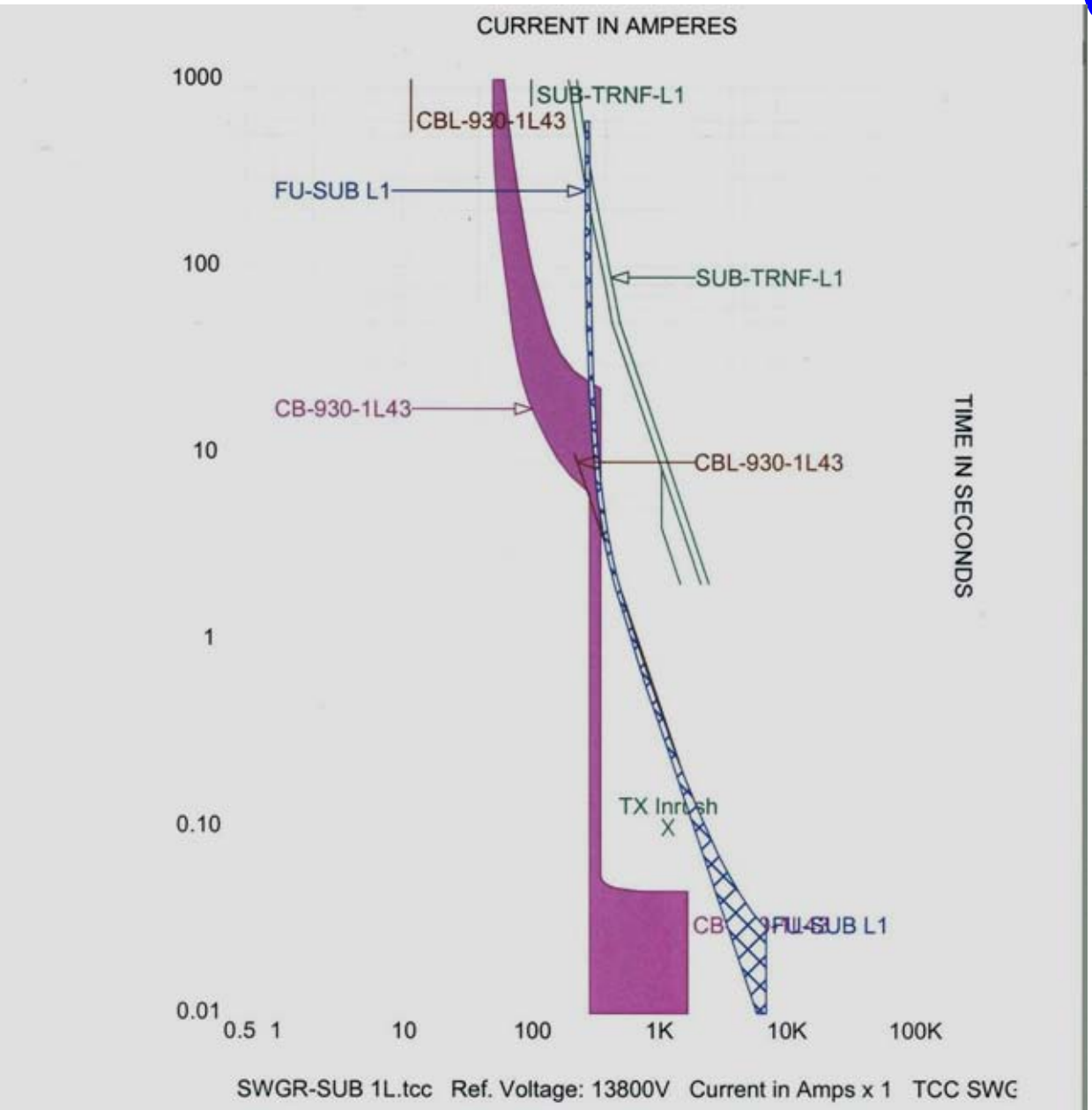

Electrical Systems

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The bottom line is that a great deal of money and manpower has been spent on the Arc Flash program at C-AD and that a lot more will be spent before the project is completed.

Very tangible safety improvements have been made and there is no question that our workers are safer because of this effort.

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- The temperature of the arc can reach **35,000°F**, or about four times as hot as the surface of the sun.

- The high arc temperature vaporizes conductors in an explosive change in state (copper vapor expands to **67,000 times** the volume of solid copper). If an arcing fault occurs while a worker is in close proximity, the survivability of the worker is mostly dependent upon (1) system design aspects, such as characteristics of the **over current protective devices** and (2)precautions the worker has taken prior to the event, such as wearing **personal protective equipment.**

Electrical Systems

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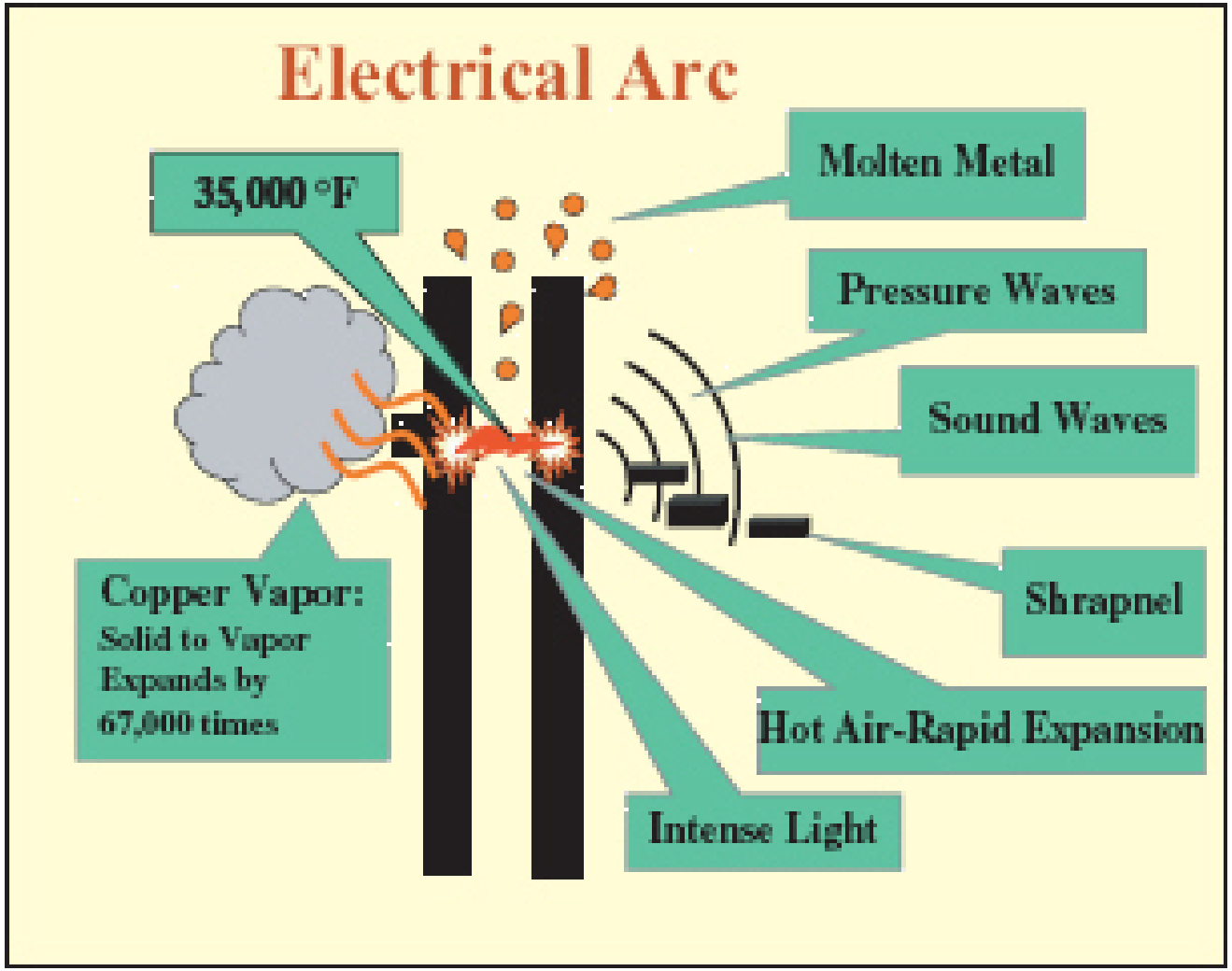

Electrical Systems

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Electrical Systems-Completed

C-AD

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Electrical Systems-Completed

C-AD

912A three new 400 kW generators

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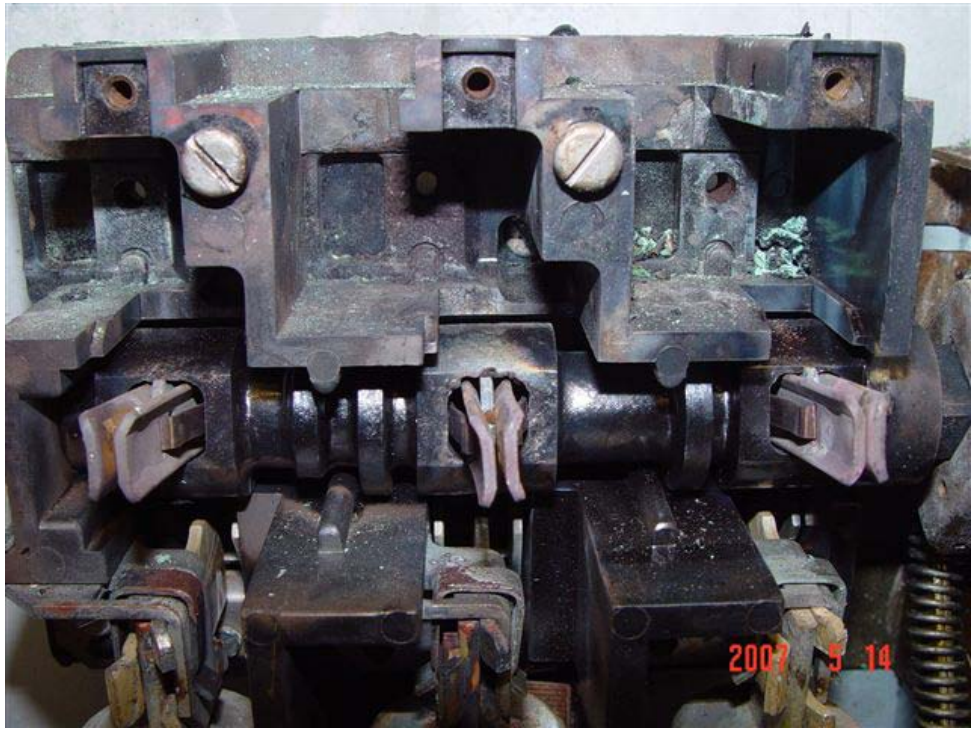
914 FDS Failure-Run 7

C-AD



Building L18

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•13.8 kV Overhead Line Maintenance replaced 19 damaged insulators

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EBIS substation L4 in full service

PHENIX 8S 1600A main switch board was replaced. 10 kA Short Circuit rating 30 kA Calculated. Improved settings reduce AF Hazard category

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Electrical Systems-Completed

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PHENIX AHU-3 duct heater circuit re-feed. The old circuit was overloaded.

PHENIX HVAC MCC replaced with new unit. The old unit had a Dangerous AF category the new unit has a main CB that reduces the AF category.

Electrical Systems-Completed

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PHENIX CMO power supply disconnect switch replaced. Switch was over-dutied. New switch has a short circuit rating of 100 kA. Additional cabling was added to reduce temperature rise of the cable.

Electrical Systems-Future Plans

C-AD

928 and 929 GE MCC
Upstream breaker
replaced reduced Hazard
from Dangerous to
Category 1

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Electrical Systems-Completed

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1000P pump room motor starters re-configured by using BRAHMS MCC.

Fuses added to the 1000P X and Y ARC power supply 3000A disconnect switches. These were over-dutied with a calculated short circuit of 36 kA. They now has a short circuit capacity to 100 kA.

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Electrical Systems-Completed

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1004B RHIC DIPOLE RAMP power supply 2500A main disconnect switches added 2500A fuses. New short circuit capacity of 100 kA

1004 B Quad Ramp power supply 800 A disconnect switches were over-dutied. Replaced with circuit breakers. Reduced arc flash hazard category

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Electrical Systems-This Summer

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1004B high bay area lighting will be added. Fluorescent lighting will be distributed around the building

Replace MDS1
and 2 panel boards
922

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Electrical Systems-This Summer

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Over-duty panel boards at PHENIX high bay area to be replaced.

1010A and 1012A N/E main panel boards are over-duty.

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Electrical Systems-This Summer

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PTR line ATS 3-5 and associated deteriorated panel boards.

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Electrical Systems-This Summer

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LINAC L1 MCC. Two water transport pump motor starters

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Electrical Systems-This Summer

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Substation A adding a 2000A main breaker. That will drop the arc flash level from DANGEROUS to 2.

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Electrical Systems-This Summer

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Replacing 928 basement SIEMENS main 480V distribution panel-board adding a main breaker. Substation shutdown will not be needed to repair the panel and arc flash hazard will be reduced.

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Electrical Systems-Future Plans

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- Add 1200A main breaker to 925 substation
- Add 1200A main breaker for STAR CWS MCC
- Add 800 main breaker for PHENIX CWS MCC
- Add main breaker for Siemens exciter
- Add load banks on 8 units for RHIC diesel generators
- Replace batter chargers on RHIC diesel generators. Remotely monitor batter conditions.
- Add lighting to 929 pump room

Electrical Systems

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LINAC MCC L1, L2, L3 and L4 to be retrofitted. Considering adding main breakers for each MCC

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Electrical Systems-Future Plans

911 pump room MCC 1 and 2 to be replaced.

Electrical Systems-Future Plans

C-AD

912 Target area GE MCC to be replaced/removed

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