

Brunswick Nuclear Plant Emergency Diesel Generators

NRC Region II Visit
October 22, 2009



Agenda

- | AC Power Reliability
- | EDG Historical Performance
- | EDG Performance Indicators
- | EDG #4 Governor
- | Organizational Lessons and Actions from Recent Events



AC Power Reliability

Installed new 230 kV supply breakers for SATs

Installed new Unit output breakers

Replaced SWYD CCVTs & Lightning Arrestors

Installed new local 230 kV capacitor banks for voltage support on Unit 2

Installed new Main Transformers - Outfitted with continuous gas monitoring instrumentation

Improved material condition of spare SAT

Replaced sudden pressure relays

Replaced no load disconnect switches

Improved PMs on Iso-Phase and Non-Seg Bus

Inspected Non-Seg Bus flex links

Established standard preventive maintenance program for buses

Installed permanent SAMA diesel generators on Unit 2

Replaced 2 transmission line breakers

Replaced 145 poles and 341 insulator sets

Revised Transmission Interface Agreement to specify plant involvement/coordination of work activities

Install new local 230 kV capacitor banks for voltage Support on Unit 1

Install permanent SAMA diesel generators on U1

Unit Auxiliary Transformer (UAT) Replacement

Replace remaining transmission line breakers

Replace Line Insulators at a rate of ~150 sets per year during each unit

Replace SATs w/auto load tap changing transformers

Upgrade 2/3 logic for Aux Transformer



Emergency Power Reliability

Installed two backup diesel powered generators (SAMA diesel generators) to power the 125 VDC batteries

Improved CDF by 68% on Unit 1 and 66% on Unit 2





EDG Historical Performance 2007 Reliability Study



2007 Reliability Study

- Multi-discipline team assembled to review EDG issues and develop short and long term action plan

- w Operations
- w Maintenance
- w Engineering
- w Technical Training

- w Licensing
- w Procurement
- w Industry Representative
- w Vendor Representative

- INPO Assist

2007 Reliability Study Inputs Used in Analysis

- | MSPI Reliability data
- | Vendor Input/Industry OE
- | Maintenance Rule Functional Failures, 2000-2006
- | BNP Equipment Reliability List
- | EDG NCRs, 2003-2006
- | EDG Planned and Unplanned Out Of Service (OOS) times, 2003-2006
- | EDG Corrective Work Orders, 2003-2006
- | EDG Material Costs, 2003-2006
- | EDG Self Assessment & Benchmarks, 2003-2006
- | EDG NRC Findings, 2003-2006
- | EDG Nonconformances
- | EDG items on Long Range Plan
- | System Engineer brainstorming sessions

EDG Actions

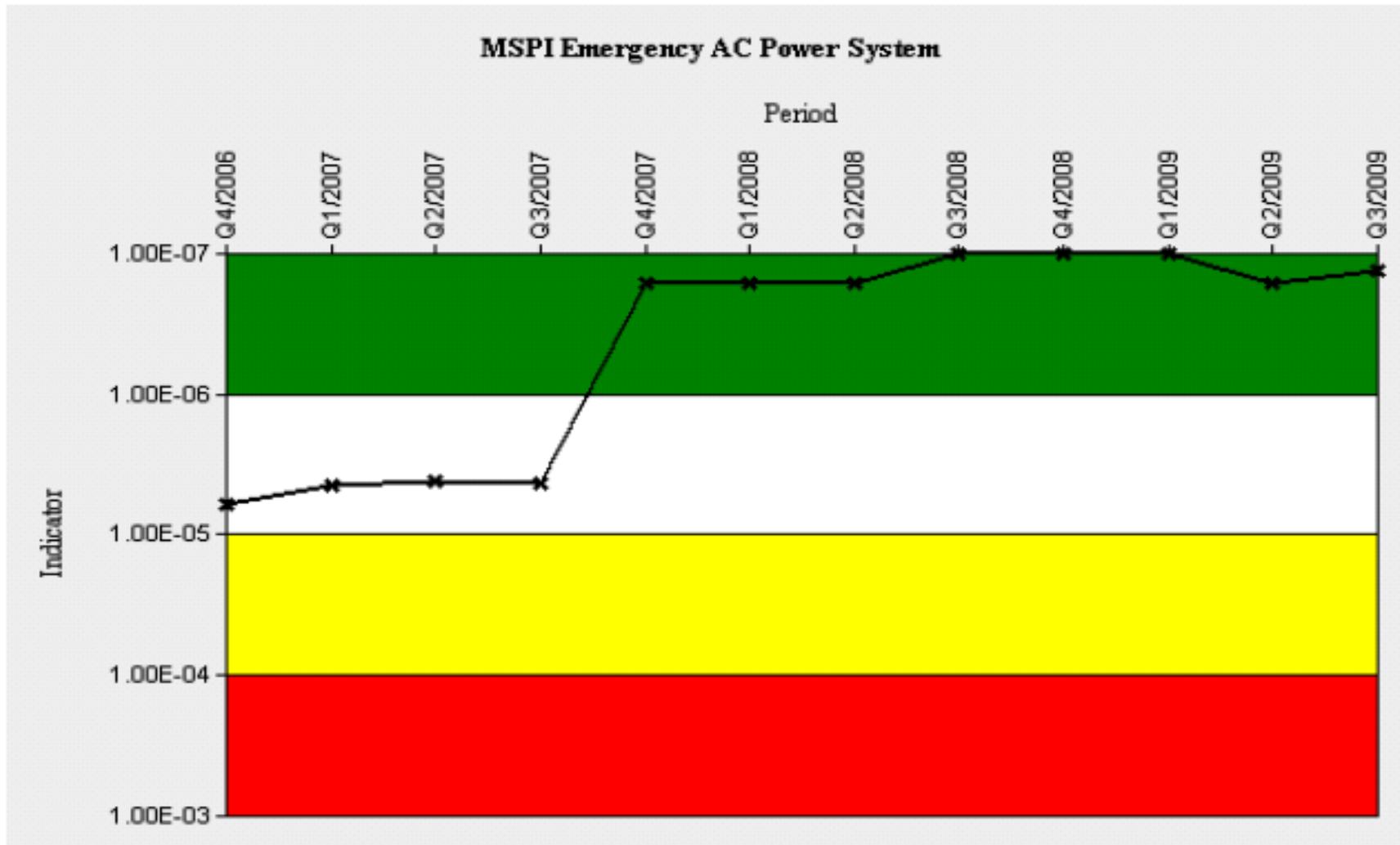
Action	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
EDG #2 exhaust bellows	Completed											
Allen Bradley relays	Completed											
Jacket Water TCVs	Completed											
SAMG DGs	Completed											
Capacitor leak	Completed											
EDG PM evaluations	Completed	Completed										
Ultra Low Sulfur Fuel	Completed	Completed										
Latent design issues	Completed	Completed										
Human perform issues	Completed	Completed	Completed									
High qual potentiometers	Completed	Completed	Completed									
GEMCO control switches		Working	Working									
Replace EDG #1 bearing			Working	Working	Working							
Collector ring			Working	Working	Working							
Starting air config/quality		Working	Working	Working	Working	Working						
Exciter/voltage regulator			Working	Working	Working	Working	Working	Working				
Governor upgrade							Scheduled	Scheduled	Scheduled	Scheduled	Scheduled	Scheduled
Piston replacement (est)							Scheduled	Scheduled	Scheduled	Scheduled	Scheduled	Scheduled



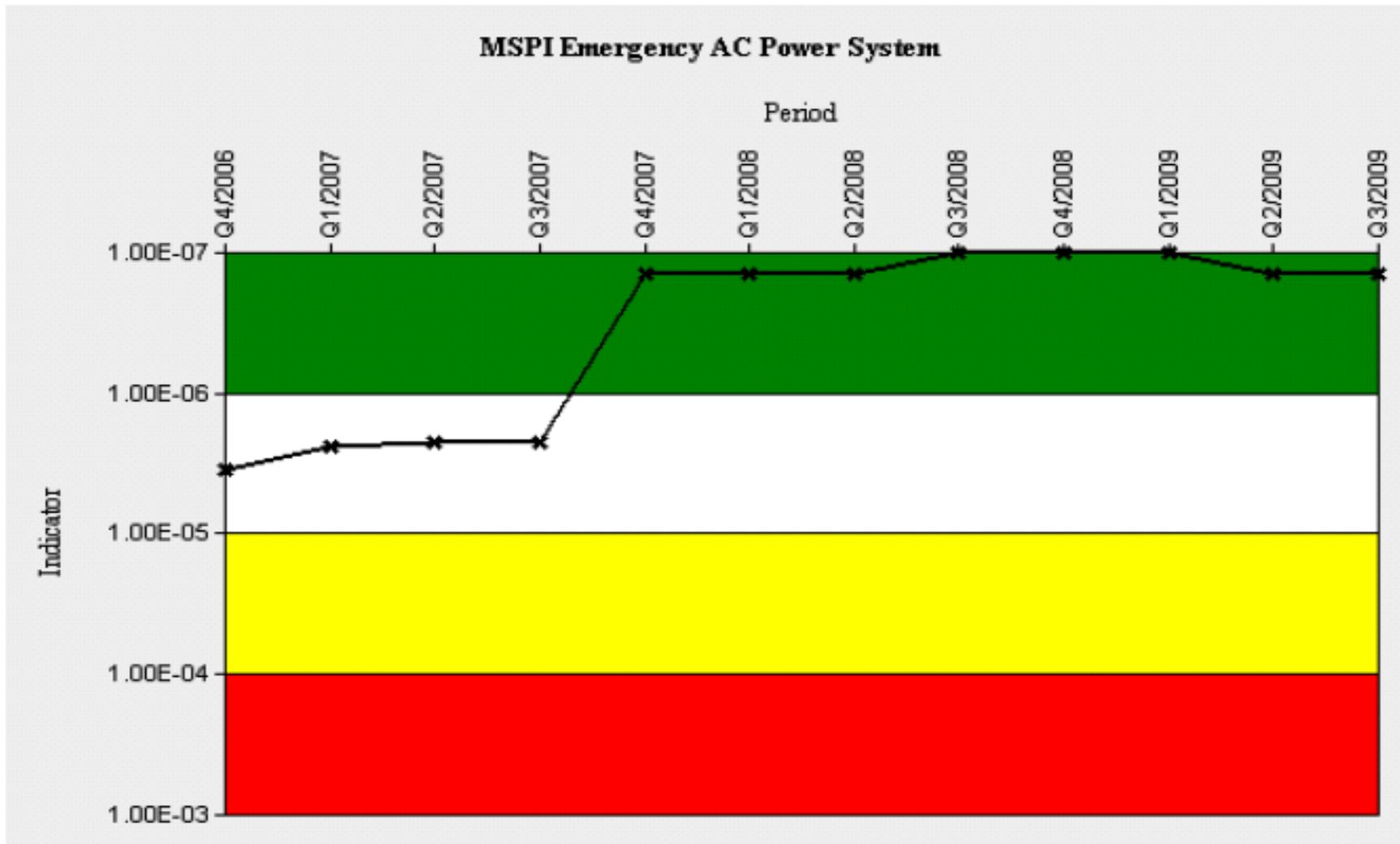


EDG Performance Indicators

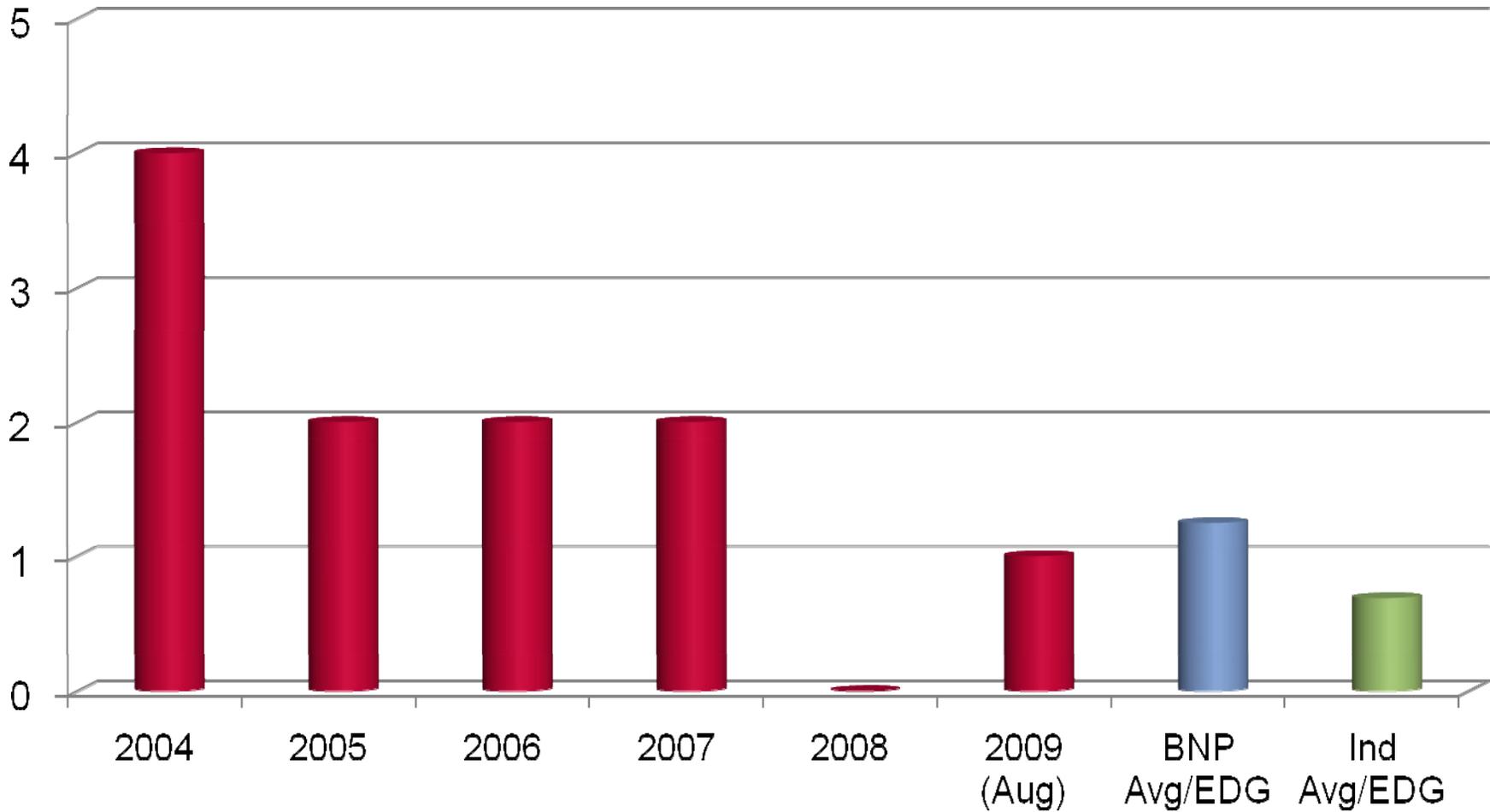
Brunswick Unit 1 Emergency AC Power System NRC Performance Indicator – MSPI (36 Months) September 2009 Status: 87% Margin Remaining in Green



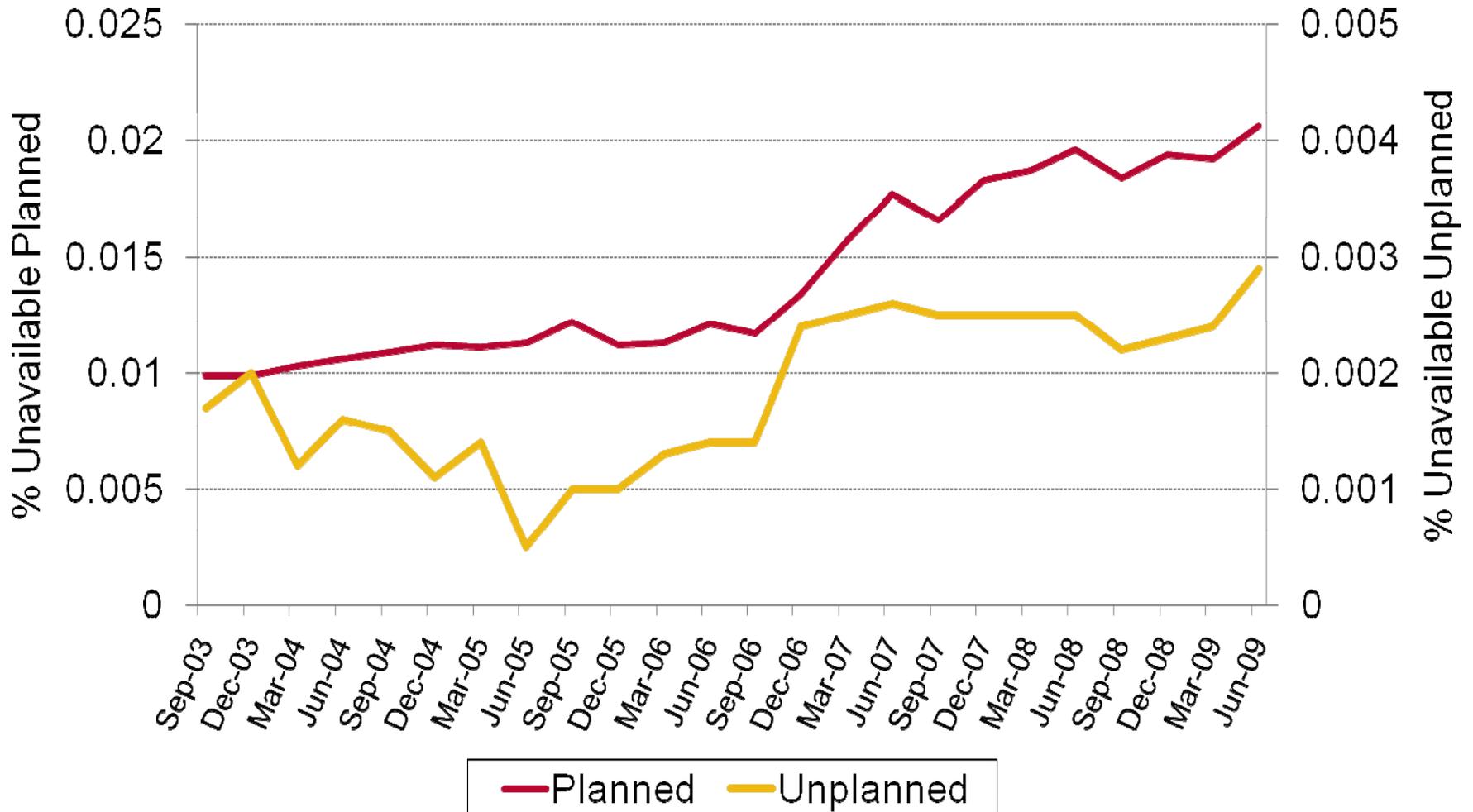
Brunswick Unit 2 Emergency AC Power System NRC Performance Indicator – MSPI (36 Months) September 2009 Status: 86% Margin Remaining in Green



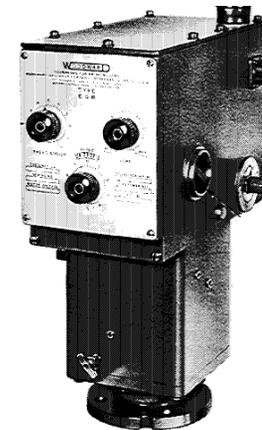
MSPI EDG Failures



Emergency Diesel Generators INPO Unavailability



EDG #4 Governor



EDG #4 Governor

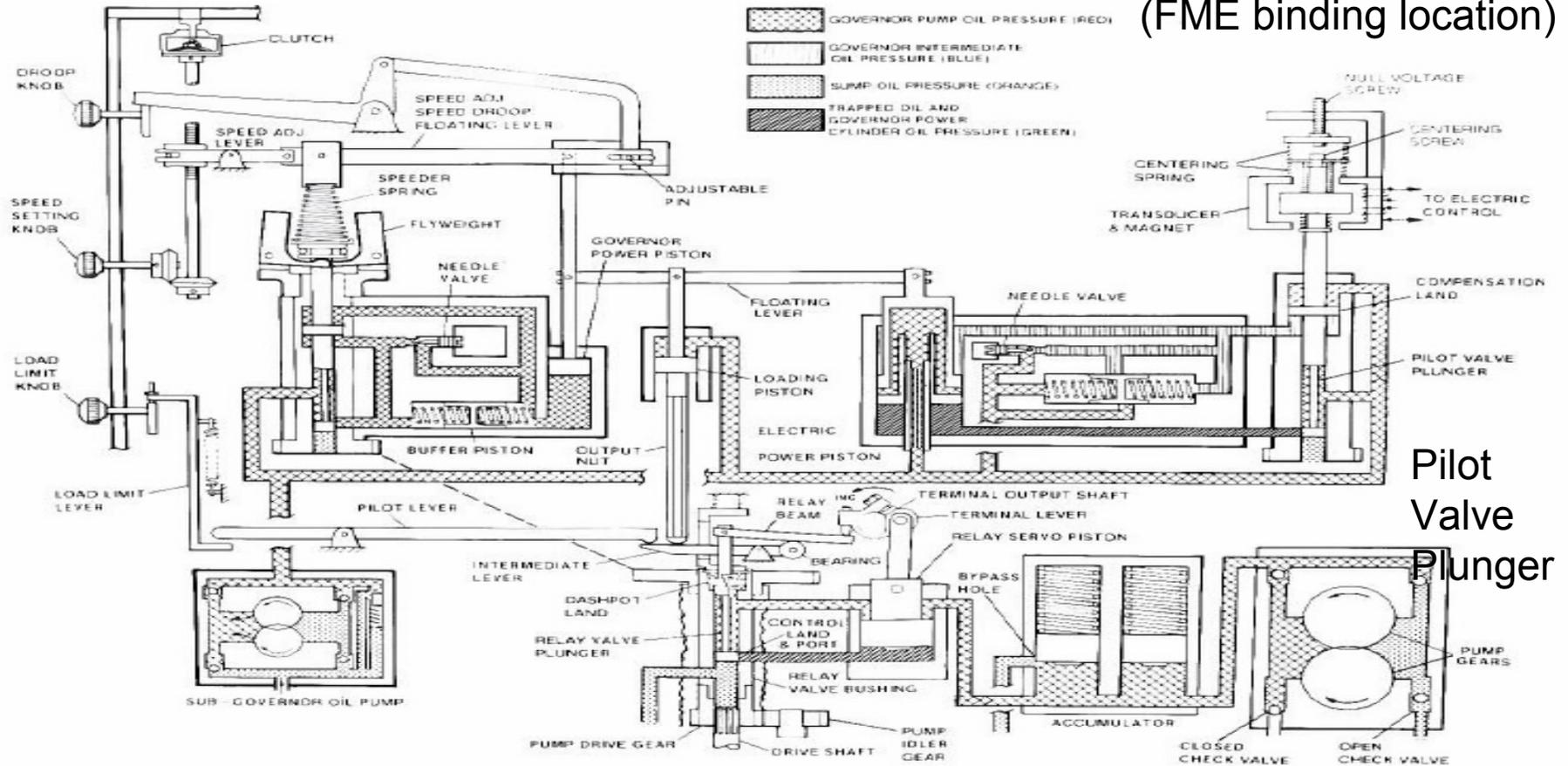
- | EDG #4 removed from service for 6 year preventive maintenance:
 - w 4.5 days planned unavailability
 - w Commenced 7 day LCO on both units
- | During Post Maintenance Testing, EDG #4 failed to start due to governor failure.
- | Governor testing, tuning, support component replacement, and oil flushing occurred for the replaced governor - resulting in the expiration of the LCO prior to completing testing.

EDG #4 Failure Analysis

- I FME on Pilot Plunger restricted movement
- I Two possible sources for particles:
 - w Internal Wear Particles
 - w External Source (FME)
- I Factors for wear of internal parts
 - w Oil analysis did not indicate abnormal wear of internal parts
 - w Inspection of internal parts during disassembly did not indicate wear
- I Potential Source(s) of FME:
 - w Vendor maintenance on Pilot assembly without flush
 - w On-site testing/installation or oil addition/flushing activities.

Evaluation of Governor

Compensation Land
(FME binding location)



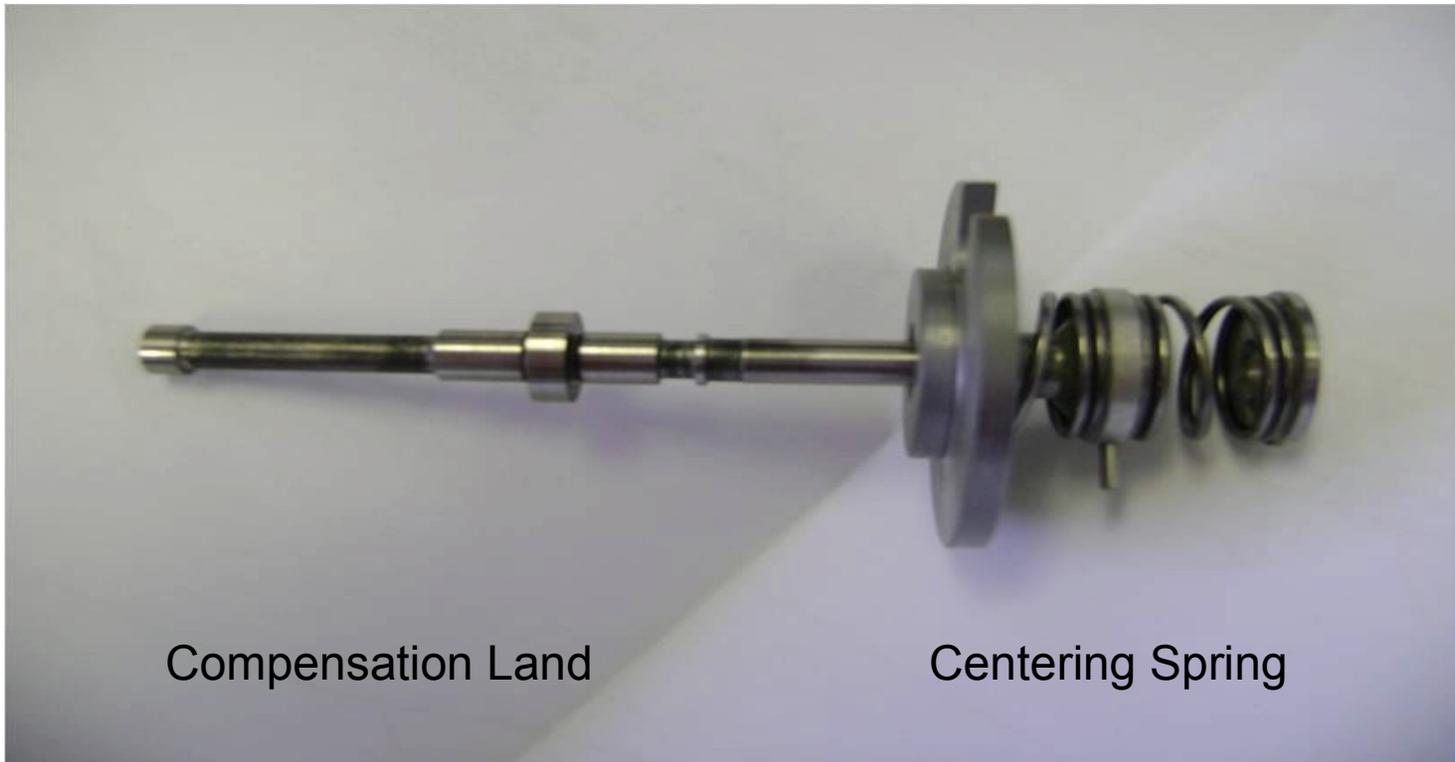
Pilot Valve Plunger

Schematic Diagram EGB-10C

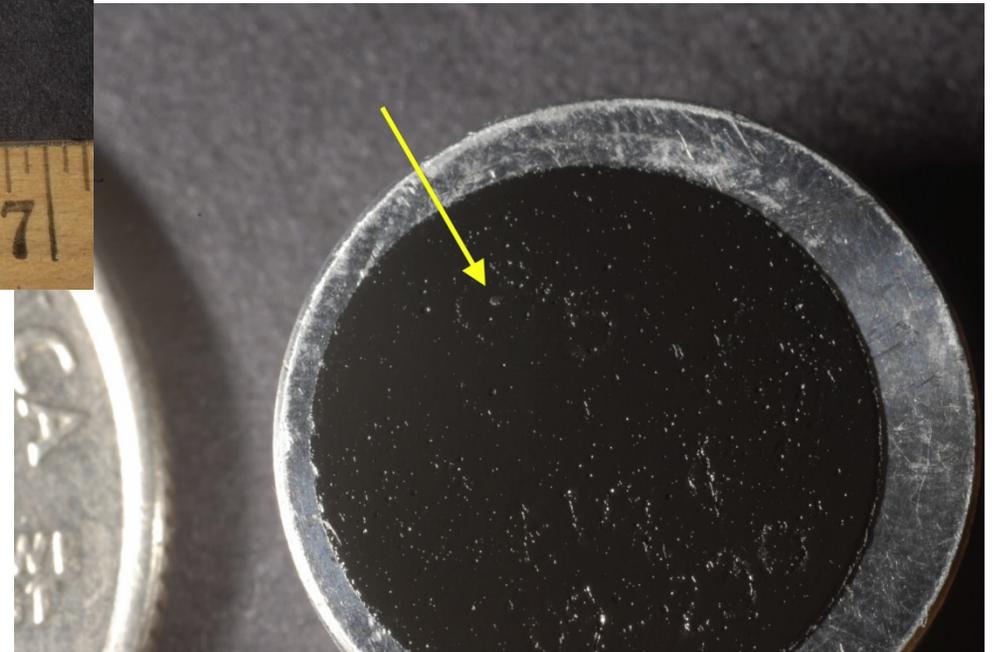
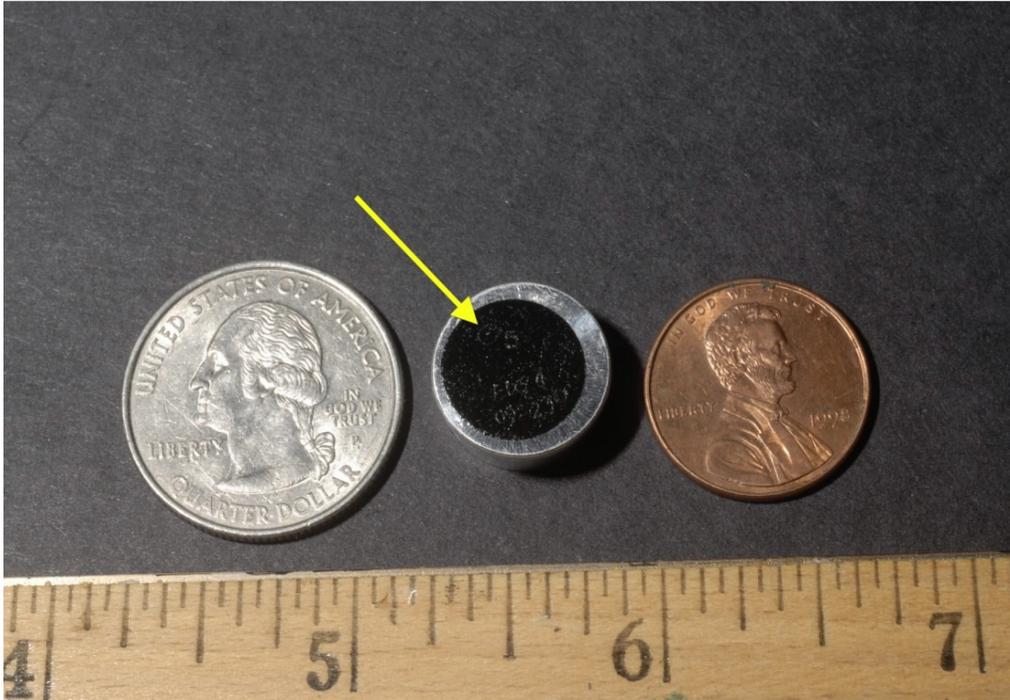
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Evaluation of Governor

Pilot Valve Plunger



FME on Pilot Plunger



Organizational Lessons and Actions from Recent Events (2007-2009)

- I Technical Rigor
 - w Technical Task Risk/Rigor procedure
 - w Engineering Product Quality Procedure revision
 - w Trending and Monitoring

- I Post Maintenance Testing Process Improvements
 - w PMT specificity based upon safety related function

Organizational Lessons and Actions from Recent Events (2007-2009)

- I Work Management
 - w Sensitivity to risk significant work
 - w Outage Control Center Use
 - w Readiness Reviews

- I Parts Quality – Interim Actions (pending permanent corrective actions)
 - w FME requirements for vendors in Purchase Orders/Contracts
 - w Increased vendor surveillance
 - w Interim EDG Spare Parts controls – inspection/testing/FME inspections
 - w Review near term EDG maintenance plans



Organizational Lessons and Actions from Recent Events (2007-2009)

I EDG Reliability Review Update

- w Validate Corrective actions taken from events since 2007 are bounding and comprehensive
- w Review problems/failures since 2007
- w Review Industry Operating Experience since 2007
- w Benchmark other utility EDG Reliability plans
- w Revise as needed near/long-term reliability improvement strategy

Organizational Lessons and Actions from Recent Events (2007-2009)

- I EDG Maintenance Strategy Improvements:
 - w Near Term – Evaluate options to address extension of 7 day LCO:
 - u Reduces overall unavailability to complete work
 - u Improved efficiency of work planning
 - w Longer Term - Evaluate options to address long duration LCO for EDG major overhaul/repairs
 - u Additional on-site emergency AC capability
 - u AC distribution alignment
 - w Common Mode Failure Strategy for Maintenance implementation

Questions?

