



Planned Outages

This is the second in a series of educational programs of the Rocky Mountain Chapter of 7x24 Exchange
Colorado Springs Satellite



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Planned Outages



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President Emeritus

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EnMax, LLC



Planned Outages



Mr. Tony Diaz

Manager, 7x24 Operations

“Failing To Plan Is A Plan That Will Surely Fail...”
Alan Lakein

- ➡ **As simple as Who, What and When?**
- ➡ **Understand The Severity of The Outage or Maintenance Objectives**
- ➡ **Understand the Expectations**
- ➡ **Understand the Functions of The Facility and How The Components Interact**
- ➡ **Understanding Team Roles & Responsibilities**

WHO?

Understanding the Customer/Vendor Roles

- ➔ Who Will We Be Impacted?
- ➔ Who Will We Be Your Primary Contact?
- ➔ Who owns what? Areas of Responsibility
- ➔ Who Needs to be Involved? Is this an “All Hands” Outage?
- ➔ Who Ensures The Necessary Skill Sets Are Available?

WHAT?

Understanding The Impact

- **What Is The Impact? Level of Severity?**
- **What Is The Level of Risk? High/Low?**
- **What Upstream / Downstream Systems or Applications Will Be Impacted?**
- **What Notifications Must Be Made?**
- **What Have You Missed?**

WHEN?

“Time is Money”

Domestic or Global Perspective

- ➔ When Will The Outage Be Scheduled? Time of Day / Day of The Week? WofO
- ➔ When Will You Be Ready? Notification(s)
- ➔ What Upstream / Downstream Systems or Applications Will Be Impacted?
- ➔ When Will Notifications Be Made?
- ➔ When Can We Check Out? Start/End Times?

FUNCTIONALITY

Understanding Facility Operations

- ➡ How Do MEC's Interact (Mechanical, Electrical, Cooling)?
- ➡ What Is the Sequence of Transfer (Utilities)?
- ➡ Do You Have A Clear Understanding of The Facility (The 10,000 ft, View)?
- ➡ Do You Know All The Players?
- ➡ Have You Planned for The Worst Case Scenario? Fallback/Failover, DR

COMMUNICATIONS

Establish Working Vendor Relationships

- ➔ Understand That The Vendors Want To “Do The Right Thing”
- ➔ Help Them Understand Your Expectations Early
- ➔ Ask Questions (Lots of Questions)
- ➔ Participate in Every Possible Meeting
- ➔ Review MOP's, Challenge Observations, and Validate Procedures

IMPLEMENTATION

Are You Ready?

- ➔ You Can Never Be Too Ready -- Can You?
- ➔ Have You Asked “All The Right Questions?”
Ask Your Vendor? A Wealth of Knowledge and Experience Is at The Ready.
- ➔ There Is No Such Thing as a Dumb Question.
Again, Ask Questions (Lots of Questions)
- ➔ Have You Taken All The Right Steps to Prepare?
- ➔ The Point of No Return – Own It!
- ➔ Don't Forget the Pizza!

Questions?



Planned Outages



Mr. Michael Donato, LEED AP
Engineering Manager

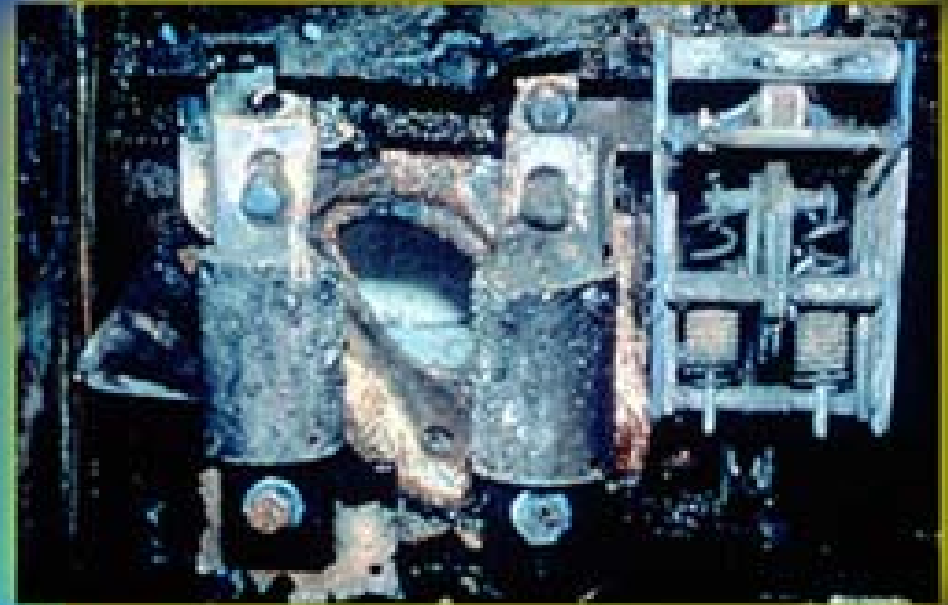
A Wise Engineer Once Said...

“If it was built by man,
it is not a matter of *if* it will fail,
but *when* it will fail.

One must consider the inevitability of an outage,
planned or not.”

Benefits of a Maintenance Outage

- Planned down time vs. unplanned
- Safety
- Reliability
- Preempting an actual problem
- Extending the life of the equipment
- Training of facility operators
- Discovery of unknown circuits and their destinations



**Avoid the
Unexpected!**

Consequences Of No Maintenance

The most common issues relating to insufficient maintenance of electrical equipment:

- Dirt & dust – restricts cooling, fouls mechanisms & lubrication, attracts moisture and compromises insulation
- Loose connections – develop heat, worsen contact resistances & develop more heat, contribute to arcing faults
- Old lubrication – restricts movement of mechanisms, worsens contact resistances and helps develop heat

Consequences Of No Maintenance

In most cases, a planned outage is the only way to perform comprehensive equipment maintenance. Lack of maintenance can lead to:

low level heating / nuisance tripping / equipment mis-operations / safety problems / accidents / electrical faults and fires / serious equipment damage

Loss of business

People hurt

Safety fines

Would you...
Buy a new car...



...and never change the oil?

Would you...
Own and occupy a building...

...and not maintain it's systems?



Reasons for no maintenance...

“If it’s not broke, why fix it?”

“Its been in operation for years . . . don’t mess with it.”

“It’s under warranty, the manufacturer will fix it if it breaks.”

“It might fail if you test it.”

“It was already tested at the factory.”

“It is not in the budget.”

“We cannot schedule an outage.”



12 12 2002



Making It Happen It Can Be Done!

- Requires advance planning and notifications to affected parties
- Commitment on the part of building owners and operators
- Ways to minimize system down time during a planned outage

What Makes A Successful Outage?

- No accidents or injuries
- Equipment is successfully maintained
- Systems back on line per schedule



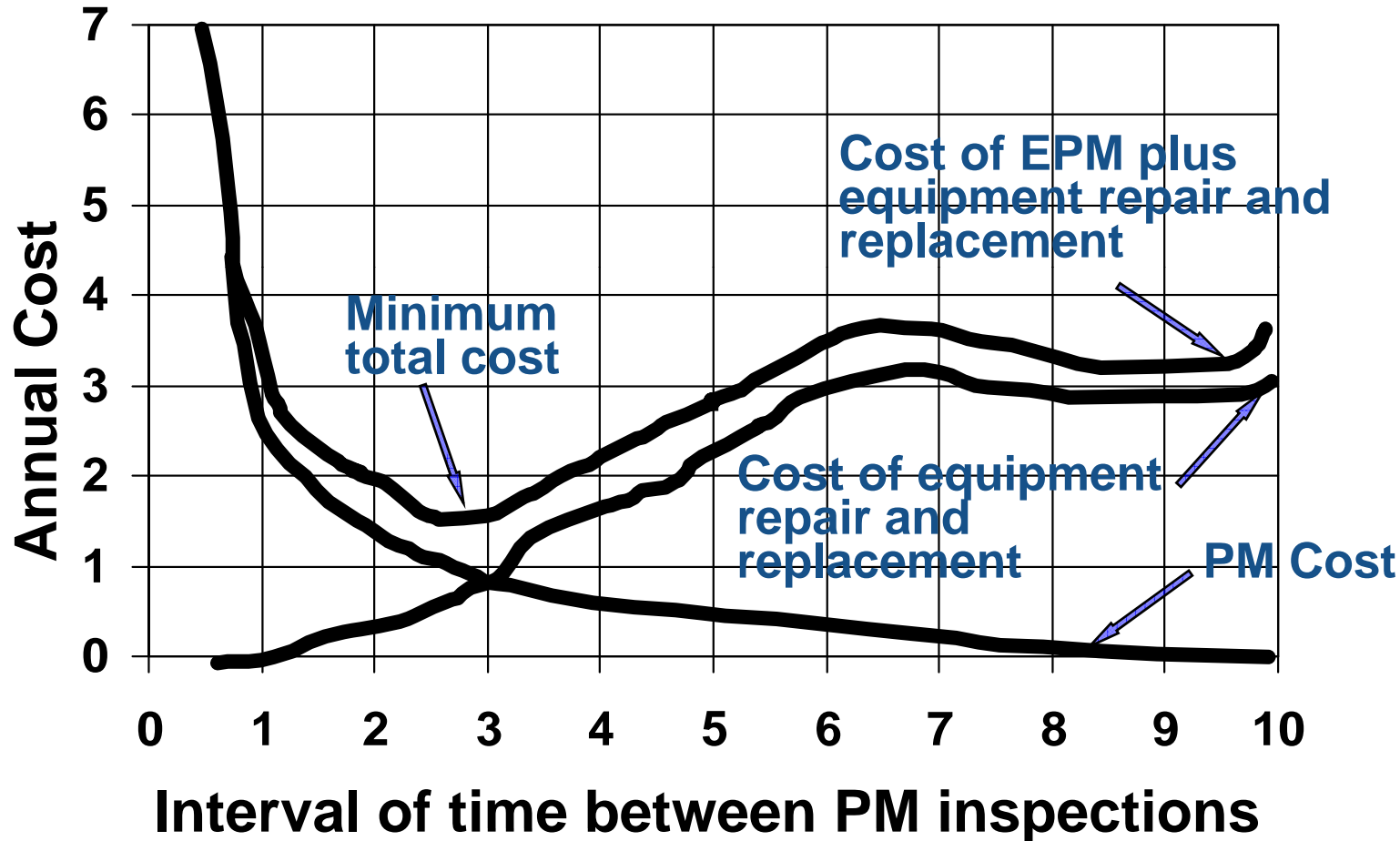
Considerations For Successful Outages

- Goal for the outage
- Scope of work
- Needs of the user groups and the building
- Timing limitations – duration & scheduling
- Picking the right company to perform the work
 - > level of experience
 - > available manpower
- Planning and advance notice
- Participation and agreement by all involved parties

Goals – What Is To Be Accomplished

- Why is this outage being performed?
- What can be accomplished during the outage?
 - > Maintenance procedures
 - > Install new equipment
 - > Upgrade existing equipment
 - > Correct known problems

Frequency – How often?



Scope – What Equipment to Include

Major electrical distribution components such as:

- > Low and medium voltage switchgear
- > Circuit breakers
- > Air switches
- > Transformers
- > Protective relays
- > UPSs
- > Transfer switches
- > Generators

Major mechanical system components.

Procedures



MISSION CRITICAL CARE



ASCO AUTOMATIC TRANSFER SWITCH SCHEDULED MAINTENANCE CHECKLIST

ASCO 962, 434 AND 7000 SERIES BYPASS MODELS DO NOT NEED TO BE DE-ENERGIZED

Refer to manufacturer's guidelines as listed in Operation and Maintenance manuals...

Or industry standards, such as NETA.

Procedure	Transfer Switch Status	
	De-energized	Energized
1. De-energize the switchgear and engine start signals.	Yes	No
2. Secure and lockout normal and emergency disconnects.	Yes	No
3. Remove the arc chutes and pole covers.	Yes	No
4. Verify and record all sensing and time delay functions in the switchgear.	Yes	Yes
5. Vacuum clean the accumulated dust from the switchgear and accessory panels.	Yes	Yes
6. Inspect for moisture or signs of previous wetness or dripping.	Yes	Yes
7. Remove dirt and grime with an approved solvent.	Yes	Yes
8. Clean and lubricate TS coil and operator linkage.	Yes	Yes
9. Inspect all insulating parts for cracks or discoloration due to excessive heat.	Yes	As Allowed
10. Inspect all main arcing contacts for excessive erosion.	Yes	Meter
11. Inspect all main current carrying contacts for pitting and discoloration due to excessive heat.	Yes	No
12. Perform contact resistance test on normal and emergency main contacts.	Yes	Meter
13. Inspect and clean all add-on panels and accessories.	Yes	Yes
14. Re-install arc chutes and pole covers.	Yes	N/A
15. Manually operate the main transfer movement to check proper contact alignment, deflection gap and wiping action and control contact operation.	Yes	No
16. Check all cable and control wire connections to the transfer switch control and sensing panel and other system components and tighten if necessary.	Yes	Controls Only
17. Reconnect Engine Start.	Yes	N/A
18. Re-energize the switchgear and conduct a test by simulating a normal source failure.	Yes	As Allowed
19. Perform millivolt drop readings across normal and emergency main contacts during transfer test.	Yes	Yes
20. Prepare Computer Generated Report* of inspection for each piece of equipment and submit to customer.	Yes	Yes

*A sample of this report is available upon request.

Procedures

Or industry standards, such
NETA.



7. INSPECTION AND TEST PROCEDURES

7.2.2.3 Emergency Systems, Automatic Transfer Switches

1. Visual and Mechanical Inspection

1. Inspect physical and mechanical condition.
2. Inspect anchorage, alignment, grounding, and required clearances.
3. Prior to cleaning the unit, perform as-found tests.
4. Clean the unit.
5. Use appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
6. Verify that manual transfer warnings are attached and visible.
7. Verify tightness of all control connections.
8. Inspect bolted electrical connections for high resistance using one of the following methods:
 1. Use of a low-resistance ohmmeter in accordance with Section 7.2.2.3.2.
 2. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 100.12.
 3. Perform a thermographic survey in accordance with Section 9.
9. Perform manual transfer operation.
10. Verify positive mechanical interlocking between normal and alternate sources.
11. Perform as-left tests.

Minimizing Down Time

- Redundant systems that allow for maintenance without facility outages
- Replacement with maintained spares
- Shutdown during “maintenance window”
- Temporary power sources and back-feeding

Method Of Procedure



CENTENNIAL BUILDING #2

MOP #103

DATE SUBMITTED: 10/20/09

Contractor Submitting MOP

Company :
 Address :
 Author :
 Contact Numbers :
 Signature of Author :

GENERAL DESCRIPTION OF WORK TO BE PERFORMED

Maintenance shut down of 1st floor Normal power distribution equipment.

SYSTEMS AFFECTED

All building Normal power electrical equipment.

RISK RATING: (Check One)

Low
 Medium
 High

PARTICIPANTS

- Building Operations and Electrical departments
 - Utility company
 - 3rd Party Testing company
 - Electrical Contractor

PROPOSED START DATE AND TIME: October 20, 2009

REVISED PROPOSED START DATE AND TIME:

ACTUAL START DATE AND TIME:

PROPOSED COMPLETION DATE AND TIME:

REVISED PROPOSED COMPLETION DATE AND TIME:

ACTUAL COMPLETION DATE AND TIME:

- Author, company, contact info
- Purpose – Goals for the outage
- General work description
- Systems affected
- Risk analysis or rating
- Participants
- Time & date info – start / finish

Version 1.0 10/14/09

MOP Safety Considerations

MOP Safety requirements should be as detailed as possible, including safety equipment and clothing, lockout / tag out and grounding procedures and locations, verification of equipment being de-energized, and checks of equipment prior to re-energizing.



General safety statements often mean that not enough attention is being paid to personnel safety, opening the door for an accident.

MOP Safety Considerations

All work should be planned and performed to be in accordance with OSHA and National Fire Prevention Association NFPA-70E requirements.

Contingency (Back-out) Plan

- Needs to be a written part of the MOP
- Indicate what scenario(s) require implementation of plan:
 - > Maintenance window requirements (duration of outage)
 - > Backup power failure
 - > Environmental parameters (temperature) exceeded
 - > Defective equipment found
- Include communication by key parties involved in the work, and final decision by owner
- Include an estimate of the time it will take to have systems back up and running under normal conditions

Contingency (Back-out) Plan

Basic Strategy of a Contingency or Back-out Plan includes:

- Thorough communication between the owner, MOP/work coordinator, and foremen for all work groups
- An evaluation of the safety considerations of the current state of affairs
- Returning all equipment currently being worked on to their normal condition
- A thorough inspection of all work sites for condition of equipment, clearance of personnel, and tool and material accountability
- Proceeding to a point in the MOP procedures where building systems begin to be returned to their normal status – re-start procedures

MOP Review Process

The MOP review process should be planned for multiple sessions by all pertinent owner, operator, contractor, and vendor groups. Plan for a minimum of 3 reviews and MOP revisions for complex procedures

Focus on:

- Safety
- Coordination of work activities
- Accuracy of procedures
- Realistic timing

Persons to include in the review process:

- Owner operations and user personnel that know the workings of the building
- Engineers that understand the design of the systems
- Contractors and other parties doing the work, know what must be accomplished

Preparation Activities

- Multiple early notifications to all building occupants
- Fuel topped off for facility emergency generator(s)
- Batteries refreshed for emergency lights
- Spare parts acquired for all equipment being worked on
- Review of past equipment issues and plan to address
- Tools, temp lights and test equipment staged
- Evaluate the need for alternate power sources
- What to do in case of injury

Other Outage Safety Issues

- Loudspeaker announcements of impending outage and that all personnel should be leaving the building
- Team(s) to sweep through the floors for any persons still in the building
- Lighting for exits & stairways
- First aid locations
- Central command point of contact

During The Outage

- Owner and lead person for the contractor stay in communication about progress, timing, and issues discovered. Any problems should be communicated to the Owner immediately.
- On larger procedures, coordinator for the contractor should have coordination and oversight as their primary function – not specifically involved in the work.
- Monitoring of building conditions such as environmental parameters, alarms, status of operating equipment.
- Each completed procedure should be initialed and the time noted on the MOP.

After The Outage

- Personnel and tool accountability
- Job completion summary – review of findings
- Defects found and action items
- Completed MOP should be kept as a template for future outages
- Safety review of personnel – Able to drive home??
- Persons coordinating the outage stay on site until all systems are back on line

Maintenance Report

The maintenance report should cover the following minimum information:

- Date of the maintenance
- Scope (list of equipment maintained)
- Maintenance procedures performed
- Results, including:
 - > Discrepancies
 - > Recommendations
 - > Maintenance and test data

Conclusion

Planned outages
and equipment
maintenance can
help keep a
situation like this...



Conclusion

...from turning
into a problem
like this!





Planned Outages



Mr. Bob Butt

Electrical Engineer

The Consulting Engineer

Responsibility/Participation

- ➡ **Design Phase / Pre-MOP (Major)**
- ➡ **MOP Planning / Preparation (Major)**
- ➡ **The Outage (Minor)**
- ➡ **Post Outage (Minor)**

Design Phase / Pre-MOP

System Design

- Verify / Update Facility Drawings
- Plans, One-Lines, Panel Schedules, etc.
- Code Requirements / Safety
- Equipment Specifications (Part 3)
- Design Analysis – Outage Description
- Cost Estimates
- Schedule
- Owner Feedback (dates, critical equipment, downtime limits, etc.)

Design Phase / Pre-MOP

Equipment Selection

- Review Vendor Proposals
- LCC Analysis / Risk / Compatibility of Alternative Proposals/Features
- Equipment Layout (to ensure fit, working clearances, construction pathways)
- Equipment Ratings (V, A, AIC, etc.)

Shop Drawing Reviews/Design Verification

Equipment Install/Acceptance Testing

Design Phase / Pre-MOP

Maintenance / Testing

- ➔ Reliability Analysis/MTBF
- ➔ Spares on hand?
- ➔ Risk Assessment/alternatives
- ➔ Scope of Work Definitions
- ➔ Specifications (NETA)
- ➔ Owner Feedback (outage window)
- ➔ Temporary Equipment Compatibility
- ➔ Safety Aspects

Contractor Short List / Prequalification

Design Phase / Pre-MOP

Temporary Utilities

- Mech / Elec Equipment Sizing (load definition)
- Power Cabling (routing, protection)
- Water – Potable / Sanitary / Fire
- Fire Alarm System
- Lighting

Equipment Tie-In Requirements

MOP Planning / Preparation

Establish Potential Outage Issues

- ➔ Equipment Age/Stress/History
- ➔ Equipment Maintenance Records
- ➔ Environmental Aspects (heat/cold, humidity, wind, snow, etc.)
- ➔ Safety
- ➔ Inadvertent Breaker Trips
- ➔ Malfunctions

MOP Planning / Preparation

Preliminary Activities (Prior to Outage)

- Definition of all Prelim. Tasks
- Establish Realistic Timeline
- Review Meetings
- Temporary Equipment Procurement / Site Delivery/Inspection
- Equipment Site Compatibility (temporary utilities)

MOP Planning / Preparation

Review Meetings

- ➡ Owner / Engineer / Contractor / Vendor Involvement
- ➡ Detailed Review of Preliminary Activities
- ➡ Detailed Review of Outage Procedures
- ➡ Responsibility Matrix / Definition
- ➡ Back-Out Planning/Triggers

MOP Planning / Preparation

Final Review and Discussion

Emergency Contact List

**Third-Party Coordination (Xcel, Qwest,
local government)**

Approval Signatures

The Outage

Observation

- ➡ **Verification of Procedures**
- ➡ **Note Variations to MOP**
- ➡ **Track Schedule**
- ➡ **Site Walk-Through/Document Findings**

The Outage

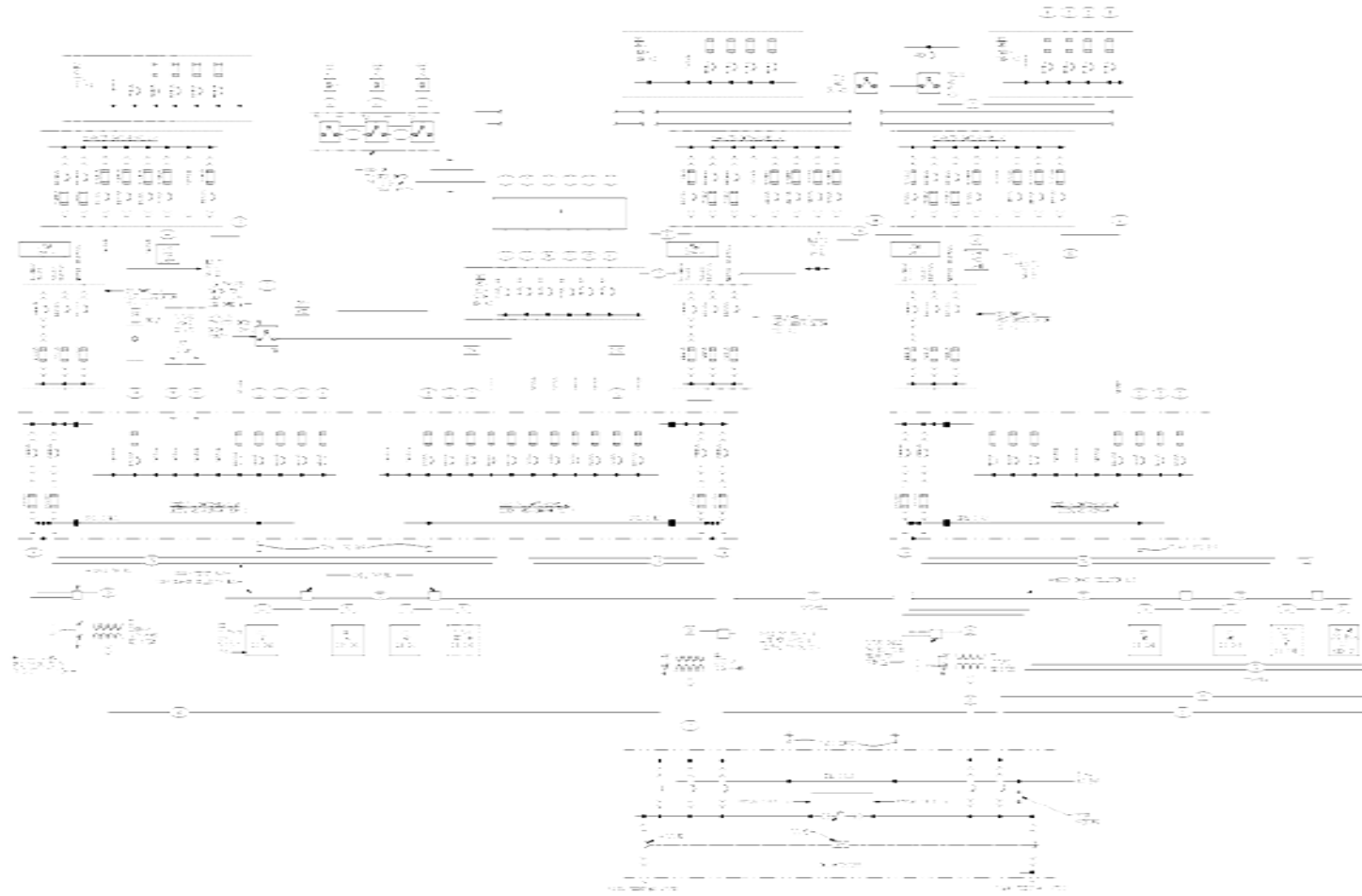
Observation

- ➡ Note values from measurements/tests.
Compare with expected data
- ➡ Update drawings with any changes
- ➡ Review observations/concerns with the
Owner

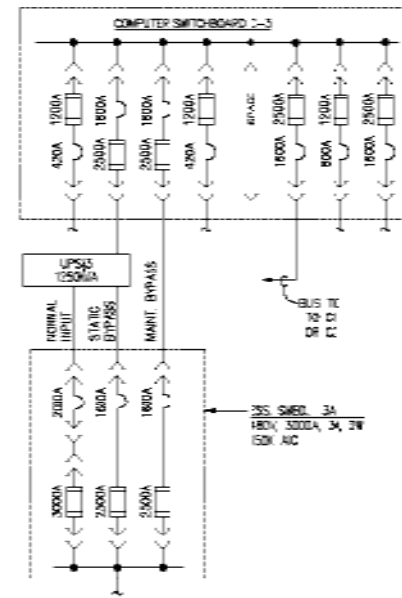
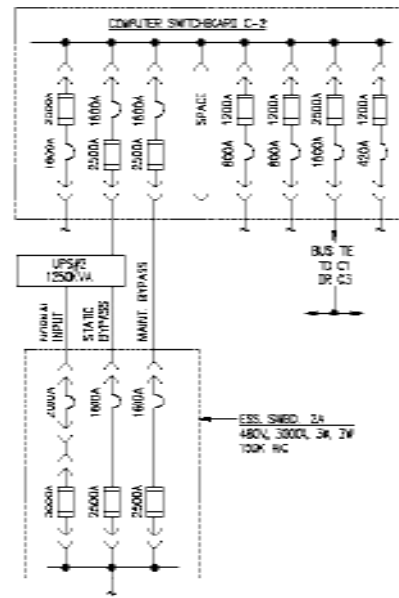
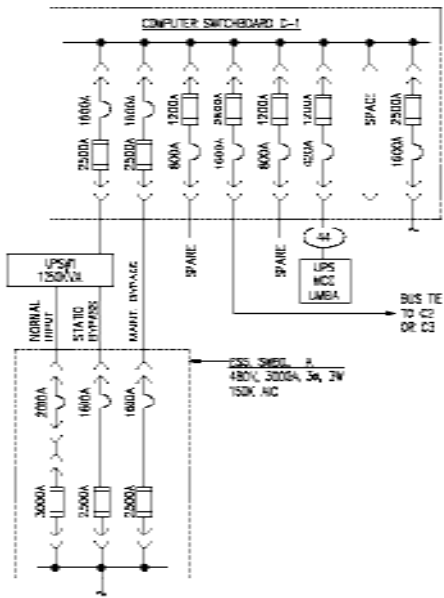
The Outage

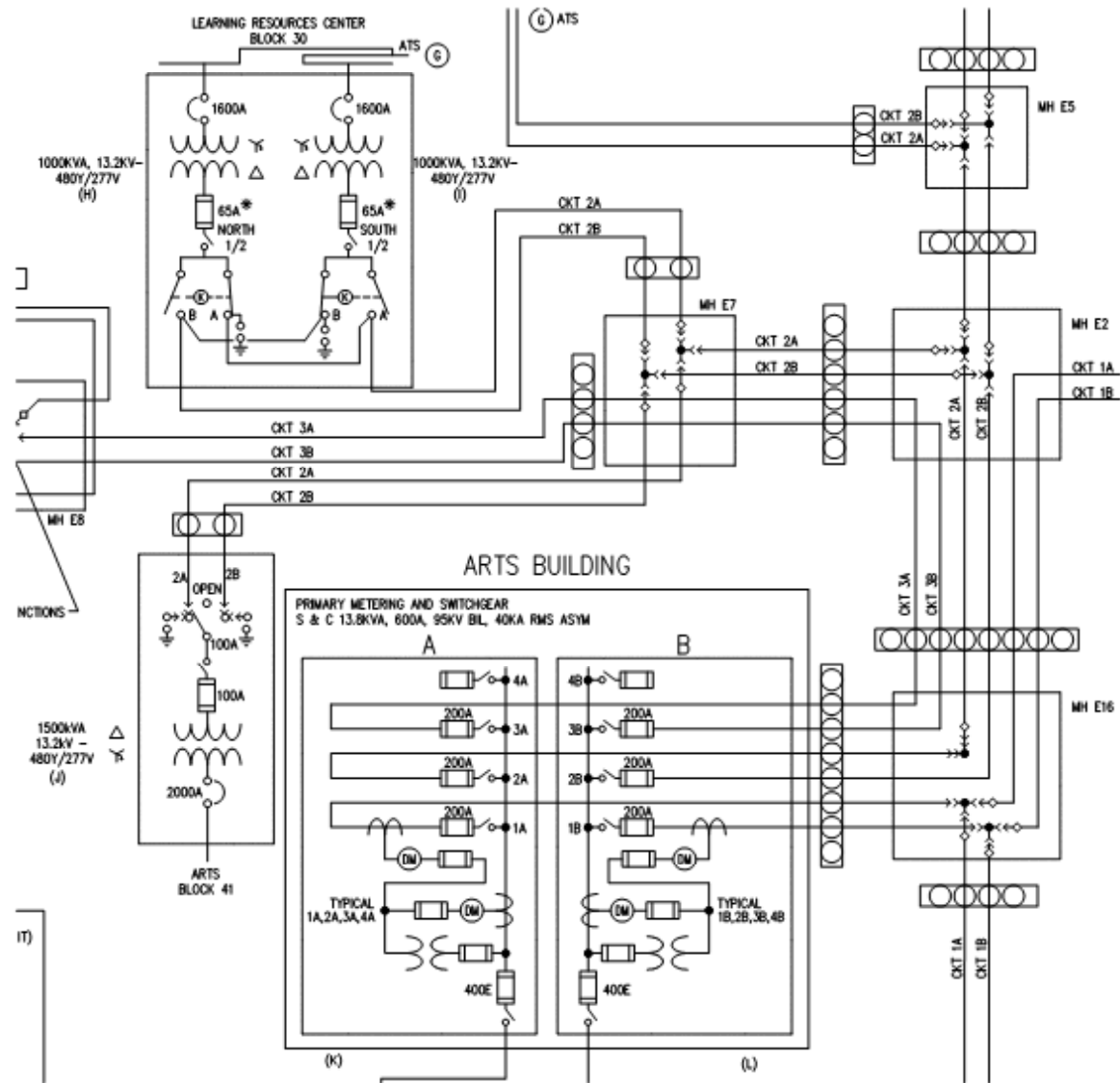
Procedural / Step Changes

- ➔ Identify problem/implications
- ➔ Identify additional/modified steps, if necessary
- ➔ Review implications of change(s) via drawings/equipment affected
- ➔ Major MOP changes typically *not* recommended during outage



ONE LINE DIAGRAM - 300,000 SQ. FT. BLDG. (125,000 SQ. FT. DATA CENTER)





The Outage

Back-Out Plan

- ➔ Potential Problems Identified During Procedure (changes to MOP)
- ➔ Equipment Failure
- ➔ Test Results Outside of Recommended Limits
- ➔ External Influence (weather, utility, etc.)
- ➔ Safety Mishap

The Outage

Back-Out Plan

- ➔ Agreement between all parties that back-out is necessary
- ➔ Impact on Facility
- ➔ Review steps / procedures
- ➔ Notify relevant external parties
- ➔ Reverse steps of approved MOP

Post Outage

Meet with all participants to review sequence of events, make observations, solicit suggestions for improvement (lessons learned for future MOP's), etc.

Discuss dates/requirements for next outage (if required).

Identify requirements to correct problems, improve equipment/system operation, etc.



Planned Outages



Mr. Don Egan

Senior Project Manager

The Electrical Contractor Overview

- MOP Planning / Preparation
- Identification of temporary Power and Cooling Needs
- Coordination of Subcontractors / Suppliers and Vendors
- The Work
- Budgeting

MOP Planning / Preparation:



Field Research

- Identify what the owner would like to accomplish during the outage.
 - > Items must be identified and incorporated into the final MOP.
- Identify what the General Contractor would like to accomplish during the outage.
 - > Items must be identified and incorporated into the final MOP.
- What is the Testing company's scope of work.
 - > Items must be identified and incorporated into the final MOP.
 - > Has a Coordination study been completed?

MOP Planning / Preparation:



Safety NFPA 70E Requirements:

- Has an ARC Flash Study been performed?
- Lock Out Tag Out Procedures.
 - > Identify what sources of power to be locked out.
 - > Identify the required persons needing to lock out.
- Lock Out Tag Out Equipment.
 - > Grounding Equipment
- Voltage Testing Equipment
 - > Phasing sticks (for medium voltage testing)
 - > True RMS Voltage Meters
 - > Digital Ammeters
 - > Phase Rotation Meters
 - > Personal meters for anyone working on electrical equipment during the MOP.

MOP Planning / Preparation:



Site Communication

- Site Radios to communicate with General Contractor, Engineer and owner.
- Cell Phones
- Does the Site have a cell phone repeater that needs to be on Temporary or Emergency Power to maintain communications in the event of an emergency?
- Contact List

MOP Planning / Preparation:



Identification of the required On-site Vendors needed to shut down / start up equipment, or in the case of a failure

- UPS Technician
- Generator Technician
- Mechanical Contractor
- Automatic Transfer Switch Technician
- Square D, Cutler Hammer, Siemens or GE
- Load Bank Vendor
- Xcel Energy
- Fire Alarm Technician
- Building Management Technician

MOP Planning / Preparation:



MOP Review Meeting

- Set a schedule: ie. Weekly or by-weekly in preparation of the MOP
- Set a time and date of when each person's input is due for completion into the final MOP
- Walk through the MOP while walking through the project. Try to identify errors in the MOP and or errors in the work sequence.
- Address any additional items that the owner may want to be accomplished during the outage.
- Discuss who is the keeper of the written working MOP while the work is being performed
 - > Follow the MOP and Check off items as they are completed
- Identification of responsible parties needing to sign the MOP

MOP Planning / Preparation:



Additional Information Needed on the MOP

- Emergency Procedures
- Evacuation Plan
- Meeting Locations
- Procedures for deviations in the sequence of work
- Phone Numbers
 - > Emergency Medical Services 911 or plant specific
 - > Denver Breaker
 - > Weaver Electric
 - > H&H Transformer
 - > Local Supply Houses
 - > Extra Man-Power

MOP Planning / Preparation:



MOP Closeout

- Tool Check
 - > Does everyone have all the tools with them they used?
- All Clear Discussion
 - > Ready to start re-energizing equipment after
- Remove Grounds
- Remove Lock out's
- Re-energize Main Service
- Phase Rotation checks
- Voltage Checks
- Equipment Start-up

Temporary Utilities



- Identification of the temporary power and or cooling requirements for the entire site direction needs to be provided by the owner
- Is the Testing Company providing their own temporary generator for operating testing equipment?
- Identification of the temporary cabling requirements
- Temporary power panel
 - > Power for small tools
 - > Power for battery chargers

Temporary Utilities



- **Temporary lighting requirements**
 - > Light Stands
 - > Temporarily feed a lighting panel?
 - > Head Lamps for all workers on site?
- **Sizing of the temporary generator set**
- **Fuel**
 - > Who Provides?
 - > How much will we need?
 - > Delivery to site?

Temporary Utilities



- **Staging**
 - > **Delivery of the Generator to the site**
 - > **Location of the temp Generator**
 - **Exhaust Fumes**
 - **Extra heat in the area**
 - **Noise**
 - > **Pickup of the Generator from the site**
 - > **Minimize the rental charges**



Coordination

Employees, Vendors/Subcontractors

- Identification of Responsibilities
- Who is paying who?
- Provide an organizational chart and include the phone number of all lead personnel
- Sign in sheet
 - > All personnel must sign in and out on or off site
- Identification of Parking Areas
- Identification of Staging areas for all contractors/vendors involved in the MOP
- Extra Man-power on call in case of an emergency!
 - > What happens if?
- Food and Liquids

The Work

- **Plan For The Un-planned**
 - > **What happens if a breaker fails during testing?**
 - > **Extra Breaker on Hand?**
 - > **Extra Trip Units for Breakers?**
 - > **Identify Long Lead Items that cannot be found locally**



The Work

- **Maximize the most out of your outage**
 - > **IR Scan Prior to the outage**
 - > **Identify areas that need extra attention or maintenance during the outage**
 - > **Clean and Torque all electrical equipment while de-energized**
 - > **Assignment of tasks to the individuals performing the work, allow ample time to complete the task, by still maintaining the overall MOP schedule**
 - > **Plan your work, work your plan!**



The Work

- **All the required Tools on site?**
 - > **Torque wrenches**
 - > **Shop Vacs**
 - > **Cleaning supplies**
 - > **Switching sticks**



The Work

- All the required PPE needed to complete the work safely
 - > Rubber Goods
 - Rubber Goods tested and up to date?
 - > Extra Safety Protection
 - > Arc Flash Protection
 - > Hearing Protection
 - > Fall Protection



Budgeting

- **Site Walk. Who should be included**
 - **Owner**
 - **General Contractor**
 - **Testing Firm**
 - **Electrical Engineer**
 - **Mechanical Engineer (if applicable)**
 - **Electrical Contractor**
 - **Mechanical Contractor**



Budgeting

- **Costs for:**
 - > **UPS Technician**
 - > **Generator Technician**
 - > **Mechanical Contractor**
 - > **Automatic Transfer Switch Technician**
 - > **Square D, Cutler Hammer, Siemens or GE**
 - > **Load Bank Vendor**
 - > **Xcel Energy**
 - > **Fire Alarm Technician**
 - > **Building Management Technician**

Questions