



Disaster Recovery Planning Using New Revisions to NFPA 70B

October 14, 2013—9:00-9:50 AM

Following this session, you will be able to:

- List key provisions of the NFPA 1600 and NFPA 70B related to disaster recovery.
- Identify the amount of internal and external recovery assistance needed.
- Describe electrical code requirements for temporary and emergency power sources.
- Discuss how NFPA 70B and NFPA 1600 principles can be used to bring electrical systems back up and functional.

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Covered Topics

- Introduction
- NFPA 1600 and NFPA 70B
- Disaster Recovery Plans
 - Emergency Action Plan
 - Safety Plan
 - Reactive Actions
- Case Studies
 - Damage Assessment
 - Recovery Assistance
 - System Priorities
- Best Practices




May 2011 Tornado Disaster - Joplin, MO

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NFPA 1600 – Disaster/Emergency Management and Business Continuity Programs

- Why have an Disaster Recovery Program?
 - Safety
 - Business recovery/continuity
- How to get started?
 - NFPA 1600 – framework for disaster recovery program
 - Covers all potential hazards and damage (not just electrical)
 - Provides a common set of guidelines for recovery plans
 - Emergency Response
 - Includes audit, testing and exercise criteria
 - Embed into the workplace culture



August 2011 - Washington Monument Earthquake Damage



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NFPA 70B – Electrical Equipment Maintenance

- Why have an Electrical Preventive Maintenance Program?
 - Key resource in a disaster recovery program (NFPA 1600)
 - Better understanding and identification of site factors which accelerate deterioration
 - Recognize impending issues and implement solutions before major damage
 - Minimize equipment breakdowns and unplanned outages
 - Maintained equipment enhances safety
- How to get started?
 - NFPA 70B-2010
 - Base requirements for a maintenance program
 - Provides thorough set of recommended practices
 - Manufacturers recommendations
 - Industry References – NEMA AB3, KS3, Water Damaged Equipment
- New 2013 Edition – Addition of Electrical Disaster Recovery Chapter

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NFPA 70B – 2013 Electrical Disaster Recovery



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NFPA 70B – 2013 Electrical Disaster Recovery

Catastrophic event categories – Understand the system exposure to both initial disaster events and potential secondary or resulting events.

Initial event

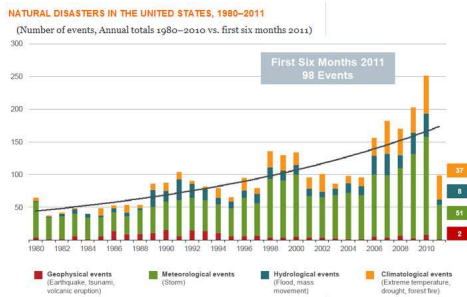
- Fire - soot, material and equipment damage, water damage, structural
- Flooding – water and structural damage
- Hurricane - water and structural damage, utility infrastructure damage
- Tornadoes - water and structural damage, utility infrastructure damage
- Earthquake – structural damage, utility infrastructure damage

Investigate area disaster history – Understand the limitations of this data.

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There are an increasing number of natural disasters



Source: © 2011 Munich Re. NatCatSERVICE

Simply determining the 100 yr flood level may not be enough.

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Example – Nashville 500 Year Flood

Background
May 3, 2010:
Opry Mills Mall,
200 stores
Up to 10 feet of water



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NFPA 70B – 2013 Electrical Disaster Recovery

Develop a Disaster Recovery Plan

- Understand what you have – Keep up to date system drawings, schematics, and equipment documentation in a safe, central location
- Define areas of responsibility
- Include a safety plan
 - Site specific
 - Key electrical safety aspects – system/equipment training, lockout/tagout, test before touch, safety grounds, PPE requirements

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NFPA 70B – 2013 Electrical Disaster Recovery

Develop a Disaster Recovery Plan - Continued

- What are the system priorities? Determine the equipment repair priorities and strategy.
 - Risk assessment
 - Equipment or spare parts with long leadtimes
 - Availability of equipment replacement
 - Equipment supplier contact

Examples of typical equipment categories are:

- (1) Category 1 Medium-voltage equipment including distribution transformers.
- (2) Category 2 Low-voltage distribution equipment.
- (3) Category 3 Electric motors.
- (4) Category 4 Balance of the plant

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Example: Transformers (Category 1)



Transformers are considered by Corporate Risk Managers and Insurers as the most critical equipment inside plants because of the large quantity of oil in contact with high voltage elements.

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What can happen?

Uncontrollable Causes:
Natural Disasters

- Lighting
- Storms
- Hurricane
- Tornados
- Earthquakes etc..



- Controllable Causes:**
Improper Maint /Operation:
- Insulation Failure
 - Design
 - Oil Contamination
 - Overloading
 - Loose Connection
 - Moisture

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Category 1 Example

Manufacturing facility produces over \$1M products per day



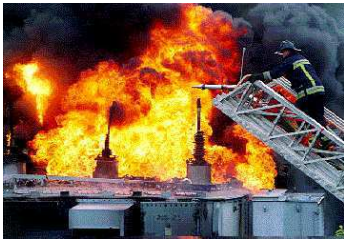
- Lighting strikes 25MVA transformer
- Resulting fire spread to adjacent main transformer

Entire facility experienced 23 day blackout.

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23 Day Blackout



- Special KVA rated transformer
- Municipal power company has no spares
- Short-Term Power Restoration
 - Identify temporary power equipment
 - Logistics
 - Financial approvals

Temporary 25 MVA Transformer Rental Cost = ~\$35,000 per month
Delivery charge priced separately

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NFPA 70B – 2013 Electrical Disaster Recovery

Develop a Disaster Recovery Plan - Continued

• **Mobilization of recovery personnel** - One of the biggest challenges for a commercial or industrial facility is providing enough qualified contractors and disaster recovery specialists to perform required remediation to the facility.

• **How do I accomplish this?**

- Understand the need based on system priority
- Availability of internal/external recovery personnel
- Service contracts
- Emergency contact information

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NFPA 70B – 2013 Electrical Disaster Recovery
Develop a Disaster Recovery Plan - Continued



• **Temporary and Emergency Power**

- What are the temporary and emergency power needs should there be a loss of utility power?
- Will the temporary and emergency source be impacted by the event? If so, external agreements in place?
- How will the standby systems provide power to critical systems and lighting?
- The plan should include **dedicated personnel responsible for temporary power** along with the procedures to be followed.

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NFPA 70B – 2013 Electrical Disaster Recovery

Develop a Disaster Recovery Plan - Continued

Onsite provisions for temporary power -

Temporary Equipment:

- Safe Transfer to temporary power
 - Power disconnect w. camlock
 - Key Interlocks
- Installation safety
 - Protection from live parts
 - Elevated, shielded by building, temporary fencing
- Other – Ventilation, noise, location



3200 Amp @ 480 Volt (2000kW) Generator Connection Cabinet - Access Door open showing Cam Lock connections

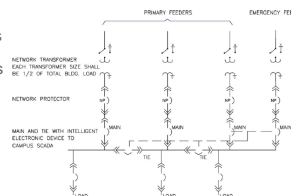
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NFPA 70B – 2013 Electrical Disaster Recovery
Develop a Disaster Recovery Plan - Continued

• **Key elements - Typical emergency power procedures**

- (1) Backfeeding of equipment
- (2) Individual motor starters for pumps
- (3) Temporary signage and barricades
- (4) Site generator location maps
- (5) Fueling schedules
- (6) Written form for the addition of electrical power
- (7) Access and exhaust flow



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NFPA 70B – 2013 Electrical Disaster Recovery

Develop a Disaster Recovery Plan – Continued

Reactive Actions: Impending Event

- **Communication to recovery personnel**
- **Securing the facility to limit damage.** If possible, electrical and mechanical systems should be shut down and secured, and critical components should be removed or preserved.

Examples of tasks to limit damage:

- (1) Remove critical motors from their base and raise them above the flood line.
- (2) De-energize power to prevent electrical short circuit and arcing damage.
- (3) Secure storage tanks and other large devices that may float away.
- (4) Sandbag the fronts of electrical equipment rooms to limit water and debris entry.
- (5) Remove critical computer and electronic equipment from the site.
- (6) Remove all electrical equipment and supplies stored at ground level.

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NFPA 70B – 2013 Electrical Disaster Recovery Develop a Disaster Recovery Plan – Continued

Reactive Actions: Post Event

- **Notification to insurance carrier.** As soon as feasible the site insurance carrier's claims representative should be notified of the event.
- **Initial damage assessment.** One of the first tasks in assessing equipment and system damage to electrical equipment involved in a disaster event is to gather all pertinent drawings and documentation available and perform a walkthrough and initial assessment of the entire electrical infrastructure.

Additional copies of electrical documents may need to be stored at an off-site safe location

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NFPA 70B – 2013 Electrical Disaster Recovery Develop a Disaster Recovery Plan – Continued

Reactive Actions: Post Event

Guidelines for restoring electrical power:

- Make sure the power is off before working on any equipment – Follow safe work practices and NFPA 70E
- Equipment with visible damage must be replaced
- Many types of electrical equipment must be replaced after exposure to water, even if no damage is apparent



<http://www.nema.org/setsd/water-damaged.cfm>
[http://www.schneider-electric.us/gf/codes... Select Applications](http://www.schneider-electric.us/gf/codes...Select%20Applications)
<https://www.nema.org/Standards/Pages/Evaluating-Fire-and-Heat-Damaged-Electrical-Equipment.aspx>

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NFPA 70B – 2013 Electrical Disaster Recovery Develop a Disaster Recovery Plan – Continued

Reactive Actions: Post Event

Guidelines for restoring electrical power:

- Electrical equipment should be selected and applied in accordance with the ratings, nameplates, wiring diagrams, instructions and warning labels for that equipment
- Electrical equipment should be installed in accordance with the National Electrical Code® and other applicable local and state codes
- Installations should be inspected by qualified authorities before restoring power



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NFPA 70B – 2013 Electrical Disaster Recovery Develop a Disaster Recovery Plan – Continued

Reactive Actions: Post Event

● **Repair or replace.** During the documentation process, initial decisions should be made pertaining to each piece of equipment that is damaged. Seeking the services of qualified equipment assessment personnel, whether manufacturer representatives or subject matter experts is important in the decision making process.



- **Repair or replace decisions.** Many factors can affect the repair/replace decision. Some of the likely decisions are:
 - (1) Can the equipment be repaired or does the equipment need to be replaced?
 - (2) Can the repairs take place on site or does the equipment need to be sent to a repair facility?

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NFPA 70B – 2013 Electrical Disaster Recovery Develop a Disaster Recovery Plan – Continued

Reactive Actions: Post Event

Repair or replace factors. Some of the factors that may affect the repair or replace decision:

- (1) Is the equipment currently manufactured?
- (2) Are there long lead times to replace with new?
- (3) Will equipment performance be compromised if repaired?
- (4) What is the age of the equipment?
- (5) What is the reliability requirement?
- (6) Can it be effectively repaired?
- (7) Is the manufacturer still in business?
- (8) Is the repair contractor qualified for the task?
- (9) Will the AHJ allow repair or replacement?
- (10) What is the financial impact?
- (11) What is the total outage time required?

**Process to
issue electronic
or manual POs
after a disaster?**

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Reactive Actions: Post Event

• **Documentation.** All electrical components or equipment should be properly documented prior to removal to ensure the equipment is reinstalled properly. The documentation process includes:

- (1) Tag each piece of equipment.
- (2) Label all control and power wires.
- (3) Take a digital picture of each piece of equipment.
- (4) Sketch an accurate diagram of each piece of equipment on the electrical equipment drawing sheet.
- (5) Fill out the electrical equipment tracking form.
- (6) Save all pictures on a local database.
- (7) File the electrical equipment drawing sheet.
- (8) Create a master electrical equipment tracking document.
- (9) Shipping documents of all electrical equipment

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Best Practices

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Best Practices: Electrical Disaster Recovery Plan

Guidelines:

1. Define the Criteria of an Disaster Emergency
2. Identify Electrical Equipment that is Critical to Business Operations
3. Selection of Outside Vendors and Pre-Negotiated Commercial Terms & Conditions
4. Define Internal and External Responsibilities
5. Define the Equipment and Service Scope
6. Emergency Contract Terms
7. Contact Information



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Best Practices

•1) Define the Criteria of an Disaster

- Lighting strikes on service entrance transformers and flooding of backup generators clearly indicate operational 'states of emergency'.
- Are nuisance tripping on circuit breakers or power quality issues considered emergencies?
- When a state of emergency should be declared should clearly define what constitutes an electrical emergency.

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Best Practices

•2) Identify Electrical Equipment That is Critical to Business Operations

- On the single-line diagram, trace the power from the incoming utility source to every piece of electrical equipment feeding critical business operations.
- Perform an analysis on each of these critical assets to include availability in the market, lead times, and a plan of action if and when the equipment is no longer functional.
- For most critical assets, it is necessary to understand requirements for both temporary and permanent power restoration.
 - Cost of temporary rentals
 - Logistics
 - Contacts
 - Testing

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Best Practices

•3) Selection of Outside Vendors and Pre-Negotiated Commercial Terms & Conditions

- Without pre-negotiated emergency service contracts, companies may suffer from overpricing and insufficient support.
- In addition to pre-negotiated normal and emergency rates, due diligence should include estimated response time and procedures for large-scale project coordination (see Step 4).
- The selected vendor(s) should have the depth and experience to handle major disasters.

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Best Practices

•4) Define Internal and External Responsibilities

- The plan should clearly define 'who has responsibility for what' in restoring power to the facility.
- Customer's responsibility such as providing:
 - Electrical one line diagrams
 - Energization procedures
 - Coordination and communication activities between multiple vendors through a central contact.
- Third-party vendor(s) should provide how they will approach an emergency at your facility such as:
 - Assessing damage
 - Mobilizing resources
 - Appointing a project manager
 - Establishing a command center.

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Best Practices

•4) Define Internal and External Responsibilities

In some cases, the plan/program should be signed off by customers **and** facility management companies. Why?



Customer leases multiple floors (one floor being a data center) from a large building. IT manager may have **no control** over the equipment feeding power to office space and data center

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Best Practices

•5) Define the Equipment and Service Scope

- This section will further define the equipment and associated work scope.
- For example:
 - Equipment:
 - An electrical distribution service company can define the equipment scope to be from the utility service entrance (13.8 kV) to low voltage switchgear (480 V).
 - Scope:
 - The associated work scopes include equipment installation and commissioning in both temporary and permanent scenarios.

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Best Practices

•6) Emergency Contract Terms

- Emergency contracts should be written for a specific time period, with an expiration date. It is also recommended to add expiration dates to the plan for self-auditing purposes.
- A suggested best practice is to audit the plan when the electrical safe work practices plan is being audited which is every three years according to NFPA 70E – 2012.

•7) Contact Information

- This section of the plan should include the latest contact information for anyone (internal or external) who has a defined responsibility in restoring power due to an emergency.

•8) Audit the Electrical Disaster Program and Embed into Culture

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Case Study: Generator Recovery

•Pinnacle Building

- Nashville's newest 29 stories class AA office tower
- LEED Gold certified skyscraper
- Officially Opened February 10, 2010 (Flood, May 2nd 2010)

•Bass, Berry & Sims, PLC

- One of the first tenants
- Occupy 9 floors of Pinnacle Building
- Over 200 Attorneys
- Around 400 employees




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Day 1

- 9 PM building power went out
- Fully operational running on generator
- Deployed IT staff to office to monitor
- At midnight Metro police evacuated building

3 hours to take action before mandatory evacuation - Priorities!



Second Avenue downtown, at the base of the newly-constructed Pinnacle building.

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Day 2

Reactive Actions


4:30 AM arrived at building

- IT was operational but generator was surrounded by water
- Water levels were holding
- Refueled generator

~10 AM water began rising

- Made decision to shut down generator but ...
- Generator flooding made the decision before soft shutdown action
- Activated emergency technology plan
 - Brainstorming session
 - Move servers
 - Replace generator

~10AM total outage including data center




Water rising next to Pinnacle building generators

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Day 3

- Located another generator in Smyrna, TN (20 miles)
- Generator power restored late afternoon
- Brought datacenter online

Data center was down for over 31 hours



Temporary Generator Next to Building

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Next Few Days

Day 4

- Building power still out:
 - No lights, air conditioning, No toilets
- Setup 24 hour staff rotation to monitor/refill temp generator(s)

Day 5

- Water level retrieved enough to inspect building generator for damage
- Drained generator but waiting on parts to make repair



AC Issue



Power Issue



Water Issue

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Next Few Days

Day 10

- Repaired generator
- Performed 4 hour load test
- Switched to firm generator
- Maintained backup generator for 2 weeks

Day 11

- Nashville Electric Service (NES) power was restored
- Switched from generator power to NES



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Summary: are you prepared for a natural disaster?

Total outage: 11 days

Power went out, data center running on temp gen.	May 2 nd 9:00pm	3 hours before mandatory evacuation
Mandatory evacuation from Metro Police	May 2 nd 12:00am	
Water rose and complete outage	May 3 rd 10:00am	EAP Priorities
Found (Lucky) and restored temp power to data center	May 4 th 4:30pm	31 hours data center down time
Able to assess generator damage but waiting on repair parts	May 6 th	
Parts received and repaired generator	May 11 th	Emergency Service Contracts
Switched to municipal power	May 13 th	5 days to bring back building generator
		Critical Spare Parts

Key Learning

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Best Practices

Pro-Active Planning: How to insure facility is prepared for natural disaster – Use NFPA 1600 & 70B

- Develop and Audit Emergency Action Plan
 - Define the equipment and service scope
 - Determine critical points and long leadtime items
 - Define the criteria of an emergency
 - Pre-Negotiated commercial details
 - Emergency Contact Information
 - Protocol Procedures for both internal and 3rd party vendor
 - Risk Analysis (High, Med, Low) & Mitigation Plan
 - All internal and vendor contact information
 - Add expiration date on document for self auditing

How to execute the right way to bring your facility back up and running

- Knowledge on water damage equipment
 - Introduction
 - What do I need to know??
 - Is there equipment that needs to be replaced in its entirety??
 - Can some equipment be dried out and reconditioned??
 - What can I use to clean my equipment??
 - Available Industry and SE standards
- How to I properly bring facility back up to power short and long-term?


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Questions???

Thank you!!!

About the Instructor

- Chad Kennedy, P.E.
 - Manager, Industry Standards at Schneider Electric
 - Member NEC CMP 13
 - Member of UL, NEMA, and IEEE Technical Committees for Panelboards, Switchboards, Switches, and Switchgear
 - Member of NFPA and NFPA Electrical Section





Additional Resources - <http://products.schneider-electric.us/support/technical-library/?event=detail&id=09008926804789e4&cat=0b00892680470585>

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