Energy Management Principles

- **Reliable**
  - Ensure reliable energy supply

- **Sustainable**
  - Reduce CO$_2$ emissions

- **Cost-effective**
  - Identify energy efficient opportunities and balance upfront investment costs with long-term savings potential
Electric Utility Mission

- Manage campus power supply
- Keep 15kV power system operational
- Maintain power quality (power factor and voltage)
- Develop standards and interface with new projects
- Maintain outdoor lighting/generators/UPS’s
- Construct new/remodeled services
- Support out-state facilities
Campus Electrical System

- 20 Electricians
- 4 Electrical Engineers
- Buildings Services (~220)
- Manholes (~400)
- Cable
- Ductbank
- 130 Generators
- Outdoor Lighting
Typical Feeder Set Annual Load Profile

CAM 11, CAM 22 AND CAM 31 LOAD PROFILE

KVA of load being fed

Date of Reading
Outage Recovery Protocol

- Receive notification
- Get on campus – easier during week (24/5 M-F)
- Find out what is w/o power
  ~BSAC, SCADA, Xcel
- Look for cause of the outage
- Isolate cause and re-energize buildings
- Repair cause and return to normal operations
High Voltage Switching Procedure
University of Minnesota
Facilities Management
Electric Utilities

11-68 CAM 32 off and grounded (B036)

DATE WRITTEN: 01 Sept 2011.

WRITTEN BY: JIM CHARTRAND

PURPOSE: To unload CAM 32 feeder to re-configure due to Norris(036) demo

RELATED PROCEDURES: None

STATUS OF SYSTEM: Grounds and Hold cards taken.
In field at start of procedure: 0GRN 0G 0H 01
Placed during procedure: 2GRN 3G 1H 03
Removed during procedure: 0GRN 0G 1H 01
Remaining in field at end of procedure: 2GRN 3G 1H 03

LOAD GAIN / SHED: CAM 42 to gain_______amps, CAM 32 to shed_______amps,

Notes: Hold cards are to be held in the name of: Alphonso Fleming (The Authorized Employee)

6. SANFORD HALL (028) pad mount transformer Key(s) no.

JOB SPECIFIC EQUIPMENT, REVIEW WITH FOREMAN

____ 6.1 Verify closed CAM 42 load break elbow terminations
____ 6.2 Verify closed CAM 32 load break elbow terminations
____ 6.3 Verify closed CAM 42 Oil switch
____ 6.4 Verify open and Hold CAM 32 Oil switch

7. WILKINS HALL (030) pad mount transformer Key(s) no.

____ 7.1 Verify closed CAM 42 dead break elbow terminations
____ 7.2 Verify closed CAM 32 dead break elbow terminations
____ 7.3 Verify closed CAM 42 Oil switch
____ 7.4 Verify open and Hold CAM 32 Oil switch

8. EDUCATION SCIENCES VAULT (041) Key(s) no.

____ 8.1 Verify closed CAM 42 PLI switch.
____ 8.2 Verify open and Hold CAM 32 PLI switch.

9. NORRIS GYM (036).

____ 9.1 Close, and verify CAM 42 PLI switch.
____ 9.2 Open, verify and Hold CAM 32 PLI switch.

10. BURTON HALL VAULT (008)

____ 10.1 Close, and verify CAM 42 PLI switch.
____ 10.2 Open, verify and Hold CAM 32 PLI switch.

11. ELLIOT VAULT 2 (020)

____ 11.1 Verify closed CAM 42 PLI switch.
____ 11.2 Verify open and Hold CAM 32 PLI switch.

12. ELLIOT VAULT 1 (020)

____ 12.1 Close, and verify CAM 42 PLI switch.
____ 12.2 Open, verify and Hold CAM 32 PLI switch.

13. FRASER HALL (051)

____ 13.1 Verify closed CAM 42 TIE PLI switch.
____ 13.2 Verify closed CAM 32 TIE PLI switch.
____ 13.3 Verify closed CAM 42 PLI switch.
____ 13.4 Verify open and Hold CAM 32 PLI switch.

14. APPLEBY HALL (037)

____ 14.1 Close, and verify CAM 42 PLI switch.
____ 14.2 Open, verify and Hold CAM 32 PLI switch.
Failure to Follow Procedure

• Probably increase the equipment damage
• Increase the cost to restore service
• Increase length of outage
• Increase the number of people affected
Internal Email Correspondence

• Leslie - I have attached a number of additional photos FYI. Xcel will be back billing Meyer contracting for hitting their ductbank and damaging the Gopher 75 feeder. The dig was being done as part of a water piping (storm) installation, so it was in no way related to examining or searching for power system components. The ductbank that was hit was a 4 barrel concrete encased duct that had been installed recently (a month ago, approximately) to move Xcel's feeders out of the path of LRT's construction. The concrete jacket and the PVC duct was demolished, and the cable was hooked by the backhoe, which is what caused the fault. Additionally, another barrel in the ductbank was slightly "caved in", but was otherwise not damaged. In the photos, the backhoe in the background was what was being used to dig the hole, and was being operated by Meyer.
# Incident Reports

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Outage / Event Date</th>
<th>Time of Day</th>
<th>Responsible Party</th>
<th>Occurrences</th>
<th>Duration (Minutes)</th>
<th>Length &gt;3min</th>
<th>Duration (Hours)</th>
<th>Feeder(s) Affected</th>
<th>Cause of Outage (Short Version)</th>
<th>Outage Details (Long Version)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>06/31/11</td>
<td>9:40:00 AM</td>
<td>Xcel</td>
<td>1</td>
<td>0.0687</td>
<td>0</td>
<td>0.0002783</td>
<td>Lost transformer</td>
<td>The second event on June 31, 2011, occurred at 9:40 AM. A transformer was tripped at Xcel’s Terminal Substation. The transformer did not feed the University directly, however, a momentary outage occurred when the substation transferred to the transformer.</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>07/25/11</td>
<td>10:41:00 AM</td>
<td>Xcel</td>
<td>1</td>
<td>312.1</td>
<td>12</td>
<td>0.2</td>
<td>Xcel</td>
<td>At approximately 10:41 AM on Friday, July 28, 2011, Xcel reported a failure on one of their 138 kV feeder 692 to their Fulton Substation. The failure was not able to be caused by any outside forces. The outage was due to a fault on one of the feeders to Fulton 6 and 692 to go down. The following buildings were partially impacted by the outage: BSE, MCB, and one of the halls at the High School. The power was restored at approximately 10:44 AM. The outage was restored by Xcel.</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>07/29/11</td>
<td>11:37:00 AM</td>
<td>Other</td>
<td>1</td>
<td>249.8</td>
<td>100</td>
<td>2.6666667</td>
<td>Box Spring</td>
<td>The lift project dug into the feeder.</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>08/06/11</td>
<td>11:18:00 AM</td>
<td>Other</td>
<td>5</td>
<td>45</td>
<td>45</td>
<td>0.75</td>
<td>Xcel</td>
<td>On Tuesday, August 8, 2011, at 11:18 AM, a power pole was in the lift space of the feeder. A pole was hit and caused the pole to fall. The pole fell into the road and the pole fell into the street. The pole fell into the building and caused a momentary outage.</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>08/12/11</td>
<td>11:52:00 AM</td>
<td>Xcel</td>
<td>1</td>
<td>0.0687</td>
<td>0</td>
<td>0.0002783</td>
<td>Lost transformer</td>
<td>On Tuesday, August 30, 2011, there was an incident on the Grid that caused a momentary outage in our buildings. The outage occurred on the Xcel feeder 60 which feeds Fulton Switch Station. One feeder (feeder 75) was affected by the outage. The feeder affected by the outage was connected to the Xcel substation at the Fulton Switch Station. The following buildings experienced outages starting at 11:52 AM: Grid outage included: BSE, MCB, MCB, and one of the halls at the High School. The outage was restored by Xcel.</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>08/33/11</td>
<td>12:30:00 PM</td>
<td>Xcel</td>
<td>1</td>
<td>90</td>
<td>90</td>
<td>1.5</td>
<td>Xcel</td>
<td>A pole in the marshland behind the 69th Street Switch Station blew up.</td>
<td></td>
</tr>
</tbody>
</table>

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**Note:** The detailed outage information includes the type of outage, the affected buildings, and the duration of the outage. The information is based on reports from Xcel Energy and other utility companies. The table provides a summary of the outages and their causes, along with the duration and affected areas.
Power Availability

- FM cannot guarantee 100% power supply/availability
  - Xcel’s standard “one outage per year greater than 5 minutes”

- Generator-supplied “emergency” systems encounter far more outages (2 per month) than “normal” power
Power Availability (cont’d)

- Peak months Jun. – Sept. Some days part of system is maxed out

- U has 4 interconnect feeders between Fulton and 4\textsuperscript{th} St. to transfer loads among 7 Xcel feeders

- Transferring load between Xcel substations may require momentary outages
Power Availability (cont’d)

- Greatest risk of power failure is loss of Xcel feeder to Fulton Switch station during peak

- Outdoor construction during these months often includes digging

- Construction of on-campus generation (CT Plant) provides ~ 15 MW of new capacity
Questions?