Emergency Response Planning for Aging Infrastructure

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Agenda

- DU History / Campus Description
- Motivations for Contingency Planning
- Project Goals
- Approach
- Proof of Theory
- Putting into Practice
University of Denver (DU)

- Founded in 1864 as Colorado Seminary in then the Colorado Territory
- 3.8 million square feet over 125 acres in the City of Denver
- 11,500 students & 3,800 staff/faculty
- Campus is a working Arboretum
- Great Private University dedicated to the Public Good

University Hall: 1864

Engineering/Computer Science: 2017
DU Campus Description

- 4 Portfolio Building Categories:
  - Millenium, Legacy, Beneficial, Transition
- 71% buildings < 25 year renovation age
- Improvements despite growing campus since 2006:
  - -18% electrical consumption and -19% MTCDE
  - +6% GSF and +7% FTE
- 18 of 88 Buildings on Central Plant
- Majority on Stand-Alone systems
- Individual Electric Meters

DIVERSE CAMPUS, FLEXIBLE APPROACH
Motivations

- Aging Distribution Infrastructure
- Lack of Building-Level Redundancy
- Major Disaster NOT required
Motivations

- 3 Failures in 3 Months

3 Building Heating Outage
- Steam Distribution failure

Centennial Towers: 600 bed Dorm
- Electrical Single Phasing

Mary Reed Administration Building
- Steam Distribution failure

PREDICTABLE REACTION TO DOWNTIME
Project Goals

- Cover critical buildings
- Provide QUICK and SIMPLE direction
  - Heat of the Moment!
- Modifiable and Expandable
- Same sheet of music for:
  - DU Emergency Operations Center
  - DU Facilities Management
  - Remediation/Recovery Contractors

GOAL: MINIMIZE BUILDING DOWNTIME
Project Approach

- Variety of Failure Modes:
  - Local Equipment (N)
  - Distribution Line
  - Power Outage
- Various Building Types and Systems
- Military / Fed / Healthcare examples
Project Approach

- Site Examination
- Site Documentation
- Refine & Finalize
- Test & Validate
- Data Organization
Project Approach

• Building Site Examination
  • Tie Points
  • Rental Equipment Location
  • Hose & Cable
    • Pathways
    • Size/Length
    • Ratings
  • Pumping Restrictions
  • Generator Connections
Project Approach

- Data Organization
- Database structure
- Expandable

- Format Considerations
- Consistent format
- Small words

- Next Level
- HTML Interface
- GIS Integration
### Chambers Center

**Address:** 1901 East Asbury Ave  
**SQFT:** 32161

**Description:** Women's College

- Building served from Sturm chilled water loop?: Yes
- Building served from Sturm steam loop?: Yes

#### Major Equipment:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Details</th>
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<tbody>
<tr>
<td>Cooling</td>
<td></td>
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<tr>
<td>Building Pumps</td>
<td></td>
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<tr>
<td>CHW: Bldg Primary (push through)</td>
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<tr>
<td>CHW: 150 GPM @ 35 FT ea.</td>
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<td>Chiller WPD: N/A</td>
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<tr>
<td>Rental Electrical Equipment: Locate near building doors where temporary connections could be routed through basement stair in building. Basement mechanical room West</td>
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<tr>
<td>Heating</td>
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<tr>
<td>Building Pumps</td>
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<tr>
<td>HW: Bldg Primary (draw through)</td>
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<tr>
<td>HW: 80 GPM @ 40 FT</td>
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<tr>
<td>Rental Heating Equipment: Locate near East building doors where temporary connections could be routed through basement stair in building. Basement mechanical room West</td>
<td></td>
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<tr>
<td>Electrical</td>
<td></td>
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<tr>
<td>Generator: N/A</td>
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<tr>
<td>Main Panel: 1000A</td>
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<tr>
<td>Bldg Voltage: 208Y/120</td>
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<td>Elec Load: 66 kVA</td>
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</tbody>
</table>

#### Service From Plant:

- **CHW:** Bldg Primary (push through) |
- **CHW:** 150 GPM @ 35 FT ea. |
- **Chiller WPD:** N/A |
- **HW:** Bldg Primary (draw through) |

#### Misc. Notes:

- Per dwgs Exp Tank max pressure ~35 psi. Ref 03' dwgs: M0.1, M1.1, M3.1, M4.1
- LOCAL EQUIPMENT FAILURE
- THE NORMAL LINE BREAK
- ELECTRICAL UTILITY LOSS
- CHILLER
- BOILER / HX
- STEAM
- CHILLED WATER

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**Aerial View**

- Rental Electrical Equipment: Locate near building doors where temporary connections could be routed through basement stair in building. Basement mechanical room West
- Rental Heating Equipment: Locate near East building doors where temporary connections could be routed through basement stair in building. Basement mechanical room West
- Rental Cooling Equipment Not Required

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**Address:** Chambers Center  
**S High St**
**Electrical**
- Min. 100 kW Rental Generator required.
- 208V Generator

**Connection Instructions:**
Connection Considerations: Existing isolation valves available. Pipe removal/modifications required.

Description: Use existing redundant HX HWS/R isolation valves for temporary heating equipment connections. Remove pipe spools from valves to HX flanged connections.

**Emergency Equipment Identification**
- Gas Pressure Available: DU Investigate lbs
- Pump Required?: Coordinate w/ rental co. existing pump (see front page) can be used with rental blr.

Connection Requirements: Provide 3” diameter, 50 psig rated hose, 2 x 175’ for temporary Sup./Ret. connections
- Chiller Requirement: Not Required

**Cooling Equipment Connection Reference**
- Lock out main circuit breaker. De-energize building breakers. Connect rental generator to electrical switchgear/panelboard through fused disconnect and confirm rental generator has over current protection.

**Heating Equipment Connection Reference**
- Boiler Requirement: 1200 MBH min required for building

**Installation Instructions:**
Connection Considerations: Existing isolation valves available. Pipe removal/modifications required.

Description: Use existing redundant HX HWS/R isolation valves for temporary heating equipment connections. Remove pipe spools from valves to HX flanged connections.
Proof of Theory

- DU walked every building and every plan
- GREAT opportunity for any new staff to learn the campus
- Account for time to tweak the plan
- Tutorial for adding new buildings/systems to the plan

TRUST, BUT VERIFY!
Putting into Practice

- Consider additional buildings/systems
- Incorporate into future designs and campus design standards
- Coordinate with Rental Companies
- Train Key Staff
- Meeting/tabletop exercises with providers
- Budget building modifications for connections
  - $50K per year to install valves, disconnects, etc.
Questions??