



ADAM FINLEY
CONSTRUCTION MANAGEMENT
SENIOR THESIS
FINAL PRESENTATION 2007

Presentation Outline

- Project Background
- Research#1:
 - Penn State Commissioning Challenges
- Mechanical Analysis#1:
 - UVGI Addition
- Electrical Analysis#2:
 - Standby Generator Emergency System
- Conclusions/ Questions

Presentation Outline

▪ **Project Background**

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UVGI Addition
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Health and Counseling Services-Project Background

Owner: The Pennsylvania State University

Construction Manager: Whiting-Turner

Location: University Park, Pennsylvania

Function: Medical

Deliver Method: Design-Bid-Build

Project Cost: 24 Million

Schedule: May 06- May 08

Size: 63,318ft²

LEED Rating: Certified



Student Health Center



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Research- Penn State Commissioning Challenges

Background

- Commissioning is a systematic and documented process of ensuring that specific building systems perform interactively according to the design intent and the owner's operational needs.
- Penn State has experienced delays to the completion of commissioning on multiple construction projects over the past 6 years.

Examples:

- SALA Building
- Life Sciences
- Forestry Building
- Medler Field

Research- Penn State Commissioning Challenges

Goals

- Contact commissioning agents that have worked on the majority or recent major renovations and base building projects.
- Determine what areas of the commissioning process typically cause challenges on Penn State construction projects.

Contacts:

- Aramark
- Sebesta Blomberg
- Facility Dynamics
- PSU In-House Commissioning Team

Research- Penn State Commissioning Challenges

Goals

- Compile a list of general items that Penn State should incorporate into their new commissioning document.
- Apply results to Health and Counseling Services.



Research- Penn State Commissioning Challenges

Results

Start of the Commissioning Process

Challenge:

- PSU project leaders are inconsistent on when the Cx agent should be brought onto the project team. The advantage of using a Cx agent is lost if they aren't brought onboard during design review.

Solution:

- Hire the Cx agent at the same time as the A/E professional or no later than 30% Design Documents.

Research- Penn State Commissioning Challenges

Results

Time

Challenge:

- Not enough time for design review. Not enough time built into the construction schedule for functional testing.

Solution:

- Attempt to allow for more time in design review by setting later occupancy dates. Hold the construction end date so that the functional testing can be done properly.

Research- Penn State Commissioning Challenges

Results

•PSU In-House Commissioning Document

Challenge:

- 2002 Cx document was not incorporated into the standard process for PSU construction projects. Different commissioning processes used by OPP project leaders.

Solution:

- The upcoming Cx document must be enforced by upper management. Reviews should be done to ensure that project leaders are following the process.

Research- Penn State Commissioning Challenges

Results

•D.I.D. (Design Intent Document)

Challenge:

- Poorly constructed D.I.D.'s leave the A/E professional to interpret what PSU needs. Often causes confusion during design review. Not updated when changes are made in construction.

Solution:

- PSU should spend more time with A/E professional creating the document. D.I.D. review should be made at each change in design. Appropriate updates should be made and distributed.

Research- Penn State Commissioning Challenges

Results

Other challenges identified:



- Communication
- Commissioning Training
- Building Systems Training
- Cx Warranty
- Design Review
- Submittal Review
- Mechanical Designs
- Building Control Systems and Sequences
- PSU In-House Staffing

Research- Penn State Commissioning Challenges

Results

Conclusions:

- Start the Cx Process before 30% Design Documents.
- Allow for a longer design phase. Hold the construction end date so that accurate functional testing can be completed.
- Enforce the PSU in-house Cx document.
- Construct clear D.I.D. and review/update regularly.

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Breadth#1-UVGI Addition

Background

- UVGI (Ultra Violet Germ Irradiation) Devices
 - Use Ultra Violet rays to destroy viruses that HEPA filters are unable to contain.
 - SARS, Anthrax, Bird Flu, Etc.
- Improve the indoor air quality of the building.
- Decrease the amount of days employees and students will be sick and increases their productivity.
- Use minimal energy and fit into any standard plenum air duct.

Breadth#1-UVGI Addition

Goals

- Locate a manufacturer that will supply data.
- Identify spaces that would benefit from UVGI Devices.
- Determine if the cost and schedule impact of the addition is feasible.



Breadth#1-UVGI Addition

Results

- Locations:
- Exam Rooms
 - Procedure Rooms
 - Offices
 - Conference Rooms
 - Lobbies/Waiting Areas
 - Hallways



Breadth#1-UVGI Addition

Results



-Manufacturer: Virobuster (Blygold America) Steritubes

-# Required: 112 Steritubes

-Initial Cost: \$295,363.00

-Schedule Impact: (Minimal)

-3 Hours to install each

-336 Total Man Hours

-Annual Cost: \$5,903.00

-Potential Annual Savings: \$844,742.00

WHAT VIROBUSTER GAINS FOR YOU	
23225	floor space in square metres
2.5	average height to ceiling
1112	number of people
0.67	number of recirculation per hour
bio pathogens drop more than factor 2.0	
	required Virobuster capacity (m ³ /h)
38,902	number of required Steritubes
	monthly energy costs (€)
488	monthly full service lease (€)
5,835	
933,862	savings on absenteeism
74,892	annual costs
858,971	net benefits by Virobuster (annual)
70	costs for each hour absenteeism
14	absenteeism costs for full space (hours)
1147%	benefit ratio for this Virobuster installation
0.06%	tipping point: minimal reduction in absenteeism is to cover the investment. Equals hours per employee
1.0	
0.8%	maximum impact on productivity (indirect)
0.26%	expected impact (indirect)
513624	potential extra indirect impact (in €)

Breadth#1-UVGI Addition

Recommendations

-The initial cost of the addition would be offset by the annual savings on absenteeism due to illness.

-Potential savings for the University would be the increased productivity of the medical staff for the building.

-The community would benefit by the decrease in absenteeism of students at businesses around State College.

-Virobuster Steritubes are a recommended addition to Health and Counseling Services.

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Breadth#2-Standby Generator Emergency System

Background

-Original design had campus standby power supply feeding emergency lighting, life safety systems, and full power to half of one floor.

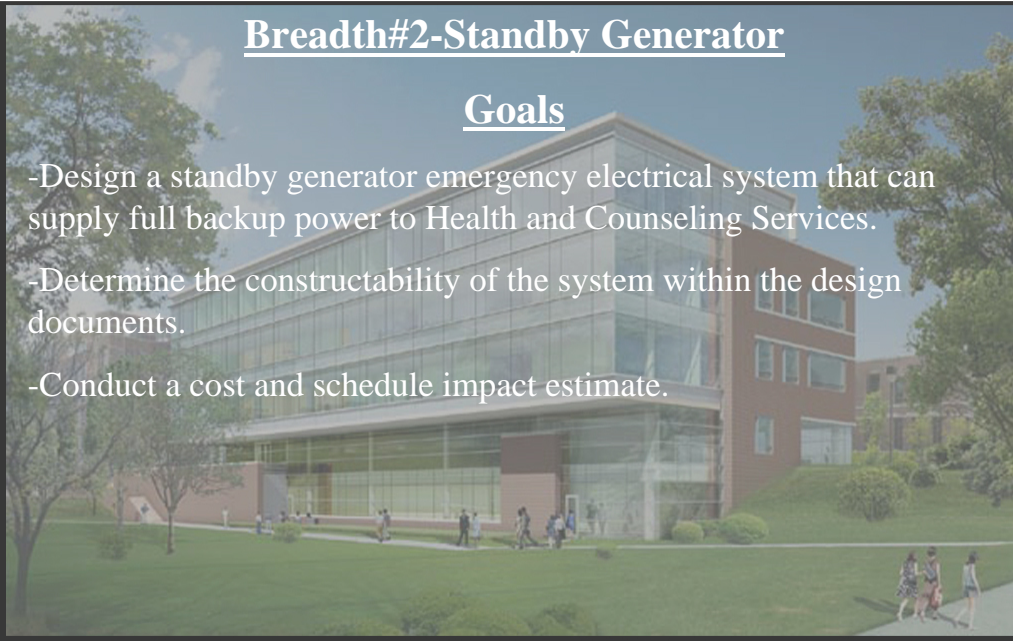
Original Design:

- Standby Power Utility: 4160-480/277V
- Main Switchgear: 1200 Amps, 480/277V
- Automatic Transfer Switch: 1200 Amps

Breadth#2-Standby Generator

Goals

- Design a standby generator emergency electrical system that can supply full backup power to Health and Counseling Services.
- Determine the constructability of the system within the design documents.
- Conduct a cost and schedule impact estimate.

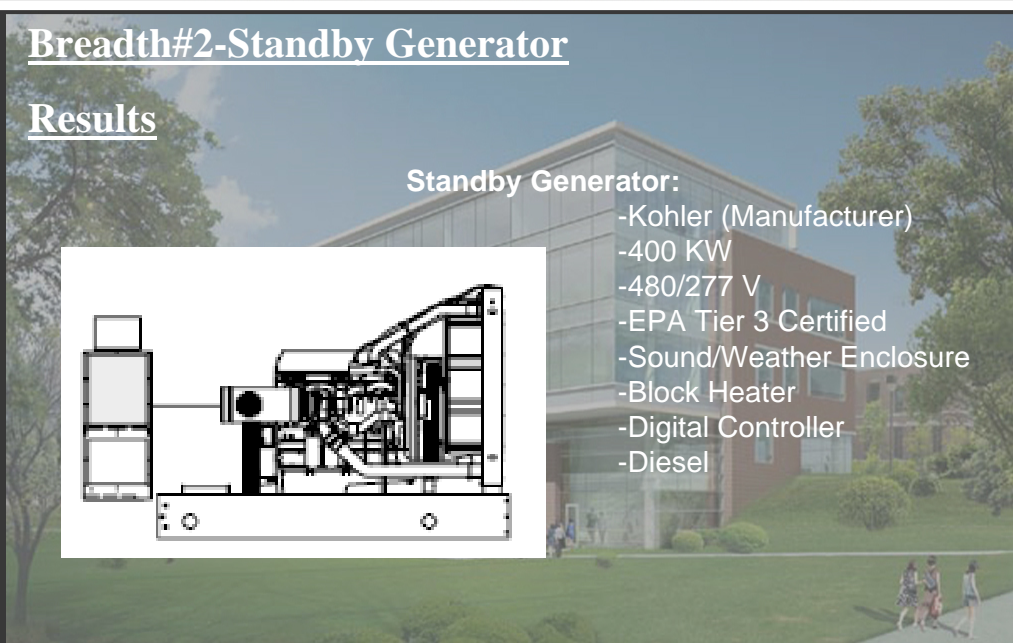
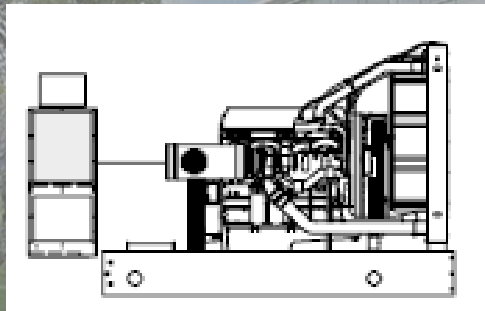


Breadth#2-Standby Generator

Results

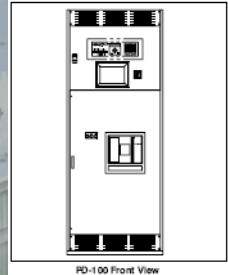
Standby Generator:

- Kohler (Manufacturer)
- 400 KW
- 480/277 V
- EPA Tier 3 Certified
- Sound/Weather Enclosure
- Block Heater
- Digital Controller
- Diesel



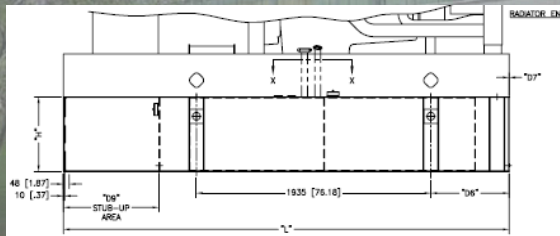
Breadth#2-Standby Generator

Results



Equipment:

- Paralleling Switchgear:
 - Kohler (Manufacturer)
 - 480/277V, 3 Phase, 4 Wire
 - 1200 Amp
 - Dual Breaker
- Fuel Storage Tank:
 - 898 Gallon Sub-base tank
 - 24 hour tank
 - Double Wall
 - Leak Detection
 - Diesel Fuel



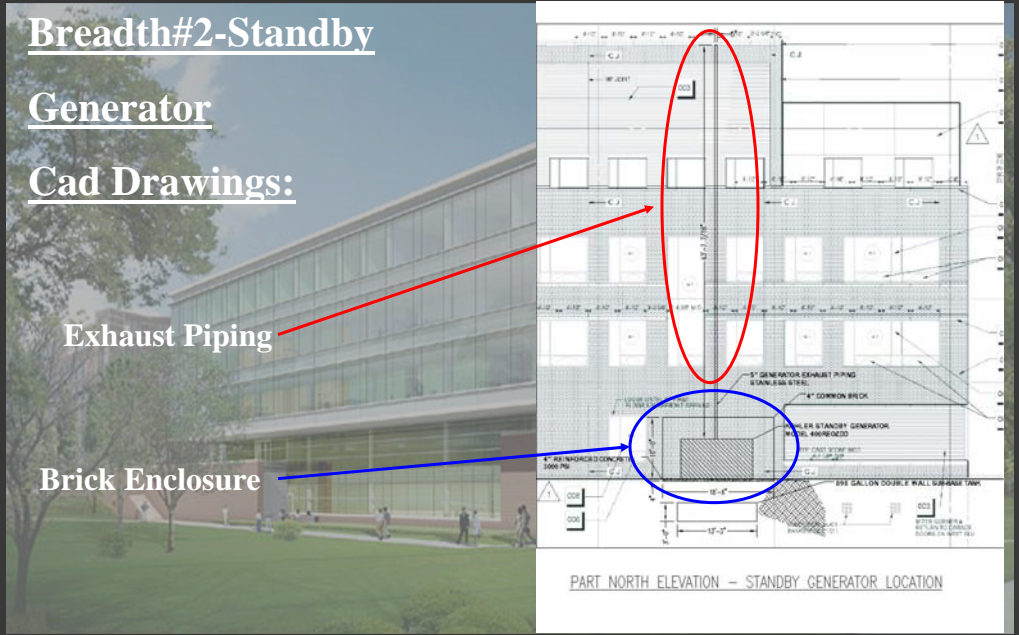
Breadth#2-Standby Generator

Results

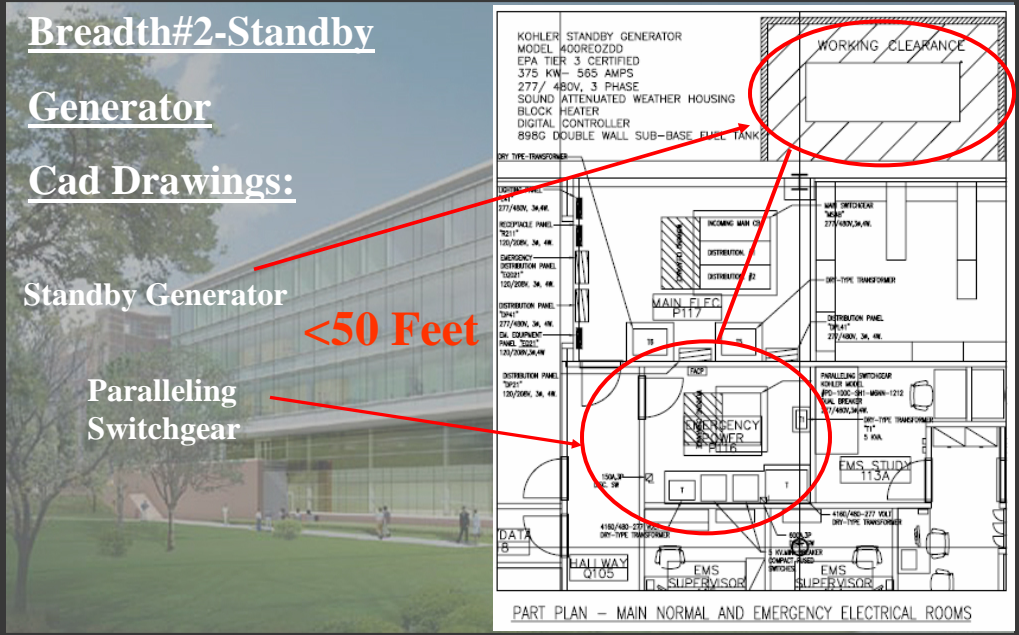
Equipment Locations:

- Standby Generator
 - NW Corner of building (Ground Floor)
 - Inside brick enclosure (19'x11'x10')
- Paralleling Switchgear
 - Emergency electrical room (1st Floor)
 - 30" Working clearance all sides

Breadth#2-Standby
Generator
Cad Drawings:



Breadth#2-Standby
Generator
Cad Drawings:



Breadth#2-Standby Generator

Results

Cost:

- Equipment:\$149,842.40
- Labor:\$68,256.00
- Total:\$218,095.40

Schedule Impact:

- 30 Days



Breadth#2-Standby Generator

Recommendations

- The addition of a standby generator backup system does not add enough value to Health and Counseling Services.
- The brick enclosure takes away green space between buildings.
- Exhaust piping running up the exterior of the building would look bad for the aesthetic of the structure.
- The \$200,000 + cost of the addition would not pay itself back over time.

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Conclusions

- PSU Commissioning
 - Bring Cx agent onboard before 30% D.D's
 - Allow for more time in design. Hold construction end dates
 - Enforce PSU in-house process map/document
 - Spend more time constructing D.I.D. and review regularly
- UVGI Addition
 - Install UVGI devices
 - Large initial cost is paid back through less absenteeism
- Standby Generator Emergency System
 - Do not install a standby generator electrical backup
 - Large initial cost with no payback over time

Acknowledgements

The Pennsylvania State University:

- John Bechtel
- Dr. Jim Friehtaut
- Terry Hansel
- Richard Harris
- Chad Spackman



Bognet Construction Associates

Aramark



Sebesta Blomberg



Facility Dynamics



THE PENNSYLVANIA STATE UNIVERSITY

ARCHITECTURAL ENGINEERING

Questions?

THE PENNSYLVANIA STATE UNIVERSITY

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Breadth#1-UVGI Addition

Virobuster Steritubes

- 7.89"x7.89"x59"
- 60 Watts at 208/110 V
- \$2.66/Month Each
- +/- 5 Pa Pressure Drop
- 176 CFM
- High Quality, Low Noise Fan
- Digitally Controlled
- 9000 Hours of Use Before Service
- Approved by Accredited Research Laboratories
- CE, UL, Kema, and TuV



THE PENNSYLVANIA STATE UNIVERSITY

ARCHITECTURAL ENGINEERING

Research- Penn State Commissioning Challenges

Results

•Communication

Challenge:

- Improper reporting of pre-functional checklist completion to Cx agent. Information not readily available regarding the status of items such as RFI's, change orders, and submittals,etc.

Solution:

- Good Cx kickoff meeting. Attaching Cx milestones to schedule of values. Have proper language in sub's contract of Cx responsibilities. Integrated construction management programs.

Research- Penn State Commissioning Challenges

Results

•Commissioning Training

Challenge:

- Level of involvement required of each member of the commissioning team is often not realized.

Solution:

- Cx agent must make it clear to everyone what is expected of them. This will benefit the university in the future since the specialty contractors will most likely be working on another PSU construction project in the future.

Research- Penn State Commissioning Challenges

Results

•Building Systems Training

Challenge:

•Sometimes the maintenance personnel that receive training are not involved with that system or that building.

Solution:

•Only maintenance personnel involved with that system and building should attend. Training sessions should be recorded for future use.

Research- Penn State Commissioning Challenges

Results

•Commissioning Warranty

Challenge:

•When does the warranty take effect? With building occupants inside the building before functional testing is completed does the warranty take effect when the building is occupied or at the submission of the final report.

Solution:

•Allow functional testing to be completed before occupancy if possible. Make more realistic construction schedules to allow for this.

Research- Penn State Commissioning Challenges

Results

•Building Control Systems and Sequences

Challenge:

•Vague designs and sequences leave interpretation up to the controls contractor. Functional testing of controls systems is extremely difficult to complete properly from designs intent.

Solution:

•Standard requirements of the A/E professional should be made so that complete designs and sequences are completed.

Research- Penn State Commissioning Challenges

Results

•In-House Staffing

Challenge:

•Large volumes of work are given to the in-house commissioning team. Difficult to accurately complete commissioning.

Solution:

•Hire/Train more employees to keep up with the amount of in-house commissioning projects. Outsource more projects to 3rd party Cx agents.