Walter Reed National Military Medical Center Bethesda, Maryland Justin Herzing – Mechanical Option WRNMMC Advisor – James Freihaut, Ph D The Pennsylvania State University

Building Overview •Cooling System Overview Mechanine System Overview Air Distribution System Overview

LCC and Conclusion

Solar Shading Analysis

Bethesdajt Martyliansd

Walter Reed National Military Medical Center

Location – Bethesda, Maryland Overall Project Cost - \$641 Million Building Use – Office/Hospital Delivery Method – Design/Build Construction Start – July 2008

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Building Size – 598,595 sf Building A – 6 Stories

Construction End – November 2010 Building B – 4 Stories WRNMMC

Presentation Outline Building Overview Cooling System Overview Heating System Overview

Air Distribution System Overview

Mechanical System Redesign

Solar Shading Analysis

LCC and Conclusion

-(3) 1,000 Ton Centrifugal Chillers -Variable Primary Pumping

-(2) Heat Recovery Chillers

-(3) 1,000 Ton Induced Draft Cooling Towers Located Off Site

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Building Overview Site Conditions

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Site Conditions

Building Overview

Presentation Outline

Building Overview Cooling System Overview Heating System Overview Air Distribution System Overview

Mechanical System Redesign

Solar Shading Analysis LCC and Conclusion

-High Pressure Steam is Delivered from Campus Plant (125 psig) -Steam Pressure Reducing Stations (75 and 15 psig)

-Humidification Steam Generators -Shell and Tube Heat Exchangers

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Building Overview •Cooling System Overview Heating System Overview Air Distribution System Overview

Mechanical System Redesign

Solar Shading Analysis

LCC and Conclusion



Building Overview Site Conditions

-(11) 50,000 cfm Air Handling Units

-(11) Total Energy Wheels -Constant Volume Supply

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Mechanical Redesign Goals and Objectives

\$/Mbtu Life Cycle Cost

Presentation Outline

Building Overview

Mechanical System Regesign
Decentralized Supply Fan Analysis
ABackpressure Steam Turbine Analysis
Combined Heat and Power Analysis
Solar Shading Analysis

LCC and Conclusion

- Reduce Stranger Steam 0.0299
- Reduce Btranger Natural Gas 0.0089 vision

- Utilize Ted

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The Penns

Mechanical Redesign Fan Analysis Floor 6

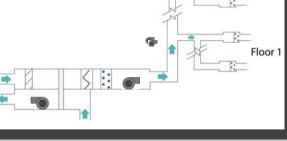
Presentation Outline

Building Overview Mechanical System Redesign

Goals and Objectives

 Decentralized Supply Fan Analysis •Backpressure Steam Turbine Analysis Combined Heat and Power Analysis

Solar Shading Analysis



LCC and Conclusion

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Mechanical Redesign Fan Analysis

Presentation Outline

Building Overview

Mechanical System Redesign

Goals and Objectives

•Backpressure Steam Turbine Analysis

Combined Heat and Power Analysis

Solar Shading Analysis LCC and Conclusion

Simple Payback – 8 Years

Total Yearly Savings - \$59,944

Initial Cost - \$297,896 Yearly O/M Cost - \$21,600

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Mechanical Redesign

BPST Analysis

Presentation Outline

Building Overview

Mechanical System Redesign

•Goals and Objectives

Decentralized Supply Fan AnalysisBackpressure Steam Turbine Analysis

Combined Heat and Power Analysis

Solar Shading Analysis

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LCC and Conclusion

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Building Overview

Mechanical System Redesign

 Goals and Objectives Decentralized Supply Fan Analysis

•Combined Heat and Power Analysis

High Pressure Steam Inlet BPST Analysis Shaft to Electric

Solar Shading Analysis LCC and Conclusion Justin Herzing - Mechanical Option Advisor – James Freihaut, Ph D

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Mechanical Redesign

Mechanical Redesign **BPST** Analysis

Presentation Outline

Building Overview

Mechanical System Redesign

 Goals and Objectives Decentralized Supply Fan Analysis

Combined Heat and Power Analysis

LCC and Conclusion

Solar Shading Analysis

Simple Payback – 7 Years

Yearly O/M Cost - \$15,240

Initial Cost - \$160,000

Total Yearly Savings - \$40,093

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CHP Analysis **Presentation Outline** Steam DelManthlan ElleAttrinth Do Esteur mixti Oron sumption **Building Overview** Mechanical System Redesign Goals and Objectives Decentralized Supply Fan Analysis

•Backpressure Steam Turbine Analysis Combined Heat and Power Analysis

Solar Shading Analysis

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Mechanical Redesign

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Building Overview

Mechanical System Redesign

Goals and Objectives

 Decentralized Supply Fan Analysis •Backpressure Steam Turbine Analysis

Solar Shading Analysis

LCC and Conclusion

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Shaft to Electric Generator

Fuel Inlet

Internal Combustion Engine

Mechanical Redesign CHP Analysis

Electric

CHP Analysis CHP without BPST

Total Yearly Savings - \$902,815

Yearly O/M Cost - \$279,322

CHP with BPST Total Yearly Savings - \$640,275 Initial Cost - \$4,457,555

Simple Payback – 7 Years

Initial Cost - \$4,208,599

Presentation Outline

Building Overview

Mechanical System Redesign

 Goals and Objectives Decentralized Supply Fan Analysis

•Backpressure Steam Turbine Analysis

Solar Shading Analysis

LCC and Conclusion

Yearly O/M Cost - \$292,407 Simple Payback – 13 Years

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Mechanical Redesign

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Building Overview Mechanical System Redesign

- •CHP Acoustical Impact •IC Engine Acoustical Properties
- Acoustical Study

Acoustic Analysis

Solar Shading Analysis

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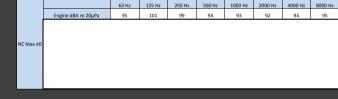
Advisor – James Freihaut, Ph D

Mechanical Space Acoustic Analysis IC Engine ---- DEPARTMENTAL BOUNDRIES ooms - OCCUPATIONAL THERAPY PHYSICAL THERAPY FUTURE USE FUTURE -The Pennsylvania State University

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Presentation Outline Building Overview Gait Lab

Mechanical System Redesign Acoustic Analysis •CHP Acoustical Impact NC Max 40 •IC Engine Acoustical Properties Acoustical Study



Solar Shading Analysis

LCC and Conclusion

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Acoustic Analysis IC Engine

Overview

Shading Analysis

Presentation Outline

Building Overview Mechanical System Redesign

Brief Overview

1000000 Solar Shading Analysis

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Conclusion Lifecycle Cost

Presentation Outline	Continue	System As	Decentralized	Backpressure	CHP without	CHP with
<u> </u>	System	Designed	Supply Fans	Steam Turbine	Steam Turbine	Steam Turbine
Building Overview	Initial Cost	\$109,500,000	\$109,797,896	\$109,660,000	\$113,708,598	\$113,957,555
March and all Oceatans Dayler ins	Discount Rate	5%	5%	5%	5%	5%
Mechanical System Redesign	Lifecycle (years)	20	20	20	20	20
Acoustic Analysis	Electric Cost	\$1,836,459	\$1,783,890	\$1,798,320	\$67,376	\$67,376
7100031107111diy313	Electric Sold to Utility	\$0	\$0	\$0	\$323,815	\$396,441
Solar Shading Analysis	Purchased Steam Cost	\$843,972	\$843,972	\$843,972	\$21,695	\$356,861
colar criading / maryolo	Natural Gas Cost	\$0	\$0	\$0	\$2,012,360	\$2,012,360
	Total O/M Cost	\$500,000	\$521,600	\$515,240	\$779,322	\$792,407
 Lifecycle Cost Analysis 	20 Year Lifecycle Cost	\$142,898,168	\$142,541,054	\$142,582,956	\$135,857,693	\$139,377,899

Questions

LCC and Conclusion

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Backpressure CHP without CHP with Steam Turbine Steam Turbine Steam Turbine \$113,957,555

Conclusion Lifecycle Cost

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Building Overview Mechanical System Redesign

Solar Shading Analysis

LCC and Conclusion

Lifecycle Cost Analysis

 Mechanical System Recommendation Questions

Lifecycle (years) \$1,798,320 Electric Cost \$1,836,459 \$1,783,890 \$67,376 \$67,376 Electric Sold to Utility \$0 \$323,815 \$396,441 \$843,972 \$843,972 \$843,972 Purchased Steam Cost \$21,695 \$356,861 Natural Gas Cost \$0 \$2,012,360 \$2,012,360 Total O/M Cost \$500,000 \$521,600 \$515,240 \$779,322 \$792,407

Decentralized

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20 Year Lifecycle Cost Rank

System

Initial Cost

Discount Rate

Designed

5%

\$109,500,000 \$109,797,89

\$142,898,168 \$142,541,05

\$142,582,95

\$109,660,000

5%

5135,857,693

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5113,708,598

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\$139,377,899

Presentation Outline Acknowledgments: **Building Overview** Chris Skoug and Tim Michael – Southland Industries Mechanical System Redesign

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All of the AE Faculty especially the Mechanical Instructors

Conclusion Acknowledgments

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Solar Shading Analysis

LCC and Conclusion

Questions

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Lifecycle Cost Analysis

Mechanical System Recommendation

The AE Class of 2010