M Resort Spa Casino

Tom Chirdon

Faculty Advisor: William P. Bahnfleth

Spring 2009

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Project Background

Project Cost : $1 Billion

Ground Breaking: Spring 2007

Opened: March 1, 2009

Owner: Marnell Corrao Associates

Location: Henderson Nevada, intersection of Las Vegas Boulevard and St. Rose Parkway

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

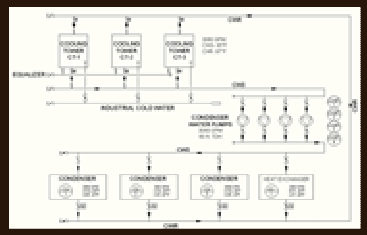
Project Background

Low Rise: 500,000 ft² includes spa, casino, restaurants kitchens, meeting rooms, ballroom, and offices

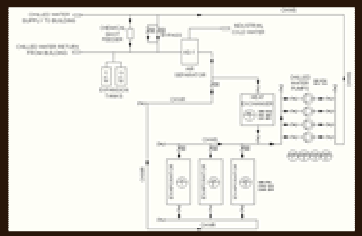
High Rise: includes 440 guest suites and lofts, along with a restaurant atop the tower

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations



Condenser Water Loop



Evaporator Loop

Existing Mechanical Summary

Cooling

Centrifugal Chiller – Refrigerant 123

Capacity - 3900 tons

Serves – AHU and FCU

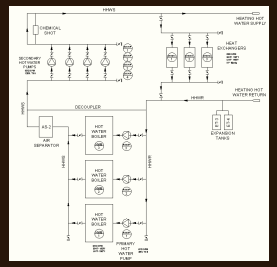
Condenser – EWT – 85F LWT – 97F

Evaporator – EWT 58F LWT 42F

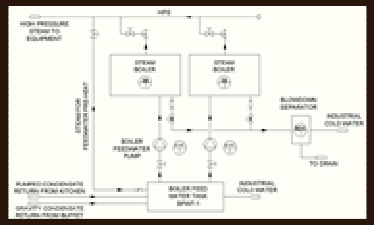
Heat Exchanger allows for free cooling with cooling tower water

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations



Heating Hot Water Loop



Steam Water Loop

Existing Mechanical Summary

Heating Hot Water

Natural Gas Boilers

Capacity – 46,800 MBH

Serves – AHU, Domestic water Heat Exchangers and Pool Heat Exchangers

Steam

Capacity - 6,400 lb/hr

Serves – kitchen steam equipment

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Existing Mechanical Summary

28 Air Handing Units

- Located on low rise and tower roofs
- Utilize Economizers where possible
- Casino Spaces are 100% Outdoor Air
- Incorporate Smoke Control

Fan Coil Units

- Located in guest areas
- Two pipe vertical stack configuration
- Integrated Wall Mullion brings in OA

Presentation Outline

- **Project Background**
- **Existing Mechanical Summary**
- **Design Objectives**
- **Alternative Description**
- **Energy Analysis**
- **Emissions Analysis**
- **Life Cycle Cost**
- **Acoustical Breadth**
- **Electrical Breadth**
- **Final Recommendations**

Design Objectives

Central Plant Analysis

Study combined heating, cooling, and power system

-Life Cycle Cost Comparison

Utility costs and First Costs

-Emission Comparison

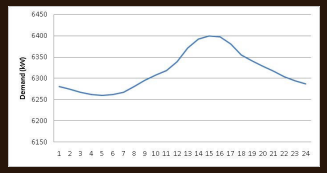
Thought – Electricity is expensive in Las Vegas area and with the Hoover Dam water level Dropping , it could become more expensive in the future.

Presentation Outline

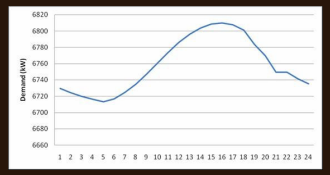
- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations




Alternative Description

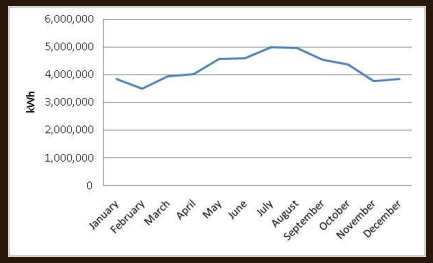


Typical February Day Demand



Typical July Day Demand

Base Model Electricity Consumption



Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

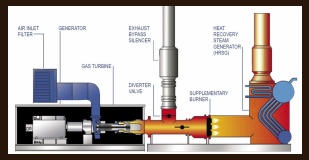
Alternative Description

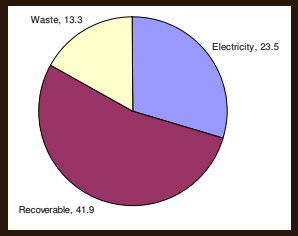
Generating Equipment – Solar Gas Turbines

5700kW and 1200kW

38.7 thousand lb/hr steam

78.8 MMBtu/hr heat input





Heat Usage

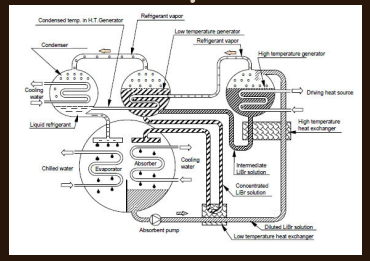
-Heating Hot Water

-Steam equipment

-Absorption Cooling

Thermo-chemical process

Water lithium Bromide



Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Energy Analysis

Electric Utility Rates (Nevada Power Company) Rate Structure LGS-3				
Period	Time	Service Charge Per month	Consumption Charge Per kWh	Demand Charge Per kW
Summer On-Peak	1PM-7PM	$167.70 + $0.00627/kWh	$0.10034	$8.47
Summer Mid-Peak	10AM-1PM, 7PM-10PM		$0.08649	$0.63
Summer Off Peak	10PM-10AM		$0.06281	$0.50
All Other Periods	Winter (October May)		$0.06281	$0.50
Natural Gas Utility Rates (Southwest Gas Corporation) Rate Structure SG-5L				
Period	Time	Service Charge Per month	Consumption Charge Per therm	Demand Charge Per therm
All Periods	All Times	$150.00	$1.1310	$0.00

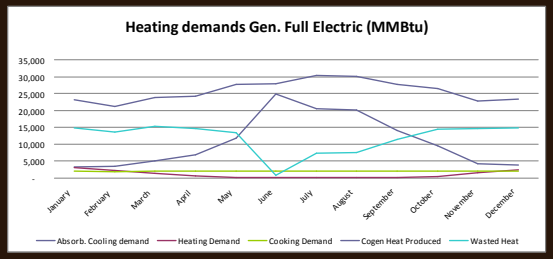
Utility Rates taken from Nevada Power, and Southwest Gas.

Spark Gap – Difference in cost between electricity and natural gas

Spark Gap						
Electricity			Natural Gas			Spark Gap
Usage	($/kWh)	$/10^6 btu	Usage	$/therm	$/10^6 btu	$
Peak	0.10661	31.25	Peak	1.131	11.31	19.94

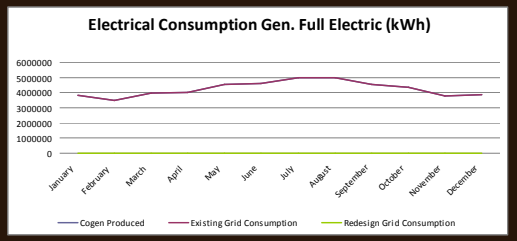
Presentation Outline



Energy Analysis

Generating to Electricity Consumption



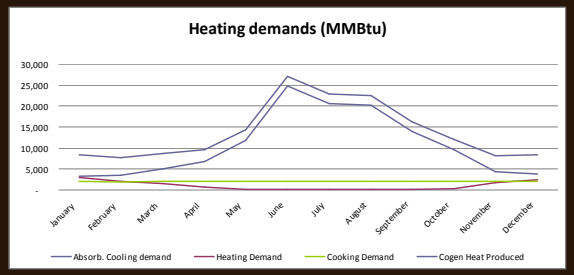
Presentation Outline

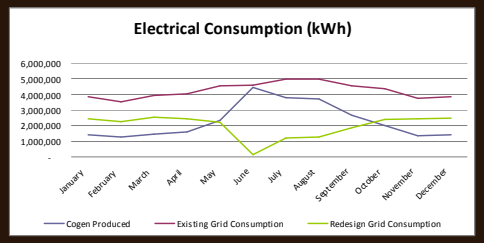
- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations




Energy Analysis

Generating to meet heating demands





Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Emissions Analysis

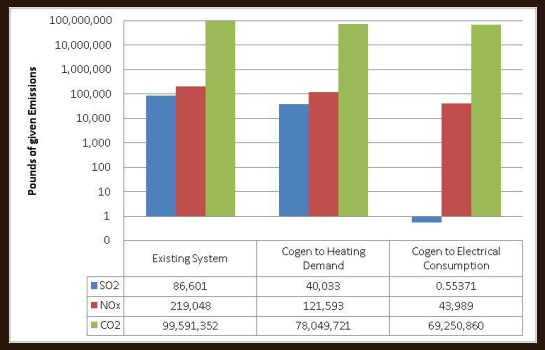
Due to the receding water in the Hoover Dam emissions data from New Mexico.

Generating to heating

64,620 Pine Trees or 387,720 Maple Trees

Generating to Electrical

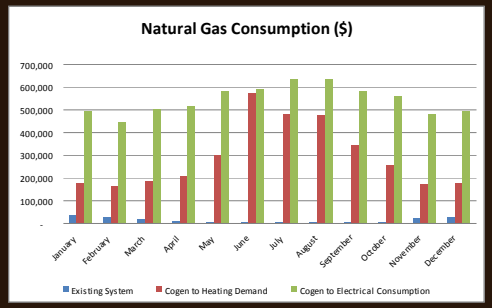
91,020 Pine Trees or 546,120 Maple Trees

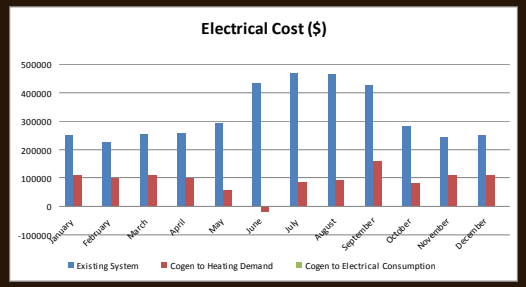


	Existing System	Cogen to Heating Demand	Cogen to Electrical Consumption
SO2	86,601	40,033	0.55371
NOx	219,048	121,593	43,989
CO2	99,591,352	78,049,721	69,250,860

Presentation Outline

Life Cycle Costs

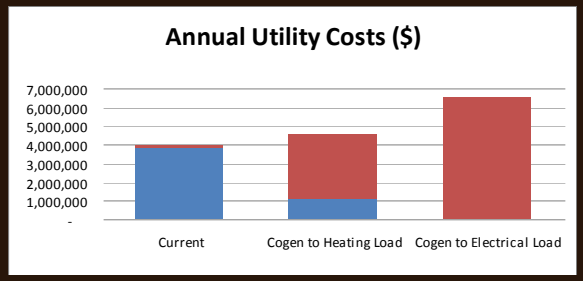




Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Life Cycle Costs

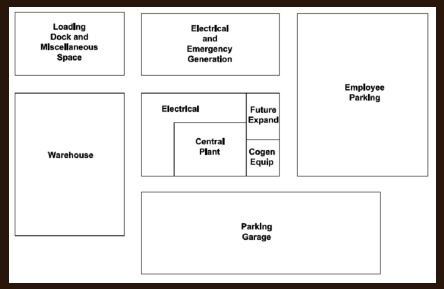


	Existing System	Redesign Cogen meeting Heating	Redesign Cogen meeting Electrical
Unchanged First Costs	$1,431,254	$1,431,254	$1,431,254
Central Plant First Costs	$1,624,000	$1,624,000	$1,624,000
Low Rise HVAC Cost	$20,850,428	$20,850,428	$20,850,428
High Rise HVAC Cost	$3,819,232	$3,819,232	$3,819,232
Chiller First Cost	$2,220,000	$2,008,500	$2,008,500
Generator First Cost	$0.00	$4,500,000	$4,500,000
Other Generator Costs	$0.00	$460,000	$460,000
TOTAL FIRST COSTS	**$29,944,914**	**$34,693,414**	**$34,693,414**
Natural Gas Cost	$499,029	$3,493,267	$6,496,278
Electrical Utility Cost	$3,841,339	$1,161,076	$0.00
TOTAL UTILITY COSTS	**$4,340,368**	**$4,654,344**	**$6,496,278**
Discount Rate	0.05	0.05	0.05
Life Cycle Length	20	20	20
Present Value of Utility Costs	$ 86,807,352	$ 93,086,875	$ 129,925,568
Total Savings After Life Cycle	-	$ (11,028,022)	$ (47,866,715)

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations



Overall NC of 48dB and limits of 45-55dB

Acoustical Breadth

Source	Octave Band Center Frequency, Hz									
	31.5	63	125	250	500	1000	2000	4000	8000	dBA
Inlet Air	76	82	88	89	90	92	95	120	112	121
Inlet Air Silencer	0	-1	-2	-3	-15	-25	-48	-55	-37	
Net Inlet Air	76	81	86	86	75	67	47	65	75	
Exhaust Air	88	91	88	91	95	87	80	72	64	94
Exhaust Air Silencer	-3	-5	-11	-19	-22	-28	-26	-17	-14	
Net Exhaust Air	85	86	77	72	73	59	54	55	50	
Oil Cooler	63	70	67	60	55	52	48	44	39	58
Taurus 60	72	65	66	67	68	64	64	60	53	70
Multiple turbines	4	4	4	4	4	4	4	4	4	
Sum of Sources	86	87	87	86	78	69	65	67	75	
A-weighted correction	-39	-26	-16	-9	-3	0	1	1	-1	
A-weighted sound level	47	61	71	77	75	69	66	68	74	81

Sound levels calculated for 50ft

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations




New Panel Board Loads for Absorption Chillers

Panel HPSA-4

Voltage: 408/277V — 300A

Description	LOAD (VA) A	LOAD (VA) B	LOAD (VA) C	Brk. Trip (A)	HPASA Ckt.#	LOAD (VA) A	LOAD (VA) B	LOAD (VA) C	Brk. Trip (A)	Description
ABS Chiller-1	11265			175/3	1	2	11265			175/3	ABS Chiller-FUT
ABS Chiller-1		11265			3	4		11265			ABS Chiller-FUT
ABS Chiller-1			11265		5	6			11265		ABS Chiller-FUT
ABS Chiller-2	11265			175/3	7	8	11265			175/3	ABS Chiller-FUT
ABS Chiller-2		11265			9	10		11265			ABS Chiller-FUT
ABS Chiller-2			11265		11	12			11265		ABS Chiller-FUT
ABS Chiller-3	11265			175/3	13	14	11265			175/3	ABS Chiller-FUT
ABS Chiller-3		11265			15	16		11265			ABS Chiller-FUT
ABS Chiller-3			11265		17	18			11265		ABS Chiller-FUT
Spare				20	19	20				20	Spare
Spare				20	21	22				20	Spare
Spare				20	23	24				20	Spare
Spare				20	25	26				20	Spare
Spare				20	27	28				20	Spare
Spare				20	29	30				20	Spare
Spare				20	31	32				20	Spare
Spare				20	33	34				20	Spare
Spare				20	35	36				20	Spare
Spare				20	37	38				20	Spare
Spare				20	39	40				20	Spare
Spare				20	41	42				20	Spare
	33795	33795	33795				33795	33795	33795		

Total Load on Phase A: 67590 VA
Total Load on Phase B: 67590 VA
Total Load on Phase C: 67590 VA
Total Load on Panel: 203.8 kVA Demand
254.0 A Demand

tom chirdon

Electrical Breadth

Purpose: To provide service to the new equipment in a cost effective manner.

Differencing chiller loads allowed different electrical connections

Panel Board Equipment Sizing				
Equipment	Full Load Current	Wire Size	Conduit Size	Breaker Size
Absorption Chiller -1	65A	#4 AWG	1"	175A
Absorption Chiller -2	65A	#4 AWG	1"	175A
Absorption Chiller -3	65A	#4 AWG	1"	175A

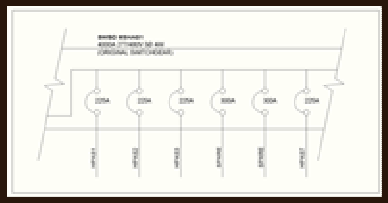
M Resort Spa Casino

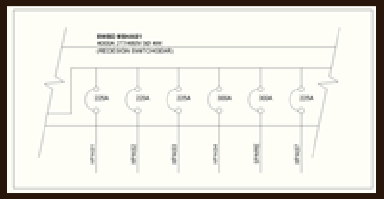
Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations



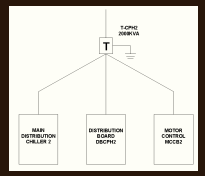

Spring 2009





Electrical Breadth

Connections changed and with the new panel the switchgear also must change



Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

tom chirdon

Final Recommendations

Based on the design objective and the results from the analysis it is a recommendation of this report that the current electrical centrifugal chillers remain. Until there is more incentive from carbon credits or if electricity prices rise the design alternative does not make economical sense.

M Resort Spa Casino

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Spring 2009

tom chirdon

Acknowledgements

Marnell Corrao Associates for their assistance and cooperation throughout this project

Mike Hallenbeck, Marc Crawford, Jessica Lucas, and Ben Johnson, from Southland Industries

Dr. William Bahnfleth and Dr. James Friehaut

Tim Robinson of Carrier Corporation and Bernie Pfeifer of Solar Turbines

My mother, Karen, my father, William, Brother Dan, Sister Ann, Brother in law Brady

Scott Earley, Scott Garley, David Miller, Dominic Manno, Chris Conrad, and all others not mentioned here especially L.C.

M Resort Spa Casino

Presentation Outline

- Project Background
- Existing Mechanical Summary
- Design Objectives
- Alternative Description
- Energy Analysis
- Emissions Analysis
- Life Cycle Cost
- Acoustical Breadth
- Electrical Breadth
- Final Recommendations

Spring 2009

Questions

tom chirdon

M Resort Spa Casino

Spring 2009