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(CONFIDENTIAL) Hearing Exhibit No. 112 from 2/5/20 DOAH Hearing. [CLK Note: See DN 10935-2019 for Exh Nos. 1, 68-75, 80, 82, 100]

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EXHIBIT NO. 112

DOCKET NO: 20190001-EI

WITNESS: Jeffrey Swartz

PARTY: DUKE ENERGY FLORIDA

DESCRIPTION:

DEF's Response to Citizens' Third Set of Interrogatories (Nos. 16-17)

PROFFERED BY: White Spring Agricultural Chemicals, Inc. d/b/a PCS Phosphate

AFFIDAVIT

STATE OF FLORIDA

COUNTY OF PINELLAS

I hereby certify that on this 31st day of July, 2019, before me, an officer duly authorized in the State and County aforesaid to take acknowledgments, personally appeared JEFFREY SWARTZ, who is personally known to me, and has acknowledged before me that he provided the answers to interrogatory numbers 16 and 17 of CITIZENS' THIRD SET OF INTERROGATORIES TO DUKE ENERGY FLORIDA, LLC (Nos. 16-17) in Docket No. 20190001-EI, and that the responses are true and correct based on his personal knowledge.

In Witness Whereof, I have hereunto set my hand and seal in the State and County aforesaid as of this 31st day of July, 2019.

Jeffrey Swartz

DEANNA LEE CARVER
Commission # GG 239923
Expires July 18, 2022
Bonded Thru Troy Fain Insurance 800-385-7019

Notary Public
State of Florida, at Large

My Commission Expires: July 18, 2022

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Bartow Steam Turbine Path Forward Recommendation

Bartow ST Project Team Summary

May 29, 2018

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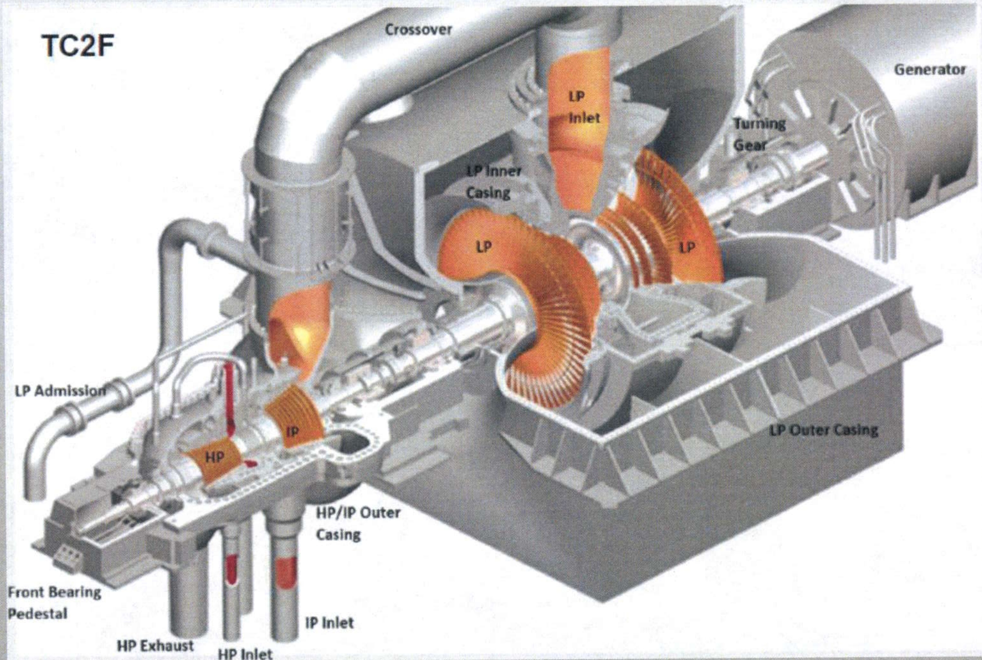
WORKING DRAFT – SUBJECT TO CHANGE



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DEF-19FL-FUEL-001602

Evaluation Overview & Agenda

- **Team evaluated 4 possible solutions for Bartow ST**
  - GE – LP retrofit
  - Siemens – LP retrofit
  - MHPS – Redesigned L-0 blade
  - Continue with the MHPS - Pressure Plate
- **Recommended solution for Bartow ST**
- **Details on our process and the selection**
  - Technical Evaluation
  - Performance Evaluation
  - Commercial Evaluation
- **Team Leaders:**
  - Dave Burney – Project Lead
  - Analytics Team – Mike Rib
  - Technical Team – Jake English
  - Total Cost of Ownership Analysis – Black & Veatch
  - Supply Chain – Jeremy Holton

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Executive Summary

Considering all elements of the evaluation (technical, cost, risk), the recommended path forward is to proceed with the new MHPS L-0 blade solution

- With GE being a close second from a business and technical perspective
- Siemens would be the less technically preferred solution to GE for an LP retrofit

Key elements of the evaluation that support the MHPS recommendation:

- All vendors have limited operating experience at the required steam flow rates, but MHPS appears to have the best understanding of the equipment, the historic L-0 issues, and the CC intricacies at Bartow. This understanding was built into their design changes.
- Their solution can be delivered before others – fuels/efficiency benefits realized earlier.
- Costs: MHPS credit of $1.5M would be lost.
- All of upgrade proposals, including the MHPS option, offer capacity and performance upgrade potential over remaining with the pressure plate
- The MHPS blade solution allows us to retain the pressure plate as a contingency plan. MHPS pressure plate is not compatible with GE or Siemens.

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Commercial Negotiations

Commercial Negotiation Goals:

- Keep MHPS accountable to resolve any design issues that may come up
- LD's to create proper response and to support our reliability goals
- Warranty provisions to limit our financial exposure (open/close, blade replacement, etc.)

To minimize financial risk, the following items need to be negotiated with MHPS:

- Material cost challenge: Previous sets of L-0 cost ~$3.5 (both ends). Proposal is $2M more with credits applied
- 10 year warranty requires active BVM monitoring at $200k per year. This cost needs to be eliminated, or significantly reduced.
- Warranty needs to be clear and LD levels need to be evaluated/adjusted
- Tie LD's to 'unknown' operating restrictions (blending limitations, exclusion zones)
- Design deficiencies, if identified, in operation (at their first commercial site in Nov '18 and/or at Bartow) need to be resolved by MHPS to eliminate any operating restrictions at Bartow

Do not inform GE of selection (contingency). Inform Siemens is cut from short list.

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Technical Evaluation: Criteria

- Technical Evaluation approached using a KT-style analysis
- Main & Sub-categories were developed based on key KPI's
- Scoring criteria were defined to ensure technical solutions were evaluated consistently & fairly
  - Note: Scoring was rated on a scale of 1 to 5, with 5 being the best possible score.
- Weighting was applied separately by the Station, RS, and TGS

%Wt.	Categories and Weighting Factors
	Impact to Future Maintenance (20%)
25%	Maintenance Interval
20%	Major Overhaul Scope $$$/Neg. Impacts
10%	Emergent Outage Scope if L-0 Blades Require Replacement
15%	Additional Support Infrastructure (e.g. Lift Oil System)
5%	Replacement Interval of L-0 blades (As Proposed)
5%	Rotor Life Extension Evaluation
15%	Tech Support -- Responsiveness, Ownership of Issues
5%	L-0 Erosion Susceptibility
	Impact to Future Operations (20%)
20%	Restrictions to Blending
40%	Restrictions on Condenser (Back Pressure / Bathtub Curves)
35%	Max Flow Limitations
5%	Low Load Limitations
	Unit Performance (10%)
30%	MW Output
70%	Heat Rate
	Unit Reliability (50%)
50%	OEM Operating Experience (At >= to Bartow Exhaust Flow)
20%	Experience with OEM ST Equipment (Fleet Experience)
30%	Ability to Detect Adverse Operations (Real Time)

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CONFIDENTIAL Technical Evaluation: Results

- Met with all 3 bidders and technically challenged their respective proposed solutions
- The technical assessment identified operational and performance deficiencies associated with continuing with the pressure plate as a long term solution
- Preferred technical selection is with MHPS and GE.

Overall Weighted Score

MHPS	GE	Siemens	Press Plate
2.91	3.04	2.81	1.87

Ops/Maint Impact ONLY

MHPS	GE	Siemens	Press Plate
1.25	1.53	1.30	1.32

Performance/Reliability ONLY

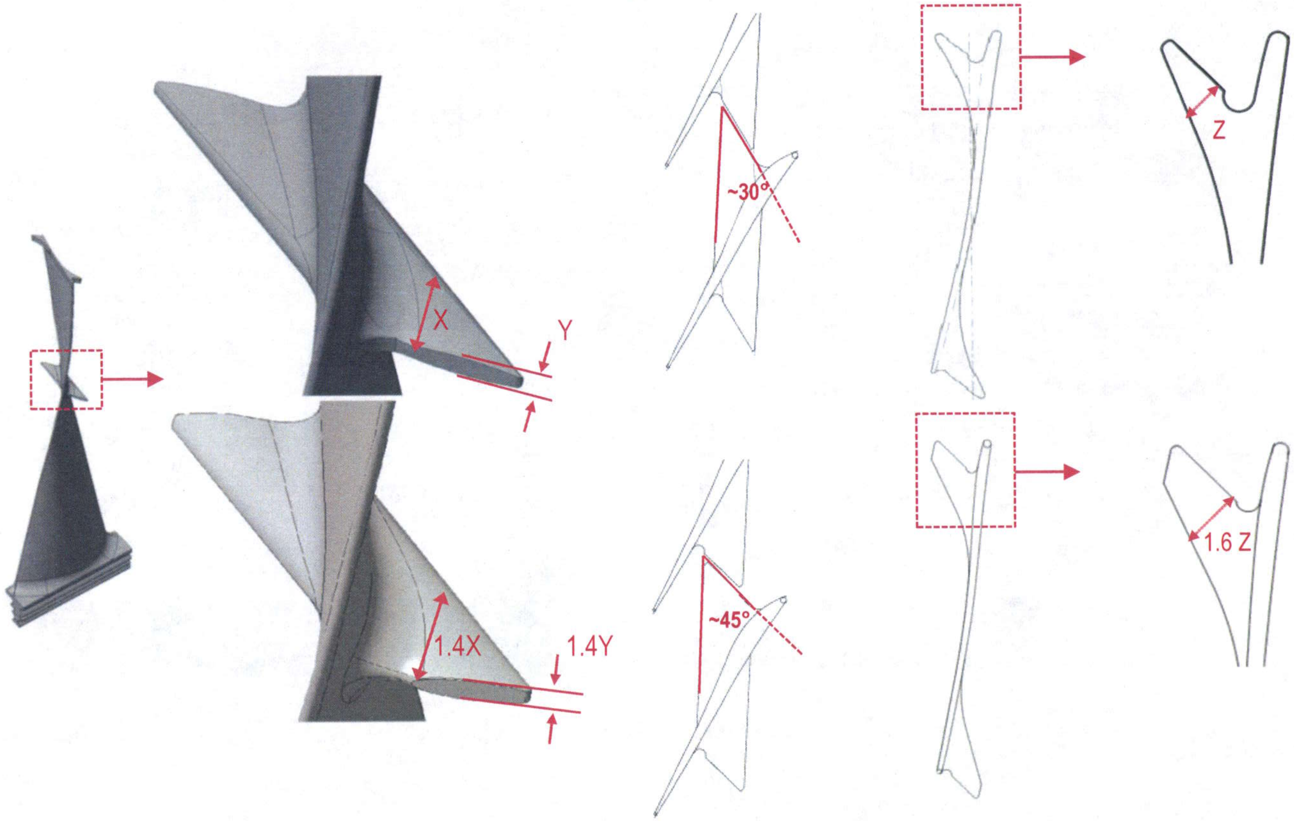
MHPS	GE	Siemens	Press Plate
1.66	1.51	1.51	0.55

For ALL solutions ➡ operational experience for the proposed designs is limited

Technical Evaluation: Original vs. Proposed L-0 Blade Design

- Improvements to mid-span stub design…
  - Increased length and thickness of the stub (by 1.4 times, each) to improve fretting fatigue strength.
  - The stub interface angle was increased to reduce tip bending by distributing fretting over a greater area.
- Improvements to shroud design…
  - Increased the shroud length by 1.6 times to improve fretting fatigue strength.
  - Adjusted the angle of shroud contact face to increase contact area as well as mechanical damping.
- Overall blade design improvements…
  - Geometry upgrades result in up to 80% less vibratory stress at the stub and shroud for same blade displacement.
  - Optimum stub and shroud gaps are designed to control contact speed and reaction force – i.e. better cold offset to get more hot/running contact face area.
  - No welding stellite (after machining) to distort contact faces as was seen on the Type 3 design.
  - 100% optic scanning of faces for acceptance testing vs. 4-point measurement to a blade fixture.

Original 40" L-0



Proposed 40" L-0

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Technical Evaluation: November 2018

- **November 2018 marks a critical milestone for MHPS in validating their upgraded blade design.**

	Napanee	vs. Takasago
L-0 Blade Type	Type 5	Type Proposed Redesign
Relative to Duke Fleet	Blade design set to go in-service at Citrus	Blade design proposed for Bartow
2018 Testing	Scheduled 4Q 2018 COD – ~457 MW Testing at higher LP steam flows comparable to Bartow (using BVM to monitor)	Scheduled November 2018 air excitation and electromagnetic excitation testing (using telemetry testing and BVM to monitor)
What Results of Testing Means for Each	• GOOD – Napanee moves forward • POOR – Replace Napanee L-0s with Proposed Redesign, or impose operational limitations. • POOR – Duke must know of possible Bartow limitations and "why".	• GOOD – Bartow project moves forward with MHPS L-0 Proposed Redesign option • POOR – MHPS must provide an acceptable remedy plan to Duke, or Bartow Project moves to an alternate contingency plan.

- **With either test case, Duke will have a vested interest in understanding the results and how they impact the long-term decision for Bartow.**

CONFIDENTIAL Technical Evaluation: Results Summary

Why we believe the MHPS L-0 solution is a viable technical solution…

- Best understanding of equipment and impacts of operation on ST.
- Previous L-0 event "fixes" were not based on an understanding of the cause.
  - Previous "fixes" were not design changes but application of coatings as an attempt to address a perceived symptom.
- Proposed L-0 design changes are significant in the new blade design.
- Initial rig testing (vibratory stress) indicates promising results. November 2018 test data to provide further validation.
- Long-term BVM during operation will provide Duke the ability to detect issues and keep track of the reliability of the upgraded L-0s.
- LP retrofits (like the GE and Siemens options) carry greater unknown risks due to lack of operating experience and experience in a 4x1 application

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Analytics: Scenarios and Cases

Black & Veatch and Performance Services worked together to establish the new heat balance cases needed to support analysis of the upgrade options.

- Original base design (matching Bibb cases) and pressure-plate model (matching actual data)
- A design model for each vendor using LP turbine data from their submitted heat balances.
- The case matrix for each vendor design and pressure-plate model established vendor-specific and pressure-plate dispatch curves:
  - 12 operating configurations from 1x70% to 4x1 PAG/duct-fired/evaporative cooling
  - 3 ambient temperature conditions (35, 74 and 95 deg F)
  - Included ALLTD cases at 2x1, 3x1 and 4x1x40%
  - 4 layers – GE, Siemens, Mitsubishi and pressure-plate
- The case matrix for alternative configuration screening included CT upgrades and chiller evaluations
  - 2 layers – one typical vendor design and pressure-plate conditions
- Total number of cases run = 238

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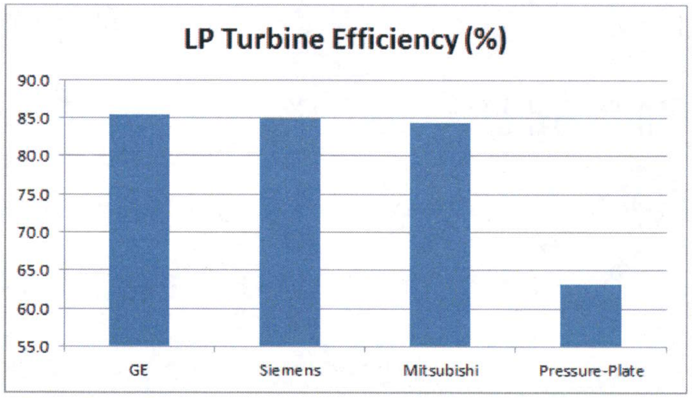
Analytics: Operating Limits

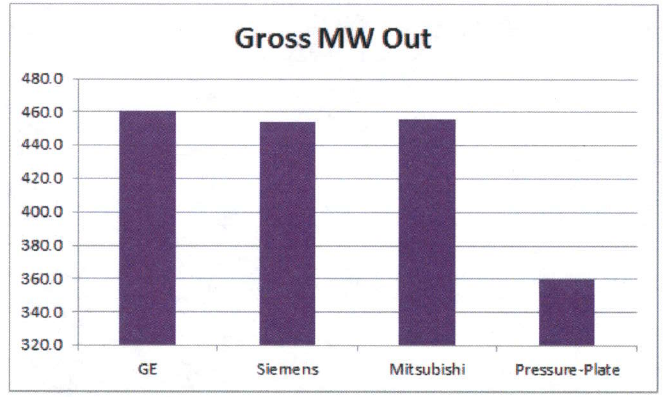
Operational limits used as limiting conditions in all of the heat balance cases:

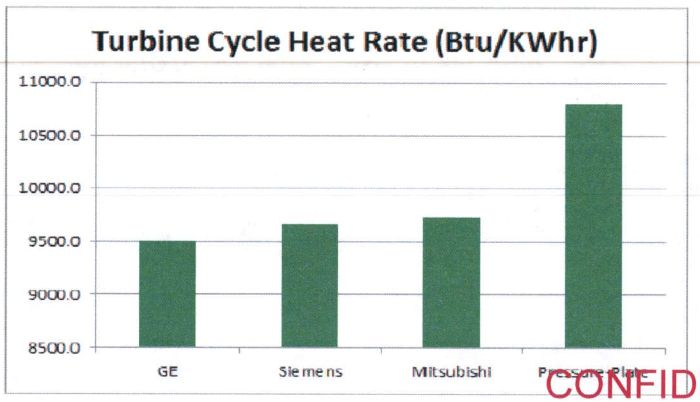
- ST HP admission pressure = 2389.7 psia
- ST IP admission pressure = 583.7 psia
- ST IP exhaust pressure = 125.7 psia (for pressure-plate cases only)
- ST generator output limit at PF 1.0 = 468 gross MW after generator losses (468 MVA)
- Duct burner fuel flow per HRSG = 10,000 lb/hr
- PAG steam flow per CT = 121,910 lb/hr
- Achieve maximum duct burner fuel flow first before bringing in any PAG steam flow for the most efficient ST operation in the ST maximum output cases
- CT maximum torque limit of 230,000 KW

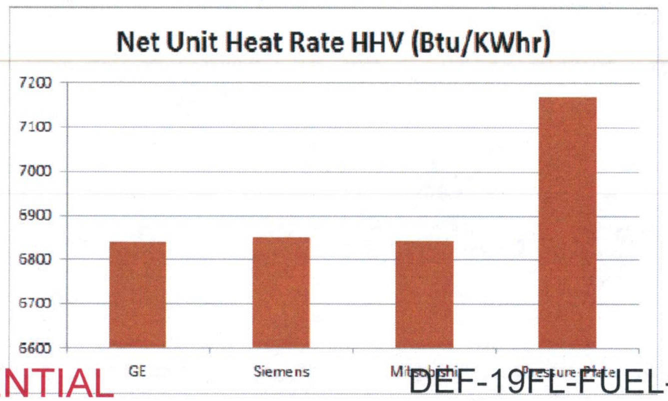
Analytics: ST Performance Comparisons

- Performance for the three OEM's is similar. With GE being slightly better than MHPS and Siemens









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Analytics: Summary of Results

- Developed design models for each vendor to validate heat balance and determined if there were any equipment limitations
- CC normalized performance comparison (Winter, 4x1 (100%) + Duct/PAG):

	GE	MHPS	Siemens	Pressure Plate
Net Load (MW)	1,309	1,309	1,308	1,252
NUHR (btu/Kwh)	7,040	7,042	7,045	7,361

- CC normalized performance comparison (Summer, 4x1 (100%) + EC/Duct/PAG):

	GE	MHPS	Siemens	Pressure Plate
Net Load (MW)	1,172	1,169	1,169	1,121
NUHR (btu/Kwh)	7,069	7,089	7,085	7,388

- *Note: CT Upgrades and Chiller options were also evaluated and are summarized in the Appendix*

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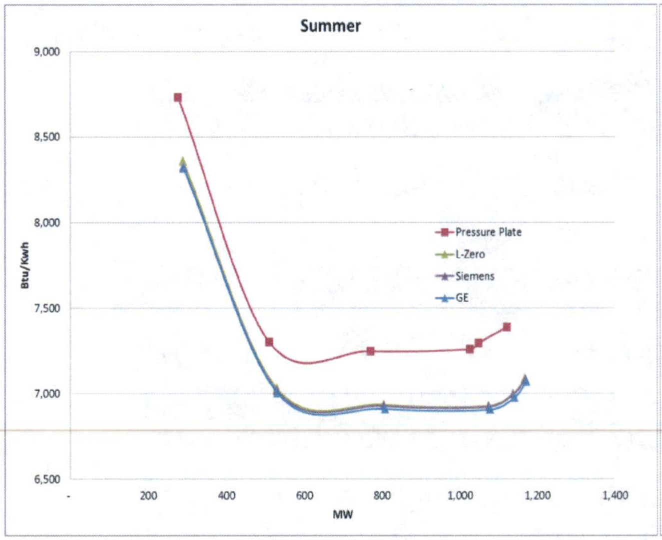
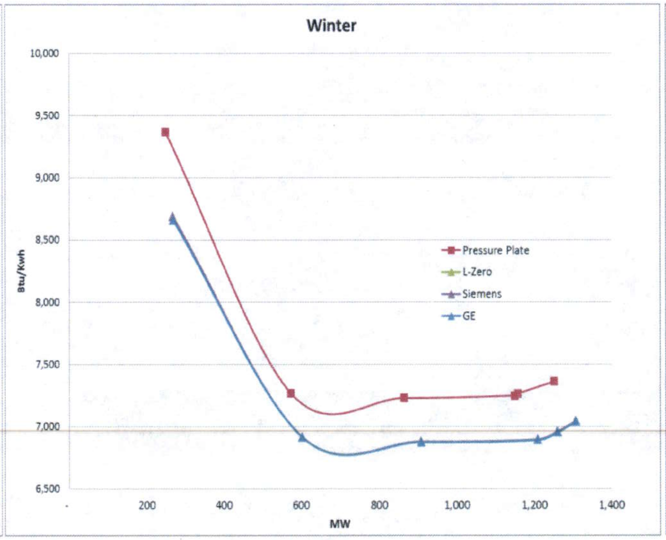
Analytics: CC Performance Overview

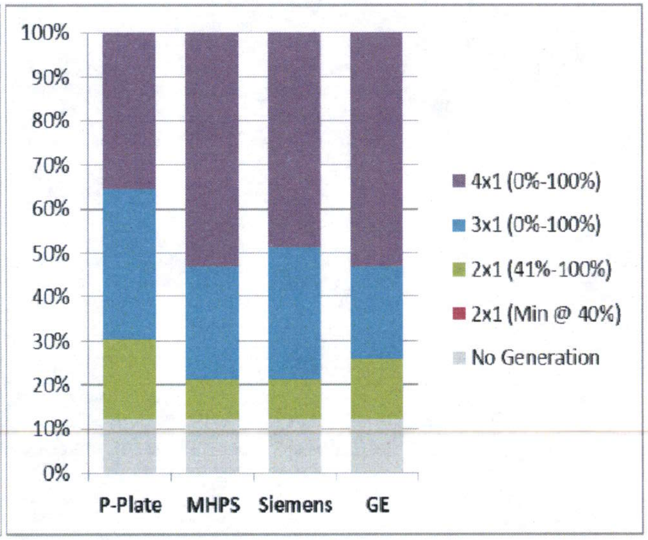
CC upgrade performance results – Pressure plate is outlier, others comparable

Comparison of Performance Curves





Comparison of Annual Operating Hours
(Annual %'s Projected for 2023)



- Notes:
  - Bartow CC is modeled as a must run unit on the DEF system
  - System production cost studies reflect positive CPVRR savings, pending finalization of the costs and timing for the upgrade projects
  - Preliminary results are subject to change as the assessment progresses

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Analytics: Fleet Generation Comparisons

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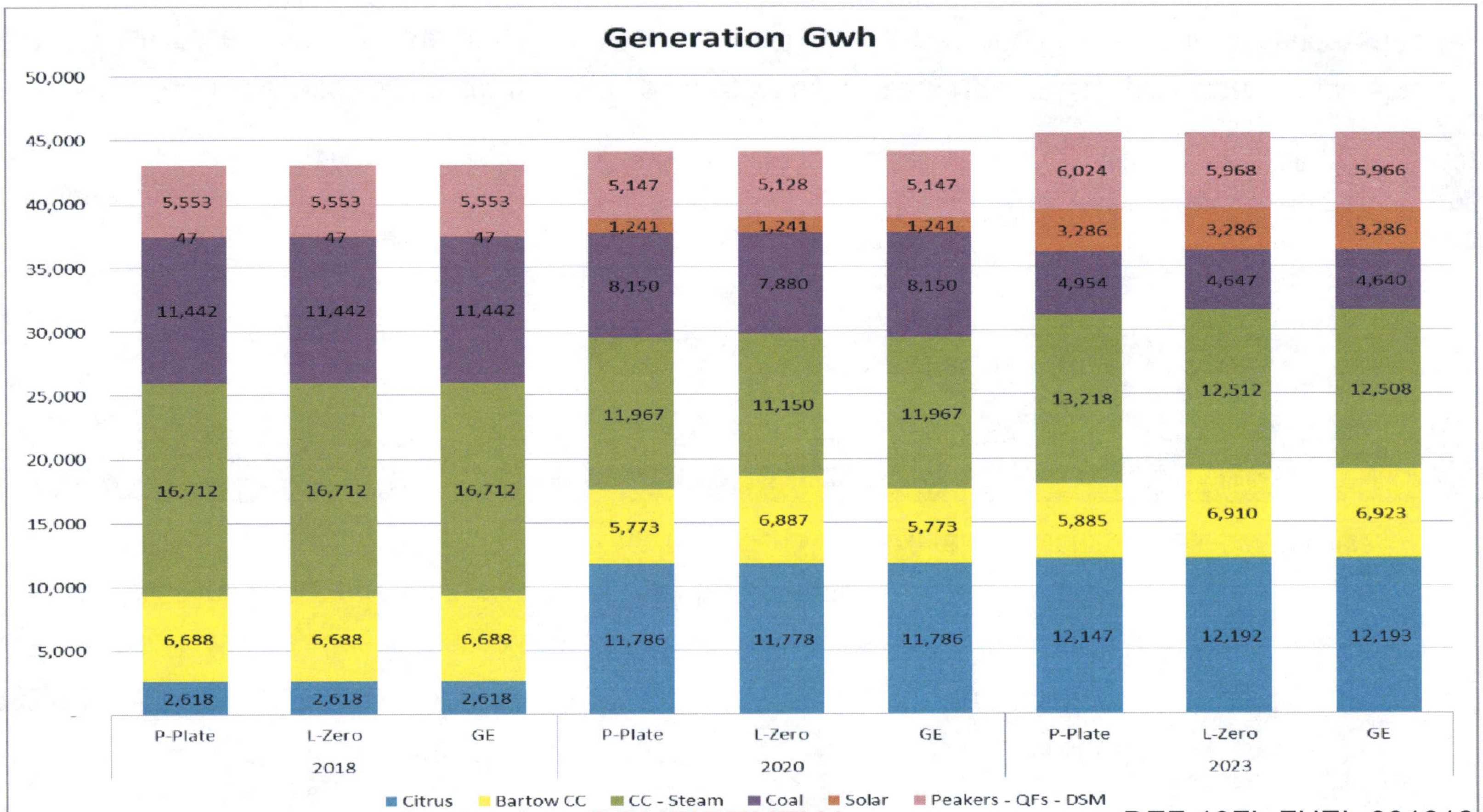

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Analytics: System Economics Summary

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Results of the comparison of alternatives performed by Integrated Resource Planning

- Reflects impacts of performance upgrades on total DEF system costs over the planning period
- Includes the projected capital cost impacts for the upgrades
- Results in Cumulative PV of Revenue Requirements ($CPVRR) reflect customer cost perspective

Comparison of Alternatives CPVRR $M	P Plate	MHPS	Siemens	GE	P Plate vs MHPS ISD Fall 2019	P Plate vs Siemens ISD Spring 2022	P Plate vs GE ISD Fall 2019
System Fixed Costs	8,077	8,077	8,077	8,077	0	0	0
System Fuel Cost	15,202	15,116	15,126	15,113	86	76	89
System VOM Cost + Start Up Costs	2,210	2,204	2,205	2,203	6	5	6
System Environmental	2,508	2,488	2,488	2,488	20	20	20
Total Production Costs	**27,997**	**27,885**	**27,896**	**27,881**	**111**	**101**	**115**
Incremental Capital RR's	-	11	11	14	(11)	(11)	(14)
Total Costs	**27,997**	**27,896**	**27,906**	**27,896**	**100**	**90**	**101**

- As noted in the summary, resulting improvements for either the MHPS or GE options are comparable
- Given these results and the commercial and technical evaluations performed, the recommendation to proceed with negotiations and risk review with MHPS is supported.

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Project Summary

- Project Cost to Install Solution (LP Section Only, in $MM)

	GE	MHPS	Siemens
Materials	$8.38	$6.94	$9.19
Labor	$1.87	$1.59	$1.76
Crane	$0.66	$0.46	$0.66
Grand Total	**$10.91**	**$8.99**	**$11.61**

  - Assumptions: OEM Turn Key labor, materials for LP only, crane cost for outage (project burdens not included)
  - MHPS: Install in 2019 MJR with HPIP. Not included - $1M pressure plate storage inventory increase
  - GE and Siemens Install – LP Only MJR in 2020
  - *Does not include cost of any potential foundation modifications to accommodate added rotor weight (if needed for GE/Siemens)*

- BVM System and Monitoring Costs (in $K)

	GE	MHPS	Siemens
System Cost	$850	Included in Base	Included in Base*
Annual Monitoring	$TBD**	$200	$44

* Siemens base package BVM offering was for 1-year installed. Siemens addendum for permanent install was "Base + $50k"

** GE is purchasing/providing a 3rd Party BVM product and leaving the long-term monitoring responsibilities for Duke to manage.

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Bartow CC Steam Turbine Optimization Project - *Alternative Configurations*

In addition to review of the ST L-0 vendor proposals, the project team also performed a screening evaluation of several additional upgrade configurations.

Alternative Configuration* Cases:

- Combustion Turbine Upgrades
- Chiller Upgrades
- Both Combustion Turbine and Chiller Upgrades

**Note: Considered configurations both with and without the ST L-0 Upgrades*

Modeling & Analytics:

- B&V developed full load and partial heat balance model cases for the upgrades and determined the performance and full output capabilities with the limiting conditions assumed for the study.
- The alternative configurations were then studied by IRP to assess the savings potential in system production cost and capacity deferral.

Results

- The observed benefits offer limited potential for these investments at this time.

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Bartow CC Steam Turbine Optimization Project - *Alternative Configurations*

Overview of Limits Observed:

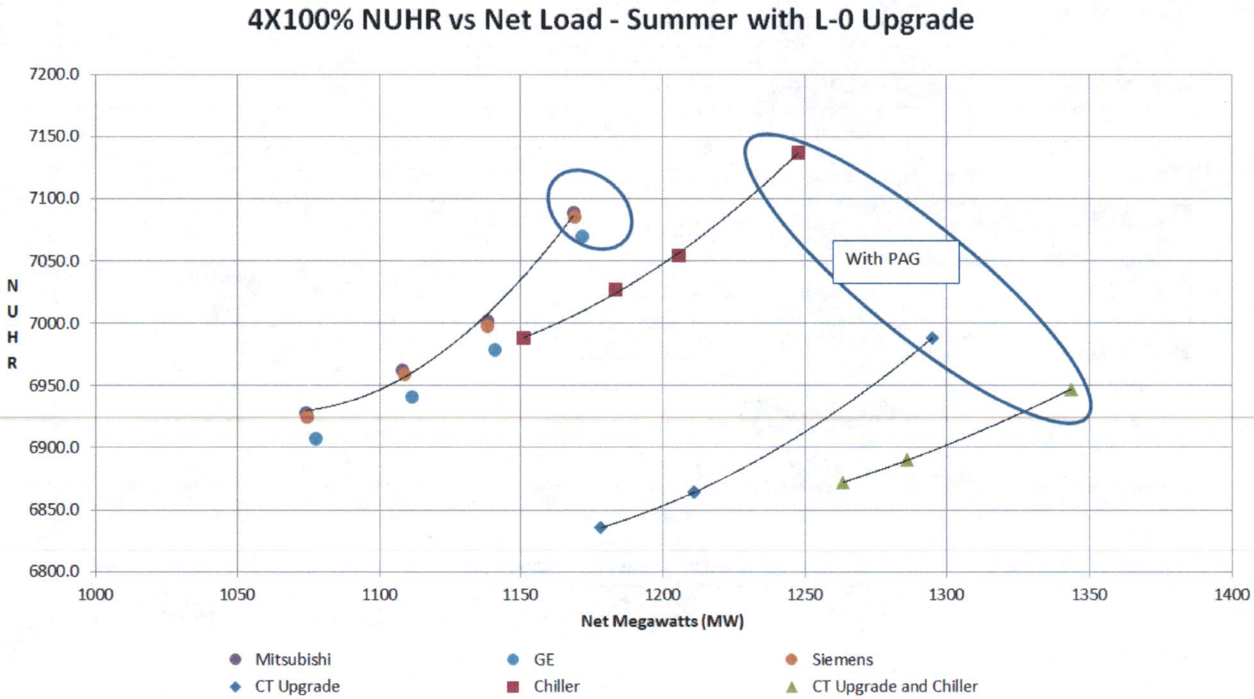
Ambient	Mode	Configuration	Rate	Evap. Cooler	Duct Firing	PAG	Fuel	L-0 Upgrade Only	GT Upgrade	Chiller	GT Upgrade and Chiller
35 F	2x1	2x100%	Max	-	-	-	Gas				
95 F	2x1	2x100%	Max	On	-	-	Gas				
35 F	3x1	3x100%	Max	-	-	-	Gas				
35 F	3x1	3x100%	Max	-	Fired	-	Gas		HPT		
74 F	3x1	3x100%	Max	-	-	-	Gas				
74 F	3x1	3x100%	Max	-	Fired	-	Gas		HPT		HPT
74 F	3x1	3x100% PAG	Max	-	Fired	PAG	Gas				HPT
95 F	3x1	3x100%	Max	On	-	-	Gas				
95 F	3x1	3x100%	Max	On	Fired	-	Gas		HPT		HPT
35 F	4x1	4x100%	Max	-	-	-	Gas				
35 F	4x1	4x100% Max DF	Max	-	Fired	-	Gas	IPT	IPT		
35 F	4x1	4x100% PAG	Max	-	Fired	PAG	Gas		IPT		
74 F	4x1	4x100%	Max	-	-	-	Gas				
74 F	4x1	4x100% Max DF	Max	-	Fired	-	Gas	IPT	IPT		IPT
74 F	4x1	4x100% PAG	Max	-	Fired	PAG	Gas				HPT
95 F	4x1	4x100%	Max	On	-	-	Gas				
95 F	4x1	4x100% PAG	Max	On	Fired	PAG	Gas		HPT		HPT
95 F	4x1	4x100% Max DF	Max	On	Fired	-	Gas	IPT	IPT	IPT	IPT

Key:
- No limit
- Limited by IPT inlet pressure
- Limited by HPT inlet pressure
- Not achievable

- Includes L-0 Upgrades
- 4x1x100% cases with max duct-firing limited by IPT inlet pressure
- 3x1x100% cases with duct-firing/PAG limited by HPT inlet pressure
- 4x1x100% cases with duct-firing limited by IPT inlet pressure
- 4x1x100% cases with duct-firing/PAG limited by HPT inlet pressure

Bartow CC Steam Turbine Optimization Project - *Alternative Configurations*

Performance Improvements:



- Includes L-O Upgrades
- Duct-firing case
  Limiting condition = IP admission pressure
- PAG case
  Limiting condition = HP admission pressure

Economic Study Results:

Comparison to Ref Case (with the ST L-0 Upgrade) 20 Yr Cumulative PV of Revenue Requirements ($M)	CT Upgrades	Chiller Additions	CT Upgrades & Chiller Additions
Fuel & Other Production Cost Savings	63	18	74
Environmental Savings	16	3	20
Upgrade Capital (CT, Chillers)	(89)	(57)	(146)
CPVRR System Savings (Costs)	**(10)**	**(37)**	**(53)**
Deferred Planned Additions Savings	17	17	89
CPVRR Total Savings (Costs)	**7**	**(20)**	**36**
MW and HR* Improvements (Summer)	**126 / (100)**	**79 / 49**	**175 / (142)**

* *HR Improvements in Btu/kWh*

Any Questions?

- T&C negotiation with MHPS
- Communicate direction with Legal to get input
- Begin building a project execution plan and budget

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Backup Slides – Additional Detail & Analysis…

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Technical Evaluation: Criteria Details

- Sub Category rating criteria and definitions

%Wt	Criteria and Weighting Factors	Rating Criteria		
		1	3	5
Impact to Future Maintenance (20%)				
25%	Maintenance Interval	Worse Than Current	Same As Current (64k Hrs)	Better Than Current
20%	Major Overhaul Scope $$$/Neg. Impacts	Templates Will Require Adjustment	No Adjustment to Templates	Template Cost Reduced
10%	Emergent Outage Scope if L-0 Blades Require Replacement	Requires Rotor Removal	NA	Does Not Require Rotor Removal
15%	Additional Support Infrastructure (e.g. Lift Oil System)	Mods/Maint Adders Req'd (Additional Maint. Impact)	Mods/Maint Adders Req'd (No Additional Maint. Impact)	No Mods/Maint. Equipment Adders
5%	Replacement Interval of L-0 blades (As Proposed)	< 1 Maintenance Interval	1 Maintenance Interval (64k Hrs)	> 1 Maintenance Interval
5%	Rotor Life Extension Evaluation	< (200k Hours / 5k Starts) before RLE	(200k Hours / 5k Starts) before RLE	> (200k Hours / 5k Starts) before RLE
15%	Tech Support -- Responsiveness, Ownership of Issues	Multi-OEM ST Config -- Higher Likelihood of Having Difficulty w Problem Solving	NA	No Conflict or Difficulty Resolving Issues
5%	L-0 Erosion Susceptibility	No Erosion Protection, Erosion Likely w Design -- Increased Reliability Risk	Likely to Have Erosion (Regardless of Protection Scheme) -- Not Likely to Cause Issues	Proven Experience with Mitigating Erosion
Impact to Future Operations (20%)				
20%	Restrictions to Blending	Restrictons / Unknown Until Ops Data Collected	Known / Acceptable Restrictions	No Restrictions
40%	Restrictions on Condenser (Back Pressure / Bathtub Curves)	Restrictons / Unknown Until Ops Data Collected	Known / Acceptable Restrictions	No Restrictions
35%	Max Flow Limitations	(< 2.38 MPPH / 420 MW) / Min Margin Available	(= 2.38 MPPH / 420 MW) / Min Margin Available	(2.7 MPPH / 450+ MW) / Margin Available
5%	Low Load Limitations	ST Output of > ~65 MW Indefinitely (1x1 or 2x1)	ST Output of ~65 MW Indefinitely w/o Sprays (1x1)	ST Output of < ~65 MW Indefinitely w/o Sprays (1x1)
Unit Performance (10%)				
30%	MW Output	Today w/ PressPlate	Nameplate (420 MW)	Bid Spec Guarantee (450MW)
70%	Heat Rate	Appreciable Increase in HR	Same as Kiewit 2009 Value	Appreciable Decrease in HR
Unit Reliability (50%)				
50%	OEM Operating Experience (At >= to Bartow Exhaust Flow)	Test Rig Only	Operation Experience < 64k Hrs	Operational Experience > 64k Hrs
20%	Experience with OEM ST Equipment (Fleet Experience)	Several Operational/Historical Design Deficiencies	Some Issues but Responds Quickly and Responsibly	Few Operational/Historical Design Deficiencies
30%	Ability to Detect Adverse Operations (Real Time)	No Telemetry Test / No BVM	Telemetry Test at Stm Conditions	BVM

Technical Evaluation: KT Assessment Details

- Scoring Results by Category (unweighted and weighted)

Criteria and Weighting Factors	Criteria Based Scoring (Unweighted)				Criteria Based Scoring (Weighted)			
	MHPS	GE	Siemens	Press Plate	MHPS	GE	Siemens	Press Plate
Impact to Future Maintenance (20%)					**3.50**	**3.70**	**2.95**	**3.10**
Maintenance Interval	3	5	5	2	0.75	1.25	1.25	0.5
Major Overhaul Scope $$$/Neg. Impacts	3	2	1	2	0.6	0.4	0.2	0.4
Emergent Outage Scope if L-0 Blades Require Replacement	1	5	5	5	0.1	0.5	0.5	0.5
Additional Support Infrastructure (e.g. Lift Oil System)	5	5	1	2	0.75	0.75	0.15	0.3
Replacement Interval of L-0 blades (As Proposed)	5	5	5	5	0.25	0.25	0.25	0.25
Rotor Life Extension Evaluation	3	3	3	3	0.15	0.15	0.15	0.15
Tech Support -- Responsiveness, Ownership of Issues	5	2	2	5	0.75	0.3	0.3	0.75
L-0 Erosion Susceptibility	3	2	3	5	0.15	0.1	0.15	0.25
Impact to Future Operations (20%)					**2.75**	**3.95**	**3.55**	**3.50**
Restrictions to Blending	4	4	4	5	0.8	0.8	0.8	1
Restrictions on Condenser (Back Pressure / Bathtub Curves)	1	4	3	5	0.4	1.6	1.2	2
Max Flow Limitations	4	4	4	1	1.4	1.4	1.4	0.35
Low Load Limitations	3	3	3	3	0.15	0.15	0.15	0.15
Unit Performance (10%)					**3.60**	**3.60**	**3.60**	**1.00**
MW Output	5	5	5	1	1.5	1.5	1.5	0.3
Heat Rate	3	3	3	1	2.1	2.1	2.1	0.7
Unit Reliability (50%)					**2.60**	**2.30**	**2.30**	**0.90**
OEM Operating Experience (At >= to Bartow Exhaust Flow)	1	1	1	0	0.5	0.5	0.5	0
Experience with OEM ST Equipment (Fleet Experience)	3	3	3	3	0.6	0.6	0.6	0.6
Ability to Detect Adverse Operations (Real Time)	5	4	4	1	1.5	1.2	1.2	0.3

Overall Weighted Score

MHPS	GE	Siemens	Press Plate
2.91	3.04	2.81	1.87

Ops/Maint Impact ONLY

MHPS	GE	Siemens	Press Plate
1.25	1.53	1.30	1.32

Performance/Reliability ONLY

MHPS	GE	Siemens	Press Plate
1.66	1.51	1.51	0.55

Technical Evaluation: Siemens Summary

- Of the three viable options this is the least preferred option
- Requires a lift oil system to manage rotor weight
- Complexity added with major maintenance requiring potential 1000T crane to lift rotor
- Torsional testing is required (nothing in the proposal covers discovery)
- Limited operating experience at the flow rate required at Bartow
- Similar design as what is in the Osprey ST.

- No engineering has been performed to determine if there are any system impacts (equipment modifications) or foundation modification due to the heavy rotor. High potential for project cost creep

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Technical Evaluation: GE Summary

- Of the three viable options this is the first preferred for an LP retro-fit option
- Rotor weight is heavier but GE indicated some additional engineering could take place to reduce weight
- No lift system required
- Torsional testing is not required , but the technical team may require detailed reviews to ensure this is not needed (nothing in the proposal covers discovery)
- Limited operating experience at the flow rate. Installed in two (2) Texas units with <10k hrs of operation
- No engineering has been performed to determine if there are any system impacts (equipment modifications) or foundation modification due to the heavy rotor. High potential for project cost creep

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Technical Evaluation: Pressure Plate Summary

- The pressure plate option was a low-scoring outlier in the technical evaluation.
- Recent inspections have shown the presence of the pressure plate causes damage to neighboring and downstream infrastructure due in part to increased steam velocities generated because of the pressure plate.
- Continued operation with the pressure plate and its effects on future recommended maintenance intervals can not yet be determined.

- IF Duke proceeds with the recommended MHPS technical offering, the pressure plate (and associated hardware) will need to be removed, blast cleaned, NDE'd and placed into Bartow inventory for short-term contingency (3-5 years).
- IF Duke proceeds with either the GE or Siemens technical offerings, the existing pressure plate will not be able to be reused in those rotor configurations.

Performance team evaluation details

Performance evaluation details

Bartow CC -LP Turbine Upgrade Study 2018

Becky McClintock
Thermal Performance M&D Center

Overview

- Load Cases Requested from Vendors
- Black & Veatch Modeling and Analysis
  - Case Matrix
  - Operational Limits
- Model Results
  - Steam turbine performance by vendor
  - Net unit heat rate
  - GT Upgrade and Chiller Operating Limitations

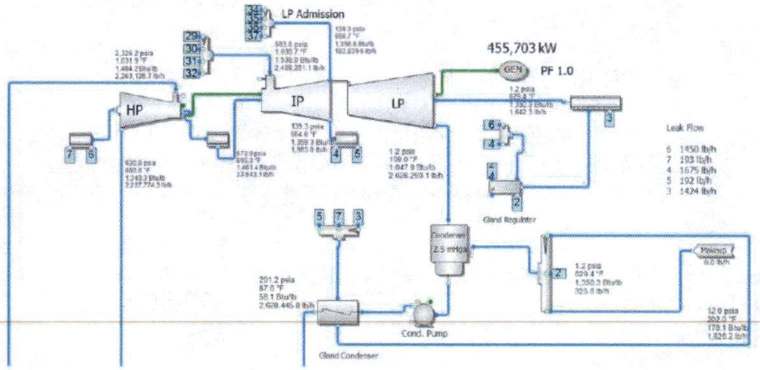
Load Cases Requested from Vendors

- Four full-load cases and one low-load case

1) 455.7 Gross MW - Maximum load on steam turbine below its operational limits and matching December 2014 steam turbine test conditions at 2.5"Hg condenser back pressure
2) 449.9 Gross MW - Maximum load on steam turbine below its operational limits and matching December 2014 steam turbine test conditions at 4.5"Hg condenser back pressure
3) 419.6 Gross MW – Guarantee load from Bibb Heat Balances for fired conditions
4) 385.7 Gross MW – Guarantee load from Bibb Heat Balances for unfired conditions
5) 59.5 Gross MW – Low load from Bibb Heat Balances (1x1x70% CT Load at 95 deg F ambient)

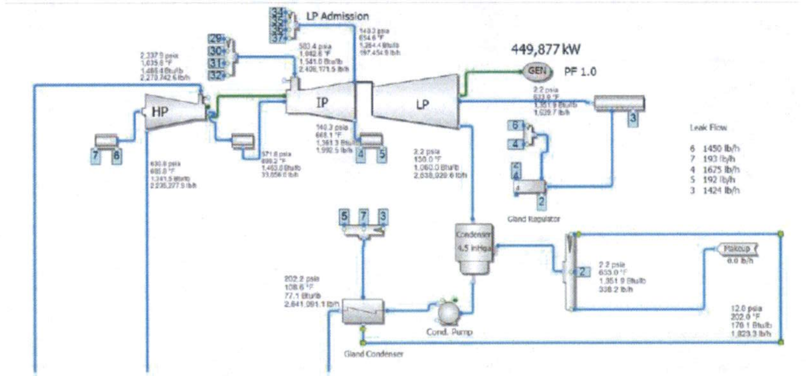
455.7 Gross MW

Valves Wide Open (IP Inlet Pressure at Nameplate - Before Control Valve) - 4x1 Fired Natural Gas, Ambient Temp 74.4 deg F, Circulating Water Inlet Temperature 66 deg F, 72% Condenser Cleanliness (to match 12/22/2014 15:16 actual data)



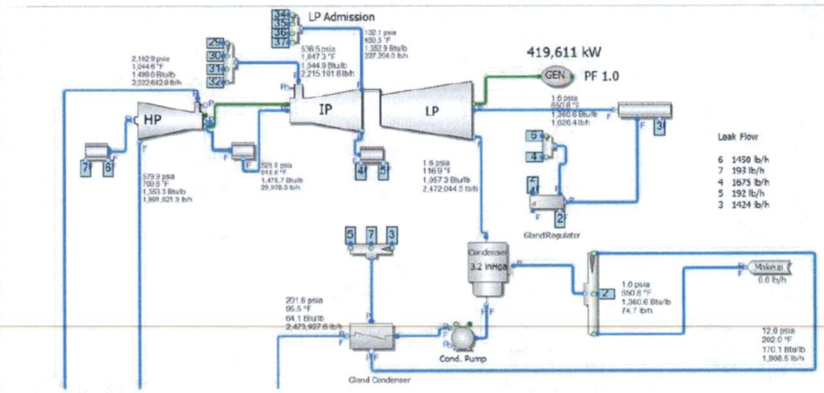
449.9 Gross MW

Valves Wide Open (IP Inlet Pressure at Nameplate - Before Control Valve) - 4x1 Fired Natural Gas, Ambient Temp 79 deg F, Circulating Water Inlet Temperature 66 deg F, 46% Condenser Cleanliness (to match 12/23/2014 14:20 actual data)



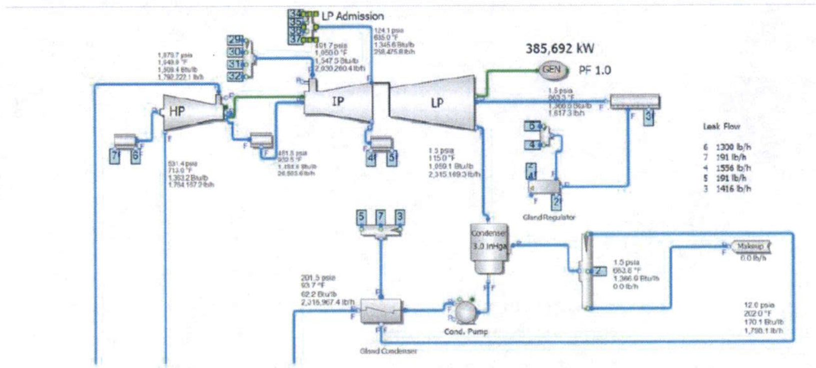
419.6 Gross MW

419.6 MW - 4x1 Fired Natural Gas, Ambient Temp 74 deg F, Circulating Water Inlet Temperature 85 deg F, 90% Condenser Cleanliness



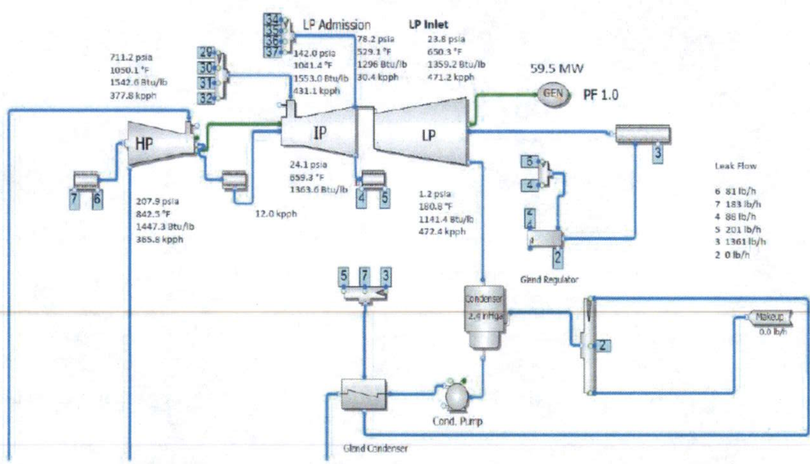
385.7 Gross MW

Rated Conditions - 4x1 Unfired Natural Gas, Ambient Temp 74 deg F, Circulating Water Inlet Temperature 85 deg F, 90% Condenser Cleanliness



59.5 Gross MW

1x1@70% CT load, Unfired Natural Gas, Ambient Temp 95 deg F,
Circulating Water Inlet Temperature 90 deg F



Black & Veatch Modeling and Analysis

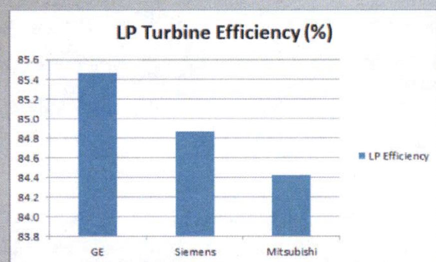
- Developed original base design (matching Bibb cases) and pressure-plate model (matching actual data)
- Developed a design model for each vendor using LP turbine data from their submitted heat balances
- Ran case matrix for each vendor design and pressure-plate model to develop vendor-specific and pressure-plate dispatch curves
  - 12 operating configurations from 1x70% to 4x1 PAG/duct-fired/evaporative cooling
  - 3 ambient temperature conditions (35, 74 and 95 deg F)
  - Included ALLTD cases at 2x1, 3x1 and 4x1x40%
  - 4 layers – GE, Siemens, Mitsubishi and pressure-plate
- Ran another case matrix for CT upgrade and chiller evaluation
  - 2 layers – one typical vendor design and pressure-plate conditions
- Total number of cases run = 238

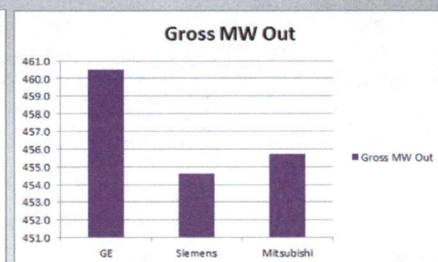
Operational Limits

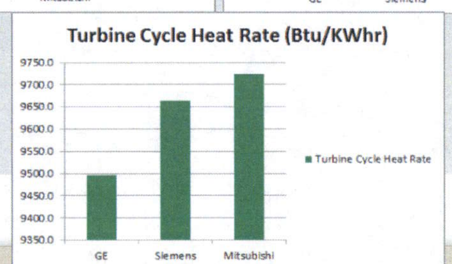
- Used operational limits as limiting conditions in all cases
  - ST HP admission pressure = 2389.7 psia
  - ST IP admission pressure = 583.7 psia
  - ST IP exhaust pressure = 125.7 psia (for pressure-plate cases only)
  - ST generator output limit at PF 1.0 = 468 gross MW after generator losses (468 MVA)
  - Duct burner fuel flow per HRSG = 10,000 lb/hr
  - PAG steam flow per CT = 121,910 lb/hr
  - Achieve maximum duct burner fuel flow first before bringing in any PAG steam flow for the most efficient ST operation in the ST maximum output cases
  - CT maximum torque limit of 230,000 KW

Model Results – ST Performance

- At ST maximum load, GE's upgrade had 1% higher LP turbine efficiency, 5 more gross MW's, and 2% lower turbine cycle heat rate than Mitsubishi upgrade

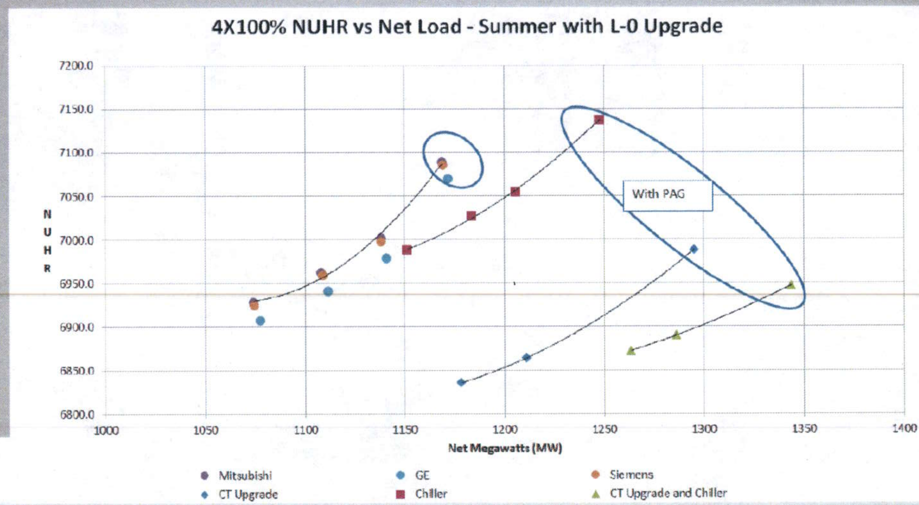






Model Results – Net Unit Heat Rate

- L-O Upgrade
- Duct-firing case limiting condition = IP admission pressure
- PAG case limiting condition = HP admission pressure



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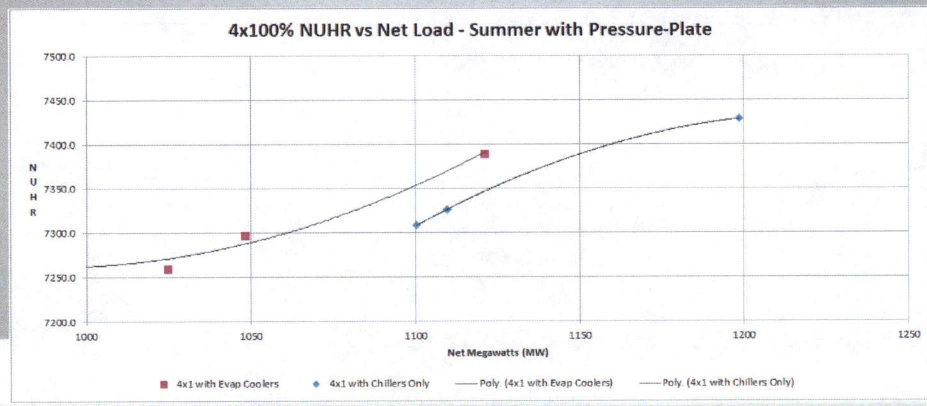
Model Results – Pressure Plate

- According to Black and Veatch, "if steam turbine is kept as-is with the pressure plate, and the CT's are upgraded, then the IPT exit pressure limit would be exceeded in many operational scenarios"
- Only the chiller operation in the summer was an available option for 4x1, yielding an additional ~75 net unit MW



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Model Results – GT Upgrade & Chiller Limitations with L-0 Upgrade

- 3x1x100% cases with duct-firing/PAG limited by HPT inlet pressure
- 4x1x100% cases with duct-firing limited by IPT inlet pressure
- 4x1x100% cases with duct-firing/PAG limited by HPT inlet pressure

Ambient	Mode	Configuration	Rate	Evap. Cooler	Duct Firing	PAG	Fuel	GT Upgrade	Chiller	GT Upgrade and Chiller
35 F	2x1	2x100%	Max	-	-	-	Gas			
95 F	2x1	2x100%	Max	On	-	-	Gas			
35 F	3x1	3x100%	Max	-	-	-	Gas			
35 F	3x1	3x100%	Max	-	Fired	-	Gas	HPT		
74 F	3x1	3x100%	Max	-	-	-	Gas			
74 F	3x1	3x100%	Max	-	Fired	-	Gas	HPT		HPT
74 F	3x1	3x100% PAG	Max	-	Fired	PAG	Gas			HPT
95 F	3x1	3x100%	Max	On	-	-	Gas			
95 F	3x1	3x100%	Max	On	Fired	-	Gas	HPT		HPT
35 F	4x1	4x100%	Max	-	-	-	Gas			
35 F	4x1	4x100%	Max	-	Fired	-	Gas	IPT		
35 F	4x1	4x100% PAG	Max	-	Fired	PAG	Gas	IPT		
74 F	4x1	4x100%	Max	-	-	-	Gas			
74 F	4x1	4x100%	Max	-	Fired	-	Gas	IPT		IPT
74 F	4x1	4x100% PAG	Max	-	Fired	PAG	Gas			HPT
95 F	4x1	4x100%	Max	On	-	-	Gas			
95 F	4x1	4x100%	Max	On	Fired	-	Gas	IPT		IPT
95 F	4x1	4x100% PAG	Max	On	Fired	PAG	Gas	HPT		HPT
95 F	4x1	4x100% ST Max	Max	On	Fired	-	Gas	IPT	IPT	IPT

No limit
Limited by IPT inlet pressure
Limited by HPT inlet pressure
Not achievable

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Model Results – GT Upgrade & Chiller Limitations with Pressure-Plate

- 3x1x100% cases with duct-firing limited by IPT exhaust pressure
- 4x1x100% cases cannot be achieved with GT Upgrade
- Only chiller cases limited by IPT exhaust pressure are at 4x1x100% with duct-firing

Ambient	Mode	Configuration	Rate	Evap. Cooler	Duct Firing	PAG	Fuel	GT Upgrade	Chiller	GT Upgrade and Chiller
35 F	3x1	3x100%	Max	-	-	-	Gas	[green]		
35 F	3x1	3x100%	Max	-	Fired	-	Gas	[purple]		
35 F	4x1	4x100%	Max	-	-	-	Gas	[red]		
35 F	4x1	4x100%	Max	-	Fired	-	Gas	[red]		
35 F	4x1	4x100% ST Max	Max	-	Fired	-	Gas	[red]		
74 F	3x1	3x100%	Max	-	-	-	Gas	[green]		[green]
74 F	3x1	3x100%	Max	-	Fired	-	Gas	[purple]		[purple]
74 F	4x1	4x100%	Max	-	-	-	Gas			[red]
74 F	4x1	4x100%	Max	-	Fired	-	Gas			[red]
74 F	4x1	4x100%	Max	-	Fired	-	Gas	[red]		[red]
95 F	3x1	3x100%	Max	On	-	-	Gas	[green]	[green]	[green]
95 F	3x1	3x100%	Max	On	Fired	-	Gas	[purple]	[green]	[purple]
95 F	4x1	4x100%	Max	On	-	-	Gas	[red]	[green]	[red]
95 F	4x1	4x100%	Max	On	Fired	-	Gas	[red]	[purple]	[red]
95 F	4x1	4x100% PAG	Max	On	Fired	PAG	Gas		[green]	
95 F	4x1	4x100% ST Max	Max	On	Fired	-	Gas	[red]	[purple]	[red]

[green] No limit
[purple] Limited by IPT exhaust pressure
[red] Not achievable

Integrated Resource Planning evaluations

Bartow CC Steam Turbine Optimization Project - Modeling Assumptions

Reference Case vs Current Configuration: Pressure Plate

- Bid # 1: Mitsubishi L-Zero Blades Replacement ISD: May 1st 2019
- Bid # 2: Siemens Rotor Replacement ISD: May 1st 2022
- Bid # 3: GE Rotor Replacement ISD: May 1st 2022

Pressure Plate Case Outage Schedule for years 2018 – 2023 based on GMS.

L-Zero, Siemens and GE cases are variations from the GMS assuming 12 week outage for the Blades / Rotor Replacement.

Presure Plate			L-Zero			Siemens & GE		
Start Date	Duration (Days)	MW Out	Start Date	Duration (Days)	MW Out	Start Date	Duration (Days)	MW Out
3/10/2018 0:00	8	700	3/10/2018 0:00	8	700	3/10/2018 0:00	8	700
3/18/2018 0:00	7	520	3/18/2018 0:00	7	520	3/18/2018 0:00	7	520
			2/6/2019 0:00	**25**	**300**			
3/2/2019 0:00	35	500	3/2/2019 0:00	34	500	3/2/2019 0:00	35	500
			3/3/2019 0:00	**25**	**300**			
4/6/2019 0:00	7	300				4/6/2019 0:00	7	300
9/28/2019 0:00	35	220	9/28/2019 0:00	35	220	9/28/2019 0:00	35	220
3/7/2020 0:00	8	700	3/7/2020 0:00	8	700	3/7/2020 0:00	8	700
3/15/2020 0:00	7	520	3/15/2020 0:00	7	520	3/15/2020 0:00	7	520
3/6/2021 0:00	8	700	3/6/2021 0:00	8	700	3/6/2021 0:00	8	700
3/14/2021 0:00	7	520	3/14/2021 0:00	7	520	3/14/2021 0:00	7	520
						2/6/2022 0:00	**26**	**300**
3/5/2022 0:00	42	500	3/5/2022 0:00	42	500	3/5/2022 0:00	42	500
						4/16/2022 0:00	**16**	**300**
3/4/2023 0:00	42	500	3/4/2023 0:00	42	500	3/4/2023 0:00	42	500

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Bartow CC Steam Turbine Optimization Project - Modeling Assumptions

Bartow CC

- Must Run Unit
- Min Capacity 2x1 @ 40%
- Maintenance Rates (Turbine and Generator Services):

2024	4.10%
2025	4.10%
2026	8.20%
2027	4.10%
2028	4.10%
2029	5.80%
2030	4.10%
2031	4.10%
2032	4.10%
2033	8.20%
2034	4.10%
2035	4.10%
2036	5.70%
2037	4.10%
2038	4.10%

Bartow CC Steam Turbine Optimization Project - Assumptions

Winter Heat Rates and Capacities values provided by Dario Zuloaga / Becky McClintock

Winter	Pressure Plate		L-Zero		Siemens		GE	
	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
4x40%	505	9,233	547	8,520	546	8,526	547.10	8,515
4x100%	1,150	7,248	1,209	6,892	1,209	6,896	1,209.69	6,890
4x100% DF	1,158	7,264	1,262	6,957	1,260	6,960	1,261.25	6,953
4x100% DF, PAG	1,252	7,361	1,309	7,042	1,308	7,045	1,309.27	7,040
3x40%	378	9,248	409	8,535	409	8,544	409.19	8,538
3x100%	865	7,229	909	6,876	909	6,879	909.46	6,873
3x100% DF	972	7,506	1,030	7,077	1,030	7,082	1,030.74	7,074
2x40%	249	9,368	268	8,685	268	8,686	269.01	8,658
2x100%	573	7,267	603	6,912	602	6,918	602.75	6,914
1x70%	200	7,898	207	7,611	208	7,592	207.93	7,581
1x100%	278	7,489	290	7,187	290	7,180	290.85	7,164

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Bartow CC Steam Turbine Optimization Project - Assumptions

Summer Heat Rates and Capacities values provided by Dario Zuloaga / Becky McClintock

Summer	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
	Pressure Plate		L-Zero		Siemens		GE	
4x40%	561	8,624	597	8,105	597.22	8,096	599.24	8,068
4x100%, EC	1,025	7,259	1,074	6,928	1,074.70	6,925	1,077.39	6,907
4x100%, EC, DF	1,049	7,296	1,138	7,001	1,138.03	6,998	1,140.70	6,978
4x100%, EC, PAG, DF	1,121	7,388	1,169	7,089	1,169.11	7,085	1,171.71	7,069
3x40%	420	8,632	444	8,159	445.33	8,143	446.65	8,119
3x100%, EC	770	7,248	805	6,935	805.48	6,929	807.45	6,912
3x100%, EC, DF	884	7,534	933	7,134	933.65	7,131	936.38	7,110
2x40%	277	8,731	289	8,358	290.37	8,325	290.66	8,317
2x100%, EC	510	7,302	529	7,031	530.20	7,018	531.20	7,005
1x70%	165	8,161	168	8,044	168.75	7,987	165.76	8,131
1x100%, EC	246	7,576	249	7,469	250.44	7,429	248.43	7,489

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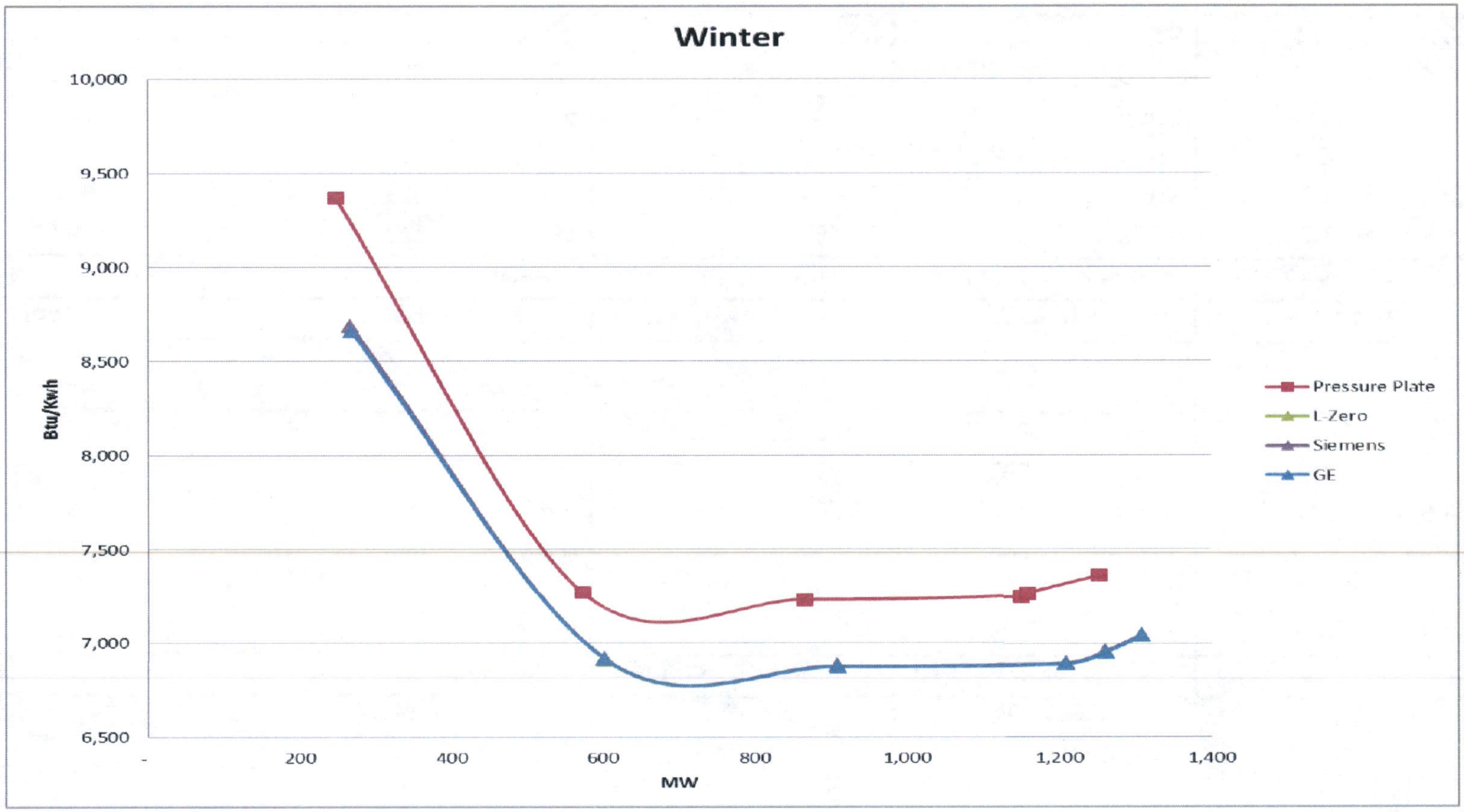
Bartow CC Steam Turbine Optimization Project - Modeling Assumptions

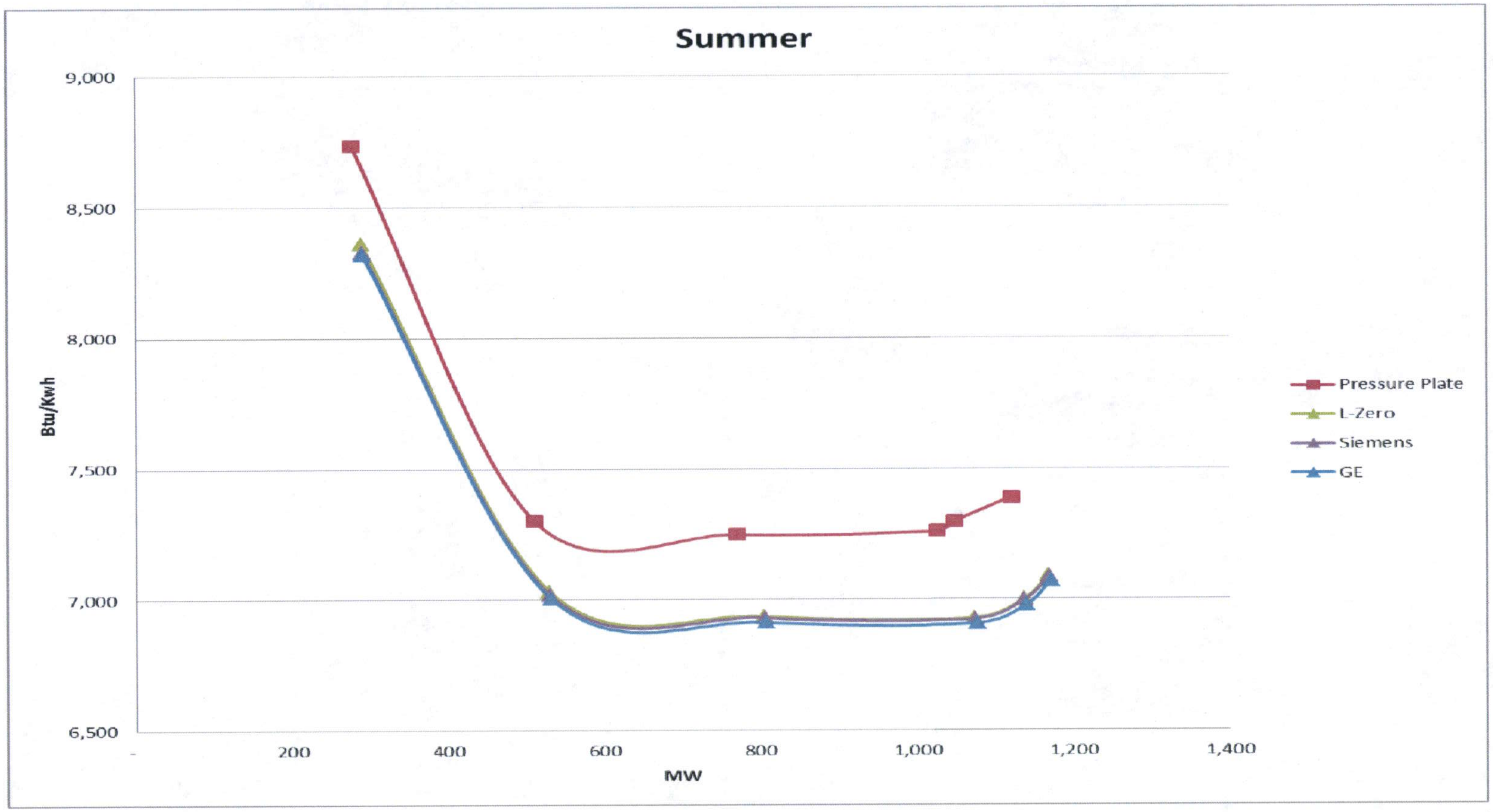
Modeled	Pressure Plate		L-Zero		Siemens		GE	
Winter	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
2x40%	249	9,368	268	8,685	268	8,686	269	8,658
2x100%	573	7,267	603	6,912	602	6,918	603	6,914
3x100%	865	7,229	909	6,876	909	6,879	909	6,873
4x100%	1,150	7,248	1,209	6,892	1,209	6,896	1,210	6,890
4x100% DF	1,158	7,264	1,262	6,957	1,260	6,960	1,261	6,953
4x100% DF, PAG	1,252	7,361	1,309	7,042	1,308	7,045	1,309	7,040

Modeled	Pressure Plate		L-Zero		Siemens		GE	
Summer	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
2x40%	277	8,731	289	8,358	290	8,325	291	8,317
2x100%, EC	510	7,302	529	7,031	530	7,018	531	7,005
3x100%, EC	770	7,248	805	6,935	805	6,929	807	6,912
4x100%, EC	1,025	7,259	1,074	6,928	1,075	6,925	1,077	6,907
4x100%, EC, DF	1,049	7,296	1,138	7,001	1,138	6,998	1,141	6,978
4x100%, EC, PAG, DF	1,121	7,388	1,169	7,089	1,169	7,085	1,172	7,069

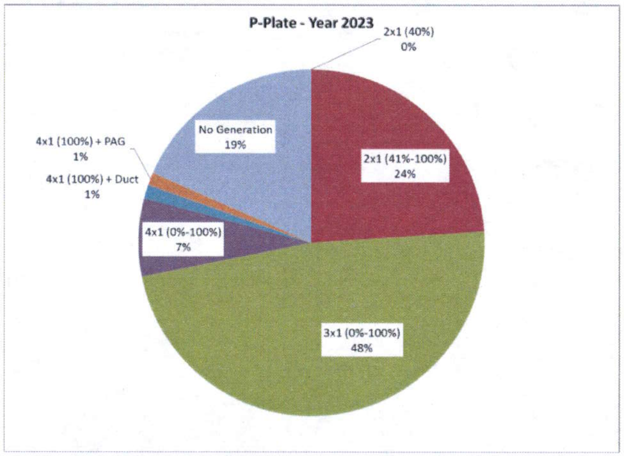
Bartow CC Steam Turbine Optimization Project - Modeling Assumptions

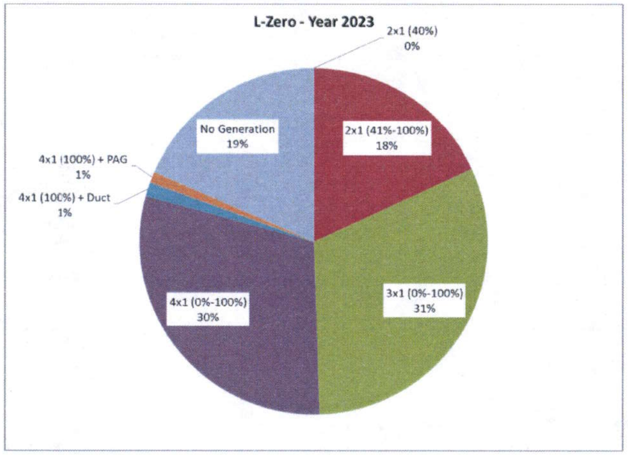


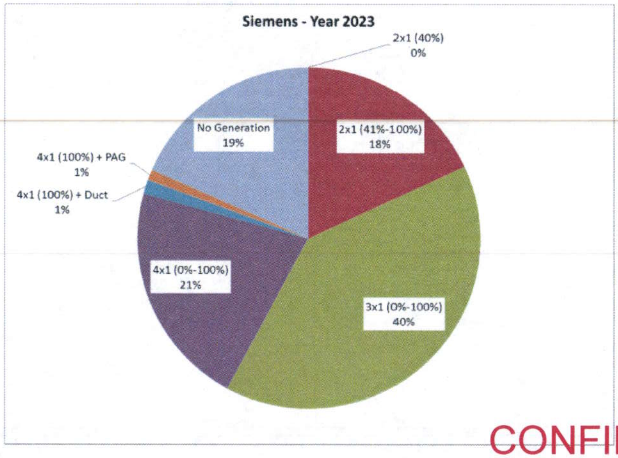
Bartow CC Steam Turbine Optimization Project - Modeling Assumptions

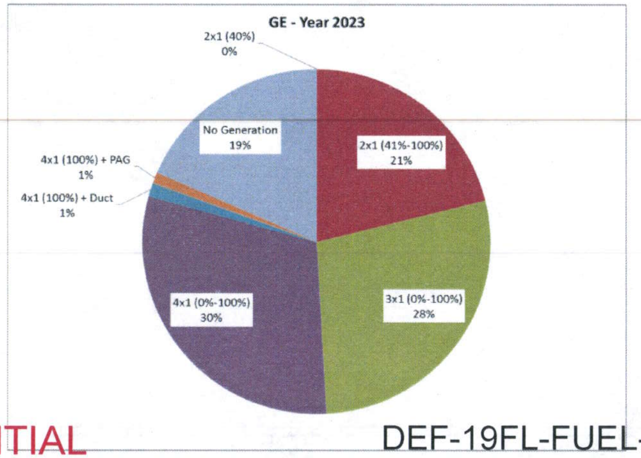


Bartow CC Steam Turbine Optimization Project - Hours of Operation Year 2023









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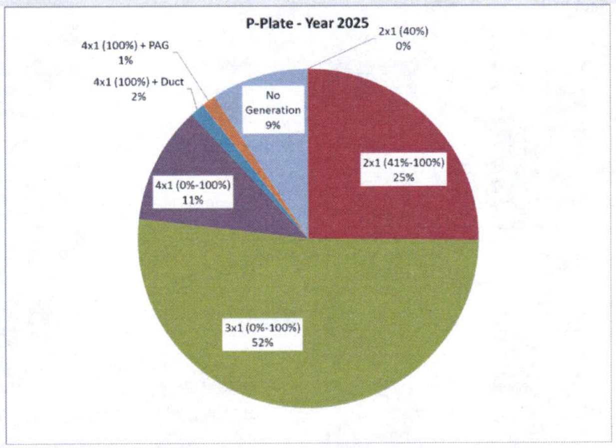
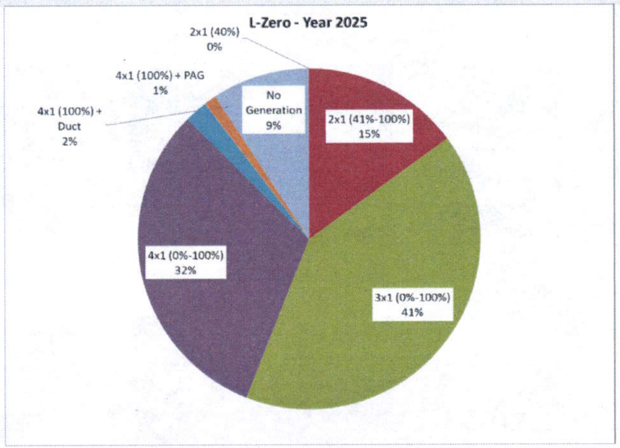
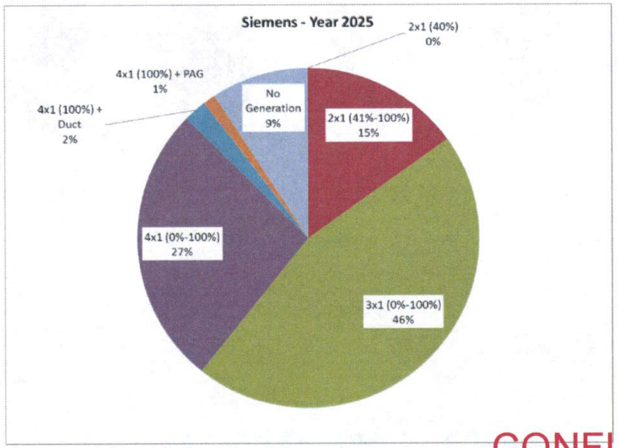
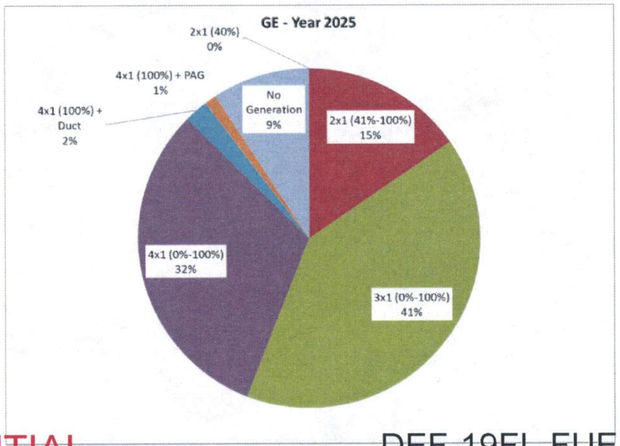
Bartow CC Steam Turbine Optimization Project - Hours of Operation Year 2025

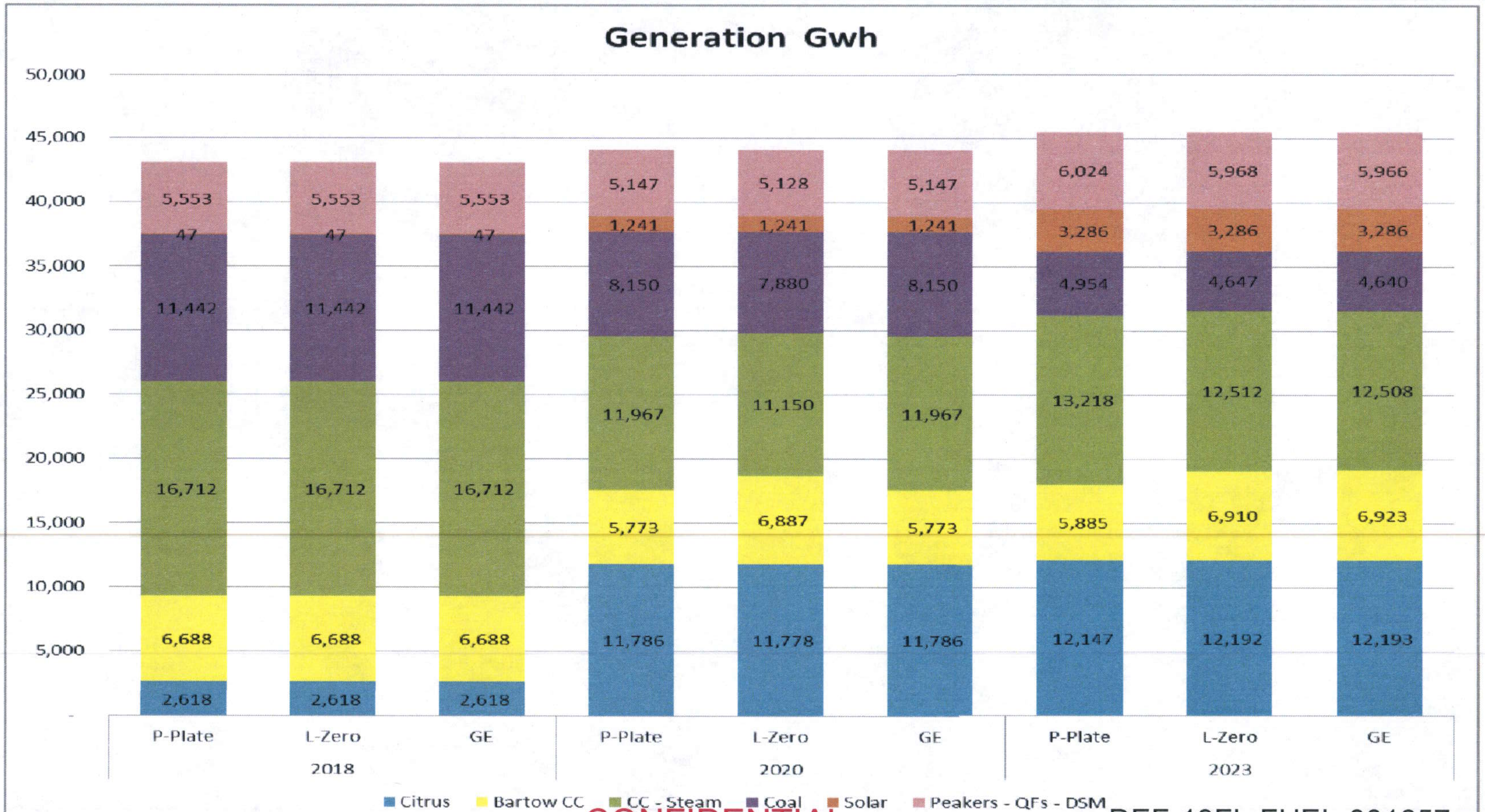








Dispatch Comparison – Generation Gwh



Dispatch Comparison – Generation %

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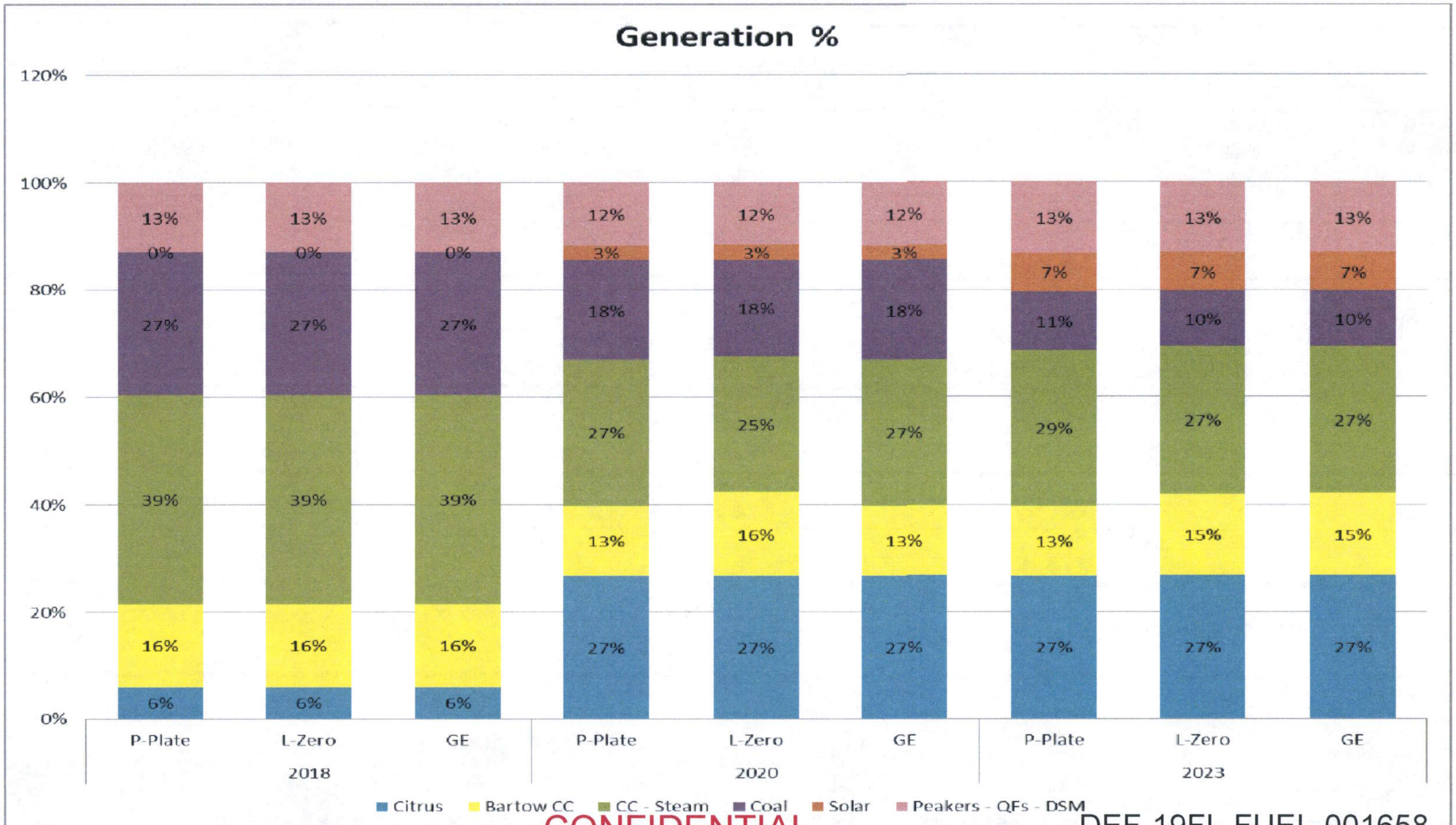

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DEF-19FL-FUEL-001658

DUKE ENERGY

Dispatch Comparison – Capacity Factors

Pressure Plate Case

CF	2018	2019	2020	2021	2022	2023
Anclote.1	21%	11%	7%	8%	9%	9%
Anclote.2	14%	9%	8%	8%	9%	9%
Bartow CC.1.0	68%	58%	60%	60%	61%	61%
Bartow CC.1.DUCT	27%	12%	9%	8%	6%	6%
Bartow CC.1.PAG	19%	8%	5%	5%	4%	4%
Citrus.CC.1	93%	86%	87%	87%	89%	89%
Citrus.CC.1.Duct	19%	15%	14%	11%	13%	19%
Citrus.CC.2	72%	80%	81%	81%	84%	84%
Citrus.CC.2.Duct	3%	15%	12%	9%	11%	17%
Crystal.4	81%	77%	58%	65%	47%	37%
Crystal.5	88%	66%	72%	64%	54%	42%
Hines.CC.1	66%	46%	46%	44%	51%	50%
Hines.CC.2	51%	35%	35%	36%	39%	45%
Hines.CC.3	63%	46%	45%	47%	50%	56%
Hines.CC.4	79%	67%	69%	69%	66%	64%
Osprey Up to 245Mws	37%	21%	25%	25%	42%	47%
Osprey Above 245MWs	16%	11%	12%	8%	9%	33%
Osprey DF	2%	1%	0%	0%	0%	1%
Tigerbay.1	56%	58%	53%	60%	66%	61%
Solar.3rdParty.Block.1	20%	23%	23%	24%	24%	24%
Solar.DEF.Block.1	24%	24%	24%	24%	24%	24%
Solar.DEF.Block.3	0%	30%	29%	29%	30%	30%

Mitsubishi L-Zero Case

CF	2018	2019	2020	2021	2022	2023
Anclote.1	21%	11%	7%	8%	8%	9%
Anclote.2	14%	9%	8%	8%	9%	9%
Bartow CC.1.0	68%	62%	68%	68%	69%	69%
Bartow CC.1.DUCT	27%	14%	9%	8%	6%	7%
Bartow CC.1.PAG	19%	2%	1%	2%	2%	2%
Citrus.CC.1	93%	86%	87%	87%	88%	89%
Citrus.CC.1.Duct	19%	15%	13%	11%	12%	18%
Citrus.CC.2	72%	81%	81%	80%	83%	85%
Citrus.CC.2.Duct	3%	14%	11%	10%	11%	17%
Crystal.4	81%	76%	56%	62%	43%	35%
Crystal.5	88%	66%	69%	61%	52%	40%
Hines.CC.1	66%	42%	40%	39%	46%	46%
Hines.CC.2	51%	34%	32%	33%	38%	42%
Hines.CC.3	63%	43%	39%	41%	46%	50%
Hines.CC.4	79%	65%	70%	69%	66%	64%
Osprey Up to 245Mws	37%	21%	24%	23%	37%	44%
Osprey Above 245MWs	16%	11%	12%	8%	9%	31%
Osprey DF	2%	1%	0%	0%	0%	1%
Tigerbay.1	56%	55%	50%	62%	69%	61%
Solar.3rdParty.Block.1	20%	23%	23%	24%	24%	24%
Solar.DEF.Block.1	24%	24%	24%	24%	24%	24%
Solar.DEF.Block.4	0%	0%	32%	30%	30%	30%

DUKE ENERGY

Dispatch Comparison – Capacity Factors

Pressure Plate Case

CF	2018	2019	2020	2021	2022	2023
Anclote.1	21%	11%	7%	8%	9%	9%
Anclote.2	14%	9%	8%	8%	9%	9%
Bartow CC.1.0	68%	58%	60%	60%	61%	61%
Bartow CC.1.DUCT	27%	12%	9%	8%	6%	6%
Bartow CC.1.PAG	19%	8%	5%	5%	4%	4%
Citrus.CC.1	93%	86%	87%	87%	89%	89%
Citrus.CC.1.Duct	19%	15%	14%	11%	13%	19%
Citrus.CC.2	72%	80%	81%	81%	84%	84%
Citrus.CC.2.Duct	3%	15%	12%	9%	11%	17%
Crystal.4	81%	77%	58%	65%	47%	37%
Crystal.5	88%	66%	72%	64%	54%	42%
Hines.CC.1	66%	46%	46%	44%	51%	50%
Hines.CC.2	51%	35%	35%	36%	39%	45%
Hines.CC.3	63%	46%	45%	47%	50%	56%
Hines.CC.4	79%	67%	69%	69%	66%	64%
Osprey Up to 245Mws	37%	21%	25%	25%	42%	47%
Osprey Above 245MWs	16%	11%	12%	8%	9%	33%
Osprey DF	2%	1%	0%	0%	0%	1%
Tigerbay.1	56%	58%	53%	60%	66%	61%
Solar.3rdParty.Block.1	20%	23%	23%	24%	24%	24%
Solar.DEF.Block.1	24%	24%	24%	24%	24%	24%
Solar.DEF.Block.3	0%	30%	29%	29%	30%	30%

GE Case

CF	2018	2019	2020	2021	2022	2023
Anclote.1	21%	11%	7%	8%	8%	9%
Anclote.2	14%	9%	8%	8%	9%	9%
Bartow CC.1.0	68%	58%	60%	60%	65%	69%
Bartow CC.1.DUCT	27%	12%	9%	8%	7%	7%
Bartow CC.1.PAG	19%	8%	5%	5%	2%	2%
Citrus.CC.1	93%	86%	87%	87%	89%	89%
Citrus.CC.1.Duct	19%	15%	14%	11%	12%	18%
Citrus.CC.2	72%	80%	81%	81%	84%	85%
Citrus.CC.2.Duct	3%	15%	12%	9%	11%	17%
Crystal.4	81%	77%	58%	65%	43%	35%
Crystal.5	88%	66%	72%	64%	52%	39%
Hines.CC.1	66%	46%	46%	44%	48%	46%
Hines.CC.2	51%	35%	35%	36%	38%	42%
Hines.CC.3	63%	46%	45%	47%	47%	49%
Hines.CC.4	79%	67%	69%	69%	66%	64%
Osprey Up to 245Mws	37%	21%	25%	25%	38%	44%
Osprey Above 245MWs	16%	11%	12%	8%	10%	31%
Osprey DF	2%	1%	0%	0%	0%	1%
Tigerbay.1	56%	58%	53%	60%	73%	61%
Solar.3rdParty.Block.1	20%	23%	23%	24%	24%	24%
Solar.DEF.Block.1	24%	24%	24%	24%	24%	24%
Solar.DEF.Block.3	0%	30%	29%	29%	30%	30%

Results – Hours of Operation Year 2023

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Winter 2023		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	-	-	-	-
	2x1 (41%-100%)	1,040	785	785	918
	3x1 (0%-100%)	2,081	1,364	1,729	1,215
Max Cap	4x1 (0%-100%)	316	1,294	928	1,310
	4x1 (100%) + Duct	55	57	58	56
	4x1 (100%) + PAG	51	43	43	44
Total Hours of Generation		**3,543**	**3,543**	**3,543**	**3,543**
No Generation		801	801	801	801
Total		4,344	4,344	4,344	4,344

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
249	9,368	268	8,685	268	8,686	269	8,658
573	7,267	603	6,912	602	6,918	603	6,914
865	7,229	909	6,876	909	6,879	909	6,873
1,150	7,248	1,209	6,892	1,209	6,896	1,210	6,890
1,158	7,264	1,262	6,957	1,260	6,960	1,261	6,953
1,252	7,361	1,309	7,042	1,308	7,045	1,309	7,040

Summer 2023		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	-	-	-	-
	2x1 (41%-100%)	545	-	-	262
	3x1 (0%-100%)	903	896	898	639
Max Cap	4x1 (0%-100%)	2,040	2,663	2,665	2,631
	4x1 (100%) + DUCT	332	433	425	454
	4x1 (100%) + PAG	320	148	152	154
Total Hours of Generation		**4,140**	**4,140**	**4,140**	**4,140**
No Generation		276	276	276	276
Total		4,416	4,416	4,416	4,416

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
277	8,731	289	8,358	290	8,325	291	8,317
510	7,302	529	7,031	530	7,018	531	7,005
770	7,248	805	6,935	805	6,929	807	6,912
1,025	7,259	1,074	6,928	1,075	6,925	1,077	6,907
1,049	7,296	1,138	7,001	1,138	6,998	1,141	6,978
1,121	7,388	1,169	7,089	1,169	7,085	1,172	7,069

DUKE ENERGY

Results – Hours of Operation Year 2023

Winter 2023		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	0%	0%	0%	0%
	2x1 (41%-100%)	24%	18%	18%	21%
	3x1 (0%-100%)	48%	31%	40%	28%
	4x1 (0%-100%)	7%	30%	21%	30%
	4x1 (100%) + Duct	1%	1%	1%	1%
	4x1 (100%) + PAG	1%	1%	1%	1%
Total Hours of Generation		**82%**	**82%**	**82%**	**82%**
No Generation		18%	18%	18%	18%
Total		100%	100%	100%	100%

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
249	9,368	268	8,685	268	8,686	269	8,658
573	7,267	603	6,912	602	6,918	603	6,914
865	7,229	909	6,876	909	6,879	909	6,873
1,150	7,248	1,209	6,892	1,209	6,896	1,210	6,890
1,158	7,264	1,262	6,957	1,260	6,960	1,261	6,953
1,252	7,361	1,309	7,042	1,308	7,045	1,309	7,040

Summer 2023		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	0%	0%	0%	0%
	2x1 (41%-100%)	12%	0%	0%	6%
	3x1 (0%-100%)	20%	20%	20%	14%
	4x1 (0%-100%)	46%	60%	60%	60%
	4x1 (100%) + DUCT	8%	10%	10%	10%
	4x1 (100%) + PAG	7%	3%	3%	3%
Total Hours of Generation		**94%**	**94%**	**94%**	**94%**
No Generation		6%	6%	6%	6%
Total		100%	100%	100%	100%

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
277	8,731	289	8,358	290	8,325	291	8,317
510	7,302	529	7,031	530	7,018	531	7,005
770	7,248	805	6,935	805	6,929	807	6,912
1,025	7,259	1,074	6,928	1,075	6,925	1,077	6,907
1,049	7,296	1,138	7,001	1,138	6,998	1,141	6,978
1,121	7,388	1,169	7,089	1,169	7,085	1,172	7,069

Results – Hours of Operation Year 2025

Winter 2025		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	-	-	-	-
	2x1 (41%-100%)	1,094	653	659	671
	3x1 (0%-100%)	2,246	1,779	1,981	1,759
Max Cap	4x1 (0%-100%)	487	1,367	1,159	1,368
	4x1 (100%) + Duct	60	96	95	98
	4x1 (100%) + PAG	57	50	51	49
Total Hours of Generation		**3,944**	**3,945**	**3,945**	**3,945**
No Generation		400	399	399	399
Total		4,344	4,344	4,344	4,344

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
249	9,368	268	8,685	268	8,686	269	8,658
573	7,267	603	6,912	602	6,918	603	6,914
865	7,229	909	6,876	909	6,879	909	6,873
1,150	7,248	1,209	6,892	1,209	6,896	1,210	6,890
1,158	7,264	1,262	6,957	1,260	6,960	1,261	6,953
1,252	7,361	1,309	7,042	1,308	7,045	1,309	7,040

Summer 2025		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	-	-	-	-
	2x1 (41%-100%)	524	-	-	250
	3x1 (0%-100%)	1,396	892	892	633
Max Cap	4x1 (0%-100%)	1,154	2,150	2,150	2,073
	4x1 (100%) + DUCT	539	839	837	915
	4x1 (100%) + PAG	526	259	261	269
Total Hours of Generation		**4,139**	**4,140**	**4,140**	**4,140**
No Generation		277	276	276	276
Total		4,416	4,416	4,416	4,416

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
277	8,731	289	8,358	290	8,325	291	8,317
510	7,302	529	7,031	530	7,018	531	7,005
770	7,248	805	6,935	805	6,929	807	6,912
1,025	7,259	1,074	6,928	1,075	6,925	1,077	6,907
1,049	7,296	1,138	7,001	1,138	6,998	1,141	6,978
1,121	7,388	1,169	7,089	1,169	7,085	1,172	7,069

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Results – Hours of Operation Year 2025

Winter 2025		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	0%	0%	0%	0%
	2x1 (41%-100%)	25%	15%	15%	15%
	3x1 (0%-100%)	52%	41%	46%	40%
	4x1 (0%-100%)	11%	31%	27%	31%
	4x1 (100%) + Duct	1%	2%	2%	2%
	4x1 (100%) + PAG	1%	1%	1%	1%
Total Hours of Generation		**91%**	**91%**	**91%**	**91%**
No Generation		9%	9%	9%	9%
Total		100%	100%	100%	100%

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
249	9,368	268	8,685	268	8,686	269	8,658
573	7,267	603	6,912	602	6,918	603	6,914
865	7,229	909	6,876	909	6,879	909	6,873
1,150	7,248	1,209	6,892	1,209	6,896	1,210	6,890
1,158	7,264	1,262	6,957	1,260	6,960	1,261	6,953
1,252	7,361	1,309	7,042	1,308	7,045	1,309	7,040

Summer 2025		P-Plate	L-Zero	Siemens	GE
Min Cap	2x1 (40%)	0%	0%	0%	0%
	2x1 (41%-100%)	12%	0%	0%	6%
	3x1 (0%-100%)	32%	20%	20%	14%
	4x1 (0%-100%)	26%	49%	49%	47%
	4x1 (100%) + DUCT	12%	19%	19%	21%
	4x1 (100%) + PAG	12%	6%	6%	6%
Total Hours of Generation		**94%**	**94%**	**94%**	**94%**
No Generation		6%	6%	6%	6%
Total		100%	100%	100%	100%

P-Plate		L-Zero		Siemens		GE	
Net Load	NUHR	Net Load	NUHR	Net Load	NUHR	Net Load	NUHR
277	8,731	289	8,358	290	8,325	291	8,317
510	7,302	529	7,031	530	7,018	531	7,005
770	7,248	805	6,935	805	6,929	807	6,912
1,025	7,259	1,074	6,928	1,075	6,925	1,077	6,907
1,049	7,296	1,138	7,001	1,138	6,998	1,141	6,978
1,121	7,388	1,169	7,089	1,169	7,085	1,172	7,069

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Capital Costs

	L-Zero	Siemens	GE
Total Direct and Indirect $M	$ 7.39	$ 12.38	$ 11.00

CPVRR $M (Production Costs and Capital) Comparison

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CPVRR $M - Spring Outages	P-Plate	L-Zero	Siemens	GE	P-Plate - L-Zero	P-Plate - Siemens	P-Plate - GE
Fixed Costs	$8,077	$8,077	$8,077	$8,077	$0	$0	$0
Fuel Cost	$15,202	$15,108	$15,126	$15,124	$94	$76	$78
VOM Cost + Start Up Costs	$2,210	$2,203	$2,205	$2,204	$7	$5	$6
Environmental	$2,508	$2,488	$2,488	$2,488	$20	$20	$20
Total Production Costs	$27,997	$27,875	$27,896	$27,893	$121	$101	$104
Capital Investment	0	$ 8	$ 11	$ 10	($8)	($11)	($10)
Total Costs	$27,997	$27,883	$27,907	$27,903	$113	$90	$94

Bid # 1: Mitsubishi L-Zero Blades Replacement — ISD: May 1st 2019

Bid # 2: Siemens Rotor Replacement — ISD: May 1st 2022

Bid # 3: GE Rotor Replacement — ISD: May 1st 2022

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Production Costs CPVRR ($M) Comparison

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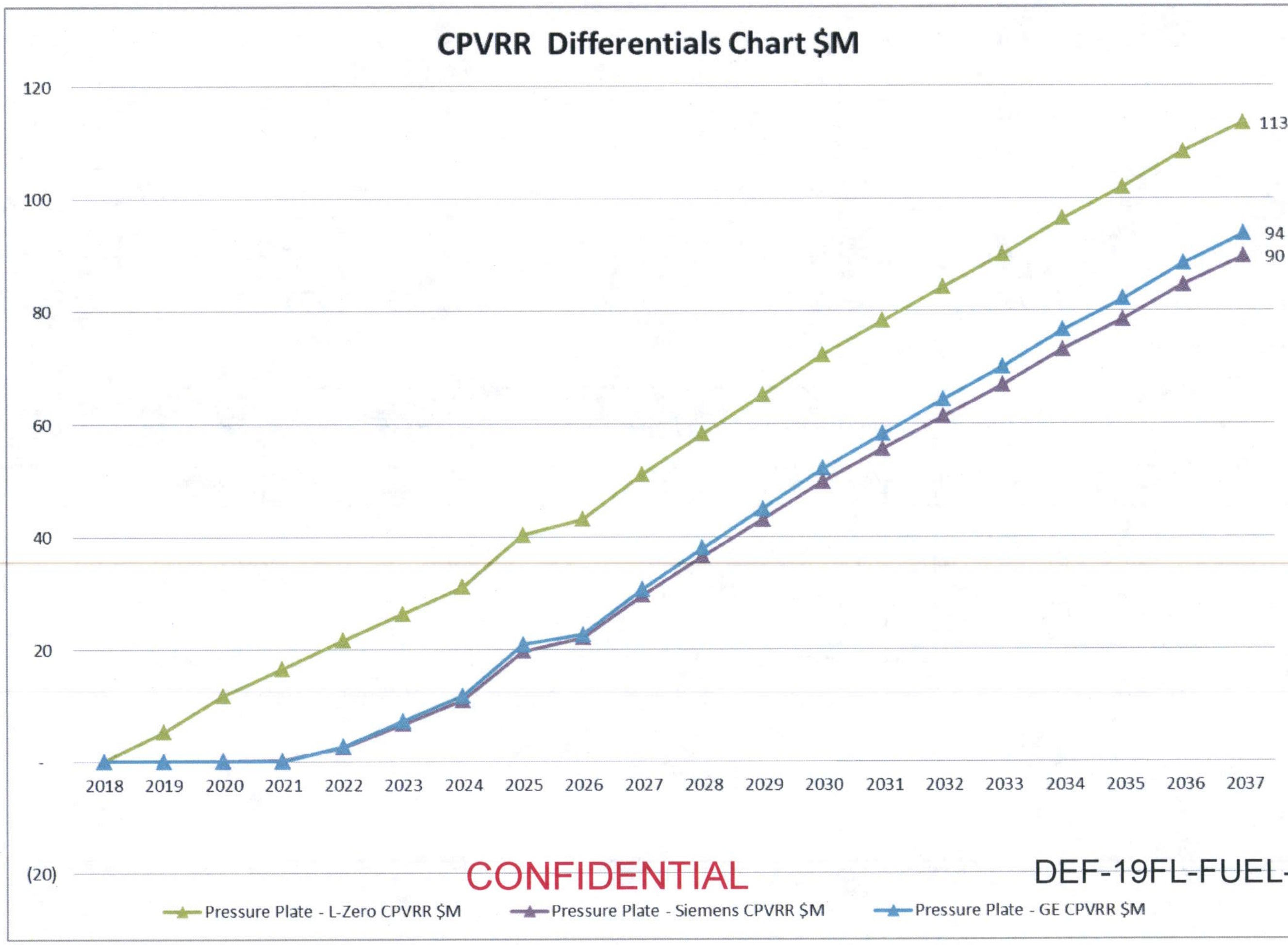

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DEF-19FL-FUEL-001667

Bartow CC Steam Turbine Optimization Project - Fall'19 Outages

Additional Scenario – Moving the Major Outage from the 2019 Spring to the 2019 Fall

- Bid # 1: Mitsubishi L-Zero Blades Replacement — ISD: Dec 1st 2019
- Bid # 3: GE Rotor Replacement — ISD: Dec 1st 2019

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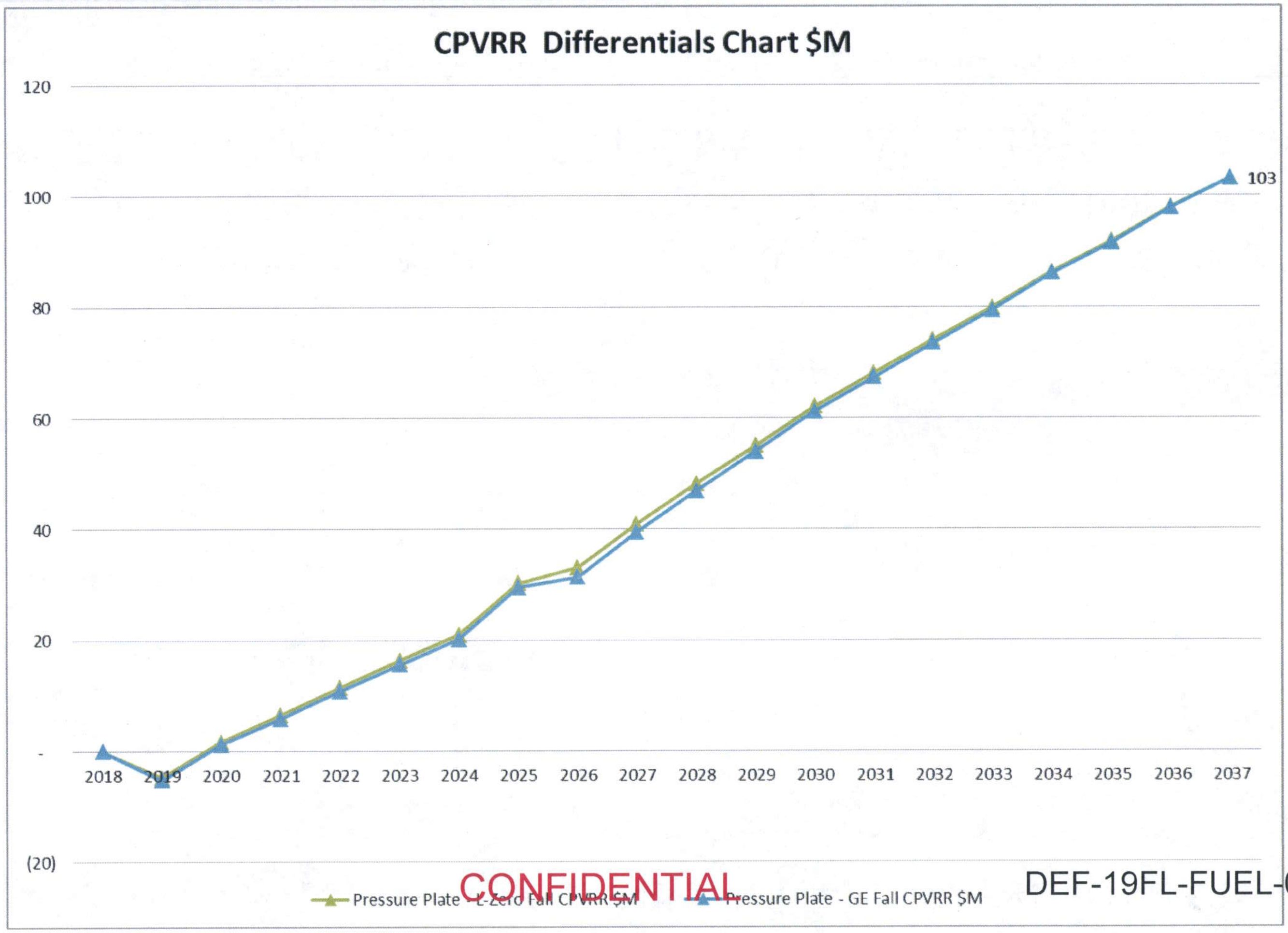
CPVRR $M (Production Costs and Capital) Comparison

CPVRR $M - Spring Outages for Steam Turbine Upgrades	P-Plate	L-Zero -Year 2019	GE - Year 2022	P-Plate - L-Zero	P-Plate - GE
Fixed Costs	$8,077	$8,077	$8,077	$0	$0
Fuel Cost	$15,202	$15,108	$15,124	$94	$78
VOM Cost + Start Up Costs	$2,210	$2,203	$2,204	$7	$6
Environmental	$2,508	$2,488	$2,488	$20	$20
Total Production Costs	$27,997	$27,875	$27,893	$121	$104
Capital Investment	0	$ 8	$ 10	($8)	($10)
Total Costs	$27,997	$27,883	$27,903	$113	$94

CPVRR $M - Fall Outages for Steam Turbine Upgrades	P-Plate	L-Zero - Year 2019	GE - Year 2019	P-Plate - L-Zero	P-Plate - GE
Fixed Costs	$8,077	$8,077	$8,077	$0	$0
Fuel Cost	$15,202	$15,116	$15,113	$86	$89
VOM Cost + Start Up Costs	$2,210	$2,204	$2,203	$6	$6
Environmental	$2,508	$2,488	$2,488	$20	$20
Total Production Costs	$27,997	$27,885	$27,881	$111	$115
Capital Investment	0	$ 8	$ 12	($8)	($12)
Total Costs	$27,997	$27,893	$27,893	$103	$103

Production Costs CPVRR ($M) Comparison – Fall Outages



Alternatives Configuration Cases:

- Combustion Turbine Upgrades
- Chiller Upgrades
- Both Combustion Turbine and Chiller Upgrades

Constraints:

- The B&V model cases for upgrades with the LP pressure plate indicated that the Bartow combined cycle can't operate in a 4x1 configuration because it violates the pressure limits set by MHI on the IP/LP turbines. Therefore, the CT upgrades for 4x1 configuration are not applicable.
- However, the 3x1 and 2x1 configurations were evaluated and met the pressure limits set by MHI in the HP/IP/LP turbines.

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CPVRR ($M) Comparison - Pressure Plate w/ Upgrades

CPVRR $M	P-Plate Ref Case	P-Plate with CT Upgrade Case	P-Plate with Chillers Upgrade Case	P-Plate with CT and Chillers Upgrade Case
Fixed Costs	$8,077	$8,077	$8,077	$8,077
Fuel Cost	$15,202	$15,266	$15,187	$15,254
VOM Cost + Start Up Costs	$2,210	$2,213	$2,208	$2,212
Environmental	$2,508	$2,528	$2,505	$2,526
CT Upgrade Capital	$0	$89	$0	$89
Chillers Upgrade Capital	$0	$0	$57	$57
Total Cost	$27,997	$28,173	$28,033	$28,214

P-Plate Ref Case - P-Plate with CT Upgrade Case	P-Plate Ref Case - P-Plate with Chillers Upgrade Case	P-Plate Ref Case - P-Plate with CT and Chillers Upgrade Case
$0	$0	$0
($64)	$16	($51)
($3)	$1	($2)
($20)	$3	($18)
($89)	$0	($89)
$0	($57)	($57)
($177)	($37)	($217)

CPVRR ($M) Comparison – L-Zero w/ Upgrades

CPVRR $M	L-Zero Ref Case	L-Zero with CT Upgrade Case	L-Zero with Chillers Upgrade Case	L-Zero with CT and Chillers Upgrade Case	L-Zero Ref Case - L-Zero with CT Upgrade Case	L-Zero Ref Case - L-Zero with Chillers Upgrade Case	L-Zero Ref Case - L-Zero with CT and Chillers Upgrade Case
Fixed Costs	$8,077	$8,077	$8,077	$8,077	$0	$0	$0
Fuel Cost	$15,108	$15,048	$15,092	$15,038	$60	$16	$70
VOM Cost + Start Up Costs	$2,203	$2,200	$2,201	$2,199	$3	$2	$4
Environmental	$2,488	$2,471	$2,485	$2,468	$16	$3	$20
CT Upgrade Capital [1]	$0	$89	$0	$89	($89)	$0	($89)
Chillers Upgrade Capital [2]	$0	$0	$57	$57	$0	($57)	($57)
Total Cost	$27,875	$27,885	$27,912	$27,928	($10)	($37)	($53)
Gen CT Capital [3]	$0	($16)	($16)	($85)	$16	$16	$85
Gen CT FOM [13]	$0	($1)	($1)	($4)	$1	$1	$4
	$27,875	$27,868	$27,895	$27,839	$7	($20)	$36

[1] CTs Upgrade Capital Investment $100M 2018$ over a 1 year period (2022 May-2023 Apr / 70% 2022 - 30% 2023)
Insurance Costs have been included. No Property Taxes have been included. Book Life assumed as the 21 Yr Remaining Life. Tax Life assumption 20 Yr.

[2] Chillers Upgrade Capital Investment $64M 2018$ over a 1 year period (2022 May-2023 Apr / 70% 2022 - 30% 2023)
Insurance Costs have been included. No Property Taxes have been included. Book Life assumed as the 21 Yr Remaining Life. Tax Life assumption 20 Yr.

[3] One of the 2027 New CTs is delayed to 2029 in the CT Upgrade Cases and the Ch Upgrades Cases
One of the 2027 is avoided in the CT and Chiller (both happening simultaneously) Upgrade Cases

Commercial "TCO" evaluation details

INTRODUCTION/SCOPE OF WORK

LP Turbine L0/steam path upgrades

TABLE 1: BID ANALYSIS SUMMARY

	Press Plate	MHPS	GE	SIEMENS	Comments
SCHEDULE:					
Delivery		12 months	13 months	20 months	
Outage duration		43 days	35 days	35 days	
a. **BASE BID PRICE (From Table 2)**	**$0**	**$6,931,284**	**$9,091,000**	**$10,398,000**	
COST ADJUSTMENTS					
b. Technical Cost Adjustment (From Table 3)	$0	$100,000	$235,806	$295,806	
c. Commercial Cost Adjustment (From Table 4)	$0	$0	$0	$0	
EXPECTED / FINAL CONTRACT PRICE (a+b+c)	**$0**	**$7,031,284**	**$9,326,806**	**$10,693,806**	
		BASE	$2,295,522	$3,662,522	
		BASE	33%	52%	
EVALUATING FACTORS					
d. Technical Evaluation (From Table 3)	$0	$0	**$50,000**	**$250,000**	Not complete evaluation cost
e. Construction Evaluation (From Table 3)	$0	$0	**$0**	**$0**	Not complete evaluation cost
g. Commercial Evaluation (From Table 4)	$0	$0	$0	$0	
EVALUATED FACTORS SUBTOTAL (d+e+g)	**$0**	**$0**	**$50,000**	**$250,000**	
TOTAL EVALUATED COST(a+b+c+d+e+f+g)	**$0**	**$7,031,284**	**$9,376,806**	**$10,943,806**	Crane not included
Minus Installation	**$0**	**$5,442,814**	**$7,533,806**	**$9,193,806**	Crane not included
		$1,588,470	$1,843,000	$1,750,000	
Evaluated Cost Difference (Evaluated Cost - Low Evaluated Cost)		BASE	$2,345,522	$3,912,522	
Percentage Difference vs. Evaluated Base (Evaluated Cost / Low Evaluated Cost)		BASE	33%	56%	

TABLE 2: PRICE BREAKDOWN					
Bidders:	Press Plate	MHPS	GE	SIEMENS	Comments
Base Bid Price	**$0**	**$6,931,284**	**$9,091,000**	**$10,398,000**	
Price Breakdown:					
Fully Bladed LP Rotor with integral coupling, high speed balanced and overspeed tested			$7,248,000	$8,430,000	
LP Inner Cylinder Complete With Attached Stationary Components (Blade Carriers, one per opposing flow, with stationary blading, integral exhaust tip diffusers and all associated half joint bolting;)			included	included	
Cooling spray nozzles and pipes connected to existing spray water system			included	included	
Pilgrim hydraulic coupling bolts and sleeves for the HP/IP- LP and LP-Generator couplings			included	included	
Sets of keys, shims, and packers for blade carrier alignment and adjustment;			included	included	
Casing guide pillars, eyebolts and bolt tensioning			included	included	
Transportation to site			included	$218,000	SIEMENS shipping costs are estimated only, not firm
Supply L0 blades only		$5,342,814	not offered	not offered	Past blade sets cost $3.5M (both ends) - significant difference
Removal of existing LPT			included		
Installation for items above		$1,588,470	$1,843,000	$1,750,000	SIEMENS cost includes T&M basis scope which needs further definition
Base Bid Price (Should Equal Base Bid Price Above)	**$0**	**$6,931,284**	**$9,091,000**	**$10,398,000**	

TABLE 3: TECHNICAL EVALUATION

Description	Press Plate	MHPS	GE	SIEMENS	Comments
Technical Cost Adjustments to Base Bid					
1 Blade Vibration Monitoring		Included	To be Provided	One year only	MHPS $200k/yr monitoring fee
2 Steel Blade Carrier			Not provided	Included	
3 High speed Lube Oil flush			$90,806	$90,806	Based on budgetary pricing
4 LP rotor and outer casing disposal			$45,000	$45,000	Estimated
5 Training		Not required	Not provided	Included	SIEMENS included 4 days
6 Torsional Testing		Not required	Not required	$60,000	Pre+Post Tests Supervised jointly
7 Performance Testing		$100,000	$100,000	$100,000	Estimated
Subtotal Technical Cost Adjustments (Subtotal Forwarded to Table 1)	**$0**	**$100,000**	**$235,806**	**$295,806**	
Technical Evaluation Factors					
Differential Balance of Plant Costs:					
1. Jacking Oil Pump Installation	Not required	Not required	Not required	$200,000	2 AC Pumps, 75 kW estimated
Differential Engineering Costs:					
1. Foundation analysis study	Not required	Not required	$50,000	$50,000	Provided by Duke; GE may not need FA study
Differential Operating & Maintenance Costs:					**NOT USED**
1. Fuel costs, 2018-2037 ($k)	$3,707,733	$4,240,626	$4,190,766	$4,195,075	Provided by Duke
2. O&M costs (k)	$38,040	$44,971	$40,231	$41,320	Using information received from Duke, bidder proposals and supplemented with EPRI SOAPP cost estimating model
Other Technical Evaluation Factors:					
1. Crane upgrades			Not evaluated	Not evaluated	Could be none or significant
2. Foundation upgrade costs			Not evaluated	Not evaluated	Could be none or significant
3. Journal bearing rebabbit costs			Not evaluated	Not evaluated	Minimal impact if needed
Subtotal Technical Evaluation Factors (Subtotal Forwarded to Table 1)	**$0**	**$0**	**$50,000**	**$250,000**	
Construction Evaluation Factors					
1. Foundation Modification			Not evaluated	Not evaluated	Could be none or significant (100-500K)
Subtotal Constructability Factors (Subtotals Forwarded to Table 1)	**$0**	**$0**	**$0**	**$0**	

DUKE ENERGY

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Operations and Maintenance Analysis Assumptions

1) Must Run All the Time @ 2x1 at 40%

2) Assumptions for the L-Zero Case (Mitsubishi proposal): Outage: 12 weeks
ISD: May 1st 2019.

3) For GE and Siemens proposals: Outage: 12 weeks
ISD: May 1st 2022.

4) Outage from Connie Bruce

2024	4.10%
2025	4.10%
2026	8.20%
2027	4.10%
2028	4.10%
2029	5.80%
2030	4.10%
2031	4.10%
2032	4.10%
2033	8.20%
2034	4.10%
2035	4.10%
2036	5.70%
2037	4.10%
2038	4.10%

Taken form the ST Templates that TGS Provided to RS/FHO Stations

	Current	
Full Major Template	$ 5,612,640	Inc $1.3M for Crane
Full Major Template (Bartow)	$ 4,492,640	
HPIP Only	$ 2,336,320	
LP Only	$ 2,336,320	

From Dave Burney

Crane (650T)	$180,000	2 weeks
Crane (1000T) - GE and Siemens adder to template	$384,000	2 weeks
adder for GE and Siemens if combined with HPIP	**$204,000**	

From Chris Holland

1 Set of TE and GE L-0 Blades $3,500,000

OPTIM Current			Z3/Z4 Due
HPIP	64,000	Hrs	2019
LP	64,000	Hrs	2022
Valves	24,000	Hrs	2019

OPTIM w/ GE LP Rotor			Assumes 8k Hrs / Yr Next OPTIM Outage	
HPIP	64,000	Hrs	2027	
LP	100,000	Hrs	2031	Assumes 2019 Install
Valves	24,000	Hrs	2021	

OPTIM w/ Siemens LP Rotor			Assumes 8k Hrs / Yr Next OPTIM Outage	
HPIP	64,000	Hrs	2027	
LP	100,000	Hrs	2034	Assumes 2022 Install
Valves	24,000	Hrs	2022	

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Fuel and Non-Fuel Operations and Maintenance Cost Estimate

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Option 1: Pressure Plate	NPV (2018)	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	Total Cost	Desc.	$/MWh	
Fuel Cost $k	$1,921,964	$156,370	$121,424	$123,732	$123,409	$124,647	$132,406	$144,958	$164,587	$169,324	$192,644	$201,359	$211,191	$223,575	$219,224	$216,227	$217,228	$233,502	$239,074	$248,003	$244,851	$3,707,735	Fuel Total		
Interval Hours			7,855	16,125	24,372	32,365	40,048	48,158	56,243	63,983	72,068	80,178	88,125	96,210	104,295	112,405	120,145	128,230	136,315	144,286	152,371				
Operating Hours		8,247	7,855	8,270	8,247	7,993	7,683	8,110	8,085	7,740	8,085	8,110	7,947	8,085	8,085	8,110	7,740	8,085	8,085	7,971	8,085				
LP Inspection Interval			Minor	Minor	Minor	Major	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Major	Minor	Minor	Minor	Minor	Minor	Minor	Major				
Cost $k	$3,466	0	0.05	0.05	0.05	$2,336	0.05	0.05	0.05	0.05	0.05	0.05	0.05	$2,336	0.05	0.05	0.05	0.05	0.05	0.05	$2,336	$7,010	LP Total		
HP/IP Inspection Interval			Major								Major								Major						
Cost $k	$4,194	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	$7,009	HP/IP Total		
																						$14,019	O&M Total		
sum	$1,929,624	$156,370	$123,760	$123,732	$123,409	$126,983	$132,406	$144,958	$164,587	$169,324	$194,980	$201,359	$211,191	$225,911	$219,224	$216,227	$217,228	$233,502	$241,410	$248,003	$247,187	$3,721,754	Fuel/O&M Total	$33.15	104.21%

Option 2: MHPS LSB Upgrade	-	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037				
Fuel Cost $k	$2,180,824.69	$156,370	$129,412	$140,663	$139,078	$141,679	$148,409	$173,025	$190,456	$196,894	$225,442	$233,848	$243,787	$261,738	$251,300	$245,858	$247,611	$269,620	$278,384	$287,218	$279,834	$4,240,626	Fuel Total		
Operating Hours		8,247	7,762	8,270	8,247	7,993	7,683	8,110	8,085	7,740	8,085	8,110	7,947	8,085	8,085	8,110	7,740	8,085	8,085	7,971	8,085				
LP Inspection Interval			MI + LSB Upgrade								Major								Major						
Cost $k	$9,119	0	$7,689	0	0	0	0	0	0	0	$2,246	0	0	0	0	0	0	0	$2,246	0	0	$12,182	LP Total		
HP/IP Inspection Interval			Major								Major								Major						
Cost $k	$4,032	0	$2,246	0	0	0	0	0	0	0	$2,246	0	0	0	0	0	0	0	$2,246	0	0	$6,739	HP/IP Total		
																						$18,921	O&M Total		
	$2,193,976	$156,370	$139,347	$140,663	$139,078	$141,679	$148,409	$173,025	$190,456	$196,894	$229,935	$233,848	$243,787	$261,738	$251,300	$245,858	$247,611	$269,620	$282,877	$287,218	$279,834	$4,259,547	Fuel/O&M Total	$31.81	100.00%

Option 3: GE LPT Upgrade	-	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037				
Fuel Cost $k	$2,138,846	$156,370	$121,424	$123,732	$123,409	$133,380	$148,403	$173,008	$190,426	$196,831	$224,698	$233,351	$243,871	$261,264	$251,897	$245,824	$247,712	$269,558	$278,297	$287,291	$280,019	$4,190,765	Fuel Total		
Interval Hours			7,855	16,125	24,372	7,739	15,422	23,532	31,617	39,357	47,442	55,552	63,499	71,584	79,669	87,779	95,519	103,604	111,689	119,660	127,745				
Operating Hours		8,247	7,855	8,270	8,247	7,739	7,683	8,110	8,085	7,740	8,085	8,110	7,947	8,085	8,085	8,110	7,740	8,085	8,085	7,971	8,085				
LP Inspection Interval				LP Replace		LP Replace (OPTIM due)										Major									
Cost $k	$9,580	0	0	$9,761	0	0	0	0	0	0	0	0	0	0	0	$2,720	0		0	0	0	$12,481	LP Total		
HP/IP Inspection Interval			Major								Major								Major						
Cost $k	$4,194	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	$7,009	HP/IP Total		
																						$19,490	O&M Total		
All in TCO	$2,160,066.59	$156,370	$123,760	$133,493	$123,409	$143,141	$148,403	$173,008	$190,426	$196,831	$227,034	$233,351	$243,871	$261,264	$251,897	$248,544	$247,712	$269,558	$280,633	$287,291	$280,019	$4,210,255	Fuel/O&M Total	$32.19	101.19%

Option 4: Siemens LPT Upgrade	-	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037				
Fuel Cost $k	$2,140,688	$156,370	$121,424	$123,732	$123,409	$133,346	$148,424	$173,609	$190,753	$195,930	$225,658	$234,965	$243,804	$261,714	$251,208	$245,781	$247,590	$269,554	$278,180	$287,709	$281,915	$4,195,075	Fuel Total		
Operating Hours		8,247	7,855	8,270	8,247	7,739	7,683	8,110	8,085	7,740	8,085	8,110	7,947	8,085	8,085	8,110	7,740	8,085	8,085	7,971	8,085				
LP Inspection Interval				LP Replace		LP Replace (OPTIM due)										Major									
Cost $k	$10,949	0	0	$11,328	0	0	0	0	0	0	0	0	0	0	0	$2,720	0		0	0	0	$14,048	LP Total		
HP/IP Inspection Interval			Major								Major								Major						
Cost $k	$4,194	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	0	0	0	0	0	$2,336	0	0	$7,009	HP/IP Total		
																						$21,057	O&M Total		
	$2,164,473	$156,370	$123,760	$135,060	$123,409	$144,674	$148,424	$173,609	$190,753	$195,930	$227,994	$234,965	$243,804	$261,714	$251,208	$248,501	$247,590	$269,554	$280,516	$287,709	$281,915	$4,216,132	Fuel/O&M Total	$32.15	101.07%