FINAL

GAS-FUELED SUPPLY SIDE RESOURCE TABLE UPDATE

B&V PROJECT NO. 199232
B&V FILE NO. 40.0000

PREPARED FOR

PacifiCorp

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Abbreviations and Acronyms

Btu	British Thermal Unit
CO	Carbon Monoxide
CCGT	Combined Cycle Gas Turbine
CTG	Combustion Turbine Generator
EPC	Engineering, Procurement, and Construction
GE	General Electric
H	Hour
HRSG	Heat Recovery Steam Generator
ISO	International Organization for Standardization 2314
kWh	Kilowatt-Hour
kW-yr	Kilowatt-Year
Lb	Pound
MMBtu	Million British Thermal Units
MW	Megawatt
MWh	Megawatt-hour
NH_3	Ammonia
NOx	Nitrogen Oxides
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OE	Owner's Engineer
$PM_{2.5}$	Particulate Matter 2.5 Microns and Larger
PM_{10}	Particulate Matter 10 Microns and Larger
ppmvd@15%O2	Parts per Million, dry-volumetric basis, corrected to 15% Oxygen (O_2)
Psia	Pounds per Square Inch-Absolute
PPA	Power Purchase Agreement
RICE	Reciprocating Internal Combustion Engine
RFP	Request for Proposals
RH	Relative Humidity
SCR	Selective Catalytic Reduction
STG	Steam Turbine Generator
VOC	Volatile Organic Compound

1.0 Introduction

The Gas-Fueled Supply Side Resource Table Update was performed in support of PacifiCorp's 2019 Integrated Resource Plan. The intent of this study is to provide current market performance, stack emissions, capital cost, non-fuel operations and maintenance (O&M) cost, and unit operational characteristic estimates for various simple cycle (peaker) and combined cycle natural gas-fueled supply-side options.

1.1 APPROACH

Black & Veatch has drawn on our extensive experience with natural gas-fueled power plant design and construction to provide PacifiCorp with reliable cost and performance estimates reflective of current market trends. Black & Veatch has utilized our past experiences and leveraged our strong relationships with major equipment suppliers to execute this work within PacifiCorp's allotted timeframe and budget.

Black & Veatch has developed performance cases, capital cost estimates, O&M cost estimates, environmental performance, and unit operational characteristic estimates for the 14 natural gas-fueled configurations presented in Table 1-1.

Table 1-1 Listing of 14 Options Evaluated

SIMPLE CYCLE	COMBINED CYCLE
• OPTION 1 - 3x0 General Electric (GE) LM6000 PF Sprint combustion turbine generator (CTG) • OPTION 2 - 2x0 GE LMS100PA+ CTG with dry inter-stage cooling • OPTION 3 - 1x0 GE 7F.05 CTG • OPTION 3B – 1x0 GE 7F.05 CTG BROWNFIELD • OPTION 4 - 6x0 Wartsila 18V50SG reciprocating internal combustion engine (RICE)	• OPTION 5 - 1x1 GE 7HA.01 CTG, no duct firing • OPTION 6 - 1x1 GE 7HA.01 CTG, 51 MW duct firing • OPTION 7 - 2x1 GE 7HA.01 CTG, no duct firing • OPTION 8 - 2x1 GE 7HA.01 CTG, 102 MW duct firing • OPTION 8B - 2x1 GE 7HA.01 CTG, 102 MW duct firing BROWNFIELD • OPTION 9 - 1x1 GE 7HA.02 CTG, no duct firing • OPTION 10 - 1x1 GE 7HA.02 CTG, 63 MW duct firing • OPTION 11 - 2x1 GE 7HA.02 CTG, no duct firing • OPTION 12 - 2x1 GE 7HA.02 CTG, 125 MW duct firing

1.2 REPORT ORGANIZATION

Following this Introduction, this report is organized into the following sections:

- Section 2.0 – Capital Cost Estimates
- Section 3.0 – Operations and Maintenance Cost Estimates
- Section 4.0 – Thermal Performance Estimates
- Section 5.0 – Stack Emissions Estimates
- Section 6.0 – Unit Operational Characteristic Estimates
- Section 7.0 – Summary of Findings

1.3 BASIS OF ESTIMATES

Screening-level estimates were developed for 14 natural gas-fueled supply-side options. Capital cost estimates are intended to be representative of normalized costs for power plant construction, maintenance, and operation in the states of Utah, Washington, Oregon, and Wyoming. Actual project costs will be dependent on factors such as but not limited to site location, terrain, labor availability, weather, and project timing. Presented below is a listing of basic plant design assumptions used in developing cost, performance, and emissions estimates:

- Greenfield option capital cost estimates assume the balance-of-plant has only been sized for the initial greenfield block. Additional site preparation, roads, equipment, and building space to accommodate a future unit addition are not included in the greenfield estimates.
- Brownfield option capital cost estimates reflect the incremental costs necessary during construction of the first block to accommodate the future unit addition as well as the cost for adding the second block. Adding the capital costs of the greenfield and brownfield together will result in the expected cost for constructing a two block power plant. Brownfield option cost estimates were only produced for Option 3 (GE 7F.05 CTG in simple cycle) and Option 8 (GE 7HA.01 CTG in 2x1 combined cycle).
- The site is free and clear. No demolition of existing structures is included.
- The site requires pile foundations under major equipment and pad foundations for all other equipment and buildings.
- Labor availability is sufficient to preclude the need for temporary housing quarters.
- Onsite water storage and mobile water treatment services for all simple cycle options.
- Onsite water storage and permanent water treatment facilities for all combined cycle options.
- CTGs are located in weather enclosures.
- RICE are located within a common building.
- Steam turbine-generators (STG) are located in a building.
- All options utilize air-cooled heat rejection. Combined cycle options utilize air cooled condensers.
- All CTG-based options utilize wetted-media evaporative coolers to cool inlet air to the CTG compressor when temperatures exceed 59° F.

- Option 1 uses a form of wet-compression, marketed as "SPRINT" by the CTGs original equipment manufacturer, GE. SPRINT entails the injection of high purity water into the compressor. This acts as a form of compressor intercooling, reducing the amount of work needed by the compressor and increasing the amount of mass flow through the machine. SPRINT injection occurs upstream of the low pressure compressor stages when ambient air temperatures exceed 45° F and upstream of the high pressure compressor stages when ambient air temperatures are below 45° F but above 35° F.
- Option 2 uses water injection to control machine nitrogen oxides (NOx) emissions. High purity water is injected into the combustion system during operation.
- All options have oxidation catalysts and selective catalytic reduction (SCR) systems for post-combustion emissions controls.
- Some of the combined cycle options utilize heat recovery steam generators (HRSGs) with duct firing capability. Duct firing was limited to an exit gas temperature of 1,525° F. Incremental duct firing output targets were sometimes missed for locations at higher elevations.

2.0 Capital Cost Estimates

Screening-level capital cost estimates were developed for each of the 14 options evaluated. The capital cost estimates were developed based on Black & Veatch's experience on projects either serving as engineering, procurement, and construction (EPC) contractor or as owner's engineer (OE). Capital cost estimates are market-based; based on recent and on-going experiences. The market-based numbers were adjusted based on technology (i.e., CTG/RICE technology, air-cooled condensing) and configuration (i.e., level of duct firing, block size, air quality control equipment) to arrive at capital cost estimates developed on a consistent basis and reflective of current market trends.

Rather than develop capital cost estimates based on a "bottoms up" methodology, the estimates presented herein have been developed using recent historical and current project pricing and then adjusted to account for differences in region, project scope, technology type, and cycle configuration. The basic process flow is as follows:

- **Leverage** in-house database of project information from EPC projects recently completed and currently being executed as well as EPC pursuits currently being bid and our knowledge of the market from an owner's engineer perspective to produce a list of potential reference projects based primarily on technology type and cycle configuration.
- **Review** differences in region and scope.
- **Exclude** references which differ significantly from study basis.
- **Adjust**. The remaining references are broken down into several cost categories and further adjusted to account for differences such as major equipment pricing, labor, and commodities escalation.
- **Scale**. Remaining reference projects are compared and a scaling curve is generated. That scaling curve forms the basis for the screening-level capital cost estimates and is ultimately used to arrive at the EPC capital cost estimate.

The estimate process described above maximizes the value of past experiences and reduces bias resulting from project outliers such as differences in scope and location with the objective of providing current market pricing for generic power projects in PacifiCorp's service territories.

Capital cost estimates presented in Appendix A are based on greenfield site development under fixed, lump sum EPC contracting. Cost estimates are broken out into three main categories: EPC Capital Cost, Land and Outside-the-Fence Infrastructure Cost, and State Taxes. The EPC Capital Cost portion of the cost estimates is based on Black & Veatch's knowledge of current market trends and assumes a 2018 notice to proceed (NTP) with nominal allowances for EPC contractor contingency and escalation necessary for multi-year project expenditures through the planned commercial operation date (COD). Cash flow weights in Appendix E give a monthly breakdown of percentage costs over the duration of construction. Simple cycle projects are assumed to have a 2021 COD. Combined cycle projects are assumed to have a 2022 COD. Contingency to cover PacifiCorp's potential project risks is excluded from the EPC Capital Cost portion and should be included as an Owner's Cost item.

The Land and Outside-the-Fence Infrastructure portion of the cost estimates is based on PacifiCorp provided data as presented in Table 2-1 and Black & Veatch estimates for annual fuel consumption, water consumption, and land requirements, escalated to mid-year 2018 US dollars. The State Taxes portion of the cost estimates is based on PacifiCorp provided state tax data as presented in

Table 2-2. Land, outside-the-fence infrastructure, and state taxes are considered to be "Owner Costs." A more comprehensive listing of potential owner costs is presented in Table 2-3.

Table 2-1 PacifiCorp Provided Land and Outside-the-Fence Infrastructure Cost Information

PARAMETER	UNIT COST (MID 2018 DOLLARS BASIS)
Electric Power Transmission (15 miles long)	
Combined Cycle	
Greenfield	$2,300,000/mile
Brownfield	$1,100,000/mile
Simple Cycle	$1,015,000/mile
Electrical Interconnection (Note 1)	
Direct Assigned Costs	$13,384,000
Natural Gas Transmission (8 miles long, Note 1)	
Nominal Pipeline Diameter of 14"	$2,120,000/mile
Nominal Pipeline Diameter of 18"	$2,483,000/mile
Nominal Pipeline Diameter of 24"	$2,942,000/mile
Water Rights (Note 2)	
One-Time Fee	$10,000/acre-feet/yr
Water Transmission (3 miles long, Note 3)	
Nominal Pipeline Diameter of 3" – 8"	$532,000 – 605,000/mile (size dependent)
Land	
Fixed Cost	$25,500/transaction
Variable Costs	$6,000/acre

Notes:

1. Electrical Interconnection and Natural Gas Transmission pricing provided in 2014 US Dollars. Prices were escalated 2% per year and rounded to the nearest $1,000.
2. Water Rights were calculated as a constant flow for 1,139 hours/year for simple cycle options and 5,694 hours/year for combined cycle options. The constant flow was estimated to be the maximum expected instantaneous evaporative cooling, maximum expected instantaneous water injection, and 3% full load steam cycle makeup, as applicable, as well as a fixed flow of 50 gallons per minute to account for other plant uses such as water wash, service water, and sanitary water.
3. Water Transmission pipeline pricing was extrapolated from Natural Gas pipeline pricing, reduced by a factor of 3.

Table 2-2 PacifiCorp Provided State Tax Information

TAX PARAMETER	TAX RATE
Utah State Taxes	
Pollution Control Equipment	Not Taxed
Balance of Plant Materials and Products	6.75%
Labor and Services	Not Taxed
Wyoming State Taxes	
Pollution Control Equipment	5%
Balance of Plant Materials and Products	5%
Labor and Services	Not Taxed
Oregon State Taxes	
Pollution Control Equipment	Not Taxed
Balance of Plant Materials and Products	Not Taxed
Labor and Services	Not Taxed
Washington State Taxes	
Pollution Control Equipment	8.9%
Balance of Plant Materials and Products	8.9%
Labor and Services	8.9%

Table 2-3 Potential Owner Costs (Excluded from Typical EPC Contract Costs)

Project Development:
- Site selection study
- Land purchase/options/rezoning
- Transmission/gas pipeline rights of way
- Road modifications/upgrades
- Demolition
- Environmental permitting/offsets
- Public relations/community development
- Legal assistance

Utility Interconnections (outside-the-fence infrastructure):
- Natural gas service
- Gas system upgrades
- Electrical transmission (including switchyard)
- Supply water
- Wastewater/sewer

Operating Spare Parts and Plant Equipment:
- SCR system and oxidation catalyst materials, supplies, and parts
- Combustion and steam turbine materials, supplies, and parts
- HRSG materials, supplies, and parts
- Air cooled condenser materials, supplies, and parts
- Balance-of-plant equipment/tools
- Rolling stock
- Plant furnishings and supplies

Owner's Project Management:
- Preparation of bid documents and selection of contractors and suppliers
- Provision of project management
- Performance of engineering due diligence
- Provision of personnel for site construction management

Plant Startup/Construction Support:
- Owner's site mobilization
- O&M staff training
- Initial test fluids and lubricants
- Initial inventory of chemicals/reagents
- Consumables
- Cost of fuel not recovered in power sales
- Auxiliary power purchase
- Construction all-risk insurance
- Acceptance testing
- Supply of trained operators to support equipment testing and commissioning

Taxes/Advisory Fees/Legal:
- Taxes
- Market and environmental consultants
- Owner's legal expenses:
  - Interconnect agreements
  - Contracts--procurement and construction
  - Property transfer

Owner's Contingency:
- Owner's uncertainty and costs pending final negotiation:
  - Unidentified project scope increases
  - Unidentified project requirements
  - Costs pending final agreement (e.g., interconnection contract costs)

Financing:
- Financial advisor, lender's legal, market analyst, and engineer
- Development of financing sufficient to meet project obligations or obtaining alternate sources of lending
- Interest during construction

3.0 Operations and Maintenance Cost Estimates

Screening-level O&M cost estimates, presented in Appendix B, were developed for each of the 14 options evaluated. O&M cost estimates will be presented in $/MWh for non-fuel variable O&M and $/kW-yr for fixed O&M. Performance was assumed at ISO conditions (59° F, 60% RH, 14.7 psia). The O&M cost estimates were developed based on Black & Veatch's experience serving our clients as OE. O&M cost estimates are based on information provided by PacifiCorp for personnel labor rates, ammonia pricing, long-term services agreements (LTSAs), and other information provided by PacifiCorp as presented in Table 3-1. Market-based numbers were adjusted based on technology and configuration to arrive at O&M cost estimates developed on a consistent basis and reflective of current market trends. O&M cost estimates are presented as levelized numbers, mid-year 2018 US dollars basis.

Table 3-1 PacifiCorp Provided Operations and Maintenance Cost Information

PARAMETER	VALUE
Simple Cycle Annual Capacity Factor (Note 1)	13.0%
Combined Cycle Annual Capacity Factor (Note 2)	65.0%
Fully Burdened Cost per Person	$164,320/year
Full-Time Equivalent O&M Staff	
Greenfield Simple Cycle	9 persons
Brownfield Simple Cycle (1x GE 7F.05)	2 persons
Greenfield 1x1 Combined Cycle	17 persons
Greenfield 2x1 Combined Cycle	20 persons
Brownfield 2x1 Combined Cycle (GE 7HA.01)	8 persons
Ammonia (including shipping, excludes tax)	
Aqueous Ammonia (Note 3)	$211.20/ton
Water	No on-going water costs. One-time water rights fees covered in capital cost estimates.
State Taxes (Note 4)	Refer to Table 2-2 for state tax information.
CTG and RICE LTSA Information	Provided in separate documents and used to calculate annual LTSA costs based on the operating profiles presented. (Note 5)

Note:
1. Annual number of simple cycle starts assumed to be 140.
2. Annual number of combined cycle starts assumed to be 150.
3. Aqueous ammonia concentration assumed to be 19% by weight.
4. State taxes have not been applied in the O&M cost estimate summaries presented within this report.
5. LTSA pricing for parts and labor was provided for GE aeroderivative CTGs and GE frame CTGs. Wartsila provided parts and consumables-only maintenance estimates. Labor costs, assumed to be 25% of parts/consumables costs, were added to the Wartsila-provided values.

4.0 Thermal Performance Estimates

Past project experience and relationships with major equipment suppliers were leveraged to develop screening-level thermal performance estimates. CTG and RICE thermal performance estimates were developed using equipment manufacturer online performance estimating tools or information provided by supplier representatives. Combined cycle thermal performance estimates were based on CTG performance data and Thermoflow GTPRO/GTMASTER thermodynamic model outputs.

Full load, new and clean, thermal performance estimates are presented in Appendix C.

5.0 Stack Emissions Estimates

Screening-level steady-state stack air emissions estimates (one per each of 14 options, presented in Appendix C) were developed based on expected CTG and duct burner (as applicable) emission rates and post-combustion air quality control equipment target emissions reductions (as applicable) at full load operations and at an ambient temperature of 51° F. Emissions for oxides of nitrogen (NO_X), carbon monoxide (CO), and volatile organic compounds (VOCs) are presented in parts per million-dry volumetric basis and corrected to 15 percent oxygen (ppmvd@15%O_2), pounds per hour (lb/h), and pounds per million British Thermal Units (lbs/mmBtu), higher heating value basis. Emissions for particulate matter (PM_{10}/$PM_{2.5}$), carbon dioxide (CO_2), and ammonia slip (NH_3) are presented in lb/h. Preliminary stack emission rate targets, considered to be consistent with recent permitted projects in the western United States, are presented in Table 5-1. Note that these values are to only be used for planning purposes. No permitting assessments have been performed to substantiate these values.

Table 5-1 Preliminary Stack Emission Rate Targets

TECHNOLOGY TYPE	NO_X STEADY-STATE STACK EMISSIONS RATE (PPMVD@15%O_2)	CO STEADY-STATE STACK EMISSIONS RATE (PPMVD@15%O_2)	NH_3 SLIP STEADY-STATE STACK EMISSIONS RATE (PPMVD@15%O_2)
Combined Cycle	2	2	5
GE LMS100PA+ CTG Simple Cycle	2.5	6	10
Wartsila 18V50SG RICE Simple Cycle	5 (4.5 provided by OEM)	15	10
Other Simple Cycles	2.5	2.5	10

6.0 Unit Operational Characteristic Estimates

To understand unit flexibility, basic operational parameters must be understood. Using past project experience and major equipment supplier published data, unit operational characteristic estimates, presented in Appendix D, were developed for each of the evaluated options. Each of the operational characteristics presented in the appendix are defined below for clarity.

Minimum Load (MW) – Minimum load is the minimum sustainable output while still achieving stack emissions targets as presented in Table 5-1. For simple cycle units, this load corresponds with the CTG or RICE minimum emissions compliance load (MECL) after accounting for effects from the SCR and oxidation catalyst. For combined cycle units consisting of a single CTG/HRSG train, minimum load is the combined net output of the CTG and STG when the CTG is operating at MECL. For combined cycle units consisting of two CTG/HRSG trains, minimum load has a dual listing. The first listing is the estimated combined net output of both CTGs and the STG. The second listing is the estimated net output of a single CTG and STG with only one CTG/HRSG train in operation.

Spinning Reserve (MWs) – Spinning reserve is defined as maximum increase in production a generating resource can achieve within ten minutes. It is considered to be either the maximum load of the unit if the unit is capable of going from off-line to maximum load in less than 10 minutes or the lesser of the difference between maximum load (considered Net Capacity) and minimum load (considered Minimum Capacity) and the units Ramp Rate over a 10 minute period. As a general rule, aeroderivative CTGs and RICE units can start in under 10 minutes. Frame CTGs and combined cycles require more time to startup so their spinning reserve capabilities are limited to ramp rates and the difference between maximum load and minimum load.

Run-up rate (MW/hr) - Run-up rate is minimum capacity divided by time required for resource to go from first fire to Minimum Capacity. Run-up rate for combined cycle resources includes the time for the entire resource, CTGs and STG, if applicable, to reach Minimum Capacity. Run-up rate assumes a warm start.

Ramp Rate (MW/h) – Ramp rate is the maximum rate of change in unit load, either an increase or decrease, expressed as MWs per hour, while maintaining stable load and stack emissions targets when operating at a load between minimum load and full load. For both simple cycle and combined cycle options, the rate of load change is assumed to be equivalent to the CTG or RICE machine load change rate capabilities. Combined cycle ramp rate capabilities can be limited by steam cycle limitations. For example, CTG exhaust temperature changes and corresponding steam temperature changes have the potential to exceed STG admission temperature tolerances and must be accounted for in the HRSG and steam conditioning design. Combined cycle ramp rates exclude STG load changes as STG load typically lags behind CTG load due to steam cycle thermal and STG rotational inertia.

Minimum Up/Down Times (hours) – Minimum up and minimum down times are often determined during system dispatch modeling. The system modeler runs a given asset under varying minimum up and down times to identify the minimum up and minimum down times that result in the optimal combination of revenue and cost. The minimum up and minimum down times presented in the appendix correspond with typical technical limitations.

The minimum up time is defined as the minimum time required during normal operation between breaker closure to breaker opening at shutdown. For both simple cycle and combined cycle units, minimum up time is often technically driven by continuous emissions monitoring system (CEMS) calibration requirements. Most generation units equipped with CEMS must perform daily

assessments per Title 40, Part 75 of the Code of Federal Regulations (e.g. calibration error tests, interference checks). Time required to perform daily assessments is expected to be in the range of 30 – 45 minutes, which can begin shortly after start initiation. However, the actual duration is dependent on the CEMS calibration gases, equipment, and umbilical cord lengths. A minimum up time of one hour has been assigned for fast start simple cycle options such as those based on aeroderivative CTG and RICE units. Longer minimum up times apply for the simple cycle frame and combined cycle options.

The minimum down time is defined as the time required between breaker opening at shutdown and start initiation. For both simple cycle and combined cycle units, minimum down time is typically driven by two factors: whether the unit is placed on turning gear following shutdown and whether the unit needs to be purged prior to restart. The timeframe to get the unit on turning gear and keep it on turning gear can be up to about 50 minutes. The timeframe to purge the unit after shutdown or prior to startup could be in the range of 5 – 20 minutes. However, National Fire Protection Association 850 allows units to avoid a purge if proper isolation can be proved continuously through the use of a triple block and double bleed valve arrangement with monitoring. A minimum down time of one hour has been assigned for all simple cycle and combined cycle options evaluated.

Warm Start-up Time to Minimum Capacity (hours) - Warm start-up time to minimum capacity (minutes) is the time to reach Minimum Capacity after a resource receives a start signal for a warm start.

Start Times (minutes) – Start times are defined as the time required to achieve CTG/RICE full load output from start initiation. Simple cycle CTG and RICE units do not typically have start times that vary depending on the time the unit had previously been offline. Therefore, each simple cycle option has been assigned a single start time. Combined cycle start times do not include the lag time between when the CTG(s) achieve full load and when the STG achieves full load.

Combined cycle unit start times are mainly driven by steam temperature control capabilities and STG warming requirements. Combined cycle CTG and STG start times and ramp rates can be reduced using a number of proven cycle design methods such as integration of auxiliary steam boilers, HRSG stack dampers, steam final point attemperation, and enhanced CTG starting systems. Combined cycle start times presented are based on conventional steam cycle designs with no fast start features. Four start times will be presented for each combined cycle, with start times defined as follows:

- Hot start corresponds with a start following a shutdown period of less than 8 hours.
- Warm start corresponds with a start following a shutdown period of 8 – 48 hours.
- Cold start corresponds with a start following a shutdown period of 48 – 72 hours.
- Ambient start corresponds with a start following a shutdown period of greater than 72 hours.

Heat input for a Warm Start (millions of British Thermal Units-Higher Heating Value) – The fuel required for the RICE unit or CTG(s) to achieve full load.

Availability - Many factors affect the availability of power generating assets. These factors include maintenance, number of starts, average run time, capacity factor, operating hours, and others. Black & Veatch investigated the equivalent forced outage rate (EFOR) and planned outage rate (POR) for the technologies being considered. When analyzing EFOR and POR it is important to keep in mind that because EFOR and POR are both rates they depend on the number of operating hours

the unit has accumulated over the year. Therefore, the percent value can change even if the total number of hours of downtime over the year is the same.

POR equals Planned outage hours / (Planned Outage Hours + Operational Hours). POR can be predicted fairly accurately because the outage schedule (Planned Outage Hours) of the unit is known in advance and the analysis assumes a certain operational strategy for the unit.

EFOR equals Forced Outage Hours / (Forced Outage Hours + Operational Hours), but also takes into account derated hours of the unit. Because forced outages are not planned, Black & Veatch uses databases such as NERC-GADS to inform the EFOR of the unit. As NERC-GADS does not distinguish between unit manufacturers, some engineering judgement is used to make the distinction.

7.0 Summary of Findings

A summary of the basic capital cost, performance, and non-fuel O&M cost estimates for the 14 natural gas-fueled options evaluated in this study are presented in Table 7-1. Performance is at full load and ISO conditions (59° F, 60% RH, 14.7 psia).

Table 7-1 Summary of Natural Gas-Fueled Supply Side Options

Option	1	2	3	3B	4	5	6	7	8
Greenfield?	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
CTG/RICE Make	GE	GE	GE	GE	Wartsila	GE	GE	GE	GE
CTG/RICE Model	LM6000PF Sprint	LMS100PA+	7F.05	7F.05	18V50SG	7HA.01	7HA.01	7HA.01	7HA.01
Number of CTG/RICE	3	2	1	1	6	1	1	2	2
Simple Cycle or Combined Cycle (SC or CC)	SC	SC	SC	SC	SC	CC	CC	CC	CC
Duct Firing?	n/a	n/a	n/a	n/a	n/a	No	Yes	No	Yes
Nominal Net Output, MW	142.0	231.3	233.1	233.1	110.6	418.6	469.6	839.9	941.9
Nominal Net Heat Rate, Btu/kWh (HHV)	9,279	8,725	9,811	9,811	8,272	6,450	6,649	6,428	6,620
EPC Capital Cost, $	$145M	$171M	$98M	$95M	$127M	$449M	$469M	$641M	$670M
EPC Capital Cost, $/kW	$1,024	$740	$422	$408	$1,148	$1,073	$999	$763	$711
Fixed O&M, $/kW-yr	$15.0	$9.5	$8.4	$3.0	$15.6	$8.6	$7.7	$5.6	$5.1
Variable Non-fuel O&M, $/MWh	$8.4	$5.3	$12.1	$12.1	$9.3	$1.7	$1.5	$1.6	$1.5

Option	8B	9	10	11	12
Greenfield?	No	Yes	Yes	Yes	Yes
CTG/RICE Make	GE	GE	GE	GE	GE
CTG/RICE Model	7HA.01	7HA.02	7HA.02	7HA.02	7HA.02
Number of CTG/RICE	2	1	1	2	2
Simple or Combined Cycle	CC	CC	CC	CC	CC
Duct Firing?	Yes	No	Yes	No	Yes
Nominal Output, MW	941.9	539.3	602.6	1,082.9	1,208.9
Nominal Heat Rate, Btu/kWh (HHV)	6,620	6,396	6,580	6,370	6,543
EPC Capital Cost, $	$663M	$484M	$505M	$691M	$722M
EPC Capital Cost, $/kW	$704	$898	$838	$638	$597
Fixed O&M, $/kW-yr	$2.9	$6.9	$6.3	$4.6	$4.3
Variable Non-fuel O&M, $/MWh	$1.5	$1.5	$1.4	$1.5	$1.4

Appendix A. Capital Cost Estimates

PacifiCorp Study B&V Project Number 199232 Preliminary Capital Cost Estimates Summary - Rev 1 September 7, 2018 **General Plant Information**	Option Description	1 Greenfield 3x0 LM6000PF Sprint	2 Greenfield 2x0 LMS100PA+	3 Greenfield 1x0 7F.05	3B Brownfield 1x0 7F.05	4 Greenfield 6x0 Wartsila	5 Greenfield 1X1 7HA.01 No Duct Firing	6 Greenfield 1X1 7HA.01 Duct Firing	7 Greenfield 2X1 7HA.01 No Duct Firing	8 Greenfield 2X1 7HA.01 Duct Firing	8B Brownfield 2X1 7HA.01 Duct Firing	9 Greenfield 1X1 7HA.02 No Duct Firing	10 Greenfield 1X1 7HA.02 Duct Firing	11 Greenfield 2X1 7HA.02 No Duct Firing	12 Greenfield 2X1 7HA.02 Duct Firing
Station Net Output (ISO conditions, 59° F, 60% RH, 14.7 psia)	MW	141.959	231.298	233.104	233.104	110.553	418.594	469.594	839.938	941.938	941.938	539.264	602.624	1082.853	1208.854
Number of CTs/RICE	#	3	2	1	1	6	1	1	2	2	2	1	1	2	2
Number of STs	#	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Reference Year for Cost Estimates	Year	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
Estimated EPC Capital Costs															
Pollution Control Equipment		$17,400,000	$19,400,000	$18,300,000	$18,300,000	$7,500,000	$6,500,000	$7,000,000	$9,900,000	$10,600,000	$10,600,000	$7,300,000	$7,900,000	$11,100,000	$11,900,000
Balance of Plant Materials and Products		$91,700,000	$109,000,000	$55,500,000	$53,000,000	$87,700,000	$262,900,000	$274,400,000	$374,700,000	$391,400,000	$387,200,000	$283,100,000	$295,100,000	$403,500,000	$421,300,000
Labor and Services		$36,300,000	$42,800,000	$24,600,000	$23,700,000	$31,700,000	$179,600,000	$187,600,000	$256,400,000	$268,000,000	$265,200,000	$193,600,000	$202,000,000	$276,400,000	$288,800,000
Total EPC Contract Costs		**$145,400,000**	**$171,200,000**	**$98,400,000**	**$95,000,000**	**$126,900,000**	**$449,000,000**	**$469,000,000**	**$641,000,000**	**$670,000,000**	**$663,000,000**	**$484,000,000**	**$505,000,000**	**$691,000,000**	**$722,000,000**
	$/kW	**$1,024**	**$740**	**$422**	**$408**	**$1,148**	**$1,073**	**$999**	**$763**	**$711**	**$704**	**$898**	**$838**	**$638**	**$597**
Estimated Land and Outside-the-Fence Infrastructure Costs															
Transmission Line, miles		15	15	15	15	15	15	15	15	15	15	15	15	15	15
Transmission		$28,609,000	$28,609,000	$28,609,000	$28,609,000	$28,609,000	$47,884,000	$47,884,000	$47,884,000	$47,884,000	$29,884,000	$47,884,000	$47,884,000	$47,884,000	$47,884,000
Water Pipeline Size, nominal inches		4	4	4	5	3	4	4	5	6	8	5	5	6	6
Water Pipeline Length, miles		3	3	3	3	3	3	3	3	3	3	3	3	3	3
Water		$1,900,000	$2,000,000	$1,900,000	$300,000	$1,700,000	$3,400,000	$3,600,000	$4,700,000	$5,200,000	$3,400,000	$3,700,000	$4,000,000	$5,400,000	$5,900,000
Natural Gas Pipeline Size, nominal inches		10	12	12	18	8	14	14	18	18	28	14	14	24	24
Natural Gas Pipeline Length, miles		8	8	8	8	8	8	8	8	8	8	8	8	8	8
Natural Gas		$14,464,000	$16,136,000	$16,136,000	$19,864,000	$12,648,000	$17,696,000	$17,696,000	$19,864,000	$19,864,000	$25,816,000	$17,696,000	$17,696,000	$23,536,000	$23,536,000
Land Acres Required		10	10	10	15	10	20	20	30	30	45	20	20	30	30
Land		$85,500	$85,500	$85,500	$30,000	$85,500	$145,500	$145,500	$205,500	$205,500	$90,000	$145,500	$145,500	$205,500	$205,500
Total Land and Outside-the-Fence Infrastructure		**$45,058,500**	**$46,830,500**	**$46,730,500**	**$48,803,000**	**$43,042,500**	**$69,125,500**	**$69,325,500**	**$72,653,500**	**$73,153,500**	**$59,190,000**	**$69,425,500**	**$69,725,500**	**$77,025,500**	**$77,525,500**
	$/kW	**$317**	**$202**	**$200**	**$209**	**$389**	**$165**	**$148**	**$86**	**$78**	**$63**	**$129**	**$116**	**$71**	**$64**
Estimated State Taxes															
Utah	**Tax Rate**														
Pollution Control Equipment	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Balance of Plant Materials and Products	6.75%	$6,189,750	$7,357,500	$3,746,250	$3,577,500	$5,919,750	$17,745,750	$18,522,000	$25,292,250	$26,419,500	$26,136,000	$19,109,250	$19,919,250	$27,236,250	$28,437,750
Labor and Services	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Utah Tax Costs		**$6,189,750**	**$7,357,500**	**$3,746,250**	**$3,577,500**	**$5,919,750**	**$17,745,750**	**$18,522,000**	**$25,292,250**	**$26,419,500**	**$26,136,000**	**$19,109,250**	**$19,919,250**	**$27,236,250**	**$28,437,750**
Wyoming	**Tax Rate**														
Pollution Control Equipment	5%	$870,000	$970,000	$915,000	$915,000	$375,000	$325,000	$350,000	$495,000	$530,000	$530,000	$365,000	$395,000	$555,000	$595,000
Balance of Plant Materials and Products	5%	$4,585,000	$5,450,000	$2,775,000	$2,650,000	$4,385,000	$13,145,000	$13,720,000	$18,735,000	$19,570,000	$19,360,000	$14,155,000	$14,755,000	$20,175,000	$21,065,000
Labor and Services	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Wyoming Tax Costs		**$5,455,000**	**$6,420,000**	**$3,690,000**	**$3,565,000**	**$4,760,000**	**$13,470,000**	**$14,070,000**	**$19,230,000**	**$20,100,000**	**$19,890,000**	**$14,520,000**	**$15,150,000**	**$20,730,000**	**$21,660,000**
Oregon	**Tax Rate**														
Pollution Control Equipment	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Balance of Plant Materials and Products	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Labor and Services	0%	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Oregon Tax Costs		**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Washington	**Tax Rate**														
Pollution Control Equipment	8.9%	$1,548,600	$1,726,600	$1,628,700	$1,628,700	$667,500	$578,500	$623,000	$881,100	$943,400	$943,400	$649,700	$703,100	$987,900	$1,059,100
Balance of Plant Materials and Products	8.9%	$8,161,300	$9,701,000	$4,939,500	$4,717,000	$7,805,300	$23,398,100	$24,421,600	$33,348,300	$34,834,600	$34,460,800	$25,195,900	$26,263,900	$35,911,500	$37,495,700
Labor and Services	8.9%	$3,230,700	$3,809,200	$2,189,400	$2,109,300	$2,821,300	$15,984,400	$16,696,400	$22,819,600	$23,852,000	$23,602,800	$17,230,400	$17,978,000	$24,599,600	$25,703,200
Total Washington Tax Costs		**$12,940,600**	**$15,236,800**	**$8,757,600**	**$8,455,000**	**$11,294,100**	**$39,961,000**	**$41,741,000**	**$57,049,000**	**$59,630,000**	**$59,007,000**	**$43,076,000**	**$44,945,000**	**$61,499,000**	**$64,258,000**
Project Cost Subtotals															
Utah Subtotal		**$196,648,250**	**$225,388,000**	**$148,876,750**	**$147,380,500**	**$175,862,250**	**$535,871,250**	**$556,847,500**	**$738,945,750**	**$769,573,000**	**$748,326,000**	**$572,534,750**	**$594,644,750**	**$795,261,750**	**$827,963,250**
	$/kW	**$1,385**	**$974**	**$639**	**$632**	**$1,591**	**$1,280**	**$1,186**	**$880**	**$817**	**$794**	**$1,062**	**$987**	**$734**	**$685**
Wyoming Subtotal		**$195,913,500**	**$224,450,500**	**$148,820,500**	**$147,368,000**	**$174,702,500**	**$531,595,500**	**$552,395,500**	**$732,883,500**	**$763,253,500**	**$742,080,000**	**$567,945,500**	**$589,875,500**	**$788,755,500**	**$821,185,500**
	$/kW	**$1,380**	**$970**	**$638**	**$632**	**$1,580**	**$1,270**	**$1,176**	**$873**	**$810**	**$788**	**$1,053**	**$979**	**$728**	**$679**
Oregon Subtotal		**$190,458,500**	**$218,030,500**	**$145,130,500**	**$143,803,000**	**$169,942,500**	**$518,125,500**	**$538,325,500**	**$713,653,500**	**$743,153,500**	**$722,190,000**	**$553,425,500**	**$574,725,500**	**$768,025,500**	**$799,525,500**
	$/kW	**$1,342**	**$943**	**$623**	**$617**	**$1,537**	**$1,238**	**$1,146**	**$850**	**$789**	**$767**	**$1,026**	**$954**	**$709**	**$661**
Washington Subtotal		**$203,399,100**	**$233,267,300**	**$153,888,100**	**$152,258,000**	**$181,236,600**	**$558,086,500**	**$580,066,500**	**$770,702,500**	**$802,783,500**	**$781,197,000**	**$596,501,500**	**$619,670,500**	**$829,524,500**	**$863,783,500**
	$/kW	**$1,433**	**$1,009**	**$660**	**$653**	**$1,639**	**$1,333**	**$1,235**	**$918**	**$852**	**$829**	**$1,106**	**$1,028**	**$766**	**$715**

Appendix B. O&M Cost Estimates

PacifiCorp Study	Option Number	1	2	3	3B	4	5	6	7	8	8B	9	10	11	12
B&V Project Number 199232															
Preliminary Non-fuel O&M Cost Estimates															
Option Arrangement															
Revision		Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Original Equipment Manufacturer		GE	GE	GE	GE	Wartsila	GE	GE	GE	GE	GE	GE	GE	GE	GE
Technology		LM6000 PF Sprint	LMS100PA+	7F.05	7F.05	18V50SG	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.02	7HA.02	7HA.02	7HA.02
Configuration		3x0 SCCT	2x0 SCCT	1x0 SCCT	1x0 SCCT	6x0 RICE	1x1 CCCT	1x1 CCCT	2x1 CCCT	2x1 CCCT	2x1 CCCT	1x1 CCCT	1x1 CCCT	2x1 CCCT	2x1 CCCT
Steam Turbine Heat Rejection		N/A	N/A	N/A	N/A	N/A	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC	ACC
Inlet Air Conditioning		Evaporative Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	None	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling	Evap. Cooling
Duct Firing Capacity (Net), MW		N/A	N/A	N/A	N/A	N/A	N/A	50.6	N/A	102	102	N/A	63.0	N/A	126
Site Condition, Greenfield or Brownfield		Greenfield	Greenfield	Greenfield	Brownfield	Greenfield	Greenfield	Greenfield	Greenfield	Greenfield	Brownfield	Greenfield	Greenfield	Greenfield	Greenfield
General Plant Information															
Net Plant Output (ISO Conditions: 59° F, 60% RH, 14.7 psia)	MW	141.959	231.298	233.104	233.104	110.556	418.954	469.594	839.938	941.938	941.938	539.264	602.264	1082.853	1208.854
Annual Capacity Factor	%	6.0%	6.0%	6.0%	6.0%	6.0%	40.7%	40.7%	40.7%	40.7%	40.7%	40.7%	40.7%	40.7%	40.7%
Number of Combustion Turbines	Count	3	2	1	1	6	1	1	2	2	2	1	1	2	2
Number of Steam Turbine Generators	Count	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Number of Full Time Equivalent Personnel	Count	9	9	9	2	9	17	17	20	20	8	17	17	20	20
Starts Per Year	Count	140	140	140	140	140	150	150	150	150	150	150	150	150	150
LTSA Basis, Starts or Fired Hours	Basis	Fired Hours	Fired Hours	Starts	Starts	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours	Fired Hours
Reference Year for Cost Estimates	Year	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
Fixed Costs, Annual, $1,000															
Labor															
Operations, Maintenance, Technical Services, and Administration		1,465	1,465	1,465	326	1,465	2,768	2,768	3,256	3,256	1,302	2,768	2,768	3,256	3,256
Labor Sub-Total		**1,465**	**1,465**	**1,465**	**326**	**1,465**	**2,768**	**2,768**	**3,256**	**3,256**	**1,302**	**2,768**	**2,768**	**3,256**	**3,256**
Maintenance															
LTSA Fixed Cost		360.0	311.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Combustion Turbine or Recip Engine Fixed Costs		47.7	71.3	71.3	71.3	48.4	47.5	47.5	95.1	95.1	95.1	47.5	47.5	95.1	95.1
Steam Turbine & Steam Plant		0.0	0.0	0.0	0.0	0.0	53.5	53.5	108.0	108.0	108.0	68.5	68.5	138.6	138.6
HRSG		0.0	0.0	0.0	0.0	0.0	31.3	31.3	62.5	62.5	62.5	34.6	34.6	69.3	69.3
Air Cooled Condensers		0.0	0.0	0.0	0.0	0.0	60.0	60.0	121.2	121.2	121.2	76.8	76.8	155.5	155.5
Water Treatment Facilities		0.0	0.0	0.0	0.0	0.0	13.0	13.0	26.3	26.3	26.3	16.7	16.7	33.8	33.8
Waste Water Treatment		0.0	0.0	0.0	0.0	0.0	13.0	13.0	26.3	26.3	26.3	16.7	16.7	33.8	33.8
Pollution Control		10.2	16.7	16.8	16.8	7.6	19.7	19.7	39.5	39.5	39.5	25.5	25.5	51.0	51.0
I&C and Electric Plant		30.7	50.1	50.4	50.4	22.8	85.3	95.6	171.1	191.8	191.8	109.9	122.7	220.6	246.1
Contracted Services		51.2	83.5	83.9	83.9	37.9	142.2	159.4	285.2	319.7	319.7	183.2	204.4	367.7	410.2
Maintenance Sub-Total		**500.0**	**533.4**	**222.4**	**222.4**	**116.7**	**465.6**	**493.2**	**935.3**	**990.5**	**990.5**	**579.5**	**613.5**	**1,165**	**1,234**
Other Expenses															
Emission Fees (Exclusive, to be provided by client.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Property Taxes (Exclusive, to be provided by client.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insurance (Exclusive, to be provided by client.)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Office and Administrative Expenses (incl telephone, computers, etc)		73.3	73.3	146.5	32.6	73.3	172.8	172.8	203.3	203.3	81.3	172.8	172.8	203.3	203.3
Training		28.6	28.6	28.6	6.4	27.0	45.0	45.0	53.0	53.0	21.2	45.0	45.0	53.0	53.0
Bonus and Incentive Pay		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Fees		61.5	100.3	100.7	100.7	45.5	134.0	150.3	268.9	301.3	301.3	172.7	192.7	346.6	386.7
Other Fixed Expenses Sub-total		**163.4**	**202.2**	**275.9**	**139.7**	**145.8**	**351.9**	**368.1**	**525.2**	**557.6**	**403.9**	**390.5**	**410.6**	**602.9**	**643.0**
Total Fixed Costs		**2,129**	**2,201**	**1,963**	**688**	**1,728**	**3,585**	**3,629**	**4,717**	**4,804**	**2,697**	**3,738**	**3,792**	**5,024**	**5,133**
Variable Costs, Annual, $1,000															
Outage Maintenance															
Outage Maintenance - Combustion Turbine (LTSA)		474	510	1,440	1,440	308	1,747	1,747	3,493	3,493	3,493	2,067	2,067	4,134	4,134
Outage Maintenance - Steam Turbine		0.0	0.0	0.0	0.0	0.0	238.3	238.3	357.4	357.4	357.4	264.8	264.8	397.2	397.2
Outage Maintenance - Generator		58.8	53.1	0.0	0.0	83.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Outage Maintenance - HRSG		0.0	0.0	0.0	0.0	0.0	125.7	125.7	251.5	251.5	251.5	139.3	139.3	278.6	278.6
SCR Catalyst Replacement		69.3	46.7	10.0	10.0	42.0	47.0	47.0	93.9	93.9	93.9	60.7	60.7	121.3	121.3
CO Catalyst Replacement		6.7	4.5	10.0	10.0	4.4	47.0	47.0	93.9	93.9	93.9	60.7	60.7	121.3	121.3
Annualized Sub-Total Outage Maintenance		**608**	**615**	**1,460**	**1,460**	**438**	**2,205**	**2,205**	**4,290**	**4,290**	**4,290**	**2,592**	**2,592**	**5,052**	**5,052**
Utilities															
Sewage		1.3	1.3	1.3	1.3	1.2	48.2	49.6	59.3	61.9	61.9	51.4	53.0	65.6	68.9
Water		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Disposables		1.1	1.9	1.9	1.9	0.8	23.2	26.0	46.5	52.1	52.1	29.8	33.3	59.9	66.8
Annualized Sub-Total Utilities		**2.5**	**3.2**	**3.2**	**3.2**	**2.1**	**71.4**	**75.5**	**105.7**	**114.0**	**114.0**	**81.2**	**86.4**	**125.5**	**135.8**
Consumables Usage															
Cooling tower		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Treatment/Pre-Treatment		0.7	0.7	0.7	0.7	0.6	43.7	48.0	79.7	88.4	88.4	54.0	59.4	100.5	111.2
RICE Lube Oil Use		0.0	0.0	0.0	0.0	44.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCR Ammonia Consumption		12.4	20.3	20.8	20.8	53.4	182.3	204.4	364.6	408.7	408.7	235.5	262.8	471.0	525.5
Annualized Sub-Total Chemical Usage		**13.1**	**20.9**	**21.5**	**21.5**	**98.8**	**226.0**	**252.4**	**444.4**	**497.1**	**497.1**	**289.5**	**322.2**	**571.5**	**636.7**
Total Variable Costs		**624**	**639**	**1,485**	**1,485**	**539**	**2,502**	**2,533**	**4,840**	**4,901**	**4,901**	**2,963**	**3,001**	**5,749**	**5,825**
O&M Cost Summary															
Net Plant Output (ISO Conditions: 59° F, 60% RH, 14.7 psia)	MW	142.0	231.3	233.1	233.1	110.6	419.0	469.6	839.9	941.9	941.9	539.3	602.3	1,083	1,209
Annual Net Generation (MWh)	MW-h/yr	74,614	121,570	122,519	122,519	58,108	1,493,705	1,674,253	2,994,648	3,358,310	3,358,310	1,922,649	2,147,264	3,860,717	4,309,951
Fixed Costs, Annual	$1000/yr	2,129	2,201	1,963	687.7	1,728	3,585	3,629	4,717	4,804	2,697	3,738	3,792	5,024	5,133
Variable Costs, Annual	$1000/yr	624.0	638.7	1,485	1,485	539.1	2,502	2,533	4,840	4,901	4,901	2,963	3,001	5,749	5,825
Total O&M Costs, Annual	$1000/yr	2,753	2,839	3,448	2,172	2,267	6,087	6,161	9,557	9,705	7,598	6,701	6,793	10,774	10,957
Fixed Costs, Annual	$/kW-yr	15.0	9.51	8.42	2.95	15.6	8.56	7.73	5.62	5.10	2.86	6.93	6.30	4.64	4.25
Variable Costs, Annual	$/MW-h	8.36	5.25	12.1	12.1	9.28	1.68	1.51	1.62	1.46	1.46	1.54	1.40	1.49	1.35

Appendix C. Thermal Performance & Stack Emissions Estimates

PacifiCorp Study	-											
B&V Project Number 199232	-											
GE LM6000PF Sprint, 3X0 Gas Turbine	-											
Preliminary Performance Summary - Rev 0	-											
August 3, 2018	-											
Case #	-	1	2	3	4	5	6	7	8	9	10	11
Revision #	-	0	0	0	0	0	0	0	0	0	0	0
Description		Nephi Site 0 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 20 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 40 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 51 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 60 deg F 100% CTG Load Evap Cooler ON	Nephi Site 80 deg F 100% CTG Load Evap Cooler ON	Nephi Site 100 deg F 100% CTG Load Evap Cooler ON	ISO 59 deg F 100% CTG Load Evap Cooler OFF	E Oregon / Washington Site 52.7 deg F 100% CTG Load	Southern / Central Oregon Site 52.7 deg F 100% CTG Load	Rock Springs Site 43.2 deg F 100% CTG Load Evap Cooler OFF
CTG Configuration	-	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0	3 x 0
Heat Rejection System	-	-	-	-	-	-	-	-	-	-	-	-
Ambient Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	59.0	52.7	52.7	43.4
Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.6	60.1	67.2	59.0	52.7	52.7	43.4
Ambient Pressure	psia	12.2	12.2	12.2	12.2	12.2	12.2	12.2	14.7	13.9	13.2	11.6
CTG Model	-	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint	LM6000PF Sprint
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level	%	100	100	100	100	100	100	100	100	100	100	100
NEW & CLEAN PERFORMANCE												
Gross CTG Output (each)	kW	43,085	42,628	40,867	41,162	41,276	40,049	38,878	47,927	46,668	44,180	38,152
GT Fuel HHV/LHV Ratio		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Gross CTG Heat Rate (LHV)	BTU/kWh	8,049	8,054	8,166	8,205	8,216	8,261	8,314	8,256	8,210	8,211	8,183
Gross CTG Heat Rate (HHV)	Btu/kWh	8,931	8,937	9,061	9,104	9,117	9,167	9,225	9,161	9,110	9,111	9,080
CTG Heat Input (LHV) each	MBTU/hr	347	343	334	338	339	331	323	396	383	363	312
CTG Heat Input (HHV) each	MBTU/hr	385	381	370	375	376	367	359	439	425	403	346
Aux Power (each)		571	568	555	557	558	548	540	607	598	579	534
Auxiliary Power Percent of Gross Power	%	1.33%	1.33%	1.36%	1.35%	1.35%	1.37%	1.39%	1.27%	1.28%	1.31%	1.40%
Evaporative Cooler Water Consumption	gpm	0.0	0.0	0.0	0.0	5.9	10.0	16.2	0.0	0.0	0.0	0.0
CTG Augmentation Water Consumption	gpm	0.0	0.0	8.0	14.8	14.7	15.5	15.5	18.6	17.0	16.1	8.0
Total Water Consumption	gpm	0.0	0.0	8.0	14.8	20.5	25.6	31.7	18.6	17.0	16.1	8.0
NET PLANT PERFORMANCE												
Net Plant Output	kW	127,542	126,181	120,937	121,816	122,155	118,502	115,015	141,959	138,210	130,802	112,854
Net Plant Heat Rate (LHV)	Btu/kWh	8,157	8,163	8,278	8,317	8,329	8,376	8,431	8,362	8,317	8,320	8,299
Net Plant Heat Rate (HHV)	Btu/kWh	9,051	9,057	9,186	9,229	9,241	9,294	9,355	9,279	9,228	9,232	9,209
Net Plant Efficiency (LHV)	%	41.8%	41.8%	41.2%	41.0%	41.0%	40.7%	40.5%	40.8%	41.0%	41.0%	41.1%
Net Plant Efficiency (HHV)	%	37.7%	37.7%	37.1%	37.0%	36.9%	36.7%	36.5%	36.8%	37.0%	37.0%	37.1%
STACK EMISSIONS (PER UNIT)												
NOx	ppmvd @ 15% O2	-	-	-	2.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0090	-	-	-	-	-	-	-
	lb/hr	-	-	-	3.4	-	-	-	-	-	-	-
CO	ppmvd @ 15% O2	-	-	-	2.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0055	-	-	-	-	-	-	-
	lb/hr	-	-	-	2.0	-	-	-	-	-	-	-
VOC	ppmvd @ 15% O2	-	-	-	1.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0038	-	-	-	-	-	-	-
	lb/hr	-	-	-	1.4	-	-	-	-	-	-	-
PM2.5/10 - Front Half Only	lb/mmBtu (HHV)	-	-	-	0.0088	-	-	-	-	-	-	-
	lb/hr	-	-	-	3.3	-	-	-	-	-	-	-
PM2.5/10 - Front and Back Half	lb/mmBtu (HHV)	-	-	-	0.0177	-	-	-	-	-	-	-
	lb/hr	-	-	-	6.6	-	-	-	-	-	-	-
CO2	lb/hr	-	-	-	42,854	-	-	-	-	-	-	-
NH3 Slip	lb/hr	-	-	-	5.0	-	-	-	-	-	-	-

PacifiCorp Study
B&V Project Number 199232
GE LMS100PA+, 2x0 Gas Turbine
Preliminary Performance Summary - Rev 0
August 3, 2018

Case #		1	2	3	4	5	6	7	8	9	10	11
Revision #		0	0	0	0	0	0	0	0	0	0	0
Description		Nephi Site 0 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 20 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 40 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 51 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 60 deg F 100% CTG Load Evap Cooler ON	Nephi Site 80 deg F 100% CTG Load Evap Cooler ON	Nephi Site 100 deg F 100% CTG Load Evap Cooler ON	ISO 59 deg F 100% CTG Load Evap Cooler OFF	E Oregon / Washington Site 52.7 deg F 100% CTG Load	Southern / Central Oregon Site 52.7 deg F 100% CTG Load	Rock Springs Site 43.4 deg F 100% CTG Load Evap Cooler OFF
CTG Configuration	-	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0	2 x 0
Heat Rejection System	-	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler	Dry Intercooler
Ambient Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	59.0	52.7	52.7	43.4
Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.6	60.1	67.2	59.0	52.7	52.7	43.4
Ambient Pressure	psia	12.2	12.2	12.2	12.2	12.2	12.2	12.2	14.7	13.9	13.2	11.6
CTG Model	-	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+	LMS100PA+
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level	%	100	100	100	100	100	100	100	100	100	100	100
NEW & CLEAN PERFORMANCE												
Gross CTG Output (each)	kW	98,140	98,156	97,792	98,151	96,719	96,458	86,838	117,198	112,030	105,956	91,925
GT Fuel HHV/LHV Ratio		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Gross CTG Heat Rate (LHV)	BTU/kWh	7,717	7,715	7,715	7,715	7,728	7,748	7,905	7,759	7,727	7,724	7,725
Gross CTG Heat Rate (HHV)	Btu/kWh	8,563	8,561	8,561	8,561	8,575	8,597	8,771	8,609	8,574	8,571	8,572
CTG Heat Input (LHV) each	MBTU/hr	757	757	754	757	747	747	686	909	866	818	710
CTG Heat Input (HHV) each	MBTU/hr	840	840	837	840	829	829	762	1,009	961	908	788
Aux Power (each)		1,306	1,326	1,348	1,351	1,340	1,353	1,251	1,549	1,485	1,425	1,289
Auxiliary Power Percent of Gross Power	%	1.33%	1.35%	1.38%	1.38%	1.39%	1.40%	1.44%	1.32%	1.33%	1.34%	1.40%
Evaporative Cooler Water Consumption	gpm	0.0	0.0	0.0	0.0	10.1	17.7	27.0	0.0	0.0	0.0	0.0
CTG Augmentation Water Consumption	gpm	52.1	51.3	49.8	49.4	46.0	43.0	38.7	59.8	58.8	54.6	46.5
Total Water Consumption	gpm	52.1	51.3	49.8	49.4	56.1	60.7	65.7	59.8	58.8	54.6	46.5
NET PLANT PERFORMANCE												
Net Plant Output	kW	193,668	193,660	192,887	193,600	190,757	190,209	171,173	231,298	221,090	209,063	181,271
Net Plant Heat Rate (LHV)	Btu/kWh	7,821	7,821	7,823	7,823	7,837	7,858	8,021	7,863	7,831	7,829	7,835
Net Plant Heat Rate (HHV)	Btu/kWh	8,678	8,678	8,680	8,680	8,696	8,720	8,900	8,725	8,689	8,687	8,694
Net Plant Efficiency (LHV)	%	43.6%	43.6%	43.6%	43.6%	43.5%	43.4%	42.5%	43.4%	43.6%	43.6%	43.5%
Net Plant Efficiency (HHV)	%	39.3%	39.3%	39.3%	39.3%	39.2%	39.1%	38.3%	39.1%	39.3%	39.3%	39.2%
STACK EMISSIONS (PER UNIT)												
NOx	ppmvd @ 15% O2	-	-	-	2.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0099	-	-	-	-	-	-	-
	lb/hr	-	-	-	8.1	-	-	-	-	-	-	-
CO	ppmvd @ 15% O2	-	-	-	7.3	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0229	-	-	-	-	-	-	-
	lb/hr	-	-	-	18.8	-	-	-	-	-	-	-
VOC	ppmvd @ 15% O2	-	-	-	1.3	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0019	-	-	-	-	-	-	-
	lb/hr	-	-	-	1.6	-	-	-	-	-	-	-
PM2.5/10 - Front Half Only	lb/mmBtu (HHV)	-	-	-	0.0040	-	-	-	-	-	-	-
	lb/hr	-	-	-	3.3	-	-	-	-	-	-	-
PM2.5/10 - Front and Back Half	lb/mmBtu (HHV)	-	-	-	0.0080	-	-	-	-	-	-	-
	lb/hr	-	-	-	6.6	-	-	-	-	-	-	-
CO2	lb/hr	-	-	-	94,515	-	-	-	-	-	-	-
NH3 Slip	lb/hr	-	-	-	10.9	-	-	-	-	-	-	-

PacifiCorp Study
B&V Project Number 199232
GE 7FA.05, 1x0 gas turbine
Preliminary Performance Summary - Rev 0
August 3, 2018

Case #		1	2	3	4	5	6	7	8	9	10	11
Revision #		0	0	0	0	0	0	0	0	0	0	0
Description		Nephi Site 0 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 20 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 40 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 51 deg F 100% CTG Load Evap Cooler OFF	Nephi Site 60 deg F 100% CTG Load Evap Cooler ON	Nephi Site 80 deg F 100% CTG Load Evap Cooler ON	Nephi Site 100 deg F 100% CTG Load Evap Cooler ON	ISO 59 deg F 100% CTG Load Evap Cooler OFF	E Oregon / Washington Site 52.7 deg F 100% CTG Load	Southern / Central Oregon Site 52.7 deg F 100% CTG Load	Rock Springs Site 43.4 deg F 100% CTG Load Evap Cooler OFF
CTG Configuration	-	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0	1 x 0
Heat Rejection System	-	-	-	-	-	-	-	-	-	-	-	-
Ambient Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	59.0	52.7	52.7	43.4
Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.1	59.1	65.5	59.0	52.7	52.7	43.4
Ambient Pressure	psia	12.2	12.2	12.2	12.2	12.2	12.2	12.2	14.7	13.9	13.2	11.6
CTG Model	-	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05	7FA.05
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level	%	100	100	100	100	100	100	100	100	100	100	100
NEW & CLEAN PERFORMANCE												
Gross CTG Output (each)	kW	202,759	200,535	198,053	196,596	197,046	196,167	193,968	235,518	223,741	211,931	186,984
GT Fuel HHV/LHV Ratio		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Gross CTG Heat Rate (LHV)	BTU/kWh	8,628	8,662	8,709	8,741	8,740	8,781	8,825	8,751	8,733	8,738	8,723
Gross CTG Heat Rate (HHV)	Btu/kWh	9,574	9,611	9,664	9,699	9,698	9,744	9,792	9,710	9,690	9,696	9,679
CTG Heat Input (LHV) each	MBTU/hr	1,749	1,737	1,725	1,718	1,722	1,723	1,712	2,061	1,954	1,852	1,631
CTG Heat Input (HHV) each	MBTU/hr	1,941	1,927	1,914	1,907	1,911	1,911	1,899	2,287	2,168	2,055	1,810
Aux Power (each)		2,168	2,152	2,133	2,122	2,126	2,119	2,103	2,414	2,326	2,237	2,050
Auxiliary Power Percent of Gross Power	%	1.07%	1.07%	1.08%	1.08%	1.08%	1.08%	1.08%	1.03%	1.04%	1.06%	1.10%
Evaporative Cooler Water Consumption	gpm	0.0	0.0	0.0	0.0	23.7	41.3	67.8	0.0	0.0	0.0	0.0
CTG Augmentation Water Consumption	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Water Consumption	gpm	0.0	0.0	0.0	0.0	23.7	41.3	67.8	0.0	0.0	0.0	0.0
NET PLANT PERFORMANCE												
Net Plant Output	kW	200,591	198,383	195,920	194,474	194,920	194,048	191,865	233,104	221,415	209,694	184,934
Net Plant Heat Rate (LHV)	Btu/kWh	8,721	8,756	8,804	8,836	8,835	8,877	8,922	8,842	8,825	8,831	8,820
Net Plant Heat Rate (HHV)	Btu/kWh	9,677	9,716	9,769	9,805	9,804	9,850	9,900	9,811	9,792	9,799	9,786
Net Plant Efficiency (LHV)	%	39.1%	39.0%	38.8%	38.6%	38.6%	38.4%	38.2%	38.6%	38.7%	38.6%	38.7%
Net Plant Efficiency (HHV)	%	35.3%	35.1%	34.9%	34.8%	34.8%	34.6%	34.5%	34.8%	34.8%	34.8%	34.9%
STACK EMISSIONS (PER UNIT)												
NOx	ppmvd @ 15% O2	-	-	-	2.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0090	-	-	-	-	-	-	-
	lb/hr	-	-	-	17.3	-	-	-	-	-	-	-
CO	ppmvd @ 15% O2	-	-	-	2.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0054	-	-	-	-	-	-	-
	lb/hr	-	-	-	10.4	-	-	-	-	-	-	-
VOC	ppmvd @ 15% O2	-	-	-	0.8	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0010	-	-	-	-	-	-	-
	lb/hr	-	-	-	2.0	-	-	-	-	-	-	-
PM2.5/10 - Front Half Only	lb/mmBtu (HHV)	-	-	-	0.0017	-	-	-	-	-	-	-
	lb/hr	-	-	-	3.3	-	-	-	-	-	-	-
PM2.5/10 - Front and Back Half	lb/mmBtu (HHV)	-	-	-	0.0035	-	-	-	-	-	-	-
	lb/hr	-	-	-	6.6	-	-	-	-	-	-	-
CO2	lb/hr	-	-	-	219,264	-	-	-	-	-	-	-
NH3 Slip	lb/hr	-	-	-	25.4	-	-	-	-	-	-	-

PacifiCorp Study
B&V Project Number 199232
Wartsila 18V50SG,6x0 Reciprocating Internal Combustion Engine
Preliminary Performance Summary - Rev 0
August 3, 2018

Case #		1	2	3	4	5	6	7	8	9	10	11
Revision #		0	0	0	0	0	0	0	0	0	0	0
Description		Nephi Site 0 deg F 100% RICE Load	Nephi Site 20 deg F 100% RICE Load	Nephi Site 40 deg F 100% RICE Load	Nephi Site 51 deg F 100% RICE Load	Nephi Site 60 deg F 100% RICE Load	Nephi Site 80 deg F 100% RICE Load	Nephi Site 100 deg F 100% RICE Load	ISO Site 59 deg F 100% RICE Load	E Oregon / Washington Site 52.7 deg F 100% RICE Load	Southern / Central Oregon 52.7 deg F 100% RICE Load	Rock Springs 43.4 deg F 100% RICE Load
RICE Configuration	-	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0	6 x 0
Heat Rejection System	-	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators	Air-Cooled Radiators
Ambient Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	59.0	52.7	52.7	43.4
Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	60.0	60.0	60.0	60.0
Ambient Pressure	psia	12.2	12.2	12.2	12.2	12.2	12.2	12.2	14.7	13.9	13.2	11.6
RICE Model	-	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG	18V50SG
RICE Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
RICE Load Level	%	100	100	100	100	100	100	100	100	100	100	100
NEW & CLEAN PERFORMANCE												
Gross RICE Output (each)	kW	18,817	18,817	18,817	18,817	18,817	18,817	17,766	18,817	18,817	18,817	18,817
RICE Fuel HHV/LHV Ratio	-	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Gross RICE Heat Rate (LHV) (Each)	Btu/kWh	7,307	7,307	7,307	7,307	7,307	7,307	7,395	7,300	7,300	7,301	7,342
Gross RICE Heat Rate (HHV) (Each)	Btu/kWh	8,107	8,107	8,107	8,107	8,107	8,107	8,205	8,100	8,100	8,101	8,147
RICE Heat Input (LHV) each	MBTU/hr	138	138	138	138	138	138	131	137	137	137	138
RICE Heat Input (HHV) each	MBTU/hr	153	153	153	153	153	153	146	152	152	152	153
Aux Power (each)	kW	391	391	391	391	391	391	386	391	391	391	391
Auxiliary Power / Losses Percent of Gross Power	%	2.08%	2.08%	2.08%	2.08%	2.08%	2.08%	2.17%	2.08%	2.08%	2.08%	2.08%
Evaporative Cooler Water Consumption	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CTG Augmentation Water Consumption	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Water Consumption	gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NET PLANT PERFORMANCE												
Net Plant Output	kW	110,553	110,553	110,553	110,553	110,553	110,553	104,281	110,553	110,553	110,553	110,553
Net Plant Heat Rate (LHV)	Btu/kWh	7,462	7,462	7,462	7,462	7,462	7,462	7,559	7,455	7,455	7,456	7,498
Net Plant Heat Rate (HHV)	Btu/kWh	8,280	8,280	8,280	8,280	8,280	8,280	8,388	8,272	8,272	8,273	8,320
Net Plant Efficiency (LHV)	%	45.7%	45.7%	45.7%	45.7%	45.7%	45.7%	45.1%	45.8%	45.8%	45.8%	45.5%
Net Plant Efficiency (HHV)	%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	40.7%	41.2%	41.2%	41.2%	41.0%
STACK EMISSIONS (PER UNIT)												
NOx	ppmvd @ 15% O2	-	-	-	4.5	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0161	-	-	-	-	-	-	-
	lb/hr	-	-	-	2.5	-	-	-	-	-	-	-
CO	ppmvd @ 15% O2	-	-	-	15.0	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0326	-	-	-	-	-	-	-
	lb/hr	-	-	-	5.0	-	-	-	-	-	-	-
VOC	ppmvd @ 15% O2	-	-	-	26.0	-	-	-	-	-	-	-
	lb/mmBtu (HHV)	-	-	-	0.0324	-	-	-	-	-	-	-
	lb/hr	-	-	-	5.0	-	-	-	-	-	-	-
PM2.5/10 - Front Half Only	lb/mmBtu (HHV)	-	-	-	-	-	-	-	-	-	-	-
	lb/hr	-	-	-	-	-	-	-	-	-	-	-
PM2.5/10 - Front and Back Half	lb/mmBtu (HHV)	-	-	-	3.2	-	-	-	-	-	-	-
	lb/hr	-	-	-	0.0	-	-	-	-	-	-	-
CO2	lb/hr	-	-	-	17849.0	-	-	-	-	-	-	-
NH3 Slip	lb/hr	-	-	-	2.03	-	-	-	-	-	-	-

PacifiCorp Study
B&V Project Number 199232
7HA.01, 1x1, Air Cooled Condenser
Preliminary Performance Summary
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Case #	Units	1	2	3	4	5	6	7	8	9	10	11
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi
Description	-	0 deg F 100% CTG Load Unfired	20 deg F 100% CTG Load Unfired	40 deg F 100% CTG Load Unfired	51 deg F 100% CTG Load Unfired	60 deg F 100% CTG Load Unfired	80 deg F 100% CTG Load Unfired	100 deg F 100% CTG Load Unfired	0 deg F 100% CTG Load Duct Fired	20 deg F 100% CTG Load Duct Fired	40 deg F 100% CTG Load Duct Fired	51 deg F 100% CTG Load Duct Fired
CTG Configuration	-	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	0.0	20.0	40.0	51.0
Ambient Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	100.0	82.0	64.0	46.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.0	59.0	65.3	0.0	20.0	40.0	51.0
Barometric Pressure	psia	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20
CTG Model	-	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	100,363	103,070	105,712	105,014	105,696	103,670	101,477	152,447	155,134	157,751	157,034
Gross CTG Output (each)	kW	254,701	254,004	251,542	246,707	248,822	242,478	238,494	254,701	254,004	251,542	246,707
Gross CTG Heat Rate (LHV)	BTU/kWh	8,118	8,122	8,162	8,176	8,180	8,195	8,223	8,118	8,122	8,162	8,176
Gross CTG Heat Rate (HHV)	BTU/kWh	9,008	9,012	9,057	9,072	9,077	9,093	9,124	9,008	9,012	9,057	9,072
CTG Heat Input (LHV) each	MBtu/hr	2,068	2,063	2,053	2,017	2,035	1,987	1,961	2,068	2,063	2,053	2,017
CTG Heat Input (HHV) each	MBtu/hr	2,294	2,289	2,278	2,238	2,258	2,205	2,176	2,294	2,289	2,278	2,238
Total Plant Auxiliary Power	kW	7,638	7,736	7,862	7,899	8,010	8,603	9,958	8,721	8,799	8,901	8,919
Auxiliary Power & Losses as Percent of Gross	%	2.15%	2.17%	2.20%	2.25%	2.26%	2.49%	2.93%	2.14%	2.15%	2.17%	2.21%
NET PLANT PERFORMANCE												
Net Plant Output	kW	347,426	349,338	349,391	343,822	346,508	337,545	330,014	398,427	400,338	400,392	394,823
Net Plant Heat Rate (LHV)	BTU/kWh	5,951	5,906	5,876	5,867	5,874	5,887	5,943	6,171	6,117	6,094	6,090
Net Plant Heat Rate (HHV)	BTU/kWh	6,604	6,553	6,520	6,510	6,518	6,532	6,594	6,847	6,788	6,762	6,757
Net Plant Efficiency (LHV)	%	57.33%	57.78%	58.07%	58.16%	58.09%	57.96%	57.42%	55.30%	55.78%	55.99%	56.03%
Net Plant Efficiency (HHV)	%	51.67%	52.07%	52.33%	52.42%	52.35%	52.24%	51.75%	49.83%	50.27%	50.46%	50.50%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	16.6	16.6	16.5	16.2	16.3	15.9	15.8	19.7	19.6	19.6	19.2
CO	ppmvd@15% O2	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.1	1.1	1.1	1.1
	lb/MBtu (HHV)	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0025	0.0025	0.0025	0.0025
	lb/hr	3.3	3.3	3.3	3.2	3.2	3.2	3.1	6.8	6.7	6.7	6.7
VOC	ppmvd@15% O2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	2.8	2.8	2.8	2.8
	lb/MBtu (HHV)	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0035	0.0035	0.0035	0.0035
	lb/hr	2.3	2.3	2.2	2.2	2.2	2.2	2.2	9.6	9.4	9.5	9.5
PM 2.5/10 - Front Half Only	lb/hr	3.7	4.2	4.7	5.2	5.7	6.2	6.7	8.0	8.5	9.0	9.5
PM 2.5/10 - Front Half and Back Half	lb/hr	7.4	8.4	9.4	10.4	11.4	12.4	13.4	17.8	18.7	19.7	20.7
CO2	lb/hr	263,628	263,052	261,762	257,180	259,512	253,367	250,047	313,470	312,250	311,085	306,550
NH3 Slip	lb/hr	30.5	30.4	30.3	29.7	30.0	29.3	28.9	36.3	36.1	36.0	35.5

PacifiCorp Study
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7HA.01, 1x1, Air Cooled Condenser
Preliminary Performance Summary
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Case #	Units	12	13	14	15	16	17	18	19	20	21	22
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	ISO	ISO	East Oregon	East Oregon	Southern / Central Oregon	Southern / Central Oregon	Rock Springs	Rock Springs
Description	-	60 deg F 100% CTG Load Duct Fired	80 deg F 100% CTG Load Duct Fired	100 deg F 100% CTG Load Duct Fired	59 deg F 100% CTG Load Unfired	59 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	43 deg F 100% CTG Load Unfired	43 deg F 100% CTG Load Duct Fired
CTG Configuration	-	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	60.0	80.0	100.0	59.0	59.0	52.7	52.7	52.7	52.7	43.4	43.4
Ambient Relative Humidity	%	39.0	25.0	11.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	48.0	59.0	65.3	52.1	52.1	52.7	52.7	52.7	52.7	43.4	43.4
Barometric Pressure	psia	12.20	12.20	12.20	14.70	14.70	13.92	13.92	13.17	13.17	11.55	11.55
CTG Model	-	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	157,673	155,738	153,465	131,269	183,265	124,929	177,009	118,365	170,439	104,158	156,511
Gross CTG Output (each)	kW	248,822	242,478	238,494	298,022	298,022	281,221	281,221	265,875	265,875	237,555	237,555
Gross CTG Heat Rate (LHV)	BTU/kWh	8,180	8,195	8,223	8,164	8,164	8,165	8,165	8,171	8,171	8,178	8,178
Gross CTG Heat Rate (HHV)	BTU/kWh	9,077	9,093	9,124	9,059	9,059	9,060	9,060	9,067	9,067	9,074	9,074
CTG Heat Input (LHV) each	MBtu/hr	2,035	1,987	1,961	2,433	2,433	2,296	2,296	2,172	2,172	1,943	1,943
CTG Heat Input (HHV) each	MBtu/hr	2,258	2,205	2,176	2,700	2,700	2,548	2,548	2,411	2,411	2,156	2,156
Total Plant Auxiliary Power	kW	8,987	9,671	10,946	10,697	11,693	10,051	11,131	9,586	10,660	8,243	9,595
Auxiliary Power & Losses as Percent of Gross	%	2.21%	2.43%	2.79%	2.49%	2.43%	2.47%	2.43%	2.49%	2.44%	2.41%	2.43%
NET PLANT PERFORMANCE												
Net Plant Output	kW	397,508	388,545	381,014	418,594	469,594	396,099	447,099	374,654	425,654	333,470	384,470
Net Plant Heat Rate (LHV)	BTU/kWh	6,094	6,113	6,158	5,812	5,993	5,797	5,996	5,799	6,007	5,826	6,020
Net Plant Heat Rate (HHV)	BTU/kWh	6,762	6,783	6,833	6,450	6,649	6,432	6,654	6,434	6,665	6,464	6,680
Net Plant Efficiency (LHV)	%	55.99%	55.82%	55.41%	58.70%	56.94%	58.86%	56.90%	58.84%	56.81%	58.57%	56.68%
Net Plant Efficiency (HHV)	%	50.46%	50.30%	49.94%	52.91%	51.32%	53.05%	51.28%	53.03%	51.20%	52.78%	51.08%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	19.4	19	18.8	19.5	22.6	18.4	21.5	17.4	20.5	15.6	18.6
CO	ppmvd@15% O2	1.1	1.1	1.2	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1
	lb/MBtu (HHV)	0.0025	0.0025	0.0025	0.0014	0.0023	0.0015	0.0024	0.0015	0.0024	0.0014	0.0025
	lb/hr	6.7	6.6	6.6	3.9	7.3	3.7	7.1	3.5	6.9	3.1	6.4
VOC	ppmvd@15% O2	2.8	2.9	2.9	0.8	2.5	0.8	2.6	0.8	2.7	0.8	2.8
	lb/MBtu (HHV)	0.0035	0.0036	0.0036	0.0010	0.0031	0.0010	0.0033	0.0010	0.0034	0.0010	0.0035
	lb/hr	9.5	9.5	9.3	2.7	9.8	2.5	9.7	2.4	9.5	2.1	9.1
PM 2.5/10 - Front Half Only	lb/hr	10.0	10.5	11.0	7.2	11.4	7.7	12.0	8.2	12.5	8.7	12.8
PM 2.5/10 - Front Half and Back Half	lb/hr	21.7	22.7	23.7	14.4	24.5	15.4	25.6	16.4	26.6	17.4	27.3
CO2	lb/hr	308,861	302,846	299,158	310,213	358,792	292,764	341,828	276,989	325,983	247,715	295,118
NH3 Slip	lb/hr	35.7	35.0	34.6	35.9	41.5	33.9	39.5	32.0	37.7	28.6	34.1

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Case #	Units	1	2	3	4	5	6	7	8	9	10	11
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi
Description	-	0 deg F 100% CTG Load Unfired	20 deg F 100% CTG Load Unfired	40 deg F 100% CTG Load Unfired	51 deg F 100% CTG Load Unfired	60 deg F 100% CTG Load Unfired	80 deg F 100% CTG Load Unfired	100 deg F 100% CTG Load Unfired	0 deg F 100% CTG Load Duct Fired	20 deg F 100% CTG Load Duct Fired	40 deg F 100% CTG Load Duct Fired	51 deg F 100% CTG Load Duct Fired
CTG Configuration	-	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	0.0	20.0	40.0	51.0
Ambient Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	100.0	82.0	64.0	46.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.0	59.0	65.3	0.0	20.0	40.0	51.0
Barometric Pressure	psia	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20
CTG Model	-	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	199,592	204,821	210,090	208,712	210,096	206,804	203,451	303,647	308,837	314,111	312,693
Gross CTG Output (each)	kW	254,701	254,004	251,542	246,707	248,822	242,478	238,494	254,701	254,004	251,542	246,707
Gross CTG Heat Rate (LHV)	BTU/kWh	8,118	8,122	8,162	8,176	8,180	8,195	8,223	8,118	8,122	8,162	8,176
Gross CTG Heat Rate (HHV)	BTU/kWh	9,008	9,012	9,057	9,072	9,077	9,093	9,124	9,008	9,012	9,057	9,072
CTG Heat Input (LHV) each	MBtu/hr	2,068	2,063	2,053	2,017	2,035	1,987	1,961	2,068	2,063	2,053	2,017
CTG Heat Input (HHV) each	MBtu/hr	2,294	2,289	2,278	2,238	2,258	2,205	2,176	2,294	2,289	2,278	2,238
Total Plant Auxiliary Power	kW	15,151	15,328	15,521	15,556	15,740	16,624	19,827	17,205	17,344	17,542	17,537
Auxiliary Power & Losses as Percent of Gross	%	2.14%	2.15%	2.18%	2.22%	2.22%	2.40%	2.91%	2.12%	2.12%	2.15%	2.18%
NET PLANT PERFORMANCE												
Net Plant Output	kW	693,844	697,501	697,653	686,570	692,001	675,136	660,612	795,844	799,501	799,653	788,570
Net Plant Heat Rate (LHV)	BTU/kWh	5,960	5,915	5,886	5,876	5,883	5,887	5,937	6,184	6,128	6,106	6,103
Net Plant Heat Rate (HHV)	BTU/kWh	6,613	6,564	6,531	6,520	6,527	6,532	6,588	6,861	6,800	6,775	6,772
Net Plant Efficiency (LHV)	%	57.25%	57.68%	57.97%	58.07%	58.00%	57.97%	57.47%	55.18%	55.68%	55.88%	55.91%
Net Plant Efficiency (HHV)	%	51.59%	51.98%	52.25%	52.33%	52.27%	52.24%	51.79%	49.73%	50.18%	50.36%	50.39%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	16.6	16.6	16.5	16.2	16.3	15.9	15.8	22.8	22.7	22.7	22.4
CO	ppmvd@15% O2	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.5	1.5	1.5	1.5
	lb/MBtu (HHV)	0.0015	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0033	0.0032	0.0032	0.0033
	lb/hr	3.3	3.3	3.3	3.2	3.2	3.2	3.1	10.3	10.2	10.2	10.1
VOC	ppmvd@15% O2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	4.3	4.2	4.3	4.3
	lb/MBtu (HHV)	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0053	0.0053	0.0053	0.0054
	lb/hr	2.3	2.3	2.2	2.2	2.2	2.2	2.2	16.9	16.7	16.7	16.7
PM 2.5/10 - Front Half Only	lb/hr	3.7	4.2	4.7	5.2	5.7	6.2	6.7	12.4	12.8	13.3	13.8
PM 2.5/10 - Front Half and Back Half	lb/hr	7.4	8.4	9.4	10.4	11.4	12.4	13.4	28.3	29.0	30.1	31.1
CO2	lb/hr	263,628	263,052	261,762	257,180	259,512	253,367	250,047	363,827	361,692	360,740	356,404
NH3 Slip	lb/hr	30.5	30.4	30.3	29.7	30.0	29.3	28.9	42.1	41.8	41.7	41.2

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Case #	Units	12	13	14	15	16	17	18	19	20	21	22
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	ISO	ISO	E Oregon	E Oregon	Southern / Central Oregon	Southern / Central Oregon	Rock Springs	Rock Springs
Description	-	60 deg F 100% CTG Load Duct Fired	80 deg F 100% CTG Load Duct Fired	100 deg F 100% CTG Load Duct Fired	59 deg F 100% CTG Load Unfired	59 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	43 deg F 100% CTG Load Unfired	43 deg F 100% CTG Load Duct Fired
CTG Configuration	-	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	60.0	80.0	100.0	59.0	59.0	52.7	52.7	52.7	52.7	43.4	43.4
Ambient Relative Humidity	%	39.0	25.0	11.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	48.0	59.0	65.3	52.1	52.1	52.7	52.7	52.7	52.7	43.4	43.4
Barometric Pressure	psia	12.20	12.20	12.20	14.70	14.70	13.92	13.92	13.17	13.17	11.55	11.55
CTG Model	-	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01	7HA.01
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	314,078	311,185	307,415	265,111	369,097	252,293	356,420	239,055	343,169	210,639	315,295
Gross CTG Output (each)	kW	248,822	242,478	238,494	298,022	298,022	281,221	281,221	265,875	265,875	237,555	237,555
Gross CTG Heat Rate (LHV)	BTU/kWh	8,180	8,195	8,223	8,164	8,164	8,165	8,165	8,171	8,171	8,178	8,178
Gross CTG Heat Rate (HHV)	BTU/kWh	9,077	9,093	9,124	9,059	9,059	9,060	9,060	9,067	9,067	9,074	9,074
CTG Heat Input (LHV) each	MBtu/hr	2,035	1,987	1,961	2,433	2,433	2,296	2,296	2,172	2,172	1,943	1,943
CTG Heat Input (HHV) each	MBtu/hr	2,258	2,205	2,176	2,700	2,700	2,548	2,548	2,411	2,411	2,156	2,156
Total Plant Auxiliary Power	kW	17,722	19,005	21,791	21,217	23,203	19,955	22,082	19,063	21,177	16,430	19,086
Auxiliary Power & Losses as Percent of Gross	%	2.18%	2.39%	2.78%	2.46%	2.40%	2.45%	2.40%	2.47%	2.42%	2.40%	2.41%
NET PLANT PERFORMANCE												
Net Plant Output	kW	794,001	777,136	762,612	839,938	941,938	794,780	896,780	751,742	853,742	669,319	771,319
Net Plant Heat Rate (LHV)	BTU/kWh	6,105	6,116	6,155	5,793	5,966	5,778	5,967	5,780	5,976	5,805	5,988
Net Plant Heat Rate (HHV)	BTU/kWh	6,775	6,786	6,830	6,428	6,620	6,411	6,621	6,413	6,632	6,441	6,645
Net Plant Efficiency (LHV)	%	55.89%	55.79%	55.43%	58.90%	57.19%	59.05%	57.19%	59.04%	57.09%	58.78%	56.98%
Net Plant Efficiency (HHV)	%	50.37%	50.28%	49.96%	53.08%	51.54%	53.22%	51.54%	53.20%	51.45%	52.97%	51.35%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	22.5	22.1	21.9	19.5	25.5	18.4	24.4	17.4	23.5	15.6	21.4
CO	ppmvd@15% O2	1.5	1.5	1.5	0.7	1.4	0.7	1.4	0.7	1.4	0.7	1.5
	lb/MBtu (HHV)	0.0032	0.0033	0.0033	0.0014	0.0030	0.0015	0.0031	0.0015	0.0031	0.0014	0.0032
	lb/hr	10.1	10.1	10	3.9	10.6	3.7	10.4	3.5	10.2	3.1	9.6
VOC	ppmvd@15% O2	4.3	4.3	4.4	0.8	3.8	0.8	3.9	0.8	4.1	0.8	4.2
	lb/MBtu (HHV)	0.0054	0.0055	0.0055	0.0010	0.0047	0.0010	0.0049	0.0010	0.0051	0.0010	0.0053
	lb/hr	16.7	16.8	16.5	2.7	16.7	2.5	16.7	2.4	16.5	2.1	15.8
PM 2.5/10 - Front Half Only	lb/hr	14.3	14.8	15.3	7.2	15.6	7.7	16.1	8.2	16.6	8.7	16.8
PM 2.5/10 - Front Half and Back Half	lb/hr	32.1	33.1	34.0	14.4	34.5	15.4	35.6	16.4	36.6	17.4	36.9
CO2	lb/hr	358,575	352,642	348,451	310,213	406,263	292,764	389,452	276,989	373,563	247,715	341,241
NH3 Slip	lb/hr	41.5	40.8	40.3	35.9	47.0	33.9	45.0	32.0	43.2	28.6	39.5

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Case #	Units	1	2	3	4	5	6	7	8	9	10	11
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi
Description	-	0 deg F 100% CTG Load Unfired	20 deg F 100% CTG Load Unfired	40 deg F 100% CTG Load Unfired	51 deg F 100% CTG Load Unfired	60 deg F 100% CTG Load Unfired	80 deg F 100% CTG Load Unfired	100 deg F 100% CTG Load Unfired	0 deg F 100% CTG Load Duct Fired	20 deg F 100% CTG Load Duct Fired	40 deg F 100% CTG Load Duct Fired	51 deg F 100% CTG Load Duct Fired
CTG Configuration	-	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	0.0	20.0	40.0	51.0
Ambient Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	100.0	82.0	64.0	46.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.0	59.0	65.3	0.0	20.0	40.0	51.0
Barometric Pressure	psia	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20
CTG Model	-	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	127,451	131,113	133,932	133,757	134,041	133,476	131,800	191,779	195,380	198,162	198,013
Gross CTG Output (each)	kW	326,959	325,845	323,064	318,536	319,994	315,775	312,643	326,959	325,845	323,064	318,536
Gross CTG Heat Rate (LHV)	BTU/kWh	8,010	8,024	8,076	8,086	8,089	8,104	8,135	8,010	8,024	8,076	8,086
Gross CTG Heat Rate (HHV)	BTU/kWh	8,888	8,904	8,961	8,972	8,976	8,992	9,027	8,888	8,904	8,961	8,972
CTG Heat Input (LHV) each	MBtu/hr	2,619	2,615	2,609	2,576	2,588	2,559	2,543	2,619	2,615	2,609	2,576
CTG Heat Input (HHV) each	MBtu/hr	2,906	2,901	2,895	2,858	2,872	2,840	2,822	2,906	2,901	2,895	2,858
Total Plant Auxiliary Power	kW	9,770	9,909	10,060	10,122	10,227	11,039	12,819	11,099	11,176	11,290	11,378
Auxiliary Power & Losses as Percent of Gross	%	2.15%	2.17%	2.20%	2.24%	2.25%	2.46%	2.88%	2.14%	2.14%	2.17%	2.20%
NET PLANT PERFORMANCE												
Net Plant Output	kW	444,639	447,049	446,937	442,171	443,809	438,213	431,625	507,639	510,049	509,937	505,171
Net Plant Heat Rate (LHV)	BTU/kWh	5,890	5,849	5,838	5,825	5,832	5,840	5,893	6,116	6,067	6,029	6,021
Net Plant Heat Rate (HHV)	BTU/kWh	6,536	6,490	6,478	6,464	6,472	6,480	6,538	6,787	6,732	6,690	6,681
Net Plant Efficiency (LHV)	%	57.93%	58.34%	58.45%	58.58%	58.50%	58.43%	57.91%	55.79%	56.24%	56.59%	56.67%
Net Plant Efficiency (HHV)	%	52.21%	52.58%	52.68%	52.79%	52.72%	52.66%	52.19%	50.28%	50.69%	51.00%	51.08%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	21	21	21	20.6	20.8	20.6	20.4	24.9	24.8	24.7	24.4
CO	ppmvd@15% O2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.1	1.1	1.1	1.1
	lb/MBtu (HHV)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0024	0.0024	0.0024	0.0024
	lb/hr	4.1	4	4	3.9	3.9	3.9	3.9	8.4	8.3	8.1	8.1
VOC	ppmvd@15% O2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	2.7	2.7	2.7	2.7
	lb/MBtu (HHV)	0.0010	0.0010	0.0010	0.0009	0.0009	0.0009	0.0009	0.0034	0.0034	0.0034	0.0034
	lb/hr	2.8	2.8	2.8	2.7	2.7	2.7	2.7	11.9	11.7	11.5	11.4
PM 2.5/10 - Front Half Only	lb/hr	5.9	5.9	5.9	5.9	5.9	5.9	5.9	11.3	11.2	11.1	11.1
PM 2.5/10 - Front Half and Back Half	lb/hr	11.8	11.8	11.8	11.8	11.8	11.8	11.8	24.7	24.6	24.2	24.2
CO2	lb/hr	333,917	333,369	332,655	328,403	330,022	326,290	324,288	395,863	394,549	392,019	387,787
NH3 Slip	lb/hr	38.6	38.6	38.5	38.0	38.2	37.7	37.5	45.8	45.6	45.3	44.8

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Case #	Units	12	13	14	15	16	17	18	19	20	21	22
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	ISO	ISO	E Oregon	E Oregon	Southern / Central Oregon	Southern / Central Oregon	Rock Springs	Rock Springs
Description	-	60 deg F 100% CTG Load Duct Fired	80 deg F 100% CTG Load Duct Fired	100 deg F 100% CTG Load Duct Fired	59 deg F 100% CTG Load Unfired	59 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	43 deg F 100% CTG Load Unfired	43 deg F 100% CTG Load Duct Fired
CTG Configuration	-	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1	1x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	60.0	80.0	100.0	59.0	59.0	52.7	52.7	52.7	52.7	43.4	43.4
Ambient Relative Humidity	%	39.0	25.0	11.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	48.0	59.0	65.3	52.1	52.1	52.7	52.7	52.7	52.7	43.4	43.4
Barometric Pressure	psia	12.20	12.20	12.20	14.70	14.70	13.92	13.92	13.17	13.17	11.55	11.55
CTG Model	-	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	198,255	198,045	196,006	168,085	232,291	159,011	223,228	150,101	214,320	130,376	194,947
Gross CTG Output (each)	kW	319,994	315,775	312,643	384,941	384,941	363,645	363,645	343,803	343,803	304,129	304,129
Gross CTG Heat Rate (LHV)	BTU/kWh	8,089	8,104	8,135	8,075	8,075	8,076	8,076	8,081	8,081	8,086	8,086
Gross CTG Heat Rate (HHV)	BTU/kWh	8,976	8,992	9,027	8,960	8,960	8,961	8,961	8,967	8,967	8,972	8,972
CTG Heat Input (LHV) each	MBtu/hr	2,588	2,559	2,543	3,108	3,108	2,937	2,937	2,778	2,778	2,459	2,459
CTG Heat Input (HHV) each	MBtu/hr	2,872	2,840	2,822	3,449	3,449	3,259	3,259	3,083	3,083	2,729	2,729
Total Plant Auxiliary Power	kW	11,440	12,608	14,025	13,762	14,968	12,802	14,019	12,249	13,468	10,476	12,047
Auxiliary Power & Losses as Percent of Gross	%	2.21%	2.45%	2.76%	2.49%	2.43%	2.45%	2.39%	2.48%	2.41%	2.41%	2.41%
NET PLANT PERFORMANCE												
Net Plant Output	kW	506,809	501,213	494,625	539,264	602,264	509,854	572,854	481,655	544,655	424,030	487,030
Net Plant Heat Rate (LHV)	BTU/kWh	6,025	6,034	6,076	5,764	5,930	5,760	5,933	5,768	5,945	5,800	5,960
Net Plant Heat Rate (HHV)	BTU/kWh	6,686	6,696	6,742	6,396	6,580	6,391	6,583	6,400	6,596	6,435	6,613
Net Plant Efficiency (LHV)	%	56.63%	56.54%	56.16%	59.20%	57.54%	59.24%	57.51%	59.15%	57.40%	58.83%	57.25%
Net Plant Efficiency (HHV)	%	51.04%	50.96%	50.61%	53.35%	51.85%	53.39%	51.83%	53.31%	51.73%	53.02%	51.60%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	24.5	24.3	24.1	25	28.7	23.5	27.2	22.3	26	19.8	23.3
CO	ppmvd@15% O2	1.1	1.1	1.1	0.6	1.0	0.6	1.0	0.6	1.1	0.6	1.1
	lb/MBtu (HHV)	0.0024	0.0024	0.0024	0.0014	0.0022	0.0014	0.0023	0.0014	0.0023	0.0014	0.0024
	lb/hr	8.1	8	8	4.7	8.8	4.5	8.6	4.2	8.3	3.8	7.7
VOC	ppmvd@15% O2	2.7	2.7	2.7	0.8	2.4	0.8	2.5	0.8	2.6	0.8	2.7
	lb/MBtu (HHV)	0.0034	0.0034	0.0034	0.0009	0.0030	0.0009	0.0031	0.0010	0.0032	0.0009	0.0034
	lb/hr	11.4	11.3	11.3	3.3	11.9	3.1	11.7	2.9	11.5	2.6	10.9
PM 2.5/10 - Front Half Only	lb/hr	11.1	11.1	11.0	5.9	11.0	5.9	11.0	5.9	11.0	5.9	10.8
PM 2.5/10 - Front Half and Back Half	lb/hr	24.2	24.2	24.1	11.8	24.1	11.8	24.1	11.8	24.0	11.8	23.6
CO2	lb/hr	389,346	385,639	383,182	396,333	455,390	374,440	433,326	354,247	412,850	313,560	370,107
NH3 Slip	lb/hr	45.0	44.6	44.3	45.8	52.7	43.3	50.1	41.0	47.7	36.3	42.8

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Case #	Units	1	2	3	4	5	6	7	8	9	10	11
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi	Nephi
Description	-	0 deg F 100% CTG Load Unfired	20 deg F 100% CTG Load Unfired	40 deg F 100% CTG Load Unfired	51 deg F 100% CTG Load Unfired	60 deg F 100% CTG Load Unfired	80 deg F 100% CTG Load Unfired	100 deg F 100% CTG Load Unfired	0 deg F 100% CTG Load Duct Fired	20 deg F 100% CTG Load Duct Fired	40 deg F 100% CTG Load Duct Fired	51 deg F 100% CTG Load Duct Fired
CTG Configuration	-	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	0.0	20.0	40.0	51.0	60.0	80.0	100.0	0.0	20.0	40.0	51.0
Ambient Relative Humidity	%	100.0	82.0	64.0	46.0	39.0	25.0	11.0	100.0	82.0	64.0	46.0
CTG Compressor Inlet Air Temperature	F	0.0	20.0	40.0	51.0	48.0	59.0	65.3	0.0	20.0	40.0	51.0
Barometric Pressure	psia	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20	12.20
CTG Model	-	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	254,273	261,369	266,951	266,579	267,199	266,652	264,593	382,865	389,914	395,426	395,036
Gross CTG Output (each)	kW	326,959	325,845	323,064	318,536	319,994	315,775	312,643	326,959	325,845	323,064	318,536
Gross CTG Heat Rate (LHV)	BTU/kWh	8,010	8,024	8,076	8,086	8,089	8,104	8,135	8,010	8,024	8,076	8,086
Gross CTG Heat Rate (HHV)	BTU/kWh	8,888	8,904	8,961	8,972	8,976	8,992	9,027	8,888	8,904	8,961	8,972
CTG Heat Input (LHV) each	MBtu/hr	2,619	2,615	2,609	2,576	2,588	2,559	2,543	2,619	2,615	2,609	2,576
CTG Heat Input (HHV) each	MBtu/hr	2,906	2,901	2,895	2,858	2,872	2,840	2,822	2,906	2,901	2,895	2,858
Total Plant Auxiliary Power	kW	19,416	19,633	19,900	19,987	20,180	21,364	25,550	22,007	22,178	22,375	22,444
Auxiliary Power & Losses as Percent of Gross	%	2.14%	2.15%	2.18%	2.21%	2.22%	2.38%	2.87%	2.12%	2.13%	2.15%	2.17%
NET PLANT PERFORMANCE												
Net Plant Output	kW	888,776	893,426	893,179	883,664	887,008	876,838	864,329	1,014,776	1,019,426	1,019,179	1,009,664
Net Plant Heat Rate (LHV)	BTU/kWh	5,893	5,853	5,842	5,830	5,836	5,837	5,885	6,117	6,067	6,031	6,021
Net Plant Heat Rate (HHV)	BTU/kWh	6,539	6,494	6,483	6,469	6,476	6,477	6,530	6,787	6,732	6,692	6,681
Net Plant Efficiency (LHV)	%	57.90%	58.30%	58.41%	58.53%	58.46%	58.46%	57.98%	55.78%	56.24%	56.58%	56.67%
Net Plant Efficiency (HHV)	%	52.18%	52.54%	52.64%	52.75%	52.69%	52.68%	52.25%	50.27%	50.69%	50.99%	51.07%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	21	21	21	20.6	20.8	20.6	20.4	28.8	28.6	28.4	28
CO	ppmvd@15% O2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.5	1.4	1.4	1.4
	lb/MBtu (HHV)	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0014	0.0032	0.0032	0.0031	0.0031
	lb/hr	4.1	4	4	3.9	3.9	3.9	3.9	12.7	12.5	12.2	12.2
VOC	ppmvd@15% O2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	4.2	4.2	4.1	4.1
	lb/MBtu (HHV)	0.0010	0.0010	0.0010	0.0009	0.0009	0.0009	0.0009	0.0052	0.0052	0.0051	0.0051
	lb/hr	2.8	2.8	2.8	2.7	2.7	2.7	2.7	20.9	20.6	20.1	20
PM 2.5/10 - Front Half Only	lb/hr	5.9	5.9	5.9	5.9	5.9	5.9	5.9	16.7	16.5	16.2	16.2
PM 2.5/10 - Front Half and Back Half	lb/hr	11.8	11.8	11.8	11.8	11.8	11.8	11.8	37.6	37.3	36.5	36.5
CO2	lb/hr	333,917	333,369	332,655	328,403	330,022	326,290	324,288	457,526	455,224	450,998	446,740
NH3 Slip	lb/hr	38.6	38.6	38.5	38.0	38.2	37.7	37.5	52.9	52.6	52.2	51.7

PacifiCorp Study
B&V Project Number 199232
7HA.02, 2x1, Air Cooled Condenser
Preliminary Performance Summary
August 3, 2018 - Rev 0

Case #	Units	12	13	14	15	16	17	18	19	20	21	22
Revision #	-	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0	Rev 0
Site	-	Nephi	Nephi	Nephi	ISO	ISO	E Oregon	E Oregon	Southern / Central Oregon	Southern / Central Oregon	Rock Springs	Rock Springs
Description	-	60 deg F 100% CTG Load Duct Fired	80 deg F 100% CTG Load Duct Fired	100 deg F 100% CTG Load Duct Fired	59 deg F 100% CTG Load Unfired	59 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	53 deg F 100% CTG Load Unfired	53 deg F 100% CTG Load Duct Fired	43 deg F 100% CTG Load Unfired	43 deg F 100% CTG Load Duct Fired
CTG Configuration	-	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1	2x1
Heat Rejection System		Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser	Air Cooled Condenser
Ambient Drybulb Temperature	F	60.0	80.0	100.0	59.0	59.0	52.7	52.7	52.7	52.7	43.4	43.4
Ambient Relative Humidity	%	39.0	25.0	11.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
CTG Compressor Inlet Air Temperature	F	48.0	59.0	65.3	52.1	52.1	52.7	52.7	52.7	52.7	43.4	43.4
Barometric Pressure	psia	12.20	12.20	12.20	14.70	14.70	13.92	13.92	13.17	13.17	11.55	11.55
CTG Model	-	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02	7HA.02
CTG Fuel	-	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
CTG Load Level		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
NEW & CLEAN PERFORMANCE												
Gross STG Output	kW	395,658	395,457	392,997	340,290	468,707	321,399	449,834	303,505	432,024	263,822	392,968
Gross CTG Output (each)	kW	319,994	315,775	312,643	384,941	384,941	363,645	363,645	343,803	343,803	304,129	304,129
Gross CTG Heat Rate (LHV)	BTU/kWh	8,089	8,104	8,135	8,075	8,075	8,076	8,076	8,081	8,081	8,086	8,086
Gross CTG Heat Rate (HHV)	BTU/kWh	8,976	8,992	9,027	8,960	8,960	8,961	8,961	8,967	8,967	8,972	8,972
CTG Heat Input (LHV) each	MBtu/hr	2,588	2,559	2,543	3,108	3,108	2,937	2,937	2,778	2,778	2,459	2,459
CTG Heat Input (HHV) each	MBtu/hr	2,872	2,840	2,822	3,449	3,449	3,259	3,259	3,083	3,083	2,729	2,729
Total Plant Auxiliary Power	kW	22,638	24,169	27,953	27,318	29,735	25,575	28,010	24,284	26,803	20,879	24,025
Auxiliary Power & Losses as Percent of Gross	%	2.19%	2.35%	2.75%	2.46%	2.40%	2.44%	2.38%	2.45%	2.39%	2.39%	2.40%
NET PLANT PERFORMANCE												
Net Plant Output	kW	1,013,009	1,002,838	990,330	1,082,853	1,208,854	1,023,114	1,149,114	966,827	1,092,827	851,202	977,202
Net Plant Heat Rate (LHV)	BTU/kWh	6,026	6,030	6,065	5,741	5,897	5,741	5,903	5,747	5,913	5,778	5,935
Net Plant Heat Rate (HHV)	BTU/kWh	6,687	6,691	6,730	6,370	6,543	6,370	6,550	6,377	6,562	6,412	6,585
Net Plant Efficiency (LHV)	%	56.62%	56.59%	56.26%	59.43%	57.86%	59.44%	57.80%	59.37%	57.70%	59.05%	57.49%
Net Plant Efficiency (HHV)	%	51.03%	51.00%	50.70%	53.56%	52.15%	53.56%	52.09%	53.51%	52.00%	53.22%	51.81%
STACK EMISSIONS												
NOx	ppmvd@15% O2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	lb/MBtu (HHV)	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
	lb/hr	28.2	28	27.7	25	32.2	23.5	30.8	22.3	29.5	19.8	26.8
CO	ppmvd@15% O2	1.4	1.4	1.4	0.6	1.3	0.6	1.3	0.6	1.4	0.6	1.4
	lb/MBtu (HHV)	0.0031	0.0031	0.0031	0.0014	0.0029	0.0014	0.0029	0.0014	0.0030	0.0014	0.0031
	lb/hr	12.2	12.1	12	4.7	12.8	4.5	12.6	4.2	12.3	3.8	11.6
VOC	ppmvd@15% O2	4.1	4.1	4.1	0.8	3.6	0.8	3.8	0.8	3.9	0.8	4.1
	lb/MBtu (HHV)	0.0051	0.0052	0.0052	0.0009	0.0045	0.0009	0.0047	0.0010	0.0048	0.0009	0.0051
	lb/hr	20	20	19.8	3.3	20.2	3.1	20	2.9	19.8	2.6	19
PM 2.5/10 - Front Half Only	lb/hr	16.2	16.2	16.1	5.9	16.0	5.9	16.0	5.9	16.0	5.9	15.7
PM 2.5/10 - Front Half and Back Half	lb/hr	36.5	36.5	36.3	11.8	36.1	11.8	36.0	11.8	35.9	11.8	35.3
CO2	lb/hr	448,307	444,748	441,576	396,333	512,555	374,440	490,464	354,247	469,746	313,560	425,904
NH3 Slip	lb/hr	51.8	51.4	51.1	45.8	59.3	43.3	56.7	41.0	54.3	36.3	49.3

Appendix D. Unit Operational Characteristic Estimates

PacifiCorp Study B&V Project Number 199232 Preliminary Unit Operational Characteristics - Rev 1 September 7, 2018	Option (s) Units	1 Simple Cycle GE LM6000PF Sprint	2 Simple Cycle GE LMS100PA+	3, 3B Simple Cycle GE 7F.05	4 Simple Cycle Wartsila 18V50SG	5, 6 1X1 GE 7HA.01	7, 8, 8B 2X1 GE 7HA.01	9, 10 1X1 GE 7HA.02	11, 12 2X1 GE 7HA.02
Minimum Load	MW-nominal	**19**	**18**	**104**	**4.7**	**145**	**132**	**218**	**172**
	% of full	**40%**	**15%**	**43%**	**25%**	**33%**	**15%**	**38%**	**15%**
	Notes	*1*	*2*		*3*	*4*	*4*	*6*	*6*
Spinning Reserve	MW-nominal	**48**	**118**	**139**	**19**	**293**	**748**	**355**	**976**
	Notes					*15*	*15*	*15*	*15*
Run-Up Rate (Warm Start)	MW/h	**144**	**133**	**432**	**56**	**83**	**75**	**124**	**98**
	Notes	*16*	*16*	*16*	*16*	*16*	*16*	*16*	*16*
Ramp Rate (Up and Down)	MW/h	**3000**	**3000**	**2400**	**1400**	**3000**	**6000**	**3000**	**6000**
	Notes								
Minimum Up Time	Hours	**1.0**	**1.0**	**1.0**	**1.0**	**6.5**	**6.5**	**6.5**	**6.5**
	Notes	*7*	*7*	*7*	*7*	*8*	*8*	*8*	*8*
Minimum Down Time	Hours	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
	Notes	*9*	*9*	*9*	*9*	*9*	*9*	*9*	*9*
Warm Start Time to Minimum Capacity	Minutes	**8**	**8**	**14.5**	**5**	**105**	**105**	**105**	**105**
	Notes								
Start Times									
Hot Start (less than 8 hour shutdown)	Minutes	**10**	**10**	**22.5**	**10**	**120**	**120**	**120**	**120**
	Notes	*10*	*11*	*12*	*13*	*14*	*14*	*14*	*14*
Warm Start (8 - 48 hour shutdown)	Minutes	**10**	**10**	**22.5**	**10**	**180**	**180**	**180**	**180**
	(Notes above)					*14*	*14*	*14*	*14*
Cold Start (48 - 72 hour shutdown)	Minutes	**10**	**10**	**22.5**	**10**	**240**	**240**	**240**	**240**
	(Notes above)					*14*	*14*	*14*	*14*
Ambient Start (greater than 72 hour shutdown)	Minutes	**10**	**10**	**22.5**	**10**	**360**	**360**	**360**	**360**
	(Notes above)					*14*	*14*	*14*	*14*
Heat Input for Warm Start	Mbtu (HHV)	**38**	**67**	**58**	**25**	**2595**	**5191**	**3176**	**6351**
	Notes								
Planned Outage Rate (POR)	%	**3.9**	**3.9**	**3.9**	**5.0**	**3.8**	**3.8**	**3.8**	**3.8**
	Notes	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*
Equivalent Forced Outage Rate (EFOR)	%	**2.6**	**2.9**	**2.7**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
	Notes	*17*	*17*	*17*	*17*	*17*	*17*	*17*	*17*

Notes:
ALL CHARACTERISTICS PRESENTED ON A PER UNIT (SIMPLE CYCLE) OR PER BLOCK (COMBINED CYCLE) BASIS
(1) GE LM6000 MECL for gas turbine-only is 50% of full load, if SCR/oxidation catalyst are in GE scope of supply, minimum load with emissions guarantees expected to be around 40% of full load.
(2) GE LMS100 MECL for gas turbine-only is 25% of full load, if SCR/oxidation catalyst are in GE scope of supply, minimum load with emissions guarantees expected to be around 15% of full load.
(3) Medium-speed spark-ignited RICE units typically have a minimum load of around 25%. Lower loads can be achieved but must be considered during permitting. Wartsila claims ~10% minimum load capabilities.
(4) Relative to unfired full load output. Based on GE 7HA.01 gas turbine-only MECL of 25% of full load. Single gas turbine/HRSG operation for 2x1 configuration.
(6) Relative to unfired full load output. Based on GE 7HA.02 gas turbine-only MECL of 30% of full load. Single gas turbine/HRSG operation for 2x1 configuration.
(7) Minimum time from breaker closure to breaker opening. Assumed to be limited by CEMS calibration/recording period for simple cycle units.
(8) Minimum time from breaker closure to breaker opening. Assumed to be the time period required to achieve ambient start plus a nominal allowance of 30 minutes for shutdown.
(9) Minimum time from breaker opening to breaker closure. Assumes purge and turning gear performed and achieved within one hour.
(10) Standard start time of 10 minutes. Five minute start time possible. Hot, warm, and cold start times considered the same.
(11) Standard start time of 10 minutes. Eight minute start time possible. Hot, warm, and cold start times considered the same.
(12) Standard start time of 22.5 minutes with NFPA 850 purge credit. Eleven minute start time possible with maintenance penalty. Hot, warm, and cold start times considered the same.
(13) Standard start time of 10 minutes. Five minute start time possible with greater engine block heating. Hot, warm, and cold start times considered the same.
(14) Combined cycle start times as required to achieve full gas turbine load. Based on conventional steam cycle design. Shorter start durations possible with certain, non-proprietary, design features.
(15) Spinning Reserve is the max increase in 10 minutes. If a unit cannot achieve full load in 10 minutes, then this value is the lesser of difference between minimum load and full load or ramp rate capability within 10 minutes.
(16) Run-up rate is Minimum Load divided by the time to Minimum Load for a Warm Start.
(17) POR and EFOR statistics presented are considered reasonable "first-pass" values. No detailed analysis was conducted to arrive at these values and dispatch of the units will impact values.

Appendix E. Cash Flow Weights

Pacificorp Cash Weights

OEM	Technology	Configuration	Total Development and Construction Implementation Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
GE	LM6000 PF Sprint	3x0 Simple Cycle	49	0.001%	0.01%	0.01%	0.04%	0.06%	0.10%	0.15%	0.23%	0.31%	0.42%	0.54%	0.69%	0.84%	1.03%	1.21%	1.43%	1.64%
GE	LMS100PA+, dry interstage cooling	3x0 Simple Cycle	49	0.001%	0.01%	0.01%	0.04%	0.06%	0.10%	0.15%	0.23%	0.31%	0.42%	0.54%	0.69%	0.84%	1.03%	1.21%	1.43%	1.64%
GE	7F.05	1x0 Simple Cycle	49	0.001%	0.01%	0.01%	0.04%	0.06%	0.10%	0.15%	0.23%	0.31%	0.42%	0.54%	0.69%	0.84%	1.03%	1.21%	1.43%	1.64%
GE	7F.05	1x0 Simple Cycle	49	0.001%	0.01%	0.01%	0.04%	0.06%	0.10%	0.15%	0.23%	0.31%	0.42%	0.54%	0.69%	0.84%	1.03%	1.21%	1.43%	1.64%
Wartsila	18V50SG	6x0 Simple Cycle	49	0.001%	0.01%	0.01%	0.04%	0.06%	0.10%	0.15%	0.23%	0.31%	0.42%	0.54%	0.69%	0.84%	1.03%	1.21%	1.43%	1.64%
GE	7HA.01	1x1 Combined Cycle	54	0.001%	0.005%	0.01%	0.02%	0.04%	0.07%	0.10%	0.15%	0.20%	0.27%	0.35%	0.45%	0.55%	0.67%	0.80%	0.95%	1.10%
GE	7HA.01	1x1 Combined Cycle	54	0.001%	0.005%	0.01%	0.02%	0.04%	0.07%	0.10%	0.15%	0.20%	0.27%	0.35%	0.45%	0.55%	0.67%	0.80%	0.95%	1.10%
GE	7HA.01	2x1 Combined Cycle	66	0.0004%	0.003%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.13%	0.18%	0.23%	0.30%	0.37%	0.46%	0.54%	0.65%	0.76%
GE	7HA.01	2x1 Combined Cycle	66	0.0004%	0.003%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.13%	0.18%	0.23%	0.30%	0.37%	0.46%	0.54%	0.65%	0.76%
GE	7HA.01	2x1 Combined Cycle	66	0.0004%	0.003%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.13%	0.18%	0.23%	0.30%	0.37%	0.46%	0.54%	0.65%	0.76%
GE	7HA.02	1x1 Combined Cycle	54	0.001%	0.005%	0.01%	0.02%	0.04%	0.07%	0.10%	0.15%	0.20%	0.27%	0.35%	0.45%	0.55%	0.67%	0.80%	0.95%	1.10%
GE	7HA.02	1x1 Combined Cycle	54	0.001%	0.005%	0.01%	0.02%	0.04%	0.07%	0.10%	0.15%	0.20%	0.27%	0.35%	0.45%	0.55%	0.67%	0.80%	0.95%	1.10%
GE	7HA.02	2x1 Combined Cycle	66	0.0004%	0.003%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.13%	0.18%	0.23%	0.30%	0.37%	0.46%	0.54%	0.65%	0.76%
GE	7HA.02	2x1 Combined Cycle	66	0.0004%	0.003%	0.01%	0.01%	0.02%	0.04%	0.06%	0.10%	0.13%	0.18%	0.23%	0.30%	0.37%	0.46%	0.54%	0.65%	0.76%

Pacificorp Cash Weights

OEM	Technology	Configuration	Total Development and Construction Implementation Time	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
GE	LM6000 PF Sprint	3x0 Simple Cycle	49	1.87%	2.10%	2.34%	2.58%	2.82%	3.05%	3.26%	3.48%	3.65%	3.83%	3.96%	4.09%	4.16%	4.23%	4.23%	4.23%	4.15%
GE	LMS100PA+, dry interstage cooling	3x0 Simple Cycle	49	1.87%	2.10%	2.34%	2.58%	2.82%	3.05%	3.26%	3.48%	3.65%	3.83%	3.96%	4.09%	4.16%	4.23%	4.23%	4.23%	4.15%
GE	7F.05	1x0 Simple Cycle	49	1.87%	2.10%	2.34%	2.58%	2.82%	3.05%	3.26%	3.48%	3.65%	3.83%	3.96%	4.09%	4.16%	4.23%	4.23%	4.23%	4.15%
GE	7F.05	1x0 Simple Cycle	49	1.87%	2.10%	2.34%	2.58%	2.82%	3.05%	3.26%	3.48%	3.65%	3.83%	3.96%	4.09%	4.16%	4.23%	4.23%	4.23%	4.15%
Wartsila	18V50SG	6x0 Simple Cycle	49	1.87%	2.10%	2.34%	2.58%	2.82%	3.05%	3.26%	3.48%	3.65%	3.83%	3.96%	4.09%	4.16%	4.23%	4.23%	4.23%	4.15%
GE	7HA.01	1x1 Combined Cycle	54	1.27%	1.43%	1.62%	1.80%	1.99%	2.18%	2.37%	2.55%	2.73%	2.91%	3.06%	3.22%	3.35%	3.48%	3.57%	3.66%	3.71%
GE	7HA.01	1x1 Combined Cycle	54	1.27%	1.43%	1.62%	1.80%	1.99%	2.18%	2.37%	2.55%	2.73%	2.91%	3.06%	3.22%	3.35%	3.48%	3.57%	3.66%	3.71%
GE	7HA.01	2x1 Combined Cycle	66	0.88%	1.00%	1.14%	1.27%	1.42%	1.57%	1.72%	1.87%	2.03%	2.18%	2.33%	2.48%	2.61%	2.75%	2.87%	2.89%	2.98%
GE	7HA.01	2x1 Combined Cycle	66	0.88%	1.00%	1.14%	1.27%	1.42%	1.57%	1.72%	1.87%	2.03%	2.18%	2.33%	2.48%	2.61%	2.75%	2.87%	2.89%	2.98%
GE	7HA.01	2x1 Combined Cycle	66	0.88%	1.00%	1.14%	1.27%	1.42%	1.57%	1.72%	1.87%	2.03%	2.18%	2.33%	2.48%	2.61%	2.75%	2.87%	2.89%	2.98%
GE	7HA.02	1x1 Combined Cycle	54	1.27%	1.43%	1.62%	1.80%	1.99%	2.18%	2.37%	2.55%	2.73%	2.91%	3.06%	3.22%	3.35%	3.48%	3.57%	3.66%	3.71%
GE	7HA.02	1x1 Combined Cycle	54	1.27%	1.43%	1.62%	1.80%	1.99%	2.18%	2.37%	2.55%	2.73%	2.91%	3.06%	3.22%	3.35%	3.48%	3.57%	3.66%	3.71%
GE	7HA.02	2x1 Combined Cycle	66	0.88%	1.00%	1.14%	1.27%	1.42%	1.57%	1.72%	1.87%	2.03%	2.18%	2.33%	2.48%	2.61%	2.75%	2.87%	2.89%	2.98%
GE	7HA.02	2x1 Combined Cycle	66	0.88%	1.00%	1.14%	1.27%	1.42%	1.57%	1.72%	1.87%	2.03%	2.18%	2.33%	2.48%	2.61%	2.75%	2.87%	2.89%	2.98%

Pacificorp Cash Weights

OEM	Technology	Configuration	Total Development and Construction Implementation Time	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
GE	LM6000 PF Sprint	3x0 Simple Cycle	49	4.08%	3.93%	3.77%	3.55%	3.32%	3.03%	2.74%	2.39%	2.04%	1.65%	1.16%	0.84%	0.43%	0.21%	0.10%		
GE	LMS100PA+, dry interstage cooling	3x0 Simple Cycle	49	4.08%	3.93%	3.77%	3.55%	3.32%	3.03%	2.74%	2.39%	2.04%	1.65%	1.16%	0.84%	0.43%	0.21%	0.10%		
GE	7F.05	1x0 Simple Cycle	49	4.08%	3.93%	3.77%	3.55%	3.32%	3.03%	2.74%	2.39%	2.04%	1.65%	1.16%	0.84%	0.43%	0.21%	0.10%		
GE	7F.05	1x0 Simple Cycle	49	4.08%	3.93%	3.77%	3.55%	3.32%	3.03%	2.74%	2.39%	2.04%	1.65%	1.16%	0.84%	0.43%	0.21%	0.10%		
Wartsila	18V50SG	6x0 Simple Cycle	49	4.08%	3.93%	3.77%	3.55%	3.32%	3.03%	2.74%	2.39%	2.04%	1.65%	1.16%	0.84%	0.43%	0.21%	0.10%		
GE	7HA.01	1x1 Combined Cycle	54	3.76%	3.76%	3.76%	3.71%	3.66%	3.55%	3.44%	3.29%	3.13%	2.92%	2.71%	2.46%	2.21%	1.92%	1.63%	1.32%	1.00%
GE	7HA.01	1x1 Combined Cycle	54	3.76%	3.76%	3.76%	3.71%	3.66%	3.55%	3.44%	3.29%	3.13%	2.92%	2.71%	2.46%	2.21%	1.92%	1.63%	1.32%	1.00%
GE	7HA.01	2x1 Combined Cycle	66	2.98%	3.00%	3.02%	3.05%	3.09%	3.09%	3.09%	3.08%	3.06%	3.06%	3.06%	3.04%	2.92%	2.77%	2.62%	2.43%	2.25%
GE	7HA.01	2x1 Combined Cycle	66	2.98%	3.00%	3.02%	3.05%	3.09%	3.09%	3.09%	3.08%	3.06%	3.06%	3.06%	3.04%	2.92%	2.77%	2.62%	2.43%	2.25%
GE	7HA.01	2x1 Combined Cycle	66	2.98%	3.00%	3.02%	3.05%	3.09%	3.09%	3.09%	3.08%	3.06%	3.06%	3.06%	3.04%	2.92%	2.77%	2.62%	2.43%	2.25%
GE	7HA.02	1x1 Combined Cycle	54	3.76%	3.76%	3.76%	3.71%	3.66%	3.55%	3.44%	3.29%	3.13%	2.92%	2.71%	2.46%	2.21%	1.92%	1.63%	1.32%	1.00%
GE	7HA.02	1x1 Combined Cycle	54	3.76%	3.76%	3.76%	3.71%	3.66%	3.55%	3.44%	3.29%	3.13%	2.92%	2.71%	2.46%	2.21%	1.92%	1.63%	1.32%	1.00%
GE	7HA.02	2x1 Combined Cycle	66	2.98%	3.00%	3.02%	3.05%	3.09%	3.09%	3.09%	3.08%	3.06%	3.06%	3.06%	3.04%	2.92%	2.77%	2.62%	2.43%	2.25%
GE	7HA.02	2x1 Combined Cycle	66	2.98%	3.00%	3.02%	3.05%	3.09%	3.09%	3.09%	3.08%	3.06%	3.06%	3.06%	3.04%	2.92%	2.77%	2.62%	2.43%	2.25%

Pacificorp Cash Weights

OEM	Technology	Configuration	Total Development and Construction Implementation Time	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66
GE	LM6000 PF Sprint	3x0 Simple Cycle	49															
GE	LMS100PA+, dry interstage cooling	3x0 Simple Cycle	49															
GE	7F.05	1x0 Simple Cycle	49															
GE	7F.05	1x0 Simple Cycle	49															
Wartsila	18V50SG	6x0 Simple Cycle	49															
GE	7HA.01	1x1 Combined Cycle	54	0.67%	0.34%	0.17%												
GE	7HA.01	1x1 Combined Cycle	54	0.67%	0.34%	0.17%												
GE	7HA.01	2x1 Combined Cycle	66	2.03%	1.81%	1.47%	1.33%	1.07%	1.00%	0.90%	0.81%	0.60%	0.54%	0.39%	0.27%	0.14%	0.10%	0.05%
GE	7HA.01	2x1 Combined Cycle	66	2.03%	1.81%	1.47%	1.33%	1.07%	1.00%	0.90%	0.81%	0.60%	0.54%	0.39%	0.27%	0.14%	0.10%	0.05%
GE	7HA.01	2x1 Combined Cycle	66	2.03%	1.81%	1.47%	1.33%	1.07%	1.00%	0.90%	0.81%	0.60%	0.54%	0.39%	0.27%	0.14%	0.10%	0.05%
GE	7HA.02	1x1 Combined Cycle	54	0.67%	0.34%	0.17%												
GE	7HA.02	1x1 Combined Cycle	54	0.67%	0.34%	0.17%												
GE	7HA.02	2x1 Combined Cycle	66	2.03%	1.81%	1.47%	1.33%	1.07%	1.00%	0.90%	0.81%	0.60%	0.54%	0.39%	0.27%	0.14%	0.10%	0.05%
GE	7HA.02	2x1 Combined Cycle	66	2.03%	1.81%	1.47%	1.33%	1.07%	1.00%	0.90%	0.81%	0.60%	0.54%	0.39%	0.27%	0.14%	0.10%	0.05%