Ohio | Public Utilities Commission

Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)

NOTE: AK Steel Corporation is seeking pre-construction PUCO approval for this project. The project described in this application is NOT COMPLETE and by executing this document AK Steel in NO WAY commits to the construction of this project.

Case No.: 14 -0146-**EL-EEC**

Mercantile Customer:

Electric Utility: Duke Energy

Program Title or Description: Waste Heat Recovery (custom)

Rule 4901:1-39-05(F), Ohio Administrative Code (O.A.C.), permits a mercantile customer to file, either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs. The following application form is to be used by mercantile customers, either individually or jointly with their electric utility, to apply for commitment of such programs in accordance with the Commission's pilot program established in Case No. 10-834-EL-POR

Completed applications requesting the cash rebate reasonable arrangement option (Option 1) in lieu of an exemption from the electric utility's energy efficiency and demand reduction (EEDR) rider will be automatically approved on the sixty-first calendar day after filing, unless the Commission, or an attorney examiner, suspends or denies the application prior to that time. Completed applications requesting the exemption from the EEDR rider (Option 2) will also qualify for the 60-day automatic approval so long as the exemption period does not exceed 24 months. Rider exemptions for periods of more than 24 months will be reviewed by the Commission Staff and are only approved up the issuance of a Commission order.

Complete a separate application for each customer program. Projects undertaken by a customer as a single program at a single location or at various locations within the same service territory should be submitted together as a single program filing, when possible. Check all boxes that are applicable to your program. For each box checked, be sure to complete all subparts of the question, and provide all requested additional information. Submittal of incomplete applications may result in a suspension of the automatic approval process or denial of the application.

Any confidential or trade secret information may be submitted to Staff on disc or via email at ee-pdr@puc.state.oh.us.

Section 1: Mercantile Customer Information

Name: AK Steel Corporation

Principal address: 9227 Centre Point Drive West Chester, Ohio 45069

Address of facility for which this energy efficiency program applies:

AK Steel Middletown Works 1801 Crawford St. Middletown, Ohio 45043

Name and telephone number for responses to questions: Lucas Dixon, 614-580-3352

Electricity use by the customer (check the box(es) that apply):

- x The customer uses more than seven hundred thousand kilowatt hours per year at the above facility. (Please attach documentation.)
- ☐ The customer is part of a national account involving multiple facilities in one or more states. (Please attach documentation.)

Section 2: Application Information

A) The customer is filing this application (choose which applies):

- x Individually, without electric utility participation.
- ☐ Jointly with the electric utility.

B) The electric utility is: ___Duke Energy Corporation ___

C) The customer is offering to commit (check any that apply):

- x Energy savings from the customer's energy efficiency program. (Complete Sections 3, 5, 6, and 7.)
- ☐ Capacity savings from the customer's demand response/demand reduction program. (Complete Sections 4, 5, 6, and 7.)
- ☐ Both the energy savings and the capacity savings from the customer's energy efficiency program. (Complete all sections of the Application.)

Section 3: Energy Efficiency Programs

A) The customer's energy efficiency program involves (check those that apply):

- ☐ Early replacement of fully functioning equipment with new equipment. (Provide the date on which the customer replaced fully functioning equipment, and the date on which the customer would have replaced such equipment if it had not been replaced early. Please include a brief explanation for how the customer determined this future replacement date (or, if not known, please explain why this is not known)).
- ☐ Installation of new equipment to replace equipment that needed to be replaced The customer installed new equipment on the following date(s): _____.
- x Installation of new equipment for new construction or facility expansion. The customer installed new equipment on the following date(s): _Anticipated install date of 11/01/2014_.
- ☐ Behavioral or operational improvement.

B) Energy savings achieved/to be achieved by the energy efficiency program:

1) If you checked the box indicating that the project involves the early replacement of fully functioning equipment replaced with new equipment, then calculate the annual savings [(kWh used by the original equipment) - (kWh used by new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings:

2) If you checked the box indicating that the customer installed new equipment to replace equipment that needed to be replaced, then calculate the annual savings [(kWh used by less efficient new equipment) - (kWh used by the higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Please describe any less efficient new equipment that was rejected in favor of the more efficient new equipment.

3) If you checked the box indicating that the project involves equipment for new construction or facility expansion, then calculate the annual savings [(kWh used by less efficient new equipment) - (kWh used by higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: Annual savings: 9,435,500 kWh

*Calculations provided in Addendum A1

Please describe the less efficient new equipment that was rejected in favor of the more efficient new equipment.

Note: As a generation/WER project no less efficient new equipment was rejected. Existing condition of wasted heat is the alternative.

4) If you checked the box indicating that the project involves behavioral or operational improvements, provide a description of how the annual savings were determined.

_____

Section 4: Demand Reduction/Demand Response Programs

A) The customer's program involves (check the one that applies):

- ☐ Coincident peak-demand savings from the customer's energy efficiency program.
- ☐ Actual peak-demand reduction. (Attach a description and documentation of the peak-demand reduction.)
- ☐ Potential peak-demand reduction (check the one that applies):
  - ☐ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a tariff of a regional transmission organization (RTO) approved by the Federal Energy Regulatory Commission.
  - ☐ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a program that is equivalent to an RTO program, which has been approved by the Public Utilities Commission of Ohio.

B) On what date did the customer initiate its demand reduction program?

_____

C) What is the peak demand reduction achieved or capable of being achieved (show calculations through which this was determined):

___ kW

Section 5: Request for Cash Rebate Reasonable Arrangement (Option 1) or Exemption from Rider (Option 2)

Under this section, check the box that applies and fill in all blanks relating to that choice.

Note: If Option 2 is selected, the application will not qualify for the 60-day automatic approval. All applications, however, will be considered on a timely basis by the Commission.

A) The customer is applying for:

□ Option 1: A cash rebate reasonable arrangement.

OR

X Option 2: An exemption from the energy efficiency cost recovery mechanism implemented by the electric utility.

OR

□ Commitment payment

B) The value of the option that the customer is seeking is:

Option 1: A cash rebate reasonable arrangement, which is the lesser of (show both amounts):

□ A cash rebate of $_____. (Rebate shall not exceed 50% project cost. Attach documentation showing the methodology used to determine the cash rebate value and calculations showing how this payment amount was determined.)

Option 2: An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider.

X An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for 9 months (not to exceed 24 months). (Attach calculations showing how this time period was determined.) See Addendum A1 for rider exemption calculations.

OR

- ☐ A commitment payment valued at no more than $_____. (Attach documentation and calculations showing how this payment amount was determined.)

OR

- ☐ Ongoing exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for an initial period of 24 months because this program is part of the customer's ongoing efficiency program. (Attach documentation that establishes the ongoing nature of the program.) In order to continue the exemption beyond the initial 24 month period, the customer will need to provide a future application establishing additional energy savings and the continuance of the organization's energy efficiency program.)

Section 6: Cost Effectiveness

The program is cost effective because it has a benefit/cost ratio greater than 1 using the (choose which applies):

- x Total Resource Cost (TRC) Test. The calculated TRC value is: __2.5444_ (Continue to Subsection 1, then skip Subsection 2)
- ☐ Utility Cost Test (UCT) . The calculated UCT value is: _____ (Skip to Subsection 2.)

Subsection 1: TRC Test Used (please fill in all blanks).

The TRC value of the program is calculated by dividing the value of our avoided supply costs (generation capacity, energy, and any transmission or distribution) by the sum of our program overhead and installation costs and any incremental measure costs paid by either the customer or the electric utility.

The electric utility's avoided supply costs were $3,877,799.00
Our program costs were _$1,524,038.00
The incremental measure costs will be $0
TRC Test Result 2.54

(Calculations in Addendum B1)

Subsection 2: UCT Used (please fill in all blanks).

We calculated the UCT value of our program by dividing the value of our avoided supply costs (capacity and energy) by the costs to our electric utility (including administrative costs and incentives paid or rider exemption costs) to obtain our commitment.

Our avoided supply costs were _____.

The utility's program costs were _____.

The utility's incentive costs/rebate costs were _____.

Section 7: Additional Information

Please attach the following supporting documentation to this application:

- Narrative description of the program including, but not limited to, make, model, and year of any installed and replaced equipment.
- A copy of the formal declaration or agreement that commits the program or measure to the electric utility, including:
  1) any confidentiality requirements associated with the agreement;
  2) a description of any consequences of noncompliance with the terms of the commitment;
  3) a description of coordination requirements between the customer and the electric utility with regard to peak demand reduction;
  4) permission by the customer to the electric utility and Commission staff and consultants to measure and verify energy savings and/or peak-demand reductions resulting from your program; and,
  5) a commitment by the customer to provide an annual report on your energy savings and electric utility peak-demand reductions achieved.
- A description of all methodologies, protocols, and practices used or proposed to be used in measuring and verifying program results. Additionally, identify and explain all deviations from any program measurement and verification guidelines that may be published by the Commission.

Ohio | Public Utilities Commission

Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)

Case No.: 14 -0146-**EL-EEC**

State of Ohio :

LARRY Schutte, Affiant, being duly sworn according to law, deposes and says that:

1. I am the duly authorized representative of:

   AK Steel Corporation
   [insert customer or EDU company name and any applicable name(s) doing business as]

2. I have personally examined all the information contained in the foregoing application, including any exhibits and attachments. Based upon my examination and inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete.

Larry Schutte Corporate Manager of Energy Optimization
Signature of Affiant & Title

Sworn and subscribed before me this 29th day of January, 2014 Month/Year

Signature of official administering oath

Jeffrey Lee Zackerman, Attorney at Law
Print Name and Title

My commission expires on N/A

NOTARIAL SEAL STATE OF OHIO

JEFFREY LEE ZACKERMAN, Attorney at Law
Notary Public, State Of Ohio
My Commission Has No Expiration Date
Section 147.03

AK Steel Energy Efficiency Rider Exemption Overview and Commitment Form:

Commitment of Savings: By signing and accepting this application AK Steel Corporation affirms its intention to commit and integrate the energy efficiency projects contained within this application towards Duke Energy Corp.'s peak demand reduction, demand response and/or energy efficiency programs.

Additionally, AK Steel Corporation agrees to serve as joint applicant in any future filings necessary to secure approval of this arrangement as required by the PUCO and to comply with any information and reporting requirements imposed by rule or as part of that approval.

Finally, AK Steel Corporation affirms that all application information submitted as part of this application pursuant to this rider exemption application is true and accurate. Information in question would include, but not be limited to, project scope, equipment specification, equipment operation details, project costs, project completion dates, and the quantity of energy conservation measures installed.

Committed Project Overview: AK Steel agrees to commit the energy savings generated from the Waste Energy Recovery Pressure reducing Valve (PRV) Turbine located and operating at the Middletown Works Facility. The project will deliver 9,435,500 kWh of energy savings per year, qualifying AK Steel for nearly 9 months of exemption from the Duke Energy Corporation energy efficiency recovery rider.

Confidentiality: AK Steel Corporation requests that the PUCO, Duke Energy Corporation and all other parties keep all relevant parts of this application strictly confidential. The steel business is highly competitive and AK Steel Corporation views the information contained within this application as a confidential business advantage directly affecting its business operation.

Non Compliance: AK Steel agrees that if for any reason the kWh promised as part of this application and measured per the requirements outlined in this application are not delivered during the stated delivery year AK Steel will be liable for the rider value associated with the kWh shortfall. This shortfall would be paid to the Duke Energy Company by the 3rd month after the end of the delivery year and after the shortfall is certified and agreed upon by Duke Energy Company, the PUCO and AK Steel.

Measurement and Verification Methodologies: AK Steel Corporation agrees to an International Performance Measurement and Verification Protocol (IPMVP) standard based measurement and verification protocol for this rider exemption eligible project. For the project in question AK Steel will install a revenue grade electric meter on the generator portion of the PRV turbine that will monitor and record the kWh and kW production of the waste energy recovery system. AK Steel will also install a revenue grade meter on the power consumption side of the PRV Turbine to measure and record any energy use resulting from the operation of the PRV Turbine. On the last day of every month both meters will be recorded and total energy use will be subtracted from total energy production of the PRV Turbine to yield total energy production from the WER project. This number will be captured and stored to be presented in AK Steel's annual rider exemption PRV Turbine production report. This report will be submitted to the PUCO no later than the 15th day after the close of the delivery year that the rider exemption was certified for. (see annual report below) Additionally, AK Steel will employ a remote

AK Steel Energy Efficiency Rider Exemption Overview and Commitment Form:

monitoring system that will allow for 24/7 production data to ensure that if there was ever a problem with the PRV Turbine AK Steel, the responsible maintenance team, and the engineering firm responsible for monitoring M&V will be notified immediately, enabling them to remedy the problem promptly.

Project Timeline/Rider Exemption Timeline: (see addendum C1) Once the PRV turbine has been placed in operation, AK Steel will submit the first months of kWh generation data as an additional item to this application and ask that it serve as the initiator of the rider exemption. AK Steel asks that when submitted this will retroactively exempt AK Steel from the energy efficiency rider from the equipment start date and that the rider exemption continue for the approved amount of time per this application and supported by the monthly production reports.

Annual Report: AK Steel agrees to provide the Utility Company and the PUCO a formal annual report that documents the energy savings and electric utility peak-demand reductions achieved for this project. This report shall be submitted electronically to the Utility Company and the PUCO no later than 15 days after the end of the delivery year and will contain all calculations and measurements to document and support the installed system's performance.

Permission to Measure: AK Steel Corporation agrees to allow the Utility, the PUCO Staff and any associated consultants access to data and access to the proposed project for inspection and verification as long as they can meet AK Steel's, confidentiality, safety and insurance requirements and that a written request for access is provided by USPS or electronically 10 business days prior to desired access date.

Signature:

I, Larry Schutte, certify that I am eligible to sign and certify this document on behalf of AK Steel Corporation.

Larry Schutte

Customer Signature

1/29/2014

Date

FORM APPROVED ATTORNEY GENERAL

NOTE: AK Steel Corporation is seeking pre-construction PUCO approval for this project. The project described in this application is NOT COMPLETE and by executing this document AK Steel in NO WAY commits to the construction of this project.

Application to Commit
Energy Efficiency/Peak Demand
Reduction Programs

Addendum A1

AK Steel currently uses a pressure reducing valve to reduce plant steam header pressure from 400 psi to 165 psi. Energy is wasted as the steam expands.

This energy can be captured by using a steam turbine to perform the function of allowing the steam to expand from high to low pressure.

Plug Smart has been contracted by AK Steel to design a PRV turbine option that would generate power and for that power to be used to meet PUCO requirements to exempt AK from the utility rider for the length of time for which the power produced meets the requirements of the utility rider exemption.

Data has been collected by AK Steel's steam flow meter on the 165 psi system. From this we know that the internal process demand for 165 psi steam from this location is typically between 63,000 pph in the winter and 10,000 pph in the summer.

The proposed turbine will consist of an Elliott turbine (or similar) coupled to a synchronous gear drive to a generator rated for 1.125 MW at a total flow of 77,800 pounds of steam per hour. This turbine will provide an exhaust stream of 165 psi steam to be used by the plant's internal industrial processes. Any additional steam required to satisfy the 77,800 pound per hour requirement will be passed through the turbine and exhausted to atmosphere to maintain the rated output of the turbine. No fuel other than process exhaust gasses is used to fuel the steam boilers based on process waste gas availability. Natural gas is used to maintain pilots on the boilers for safety. The volume of available process gas to create steam significantly exceeds the additional demand that this turbine may demand during lower process steam demand periods.

This equipment will be installed in parallel to, and replace in function, the existing PRV valve. The existing PRV valve will remain in place as an emergency backup.

Calculations:

These turbines are very robust and down time for maintenance is expected to be minimal so it is conservatively assumed that the unit will be available to make power 96% of the time.

Energy consumed by the turbine generator assembly called parasitic losses are less than 1 kW each for the following: oil cooling, compressed air required for controls, and control system power for a total of less than 3 kW.

So annual output: (1.125MW-3kW)*(8760 hours/year)*(.96) = **9,435,500 kWh**

The average annual total electricity consumption for AK Steel Middletown Works over the past three years is 1,310,095.9 MWh. (2013-2011)

Total Usage for 2011 was 1,302,509 MWH
Total Usage for 2012 was 1,315,525 MWH
Total usage for 2013 was 1,321,254 MWH

Since 1% annual reduction is required to offset the rider for the year 2015, the annual rider reduction requirement is: 0.01*1,310,096 MWh = 13,100,960 kWh.

Application to Commit
Energy Efficiency/Peak Demand
Reduction Programs

This project will offset 9,435,500 kWh /13,100,960kWh = 72% of the annual rider requirement

This is equivalent to nearly nine months' worth of rider exemption.

Addendum B1

Total Resource Cost Test (TRC) Calculations:

Annual Production: kWh	9,435,500
Average kWh Rate:	$ 0.0411
Minimum Useful Life: years (Conservative)	10
Electric Utility's Lifetime avoided supply costs=	$ 3,877,799
Our program costs were:	$1,524,038.00
The incremental measure costs will be:	$0
Total Costs	$1,524,038.00
Total Resource Cost Test:	2.5444
Calculations Explained:	
Production x kWh Rate x minimum useful life= Electric utility's avoided supply costs	
Avoided Supply Costs/ (Program costs+ Incremental measure costs)= TRC Test	

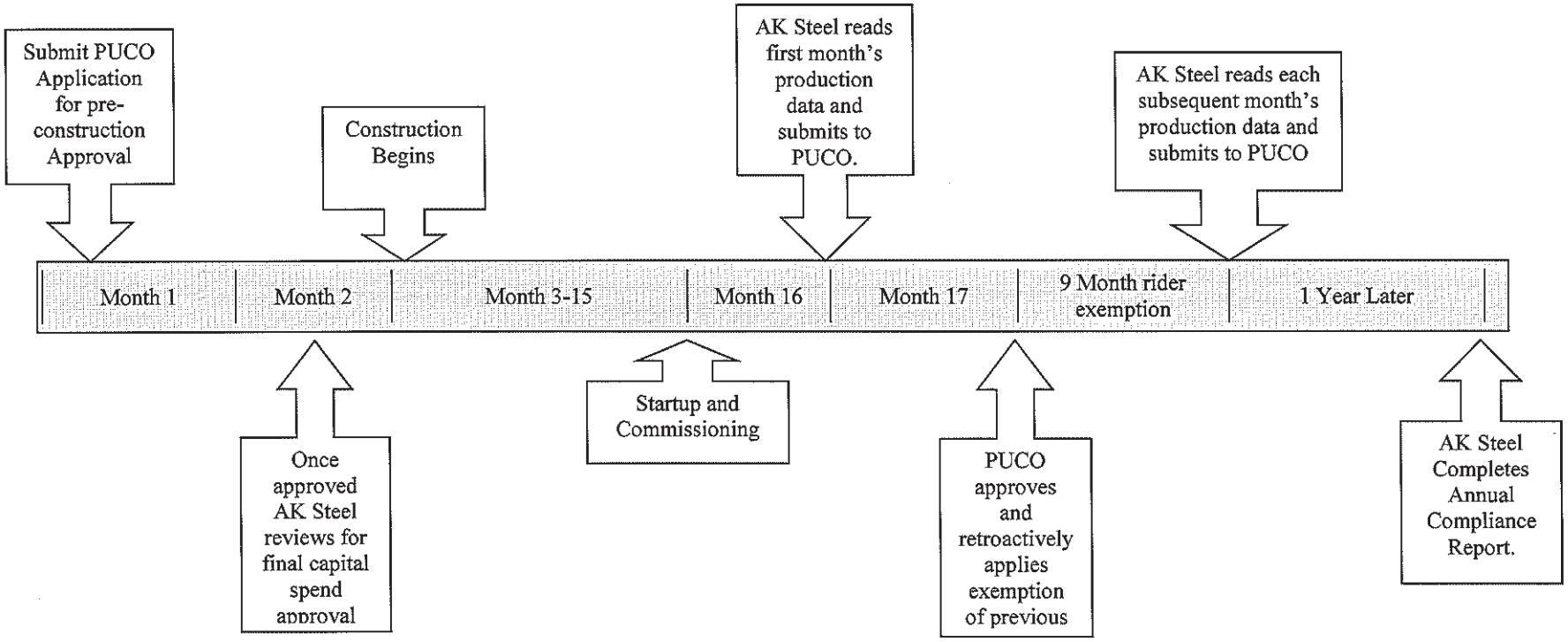
Addendum C1: Timeline

(See attached project timeline)

Addendum D1: Project Specifications

(See attached product specification Sheets)

AK Steel PRV Project Timeline



ELLIOTT GROUP
EBARA CORPORATION

Turbine Datasheet

OPERATING CONDITIONS for Steam Turbine Tag No: *STG #1*

	Power kW	Speed RPM	INLET Throttle Flow lb/hr	INLET Press PSIG	INLET Temp °F	EXHAUST Press PSIG	EXHAUST Temp °F	No. of HV's Open	Guar.
Normal	1,125.0	1,800	77,800.0	400.00	700.0	165.00	571.0	0	Yes

Turbine Speed Range: 5286 to 5612 rpm Turbine Trip Speed: 6023 rpm Gear Ratio: 3.027 :1 Rotation: CW *

STEAM CONDITIONS	Min	Normal	Max	Units
Inlet Pressure	0.00	400.00	0.00	PSIG
Inlet Temperature	0.00	700.00	0.00	F
Exhaust Pressure	0.00	165.00	0.00	PSIG
Atmospheric Pressure		14.7		PSIA

CASING DESIGN	Max	Units
Inlet Pressure	770	PSIG
Inlet Temperature	750	F
Exhaust Pressure	275	PSIG

Note: Casing design is not an operating point.

CONSTRUCTION

Design Specification:	Industrial	**Bearings:**	
		Radial Bearing Type:	Liner
Casing:		Thrust Bearing Type:	Ball
Turbine Type:	Horizontal	Lubrication Type:	Pressure Lube
Number of Stages:	1	Bearing Housing Seal Type:	Labyrinth
Casing Support:	Centerline	Oil Type:	Mineral Base
End Seal Type:	Carbon Ring		
Interstage Seal Type:	N/A	**Trip:**	
		Trip Valve:	Integral
Rotor:		Trip Type:	Mechanical - Trip Pin (Std)
Construction:	Built-Up		
Shaft End:	Straight 1 key	**Expected Sound Level @ 1M:**	95 dBA

MATERIALS

High Pressure Casing:	ASTM-A-216 WCB	Strainer:	300 Series SS
Exhaust Casing:	ASTM-A-216 WCB	Shaft Coating under Packing:	400 Series SS
Nozzles:	ASTM A-276 Type 405		
Rotor Shaft:	AISI 4340	Copper Allowed / Atmosphere:	Yes
Rotor Disks:	AISI 4340	Copper Allowed / Steam Path:	Yes
Rotor Blading:	403 SS	Aluminum Allowed / Atmosphere:	Yes

TURBINE ONLY – OIL, WATER, AND AIR REQUIREMENTS

Utility	Flow (steady state)	Flow (transient)	Pressure	Viscosity	Heat Load	Temperature
Lubrication Oil:	2 GPM	N/A	7-9 PSIG	ISO VG 68	6697.8 BTU/HR	120 °F
Control Oil:	N/A	N/A	N/A	ISO VG 68		120 °F
Cooling Water:	N/A		N/A			N/A
Trip Air:			N/A			
Control Air:			80 - 125 PSIG			
Handvalve Air:			N/A			

Area Classification: Non-Hazardous

Casing Connections	Size	Rating	Facing	Position *
Inlet	6	600	Raised Face	Right Hand
Exhaust	8	300	Raised Face	Left Hand

* Viewed from Non-Drive end of turbine

Steam Turbine

- BYRH Single Stage Steam Turbine, Tag No. STG #1
- Forged Rotor Shaft
- Forged Rotor Disks
- Rotor Shaft Grounding Brush, Qty (1)
- Valtek-25 Sq.In. Pneumatic Actuator
- Mechanical Trip Pin, Overspeed Trip
- Remote Trip Device, Electric Solenoid
- Babbited Horizontally Split Liner Radial Bearings
- Spring Loaded Temperature Sensor, Single Element, Radial Bearings, Total Qty (2)
- Thermal Blanket Insulation
- Mounting Bolts, Shims, Dowels, and Vertical Jackscrews
- Turbine Surface Preparation - Commercial Cleaning (SSPC-SP1/SP6)
- Turbine Paint System - Self-Priming Silicone Aluminum Topcoat
- Metal flange covers for shipping protection
- Warranty is 12 months after start-up or 18 months after shipment, whichever occurs first.

Gear

- Gear (AGMA), Double helical horizontally offset with integral lube system, stainless steel pipe
- Main Oil Pump, shaft driven
- Auxiliary Oil Pump, TEFC
- Oil Cooler
- Oil Filter
- Pressure Gauge, Oil Supply (Local Mount)
- Low Oil Pressure Switch (Local Mount)
- Low Oil Level Switch (Local Mount)
- Gear Surface Preparation - Commercial Blast (SSPC-SP6)
- Gear Paint System - Inorganic Zinc Primer/Urethane Enamel Topcoat - Gray (std)

Industrial Type, Low Voltage, Three Phase, Synchronous Generator

- Voltage: 13,200 V
- Frequency: 60 Hz
- Power Factor: 0.8
- Insulation: Class H
- Temperature Raise: 80 °C / 40 °C, Ambient
- Altitude : 1000 m or less
- Excitation: Brushless
- Poles: 4
- Connection: WYE
- Leads: 6
- Enclosure: Open Drip Proof
- Bearing Design: Ball Bearings
- Permanent Magnet Generator (PMG)
- Automatic Voltage Regulator
- Two (2) RTD's per Phase (Total = 6)
- One (1) RTD per Bearing (Total = 2)

Packaging

- Structural Steel Baseplate
- Mounting Plate Surface Preparation - Commercial Blast (SSPC-SP6)
- Mounting Plate Paint System - Inorganic Zinc Primer / Acrylic Topcoat - Gray
- Flexible Disk Spacer Coupling
- Coupling Guard, Aluminum, Cantilevered Design, Vented Bottom
- Flexible Disk Spacer Coupling
- Coupling Guard, Aluminum, Cantilevered Design, Vented Bottom
- Steam Ejector Only
- Turbine Interconnecting Oil Piping with Gear Lube System, 304/304L SS Tubing/Pipe
- Threaded Leakoff and Drain Piping w/Flanged Customer Conns.

Panels and Instruments

- Panel, Including all items listed as panel mounted
- Panel Surface Preparation - Commercial Blast (SSPC-SP6)
- Panel Paint System - Inorganic Zinc Primer / Acrylic Topcoat - Gray RAL 7038
- Magnetic Speed Pick-Up, Qty (2)
- Conduit Turbine RTD/Thermocouples to Local Panel
- Conduit Magnetic Speed Pickups to Local Panel
- Conduit Solenoids to Local Panel
- Conduit Actuator Signal to Local Panel
- Conduit Driven Equipment RTD/Thermocouples to Local Panel

Inspections and Testing

- Hydrotest, Turbine Casing & Steam Chest
- Multiplane Dynamic Rotor Balance
- Magnetic Particle Testing, Turbine Casing & Steam Chest
- Ultrasonic Inspection, Forged Rotor Shaft
- Ultrasonic Inspection, Forged Rotor Disks
- No-Load Mechanical Run Test, 1/2 Hour

Optional Scope of Supply

• Generator - 3 Phase Reactive Droop Module for Paralleling with Other Generators, Total Qty (1)	$ 966
• Generator - VAR / PF Control Module for Paralleling with the Grid, Total Qty (1)	$ 2,808
• Circuit Breaker, Total Qty (1)	$ 70,290
• Control System Communications Package, Total Qty (1)	$ 5,754
• Remote Control Station, Total Qty (1)	$ 10,275
• Enclosure Air Conditioner, Total Qty (1)	$ 4,110
• Test Switches (Each)	$ 710

Notes:

- Quoted Delivery does not include *Optional Scope of Supply* items, if applicable.

Drawings

- Drawing, Gearbox Outline - Initial Submittal 16 weeks ARO
- Drawing, Combined Outline - Initial Submittal 16 weeks ARO
- Drawing, Wiring Diagram - Initial Submittal 12 weeks ARO
- Drawing, P&I Diagram - Initial Submittal 8 weeks ARO
- Drawing, Combined Purchaser's Connections - Initial Submittal 18 weeks ARO
- Drawing, Coupling Outline - Initial Submittal 12 weeks ARO
- Drawing, Gauge Panel Outline - Initial Submittal 12 weeks ARO
- Drawing, Steam Ejector - Initial Submittal 12 weeks ARO

Quality Record Book

- Instruction Book CD - Submittal 2 Weeks After Shipment
- Instruction & Operation Manual Language - English

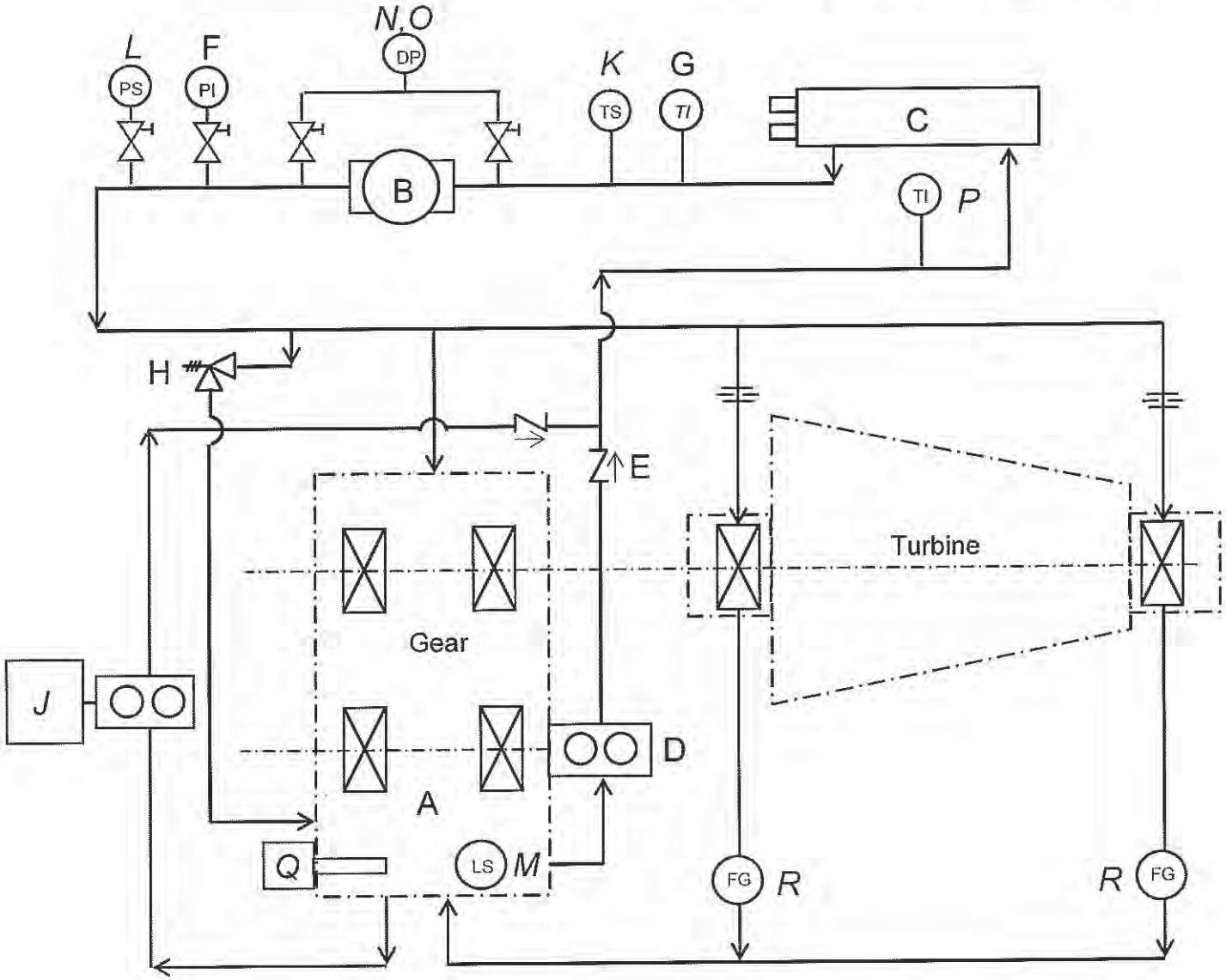
Notes:

- Scope or design changes may impact quoted price and delivery.
- Drawings are issued for record only and are not subject to customer comment.
- Drawing symbols, format and layout is accordance with Elliott Group standards.
- Customer supplied cover sheets to be incorporated onto Elliott's drawing must be provided at order award and in .dwg or .dxf format.

Lubrication System Schematic

STANDARD ITEMS		OPTIONAL ITEMS	
A	Reservoir, Gear Case	*B*	*Duplex Oil Filter*
B	Oil Filter	*C*	*Dual Oil Coolers, Shell and Tube*
C	Oil Cooler, Shell and Tube	*J*	*Auxiliary Oil Pump, Motor Driven*
D	Main Oil Pump, Shaft Driven	*K*	*Switch, High Oil Temperature*
E	Check Valve	*L*	*Switch, Low Oil Pressure*
F	Pressure Indicator, Oil Supply	*M*	*Switch, Low Oil Level*
G	Temperature Indicator, Downstream of Cooler	*N*	*Differential Pressure Gauge, Oil Filter*
H	Safety Relief Valve	*O*	*Differential Pressure Switch, Oil Filter*
		P	*Temperature Indicator, Upstream of Cooler*
		Q	*Heater with Low Oil Level Switch*
		R	*Sight Flow, Turbine Oil Drain (Qty 2)*

See Scope of Supply for included optional items or pricing.



Turbine Generator Control System

The Turbine Generator Control System incorporates turbine control, auto synchronizing, steam pressure control, optional temperature and pressure monitoring and generator/intertie protection into a single fully-integrated cogeneration control system designed to operate in parallel with utility power. The controls incorporate all the features needed to operate a cogeneration system that maximizes efficiency and is easy to use.

- Automatic controlled start with manual override
- Automatic and manual synchronizing
- Inlet or Exhaust pressure control, with power output limiting
- Electronic overspeed protection to backup mechanical protection on the turbine
- Lube oil pump control, as required
- Turbine generator monitoring including alarming, tripping and data display on the HMI
  - Turbine speed
  - Inlet or exhaust pressure
  - Lube oil temperature and pressure for pressurized lube systems (optional)
  - Vibration and bearing temperature monitoring for the turbine, gear and generator (optional)
  - Generator stator temperature monitoring (optional)
  - Revenue grade electrical metering for volts, amps, power (kW), kWH, kVAR, frequency and power factor
- Turbine trip relay, de-energize to trip, sequential trip
  - Overspeed trip
  - High bearing vibration (optional)
  - High bearing temperature (optional)
  - Low lube oil pressure
  - High lube oil temperature
  - High exhaust pressure
  - Customer trips
  - Emergency stop pushbuttons

Control System Components

Enclosure – Heavy duty free-standing welded NEMA 12 enclosure with gasketed door and 3-point latch, and interior light and service receptacle. Dimensions 72H x 36W x 24D

Human Machine Interface (HMI) -- 8 inch color touchscreen HMI in main panel. The following screens are typical.

- Directory screen and other screens required for HMI navigation
- System overview screen showing system status, control mode and a summary of operating parameters
- Startup screen
- Shutdown screen
- Overspeed test
- Screens for setpoints for control and monitoring parameters
- Service screens for PID tuning with real time trending
- Alarms and shutdowns

Auto Synchronizer

- Fully automatic synchronizing
- Backup manual synchronizing including display of generator and bus frequency and voltage and synchroscope display
- Both automatic and manual synchronizing are supervised by the synch check relay in the generator protection relay.

Generator Protection Relay – Schweitzer Engineering Laboratories SEL 700G utility-grade generator protection relay for complete electrical system protection including sync check (25), voltage (27/59), reverse power (32), loss of field (40), current imbalance (46), voltage controlled time overcurrent (51V), loss of PT fuse (60FL) frequency (81O/U) and many other functions. Relay settings are not included.

Mounting and Wiring AVR Supplied by Others

This option is to mount and wire the AVR supplied by the generator vendor in the control panel.

Temperature Monitoring

RTD temperature monitoring for generator stator, bearings, lube oil or other monitoring points. Monitored points will be used for alarms and trips and data will be displayed on the HMI.

Additional Analog Signal Monitoring

The base proposal includes monitoring for turbine speed, exhaust (or inlet) pressure, remote pressure setpoint and generator power (kW). This option is for monitoring additional analog signals such as vibration, additional steam pressures or other analog signals.

Options

15 kV Voltage Circuit Breaker

Indoor metal clad switchgear with drawout vacuum circuit breaker, 3 phase, 3 wire

- Rated per ANSI C37.06-2000 standards
  - Up to 13.8 kV design voltage
  - 1200 A maximum continuous current
  - 500 MVA/ 18 kA short circuit rating
  - 95 kV BIL rated
- Silver plated copper bus with fluidized bed epoxy insulation
- Control power is 125 VDC (by others).
- 3 metering and relaying current transformers
- Metering and relaying potential transformers, drawout, fused, (1 for bus and 2 for generator)
- Breaker trip/close switch and indicating lights
- Ground bus
- Position indicating lights and control switch
- Approximate dimensions (inches): 95H x 36W x 96D

Communications
Modbus RS 485 communications to the plant DCS for communication of turbine, generator and electrical operating parameters using standard map. Data includes speed, valve position, electrical data and temperature and vibration data if options are selected.

Remote Control Station
An auxiliary remote control panel can be located next to T/G set, or in a remote control location. The panel is designed for complete operator control including starting, stopping and display of operating data.

Enclosure Air Conditioner
Enclosure cooling is required in applications where the ambient temperature is above 40°C (104°F). This air conditioner mounts on the side of the panel and adds 9" to the panel width. It is thermostatically controlled and has a digital display of the enclosure temperature. Air flow is closed loop so ambient air is not introduced into the enclosure.

Test Switches
Test switches are mounted on the enclosure door to facilitate testing the generator protection relay. They may be required by certain utilities. The number of switches required depends on the complexity of the system and the utility requirements. Small systems with a single generator protection relay usually need two switches, if switches are required. Test switches are very difficult to add after construction.

Elliott Technical Training - On-site or at Factory

Elliott recommends formal training of your operations and maintenance staff to ensure proper equipment performance and to minimize life cycle costs. In addition to the equipment addressed in this proposal, Elliott's Technical Training group is prepared to address your specific needs.

Training can be scheduled at your facility or at our factory in Jeannette, Pennsylvania. Our training programs provide experienced instructors to train operator, maintenance, and supervisory personnel in the proper utilization of your Elliott Steam Turbine Generator. Our primary focus is to provide significant reductions in your operating and maintenance cost. Proper operation and maintenance is essential for long, reliable equipment life.

Classroom Training Topics Include:

- Introduction to Steam Turbines
- Overview of Steam Turbine Components
- Auxiliaries
- Lubrication System (as applicable)
- Gear Overview (if applicable)
- Generator Overview
- Troubleshooting
- Routine Inspections & Preventative Maintenance
- Turbine Generator Controls
- Equipment Operational Precautions
- Operating the Steam Turbine Generator

Factory Training includes (in addition to Classroom Training Topics):

- Tour of manufacturing and assembly operations
- Coupling assembly / disassembly

If you are interested in on-site or factory training, please contact the Elliott Technical Training Department at
(724) 600-8521 or training@elliott-turbo.com.

For a formal quote, please provide the following information:

- Customer name and Elliott proposal number
- Desired training location
- Number of Participants/Number of shifts to be trained
- Type of Participants (operators, maintenance, etc.)
- Desired Length of Training

Turbine Generator Installation and Commissioning Services

Elliott recommends qualified technical support throughout the planning, installation, and commissioning phases of your project to ensure proper equipment performance and to minimize life cycle costs. In addition to the equipment addressed in this proposal, Elliott's Global Field Service group is prepared to address your specific needs.

Elliott recommends early coordination with our Field Service organization to ensure proper installation and commissioning of your steam turbine generator and associated equipment. Because a good installation results from a clear understanding of customer needs and capabilities, a Field Service representative will contact you to discuss options and pricing available for planning, installation, and commissioning support. Your service representative is:

Ken Clark, Regional Service Manager
225-772-0218
kclark@elliott-turbo.com

Steam turbine generators are complex pieces of precision equipment. They require specialized care and experience in assessing and addressing the interfaces between Elliott equipment and the plant.

The mechanical installation of a baseplate mounted steam turbine generator and separate lube oil system (if supplied) typically follows the following sequence:

- Pre-Installation activity
- Receiving Inspections
- Foundation/chock block inspection
- Equipment Installation and setting of lube oil systems (if provided)
- Final steam line blow down
- Final site lube oil flush
- Piping connection make-up, piping strain and shaft alignment
- General Pre-commissioning and Commissioning Activity

As the scope and schedule for the site work becomes more defined, it is expected that the various components of field support can be integrated into the site schedule resulting in efficient work flow, load leveling, staffing, and supervision. Elliott can provide the necessary flexibility in support of the final schedule and for the ultimate benefit of the owner.

All installation and commissioning activities will be separately quoted after consultation with the Customer to determine specific needs and requirements.

Steam Purity Guidelines:

Elliott Company's recommended guidelines for steam purity limits for both start-up and continuous operation of steam turbines are defined in the following table, adapted from Table 9-2 of NEMA SM23-1991 with Chlorine comment added:

		CONTINUOUS	STARTUP
Conductivity -			
Micromhs/cm at 25°C			
	Drum	0.3	1.0
	Once through	0.2	0.5
SiO_2	(ppb, max.)	20	50
Fe	(ppb, max.)	20	50
Cu	(ppb, max.)	3	10
Na + K	(ppb, max.)		
	up to 800 psig (5516 kPag)	20	20
	801 to 1450 psig (5517 to 9998 kPag)	10	10
	1451 to 2400 psig (9999 to 16548 kPag)	5	5
	over 2400 psig (over 16548 kPag)	3	3
Chlorine	(ppb, max.)	10	10-30

Notes:
1. TDS (total dissolved solids) 100 ppm, max.
2. Other contaminants should be advised by Purchaser and reviewed by Elliott on an individual basis.

Steam Quality Guidelines:

Turbine applications that operate on Dry & Saturated inlet steam conditions require special attention regarding moisture removal. The purchaser/purchaser's engineer shall be responsible to coordinate the moisture removal requirements between the steam supply source and the turbine inlet connection. This may require a combination of special insulation, drain traps and a steam separator, depending on the site-specific physical piping layout.

Elliott does not recommend using Dry & Saturated inlet steam above 400 psig.

Summary: Application In the matter of the application to Commit Energy Efficiency/Peak Demand Reduction Programs electronically filed by Mr. Lucas Dixon on behalf of AK Steel Corporation electronically filed by Mr. Lucas M Dixon on behalf of Plug Smart and Mr. Lucas M Dixon