Jennifer Brooks Hutchinson
Senior Counsel

April 8, 2013

VIA HAND DELIVERY & ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Docket 4397 - Review of Energy Efficiency and Advanced Gas Technology Incentives For 12.5 MW Combined Heat and Power System
Responses to Commission Data Requests – Set 1

Dear Ms. Massaro:

On behalf of National Grid[1] attached are the Company's responses to the Commission's First Set of Data Requests issued in the above-captioned proceeding.

Thank you for your attention to this filing. If you have any questions concerning this transmittal, please feel free to contact me at (401) 784-7288.

Very truly yours,

Jennifer Brooks Hutchinson

Enclosures

cc: Docket 4397 Service List
Leo Wold, Esq.
Steve Scialabba, Division

[1] The Narragansett Electric Company d/b/a National Grid (hereinafter referred to as "National Grid" or the "Company").

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Certificate of Service

I hereby certify that a copy of the cover letter and/or any materials accompanying this certificate were electronically transmitted to the individuals listed below. Paper copies of this filing were hand delivered to the Rhode Island Public Utilities Commission.

______________________________ April 8, 2013

Joanne M. Scanlon Date

Docket No. 4397 - National Grid - Energy Efficiency and Advanced Gas Technology Incentives for 12.5 MW CHP System Package to Toray
Service list updated 3/11/13

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Commission 1-1

Request:

What was the rational for using the 10.05% discount rate in calculating the lifetime net present value of the CHP Project?

Response:

The calculation referred to in the question is understood as the calculation of the net present value ("NPV") of the incremental gas revenues related to the proposed CHP project. These revenues are future revenues of the Narragansett Electric Company's gas delivery business. The 10.05% is the current pre-tax Weighted Average Cost of Capital ("WACC") for the gas delivery business, as approved in the Amended Settlement agreement entered on December 20, 2012 and as filed with the Commission on January 24, 2013, in Compliance Attachment 6, Schedule MDL-3-GAS, page 56, row 9, column (e). As future revenues of the gas company, the current NPV of those revenues is most appropriately determined by using the WACC of the gas delivery portion of the Company.

Prepared by or under the supervision of: Ian Springsteel

Commission 1-2

Request:

According to page 5 of the Petition, the CHP Project is expected to reduce electricity consumption of centrally generated grid-supplied energy by 87,473 MWh/year with a total system efficiency of 58%. Please explain how you arrived at 87,473 MWh.

Response:

The 87,473 MWh/year energy supply is based on the finalized Technical Assessment (TA) study, whereby the base line of 101,657 MWh/year was calculated using Toray's existing consumption for the prior two years. Using the proposed generators data provided by the equipment's manufacturer, the Company calculated, in an electrically following mode, that the two engines would generate 87,473 MWh/year net. This is a combination of running production hours minus any new ancillary equipment.

Prepared by or under the supervision of: Mark DiPetrillo

Commission 1-3

Request:

Your AGT Financial Analysis references equipment life of 20 years. Why does the Offer Letter assume cogeneration equipment will remain in operation as the primary source of energy for a minimum period of 10 years? Why not 20 years?

Response:

The major components of the CHP installation are expected to last approximately 20 years, so the assessment of the full lifetime benefit from the incremental gas sales is based on 20 years of such revenues. The minimum performance period was designed to be less than this expected useful life as a minimum commitment by the customer to keep the CHP plant in place and operational, or face a financial penalty. Maintenance requirements in the Minimum Requirements Document (Attachment A to the Petition) are intended to reinforce this commitment by the customer.

Prepared by or under the supervision of: Mark DiPetrillo and Ian Springsteel

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Commission 1-4

Request:

According to the Letter of Award & Acceptance, (Offer Letter, Attachment 2, p. 7 of 9), "Customer agrees to allow National Grid periodic access to Toray Plastics (America), Inc. Energy Project's invoices, records, utility bills, etc. to confirm the actual versus estimated performance as documented in the DSM Application and Technical Report. This periodic access will not exceed the first two (2) years of the Energy Project's commercial operation." Why is the periodic access limited to two (2) years and not four (4) or more years?

Response:

The term of (2) years is based on the Company's existing Advanced Gas Technology program. However, this provision would not preclude the Company from collecting performance data over a four-year period, as specified in the offer letter (Attachment A to the Petition).

Prepared by or under the supervision of: Mark DiPetrillo

Commission 1-5

Request:

Page 3 of the Petition appears to discuss some, but not all, of the statutory criteria factored into the CHP plan. Please explain how each of the statutory factors listed in R.I.G.L. §39-1-27.7(c)(6)(iii) were considered in the CHP plan.

Response:

Rhode Island General Laws §39-1-27.7(c)(6)(iii) required the Company to factor the following criteria into its CHP program: "(A) Economic development benefits in Rhode Island, including…investments in combined heat and power systems; (B) Energy and cost savings for customers; (C) Energy supply costs; (D) Greenhouse gas emissions standards and air quality benefits; and (E) System reliability benefits." These factors were considered in the CHP plan as part of the 2013 Energy Efficiency Program Plan ("EEPP"), approved in Docket 4366 as follows:

> Economic development benefits were considered through the modification of the benefit cost test as proposed and adopted in the 2013 EEPP, Attachment 2, page 36. These benefits were included in the screening process for the Toray project, as noted on page 3 of the Petition.
>
> Energy and cost savings for customers, as well as energy supply costs are considered in the cost effectiveness testing of all energy efficiency programs, including CHP. The costs and benefits of energy efficiency are among the factors included in the Total Resource Cost test as defined by the Standards approved by the Commission in Docket 4202.
>
> Greenhouse gas benefits were considered through the modification of the benefit cost test as proposed and adopted in the 2013 EEPP, Attachment 2, page 36. Although environmental benefits were not specifically considered in the benefit cost test for the Toray project, these benefits will be created by the installation of the project.
>
> System reliability benefits for CHP were considered through the modification of the benefit cost test as proposed and adopted in the 2013 Energy Efficiency Program Plan (EEPP), Attachment 2, page 35, to consider location specific distribution benefits, instead of system-wide benefits. For the Toray project, local distribution benefits were zero.

Prepared by or under the supervision of: Jeremy Newberger

Commission 1-6

Request:

Assuming the incentives for the CHP Project are approved, when do you anticipate executing the final contract with Toray? Will the contract be subject to Commission approval?

Response:

If the incentive package is approved by the Commission, then following such approval, the Company would negotiate and enter into an agreement with Toray that reflects the terms contained in the offer letter and any other terms and conditions that the Commission may order. If requested by the Commission, the Company would file a copy of the final agreement with the Commission.

Prepared by or under the supervision of: Mark DiPetrillo

Commission 1-7

Request:

Please provide a copy of the TA Study used to determine Toray's eligibility for the EE incentives.

Response:

Please see Attachment COMM 1-7 for a copy of the TA Study.

Prepared by or under the supervision of: Mark DiPetrillo

Combined Heat & Power

Technical Assistance Study

prepared for

Toray Plastics (America), Inc.
North Kingstown, Rhode Island

&

National Grid
Providence, Rhode Island

(Primarily based on Waldron's Combined Heat & Power Feasibility Study dated July 25, 2012.)

Executive Summary

Toray Plastics (America), Waldron Engineering and National Grid jointly participated in a Technical Assistance Study to investigate and conclude the optimal Combined Heat & Power System (CHP) based on Toray's 2011 energy usages and anticipated energy and preventive maintenance costs.

The optimal CHP concluded is a pair of Kawasaki reciprocating engines totaling 12 MWe (Net), while also generating a total of 11,500 Pounds per Hour (pph) of 135 psig steam and 1,000 Tons of chilled water. Medium pressure steam is generated from the engines' exhaust gases heat and the chilled water is generated by a steam turbine-driven, centrifugal chiller. All of the generated electricity will be directed toward the FAN building's loads and all of the chilled water will be directed to the Lumirror building's loads. The generated steam will be used by both the Lumirror and FAN buildings.

Boiler No.3 will continue to remain in Hot Standby (5,000 pph, 650 psig steam) and Lumirror's existing Combustion Gas Turbine (CGT) will continue to serve Lumirror's electric loads. Although the CGT's Duct-Burner will continue to operate, it will be at a much reduced load due to the engines' steam production. Lumirror's chilled water plant will continue utilizing Free-Cooling as the first choice and be followed by the steam turbine-driven chiller when excess steam is available, then the existing electric chillers.

Toray has requested and received contractor costs for the major components of the project (i.e., building, piping, electrical, controls, electric and NG utility interconnections, etc.) in addition to vendor prices on the major equipment (i.e., engine-generator sets, radiators, heat recovery boilers, emission control systems, etc.); including a special offer from Kawasaki for the engines-generators sets.

The following two (2) tables summarize the anticipated financial and energy performance of the proposed CHP, respectively.

Financial Summary								
Case Description	Capital Cost ($)	Electricity & Natural Gas Incentives[1] ($)	Net Capital Cost ($)	Electric Costs[2] ($)	Natural Gas Costs[3] ($)	Preventive Maintenance Costs ($)	Total Costs ($)	Net Simple Payback (Years)
Existing	N/A	N/A	N/A	$7,987,360	$4,704,237	$776,309	$13,467,906	N/A
Proposed	$22,700,000	$13,150,000	$9,550,000	$1,382,711	$8,451,663	$2,021,480	$11,855,854	N/A
Savings/(Costs)	($22,700,000)	$13,150,000	($9,550,000)	$6,604,649	($3,747,326)	($1,245,171)	$1,612,052	5.9

Notes:

1. *Electric Energy Efficiency Program Incentive of $11,350,000 and Natural Gas Advanced Gas Technologies Program Incentive of $1,800,000.*
2. *Based on NGrid's projected electric B-62 Distribution Tariff and Toray's projected electric commodity price.*
3. *Based on Toray's projected Natural Gas commodity price.*

Energy Summary							
Case Description	Electric Energy (kWh/Y)	Electric Demand (kW)	Natural Gas (Therms/Y)	Steam 650 psig (Lbs./Y)	Steam (135 psig) (Lbs./Y)	Electric Chilled Water[1] (Ton-H)	Steam Chilled Water (Ton-H)
Existing	101,657,000[1]	21,000[1]	7,970,581[2]	339,753,934[3]	0	6,670,597[3]	0
Proposed	14,184,000	14,000	14,319,999	321,191,954	88,805,215	2,167,292	4,503,305
Decreases/(Increases)	87,473,000	7,000	(6,349,418)	18,561,980	(88,805,215)	4,503,305	(4,503,305)

Notes:

1. *Based on NGrid's total, metered data for both Lumirror and FAN in 2011.*
2. *Based on NGrid's total, metered data for the CTG CHP and Boiler No.3 in 2011; all other NG usages excluded.*
3. *Based on metered data provided by Toray.*

2 Facility Description

Toray Plastics (America) has a 70 acre campus located in North Kingston, RI that houses the TorayFan and Lumirror factories along with the corporate headquarters. The TorayFan factory was built in 1987 and is approximately 400,000 square feet. The Lumirror factory, which was built in 1989, is approximately 300,000 square feet. Toray Plastics (America) employs about 680 people and operates twenty-four hours per day, seven days per week, 365 days per year.

The following table summarizes the existing utility infrastructure for both Lumirror and TorayFan.

Existing Lumirror CHP Facility Equipment	
(1) Combustion Turbine Generator, Taurus 70	7.5 MWe, nominal output
(1) Heat Recovery Steam Generator with Natural Gas Duct Burner	600 psig, saturated steam 28,000 lbs/hr Unfired 65,000 lbs/hr with Duct Firing
(5) Electric Centrifugal Chillers	(4) at 450 tons each, 0.567 kW/ton (1) at 700 tons, 0.67 kW/ton
Existing TorayFan Chiller Plant Equipment	
Area A3 Chiller Plant	(2) at 450 ton Electric Centrifugal Chillers
Area A4 Chiller Plant	(2) at 450 ton Electric Centrifugal Chillers
Area A5 Chiller Plant	(2) at 400 ton Electric Centrifugal Chillers
Area J Chiller Plant	(1) at 400 ton Electric Centrifugal Chiller (1) at 500 ton Electric Centrifugal Chiller
Existing Central Boiler Plant Equipment (serves both Lumirror and TorayFan)	
Boiler 1 (being decommissioned)	650 psig, saturated steam 33,000 lbs/hr
Boiler 2 (being refurbished)	650 psig, saturated steam 33,000 lbs/hr
Boiler 3 (normal hot stand-by boiler)	650 psig, saturated steam, 80,000 lbs/hr each

Figure 5 - Existing Facility Equipment Summary

Figure 6 is a schematic representation of the utility infrastructure at Toray Plastics. For additional site information, see the site plan in Appendix A.

Facility Description

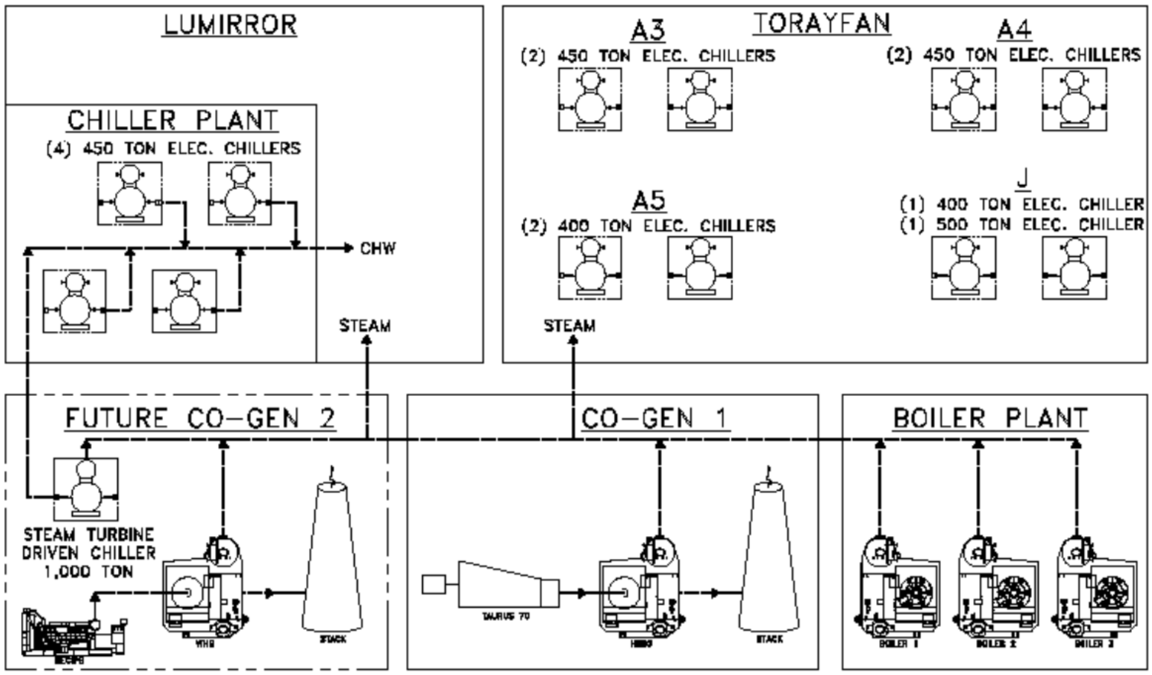


Figure 6 - Utility Infrastructure Schematic

Historic Energy Usages & Costs							
Month	Year	Natural Gas			Electricity		
		(Therms)	($/Therm)	($)	(kWh)	($/kWh)	($)
Jan	2011	814,239	$0.841	$684,775	7,648,363	$0.07857	$600,943
Feb	2011	713,326	$0.841	$599,907	6,916,410	$0.07857	$543,433
Mar	2011	771,750	$0.841	$649,042	7,876,312	$0.07857	$618,854
Apr	2011	635,224	$0.841	$534,224	8,915,153	$0.07857	$700,477
May	2011	631,286	$0.841	$530,912	8,441,409	$0.07857	$663,254
Jun	2011	637,478	$0.841	$536,119	8,589,428	$0.07857	$674,884
Jul	2011	625,631	$0.841	$526,155	9,695,895	$0.07857	$761,821
Aug	2011	625,898	$0.841	$526,380	9,154,925	$0.07857	$719,316
Sep	2011	594,280	$0.841	$499,789	8,757,692	$0.07857	$688,105
Oct	2011	596,348	$0.841	$501,529	9,428,865	$0.07857	$740,840
Nov	2011	620,901	$0.841	$522,177	8,059,351	$0.07857	$633,235
Dec	2011	704,221	$0.841	$592,250	8,173,406	$0.07857	$642,197
Totals		**7,970,581**	**$0.841**	**$6,703,259**	**101,657,209**	**$0.07857**	**$7,987,360**

4 Load Profiles

The first phase of the study was to develop hourly utility load profiles for steam, chilled water, and electricity. These hourly load profiles are loaded into Waldron's 8,760 model to calculate prime mover performance, auxiliary electric loads, waste heat recovery, utility costs, and operating and maintenance costs.

4.1 Steam Load Profile

There are four (4) steam pressure systems used at Lumirror and TorayFan. Currently, all the campus steam is generated at 45 bar. A portion of the steam is reduced to 16 bar for steam loads in Lumirror, another portion is reduced to 7 bar for steam loads in TorayFan, and a third portion is reduced to 5 bar for building heating loads.

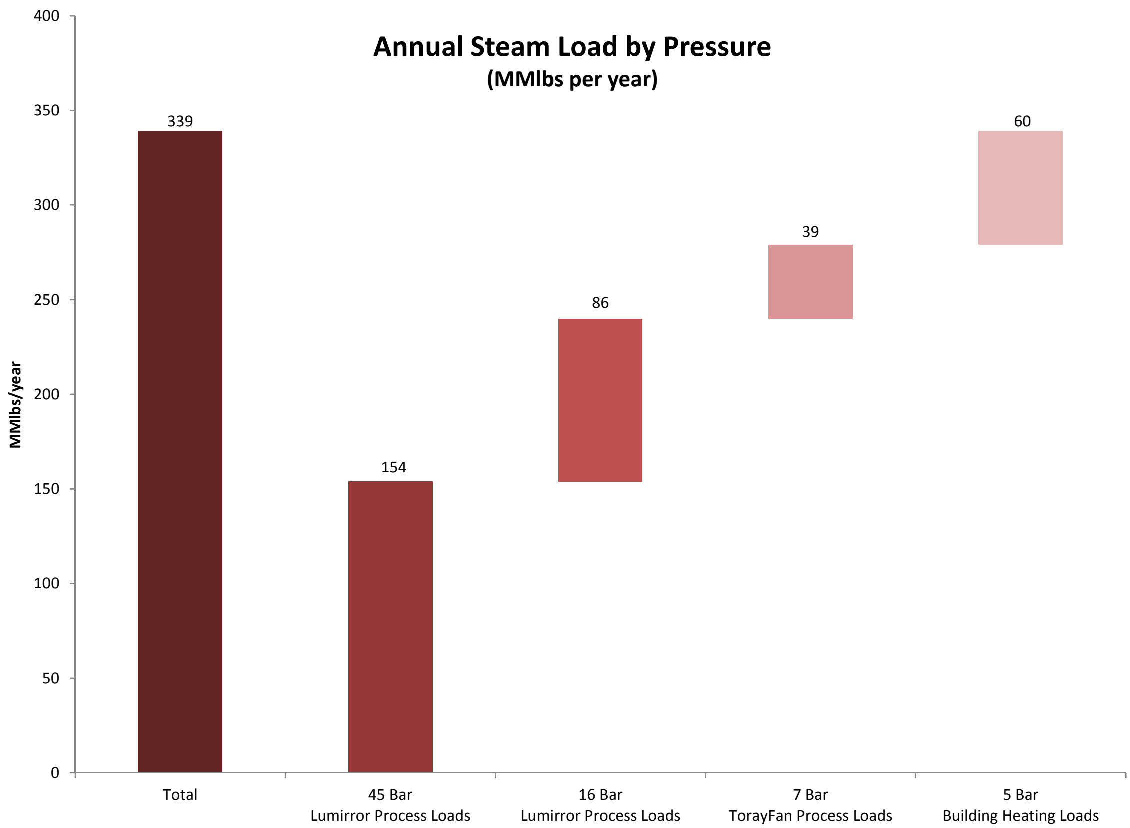


Figure 9 - Annual Steam Load by Pressure

During peak heating season, the unfired capacity of the HRSG is not sufficient to cover the entire steam load, so the duct burners are fired to increase steam production. In the event that the duct fired capacity of the HRSG is insufficient to cover the loads, Boiler #3 is dispatched to cover the remainder.

Toray provided Waldron with historical steam load data for each of the pressure headers on a daily basis.

Load Profiles

Hourly steam load data was also provided for a one month period of time. This hourly load data was used to develop the shape of a normalized curve that correlates to the steam load in excess of the process steam load. The process steam load is taken to be constant throughout the year and equates to 30,500 lbs/hr. The 8,760 steam profile was developed by taking the total steam production for the day, netting out the process load, and applying the normalized curve to the residual steam. As a result of this, the general shape of the steam profile for each day is similar, but the magnitude of the curve varies based on the daily total steam load. Figure 10 below shows three examples of the daily steam profile; one curve is for a winter daily steam load of 1.415 MMlbs/day, one curve is for a shoulder season daily steam load of 1.115 MMlbs/day, and one curve is for a summer daily steam load of 0.775 MMlbs/day. In all cases, there is a constant steam process load of 0.732 MMlbs/day.

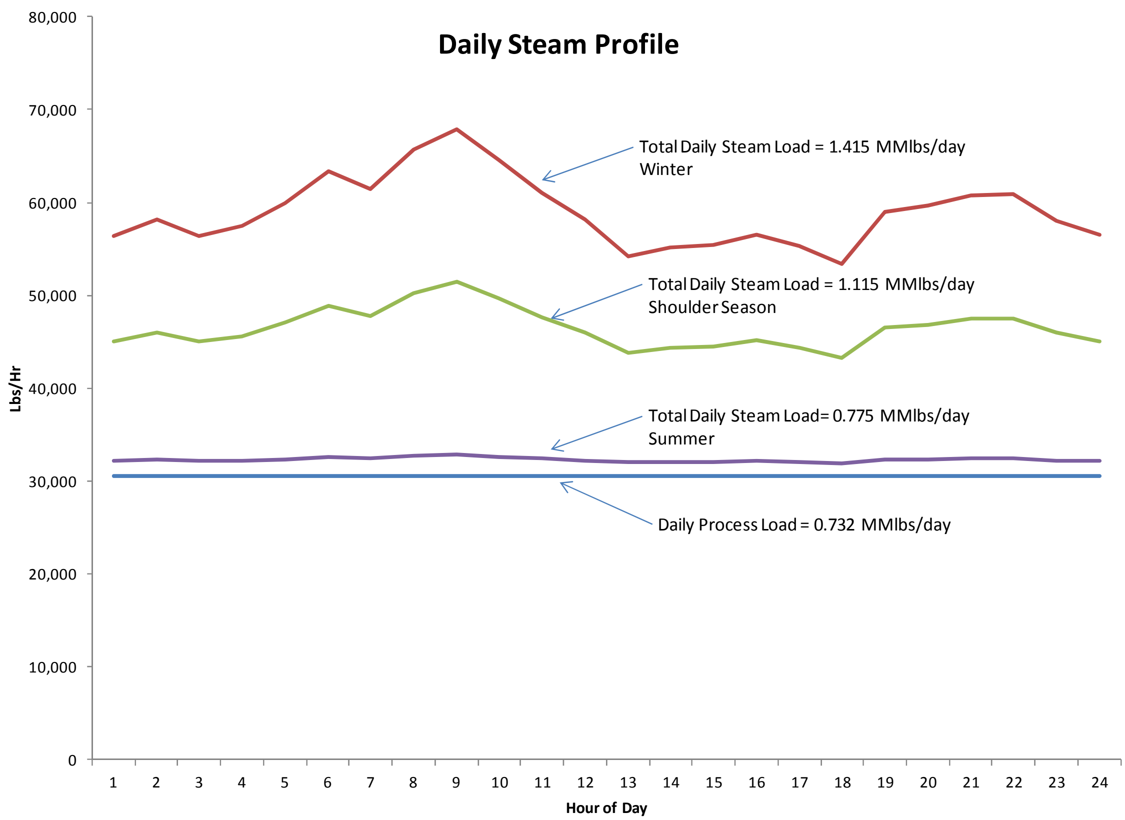


Figure 10 – Shape Examples of Daily Steam Profile

Figure 11 below shows the 8,760 hour total steam load profile for 2011. The annual total of this 8,760 steam profile is within 0.23% of the annual total of the daily load data provided by Toray.

Load Profiles

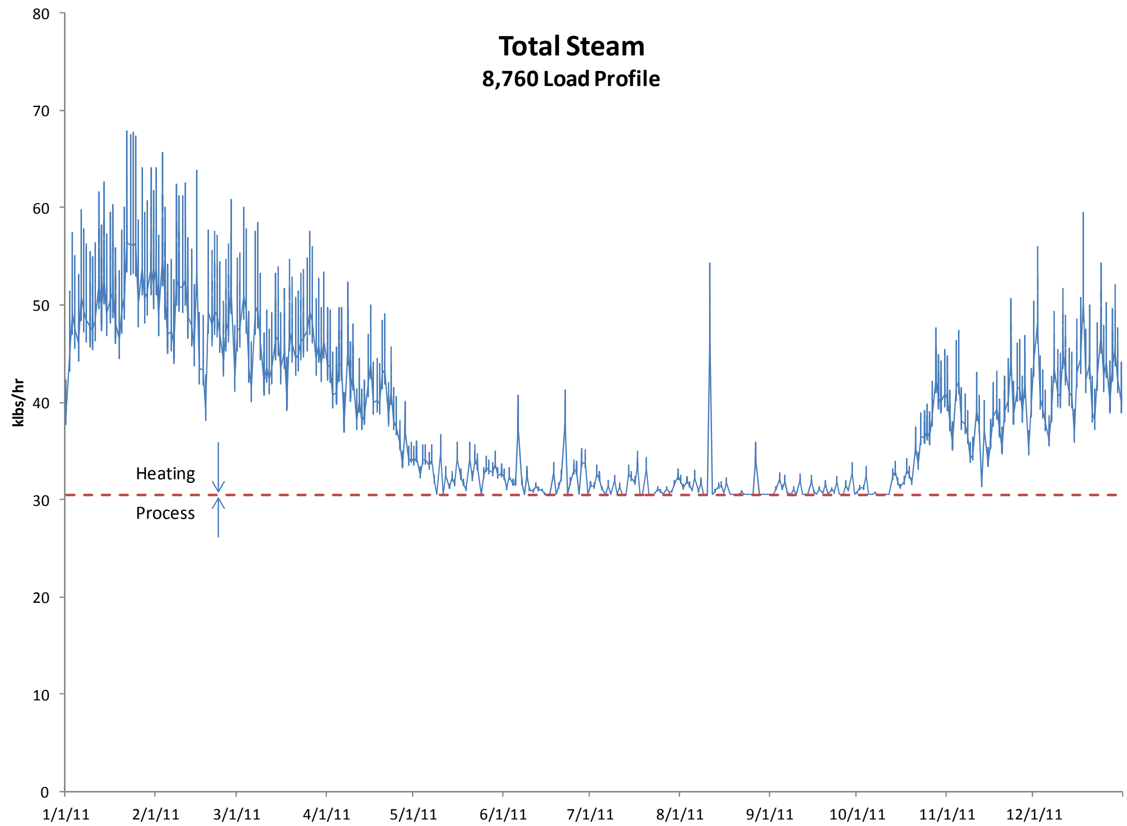


Figure 11 - 8,760 Steam Load Profile

Figure 11 shows the manufacturing process steam load of just over 30 kpph is maintained throughout the year. During the heating season, the steam load increases to a peak of about 68 kpph. The general shape and magnitude of the steam profile was the same for 2010 and 2011.

To maximize the steam production from the recip engines, they were configured to produce steam at 9.5 bar. This provides for better heat recovery compared to generating at 45 bar, and provides sufficient pressure to the steam turbine driven chiller. In order to verify that the steam could be fully utilized, a second steam profile was generated using the same methodology. This steam profile, shown in Figure 12 on the following page, corresponds to the 7 and 5 bar loads and was the profile against which the recip waste heat boilers operate.

Load Profiles

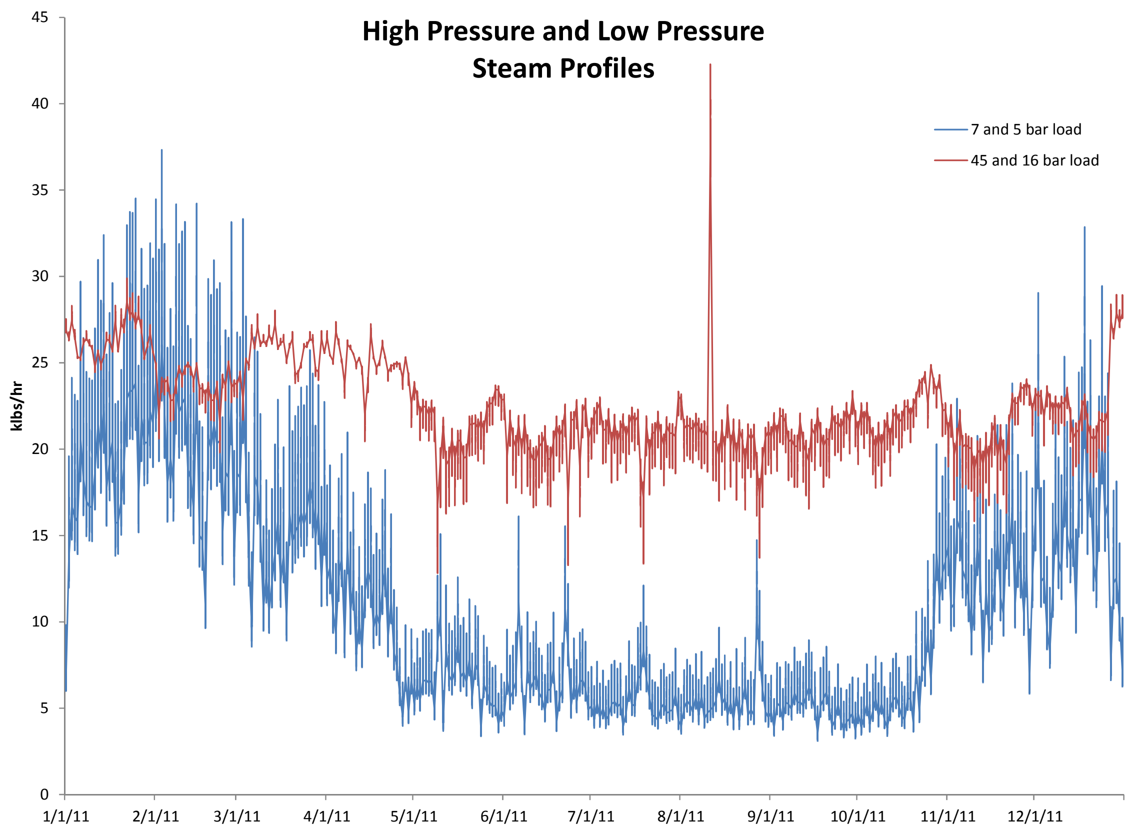


Figure 12 - High Pressure and Low Pressure Steam Profiles

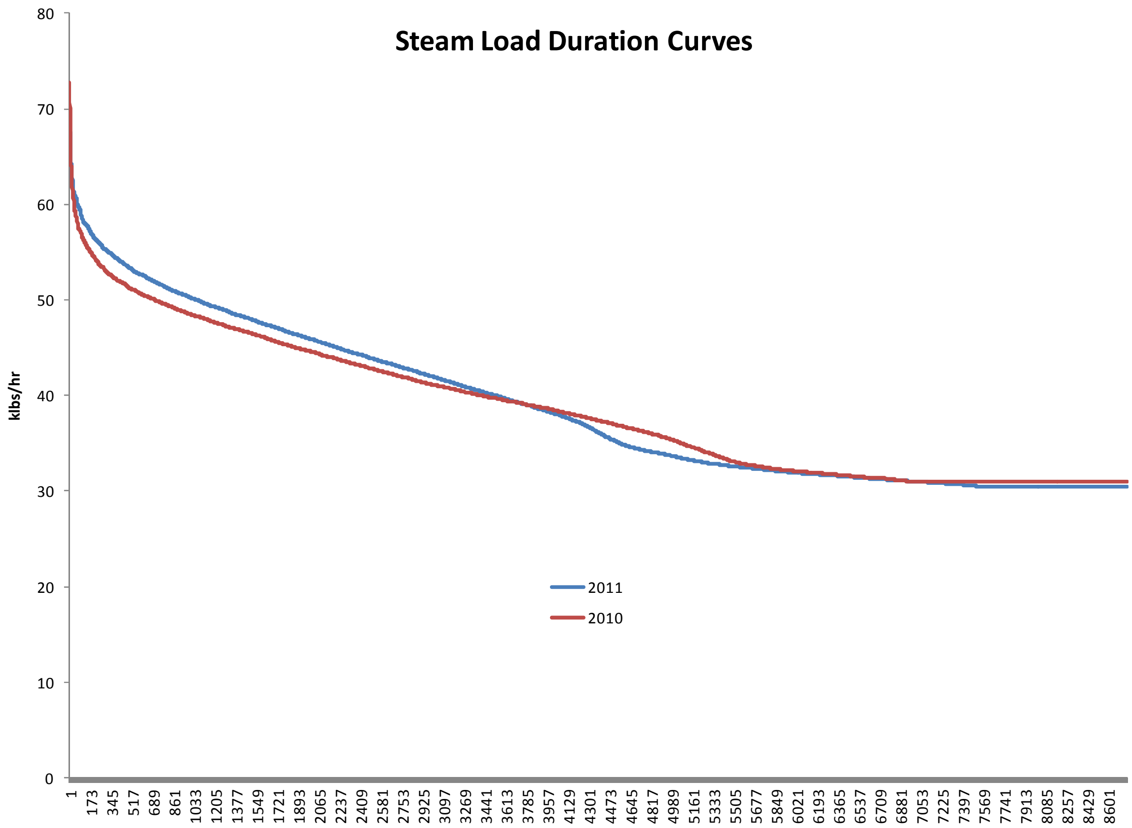


Figure 13 - Steam Duration Curves

Figure 13 shows the load duration curve for 2010 and 2011, which confirms that the year to year steam loads do not differ significantly.

4.2 Electrical Load Profile

Currently the Lumirror factory and the TorayFan factory are metered separately. The Lumirror factory uses the electricity generated by the Solar Taurus 70 CTG in Cogen 1 to offset purchased electricity. Any required electricity that is not provided by the CTG is purchased.

The TorayFan factory has no on-site electrical generation and therefore purchases all needed electricity.

8,760 electric load profiles were generated for both factories based on historical 15 minute interval data provided by Toray.

Although Lumirror and TorayFan are independent load centers, Toray Plastics is a single customer to the utilities (e.g. Toray Plastics receives a single bill for both factories).

The Lumirror electric load profile was used to model the hourly performance of the Taurus 70 CTG, which in turn affects the steam production of the HRSG and Duct Burner. The TorayFan electric profile was used to model the performance of the proposed CHP. Details of the modeling calculations are provided in Section 6 Modeling Methodology.

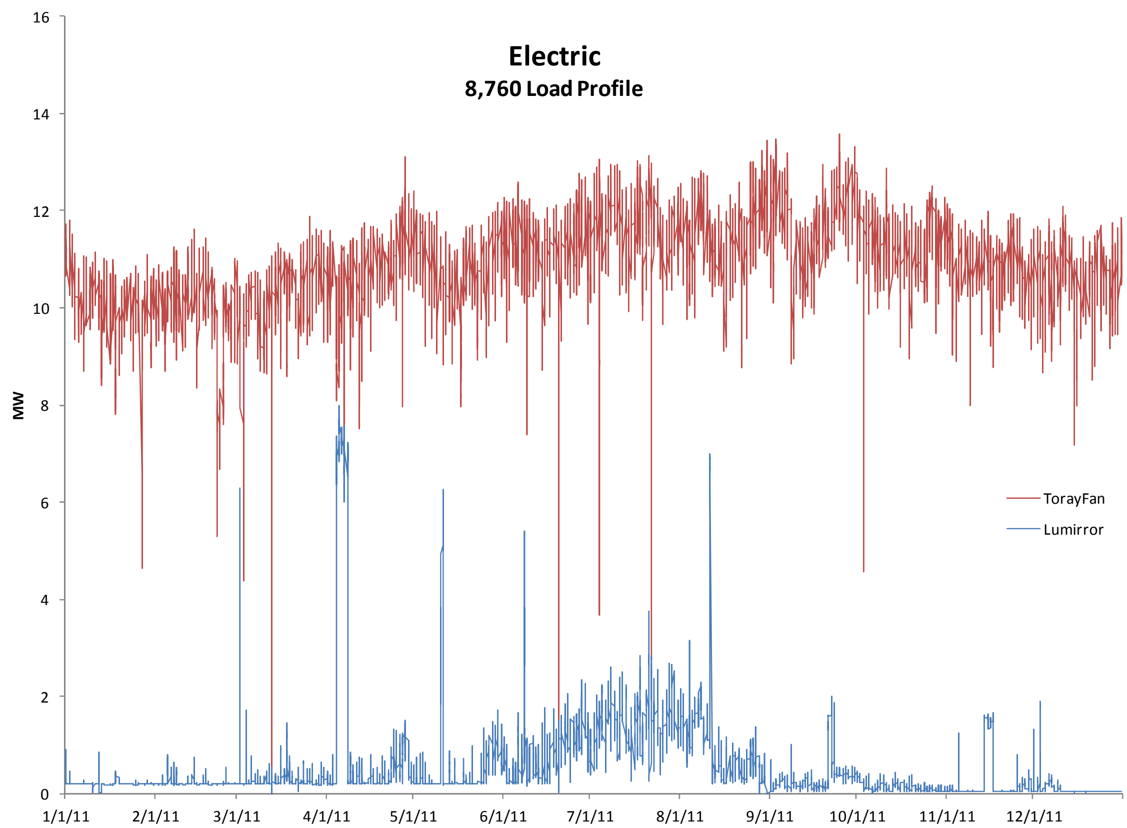


Figure 14 - 8,760 Electric Load Profiles

Figure 14 shows the 8,760 electric load profiles for both TorayFan and Lumirror. Figure 15 shows the load duration curves for both Lumirror and TorayFan for the years 2010 and 2011.

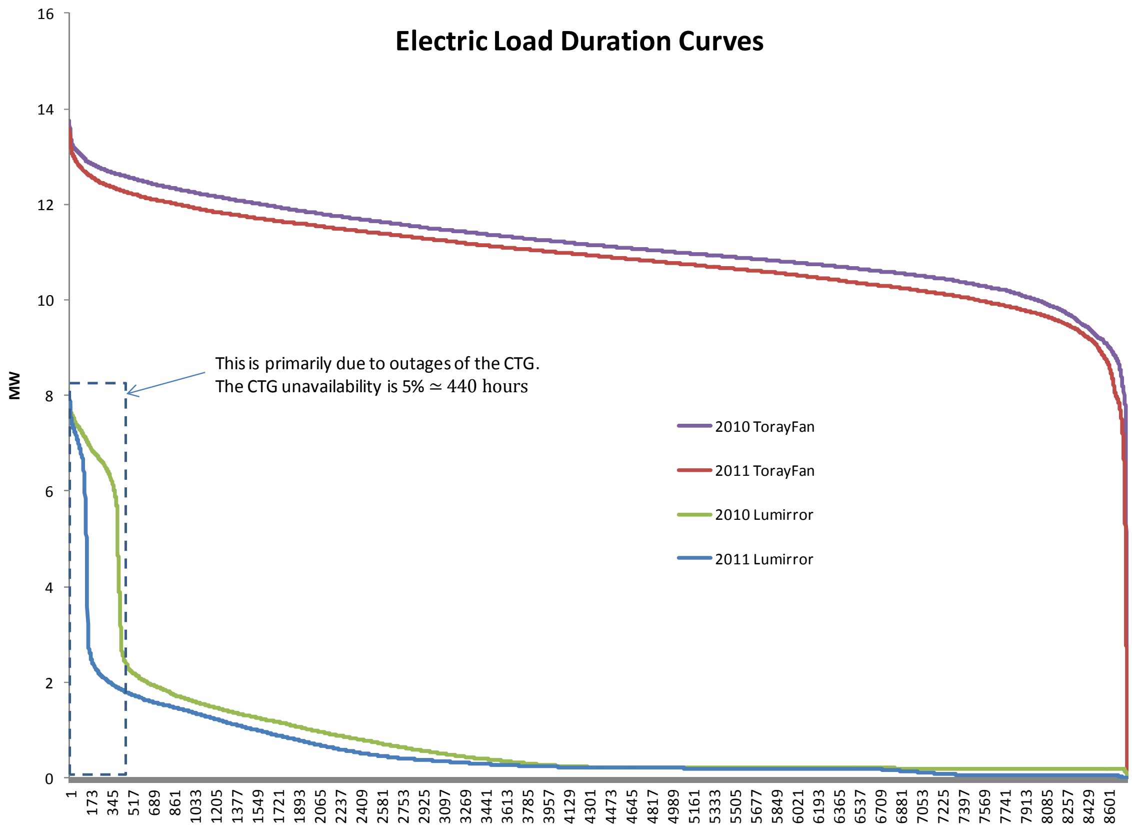


Figure 15 - Electric Load Duration Curves

4.3 Chilled Water Load Profiles

Chilled water for the TorayFan plant is supplied from four different chiller plants within the factory. Historical load data was not available for these chillers. Furthermore, it would be expensive to distribute chilled water from the proposed CHP site to the distributed chiller plants in the TorayFan facility because of their locations relative to the site of the proposed CHP. The Lumirror chiller plant, on the other hand, is located adjacent to the proposed CHP site and it houses all of Lumirror's chillers and chilled water pumps. It would be more cost effective to connect to this system and historical load data existed for this plant, therefore, it was decided to use the proposed steam turbine driven chiller in the CHP to offset the electric motor driven chillers in Lumirror.

Section 6 Modeling Methodology details the electric and thermal interactions between TorayFan and Lumirror and the effects that connecting to Lumirror's chiller plant has on the existing Cogen 1 performance.

Figure 16 shows the 8,760 chilled water profile for Lumirror for 2011. The graphic also illustrates the times during the year when a "free cooling" heat exchanger was used to cover the chilled water load. When the free cooling heat exchanger is used, it is able to cover the entire chilled water load.

Load Profiles

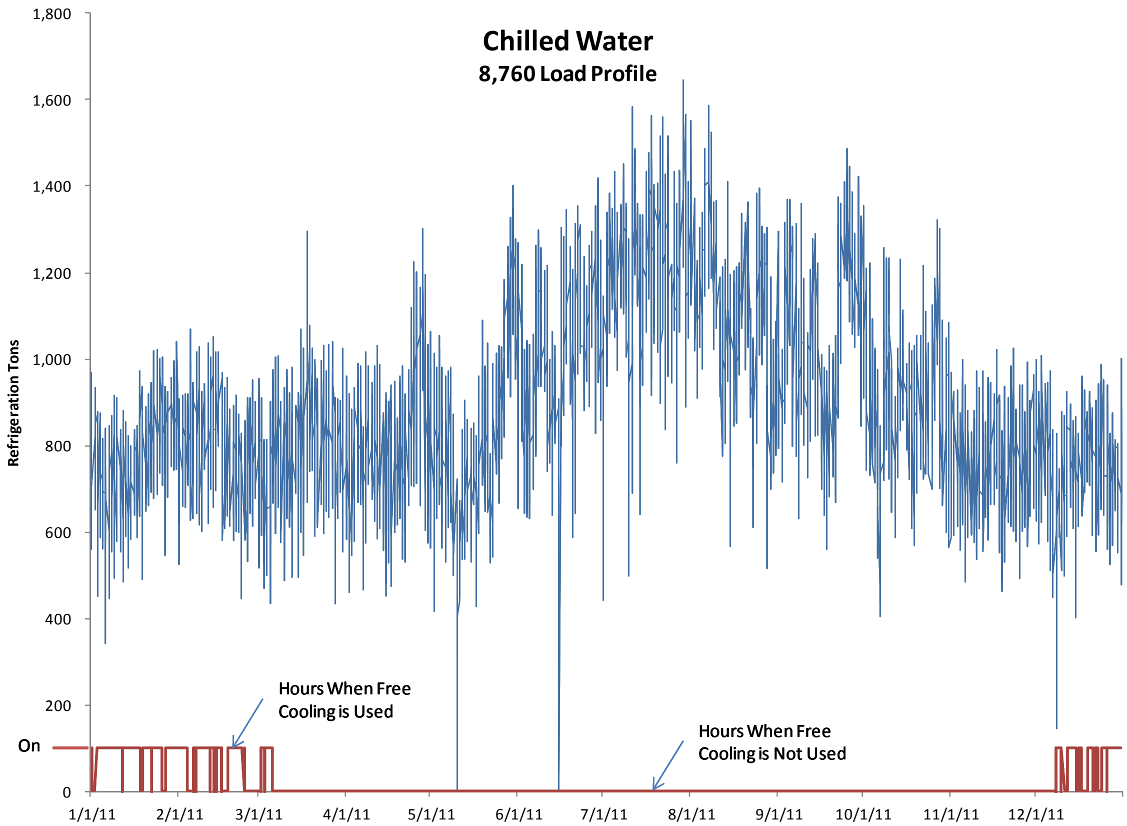


Figure 16 - Chilled Water Load Profile

CHP System Description

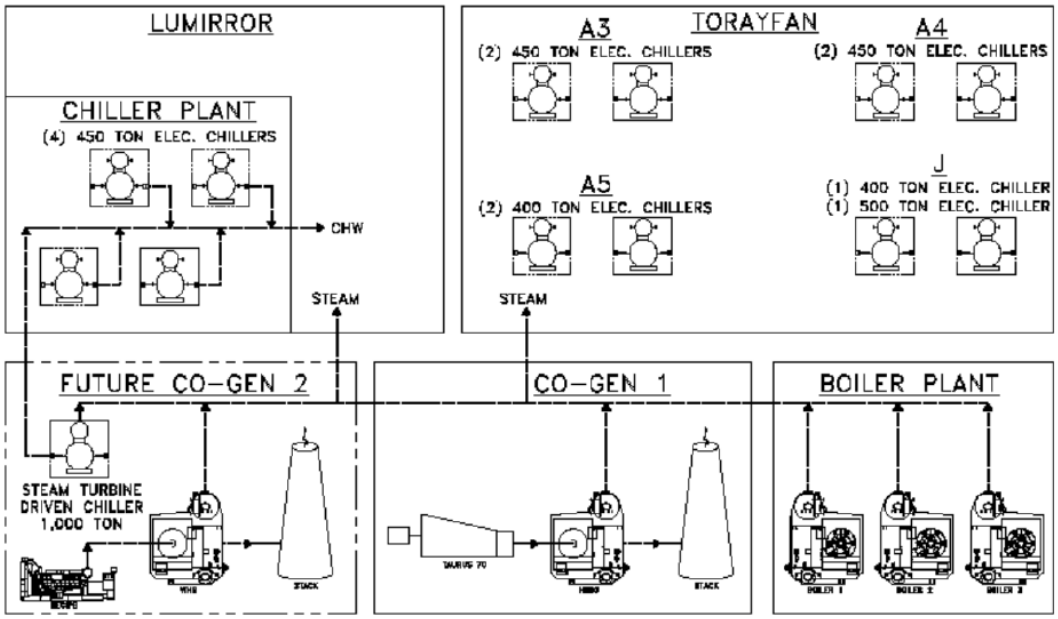
The proposed CHP consists of the following major equipment and is graphically represented by the below diagram.

1. 1 x Reciprocating engine rated at 7.5 MWe and manufactured by Kawasaki Heavy Industries; M/N: KG-18-V.
    a. 1 x Heat Recovery Steam Generator (HRSG) rated at 7,000 pph of 135 psig saturated steam and manufactured by Cleaver-Brooks; M/N: S-2.5-1414.
    b. 1 x Air-Cooled Hot Water Waste Heat Radiator.
    c. 1 x NO_x and CO emissions control system.
    d. 0 x Natural Gas (NG) compressor (i.e., 38 psig supply pressure is acceptable).
2. 1 x Reciprocating engine rated at 5.0 MWe and manufactured by Kawasaki Heavy Industries; M/N: KG-12-V.
    a. 1 x HRSG rated at 4,500 pph of 135 psig saturated steam and manufactured by Cleaver-Brooks; M/N: S-2.5-1414.
    b. 1 x Air-Cooled Hot Water Waste Heat Radiator.
    c. 1 x NO_x and CO emissions control system.
    d. 0 x Natural Gas (NG) compressor (i.e., 38 psig supply pressure is acceptable).
3. 1 x Steam Turbine-Driven Chiller rated at 1,000 Tons and manufactured by York International; M/N: YSTLKLJH9-KGF.
4. 1 x Lot of Electric Parasitic Loads equal to 443 kWe (i.e., 3.54% of each engine's electrical rating).
    a. Various fans and pumps for radiator fans, building exhaust fans, emission control solution pumps, boiler feed-water pumps, etc.
5. 1 x Lot of controls for the proposed CHP and also to integrate the existing CHP's control.
6. 1 x Lot of a new building to house all of the abovementioned equipment as well as the new electric switchgear, piping, plumbing, etc.

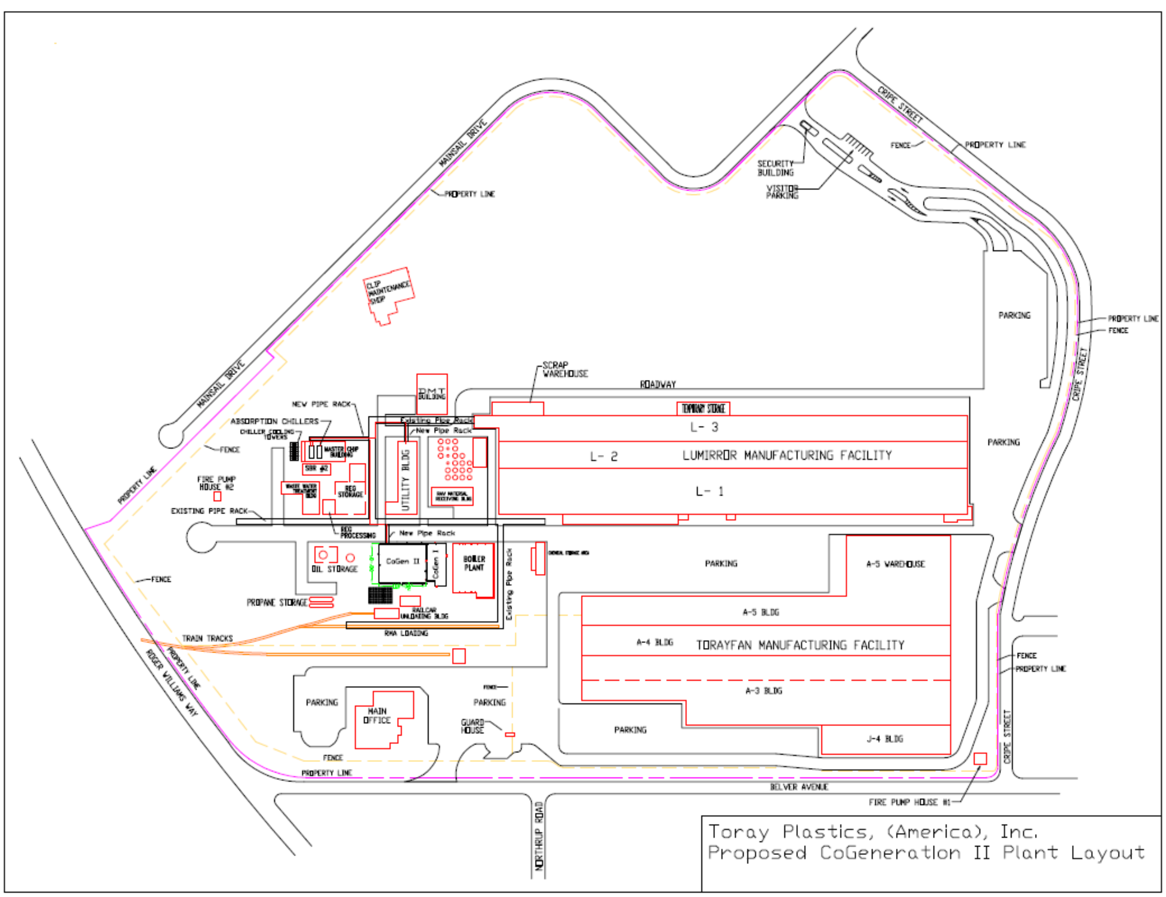
All of the generated electricity will be directed toward the FAN building's process and general loads and all of the chilled water will be directed to the Lumirror building's process and general loads. The 135 psig generated steam generated by the reciprocating engines will be used by both the Lumirror and FAN buildings for both process and space heating and to generate chilled water via the proposed steam turbine-driven chiller.

With regard to the existing major equipment and systems, Boiler Nos. 1 & 2 will remain inoperative, while Boiler No.3 will continue to remain in Hot Standby (i.e., always generating ~5,000 pph, 650 psig steam). Lumirror's existing CGT will continue to serve Lumirror's process and general electric loads. Although the CGT's Duct-Burner will continue to operate, it will be at a significantly reduced 650 psig steam load due to the engines' generating virtually all of the 135 psig steam for Lumirror and FAN. Lumirror's chilled water plant will continue utilizing Free-Cooling as the first choice and be followed by the steam turbine-driven chiller when sufficient steam is available from the reciprocating engines. The existing electric chillers will be the last choice for generating chilled water for Lumirror's process and general chilled water loads. FAN's decentralized chiller plants will not be affected by the proposed CHP.

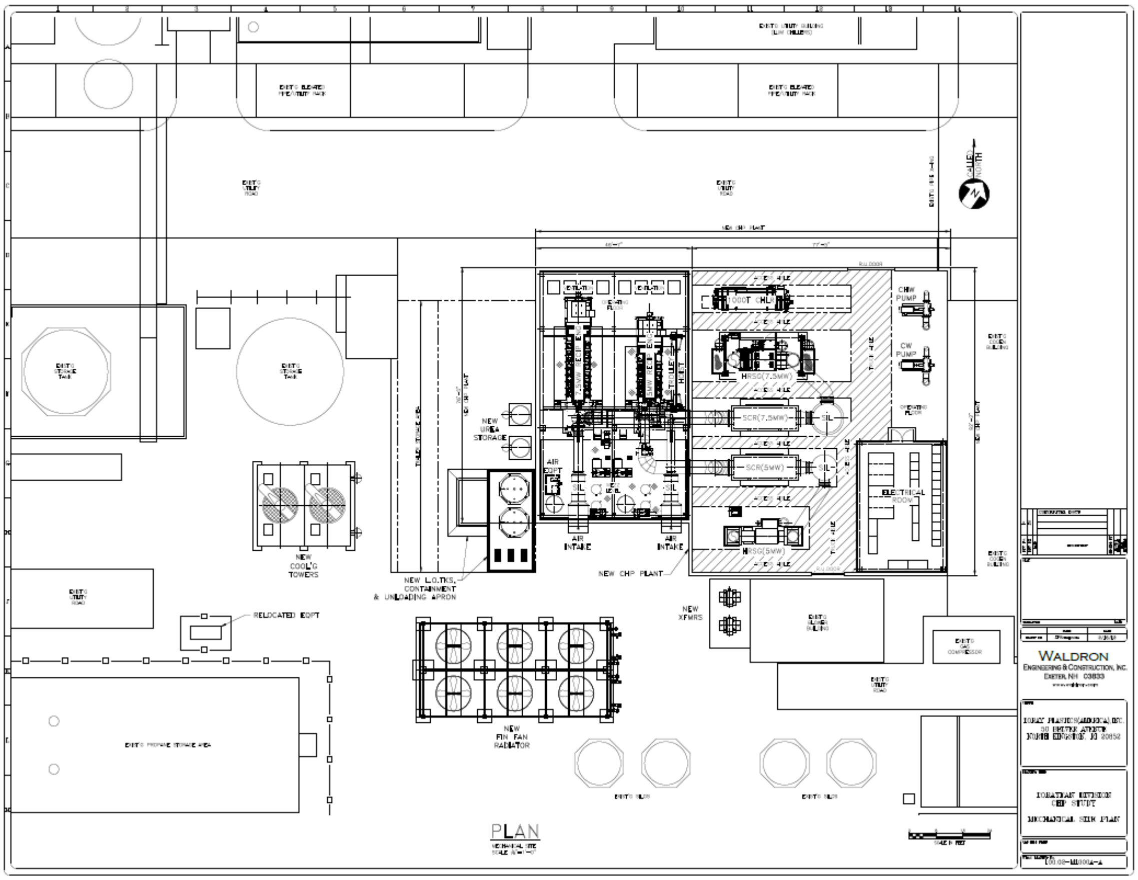
Existing & Proposed Major Equipment & Systems Schematic Diagram



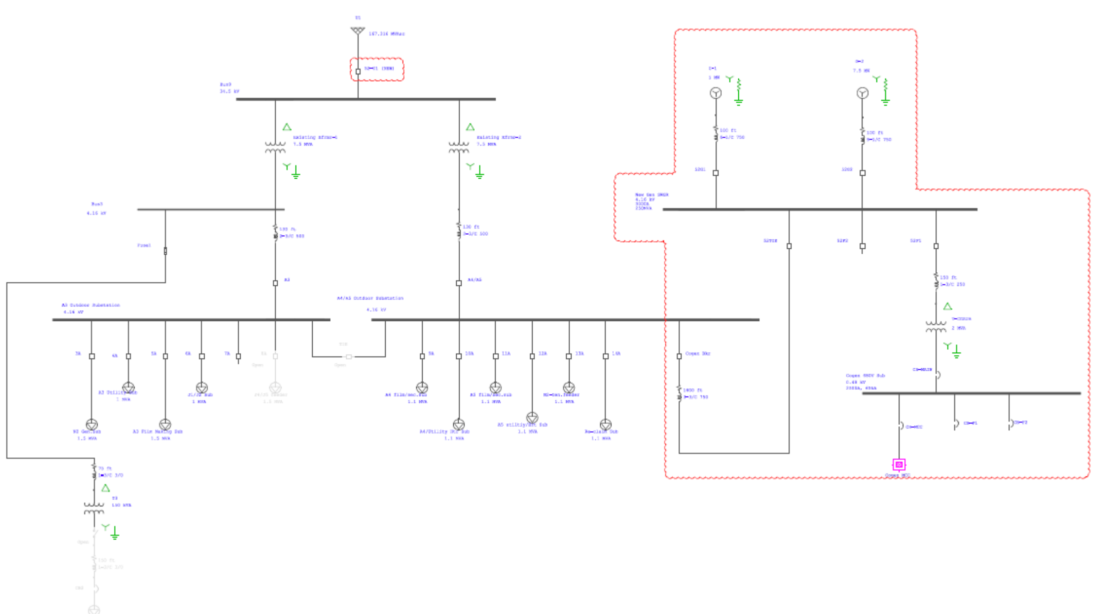
Proposed CHP System Site Plan Building Location



Proposed CHP System
General Arrangement



Proposed CHP System
Electric One-Line Diagram



6 Modeling Methodology

The model developed for this study dispatches the available plant equipment associated with each case in each hour of the year in a sequence intended to meet the facility's utility loads in the lowest overall cost of operation possible. The model contains equipment dispatch sequences for electricity production, steam production and chilled water production, as well as a methodology for utilizing steam and/or electricity to produce chilled water which is dependent upon the available on-site electrical and steam generation resources.

The purchased fuel and electricity associated with the results of each hourly dispatch calculation are fed into rate structure models which apply each line item of the applicable tariffs in order to calculate utility expenses. In addition to the costs associated with purchased fuel and purchased electricity, operation and maintenance costs are accrued in the model based upon equipment operating hours and maintenance cost factors for prime movers, boilers and chillers. Refer to Section 5.1Utility Cost Basis for a summary of the actual prices applied to each of these line item components of overall operating costs.

The model was run for one representative year for each case, and then a life cycle model was created by applying the capital cost and annual savings for each case into a 15-yr pro forma model. The life cycle model treats the capital cost of each case as an "overnight cost", and escalates the annual savings in each future year by 2.2%/yr to create the cash flows over the life of the project.

6.1 Dispatch Sequences and Constraints

Electrical Generation Dispatch Sequence

Electrically, although Toray Plastics is billed by its local utility (NGrid) and its electricity supplier (Freedom?) as a single entity, physical constraints within the facility necessitated the creation of two independent electric nodes within the model: one for Lumirror and one for TorayFan. At each node, the prime movers contained in each case were dispatched in an effort to meet, but never exceed, the electric load of the respective node. Put simply, the existing Taurus 70 combustion turbine at Lumirror can only serve Lumirror electric loads, and likewise new electrical generators proposed for the TorayFan node can only supply power to meet the TorayFan profile. As a result of this configuration, the model independently dispatches the electric generators at each node in each hour of the year, and then calculates the various cost components under the electrical tariff by assessing the coincident outcomes at each node. It is important to note that a minimum electric import is employed in the model at each node to provide a buffer against exporting electricity to the grid. For the CTG the minimum import is 200 kW and for the proposed plant, the minimum import is 350 kW.

The sequencing at each node is straightforward because the electric loads at each node far exceed the minimum operating load of the equipment considered in each case. Thus, the equipment always runs-subject to an availability profile which shuts the equipment down in various hours to simulate scheduled and forced outages- in a load-following mode at each node.

The electrical load at each node is the sum of multiple components: the base electrical profile of the node, the calculated auxiliary loads required to run the utility plant, and the calculated auxiliary loads required to produce chilled water.

Steam Generation Dispatch Sequence

With respect to steam, the model contains a "high pressure" (45 bar) and "low pressure" (9.5 bar) profile. The high pressure profile corresponds to the combination of the 45 and 16 bar loads; the low pressure profile corresponds to the 7 and 5 bar loads. The low pressure header is intended to be maintained at 9.5 bar to provide adequate steam pressure to the steam turbine driven chiller.

The steam load is the sum of multiple components: the base steam profile of the facility and the calculated steam consumption of steam chillers as applicable in each case. (Note: pegging steam to the deaerator is implicitly contained within the base steam profiles.) Steam is dispatched to produce chilled water in accordance with the Chilled Water Dispatch Sequence described in the following section.

Once the steam load is established, the steam dispatch sequence is as follows:

1. Maximize use of steam produced using waste heat from the electric generators at each node, without duct-firing. Excess unfired steam production from waste heat is simply vented to atmosphere in the model.

2. If additional steam is needed to satisfy the steam loads, dispatch duct-firing in the existing HRSG at Lumirror.

3. If the Taurus 70 is down for maintenance and duct-firing is not available, dispatch one of the existing package boilers at the facility.

Chilled Water Generation Dispatch Sequence

The model explicitly deals with a single chilled water node, which is at Lumirror. The existing chilled water load(s) at TorayFan are implicitly contained within the historical TorayFan electrical load profile, and are addressed simply by supplying the required electricity. The electricity required historically to meet the Lumirror chilled water demand, however, was calculated in an hourly model (which also took into account historical free cooling at Lumirror) and then subtracted from the historical electric profile at Lumirror. The corresponding chilled water load profile for Lumirror was included in the model, and chillers are dispatched in the hourly dispatch calculations as required to meet this profile.

Because the summer steam load of the entire facility is already satisfied using steam produced by the existing HRSG at Lumirror, any steam produced in the summer from waste heat at the new TorayFan electrical node would be under-utilized. A steam-turbine driven chiller was thus included at Lumirror in each case in an effort to better utilize the available steam and improve the overall efficiency and economics of the proposed cases.

The introduction of a steam-driven chiller introduces new interactions to the model, however, since chilled water could be produced from six different resources (not listed in order of priority):

- Electricity self-generated at Lumirror with the Taurus 70;

- Steam self-generated at Lumirror from waste heat;
- Steam self-generated at Lumirror from duct-firing;
- Steam self-generated at Lumirror from package boiler operation;
- Steam self-generated at TorayFan from waste heat; and
- Grid-purchased electricity.

The actual dispatch sequence for chilled water production follows the following dispatch sequence in order to produce the lowest possible production cost for each case:

1. Utilize steam produced from waste heat first; however, only use unfired steam for chilled water production if the process steam load has been satisfied. This means that much of the year unfired steam is unavailable for chilled water production.
2. If the Taurus 70 at Lumirror is less than fully loaded, increase electrical output of the combustion turbine and use the incremental electricity to produce chilled water and/or power chiller plant auxiliary loads, while using the incremental unfired steam production to produce chilled water in the steam-driven chiller.
3. These two modes cover the bulk of the annual chilled water production at Lumirror; however, if the combustion turbine is down for maintenance or additional chilled water is still required, then grid-purchased electricity is utilized to produce chilled water. This was selected as the next resource dispatched because of the low cost of power: in the base case model chilled water may be produced for approximately 1¢ per ton cheaper using power purchased from the grid.
4. Finally, steam from package boilers is utilized to produce chilled water.

6.2 Equipment Performance Calculations

Combustion Turbine Performance

Four basic parameters of combustion turbine performance are calculated in each hour for the existing Taurus 70 at Lumirror: output, heat rate, exhaust mass flow and exhaust temperature. Each of these values is calculated as a function of turbine load (% of full load output at the ambient temperature that hour) and ambient temperature (using typical meteorological year data for Providence, RI, per NGrid's requirements). The model contains a curve for turbine performance for each parameter at 100%, 75% and 50% load, covering a range of ambient temperatures from 0-100 deg F. The values used in the model for each hour are based upon interpolation between these curves.

These curves were calibrated to historical performance of the Lumirror Taurus 70 utilizing data supplied by Toray and corresponding historical weather data. Comparisons between vendor performance maps and actual measured performance at several operating points were made, and the performance curves were scaled accordingly. The "calibrated" performance map of the turbine was validated by calculating annual fuel consumption of this turbine as it ran against an historical generator output profile, in an 8,760-

hr model, and comparing the calculated fuel consumption to historical fuel records provided by Toray. A similar approach was taken to calibrate steam production in the existing waste heat boiler to historical values.

The performance maps of the existing Taurus 70 are shown below for output and heat rate.

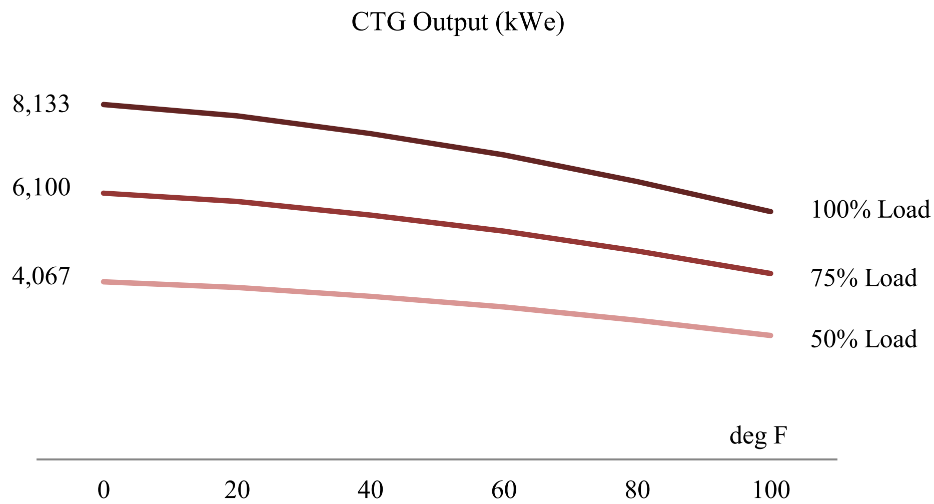


Figure 22 - Existing Taurus 70 Output Curves

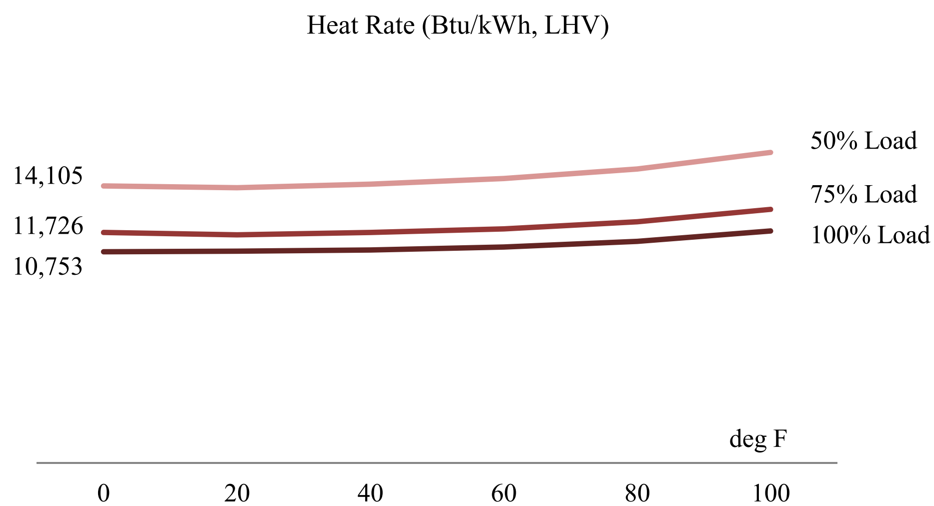


Figure 23 - Existing Taurus 70 Heat Rate Curves

Ambient Temperature (deg F)	100% Output (kW)	75% Output (kW)	50% Output (kW)	100% Heatrate (Btu/kWh, LHV)	75% Heatrate (Btu/kWh, LHV)	50% Heatrate (Btu/kWh, LHV)
0	8,133	6,100	4,067	10,792	11,769	14,157
20	7,875	5,907	3,938	10,811	11,654	14,061
40	7,465	5,599	3,733	10,880	11,765	14,236
60	6,977	5,232	3,488	11,026	11,960	14,523
80	6,367	4,775	3,184	11,317	12,317	15,019
100	5,677	4,258	2,839	11,845	12,946	15,866

Ambient Temperature (deg F)	100% Exhaust Flow (lb/hr)	75% Exhaust Flow (lb/hr)	50% Exhaust Flow (lb/hr)	100% Exhaust Temp (deg F)	75% Exhaust Temp (deg F)	50% Exhaust Temp (deg F)
0	244,703	204,267	160,686	887	905	978
20	237,585	195,449	152,549	904	921	1,006
40	230,335	189,706	148,442	910	928	1,013
60	221,387	182,483	143,216	919	940	1,024
80	209,188	172,760	136,116	935	957	1,040
100	195,745	162,121	128,366	961	983	1,063

Figure 24 - Existing Taurus 70 Performance Data Table

Reciprocating Engine Performance

An identical methodology is utilized for calculating the performance of the reciprocating engines proposed for the various cases. The data tables for the reciprocating engines reviewed in this study are contained below, and are based upon data supplied by Kawasaki (refer to Appendix F):

Ambient Temperature (deg F)	100% Output (kW)	75% Output (kW)	50% Output (kW)	100% Heatrate (Btu/kWh, LHV)	75% Heatrate (Btu/kWh, LHV)	50% Heatrate (Btu/kWh, LHV)
10	5,000	3,750	2,500	6,784	6,964	7,418
30	5,000	3,750	2,500	6,840	7,023	7,485
50	5,000	3,750	2,500	6,895	7,081	7,551
60	5,000	3,750	2,500	6,918	7,106	7,579
80	5,000	3,750	2,500	6,965	7,155	7,635
100	5,000	3,750	2,500	7,037	7,231	7,722

Ambient Temperature (deg F)	100% Exhaust Flow (lb/hr)	75% Exhaust Flow (lb/hr)	50% Exhaust Flow (lb/hr)	100% Exhaust Temp (deg F)	75% Exhaust Temp (deg F)	50% Exhaust Temp (deg F)
0	66,960	50,760	35,280	583	655	691
20	66,960	50,760	35,280	590	662	698
40	66,960	50,760	35,280	597	669	705
60	66,960	50,760	35,280	601	673	709
80	66,960	50,760	35,280	608	680	716
100	66,960	50,760	35,280	622	695	730

Figure 25 - Kawasaki KG-12 Engine Performance Data Table

Ambient Temperature (deg F)	100% Output (kW)	75% Output (kW)	50% Output (kW)	100% Heatrate (Btu/kWh, LHV)	75% Heatrate (Btu/kWh, LHV)	50% Heatrate (Btu/kWh, LHV)
10	7,500	5,625	3,750	6,784	6,964	7,418
30	7,500	5,625	3,750	6,840	7,023	7,485
50	7,500	5,625	3,750	6,895	7,081	7,551
60	7,500	5,625	3,750	6,918	7,106	7,579
80	7,500	5,625	3,750	6,965	7,155	7,635
100	7,500	5,625	3,750	7,037	7,231	7,722

Ambient Temperature (deg F)	100% Exhaust Flow (lb/hr)	75% Exhaust Flow (lb/hr)	50% Exhaust Flow (lb/hr)	100% Exhaust Temp (deg F)	75% Exhaust Temp (deg F)	50% Exhaust Temp (deg F)
0	100,440	76,140	52,920	583	655	691
20	100,440	76,140	52,920	590	662	698
40	100,440	76,140	52,920	597	669	705
60	100,440	76,140	52,920	601	673	709
80	100,440	76,140	52,920	608	680	716
100	100,440	76,140	52,920	622	695	730

Figure 26 - Kawasaki KG-18 Engine Performance Data Table

Chiller Performance

The energy consumption per ton (e.g. lbs/hr of steam or kW of electricity) is calculated for each chiller dispatched. This parameter is calculated as a function of condenser water temperature and chiller load factor. The condenser water temperature is set based upon the ambient wet bulb temperature. The model contains performance data tables for each chiller which contain data from a chiller manufacturer for the energy consumption per ton at three condenser water temperatures- 65°F, 75°F and 85°F- at load factors from 10% - 100%.

Chiller Load	65F ECWT	75F ECWT	85F ECWT
10%	0.545	0.635	0.738
20%	0.454	0.536	0.618
30%	0.423	0.498	0.585
40%	0.414	0.485	0.568
50%	0.414	0.484	0.567
60%	0.446	0.524	0.616
70%	0.441	0.518	0.609
80%	0.441	0.516	0.608
90%	0.444	0.519	0.612
100%	0.451	0.527	0.62

Figure 27 - Chiller Performance Data, Existing Electric Chillers (kW/ton)

Chiller Load	65F ECWT	75F ECWT	85F ECWT
15%	7.62	9.98	13.82
20%	7.01	9.17	12.36
30%	6.42	8.55	11.39
40%	5.97	8.27	10.75
50%	5.87	7.99	10.13
60%	5.96	7.73	9.73
70%	6.09	7.64	9.56
80%	6.26	7.69	9.70
90%	6.42	7.84	9.76
100%	9.94	8.31	9.93

Figure 28 - Chiller Performance Data, Steam Turbine Driven Chiller (lbs/ton-hr)

The steam turbine driven chiller performance is based on a York YSTLKLJH9-KGF.

Auxiliary Steam and Electric Loads

The model calculates auxiliary loads by multiplying an auxiliary load factor by a corresponding quantity of generation. For instance, in order to calculate the electrical power to operate the pumps and fans associated with operation of the reciprocating engines, the electrical output of the engines is multiplied by 4% to estimate these auxiliary loads.

The following auxiliary load factors were applied:

Reciprocating Engine, Balance of Plant Electric Auxiliaries:	4% of Output
Combustion Turbine, Balance of Plant Electric Auxiliaries:	3.54% of Output*
Electric Chiller Operation, Chilled/Condenser Water Auxiliaries:	0.2 kW per ton
Steam Chiller Operation, Chilled/Condenser Water Auxiliaries:	0.25 kW per ton

* The CTG auxiliaries are based on 75% of the Cogen-1 connected auxiliary equipment motor load list, including: oil cooler(s), gas compressor, air compressor(s), etc.

Unfired Steam Production

Steam production from waste heat is calculated in accordance with the following basic equation:

$$Steam_{Unfired} = \frac{Mass_{exhaust} * C_{p,exh} * (T_{exh} - T_{stack})}{(h_{steam} - h_{feedwater})}$$

$Mass_{exhaust}$ = Prime Mover Exhaust Flow, lbs/hr, from Performance Curves
$C_{p,\ exh}$ = Specific Heat of Exhaust Gas, 0.265 Btu/lb-deg F
T_{exh} = Primer Mover Exhaust Temperature, deg F, from Performance Curves
T_{stack} = Exhaust Temperature After Heat Recovery, 354 deg F for Cogen-1 and 402 deg F for the new CHP.
h_{steam} = Enthalpy of Steam, 1,202 Btu/lbm (650 psig, saturated)
$h_{feedwater}$ = Enthalpy of Deaerated Feedwater, 208 Btu/lbm

Duct Fired Steam Production

Steam production from duct-firing is calculated in the same basic manner; however, the exhaust temperature in the numerator of the equation above is replaced with the duct burner outlet temperature, and the stack temperature is reduced to reflect increased efficiency of heat transfer with duct-firing. The stack temperature when duct firing is interpolated between the un-fired and fired temperatures shown in Figure 28. The interpolation is based on the ratio of duct burner fuel input for that hour to the maximum duct burner fuel input.

	Exhaust Stack Temperature (°F)	
	Unfired	Fired
Gas Turbine	354	289
Recip Engine	402	n/a

Figure 29 - Stack Temperatures

The heat input to the duct burner is calculated assuming a 90% efficiency on an HHV basis, meaning that 90% of the HHV energy content of the fuel is available for steam production.

Modeling Interactions

The above sections describe the basic methodology of the model; however, they do not in and of themselves provide insight into some of the types of interactions that emerged as a result of its application. The trends described below are described in relation to the 12.5 MW Kawasaki Case, which is the case that produced the best overall economic result.

Reduced CTG Output at Lumirror

The use of unfired steam from the new reciprocating engine plant at TorayFan to produce chilled water at Lumirror resulted in a slight reduction in the annual electrical output of the existing Taurus 70. The magnitude of the reduction was approximately 3.6% of the Base Case value.

Reduced Duct-Firing at Lumirror

Duct-firing at Lumirror was reduced due to the steam production from the new reciprocating engine plant at TorayFan. The magnitude of the reduction was 83% of the Base Case value.

Increased Unit Price of Electricity

Although the total annual cost of purchased electricity dropped considerably as a result of the electrical production from the new reciprocating engine plant at TorayFan, the residual quantity of purchased electricity cost nearly twice as much as the Base Case value on a unit basis.

In the Base Case, the all-in cost of purchased electricity was $0.079/kWh, and in the 12.5 MW Kawasaki Case the value increased to $0.098/kWh. The former value is for a purchased electricity profile with a very high and consistent load factor, and the latter reflects a plant with a fairly low load factor. This is primarily due to the fact that demand charges simply do not fall in proportion to the reduction of total purchased electricity.

Availability Assumptions

In all the models that Waldron generated, the Taurus 70 CTG availability was based on the historical availability of the plant, which was derived from the electric metered data for the CHP.

In models that included a Recip engine, an availability of 93% was used to randomly generate periods of time for scheduled and unscheduled maintenance.

	Screening Model	Refined Model
Combustion Turbine with Medium Pressure HRSG's ($/kWh)	0.014	0.014
Reciprocating Engine ($/kWh)	0.012	0.014
MP Boiler Plant ($/klb)	0.15	0.15
Chiller Plant O&M ($/ton-hr)	0.004	0.004 (electric) 0.0052 (steam)

Capital Cost Methodology & Estimate

The proposed CHP's Capital Cost estimate was initially estimated by Waldron Engineering and later-on refined by Toray's Engineering Department. Waldron's original estimate is shown in the below table, but is not used in this TA Study, since Toray has chosen an in-house approach on constructing their CHP project, rather than Waldron's initially proposed turn-key approach.

Toray's Capital Cost estimate refinement eliminated services and the commensurate costs typically provided by third-parties proposing turn-key services, while simultaneously adding other necessary line items such as, electric utility interconnection costs. Since Toray has previously installed a 7.5 MWe CHP onsite, it plans on providing these services with their in-house staff. To that end, the below table represents Toray's refined pricing, which is partly based on Waldron's line item estimates and more detailed pricing for the major equipment and installation services from major equipment vendors (i.e., reciprocating engines, switchgear, controls, etc.) and local construction (i.e., site work, building, piping, plumbing, electrical, controls, etc.) companies. Where local construction costs were used, the average of two (2) or more proposals was used.

It's important to note the most significant component of *Line Item No.2 - Procurement (Equipment)* is the Kawasaki engine-generator sets and their shipping charge. In short, Toray solicited and used local pricing to support ~90% of the total, Capital Cost of $22,700,000 (i.e., 92% = $21,000,000 ÷ $22,700,000).

Capital Cost Estimate

		WALDRON	TORAY	
ITEM NO.	DESCRIPTION	$	$	
1	Engineering	$1,299,196	Included	
2	Procurement (Equipment)	$13,992,237	$12,022,168	
3	Construction Directs			
	Building	$2,061,059	$1,600,000	
	Piping/Insulation	$773,575	$2,445,898	
	Elect/Controls	$702,535	$3,584,513	Includes Elect. Equip.
	Rigging	$275,840	$275,840	
	Duct	$143,293	$143,293	
	Construction Support	$1,515,868	Included	
	Ngrid Interconnection	$0	$1,200,000	
	Subtotal # 1	$5,472,170	$9,249,544	
4	Construction Indirects	$0		
5	Commissioning & Start-up	$319,327	$319,327	
6	Construction Management	$1,167,864	$0	
	Subtotal # 2	$22,250,795	$21,591,039	
7	7% Sales Tax	$1,170,983	$0	
8	3% Estimating Contingency	$667,524	$0	
	Subtotal # 3	$24,089,301	$21,591,039	
9	7.5% Construction Contingency	$410,413	$0	
10	5.0% Project Contingency	$0	$1,079,552	
	Subtotal # 4	$24,499,714	$22,670,591	
11	5% Overhead	$1,224,986	$0	
12	5% Profit	$1,224,986	$0	
	Subtotal # 5	$26,949,685	$22,670,591	
13	FINAL TOTAL	$26,949,685	$22,670,591	
14	FINAL TOTAL	$26,950,000	$22,700,000	

Financial Analysis

The financial analysis focuses on quantifying the Operating Costs associated with purchasing NG, displacing electricity and NG and performing Preventive Maintenance on the existing and proposed equipment. In short, future energy costs were applied to the Base Case (2011 energy usages) and Proposed Case (modeled energy usages). Both Cases' energy usages were modeled for 8,760 Hours/Year, therefore, the correct energy and demand values could be easily identified and used to correctly calculate the "all-in" electricity and NG costs (i.e., Commodity and regulated Distribution services). Preventive Maintenance costs were performed in similar level of detail and precision. Once these costs were correctly assigned, the Proposed Case's total, Operating Cost was subtracted from the Base Case's total, operating Cost to arrive at the net, annual Operating Cost savings.

Since Toray has its own in-house, Internal Rate-of-Return Financial Analysis, this TA Study focused on providing the data essential to Toray running its analysis. Thus, only Simple Payback (i.e., Capital Cost ÷ Annual Operating Savings) is addressed in this TA Study.

Natural Gas

The NG costs are comprised of three (3) major components…

1. Commodity;
2. Basis points; and
3. National Grid's current Distribution Service Rate.

The Commodity unit cost is derived from the NYMEX (Henry Hub delivery point) Wholesale Charge for Futures Contracts. At the time of this TA Study (i.e., Trade date of 02/08/2012.), the traded, unit price for Commodity was $4.092/MMBtu for a 01/01/2014 Delivery date (i.e., initially estimated CHP availability).

The Basis Points is the charge a third-party marketer will charge Toray to move the NG from Henry Hub to National Grid's "RI City Gate". Toray has supplied documentation illustrating its purchasing power to acquire this service at $0.86/MMBtu (i.e., "TPA Utility Cost Analysis 2-20-12.xls" and an invoice).

The Distribution Service Rate used in this TA Study is National Grid's Extra-Large, High Load Factor, Rate 24. After running the Base Case and Proposed Case through the Service Rate, it results in $0.95/MMBtu.

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Trade Date: 2/8/2012

Market Data is delayed at least 10 minutes

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Month	Charts	Last	Change	Prior Settle	Open	High	Low	Volume	Hi / Lo Limit	Updated
Mar 2012		2.482	+0.010	2.472	2.492	2.508	2.390	98,720	5.472 No Limit	11:37:47 AM CT 2/8/2012
Apr 2012		2.621 b	-0.007	2.628	2.638	2.649	2.547	42,653	5.628 No Limit	11:37:42 AM CT 2/8/2012
May 2012		2.725	-0.019	2.744	2.757	2.761	2.660	33,670	5.744 No Limit	11:37:35 AM CT 2/8/2012
Jun 2012		2.810	-0.022	2.832	2.828	2.840 b	2.750	19,224	5.832 No Limit	11:35:40 AM CT 2/8/2012
Jul 2012		2.886 b	-0.024	2.910	2.915	2.920 b	2.830 a	16,649	5.910 No Limit	11:37:42 AM CT 2/8/2012
Aug 2012		2.923	-0.022	2.945	2.950	2.957	2.864 a	11,391	5.945 No Limit	11:35:41 AM CT 2/8/2012
Sep 2012		2.931	-0.025	2.956	2.921	2.948	2.875	4,080	5.956 No Limit	11:36:12 AM CT 2/8/2012
Oct 2012		2.975	-0.026	3.001	3.009	3.014	2.921 a	10,170	6.001 0.001	11:36:38 AM CT 2/8/2012
Nov 2012		3.135	-0.027	3.162	3.161	3.171 b	3.095	1,517	6.162 0.162	11:35:34 AM CT 2/8/2012
Dec 2012		3.431 b	-0.030	3.461	3.481	3.472 b	3.387 a	1,602	6.461 0.461	11:35:41 AM CT 2/8/2012
Jan 2013		3.562	-0.029	3.591	3.589	3.602 b	3.522	3,151	6.591 0.591	11:37:35 AM CT 2/8/2012
Feb 2013		3.571 b	-0.028	3.599	3.581	3.582	3.541	478	6.599 0.599	11:36:39 AM CT 2/8/2012
Mar 2013		3.553	-0.027	3.580	3.560	3.568	3.512 a	802	6.580 0.580	11:23:06 AM CT 2/8/2012
Apr 2013		3.517 b	-0.024	3.541	3.541	3.556 b	3.485	1,013	6.541 0.541	11:35:41 AM CT 2/8/2012
May 2013		3.545 b	-0.025	3.570	3.512	3.554	3.509	101	6.570 0.570	11:36:27 AM CT 2/8/2012
Jun 2013		3.584 a	-0.020	3.604	3.575	3.591	3.581	79	6.604 0.604	11:36:15 AM CT 2/8/2012
Jul 2013		3.625 a	-0.022	3.647	3.587	3.637	3.587	154	6.647 0.647	11:34:12 AM CT 2/8/2012
Aug 2013		3.639	-0.025	3.664	3.612	3.653	3.599	119	6.664 0.664	11:13:46 AM CT 2/8/2012
Sep 2013		3.645 b	-0.020	3.665	3.605	3.650	3.602	50	6.665 0.665	11:35:41 AM CT 2/8/2012
Oct 2013		3.685 b	-0.019	3.704	3.710	3.713 b	3.622	388	6.704 0.704	11:35:41 AM CT 2/8/2012
Nov 2013		3.785 a	-0.017	3.802	3.780	3.795	3.776 a	28	6.802 0.802	11:34:06 AM CT 2/8/2012
Dec 2013		3.986 a	-0.013	3.999	3.973	3.990	3.973	12	6.999 0.999	11:34:06 AM CT 2/8/2012
Jan 2014		4.092 a	-0.014	4.106	4.042	4.098	4.042	35	7.106 1.106	11:34:12 AM CT 2/8/2012
Feb 2014		4.080 a	-0.014	4.094	-	4.084 b	4.077 a	0	7.094 1.094	11:34:06 AM CT 2/8/2012
Mar 2014		4.040 a	-0.016	4.056	4.038	4.046 b	4.038	0	7.056 1.056	11:20:16 AM CT 2/8/2012
Apr 2014		-	-	3.941	-	-	-	0	6.941 0.941	8:44:58 AM CT 2/8/2012
May 2014		3.940	-0.016	3.956	3.940	3.940	3.940	0	6.956 0.956	8:44:58 AM CT 2/8/2012
Jun 2014		-	-	3.981	-	-	-	0	6.981 0.981	8:44:58 AM CT 2/8/2012
Jul 2014		4.010	-0.007	4.017	4.010	4.010	4.010	0	7.017 1.017	8:44:58 AM CT 2/8/2012
Aug 2014		-	-	4.034	-	-	-	0	7.034 1.034	8:44:58 AM CT 2/8/2012
Sep 2014		-	-	4.036	-	-	-	0	7.036 1.036	8:44:58 AM CT 2/8/2012

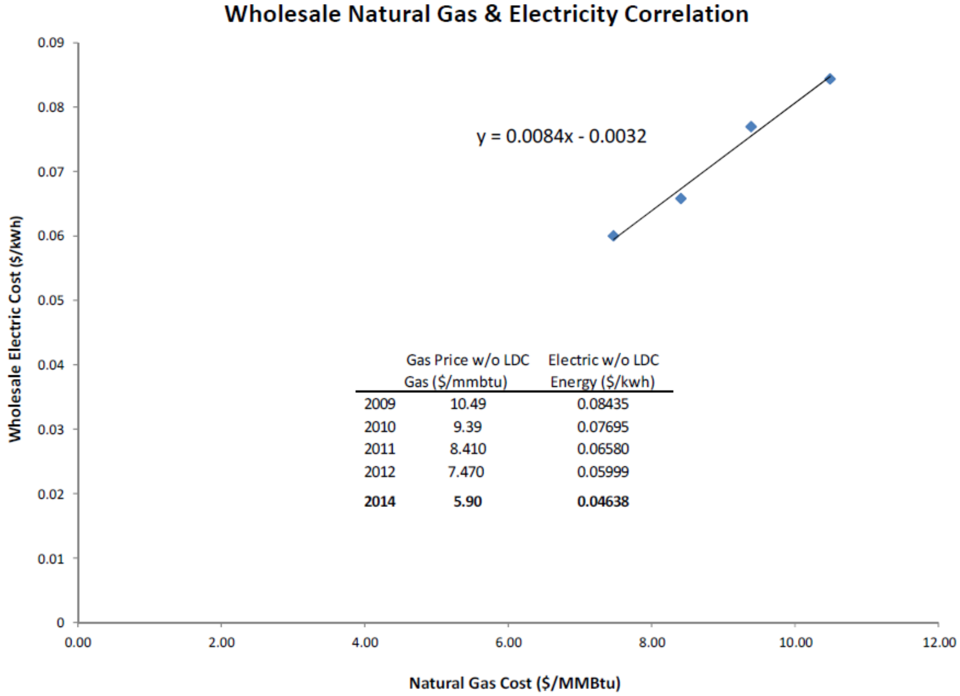
When project comes on-line

Electricity

The electricity costs are comprised of four (4) major components…

1. Commodity/Wholesale;
2. Forward Capacity Market;
3. Broker Fee; and
4. National Grid's anticipated, future Distribution Service Rate.

The Commodity cost is the future unit cost of just the energy portion (kWh) of purchasing electricity. In New England, due to the large number of power plants using NG as their primary fuel, the cost of electric energy directly correlates to the Commodity cost of NG. To estimate the future electric energy Commodity cost, Toray correlated their historic, annual average Commodity NG costs to their historic, annual average electric energy Commodity costs. Using this correlation and the NYMEX Futures Contract NG cost for January 2014 ($4.092/MMBtu) an electric Commodity cost of $0.0464/kWh results. This unit cost was credited to all kWhs displaced by the proposed CHP. See the below graphic illustration of this site specific correlation.



	Gas Price w/o LDC Gas ($/mmbtu)	Electric w/o LDC Energy ($/kwh)
2009	10.49	0.08435
2010	9.39	0.07695
2011	8.410	0.06580
2012	7.470	0.05999
2014	**5.90**	**0.04638**

The second major component of the electric costs is the Forward Capacity Market charge (FCM), which represents the cost to purchase and reserve "space"/capacity on the electric transmission system to move the electric energy cited in the first major electricity cost component to National Grid's distribution system. At the time of this TA Study, ISO-NE's posted price for 2014 was $3.209/kW. This charge was calculated monthly by taking the peak demand needed for the month and multiplying it by the FCM unit cost of $3.209/kW to match Toray's current billing. Toray provided this unit cost via its document titled "TPA Utility Cost Analysis 2-20-12.xls".

The third major component of the electric costs is the Broker Fee, which is a charge Toray pays a third-party to solicit the best price for electric energy based on Toray's needs. It's important to note Toray's historic, annual costs used to develop the aforementioned correlation includes a Broker Fee of $0.0004/kWh. This unit cost was credited to all kWhs displaced by the proposed CHP.

The forth – and last - major component of the electric costs is the appropriate National Grid Service Rate. Since Toray already has a large CHP and its multiple meters are merged and billed as a single Service Rate, the appropriate Service Rate for both the Base Case and Proposed Case is the *3,000 kW Back-Up Service Rate (B-62), Retail Delivery Service*. Starting on January 1, 2012, National Grid instituted a slightly redesigned Distribution Service Rate that applies to the proposed CHP. This Service Rate defines the cost to distribute the electric energy from National Grid's point of differentiation between Transmission and Distribution to National Grid's electric meters serving Toray's facilities. Although most of the $/kWh and $/kW charges are straightforward, in order to properly estimate Toray's future costs, the currently anticipated future costs associated with the Deepwater Project have been added to this Financial Analysis. The value used is based on a currently anticipated $500,000,000 profit margin for the Deepwater project. The Deepwater Component used is $0.0036/kWh.

Preventive Maintenance

The following unit costs were applied to the appropriate equipment (i.e., existing and proposed major equipment) as part of calculating the total, Operating Cost for both the Base Case and Proposed Case.

1. Base Case Major Equipment
    a. Combustion Gas Turbine with Medium Pressure HRSG: $0.014/kWh.
    b. Medium Pressure Boiler Plant: $0.15/kLbs.
    c. Electric Chillers: $0.004/Ton-H.
2. Proposed Case Major Equipment
    a. Reciprocating Engines: $0.014/kWh.
    b. Medium Pressure Boiler Plant: $0.15/kLbs.
    c. Electric Chillers: $0.004/Ton-H.
    d. Steam Turbine-Driven Chiller: $0.0052/Ton-H.

The most important part of the Preventive Maintenance costs relates to the CGT and reciprocating engines' costs. The CGT costs are based on historic costs Toray incurred, while the 2 x reciprocating engines' costs are based on following Kawasaki's Preventive Maintenance Schedule averaged over a 12 year period. This is common-place to format the Preventive Maintenance costs (i.e., materials, labor hours and labor rates) as an "annuity" for the life of the CHP in CHP analyses.

The following table summarizes the anticipated financial performance of the proposed CHP.

Financial Summary

Case Description	Capital Cost ($)	Electricity & Natural Gas Incentives[1] ($)	Net Capital Cost ($)	Electric Costs[2] ($)	Natural Gas Costs[3] ($)	Preventive Maintenance Costs ($)	Total Costs ($)	Net Simple Payback (Years)
Existing	N/A	N/A	N/A	$7,987,360	$4,704,237	$776,309	$13,467,906	N/A
Proposed	$22,700,000	$13,150,000	$9,550,000	$1,382,711	$8,451,663	$2,021,480	$11,855,854	N/A
Savings/(Costs)	($22,700,000)	$13,150,000	($9,550,000)	$6,604,649	($3,747,326)	($1,245,171)	$1,612,052	5.9

Notes:

1. *Electric Energy Efficiency Program Incentive of $11,350,000 and Natural Gas Advanced Gas Technologies Program Incentive of $1,800,000.*
2. *Based on NGrid's projected electric B-62 Distribution Tariff and Toray's projected electric commodity price.*
3. *Based on Toray's projected Natural Gas commodity price.*

Building Energy Efficiency Measures

National Grid's Energy Efficiency Program's CHP Initiative is focused on and designed to support projects that first address reducing the total quantity of energy used to conduct a given company's business, then provide incentives to use the remaining, minimal amount energy efficiently. To that end, over the past several years Toray has aggressively pursued the identification and implementation of energy projects that both reduce usage through conservation and further increase the efficient use of the remaining energy to lower costs to not only itself, but also all customers participating in the System Benefits Charge (SBC).

As part of the CHP Initiative, it's important to ensure Toray has conserved a significant amount of energy, so the CHP is sized and applied to electric, steam and chilled water load profiles with little chance of significantly changing due to future energy efficiency projects. This provides the CHP with the best opportunity to be economically successful for the foreseeable future. The following lists the potential Energy Efficiency Measures (EEM) identified with Toray's Utility Engineering Department in late 2011. Although the list is comprehensive, not any individual or the sum of them will have a significant impact on the load profiles used in this TA Study to model the energy and financial performance of the proposed CHP.

Torayfan and Lumirror

- ❑ Plant wide pump and fan optimization – The two facilities have hundreds of fans and pumps, most of which are not controlled by VFDs. The future survey efforts will focus on identifying the fans and pumps for VFD application and other system changes for improvements.

- ❑ Steam trap assessment – A steam trap survey to identify the largest traps was discussed so that as soon as the big traps fail they can be identified for replacement.

- ❑ Insulation - According to the facility staff, majority of the steam, condensate and chilled water pipes are well insulated. However, there may be small pockets of no insulation, worn insulation, uninsulated valves and heat exchangers that will be reviewed in the future.

- ❑ Compressed air optimization - The Lumirror and Torayfan operations have independent compressor plants, each with over 4 to 5 compressors each in excess of 150-hp. All compressors are water-cooled, rotary screw, load-unload, oil-free type. Most of them were two-stage compressors, which is good. A compressed air study was done a couple years ago. The study largely focused on identifying air leaks and found that retrofitting the compressors with VFDs was not economical. Opportunity exists to review the entire compressed air system starting with a review of the end uses (review inappropriate end uses such as vacuum, cooling etc), survey of leaks (as an annual survey is highly recommended), survey of uncontrolled end uses and then a review of the compressor plant for optimization. The facility also has a mix of blower driven desiccant dryers which could be reviewed for efficient alternatives.

- ❑ Chilled water system optimization - The chiller plant in both buildings are fairly new (less than 5 years). The chiller plant in Lumirror is setup for free cooling while the one in Toray fan is not. The chillers are all VFD driven centrifugal type. The chilled water plant is setup with variable primary flow. The chilled water is supplied constantly at 45 F throughout the year. The cooling tower water is set at 72 F. The chilled water pumps and the tower fans feature VFDs. Several opportunities exist associated with optimizing the chilled water plant operations –

  - ❑ VFDs on condenser water pumps
  - ❑ Free cooling in Toray fan. A4/A5 lines do not have free cooling.
  - ❑ Optimizing the chilled water, condenser water temperatures with outdoor conditions

- ❑ HVAC controls optimization - The Lumirror process areas are conditioned by nine large AHUs that maintain tight temperature and humidity conditions at all times. Humidification is achieved by injecting steam in the ducts. Cooling is supported by the chillers and heating is supported by steam provided by the central plant. All fans in these units feature VFDs that are manually controlled by the operators in the process areas. These units are not connected to any energy management system (EMS). We suggested testing the large AHUs for cooling, heating, humidification optimization. It is not uncommon to find simultaneous heating and cooling in these types of units that can be avoided by simple programming changes or by replacement of sensors. The Torayfan process areas are conditioned using six DX type AHUs. The control network in this facility was upgraded two years ago. Therefore, savings potential is projected to be limited. Potential for installing low pressure drop filters in the AHUs is also on the list of future measures.

- ❑ Cogged belts and sheaves – According to the facility staff a review of the v-belts and sheaves could result in savings.

<u>Lumirror Only</u>

- ❑ Pit exhaust blower control - This is a project identified by the in house energy team. The intent here is to install dampers on these blowers to reduce the heat loss during the winter months. The current practice is to operate the blowers at full speed all the time.

- Metalizer cooling optimization - The Metalizer requires cooling and when it goes down for maintenance, the cooling pumps continue to run at constant speed in dead head condition. The proposed action is to install VFDs on these cooling pumps. Preliminary analysis of one system indicated savings of $3,000 per year. Additionally, there are three 20-hp and one 15-hp pumps that could also benefit from this retrofit.

- Warehouse heating optimization – Replace steam based forced air units with gas fired infrared heaters. The facility management is currently reviewing its options connected with heating its warehouses.

- Replace steam orifice plates in the process with control valves - According to the facility staff, the process areas have over 60 orifice plates that are used to achieve design steam flow to the drums. Due to the simple design of the orifice plate, it cannot adjust to fluctuating production conditions. The energy team is interested in reviewing other steam flow control alternatives to the orifice plates. One potential alternative is to install ball valve type control valves with feedback controls. The energy savings would result from avoiding steam being dumped into the condensate return during non design operating conditions.

- Replace steam hot water heater with condensing gas fired unit - The Lumirror building has a steam fired tankless heater that supplies domestic hot water to majority of the building. The energy team is interested in reviewing replacement options for this heater. One replacement idea is to replace the steam heater with a new gas-fired tankless condensing hot water heater.

- REG tower steam vent - According to site staff, the REG tower has a steam vent coming off of the condensate return tank. We will review opportunities to recover the heat from this flash steam.

- Replace DC motors with AC alternatives - The facility has numerous DC motors totaling over 1,000 hp that operate the process equipment. We will review DC motors that can be replaced with new VFD driven AC motors.

- Polyarea lighting - The Lumirror building has over 500 explosion-proof, 2-lamp T12 fixtures in the Poly area. These lights stay on 24x7. As a part of this measure we will review a couple fixture replacement alternatives – such as LED and induction lighting as the labor costs associated with replacing the lamps in these fixtures is very high

Cogen/Boiler Room

- Boiler optimization - Boiler #3 runs at low fire year round. It has older fuel and air controllers. There is a small potential to save by installing new controllers and fuel metering. The boiler was observed to run at 3% oxygen during the site visit. It was also noted that the FGR on the boiler requires operating the boiler a slightly higher oxygen levels in the exhaust. In non FGR setup, the oxygen in exhaust could be brought down to 2% or lower.

Based on our understanding of the operations in the facility, the listed measures will not significantly affect the steam consumption in the Lumirror building. The few steam based measures identified for the Lumirror building have small potential that will not significantly alter the steam demand in the facility. Majority of the steam use in the Lumirror building is used in process heating and those operations are not going to change in the near future.

Appendix A: Capital Cost

<u>Sequential Order:</u>
Toray eMail.
Grand-Total Estimate.
Major Equipment Sub-Estimate.
Kawasaki Engine-Generator Sets Proposal (Partial).
Kawasaki Engine-Generator Sets Shipping Estimate.
HRSGs & Emissions Controls Systems Proposal (Partial - RENTECH).
Building Design/Build Construction (Sample – NAPPA Construction).
Piping/Insulation/Rigging Design/Build Construction (Sample – SPEC).
Electrical/Controls Major Equipment & Design/Build Construction (Sample – ABB).
National Grid Interconnection Costs (Narrative).

From: Eric Carlson/NKCorp/TPA
To: "McKiernan, Frederick" <Frederick.McKiernan@nationalgrid.com>
Cc: "'Jeffrey.L'Heureux@TorayTPA.com'" <Jeffrey.L'Heureux@TorayTPA.com>, "'Shigeru.Osada@Toraytpa.com'" <Shigeru.Osada@Toraytpa.com>
Date: 07/18/2012 12:19 PM
Subject: RE: CoGen 2 budget

Hello Fred,

Here is the requested information.
First, a few points of clarification.

Item No. 1 - The engineering costs were removed in TPA's estimate. This is because we quoted the building, piping and electrical work, design build.

Item No. 2 - I have attached the detail sheet which shows how we arrived at the total.
For items we received competitive quotes on I have attached those.
Unless indicated otherwise, we used Waldron's estimates.
Please note the electrical items have been removed and are include in the Electrical/Controls quote.

Item No. 3 -
For the building, we received 4 quotes. We used the average.
For the piping, we received 3 quotes. We used the average.
Elect/Controls we received one quote to date, ABB it is for turnkey supply and install.
For Rigging and Duct, we used Waldron's numbers.

CG-2 BUDGET SUMMARY

		WALDRON	TORAY	
ITEM NO.	DESCRIPTION	$	$	
1	Engineering	$1,299,196	Included	
2	Procurement (Equipment)	$13,992,237	$12,022,168	
3	Construction Directs			
	Building	$2,061,059	$1,600,000	
	Piping/Insulation	$773,575	$2,445,898	
	Elect/Controls	$702,535	$3,584,513	Includes Elect. Equip.
	Rigging	$275,840	$275,840	
	Duct	$143,293	$143,293	
	Construction Support	$1,515,868	Included	
	Ngrid Interconnection	$0	$1,200,000	
	Subtotal # 1	$5,472,170	$9,249,544	
4	Construction Indirects	$0		
5	Commissioning & Start-up	$319,327	$319,327	
6	Construction Management	$1,167,864	$0	
	Subtotal # 2	$22,250,795	$21,591,039	
7	7% Sales Tax	$1,170,983	$0	
8	3% Estimating Contingency	$667,524	$0	
	Subtotal # 3	$24,089,301	$21,591,039	
9	7.5% Construction Contingency	$410,413	$0	
10	5.0% Project Contingency	$0	$1,079,552	
	Subtotal # 4	$24,499,714	$22,670,591	
11	5% Overhead	$1,224,986	$0	
12	5% Profit	$1,224,986	$0	
	Subtotal # 5	$26,949,685	$22,670,591	
13	FINAL TOTAL	$26,949,685	$22,670,591	
14	FINAL TOTAL	$26,950,000	$22,700,000	

Waldron Engineering & Construction

Date:

CLIENT: TORAY Plastics 24-Feb-12
Project: CHP Study
Location: North Kingston, RI

Estimate Sheet: Procurement

CODE	DESCRIPTION	Type/Size	QTY	UOM	LABOR						PLANT EQUIPMENT		MATERIAL		SUBCONTRACTOR		OTHER			Notes
					CREW SIZE	HRS PER DAY	DAYS	MAN HOURS	LABOR RATE	LABOR $	UNIT EQ $	EQ $	UNIT MAT $	MAT $	UNIT SUB $	SUB $	UNIT OTH $	OTHER $	TOTAL $	
	Kawasaki 5MW Recip Genset		1.0	Ea							3,125,000	3,125,000						435,300	3,560,300	shipping included
	Kawasaki 7.5MW Recip Genset		1.0	Ea							3,575,000	3,575,000						435,300	4,010,300	shipping included
	Fin Fan Radiator for Engines		2.0	Ea							185,000	370,000							370,000	
	Fresh and Waste Lube Oil Storage Tanks		1.0	Lot							30,000	30,000							30,000	
	Exhaust Expansion Joints		1.0	Lot							55,000	55,000							55,000	
	Engine Exhaust Expansion Joints		1.0	Lot							40,000	40,000							40,000	
	Engine cooling circuit Exp Tanks		1.0	Lot							25,000	25,000							25,000	
	Heat Recovery Steam generators (7.5 MW machine)		1.0	Ea							738,000	738,000							738,000	Rentech Boilers
	Exhaust Stack																			
	SCR/CO Catalyst																			
	UREA Dosing Pump																			
	Economizer																			
	Duct																			
	Heat Recovery Steam generators (5 MW machine)		1.0	Ea							685,000	685,000							685,000	Rentech Boilers
	Exhaust Stack																			
	SCR/CO Catalyst																			
	UREA Dosing Pump																			
	Economizer																			
	Duct																			
	Steam Absorption/Turbine Driven Chiller (1000 tons)		1.0	Ea							1,100,000	1,100,000							1,100,000	York Chiller
	Pressure Regulators		1.0	Lot							35,000	35,000							35,000	
	Control Valves		1.0	Lot							35,000	35,000							35,000	
	Purge Air Fan Filters		2.0	Ea							1,500	3,000							3,000	
	Purge Air Fans		2.0	Ea							5,000	10,000							10,000	
	Purge Air Dampers		2.0	Ea							7,500	15,000							15,000	
	Recip Engine Comb Air Filters		4.0	Ea							20,000	80,000							80,000	
	Oil Mist Eliminators		4.0	Ea							15,000	60,000							60,000	
	Relief Valves		1.0	Lot							15,000	15,000							15,000	
	Gas Detection (panel and monitoring)		1.0	Lot							35,000	35,000							35,000	
	Fresh Lube Oil Pumps		2.0	Ea							5,300	10,600							10,600	
	Waste Lube Oil Pumps		1.0	EA							5,300	5,300							5,300	
	Waste Water/Sump Pump		1.0	EA							7,000	7,000							7,000	
	Boiler Feedpumps		3.0	Ea							25,000	75,000							75,000	

Page 1 of 2

Waldron Engineering & Construction

Date:

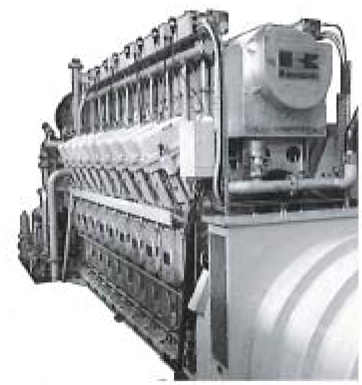
CLIENT: TORAY Plastics 24-Feb-12
Project: CHP Study
Location: North Kingston, RI

Estimate Sheet: Procurement

CODE	DESCRIPTION	Type/Size	QTY	UOM	LABOR						PLANT EQUIPMENT		MATERIAL		SUBCONTRACTOR		OTHER			Notes
					CREW SIZE	HRS PER DAY	DAYS	MAN HOURS	LABOR RATE	LABOR $	UNIT EQ $	EQ $	UNIT MAT $	MAT $	UNIT SUB $	SUB $	UNIT OTH $	OTHER $	TOTAL $	
	Cooling Water Pumps (fin-fan radiators)		2.0	EA							7,500	15,000							15,000	
	Overhead Bridge Crane		1.0	Ea							75,000	75,000							75,000	
	Monorail Cranes		6.0	Ea							5,000	30,000							30,000	
	Air Compressors		2.0	EA							50,000	100,000							100,000	
	Chilled Water Pumps		2.0	EA							15,000	30,000							30,000	
	Chiller Cooling Water Pumps		2.0	EA							15,000	30,000							30,000	
	Chiller Radiator		1.0	EA							100,000	100,000							100,000	
	HVAC Units		1.0	Ea							25,000	25,000							25,000	
	Explosion Relief Valves/Rupture discs		4.0	Ea							16,000	64,000							64,000	
	Starting Air Receiver		2.0	Ea							20,000	40,000							40,000	
	National Grid Reqd Instrumentation for Grant																			
	Engine Exhaust Silencer		2.0	Ea							50,000	100,000							100,000	
	Engine Intake Silencer		2.0	Ea							25,000	50,000							50,000	
	Urea Tanks		2.0	Ea							18,000	36,000							36,000	
	CEMS/PEMS		1.0	Ea							150,000	150,000							150,000	
	Freight & Insurance		1.5%														11,844,500	177,668	177,668	11,844,500
	PROCUREMENT TOTAL											**10,973,900**						**1,048,268**	**12,022,168**	
																		TOTAL	**$ 12,022,168**	

Messrs. Toray Plastics (America), Inc.

COMMERCIAL PROPOSAL



FOR

7.5MWe x 1 Set + 5MWe x 1 Set Total 12.5MWe

KHI REF. NO. KG-PP-GA-167.00 REV 1

April 2012

H. Kugimiya,
Manager
Power Generation Sales Dept.
Machinery Division
Gas Turbine & Machinery Company
KAWASAKI HEAVY INDUSTRIES, LTD.

TABLE OF CONTENTS

Note: Any discrepancies between Article A to G and ANNEX-1 or ANEX-2, Article A to G will be prevail.

KAWASAKI HEAVY INDUSTRIES, LTD.

COMMERCIAL PROPOSAL

KHI PROPOSAL NO.: KG-PP-GA-167.00 REV1 *2012/April/26*

A. PRICE

(A-a) BASE SCOPE OF SUPPLY (FOB JAPANESE and European SEAPORT BASIS):

0.	KG-12-V Gas Engine Generator Package *1	1 set	JPY: 290,000,000 – **(Say Two hundred and Ninety million Japanese Yen only)**
0-1	Very Special Discount of KG-12-V for Toray		JPY:-40,000,000- **(Deduct Forty million Japanese Yen)**
1	KG-12-V Gas Engine Generator Package *1 after very special discount.	1 set	JPY: 250,000,000 – **(Say Two hundred and Fifty million Japanese Yen only)**
2	KG-18-V Gas Engine Generator Package *2	1 set	JPY: 320,000,000 – **(Say Three hundred and twenty million Japanese Yen only)**
3.	Special Discount for above item No1 and 2.	-	JPY: -34,000,000- **(Deduct Thirty four million Japanese Yen)**
4	Gland Total	-	JPY 536,000,000- **(Say Five hundred and Seventy four million Japanese Yen only)**

(A-b)OPTIONAL ITEMS FOR GAS ENGINE GENERATOR PACKAGE

1.	TECHNICAL ADVISORY SERVICE	-	REFER TO ANNEX-2 "FIELD SERVICE RATES"

NOTE:

*1

ABOVE PRICE IS SUBJECT TO OUR TECHNICAL PROPOSAL No. KG-T-GA-167.01 REV1 dated 26th April 2012.

*2

ABOVE PRICE IS SUBJECT TO OUR TECHNICAL PROPOSAL No. KG-T-GA-167.02 REV dated 15th May 2012.

B. DELIVERY TERMS and TIME

Total Two (2) sets of Gas Engine Generator Packages will be ready for shipment on a basis of FOB Kobe and European Sea Port by following schedule, subject to contract effective date.

Eight (8) Months from contract effective date.

The delivery period proposed above shall be general information, and shall be confirmed before receipt of purchase order.

All proposed goods shall be delivered within the delivery period mentioned as above after our receiving your first milestone payment as provided in the PAYMENT TERMS of this COMMERCIAL PROPOSAL.
Delivery condition shall be in accordance with INCOTERMS 2010.

C. VALIDITY

This PROPOSAL shall remain valid and effective until 26th May, 2012. Further Validity extension of the PROPOSAL shall be subject to confirmation.

D. PAYMENT TERMS

Payments shall be made by T.T within 30 days and an Irrevocable Letter of Credit as per progress payment based on the Milestone as follows;

No	(%)	MILESTONE SCHEDULE	MEANS
1.	20%of Total Contract Price	Due upon placement of order or Letter of Intent by Buyer to us for this Project whichever comes earlier.	By Telegraphic Transfer within 30 days after the date of Invoice.
2.	75% of Total Contract Price	Due upon shipment of each Gas Engine Generator Package.	By an irrevocable Letter of Credit at sight.
3	5% of Each Lot	Due upon issue of Acceptant Certification for each Gas Engine Generator Package by Buyer.	By Telegraphic Transfer within 30 days after the date of Invoice.

A) Payment shall be made on each Package basis.

B) If any amount payable to us under the Contract is overdue, KHI may charge the Buyer simple interest on overdue amount at one (1) percent per months calculated on a day to day basis from the date payment is due until the date when such payment is received by KHI.

C) Amendment to Order Price effected after acceptance of the original Order shall be subject to the same milestones and shall be invoiceable on a cumulative basis for milestone previously achieved.

D) Above L/C for No.2 and 3 payments shall be irrevocable, and the same shall be issued within two (2) months after Contract effective date by a first class international bank acceptable to KHI.

BY Toray International

Total Shipping Cost for KHI Engine CIF NY Port 5/4/2012

EX-GO value	本体価格	¥ 536,000,000	80	$ 6,700,000.00	

		JPY	currency ($1= JPY)	USD	
Shipping fee	物流費用	¥38,000,000	80	$ 475,000.00	
Insurance fee	保険	¥1,300,000	80	$ 16,250.00	
Customes procedure fee	輸入通関料	¥23,000	80	$ 287.50	
Customes duty	関税	¥13,555,000	80	$ 169,437.50	FOB Value(=6,200,000JPY) 536,000,000JPY(Ex-Go value)+6,200,000JPY=542,200,000JPY 542,200,000JPY*2.5%=13,555,000 JPY
VAT(Value added TAX)	付加価値税	¥720,000	80	$ 9,000.00	
TI fee	TI手数料	¥13,400,000	80	$ 167,500.00	EX-go value(=536,000,000 JPY)*2.5%
Toray Purchasing Dept.fee	資材部手数料	¥5,360,000	80	$ 67,000.00	EX-go value(=536,000,000 JPY)*1.0%
	Shipping Cost	**¥72,358,000**		**$ 904,475.00**	

Total Price	**¥ 608,358,000**		**$ 7,604,475.00**

Shipping Fee=海上運賃+FOB費用(31.8百万+6.2百万=38百万)
Ex-Go value=税抜き本体価格
FOB Value=船積料金、クレーン費用

HSコードについて、物流部経由で再度現地へ確認させたところ、税率の変更がありました。
申し訳ありませんが、訂正させてください。当初は２ .０％でのご案内をさせて頂きましたが、
税番が8502.39となりますので２．５％となります。
（理由）
★ 天然ガスを燃料として、エンジンを動かして発電するため
★ 原動機とセットにした発電機のうち、ディーゼルエンジン、ピストンエンジン以外のエンジンと
セットにした発電機のため

HRSG

CROSS FLOW

RENTECH

Budget Proposal:

For

Toray Plastics
HRSG/SCR

RENTECH Boiler Systems Quotation: GTB-3621-KS

Boilers for people who know and care

"RENTECH *Boilers for people who know and care.*"®

May 2, 2012

Toray Plastics

Attn: Jeffrey L'Heureux

Subject: HRSG & SCR for Kawasaki Engine
RENTECH Proposal No. GTB-3621-KS

Within the pages of this proposal you will find our unique offering which is tailor made to meet the specific requirements of your application.

Please to not hesitate to contact us if you want to discuss this HRSG offering in more detail.

Very truly yours,
RENTECH Boiler Systems, Inc.

Kevin Slepicka
Sr. Sales Engineer
Email: kslepicka@rentechboilers.com

Cc: Joe Richter

I. Summary Information

A. General Design Conditions

The HRSG system described in this proposal has been designed for the following main parameter:

Engine	
Size:	7.5 MW & 5 MW
Fuels:	Natural Gas
Steam Conditions:	
Steam Pressure:	100 psig
Steam Temperature:	Saturated
Steam Flow (7.5 MW/ 5 MW):	7,100 / 4,700
F.W. Temperature	228 °F (Deaerated)
HRSG Design Pressures	
Evaporator:	200 psig
Economizer:	250 psig
HRSG Design Codes	
Evaporator:	ASME Section I
Economizer:	ASME Section I

RENTECH Boiler Systems, Inc. • 5025 E. Business 20 • Abilene, TX 79601 • Phone: 325-672-3400 • Fax: 325-672-9996

V. HRSG Pricing Summary

A. Budget Price – 7.5 MW Engine

The budget price for the supply of one (1) HRSG/SCR system as described within this proposal for the 7.5 MW engine, Ex-Works Abilene, TX is: ***$738,000 USD.***

B. Budget Price – 5 MW Engine

The budget price for the supply of one (1) HRSG/SCR system as described within this proposal for the 7.5 MW engine, Ex-Works Abilene, TX is: ***$685,000 USD.***

C. Terms of Payment

For this order, progress payments in accordance with the following schedule will be required.

10% Upon receipt of purchase order
10% Upon submittal of approval drawings
15% Upon receipt of tubes
15% Upon receipt of drum cylinders
20% Upon stabbing first tube
25% Upon shipment
5% Upon documentation

Payment Terms: Net 30 days

Warranty – 12 months from acceptance, not to exceed 18 months from shipment.

D. Drawing Schedule

The following preliminary schedule is provided for your consideration.

Schedule for Drawing Submittals will be as follows:
Overall General Arrangement – 8 Weeks ARO
Trim and Piping Drawing – 8 Weeks ARO
Foundation Plan with Loads – 8 Weeks ARO
Process and Instrument Drawings – 8 Weeks ARO
Return of approved drawings: 2 weeks ARO.

E. Shipment

The following preliminary schedule is provided for your consideration.

The HRSG equipment will be ready for shipment 36 weeks after order with release to purchase long lead materials at the time of the purchase order.

NAPPA CONSTRUCTION MANAGEMENT, LLC

473 Washington Street
Providence, Rhode Island 02903

p 401.274.3917
fx 401.521.5030

June 28, 2012

Jeffrey L'Heureux
Mechanical Engineer
Toray Plastics (America), Inc.

Dear Mr. L'Heureux,

Nappa Construction Management proposes to furnish all materials, labor and equipment necessary to complete the CG II Project Lumirror Division new building to be located at 50 Belver Avenue, No. Kingstown, Rhode Island 02852.

Our Pricing and scope are based on a design build scenario. It is with our experience and understanding of the building code requirements that we feel this project can be completed for the budget.

The cost to complete the scope is One Million Four Hundred Two Thousand One Hundred Forty Three Dollars ($1,402,143.00)

The Scope of work is based on the plans provided by Toray as well as the detailed scope letter provided. In addition, the Architectural Services Proposal from RGB and the Engineering Services Proposal from BER is included with this document and is included in our design build costs..

The following qualifications were considered as part of this proposal:

- At this time, all Gen-set equipment and connections are by others
- The pre-engineered building and components are by Star Buildings.
- Architectural and Engineering services will be provided by RGB
- Onsite staging area and unfettered access to the area to be provided to GC.
- Cooling will be provided for the electrical room only.
- Underground utilities are assumed to be within 10' of building perimeter.
- Lighting is considered as high bay lighting in open areas and industrial lighting under mezzanine.

The completion of this scope will take approximately twenty (28) weeks from issuance of the building permit with the following milestone dates for key items:

- Design phase Six (6) weeks from acceptance- approximately August 7, 2012
- Groundbreaking Eight (8) weeks from acceptance – approximately August 21, 2012
- Foundation complete on or about October 16, 2012
- Building erected by November 15, 2012.

Nappa Construction Management carries general liability insurance as well as full worker's compensation insurance. Certificates of insurance are available upon request. We also offer a one (1) year warranty on all work completed within our scope. Please don't hesitate to contact us with any question or concerns.

Thank you for the opportunity to work with you on this project.

Sincerely,

Accepted

Bill Brzoza

Project Manager

____

RGB architecture engineering interior design

June 25, 2012

Bill Brzoza
Nappa Construction Management
473 Washington Street
Providence, RI 02903

Re: Professional Service Proposal
Cogeneration 2 Project
RGB #305-072-2

Dear Mr. Brzoza,

The Robinson Green Beretta Corporation (RGB) is pleased to submit this proposal for professional design services for the proposed new Cogeneration 2 project located at Toray Plastics in North Kingstown, Rhode Island.

Scope of Work:
The scope of work is to design an approximate 8,350 square foot insulated metal building addition to house the cogeneration 2 plant and provide construction administration services.

Scope of Services:
RGB will provide professional design services, drawings and specifications for obtaining a building permit and for construction. Design services include civil, architectural, structural, mechanical, electrical, plumbing and fire protection and acoustical engineering.

- Civil engineering includes site grading and resurfacing at the perimeter of the addition; fire service to the building and tank truck unloading pad.
- Architectural services includes meetings, coordination of the team of engineers, construction drawings and specifications and construction administration.
- Structural engineering includes structural design of the foundations and equipment and tank pads, mezzanines, stairs and miscellaneous steel items.
- Mechanical engineering includes HVAC design for the split system cooling for the high voltage electric room, supply and exhaust fans, and intake louvers.
- Electrical engineering includes designing all panels, transformers and feeders to support house loads in the addition, lighting fixtures, exit signs, emergency lighting and controls for the addition, and general purpose receptacles for the addition. Design for fire alarm devices, tied to an existing fire alarm control panel, power provisions for the split system cooling, and building mounted security lighting.
- Plumbing engineering includes designing floor drains tied to a sump pump.
- Fire protection engineering to design new incoming sprinkler service and new pre-action system with branch sprinkler piping and head layouts for the addition.
- Acoustical engineering design to reduce the interior-to-exterior sound level from 110 to 85 db; at the exterior walls and roof.

Both the roof construction and sprinkler design will conform to Factory Mutual Insurance requirements. RGB will attend bi-weekly construction meetings and site visits, assuming construction duration of four months.

Schedule
The proposed schedule is as follows:

July 6, 2012	Notice to proceed
August 3, 2012	Complete construction documents; project goes out to bid, Drawings submitted for review for permitting
August 24, 2012	Bids due
September 7, 2012	Construction begins

Exclusions
Furnishing and installation of cogeneration equipment as defined in the documentation provided by Toray Plastics, Inc. Soil investigations and testing; testing and/ or upsizing utilities to supply the facility, Zoning research or hearings, RIDEM approvals, Town approvals, fire flow testing. Assumes the prefabricated metal building engineer designs the building structure; RGB provides the drawing documents and specifications for the building structure. Tel/data provisions are provided by Toray. Evaluation of site noise levels and evaluation of noise to receptors would be considered and additional service.

Fees:
Compensation for the scope of services indicated above shall be broken down as follows:

Civil	$8,500.00	
Allowance for Survey (within 50' of building perimeter)	$1,800.00	
Subtotal		**$ 10,300.00**
Architectural	$59,800.00	**$ 54,200.00**
Structural	$20,900.00	**$ 20,900.00**
Mechanical	$ 6,900.00	**$ 6,900.00**
Electrical	$ 7,900.00	**$ 7,900.00**
Plumbing	$ 3,200.00	**$ 3,200.00**
Fire Protection	$ 5,200.00	**$ 5,200.00**
Acoustical Engineer	$ 3,850.00	**$ 3,800.00**
Subtotal		**$112,400.00**

Please note that if the acoustical engineer is required to design for interior noise reductions the fee will increase by $1,650.00.

All requests for payment will be billed on a monthly basis. Payments are due within 30 days of invoice date. Payments that are due to RGB and unpaid under the Agreement after 31 days from invoice date shall bear interest at the rate of 1.5% per month.

Expenses:
Reimbursable Expenses are in addition to the Basic Compensation and include actual expenditures made by the Architect and the Architect's employees and/or consultants in the interest of the project. Additional reimbursable expenses will include all printing, photocopying, mailing, shipping, etc.

All reimbursable expenses will be invoiced at cost with the markup of 10% for handling and administrative costs.

Additional Services:
If additional services beyond the scope those outlined are required, the fee for these services will be in addition to the basic fee and provided only upon the authorization of Toray Plastics, Inc.

If the schedule, scope of work or value of construction for this project is adjusted, RGB reserves the right to renegotiate this Agreement.

Expiration:
The fee for the Scope of Services as set forth in the Agreement is valid for 60 days from the date of the Agreement.

Thank you again for the opportunity to submit this Agreement/Proposal. If the terms of this Agreement are acceptable to you, please sign both copies and return one copy to us.

This letter shall serve as a letter of intent to begin work. RGB will then prepare and execute an AIA Document A107, which will serve as our Agreement for this project. Please call me if you have any questions or require additional information.

Respectfully submitted,

Cyndi Gerlach, AIA, NCARB, LEED AP
Associate
The Robinson Green Beretta Corporation

DLD:cae

cc: DLD, JRB/ANR, RGB

Accepted by: ______________________

Name: ______________________

Title: ______________________

Date: ______________________

BER

BUILDING ENGINEERING RESOURCES, INC.

(Revised June 25, 2012)
June 15, 2012

Ms. Cyndi Gerlach
Robinson Green Beretta Corp.
50 Holden Street
Providence, Rhode Island 02908

RE: Toray Plastics – North Kingstown, RI
Engineering Services Proposal

Dear Cyndi:

We are pleased to provide this Proposal for Mechanical, Electrical, Plumbing and Fire Protection engineering services for the proposed renovation addition to the Toray Plastics Facility located on Belver Ave in North Kingstown, Rhode Island. Our Proposal is as follows:

DESCRIPTION OF WORK:

A. We understand this project is a 14,000sf multi-level addition. The addition will house new Co-Gen equipment to be furnished and installed by Client. All process related systems are not included. This Proposal is for Base Building shell provisions only. Engineers shall field verify all "MEP/FP" existing conditions.

B. This Proposal includes all Affidavits and Code required Calculations and Narratives.

C. This Proposal is for "Design-Build" level services. We anticipate the General Contractor will have preferred Sub-Contractors. Sub-Contractors will assist Team with pricing and preferred Equipment Vendors.

SCOPE OF WORK:

A. Design:

1. Provide HVAC engineering and design services, drawings and specifications for the following:

   a. Split system cooling for high voltage Electric Room.
   b. Supply and exhaust fans.
   c. Intake louvers.
   d. Unit heaters and controls for all areas.

2. Provide Electrical engineering and design services, drawings and specifications for the following:

   a. Provide all panels, transformers and feeders to support house loads in addition.
   b. Lighting fixtures, Exit signs, emergency lighting and controls for addition. All emergency lighting via battery units.
   c. General purpose receptacles for addition.
   d. Fire Alarm devices tied to the existing Fire Alarm Control Panel (FACP) and coordination with local Fire Department.
   e. Power provisions for HVAC equipment.
   f. Tel/Data outlet backboxes and backboards only.
   g. Building mounted security lighting.

3. Provide Plumbing engineering and design services, drawings and specifications for the following:

   a. Utilize existing domestic water, sanitary and gas services.
   b. Coordinate new gas loads with Utility Company.
   c. Gas piping and connections for new rooftop units and stubs for Co-Gen units.
   d. Floor drains tied to existing sump pump.

4. Provide Fire Protection engineering and design services, drawings and specifications for the following:

   a. New incoming sprinkler service. Interface with existing service.
   b. New Pre-action System with branch sprinkler piping and head layouts for addition.

5. Scope of Work shall include Spec Notes on Plans.

6. Field Verification and Meetings:

   a. Engineers shall perform one (1) initial site visit to verify "MEP/FP" existing conditions.
   b. Engineers shall attend one (1) "Team" Design Coordination meeting.

7. Deliverables:

   a. Progress Plot Sets will be available at each milestone. We anticipate two (2) Progress Sets for Coordination.
   b. One (1) set of Final Plots and Specifications to be delivered at 100% completion.
   c. Emails of "electronic" files are available upon request at no charge.

B. Excluded from Scope of Work:

1. Security System wiring and equipment.
2. Sound/PA System wiring and equipment.
3. Tel/Data wiring and equipment.
4. Upgrades of Base Building "MEP/FP" Systems.
5. Flow Test for Fire Protection System.
6. Cost Estimating and Life Cycle Cost Analysis.
7. UPS System.
8. Emergency Generator.
9. Value Engineering: Including Recommendations, Meetings, and Plan Revisions.
10. FM 200 Fire Suppression System.
11. Site lighting.
12. Acoustic Consulting.
13. Demolition Drawings.
14. As-Built Record Drawings.
15. Commissioning of HVAC, Plumbing and Electrical Systems
16. LEED Design Services.
17. Design utilizing "3D" modeling, Revit, etc.
18. Design of structural supports, site utility support, concrete pads, trenching and backfill of utilities.
19. High Voltage Distribution Equipment Co-Gen Units.

C. Assumptions:

1. Tel/Data wire management shall include conduit, pullstrings, backboxes and plywood backboards only.
2. All Base Building "MEP/FP" systems are adequate to support the proposed build-out.
3. Fire Alarm System is ADA Compliant.
4. Sprinkler service has a backflow preventor.
5. No internal roof drains required. Gutters and downspouts by Others.
6. New Restrooms.
7. No changes required to existing Pre-Action System.
8. Architect is to provide Base Plans in AutoCAD Format.
9. Field verification is based on receipt of Existing Condition Documents. If documentation is not available Existing Conditions take-off will be billed on a *"Time and Materials Basis"*.

D. General Conditions of this Proposal:

1. Substantial Revisions or Scope changes after start of Design will be considered "Additional Services".

E. Construction Administration to include shop drawing reviews, responses to Contractor field questions, three (3) Progress Site Visits, Final Punch List and Final Affidavits. Additional site visits will be performed only as requested by the Owner and will be billed on a *"Time and Materials Basis"*. Please allow $600.00 average per visit.

FEE:

A. Our Fee for the above outlined Scope of Work will be invoiced monthly as follows:

1. Design Development:		$ 20,000
2. Construction Administration:		$ 3,200
	Total	$ 23,200

B. See Attached "Terms and Conditions" sheet.

C. Reimbursable Expenses Includes:

1. Please budget $1,000 for Reimbursable Expenses.

   a. Basic in-house printing, plotting and copying are included in our Base Fee. Printing of multiple "Review" Sets, "Permit" Sets and "Bid" Sets will be billed at Cost.
   b. Express/Overnight mail and Courier delivery services will be billed at Cost.
   c. Mileage for travel to site and meetings will be invoiced at $0.46 per mile.

UNDERSTOOD AND ACCEPTED BY:

A. If you are in agreement with the above Scope of Work and Fees, please sign and return a copy of this Proposal to our office so we may begin the work.

Name/Title: ______________________________ **Date:** ______________

If you should have any questions with the above, please do not hesitate to contact this office.

Very truly yours,

Marc R. Plante, PE
Principal

Attachment

TERMS AND CONDITIONS (*)

Reimbursable Expenses:

Reimbursable expenses will include the following:

- Out of town travel and travel related expenses (hotels, meals, car rental, taxis, etc.).
- Messenger service and Overnight mail.
- Document printing, reproduction and plotting costs (Permit Sets).
- Specialty Consultants (if required and approved by the Client).
- Services of Systems Testing Agencies (if required and approved by the Client).
- Automobile expenses at $0.46 per mile.

Reimbursable expenses will be billed with a 10% mark-up.

Hourly Rates:

The following hourly rates are used for "Additional Services" and for Contracts that Building Engineering Resources, Inc. (BER) is performing basic services on a time and material basis. These rates are valid through December 31, 2012.

- Principal-in-Charge: $175
- Senior Engineer: $135
- Engineer: $110
- Designer: $ 90
- Draftsperson/CADD Operator $ 75

Payment Schedule:

Once our work has commenced, invoices for Basic Services, Additional Services and Reimbursable Expenses will be submitted on a monthly basis. Invoices will be considered correct as rendered if not questioned in writing by your office within five (5) days of the invoice date. Payment is due within 30 days of the invoice date. Payment of the Fee shall not be dependent upon project financing.

BER reserves the right to suspend all work on the project if payment is not received when due. In the event of such suspension, the Client will waive all rights, claims, etc. which it might otherwise have against BER as a direct or indirect result of such suspension.

If the Client defaults and fails to pay according to the terms of this contract, then BER shall have the right to terminate this contract immediately and to seek to collect any fees, costs or reimbursable expenses due by the Court. The Client agrees that in addition to the amount invoiced, the Client shall be responsible for any and all attorney fees or costs incurred by BER in any efforts to collect this balance due.

Terms and Conditions:

In the event that BER is bound by the terms of a Prime Agreement with the Client/Owner, the Architect shall provide BER with a complete copy of this agreement for our review and comment, prior to the execution of the agreement.

The Architect shall disclose to BER, in writing and prior to the execution of this agreement, any contingent or other special provisions relative to Compensation, that is included in the Architect's understanding with the Client/Owner or in the Prime Agreement. In the absence of such disclosure, such contingencies or special provisions will not bind BER.

Any items that are not specifically stated in the above proposed services are to be considered excluded from this Agreement, and if requested, will constitute an Additional Service Fee.

No deductions will be made from the compensation on account of any penalty, liquidated damages or other sums withheld from payments to Contractors, or on account of the cost of changes in the Project.

In the event of any dispute, claim, question or controversy arising out of this Agreement, its performance, breach and/or interpretation, the same will be determined by arbitration pursuant to the Construction Industry Arbitration Rules of the American Arbitration Association.

If the project is suspended in whole or in part for a period of more than ninety (90) days, the balance of the Fee shall be entitled to an equity adjustment.

BER will not be responsible for or be liable in any way with the discovery, presence, handling, removal, disposal of or exposure of persons to hazardous materials in any form at the Project.

BER will not be responsible for the acts or omissions of the Contractor, Subcontractors or any other persons performing any of the work or for the failure of any of these parties to carry out the work in accordance with the Construction Documents.

This Agreement may be terminated by either party upon fourteen (14) days written notice in the event that the other party fails substantially to perform its obligations under this Agreement through no fault of the party initiating the termination. BER will be paid for all services rendered up to and including the date of termination.

BER will not be liable to redesign to meet the Project Budget Costs unless this is a pre-condition of the Contract and BER has agreed to the Project Budget Costs.

Location	Phase Code	Description	Takeoff Quantity	Unit	Material Amount	Labor Cost	Unit Cost	Total Amount	Location Total	SF COST
		Torray Plastics								2,200
DIVISION 1 - GENERAL REQUIREMENTS				LS				$ 230,625.00	$ 230,625.00	$ 104.83
DIVISION 2 - EXISTING CONDITIONS										
	02 41 19	Selective Demolition	1	LS			$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 2.27
DIVISION 3 - CONCRETE										
	03 00 00	Footings, Foundations, and pads Labor	1	LS			$ 61,500.00	$ 61,500.00	$ 186,250.00	$ 84.66
	03 00 00	Footings, Foundations, and pads concrete material	800	CYD			$ 100.00	$ 80,000.00		
	03 00 00	Slab on grade place and finish	1	LS			$ 14,500.00	$ 14,500.00		
	03 00 00	Concrete slabs on grade					$ -	$ -		
	03 00 00	Re-inforcing steel and mesh allowance (10 tons)	1	Allowance			$ 25,250.00	$ 25,250.00		
	03 00 00	Misc. Concrete material	1	LS			$ 5,000.00	$ 5,000.00		
DIVISION 4 - MASONRY										
	04 00 00						$ -	$ -	$ -	$ -
	04 00 00						$ -	$ -		
DIVISION 5 - METALS										
	05 00 00	Metal building component with Siding w/ steel supports for ope	1	LS			$ 225,000.00	$ 225,000.00	$ 380,000.00	$ 172.73
	05 00 00	Metal building erection	1	LS			$ 54,000.00	$ 54,000.00		
	05 00 00	Galvanized exterior stair case	1	LS			$ 30,000.00	$ 30,000.00		
	05 00 00	Interior galvanized platforms and stairs	1	LS			$ 56,000.00	$ 56,000.00		
	05 00 00	Galvanized cooling tower frames	1	LS			$ 15,000.00	$ 15,000.00		
DIVISION 6 - WOOD, PLASTIC, AND COMPOSITES										
	06 10 00	Misc. Rough Carpentry	1	LS			$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 11.36
DIVISION 7 - THERMAL AND MOISTURE PROTECTION										
	07 10 00	Foundation sealer and Insulation	1	LS			$ 3,800.00	$ 3,800.00	$ 81,000.00	$ 36.82
	07 21 00	Insulation - included in building compnents		LS			$ -	$ -		
	07 31 13	EDPM Roofing	1	LS			$ 75,000.00	$ 75,000.00		
	07 71 19	Gutters and downspouts	1	LS			$ 2,200.00	$ 2,200.00		
DIVISION 8 - OPENINGS										
	08 10 00	Doors frames and hardware	1	LS			$ 1,800.00	$ 1,800.00	$ 19,800.00	$ 9.00
	08 71 00	Coiling overhead doors	4	EA			$ 4,500.00	$ 18,000.00		
DIVISION 9 - FINISHES										
	09 29 00	Gypsum Board partitions at electrical room	1	LS			$ 20,000.00	$ 20,000.00	$ 36,000.00	$ 16.36
	09 90 00	Painting - Interior	1	LS			$ 16,000.00	$ 16,000.00		
DIVISION 10 - SPECIALTIES							$ -	$ -	$ -	$ -
DIVISION 11 - EQUIPMENT		All Equipment, associated power and connections are by others		LS			$ -	$ -	$ -	$ -
DIVISION 12 - FURNISHING									$ -	$ -
DIVISION 13 SPECIAL CONSTRUCTION									$ -	$ -
DIVISION 14 CONVEYING SYSTEMS									$ -	$ -
DIVISION 15									$ -	$ -

Location	Phase Code	Description	Takeoff Quantity	Unit	Material Amount	Labor Cost	Unit Cost	Total Amount	Location Total	SF COST
		Torray Plastics								2,200
DIVISION 16 ELECTRICAL									$ 100,000.00	$ 45.45
16100		General Lighting, outlet, and fire alarm w/ associated panels	1	LS			$ 100,000.00	$ 100,000.00		
							$ -	$ -		
DIVISION 17 through 20									$ -	$ -
		NOT USED					$ -	$ -		
DIVISION 21									$ 53,000.00	$ 24.09
		Fire Suppression	1	LS			$ 53,000.00	$ 53,000.00		
DIVISION 22 - PLUMBING									$ 25,000.00	$ 11.36
		Plumbing	1	LS			$ 25,000.00	$ 25,000.00		
		Trench Drain - Sump pump	1	LS						
DIVISION 23 - HVAC									$ 20,000.00	$ 9.09
		Cooling at electrical room	1	LS			$ 20,000.00	$ 20,000.00		
DIVISION 31 - EARTHWORK									$ 43,000.00	$ 19.55
		Excavation / Backfill	1	LS			$ 20,000.00	$ 20,000.00		
		Slab prep	1	LS			$ 8,000.00	$ 8,000.00		
		Misc. Clean fill	1	Allowance			$ 15,000.00	$ 15,000.00		
DIVISION 32 - EXTERIOR IMPROVEMENTS									$ 45,000.00	$ 20.45
		Asphalt paving allowance	1000	SYD			$ 30.00	$ 30,000.00		
		Site drainage allowance	1	Allowance			$ 15,000.00	$ 15,000.00		
DIVISION 33 - UTILITIES									$ 25,000.00	$ 11.36
		Utility allowance	1	LS			$ 25,000.00	$ 25,000.00		
							$ -	$ -		
									$ 1,274,675.00	$ 579.40
								Fee	$ 127,467.50	$ 57.94
								Total	$ 1,402,142.50	$ 637.34
									$ -	
									$ 1,402,142.50	

SPEC
PROCESS ENGINEERS WHO BUILD
www.spec-eng.com

June 19, 2012

Eric Carlson
Director of Engineering
Toray
50 Belver Ave.
North Kingstown, RI 02852

Dear Eric:

SPEC is pleased to provide this proposal in response to your CGII Piping Bid Package for the installation of the two KGG modules and two KGA modules at Toray's North Kingstown, RI facility.

Scope of work
SPEC will design the associated piping and install the two KGG and two KGA modules according to the equipment installation documentation provided by Toray. This work will include the design of piping systems to connect the modules based on the P&IDs provided, and the design and installation of pipe supports to meet Toray's pipe support specification. As part of the installation scope, SPEC will pull a mechanical building permit with P.E. stamped drawings.

Schedule and Pricing
SPEC is proposing to complete the above scope of work in a duration of approximately 7 to 8 months and assumes that Toray's equipment procurement, overall permit, and related subcontractor efforts would support a duration no longer than 8 months for our portion of the work.

SPEC's Budget Estimate for the Mechanical piping design and installation is **$3,294,000.** The budget is based upon the scope documents received and the following key provisions:

1. All equipment procured and delivered to the site by Toray
2. All instrumentation provided by Toray, installed by SPEC
3. All concrete work, steel work, electrical work, exhaust duct, & roofing work by Toray(except as noted)
4. Steam blow temporary piping and gas line high velocity air blow excluded(start up)
5. RI Sales Taxes(assumed Toray will provide tax exempt certificate)

The scope we have provided and estimated at this time includes:

1. Piping design, stamped drawings, mechanical permit
2. Construction coordination, field supervision, project management
3. Rigging of listed equipment per the Toray's list with additions as discussed
4. Piping installation with supports, expansion loops, tie ins and testing
5. Structural steel for rack to Utility Building as discussed(including excavation, concrete, and backfill for three pipe bridge foundations)
6. Demo of the Utility Building Wall to remove Chiller Number 5 and replace of same once installation of the new turbine driven chiller has been completed.

17 A Street Burlington, Massachusetts 01803
Phone (781) 743-0123 Facsimile (781) 221-7212

SPEC
PROCESS ENGINEERS WHO BUILD
www.spec-eng.com

7. Piping Insulation is excluded at this time as the subcontractor bid was not received In time for this response.

The rigging involved with the proposed project is extensive and involves a significant portion of the quoted budget estimate. The interfacing of the equipment suppliers with a riggers yard or directly to the site will be a key project issue. Site preparation for the rigging equipment will also be extensive due to the weights involved(90 and 120 tons for the engines involved). A detailed rigging package with all equipment cuts, weights, dimensions, building drawings and a site plan is needed in order to confirm this major scope item and provide better pricing than that which we have obtained in the short time available. Industrial Transfer and Storage would be our preferred rigger and they have both the equipment and recent Cogen experience. On the piping side we have teamed with Notch Mechanical who has worked with SPEC for over 8 years. Both these subcontractors have worked with SPEC in Rhode Island and have excellent work practices and safety records.

Thank you for your interest in working with SPEC, I will follow up with you to make sure this proposal meets with your approval.

Sincerely,

Steve Murray
Vice President of Design

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

Toray Plastics Co-Generation Plant, at Rhode Island, USA

Proposal For
ELECTRICAL, AND CONTROL SYSTEM

JUNE 2012

ABB INC.

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

Toray Plastics (America), Inc.
ABB Toray Plastics Co-Generation Palnt
PROPOSAL No. 12720 4044_0

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BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 1

June 20, 2012

Toray Plastics America
North Kingstown, RI

Attention: Geoffrey D. Saucier

Reference: Toray Plastics Gas Engine Co-generation System
ABB Integrated electrical and control system
ABB Proposal No. 12720 4044_0

Attached is our proposal for the electrical and control balance of plant scope for the Toray Plastics (America) Co-generation project being consider at the Torayfan Division in New Kingstown, RI.

The ABB electrical and control solution provides a single source of supply for the equipment, engineering, installation and project management of the critical electrical core and automation infrastructure.

The scope of our solution is detailed in the commercial and technical offer along with the attached appendices.

We hope that you will find our submission valuable and informative. We guarantee the highest possible level of quality in all of our products and services and look forward to an opportunity to discuss this tender in detail. All enquires of technical or commercial nature should be directed to Rick Ulam at 330 423 8667 (cell).

Thank you very much for your interest in our solution.

Yours truly,

Rick Ulam
Executive Account Manager
Power Generation System
ABB
Wickliffe, Ohio
O: 234 759 3160
M: 330 423 8667
E: rick.l.ulam@us.abb.com

ABB

Per: Indra K Kusuma
Power Systems Power Generation
Bids and Proposal Manager
ABB Inc.

Per: John A Ieraci
Power Systems Power Generation
NAM Sales Manager
ABB Inc.

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 2

2. COMMERCIAL SUMMARY

IMPORTANT NOTE: This ABB budgetary estimate is preliminary and not final and as such is non-binding. It is tendered for discussion only, does not constitute a term to contract and ABB can, without notice, make any changes in ABB own discretion.

2.1 Confidentiality

This proposal contains information that is proprietary to ABB Inc.

2.2 Abbreviation Key

The following abbreviations apply throughout this proposal:

ABB / ABB Inc. = ABB Inc.

Client / Customer / Owner / Others = Toray Plastics (America), Inc.

2.3 Bid Pricing

The prices below include the scope of supply for Toray Plastics Co-Generation Plant as described in the Technical Proposal is as follows:

TORAY PLASTICS CO-GENERATION ELECTRICAL AND CONTROL EQUIPMENT	PRICE (USD)
B.1 Price for procurement package with scope as described in the Technical Proposal under TAB 3.	USD$2,410,799.00

2.4 Optional Pricing

Optional Pricing is offered as follows:

TORAY PLASTICS CO-GENERATION INSTALLATION OF ELECTRICAL AND CONTROL EQUIPMENT	PRICE (USD)
O.01 Price for installation of equipment quoted under 2.3 above only (Union Labour), including Site Manager services and excluding Site Supervision Services described under 2.6 below.	USD$1,173,714.00

2.5 Project Execution

Anticipated Notice to Proceed : July 20, 2012

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 2

Anticipated Commercial Operation Date (COD) : July 20, 2013

2.6 Site Services

Site supervision services for installation and commissioning are not included in our price. but can we quoted if requested.

2.7 Currency

All pricing shown is in USD.

2.8 Bonds

Our proposal does not include for any bonds or Letters of Credit.

2.9 Terms of Payment

We have prepared our proposal based on payment milestones which would allow for a neutral cash flow, with the consequent savings of financial expenses.

The terms of payment suggested in this offer are:

15% Advance Payment

20% of offer price upon submission of Design Engineering;

10% of offer price upon approval of Design Engineering;

30% of offer price upon Advice of Ready to Ship;

20% of offer price upon Arrival at Site;

5% of offer price upon Commissioning;

The payment will be effected through an irrevocable, standby Letter of Credit from an investment-grade bank, in terms acceptable to ABB. This LoC will be required at the time of the Contract signature and it will be for a value representing the difference between the Contract Value and the Advance Payment. Bank fees for LoCs will be paid by the applicant.

2.10 Freight

Freight is DAP to site, per INCOTERMS 2010.
The equipment will be shipped using ABB standard packaging procedures.
Equipment is shipped via ABB selected carrier.

2.11 Delivery

The schedule is to be decided by mutual agreement between Toray Plastics and ABB. We have prepared our proposal based on the following key dates:

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 2

Our latest estimated delivery time is 34 Weeks until Advice of Ready to Ship.

Please note that our estimated delivery time is based on contract effectiveness and timely receipt of necessary design data and approval.

2.12 Taxes and Duties

Taxes are excluded from our proposal. Duties are not applicable.

2.13 Warranty

Proposed warranty is 18 months from shipment or 12 months after acceptance, whichever occurs first.

Please note that above warranty will cover the costs of replacement of the warranted item EXW the respective supplier's factories. All other costs associated with the item's replacement (including diagnosis, removal, shipment to supplier's factory, and re-installation in the system) are not covered under the warranty.

2.14 Publication

Purchaser approves the use of its name in ABB newsletters, press releases, proposals, experience lists, and resumes (for proposal purposes) of our employees.

2.15 Training

Training is not included in this offer, but can be quoted if requested.

2.16 Spare Parts

Spares are not included in this offer, but prices can be quoted if requested.

2.17 Tests and Inspections

All equipment is subject to standard manufacturing tests. Should acceptance tests be required, then these will be charged extra.

2.18 Meeting

The following meetings are considered in our proposal.

- One (01) one-day Kick of Meeting with Toray Plastics in Rhode Island, USA
- One (01) two-day design review meeting with Toray Plastics at ABB, Burlington, Ontario, Canada (See Note* below)

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 2

- One (01) one-day design review meeting with Toray Plastics in Rhode Island, USA
- One (01) one-day pre construction meeting with Toray Plastics in Rhode Island, USA (If Installation Option O.01 under 2.4 above is purchased)
- One (01) one-day construction follow-up meeting with Toray Plastics in Rhode Island, USA (If Installation Option O.01 under 2.4 above is purchased)

Note*: Expenses for Toray Plastics personnel are not included.

If required, ABB is ready to actively participate in any necessary meetings. In such case the offer price will be adjusted by mutual agreement between Toray Plastics and ABB.

2.19 Documentation

This Price includes one (1) electronic set of standard ABB manuals in the English language.

Please note that due to copyright considerations, third party documentation for hardware and software not produced by ABB is limited to the form and number of software licenses or equipment purchased from the third party.

2.20 Quote Validity

The proposal is valid until July 20, 2012.

2.21 Order Acceptance

Order acceptance is subject to credit approval by ABB.

2.22 Named Suppliers

ABB Inc. reserves the right to replace named suppliers for others of equal performance and quality.

2.23 Standard Equipment

All ABB standard specifications (e.g.: cabinet size, paint, colors, etc.) apply unless otherwise noted in our proposal. ABB reserves the right to provide the revisions of software and hardware that are in current use at the time of project execution. Also, ABB is not responsible for any design provided by the client or client's consultant.

2.24 Site Requirements for Site Services

Following are the Site Requirements for our personnel during the site activities:

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 2

- Health and Safety program for the overall site works
- Safe temporary power, water and lighting.
- Site medical services facilitated by the owner
- Access roads to the site and to go through the site
- Secure warehousing for equipment storage
- Site office equipped with photocopier, internet access, etc.

This proposal considers that the above requirements will be provided to ABB free of charge.

2.25 Soil, Access Roads and Civil Works Conditions

ABB is not responsible for the conditions of the soil, access roads or civil works and, should ABB incur in a delay due to soil, access roads or civil works conditions, it shall not be penalized for any delay; and should any additional costs be incurred by ABB due to soil, access roads or civil works conditions, such costs shall be passed to the Client. ABB assumes that any required work to correct soil, access roads or civil works conditions in order to install the equipment at site will be done by others

2.26 Destination Control

End Use
This offer is based on the condition that a statement of end use regarding the offered products, technical data and/or services will be supplied to ABB by the end user, prior to ABB's acceptance of any order for such products/technical data or services.

Nuclear Restrictions
The products delivered by ABB under this order must not under any circumstances be used in connection with a nuclear reactor or other nuclear facility. Any such nuclear use requires full protection against nuclear liability for the benefit of ABB and its sub-suppliers in accordance with conditions to be determined by ABB.

ABC-Weapons Restrictions

(a) The items described herein are not for use, directly or indirectly, in any activities related to the design, use or stockpiling of chemical, biological or nuclear weapons or missiles.

(b) The sale, re-export, delivery, or retransfer, directly or indirectly, to any activities related to the design, production, use, or stockpiling of chemical, biological or nuclear weapons or missiles is strictly prohibited.

Export/Re-Export Authorization
This offer is based on the condition that required export/re-export authorizations will be granted by the competent authorities in the countries of origin of the offered product and its parts and components. Refusal or withdrawal of said

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.1 Scope of Supply and Services

ABB is pleased to provide this Electrical, and Control engineered solution for the Toray Plastics Co-Generation Plant at the Torayfan Division, New Kingston Rhode Island, USA facility. In addition to the security of knowing that you are working with a world-class organization in ABB, the proposal affords the following benefits.

- Lower overall cost
- Reduced procurement effort
- Reduced sub-supplier coordination effort
- Reduced risk in electrical/automation/mechanical system changes that impact cost and schedule
- More efficient electrical, mechanical and automation engineering
- Long term life cycle service

ABB's scope of supply and services for the Toray Plastics Co-Generation Plant is based on the following integrated solution (please refer to the single line diagram in Appendix A-1, and Appendix A-4, TAB 4 of this proposal):

Electrical, and Control Package:

Electrical

One (1) Set	:	4.16kV Medium Voltage Switchgear System (Two Breakers + Transition cell to be added to the existing outdoor 4.16 kV line-up. Another lineup of four breakers to be installed at the Cogen plant location to take care of the two Generator, Auxiliary Transformer and Outgoing feeder to the existing outdoor 4.16 Switchgear.)
Two (2) Sets	:	Neutral Grounding Cubicle
Two (2) Sets	:	460V Low Voltage Motor Control Center
Two (2) Set	:	230V AC Distribution Panels
One (1) Set	:	3500kVA Auxiliary Transformer
Two (2) Sets	;	50kVA Auxiliary Transformers
Two (2) Set	:	DC Distribution Panels
One (1) Set	:	Battery Bank of 125V
One (1) Set	:	Charger / Rectifier
One (1) Set	:	Uninterrupted Power Supply System (UPS)
One (1) Set	:	4.16kV Medium Voltage Cable, 600V Low Voltage, Control Cable, Optical Fiber Cable (to connect to computers), and Cable Terminals
One (1) Set	:	Grounding Cable (for equipment under ABB's Scope of Supply and Services, from Equipment to Grounding Grid) and Grounding Rod (4 Nos.)

Control

One (1) Set	:	Control Cabinet
One (1) Set	:	Desk and Computer (One Control Desk and Four Personal Computers)

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

Services:

- Engineering – for ABB scope of supply and services stated in the ABB's proposal
- Procurement (Negotiation, order placement and delivery) - for ABB scope of supply and services stated in the ABB's proposal
- Project Management - for ABB scope of supply and services stated in the ABB's proposa
- Drawings and documents - for ABB scope of supply and services stated in the ABB's proposal
- O&M Manuals - - for ABB scope of supply and services stated in the ABB's proposal
- Painting and exposed surfaces of equipment - for ABB scope of supply and services stated in the ABB's proposal

Services (Option):

- Installation - for ABB scope of supply and services stated in the ABB's proposal
- Commissioning - for ABB scope of supply and services stated in the ABB's proposal
- Site Management, Site Health and Safety - for ABB scope of supply and services stated in the ABB's proposal
- Site supervision services during project execution (i.e. installation, commissioning etc.)
- Permit - for ABB scope of supply and services stated in the ABB's proposal

3.2 Out of Scope of Supply and Services

All equipment and services other than those stipulated in Section 3.1 above are not included in our proposal.
For example:

- Gas Engine
- Generator and Accessories
- Generator Control Panel
- Engine Control Panel (generator control, supervising and protection)
- Generator Protection
- Generator CTs [ex. (3) pcs at Generator neutral side, (3) pcs for loose supply, (3) pcs at Generator neutral side etc.]
- Remote Monitoring System
- Instrumentation
- Mechanical Auxiliary Equipment
- Any Kind of Civil Work
- Site preparation civil works
- Performance testing

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.3 Proposal Base

The technical proposal is prepared as a result of the optimum system design based on the Customer's specification as listed below, including several comments from the requirements as stated in the Customer's specification. (Current version as of June 08, 2012).

- TFN-TIE-IN.DWG
- TA5-P50013-E1001-OUTDOOR TA5-P50013-E1001 (1).pdf
- Air View TPA 2.pdf
- Equipment Layout.pdf
- SITEPLAN,COGEN2 Layout A size (1).pdf
- GA-167-02 Toray Plastics(USA)_KG18V_Tech proposal_R2 120531.pdf
- GA-167-02 Toray Plastics_USA__KG18V_appendix_120531.pdf
- GA-167-01 Toray Plastics(USA)_KG12V_Tech proposal_R2 120531.pdf
- GA-167-01 Toray Plastics_USA__KG12V_appendix_120314.pdf
- Cogen1 Building_1.jpg
- Cogen1 Building_2.jpg
- Cogen2 Building Location_1.jpg
- Cogen2 Building Location_2.jpg
- Electric Utility Manhole Cover Behind Switchgear.jpg
- Outdoor Switchgear_1.jpg
- Outdoor Switchgear_2.jpg
- T1 & T2 Utility Transformers.jpg
- ABB Assumptions

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.4 Document Priority

In the event of any inconsistencies between descriptions in the documents constituting the technical proposal, the order of precedence of the documents shall be in accordance with the following

1. Technical Comments, Section 3.6, TAB 3 of this proposal
2. Scope of Supply and Services, Section 3.1, Out of Scope of Supply and Services , Section 3.2, System Design Description, Section 3.5, TAB 3 of this proposal
3. Other documents of this proposal
4. Customer's specification as stated in Section 3.3, TAB 3 of this proposal

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.5.10 Control System

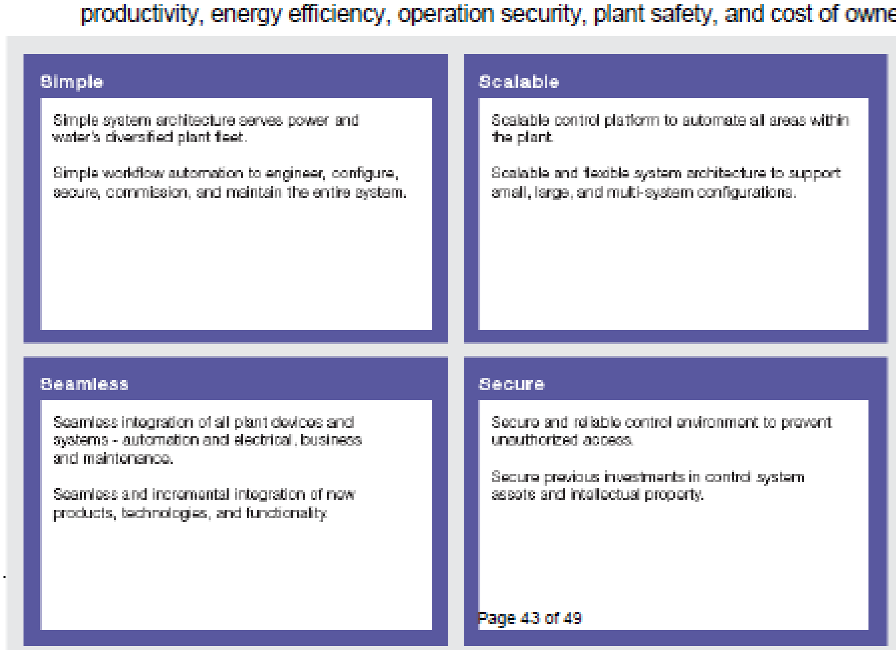
3.5.10.1 Introduction

3.5.10.1.1 Symphony PlusTM

Symphony PlusTM represents the new generation of ABB's widely acclaimed Symphony family of distributed control systems (DCS) – the most widely used DCS in the power generation and water industries. In all, there are more than 6,000 Symphony DCS installations in operation all over the world, with more than 4,000 in power and water applications.

For more than 30 years, ABB has evolved the Symphony family, ensuring that each new generation enhances its predecessors and is backwardly compatible with them – all in accordance with our long-held policy of 'Evolution without obsolescence.'

With Symphony Plus, ABB is taking the Symphony success story to the next level. Like its predecessors, Symphony Plus is designed to meet the requirements of plant owners in all geographic markets and in all types of power generation and water plants and meet the performance objectives of various users – in operations, maintenance, engineering, IT and management. And it targets the key focus areas of the power and water industries – plant productivity, energy efficiency, operation security, plant safety, and cost of ownership.



BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.5.10.1.2 S+ Operations

Operator effectiveness is fundamental to plant performance. With fewer plant operators, a generational shift in the operator workforce, and increasing complexity of plant operations, this is becoming ever more challenging, but not insurmountable. Symphony Plus, with its intuitive, easy-to-use human machine interface (HMI), leads operators to greater awareness, faster response and better decisions.

S+ Operations is based on the proven technology of Power Generation Portal (PGP) that has more than 2,300 installed systems worldwide. S+ Operations also has an integrated Power Generation Information Manager (PGIM) that is another proven ABB technology.

Features	Benefits
Simple and flexible system architecture/structure	Low investment, low maintenance costs
Large-scale networks possible	Expandable when needs evolve
Flexible single and multi-system facility	Adapts to any requirement - even the most demanding
Server-less and server-based installations possible	Adapts to any requirement
Miscellaneous data from multiple servers seamlessly integrated in one display	Saves time, efforts and thus human resources
Any requested redundancy possible	Provides the maximum system stability and reliability
Easy modification and expansion of configurations	Protects existing assets as the business evolves
Active (real-time) data and history information fully integrated in the information management system	Provides quick, easy, and seamless access to all stored data within one single system
Short-time history data stored within every workstation	Enables a quick overview of the evolution of situations; gives the time and opportunity for correct decision-making
Dedicated history servers	Guarantees data consistency under all circumstances
Elaborate human machine interface	Delivers intuitive, clearly arranged workplaces and direct access to all details
Utilizing web standards	Allows utilization of standard software and hardware
Perfect basis for ABB optimization tools	Facilitates proactive and predictive maintenance

3.5.10.1.3 S+ Engineering: Composer Harmony

Symphony Plus includes a comprehensive suite of engineering tools. S+ Engineering's Composer tools provide a visual environment for easy configuration of the control system strategies, global configuration databases, and manage system libraries of reusable software components.

The working environment provided by Composer simplifies the configuration and maintenance of Symphony™ and Symphony™ Plus systems. Composer is designed to operate on the Microsoft Windows 7 Professional or Server 2008. It is compatible with INFI 90 OPEN system configurations and is capable of importing existing WinTools configurations. Once imported, these configurations can be fully integrated into Composer and utilize all its features.

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3.5.10.1.4 Control Processors

ABB's Symphony Plus Controller is the latest evolution of Harmony Controllers. The Symphony Plus Controller Package is made up of a DIN Rail mountable termination unit and the Harmony Control Processor (HC800) and Communications Processor (CP800) modules. The control network between the Symphony Plus Controllers and Symphony Plus Servers is based on 100MB Fast Ethernet TCP/IP.

The Harmony Control Processor executes INFI 90 fuction codes and includes the combined functionality of the Harmony Rack BRC and HPG modules. It can process up to 30,000 INFI 90 Function Blocks, Batch 90, UDF and 'C' programs and registers up to 1,000 Exception Reports per second.

The Communications Processor is the control network interface. This module has the combined functionality of the NIS and NPM Harmony Rack Modules.

The Symphony Plus Controller Package is mounted on the Communication Termination Board (CTB810/811) which follows the same form factor as the 800xA AC800M Controllers allowing it to easily integrate with ABB's S800 I/O. The Termination Board also accepts a typical S800 24 VDC power supply removing the necessity of the MPSIII Power System. The Termination Board features the following interfaces:

- HN800 H-Net Interface for communication with Rack I/O and S800 I/O
- CW800 provides peer-to-peer communications between controllers
- Ethernet Modbus TCP interface for control level interfaces
- Fast Ethernet TCP/IP for communication to the Symphony Plus Operations Console.

3.5.10.1.5 System Architecture

Please see the System Overview Drawing for a description of the proposed architecture in Clause Appendix A-3, TAB 4 of this proposal.

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

3.6 Technical Comments

Technical Assumptions, Exceptions, Comments and Clarifications

This offer is based on the Specification Documents sent by Customer for Toray Co-Generation Plant. This solution's scope of supply is only related to the electrical, control equipment as stated of this proposal. We have not identified any important deviations which would, in our view, prevent our solution from providing you with a safe and easily operable and maintainable system.

ABB considers the management of the design, engineering and execution phases to be critical to the success of both the schedule and costs of this type of project. Therefore, the engineering hours included are based upon the assumption that a rigorous and mutually agreed design methodology and schedule is developed for execution of the works, prior to commencement of the contract. This is necessary in order to efficiently employ the resources of both the customer and ABB to maximize the effectiveness of the contract execution.

We are prepared to discuss these points further in more detail after your review of our budgetary proposal, in order to finalize and be clear on technical details.

General:

1. All equipment and services other than those stipulated in Clauses 3.1, and 3.5, TAB 3 of this proposal are not included in our proposal.
2. This proposal is based on ABB standard practices for power generation and other engineering projects. Unless otherwise explicitly stated, ABB's standard design, practices, equipment, documentation, etc, will be applied.
3. The installation services included in this proposal as an option and are in accordance with the project specifications. The general principles of the installation scope includes the placement of the equipment, fixations to the concrete floor or steel wall frame, bonding of the supplied equipment to the embedded grounding system, supply and installation of necessary cable tray network, and the supply, installation, and termination of power and control cables interconnecting the equipment supplied within the defined scope.
4. Permit fees are not included in our proposal.
5. The Customer shall provide ABB details of the existing bus such as horizontal and vertical elevation, quantity and size bus bar per phase etc.

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

6. The Customer shall provide ABB complete list of auxiliary load.
7. Seismic information was not received from the Customer. This offer therefore does not considered special provisions for meeting seismic requirements.
8. Seismic studies and/or a system stability study are not included.
9. The execution of civil works is not included in the offer. Primary and secondary concrete work is not included in our proposal.
10. The pre-operation, operation and soil studies for the power plant are not included in this offer.
11. The Environmental and archeological Studies as well as preparation of report are not included.
12. MV metal-clad switchgear is non arc resistant design.
13. The T7 Main circuit breaker has been priced with (2) CT's and ABB standard Shark200 Digital Meter (for LV MCC).
14. Electrical equipment is suitable for is Toray Co-Generation site altitude.
15. The installation and commissioning supervisor services are not included in this proposal for ABB's scope of supply and services stated in Clause 3.1 and 3.5, TAB 3 of this proposal.
16. ABB cannot provide any design analysis or design calculations because it is considered intellectual property.
17. The proposed equipment will be manufactured in conjunction with quality standards and the best engineering practices. Blanket compliance to all codes and standards cannot be offered because many are inapplicable to all classes of equipment and some are mutually exclusive. In general, it is ABB's practice to comply with relevant sections of major standards.
18. All equipment will be tested in the factory prior to shipping to site. This estimate does not include manufacturer's standard Factory Acceptance Testing (FAT) customer-witnessed for the equipment supplied by the ABB.

    If witness test required by the Customer the following shall be applied.

    1) Where the production facility or test/inspection location for travels inside Bolivia;
    Fixed test/inspection date : Seven (7) calendar days in advance

    2) Where the production facility or test/inspection location for overseas travels from Bolivia;
    Fixed test/inspection date : Twenty-one (21) calendar days in advance

    The customer or its representative shall inform to the ABB whether the Customer or its representative will attend the test and inspection, no later than five (5) calendar days prior to the commencement of notified test and inspection.

    Should the customer fail to attend on the appointed date, the test shall proceed in his absence and shall be deemed to have been made in his presence and the customer shall be bound by the results thereof. Should ABB agree to delay a witnessed test specified above, all

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

reasonable expenses which ABB may incur as a result of the delay will be charged extra and shall be payable by the Customer.

19. The Customer and ABB will mutually agree the submission dates and which documents have to be submitted for approval or for information.

20. This proposal is based on a once-through review of the engineering documents within two weeks. Additional reviews with extra comments not addressed on the first review or providing comments after two weeks from receipt of documents will result in a schedule delay and extra engineering/management costs which will apply accordingly as additional fees.

    Failure of Customer to respond within two weeks shall be interpreted as deemed approval of the drawings as submitted without comment.

21. The design, manufacture, and testing of equipment are based on the applicable editions/versions of the codes and standards as on the date of the proposal submission. If codes and standards are revised after the submission of proposal and it is felt necessary to follow the updated / revised versions during the execution phase of the project then, the ABB may use a later version after notifying the customer and applying the required procedure such as an amendment of contract. As a consequence, cost and project schedule implication if any for adopting the revised standards and codes shall be adjusted accordingly.

22. Local laws, standards and regulations other than clearly mentioned in the customer's specification are not considered in our proposal.

23. ABB and its suppliers have history to supply standard equipment in the power industry. ABB will provide standard information about our quality assurance to Customer. ABB's proposal does not considered to provide additional information and/or to our standard program.

24. Standard packing will be used for equipment under ABB's cope of supply and services. Special packing provision will not be applied.

25. Operation and maintenance manuals will be provided only for the ABB's equipment within the scope of supply.

26. On site assembly manual will not be provided as ABB is not responsible for installation.

27. The manufacturer standard painting specification will be used.

28. ABB reserves the right to change suppliers based on project and time requirements.

29. The Customer shall at his expense provide open space as the ABB reasonably requires for all activities connected with the execution of site works (If Installation Option O.01 under 2.4, TAB 2 is purchased).

    As soon as additional open space is necessary for the activities connected with the execution of site works, the ABB shall be able to obtain such open space on free of cost from the Owner.

30. The Customer shall at his expense provide utilities below as the ABB reasonably requires for erection use, commissioning use, temporary storage/workshop, and temporary ware/tool house and ensure that such facilities and assistance are safe and comply with legislation, by-laws, standards, codes of practice and other requirements from time to time applicable (If Installation Option O.01 under 2.4, TAB 2 is purchased).

    - Electricity

BUDGETARY ESTIMATE – FOR DISCUSSION ONLY

TAB 3

- Water
- Telephone
- Fax
- Internet

The ABB shall not be held responsible to make his own back up arrangement for such utilities mentioned above. The ABB shall not be liable for any unavailability of or interruption to supply.

In case of non-availability of electricity and water from Customer at the desired quality and quantity, the ABB shall be entitled to claim for an extension of time for completion of the works as well as variation to contract price.

31. The Customer shall arrange for canteen facilities to cater to the requirements of the ABB's personnel (If Installation Option O.01 under 2.4, TAB 2 is purchased).
32. All costs for import and export, duties, legal fees, taxes or other costs incurred in connection with the presence of our tools in the country of installation shall be carried by the Customer. If the tools cannot be exported back to the country of origin immediately after the completion of the installation work, the Customer shall pay rent for the tools until shipment takes place
33. It is the customer's duty to ensure that the ABB shall have the right of reasonable access to any place or facility for carry out the activities connected with the execution of site works without the prior approval of customer and restriction of time (If Installation Option O.01 under 2.4, TAB 2 is purchased).
34. The customer shall provide adequate training his personnel in the application of the site-specific safety rules (If Installation Option O.01 under 2.4, TAB 2 is purchased).
35. The Customer shall at his expense provide waste disposal facilities in the power plant. The ABB will dispose disassembled and/or useless parts and/or waste removed by the ABB to the designated place by the Customer in the Power Plant (If Installation Option O.01 under 2.4, TAB 2 is purchased).
36. The Customer shall at his expense provide sewage system for the ABB at site. The ABB will connect the ABB's temporary sewage system for his temporary site office and accommodation to the Customer's sewage system near the ABB's temporary site office and accommodation (If Installation Option O.01 under 2.4, TAB 2 is purchased).
37. The HAZOP studies are by others.
38. The ABB will provide First-aid facilities for his employees, representatives and workmen at the site, Subject to the ABB may be permitted to use, free of charge the Customer's First-aid medical facility (If Installation Option O.01 under 2.4, TAB 2 is purchased).
39. ABB will not be responsible for building and maintaining at his own cost temporary installations which are not part of the project works such as roads and other temporary constructions.

National Grid – Electric Interconnection Costs (Fred McKiernan, 401-784-7413)

As of 07/31/12, National Grid has estimated the total cost of performing all engineering, coordination and field work to be approximately $1,200,000, which is shown in Toray's Grand-Total Capital Cost Estimate.

Appendix B: Energy Analysis

<u>Sequential Order:</u>

Base Case - Summary Output[1] (Waldron's Proprietary Software).

Proposed Case – Summary Output[1] (Waldron's Proprietary Software).

Notes:

1. *Due to the 8,760 H/Y type analysis performed for this project, there is too much raw, intermediate and final data and information to present in the limited space of 8.5" x 11.0". With Toray's written permission and acknowledgement, this information is available by contacting Fred McKiernan at National Grid (401-784-7413).*

Base Case -Take 4_OUTPUT

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Electricity Balance													
Demand, Campus (MW)	18	19	19	20	19	20	20	19	19	19	19	19	20
Demand, Auxiliaries (MW)	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Electricity Demand (MW)	19	19	19	21	20	21	21	21	20	20	19	19	21
Direct-Connected Bldg Loads (MWh)	12,438	11,054	12,380	12,393	12,447	12,685	13,375	12,870	12,327	12,800	11,546	12,279	148,594
Grid-Connected Bldg Loads (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Chilling Auxiliary Loads (MWh)	177	156	177	141	162	168	160	159	150	140	141	157	1,888
Chilled Water Production (MWh)	42	116	331	370	399	493	678	605	526	442	345	173	4,519
Total Electricity Required (MWh)	12,657	11,326	12,889	12,904	13,007	13,347	14,212	13,634	13,003	13,381	12,031	12,609	155,001
CTG Electricity Production (MWh)	5,009	4,410	5,013	3,989	4,566	4,757	4,516	4,482	4,245	3,952	3,972	4,436	53,347
Recip Electricity Production (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Electricity Production (MWh)	5,009	4,410	5,013	3,989	4,566	4,757	4,516	4,482	4,245	3,952	3,972	4,436	53,347
Peak Purchased Demand (MW)	12	17	19	19	20	14	21	19	19	19	14	18	21
On-Peak Electricity Purchased (MWh)	3,217	2,883	3,123	3,276	3,060	3,698	3,690	3,978	3,566	3,297	2,907	3,625	40,319
Off-Peak Electricity Purchased (MWh)	4,432	4,034	4,753	5,639	5,382	4,891	6,006	5,177	5,192	6,131	5,152	4,548	61,338
Steam Balance													
Demand, Buildings & Process (klbs/hr)	63	61	55	47	32	36	30	49	29	43	46	55	63
Demand, Chilling & Auxiliaries (klbs/hr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Network Total Steam Demand (klbs/hr)	63	61	55	47	32	36	30	49	29	43	46	55	63
Non-Chilling Steam Load (klbs)	35,024	30,385	31,484	25,922	20,824	19,545	19,641	19,827	18,776	21,567	24,428	28,532	295,954
Steam to Chilled Water Production (klbs)	0	0	0	0	0	0	0	0	0	0	0	0	0
Steam to Plant Parasitic Steam Loads (klbs)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Steam Production Required (klbs)	35,024	30,385	31,484	25,922	20,824	19,545	19,641	19,827	18,776	21,567	24,428	28,532	295,954
HRSG Steam Production (klbs)	35,024	29,809	30,906	20,405	21,157	21,842	20,960	21,132	19,866	18,835	21,665	27,372	288,972
MP Boiler Steam Production (klbs)	0	576	578	5,574	694	0	1,267	1,220	980	3,631	2,773	1,159	18,453
Recip WHB Steam Production (klbs)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Steam Production (klbs)	35,024	30,385	31,484	25,979	21,851	21,842	22,227	22,352	20,846	22,466	24,438	28,531	307,425
Chilled Water Balance													
Peak Chilled Water Demand (tons)	970	1,069	1,296	1,300	1,400	1,420	1,645	1,587	1,487	1,356	1,025	1,009	1,645
On-Peak Chilled Water Load (ton-hrs)	11,731	63,655	209,062	225,791	214,916	315,066	353,634	357,602	309,906	235,989	200,600	109,308	2,607,262
Off-Peak Chilled Water Load (ton-hrs)	53,961	121,003	316,445	358,820	386,204	402,962	565,733	468,566	444,393	444,331	348,263	164,714	4,075,394
Total Chilled Water Required (ton-hrs)	65,691	184,658	525,508	584,611	601,120	718,028	919,367	826,168	754,299	680,320	548,864	274,022	6,682,656
Electric Drive Chilled Water (ton-hrs)	65,811	183,504	522,400	584,117	601,852	718,033	919,360	826,008	754,621	678,722	543,316	272,852	6,670,597
Steam Drive Chilled Water (ton-hrs)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chilled Water Production (ton-hrs)	65,811	183,504	522,400	584,117	601,852	718,033	919,360	826,008	754,621	678,722	543,316	272,852	6,670,597
Fuel Balance													
Fuel to Combustion Turbines (MMBtu)	62,543	55,151	62,073	49,053	57,549	59,110	56,388	56,118	53,754	49,590	50,378	56,588	668,296
Fuel to Duct Burners (MMBtu)	14,259	11,301	9,772	3,164	107	164	0	354	0	973	3,840	7,791	51,725
Fuel to Medium Pressure Boilers (MMBtu)	0	706	708	6,832	850	0	1,553	1,495	1,201	4,450	3,399	1,421	22,616
Fuel to Recips (MMBtu)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Fuel Consumption (MMBtu)	76,802	67,158	72,553	59,049	58,507	59,275	57,941	57,968	54,955	55,013	57,617	65,800	742,637
Energy-Only Expenses													
On-Peak Electricity Charges	$201,646	$180,708	$195,773	$205,382	$191,811	$231,825	$231,302	$249,374	$223,539	$206,714	$182,236	$227,272	$2,527,582
Off-Peak Electricity Charges	$277,830	$252,882	$297,993	$353,509	$337,381	$306,646	$376,533	$324,549	$325,481	$384,381	$323,005	$285,119	$3,845,309
Backup Demand Charges	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$19,031	$228,371
Supplemental Dist Demand Charges	$33,764	$33,732	$34,252	$39,035	$35,949	$38,440	$40,344	$38,120	$36,772	$35,510	$34,207	$34,175	$434,300
Supplemental Transm Demand Charges	$33,633	$33,558	$34,012	$38,820	$38,292	$40,135	$43,620	$39,927	$39,661	$36,007	$34,170	$35,026	$446,862
Forward Capacity Market Charges	$38,004	$37,920	$38,432	$43,865	$43,268	$45,351	$49,289	$45,116	$44,816	$40,686	$38,611	$39,578	$504,936
Fuel Charges	$453,284	$396,365	$428,207	$348,510	$345,305	$349,840	$341,968	$342,125	$324,344	$324,685	$340,056	$388,352	$4,383,041
Total Energy Costs	$1,057,191	$954,196	$1,047,700	$1,048,153	$1,011,038	$1,031,269	$1,102,087	$1,058,242	$1,013,644	$1,047,014	$971,316	$1,028,552	$12,370,401
Operation & Maintenance Expenses													
Lumirror (CTG) O&M	$70,387	$62,560	$72,352	$59,016	$66,433	$69,472	$67,098	$66,235	$62,597	$58,593	$58,197	$63,370	$776,309
TorayFan (Recip) O&M	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Site Electric Demand (Gen + Import)	19.06	19.05	19.23	20.90	19.82	20.69	21.36	20.58	20.11	19.67	19.21	19.20	
Billing Demand	19.06	19.05	19.23	20.90	19.82	20.69	21.36	20.58	20.11	19.67	19.21	19.20	
Back-Up Demand	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	7.25	
Supplemental Distribution Demand	11.81	11.79	11.98	13.65	12.57	13.44	14.11	13.33	12.86	12.42	11.96	11.95	
Supplemental Transmission Demand	11.84	11.82	11.98	13.67	13.48	14.13	15.36	14.06	13.97	12.68	12.03	12.33	
Total Costs	$1,127,578	$1,016,756	$1,120,052	$1,107,169	$1,077,471	$1,100,741	$1,169,185	$1,124,477	$1,076,241	$1,105,607	$1,029,513	$1,091,922	$13,146,711
Average $/MMBtu	**$5.90**												
Average $/kWh	**$0.0786**												
Average btu/kWh	12,527												

Kawasaki 12.5MW- Take 4_OUTPUT

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Electricity Balance													
Demand, Campus (MW)	18	19	19	20	19	20	20	19	19	19	19	19	20
Demand, Auxiliaries (MW)	1	1	1	1	2	1	1	2	1	1	1	1	2
Total Electricity Demand (MW)	19	19	20	21	20	21	21	20	20	20	20	20	21
Direct-Connected Bldg Loads (MWh)	12,438	11,054	12,380	12,393	12,447	12,685	13,375	12,870	12,327	12,800	11,546	12,279	148,594
Grid-Connected Bldg Loads (MWh)	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Chilling Auxiliary Loads (MWh)	428	385	440	382	429	439	457	446	422	389	388	422	5,026
Chilled Water Production (MWh)	35	111	306	251	165	197	335	277	232	248	239	145	2,541
Total Electricity Required (MWh)	12,902	11,550	13,126	13,025	13,041	13,321	14,166	13,594	12,981	13,436	12,173	12,846	156,161
CTG Electricity Production (MWh)	4,994	4,391	4,938	3,849	4,312	4,570	4,414	4,206	3,885	3,686	3,780	4,379	51,405
Recip Electricity Production (MWh)	7,100	6,498	7,492	6,931	7,809	7,820	8,486	8,386	8,043	7,300	7,183	7,533	90,580
Total Electricity Production (MWh)	12,094	10,889	12,430	10,780	12,122	12,390	12,900	12,592	11,928	10,986	10,963	11,912	141,985
Peak Purchased Demand (MW)	6	7	8	13	8	9	10	9	11	14	8	7	14
On-Peak Electricity Purchased (MWh)	356	218	232	752	257	445	462	472	372	844	468	438	5,316
Off-Peak Electricity Purchased (MWh)	451	443	465	1,493	662	486	807	533	681	1,607	742	495	8,868
Steam Balance													
Demand, Buildings & Process (klbs/hr)	63	61	55	47	32	36	30	49	29	43	46	55	63
Demand, Chilling & Auxiliaries (klbs/hr)	9	7	8	10	10	10	10	10	10	10	9	9	10
Network Total Steam Demand (klbs/hr)	72	68	63	57	42	46	40	59	39	53	54	64	72
Non-Chilling Steam Load (klbs)	35,024	30,385	31,484	25,922	20,824	19,545	19,641	19,827	18,776	21,567	24,428	28,532	295,954
Steam to Chilled Water Production (klbs)	212	250	1,104	3,041	4,936	5,555	6,313	5,787	5,591	4,478	3,191	958	41,415
Steam to Plant Parasitic Steam Loads (klbs)	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Steam Production Required (klbs)	35,235	30,634	32,588	28,963	25,760	25,100	25,954	25,614	24,367	26,045	27,619	29,490	337,369
HRSG Steam Production (klbs)	27,982	23,746	24,528	18,754	22,071	22,932	22,352	21,724	20,459	18,681	19,151	22,490	264,870
MP Boiler Steam Production (klbs)	0	448	447	4,143	418	0	730	779	574	2,212	1,957	814	12,522
Recip WHB Steam Production (klbs)	7,328	6,722	7,771	6,772	7,801	7,514	8,014	7,970	7,530	6,917	6,987	7,480	88,805
Total Steam Production (klbs)	35,309	30,916	32,746	29,668	30,291	30,446	31,096	30,473	28,563	27,810	28,095	30,784	366,197
Chilled Water Balance													
Peak Chilled Water Demand (tons)	970	1,069	1,296	1,300	1,400	1,420	1,645	1,587	1,487	1,356	1,025	1,009	1,645
On-Peak Chilled Water Load (ton-hrs)	11,731	63,655	209,062	225,791	214,916	315,066	353,634	357,602	309,906	235,989	200,600	109,308	2,607,262
Off-Peak Chilled Water Load (ton-hrs)	53,961	121,003	316,445	358,820	386,204	402,962	565,733	468,566	444,393	444,331	348,263	164,714	4,075,394
Total Chilled Water Required (ton-hrs)	65,691	184,658	525,508	584,611	601,120	718,028	919,367	826,168	754,299	680,320	548,864	274,022	6,682,656
Electric Drive Chilled Water (ton-hrs)	49,352	168,448	457,130	277,431	30,997	45,663	222,932	157,251	101,136	188,848	268,068	200,037	2,167,292
Steam Drive Chilled Water (ton-hrs)	16,161	15,613	66,015	301,344	566,736	661,924	690,424	656,212	643,434	485,702	275,938	71,416	4,450,918
Total Chilled Water Production (ton-hrs)	65,513	184,062	523,145	578,775	597,733	707,586	913,356	813,462	744,569	674,550	544,006	271,452	6,618,210
Fuel Balance													
Fuel to Combustion Turbines (MMBtu)	62,463	55,020	61,463	47,885	55,337	57,545	55,564	53,755	50,551	47,220	48,661	56,127	651,591
Fuel to Duct Burners (MMBtu)	4,186	2,703	952	180	0	0	0	17	0	6	39	753	8,835
Fuel to Medium Pressure Boilers (MMBtu)	0	549	548	5,077	513	0	895	954	704	2,711	2,398	998	15,347
Fuel to Recips (MMBtu)	55,033	50,453	58,244	53,654	60,715	60,638	65,785	65,004	62,192	56,394	55,510	58,185	701,805
Total Fuel Consumption (MMBtu)	121,682	108,725	121,207	106,796	116,564	118,183	122,244	119,731	113,446	106,331	106,607	116,062	1,377,578
Energy-Only Expenses													
On-Peak Electricity Charges	$22,305	$13,680	$14,513	$47,140	$16,133	$27,923	$28,951	$29,580	$23,328	$52,917	$29,340	$27,477	$333,287
Off-Peak Electricity Charges	$28,298	$27,768	$29,173	$93,627	$41,483	$30,460	$50,621	$33,417	$42,718	$100,760	$46,543	$31,055	$555,922
Backup Demand Charges	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$22,434	$269,214
Supplemental Dist Demand Charges	$0	$147	$573	$4,292	$2,205	$3,301	$5,244	$2,906	$1,898	$479	$288	$426	$21,761
Supplemental Transm Demand Charges	$1,867	$1,627	$3,032	$4,262	$22,740	$4,264	$24,829	$3,978	$5,755	$20,140	$795	$1,792	$95,081
Forward Capacity Market Charges	$2,111	$1,839	$3,426	$4,816	$25,695	$4,819	$28,056	$4,496	$6,504	$22,758	$899	$2,026	$107,446
Fuel Charges	$718,169	$641,694	$715,365	$630,309	$687,961	$697,516	$721,486	$706,650	$669,560	$627,566	$629,196	$684,995	$8,130,468
Total Energy Costs	$795,184	$709,190	$788,517	$806,881	$818,651	$790,718	$881,622	$803,462	$772,197	$847,054	$729,496	$770,205	$9,513,178
Operation & Maintenance Expenses													
Lumirror (CTG) O&M	$70,117	$62,210	$71,023	$55,621	$60,560	$64,163	$62,800	$59,630	$54,881	$52,695	$54,282	$62,235	$730,216
TorayFan (Recip) O&M	$99,486	$91,059	$105,233	$98,597	$112,275	$112,919	$122,394	$120,810	$115,946	$104,719	$101,997	$105,830	$1,291,264
Total Site Electric Demand (Gen + Import)	19.34	19.46	19.61	20.91	20.18	20.56	21.24	20.43	20.07	19.58	19.51	19.56	
Billing Demand	19.34	19.46	19.61	20.91	20.18	20.56	21.24	20.43	20.07	19.58	19.51	19.56	
Back-Up Demand	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	
Supplemental Distribution Demand	0.00	0.05	0.20	1.50	0.77	1.15	1.83	1.02	0.66	0.17	0.10	0.15	
Supplemental Transmission Demand	0.66	0.57	1.07	1.50	8.01	1.50	8.74	1.40	2.03	7.09	0.28	0.63	
Total Costs	$964,788	$862,459	$964,773	$961,098	$991,486	$967,800	$1,066,816	$983,902	$943,024	$1,004,468	$885,775	$938,270	$11,534,658
Average $/MMBtu	$5.90												
Average $/kWh	$0.0975												
Average btu/kWh	9,532												

Appendix C: Technical Data

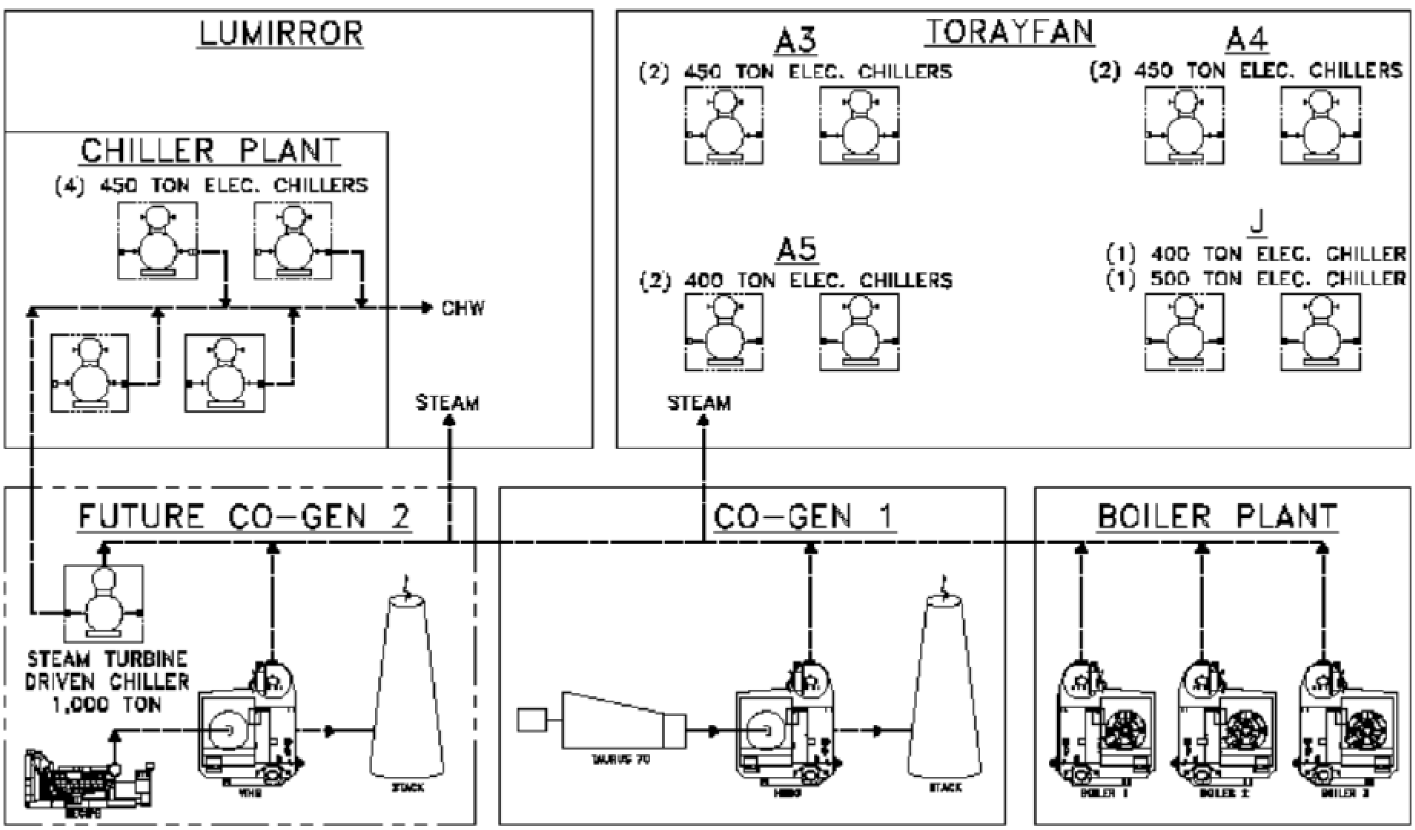
<u>Sequential Order:</u>

Existing & Proposed Major Equipment & Systems Schematic Diagram
Proposed CHP System Site Plan Building Location Drawing
Proposed CHP System General Arrangement Drawing
Proposed CHP System Electric One-Line Diagram
Reciprocating Engines' Electric & Steam Performances (100% Load; Part- Load in TA Study.)
HRSGs' & Emissions Controls Systems' Performances (Quoted HRSGs, not Modeled.)
Steam Turbine-Driven Chiller's Performance
Electric Parasitic Nameplate Loads – Existing Combustion Gas Turbine
Hourly Load Profiles Data[1] (Electric; Steam, 45 Bar; Steam, 7 Bar; Steam, 5 Bar; Chilled Water; Free-Cooling)
Free-Cooling Heat Exchanger Design Capacity
Reciprocating Engines' Recommended Preventive Maintenance Labor & Materials Costs
Waldron's Minimum Technical Requirements© (Preliminary) Rev. B, Dated 07/06/12[2]

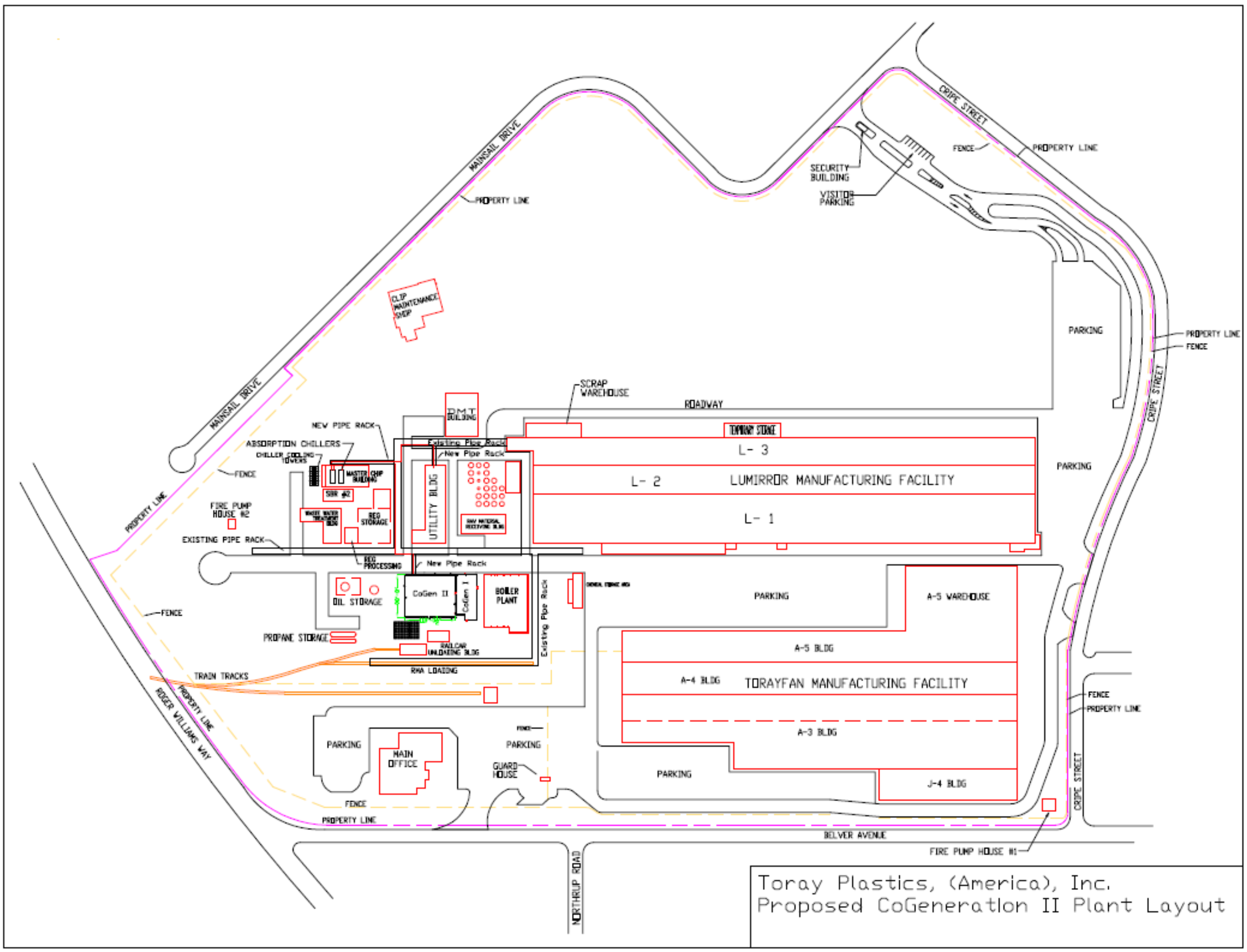
Notes:

1. *Due to the 8,760 H/Y type analysis performed for this project and the editing of the metered Electric, Steam, Chilled Water and Free-Cooling raw data, there is too much raw, intermediate and final data and information to present in the limited space of 8.5" x 11.0". With Toray's written permission and acknowledgement, this information is available by contacting Fred McKiernan at National Grid (401-784-7413).*
2. *This product is proprietary to Waldron Engineering & Construction, Inc. and all rights are reserved under copyright law, therefore, it is only available by contacting Waldron Engineering at (603) 772-7153.*

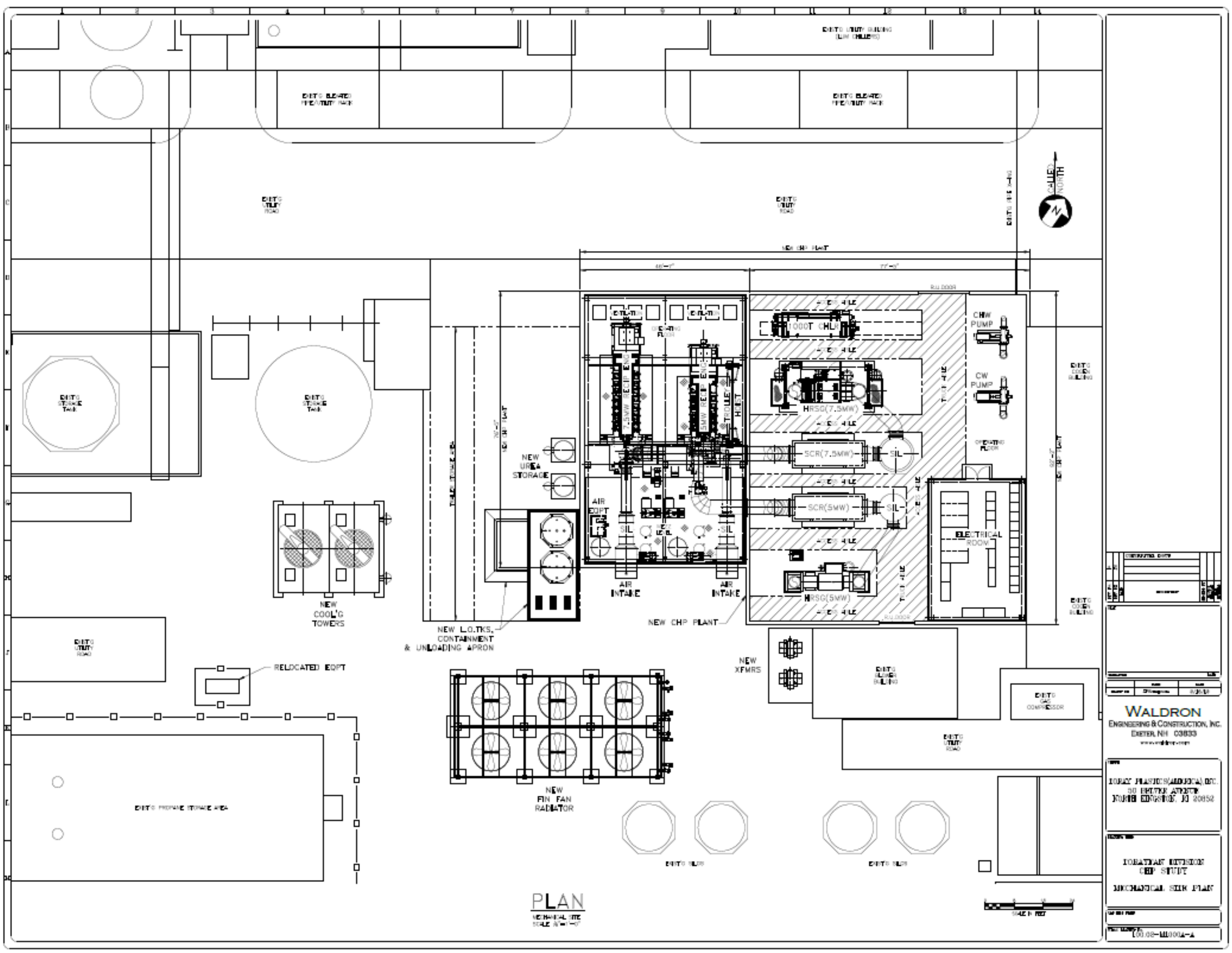
Existing & Proposed Major Equipment & Systems Schematic Diagram



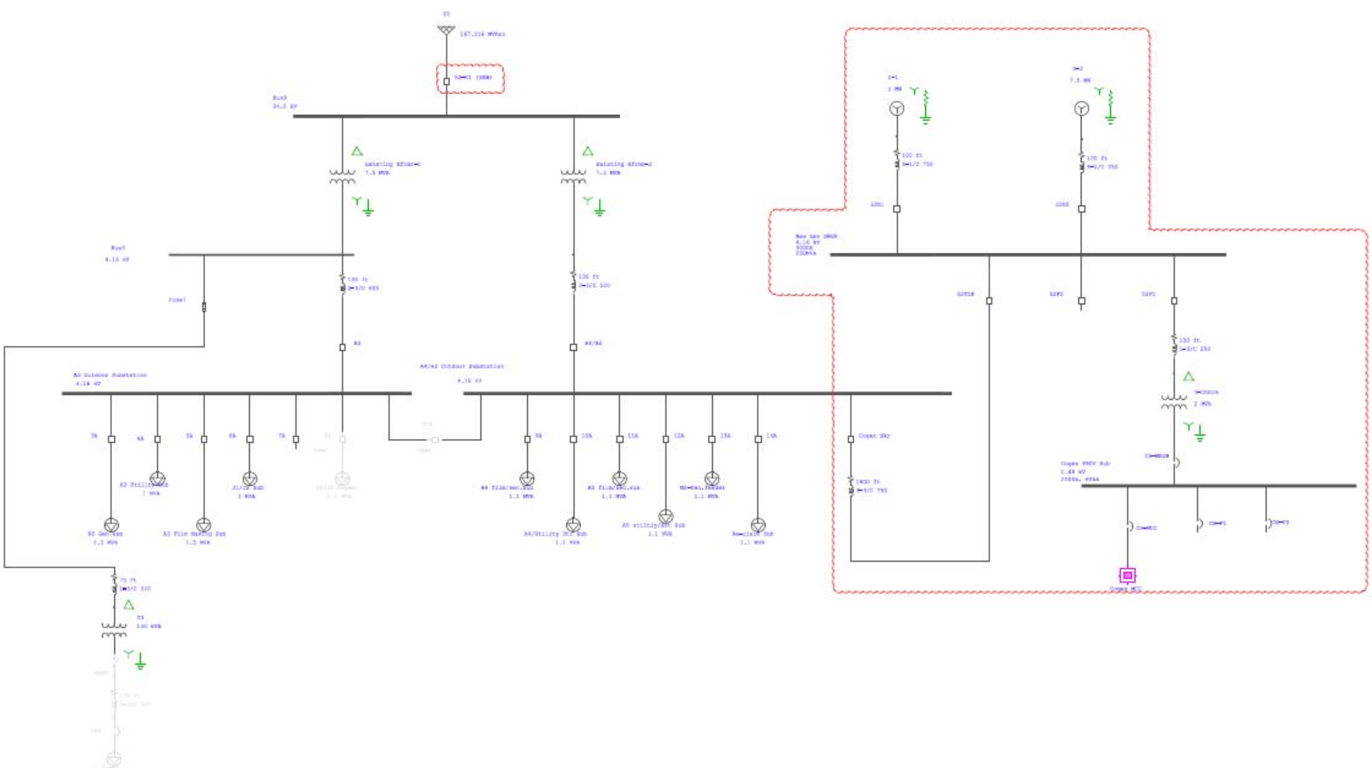
Proposed CHP System Site Plan Building Location Drawing



Proposed CHP System General Arrangement Drawing

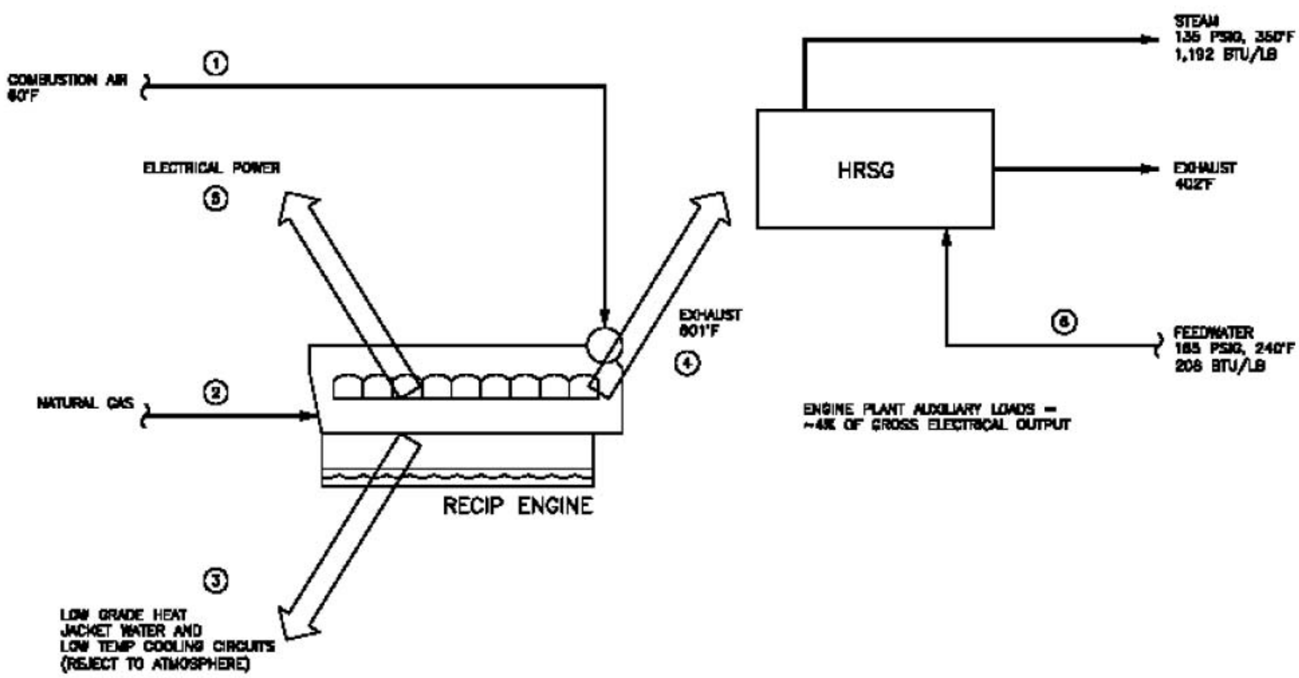


Proposed CHP System Electric One-Line Diagram



12.5 MW Option - Heat Balance

	Combustion Air (lbm/hr) 1	Natural Gas (MMBtu/hr, LHV) 2	Low Grade Heat (MMBtu/hr) 3	Engine Exhaust (lbm/hr) 4	Electricity (MW) 5	Steam Cycle Flow (lbm/hr) 7	Fuel Utilization Efficiency, LHV (%)
7.5 MW Engine	97,846	51.89	6.296	100,440	7.5	5,382	59.5%
5 MW Engine	65,230	34.59	4.198	66,960	5.0	3,588	59.5%



HRSG

CROSS FLOW

Budget Proposal:

For

Toray Plastics
HRSG/SCR

RENTECH Boiler Systems Quotation: GTB-3621-KS

Boilers for people who know and care

I. Summary Information

A. General Design Conditions

The HRSG system described in this proposal has been designed for the following main parameter:

Engine	
Size:	7.5 MW & 5 MW
Fuels:	Natural Gas
Steam Conditions:	
Steam Pressure:	100 psig
Steam Temperature:	Saturated
Steam Flow (7.5 MW/ 5 MW):	7,100 / 4,700
F.W. Temperature	228 °F (Deaerated)
HRSG Design Pressures	
Evaporator:	200 psig
Economizer:	250 psig
HRSG Design Codes	
Evaporator:	ASME Section I
Economizer:	ASME Section I

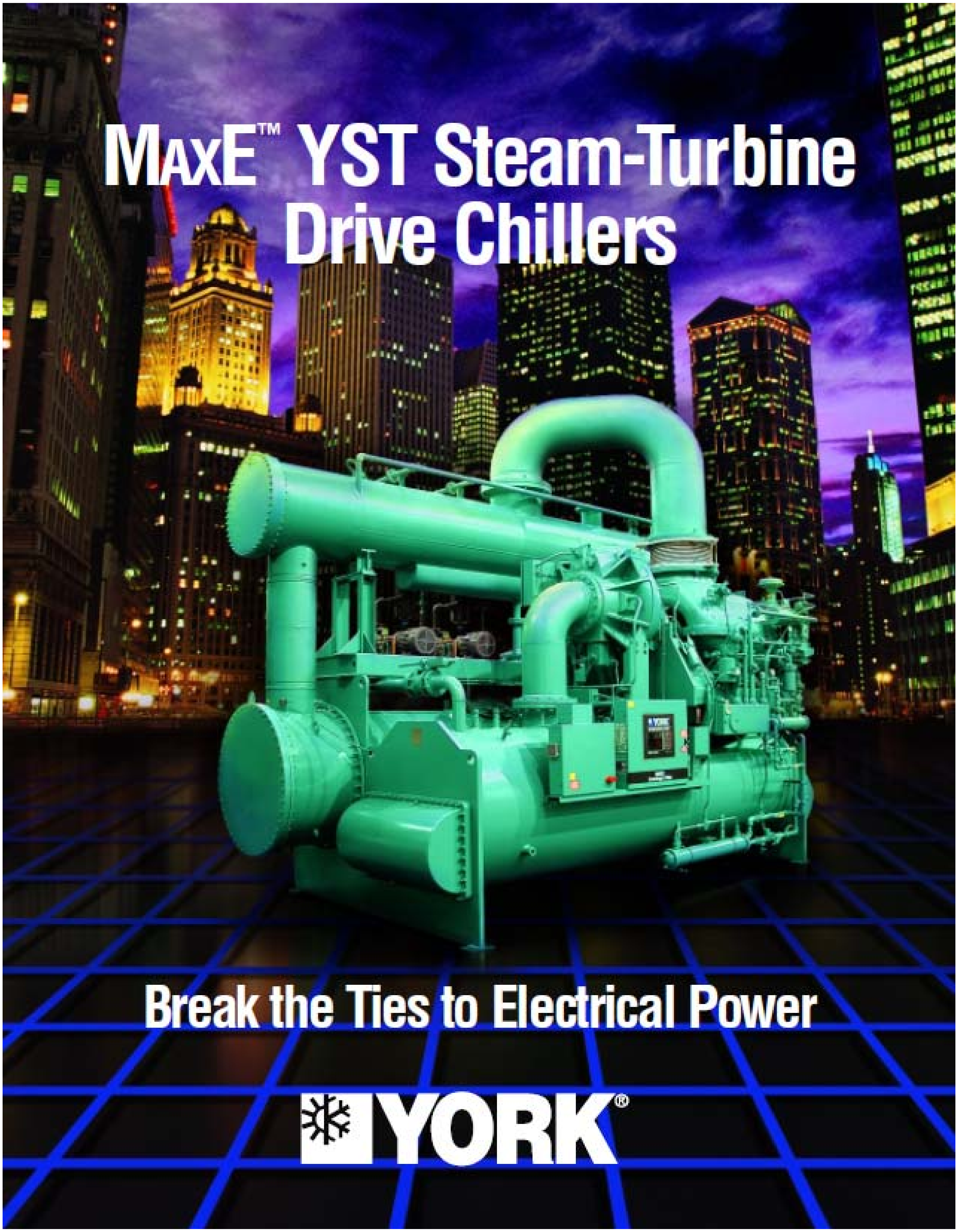
RENTECH BOILER SYSTEMS, INC.

"RENTECH *Boilers for people who know and care.*"®

C. Expected HRSG Performance

Gas Side	Units	7.5 MW Engine	5 MW Engine
Gas Flow	Lb/Hr	100,080	66,720
Gas Inlet Temperature	°F	608	608
Stack Temperature	°F	333	332
Gas Pressure Drop	In. WC	7.57	7.41
Flame Temperature	°F	608	608
Burner Duty	MMBTU/Hr	0	0
Fuel Flow	Lb/Hr	0	0
FLUE GAS ANALYSIS - Turbine Exhaust			
CO_2	% vol	4.32%	4.32%
H_2O	% vol	9.56%	9.56%
N_2	% vol	73.93%	73.93%
O_2	% vol	11.30%	11.30%
Ar	% vol	0.88%	0.88%
Group Data			
Final Steam Flow	Lb/Hr	7,169	4,798
Spray Flow	Lb/Hr	0	0
Process Flow	Lb/Hr	0	0
Steam Drum Exit Flow	Lb/Hr	7,169	4,798
Blowdown Flow	Lb/Hr	146	98
Feedwater Temperature		228	228
Feedwater Flow	Lb/Hr	7,316	4,896
Steam Pressure at exit	psia	114	114
Steam Saturation Temp	°F	341	341
Steam Final Exit Temp	°F	341	341
Pinch	°F	20	18
Approach	°F	17	19

RENTECH Boiler Systems, Inc. • 5025 E. Business 20 • Abilene, TX 79601 • Phone: 325-672-3400 • Fax: 325-672-9996


MaxE™ YST Steam-Turbine
Drive Chillers
Break the Ties to Electrical Power
YORK®

Issue Date: 5/12	Program: LTC
Project: Project	Rev: v1_121.idd
Engineer: Sales Eng	Date: 05/21/12
Customer: customer	Page: 2 of 2

PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT (°F)
100.0	1000.0	100.0	737.0	4424.5	1.08	9934	8	54.00	42.00	85.00	94.30	100.50
90.0	900.0	58.2	414.0	3741.2	1.62	5778	6	52.80	42.00	65.00	72.90	76.60
80.0	800.0	50.4	345.2	3558.6	1.66	5010	6	51.60	42.00	65.00	72.00	75.20
70.0	700.0	42.9	280.6	3380.5	1.71	4261	6	50.40	42.00	65.00	71.10	73.90
60.0 *	600.0	36.0	227.7	3228.6	1.74	3573	6	49.20	42.00	65.00	70.20	72.60
50.0 *	500.0	29.6	187.4	3200.0	1.76	2936	6	48.00	42.00	65.00	69.30	71.30
40.0 *	400.0	24.0	153.2	3200.0	1.73	2388	6	46.80	42.00	65.00	68.50	70.00
30.0 *	300.0	19.4	123.9	3200.0	1.61	1927	6	45.60	42.00	65.00	67.60	68.90
20.0 *	200.0	14.1	90.1	3200.0	1.47	1401	6	44.40	42.00	65.00	66.80	67.70
15.0 *	150.0	11.5	73.5	3200.0	1.35	1143	6	43.80	42.00	65.00	66.30	67.10

(*) The performance is not guaranteed for any part load point. Points further identified with an * are outside the normal calculation range and are best estimates only.
Ratings outside the scope of AHRI STD 550/590.

YORK
A JOHNSON CONTROLS COMPANY

Issue Date: 5/12	Program: LTC
Project: Project	Rev: v1_121.idd
Engineer: Sales Eng	Date: 05/21/12
Customer: customer	Page: 3 of 3

PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT(°F)
100.0	1000.0	100.0	611.9	4164.1	1.27	8305	8	54.00	42.00	75.00	84.10	89.30
90.0	900.0	85.0	517.4	4001.4	1.34	7056	6	52.80	42.00	75.00	83.10	87.60
80.0	800.0	74.0	436.1	3835.0	1.37	6150	6	51.60	42.00	75.00	82.20	86.10
70.0	700.0	64.4	366.5	3692.6	1.37	5349	6	50.40	42.00	75.00	81.20	84.70
60.0	600.0	55.8	308.3	3567.5	1.36	4636	6	49.20	42.00	75.00	80.30	83.30
50.0	500.0	48.1	258.6	3516.7	1.31	3994	6	48.00	42.00	75.00	79.40	82.10
40.0 *	400.0	39.8	211.7	3461.5	1.26	3306	6	46.80	42.00	75.00	78.60	80.70
30.0 *	300.0	30.9	164.8	3421.9	1.22	2565	6	45.60	42.00	75.00	77.70	79.40
20.0 *	200.0	22.1	118.6	3411.1	1.13	1833	6	44.40	42.00	75.00	76.80	78.00
15.0 *	150.4	18.0	98.2	3491.9	1.04	1497	6	43.80	42.00	75.00	76.40	77.40

(*) The performance is not guaranteed for any part load point. Points further identified with an * are outside the normal calculation range and are best estimates only.
Ratings outside the scope of AHRI STD 550/590.

Issue Date: 5/12	Program: LTC
Project: Project	Rev: v1_121.idd
Engineer: Sales Eng	Date: 05/21/12
Customer: customer	Page: 3 of 3

PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT (°F)
100.0	1000.0	100.0	737.0	4424.5	1.08	9934	8	54.00	42.00	85.00	94.30	100.50
90.0	900.0	88.4	634.5	4239.2	1.09	8784	8	52.80	42.00	85.00	93.30	98.80
80.0	800.0	78.2	547.4	4108.2	1.10	7762	8	51.60	42.00	85.00	92.40	97.30
70.0	700.0	67.4	469.9	3983.5	1.11	6692	6	50.40	42.00	85.00	91.40	95.70
60.0	600.0	58.8	402.4	3939.0	1.09	5840	6	49.20	42.00	85.00	90.50	94.20
50.0	500.0	51.0	340.7	3903.0	1.04	5063	6	48.00	42.00	85.00	89.60	92.80
40.0	400.0	43.3	280.6	3872.3	0.98	4298	6	46.80	42.00	85.00	88.70	91.50
30.0 *	300.0	34.4	218.2	3839.0	0.92	3418	6	45.60	42.00	85.00	87.80	90.00
20.0 *	200.0	24.9	160.8	3914.0	0.85	2472	6	44.40	42.00	85.00	86.90	88.50
15.0 *	150.4	20.9	137.4	4073.1	0.76	2073	6	43.80	42.00	85.00	86.40	87.80

(*) The performance is not guaranteed for any part load point. Points further identified with an * are outside the normal calculation range and are best estimates only.
Ratings outside the scope of AHRI STD 550/590.

COGEN 1							
EQUIPMENT							
	HP	Frame	RPM	Volts	Amps	Ser. Fact	Effic.
Turbine							
Oil Cooler Motor	7.5	213T	1760	480	10.2	1.15	89.5
Gas Compressor							
Main Motor	400	S449SS	3570	480	420	1.15	95.8
Cooler Motor	15	254T	1800	480	17	1.15	85.5
Oil Pump Motor	1	145TS	1745	480	1.5	1.15	82.5
Air Compressor							
Motor	15	215T	3450	480	17.5	1.15	89.5
Fuel Oil Forwarding Pump							
Motor	1.5	192T	1165	480	2.8	1.15	85.5
Scanner Air Blower							
Motor	1.5	143TCZ	3450	480	2.5	1.15	N/A

1. Actual load data was not provided by Toray.
2. Waldron assumed 75% of the attached HP would be a reasonable approximation of load during operation.

Total attached motor capacity of auxiliaries:	441.5	HP
75% of above:	331.125	HP
Equivalent kW:	247.1082	kW
Capacity of CTG:	6.977	MW
kW/kW:	**3.54%**	

This was used in the model to estimate CTG auxiliary loads

Mar-08-99 02:29P Carrier Building Systems 4013330285 P.02

003/007

TPA Engineering

☐ Approved ☐ Rejected
☑ Approved with Comments
Name: [handwritten signatures]
Date: 3/11/99 3/11/99

Max load covered by free cooling HX in model is 1040 tons.
1398 > 1040, so ok.

graham
Vacuum and Heat Transfer

PLATE HEAT EXCHANGER SPECIFICATIONS

Toray Plastics (America), Inc.

Customer: Carrier
Customer Ref: Withem & Assoc.
Item: HX-3 (Alt.#3)

Graham Ref: 183 HVA 98
Date: 03/05/99
Engineer: RLO

3500gpm x 500 x (55.59-46) = 16.8MMbtu
16.8MMbtu/12,000 btu/ton = 1398 tons

	HOT SIDE	COLD SIDE
Fluids:	Water	Water
Flow (gpm)..................	3360.00	3500.00
Flow (pph)..................	1679931.38	1750498.13
T-in (deg. F).............	58.00	46.00
T-out (deg. F).............	48.00	55.59
Specific Gravity...........	1.00	1.00
Specific Heat (Btu/lb./F)...	1.00	1.00
Thermal Conductivity........	0.35	0.35
Viscosity (cp).............	1.22	1.26
Operating Pressure (psig)...		
Pressure Drops (psi)........	10.00	10.00
Passes......................	1.	1.
Nozzle Diameter (inches)....	12.0	12.0
Nozzle Material.............	316SS	316SS

Heat Exchanged (Btu/hr).................. 16862422.

UNIT TO HAVE S.S. STAMPED TAG WITH TPA PART # & EQ. NAME.
IE LH2-16-1 FREE COOLING HEAT EXCHANGER.

Model....................................	GPE-145
Plate Thickness (inches)................	0.0197
Plate Material..........................	304SS
Gasket Material.........................	Nitrile
Frame Material..........................	CARBON STEEL
Design/Test Pressure (psig).............	125./188.
Design Temperature (deg. F).............	220.
Est. Weight: empty/flooded (lbs.)........	13640./17380.

Remarks:
Construction per ASME Section VIII Division I.
ASME inspection and stamp available for a premium.
Shipment stated reflects current inventory and manufacturing schedules. Improvement in shipment may be possible upon your request.
Customer to verify suitability of materials.
Performance is guaranteed in accordance with data and operating conditions stated herein.
Terms of payment net 30 days.
F.O.B. Batavia, New York.

Terms & Conditions of Sale per GMC-1002-E unless otherwise indicated.

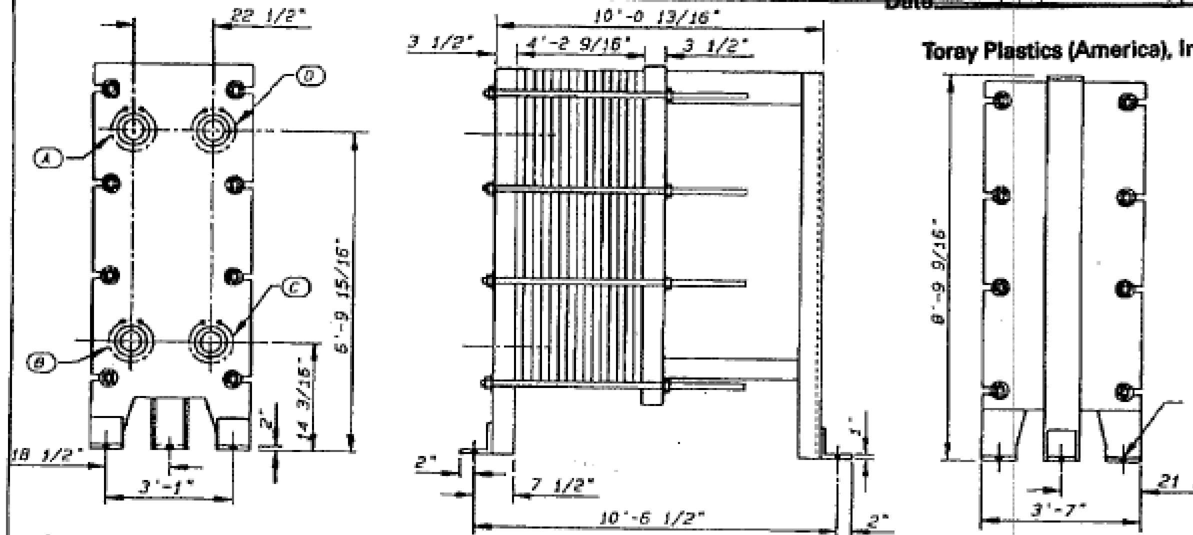
Graham Corporation, P.O. Box 719, Batavia, NY 14021-0719
Corporate and Sales Headquarters: 20 Florence Avenue, Batavia, NY 14020
TEL.:716-343-2216 FAX:716-343-1097 EMAIL:equipment@graham-mfg.com WEBSITE:http://www.graham-mfg.com

TPA Engineering

☐ Approved ☐ Rejected
☒ Approved with Comments
Name:
Date: 3/11/99 3/11/99.

Toray Plastics (America), Inc

NOZZLE SCHEDULE	
SIZE: 12"	
TYPE: 150# STUDDED	
NOZZLE	DESCRIPTION
B	HS INLET
D	HS OUTLET
A	CS INLET
C	CS OUTLET



CUSTOMER: Carrier
CUSTOMER REF. NO.--
GRAHAM REF. NO.-- 183 HVA 99
DESIGN / CONSTRUCTION: ASME Section VIII Division I
INSPECTION:
STAMPING: none
SURFACE PREPARATION: GRITBLAST PER SSPC-SP6
PAINT (EXT CARBON STL): INDURACOTE IC-7837 ~~GRAHAM BLUE~~ TORAY GREEN
TAG:

LII2-1C-1
FREE COOLING HEAT EXCHANGER

PLATE HEAT EXCHANGER MATERIAL LIST		
PART NAME	MATERIAL	SPEC. NO.
FIXED COVER	CARBON STEEL	SA-516-70
MOVABLE COVER	CARBON STEEL	SA-516-70
CARRYING BAR	CARBON STEEL	A-36
GUIDE BAR	304SS	SA-240
HS LINERS/NOZ	316SS	SA-240
CS LINERS/NOZ	316SS	SA-240
PLATES	304SS	SA-240
GASKETS	Nitrile	----
BOLTING	ALLOY STEEL	SA-193-B7, SA-194-2H

NOTES:
1. OVER-PRESSURE PROTECTION MUST BE PROVIDED BY OTHERS PRIOR TO PLACING THE VESSEL IN SERVICE.
2. PULSATING PUMPS MUST HAVE ADEQUATE PULSATION DAMPENERS PROVIDED.
3. UNIT SHOULD BE LIFTED BY HOLES/TABS PROVIDED ON FRONT FIXED COVER AND REAR SUPPORT LEG. LIFTING UNIT BY REAR MOVABLE COVER MAY CAUSE DAMAGE.
4. BOLT HOLES STRADDLE CENTERLINES.
5. MARK ALL CONNECTIONS WITH FLOW LABELS.
6. ALL CONN. ARE ANSI STD PIPE THREAD.
HX-3 (A1).#3)

PRELIMINARY
GRAHAM MFG. CO. INC.

GRAHAM MANUFACTURING CO., INC.
20 FLORENCE AVE. BATAVIA, NEW YORK

GPE-145 PLATE HEAT EXCHANGER

	M.A.W.P. (P.S.I.G.)	TEMPERATURE MOHT/DESIGN (DEG F)	HYDRO TEST (P.S.I.G.)	NUMBER OF PASSES	EST'D WGTS. (LBS)	
HOT SIDE	125.0	0/ 220.0	187.5	1	EMPTY	13640
COLD SIDE	125.0	0/ 220.0	187.5	1	FLOODED	17380

SCALE	MADE	CHKD	DATE	DWG. NO.	REV.
NONE	RLO	---	03/05/99	A-183 HVA 99-1	0

RLO 03/05/99 > PE153804.BLK

Maintenance cost (Engine+Control) for KG-18

Year	Operating Hour	Maintenance Level	Expected Downtime (Days)	Main Works	PARTS ONLY CONVERSION TO $ @ 78 YEN/$	LABOR ESTIMATE @ $100/HOUR	TOTAL PARTS AND LABOR	ANNUAL COSTS BY YEAR				
1	2,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	4,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	6,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	8,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$112,465	$112,465	99.43%	$0.002	$/kWh
2	10,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	12,000	C	12	Replacement of piston rings	$511,323	$64,500	$575,823					
	14,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	16,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$622,854	$735,319	98.86%	$0.006	$/kWh
3	18,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	20,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	22,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	24,000	D	14	Replacement of Crankpin and main bearings and valves,battery	$750,371	$113,800	$864,171	$960,528	$1,695,846	98.55%	$0.009	$/kWh
4	26,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	28,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	30,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	32,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$112,465	$1,808,311	98.77%	$0.007	$/kWh
5	34,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	36,000	C	12	Replacement of piston rings	$511,323	$64,500	$575,823					
	38,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	40,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$622,854	$2,431,165	98.68%	$0.008	$/kWh
6	42,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	44,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	46,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	48,000	E	17	Replacement of piston crowns and thrust bearing ,battery	$1,232,739	$137,800	$1,370,539	$1,466,896	$3,898,060	98.50%	$0.010	$/kWh
7	50,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	52,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	54,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	56,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$112,465	$4,010,525	98.63%	$0.009	$/kWh
8	58,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	60,000	C	12	Replacement of piston rings ,Cylinder controller and ignition device	$1,053,958	$64,500	$1,118,458					
	62,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	64,000	A	1	Replacement of Spark Plug	$14,908	$1,200	$16,108	$1,165,489	$5,176,014	98.59%	$0.010	$/kWh
9	66,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	68,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	70,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	72,000	D	14	Replacement of Crankpin and main bearings and valves ,battery	$750,371	$113,800	$864,171	$960,528	$6,136,541	98.52%	$0.011	$/kWh
10	74,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	76,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	78,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	80,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$112,465	$6,249,006	98.61%	$0.010	$/kWh
11	82,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	84,000	C	12	Replacement of piston rings	$511,323	$64,500	$575,823					
	86,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	88,000	A	1	Replacement of Spark Plug ,battery	$14,908	$1,200	$16,108	$622,854	$6,871,860	98.58%	$0.010	$/kWh
12	90,000	B	2	Replacement of non-return valves	$57,434	$8,000	$65,434					
	92,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	94,000	A	1	Replacement of Spark Plug	$14,262	$1,200	$15,462					
	96,000	F	17	Replacement of cylinder liners ,battery	$1,502,730	$136,000	$1,638,730	$1,735,087	$8,606,947	98.50%	$0.011	$/kWh
Sub Total					$7,745,147	$861,800	$8,606,947	$8,606,947				
								$717,245.59				
				0.036073059								
			158				717,246					
				Years Average			$0.0120	$/kWh				

Appendix D: Minimum Requirements Document

Minimum Requirements Document

nationalgrid

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

This document specifies the agreed upon minimum equipment specifications and operational requirements of the proposed system. These requirements shall address the criteria necessary to be met to achieve the demand and energy savings estimated in the engineering analysis for this project. (Use additional sheets if necessary).

Circle yes or no Pre Construction	**SEQUENCE OF OPERATION:** Provide a description of equipment operating sequences, setpoints, operating schedules, balancing requirements (flow, velocity, head, etc) or any other required operating parameters **Submittals:** Provide major equipment data sheets
Yes No	Milestone No.1. Equipment submittal and approval of Sequence of Operation (SOO). Required Completion Date: Before the start of the CHP installation at the site and prior to releasing the production of the major equipment. 1. 2 x Reciprocating Engines (Normal Operation): Both engines' electric output will be dedicated to FAN's total electric loads and always attempt to have Net Production equal Load, minus Import/Export Controller's set-point. Both engines will operate in parallel with each other and NGrid's distribution system. Both engines will operate under the electrically load following Mode of Operation (MOO) and at equal electric Load Factors. CHP system's Import/Export Controller set-point will allow a continuous electricity import from NGrid's distribution system less than or equal to 350 kWe, but not ever allow CHP generated electricity to export into NGrid's distribution system. Both engines' planned maintenance will not simultaneously occur and each engine will follow the respective, attached maintenance schedule and durations (Attachment No.1 for NG-Fired, Kawasaki, M/N: KG-18-V Reciprocating Engine. M/N: KG-12-V's planned maintenance will be equal to or less than KG-18-V engine.); inclusive of engines' cool-down and start-up durations. 2. 2 x Heat Recovery Steam Boilers (Normal Operation): Each engine's Heat Recovery Steam Generator (HRSG) will be connected and operated so as to always receive each engine's full exhaust flow to maximize 135 psig steam production. Any decreased 652 psig steam load as a result of the engines' HRSGs production will first reduce the Combustion Gas Turbine's (CGT) HRSG's Duct-Burner (DB) firing-rate. If, after full DB reduction, more reduction is needed, then the CGT's HRSG will vent excess 652 psig steam. Each engine's HRSG will generate saturated, steam at 135 psig. Both HRSGs will be tied-into a common steam header and production will be connected down-stream of FAN's 652 psig-to-102 psig Pressure Reduction Valve (PRV), while a second connection will be down-stream of Lumirror's 652 psig-to-73 psig PRV. Both connections' pressure will be set high enough to allow all of the 2 x HRSGs' steam production to always take higher priority over all other 102 psig and 73 psig steam production sources. Both HRSGs' planned maintenance will only occur simultaneously with its respective engine's planned maintenance schedule and not exceed the respective engine's down-time duration. 3. 2 x Engine's Hot Water Rejection Systems (Normal Operation): Both engines will direct all sources of engine generated hot water to individual Waste Heat Radiators (WHR) to control engine return water temperatures.

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

4. **2 x Engine NO_x & CO Emission Control Systems (Normal Operation):** Both Emission Control System's will operate on a continuous basis to meet applicable Local, State and Federal emission permit limits with it's respective engine and planned maintenance will only occur simultaneously with its respective engine's planned maintenance schedule and not exceed the respective engine's down-time duration.
5. **1 x ST CH & Lumirror CHW Plant (Normal Operation):** Free-Cooling will be higher priority than electric-driven and steam-driven chilling. The Steam Turbine Chiller (ST CH) will be higher priority than the electric CHs, whenever both proposed CHP HRSGs' combined production is greater than the total process steam load (i.e., 102 psig FAN process load and 73 psig Lumirror process load) by an amount equal to the ST CH's minimum steam flowrate when mechanical CHW production is required. Lumirror's CHW Plant's electric CHs will always operate at equal Load Factors regardless of the quantity needed to meet CHW load; unless a more energy efficient electric CH sequence is demonstrated. ST CH's planned maintenance will occur during Free-Cooling periods and/or periods when ST CH is not commanded On (i.e., see second sentence SOO). The ST CH's down-time will not exceed the duration of either of these periods.
6. **CGT's & Reciprocating Engines' Electric Parasitic Loads:** The respective electric parasitic loads will only operate when the individual, associated engine (i.e., CGT or Reciprocating) is running and will not exceed 3.54% of each engine's gross electrical production at the corresponding loads and weather conditions.
7. **Sequence of Operations (SOO):** Provide detailed written description of the above proposed SOO of the existing and proposed CHP systems and all connected systems. The SOO must include detailed descriptions of how the proposed CHP sub-systems will be "first in-line" to serve electric, steam and CHW loads as well as track the same loads.
8. **Equipment Submittals:** Prior to releasing the proposed CHP equipment for production, customer shall provide a copy of the major and parasitic load equipment submittals including performance ratings for review of general compliance with this Minimum Requirements Document (MRD) and the final assumptions, savings calculations and Technical Assistance Study approved by NGrid.
9. **Electric and P&IDs:** Electric and Process & Instrumentation Diagrams showing all proposed CHP system equipment, inclusive of electrical systems (i.e., engine-generators and parasitic loads) and meter(s), fuel and meter(s), lube oil, steam and meter(s), hot water, chilled water and meter(s), emissions' systems consumables and instruments.
10. **Performance Criteria:** The proposed CHP system is designed to meet the following minimum performance criteria. Average, annual production equal to or greater than a) 90,579,920 kWh (Net), b) 4,450,918 Ton-Hrs of (ST CH) chilled water, c) 88,805,215 Pounds of 135 psig saturate steam, d) Electrical Efficiency = 44.1% (HHV), E) Thermal Efficiency = 12.6% (HHV), and F) Total Efficiency = 56.6% (HHV). Average, annual NG usage by the two (2) engines will be less than or equal to 7,018,053 Therms (HHV). CHP system's minimum, average annual availability will be equal to or greater than 93.0% (each engine and related equipment).

Minimum Requirements Document

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Post Inspection	Installation Completion: Provide a list of equipment or materials installed as part of this project. Include mfr, model, HP, kW, efficiency ratings, etc .and confirm completion
Yes No	**Milestone No.2a. - Installation Completion**

1. **2 x Reciprocating Engines:** 1 x NG-Fired, Kawasaki, M/N: KG-18-V Reciprocating Engine running at 720 rpm and nominally rated at 7.5 MWe (Gross) continuous output. 1 x NG-Fired, Kawasaki, M/N: KG-12-V Reciprocating Engine running at 720 rpm and nominally rated at 5.0 MWe (Gross) continuous output. Different engines may be selected based on customer's competitive bid process, however, the proposed CHP system will have a minimum, power output equal to 12.0 MWe (Net) and an electrical efficiency of 49.0% (LHV) at 100% load with 38 psig NG delivered to the engines' skids. Moreover, part-load curves will be equal or greater energy efficiency than provided below. The proposed CHP system will meet applicable Local, State and Federal codes, including pollutant emissions, environmental and noise regulations and will comply with National Grid's interconnection requirements. See Attachment No.2 for details.

Ambient Temperature (deg F)	100% Output (kW)	75% Output (kW)	50% Output (kW)	100% Heatrate (Btu/kWh, LHV)	75% Heatrate (Btu/kWh, LHV)	50% Heatrate (Btu/kWh, LHV)
10	5,000	3,750	2,500	6,784	6,964	7,418
30	5,000	3,750	2,500	6,840	7,023	7,485
50	5,000	3,750	2,500	6,895	7,081	7,551
60	5,000	3,750	2,500	6,918	7,106	7,579
80	5,000	3,750	2,500	6,965	7,155	7,635
100	5,000	3,750	2,500	7,037	7,231	7,722

Ambient Temperature (deg F)	100% Exhaust Flow (lb/hr)	75% Exhaust Flow (lb/hr)	50% Exhaust Flow (lb/hr)	100% Exhaust Temp (deg F)	75% Exhaust Temp (deg F)	50% Exhaust Temp (deg F)
0	66,960	50,760	35,280	583	655	691
20	66,960	50,760	35,280	590	662	698
40	66,960	50,760	35,280	597	669	705
60	66,960	50,760	35,280	601	673	709
80	66,960	50,760	35,280	608	680	716
100	66,960	50,760	35,280	622	695	730

Figure 24 - Kawasaki KG-12 Engine Performance Data Table

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	**EI or D2**	**EI**
Location	50 Belver Avenue North Kingstown, RI 02852	**Application No.**	1999989
EEM:	**1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).**		

Ambient Temperature (deg F)	100% Output (kW)	75% Output (kW)	50% Output (kW)	100% Heatrate (Btu/kWh, LHV)	75% Heatrate (Btu/kWh, LHV)	50% Heatrate (Btu/kWh, LHV)
10	7,500	5,625	3,750	6,784	6,964	7,418
30	7,500	5,625	3,750	6,840	7,023	7,485
50	7,500	5,625	3,750	6,895	7,081	7,551
60	7,500	5,625	3,750	6,918	7,106	7,579
80	7,500	5,625	3,750	6,965	7,155	7,635
100	7,500	5,625	3,750	7,037	7,231	7,722

Ambient Temperature (deg F)	100% Exhaust Flow (lb/hr)	75% Exhaust Flow (lb/hr)	50% Exhaust Flow (lb/hr)	100% Exhaust Temp (deg F)	75% Exhaust Temp (deg F)	50% Exhaust Temp (deg F)
0	100,440	76,140	52,920	583	655	691
20	100,440	76,140	52,920	590	662	698
40	100,440	76,140	52,920	597	669	705
60	100,440	76,140	52,920	601	673	709
80	100,440	76,140	52,920	608	680	716
100	100,440	76,140	52,920	622	695	730

Figure 25 - Kawasaki KG-18 Engine Performance Data Table

2. <u>2 x Heat Recovery Steam Boilers:</u> Both Cleaver-Brooks', Slant Series HRSGs, M/N: S-2.5-1414. Different HRSGs may be selected based on customer's competitive bid process, however, the proposed CHP system will have a minimum, total, steam production flowrate of 11,500 pph of 135 psig (Net of heat-loses.), saturated steam at 100% engine load and engine OEM's specified, maximum back-pressure. Moreover, part-load curves will be equal or greater energy efficiency than a linear relationship between Heat Input and Heat Output. The proposed HRSGs will meet applicable Local, State and Federal codes.

3. <u>2 x Engine NO_x & CO Emission Control Systems:</u> Both Emission Control Systems will meet all applicable Local, State and Federal codes and Air Quality permitting requirements approved for the specific site by the appropriate authorities.

4. <u>1 x Steam Turbine-Driven Chiller:</u> 1 x York International, Series MaxE YST, steam turbine-driven, 1,000 Ton Chiller using a condensing steam turbine-drive. A different ST CH may be selected based on customer's competitive bid process, however, the proposed ST CH will have a minimum, cooling output equal to 1,000 Tons at 100% load. Moreover, part-load curves will be equal or greater energy efficiency than provided below. The proposed ST Ch will meet applicable Local, State and Federal codes.

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PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT (°F)
100.0	1000.0	100.0	737.0	4424.5	1.08	9934	8	54.00	42.00	85.00	94.30	100.50
90.0	900.0	58.2	414.0	3741.2	1.62	5778	6	52.80	42.00	65.00	72.90	76.60
80.0	800.0	50.4	345.2	3558.6	1.66	5010	6	51.60	42.00	65.00	72.00	75.20
70.0	700.0	42.9	280.6	3380.5	1.71	4261	6	50.40	42.00	65.00	71.10	73.90
60.0 *	600.0	36.0	227.7	3228.6	1.74	3573	6	49.20	42.00	65.00	70.20	72.60
50.0 *	500.0	29.6	187.4	3200.0	1.76	2936	6	48.00	42.00	65.00	69.30	71.30
40.0 *	400.0	24.0	153.2	3200.0	1.73	2388	6	46.80	42.00	65.00	68.50	70.00
30.0 *	300.0	19.4	123.9	3200.0	1.61	1927	6	45.60	42.00	65.00	67.60	68.90
20.0 *	200.0	14.1	90.1	3200.0	1.47	1401	6	44.40	42.00	65.00	66.80	67.70
15.0 *	150.0	11.5	73.5	3200.0	1.35	1143	6	43.80	42.00	65.00	66.30	67.10

PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT(°F)
100.0	1000.0	100.0	611.9	4164.1	1.27	8305	8	54.00	42.00	75.00	84.10	89.30
90.0	900.0	85.0	517.4	4001.4	1.34	7056	6	52.80	42.00	75.00	83.10	87.60
80.0	800.0	74.0	436.1	3835.0	1.37	6150	6	51.60	42.00	75.00	82.20	86.10
70.0	700.0	64.4	366.5	3692.6	1.37	5349	6	50.40	42.00	75.00	81.20	84.70
60.0	600.0	55.8	308.3	3567.5	1.36	4636	6	49.20	42.00	75.00	80.30	83.30
50.0	500.0	48.1	258.6	3516.7	1.31	3994	6	48.00	42.00	75.00	79.40	82.10
40.0 *	400.0	39.8	211.7	3461.5	1.26	3306	6	46.80	42.00	75.00	78.60	80.70
30.0 *	300.0	30.9	164.8	3421.9	1.22	2565	6	45.60	42.00	75.00	77.70	79.40
20.0 *	200.0	22.1	118.6	3411.1	1.13	1833	6	44.40	42.00	75.00	76.80	78.00
15.0 *	150.4	18.0	98.2	3491.9	1.04	1497	6	43.80	42.00	75.00	76.40	77.40

Minimum Requirements Document

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PART LOAD PERFORMANCE:

Pct Load	Capacity (TR)	Pct Steam Flow	Shaft HP (HP)	RPM	COP	Steam Flow (lb/hr)	No. Nozzle	EEFT (°F)	ELFT (°F)	CEFT (°F)	CLFT (°F)	Steam CLFT (°F)
100.0	1000.0	100.0	737.0	4424.5	1.08	9934	8	54.00	42.00	85.00	94.30	100.50
90.0	900.0	88.4	634.5	4239.2	1.09	8784	8	52.80	42.00	85.00	93.30	98.80
80.0	800.0	78.2	547.4	4108.2	1.10	7762	8	51.60	42.00	85.00	92.40	97.30
70.0	700.0	67.4	469.9	3983.5	1.11	6692	6	50.40	42.00	85.00	91.40	95.70
60.0	600.0	58.8	402.4	3939.0	1.09	5840	6	49.20	42.00	85.00	90.50	94.20
50.0	500.0	51.0	340.7	3903.0	1.04	5063	6	48.00	42.00	85.00	89.60	92.80
40.0	400.0	43.3	280.6	3872.3	0.98	4298	6	46.80	42.00	85.00	88.70	91.50
30.0 *	300.0	34.4	218.2	3839.0	0.92	3418	6	45.60	42.00	85.00	87.80	90.00
20.0 *	200.0	24.9	160.8	3914.0	0.85	2472	6	44.40	42.00	85.00	86.90	88.50
15.0 *	150.4	20.9	137.4	4073.1	0.76	2073	6	43.80	42.00	85.00	86.40	87.80

5. Meters: Customer will purchase and install (in accordance with each meter's OEMs' recommendations) utility revenue grade energy meters as required and as outlined in Milestone No.1 and related documents to monitor and record (for each engine and the total, proposed CHP system) gross electric production, corresponding engine electric parasitic loads, 135 psig steam production, ST CH steam usage and CHW production and NG usage (for each engine). At a minimum, the each meter will be able to capture hourly interval data for each of the abovementioned and the hourly interval data will be provided in the form of Time-stamped, Trend Logs in MS-Excel format or other NGrid acceptable electronic format. The proposed CHP system's control system will be capable of trending and archiving the hourly interval data for a period of one year before overwriting. During Post-Installation Inspection, customer will confirm the data collection system is installed, connected to recently calibrated metering (within six (6) months of commencing data acquisition) and properly report and archiving data.

Milestone No.2b. - Demonstration of Operability

(Completion of Milestone Nos.2A and 2b is required for the payment of 80% of the incentive.)

Confirm that the above noted equipment is installed and operational for completing Milestone 2b. Installed and operational is defined as :

- Yes No — All components of the CHP system are installed and operational.
- Yes No — All equipment, piping (including flushing), electrical and control wiring is completed, so the equipment can operate in an automatic mode.

Minimum Requirements Document

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Yes No Yes No Yes No Yes No Yes No	▪ Interconnection to customer's NG, electrical and thermal loads are operational. Interconnection facilities are completed and accepted by Retail Connections Engineering and insurance certificates are in place. This does not absolve the customer from meeting any other jurisdictional permits or other regulatory requirements. ○ All instrumentation and energy meters required by MRD (as specified in Milestone No.3) are installed, calibrated within the past six (6) months and are properly working. ○ The CHP system is capable of continuously operating in automatic mode. ○ Hourly interval data will be made available to NGrid (MS-Excel or NGrid acceptable electronic format) to prove the operation of the CHP System and sub-systems matches the energy savings calculations and Technical Assistance Study. ○ Customer has completed its own substantial Check-Out, Start-Up and Commissioning of the full CHP system.
Post Operational Assessment	**DOCUMENTATION:** List written documentation required to train, verify, operate, or maintain the equipment being installed or controlled. This may include specification sheets, test reports, construction drawings, etc. : Provide a list of Trending Requirements required to verify proper system operation. Trends should document operational sequences, setpoints and scheduling of equipment as described in TA Study
Yes No	**Milestone No.3. (Remaining 20% of the incentive will be paid only after Milestone 3 & 4 are satisfactorily completed.)** Validate the following items: (a) O&M manuals and documentation on-site. 1. All equipment catalogs and performance specifications. O&M manuals for the following equipment: a. Each Reciprocating Engine-Generator Set; b. Each Heat Recovery Steam Generator; c. Each NOx & CO Emissions Control Systems; d. Each engine-generator sets' electric parasitic loads (i.e., pumps, motors, air compressors, fans, etc.); e. CHP System master and individual control systems; and f. Each Energy Meter (i.e., NG usage, electricity (i.e., gross & parasitic loads), 135 psig steam production and usage, HRSG feedwater flowrate and temperature, ST CH steam usage and CHW production, etc.). 2. As-Built design drawings & specifications (i.e., P&IDs, Mechanical Piping Drawings, Instrumentation List and equipment Data Sheets, etc.) are available on-site. (b) Availability of Trend Logs and confirmation of NGrid acceptable electronic format.

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	3. Provide 1 hour interval data for the following points as a <u>minimum (15 minute interval data is desirable)</u>. Provide the capacity for and enable trend data archiving for a period of at least one year. a. Gross and Net kW and kWh electrical output; b. Fuel Input to CHP system (Therms or MMBtu at stated Heating Value); c. Steam generated and utilized (Therms or MMBtu); and d. ST CH steam usage and CHW generated and utilized (Tons). Other meters may be required based on the final design P&ID to measure parasitic Loads. 4. Provide ability to electronically export weekly data-files to third-party via email or FTP at all times. 5. Post operational assessment process will require functional testing of the CHP and the thermal and electrical interface to the buildings, a minimum 2 weeks and up to 6 months of concurrent 1 hour interval data for all points noted above. If equipment fails to meet expected sequences of operations and corrections are needed, an additional trend data shall be provided to confirm any seasonal changes in operations. 6. Provide meter calibration data/certification. (c) Sequence of Operation is working as outlined in MRD, TA Study and supporting energy saving calculations. The customer's full Commissioning Report is received and the remotely available performance data is reviewed by NGrid and the CHP system is operating in compliance with the proposed plant performance criteria specified in the MRD.
Post Inspection	**OTHER REQUIRMENTS:** Describe any requirements for demolition, removal, etc of existing equipment.
Yes No	<u>Milestone No.4</u> 1. Customer will have a 3-year maintenance contract (minimum) for each reciprocating engine, steam turbine-driven chiller, HRSG, air quality emissions control equipment, switchgear, instrumentation and controls to help achieve long-term, proposed operational strategies and energy cost savings. Normal planned /routine maintenance will be conducted where possible during NGrid's Off-Peak billing and Energy Efficiency Program periods. 2. Provide detailed project cost breakdown by major system components. Provide copies of all paid invoices reflecting the total Capital Cost to insure, design, permit, manage, build, check-out, start-up, test, commission and put into Commercial Operation in

Minimum Requirements Document

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	accordance with all satisfied, applicable permits and electrical interconnection requirements and customer's full CHP system acceptance. 3. Provide RI State Tax Exempt Certificate. 4. Provide any and all Local, State and Federal tax credits, grants and similar financial benefits effectively reducing the Capital Cost of the proposed CHP System.

The pre-approved incentive is subject to Retail Companies' POST INSPECTION of final specifications, drawings and operation of the proposed equipment. In the event the proposed system is altered from the above description, notify the Company of the change prior to the equipment purchase and installation as the change in design and operation may impact the available incentive.

Toray Plastic (America) Authorized Signature — Date

APPROVED
By Fred McKiernan at 2:24 pm, Jul 25, 2012

National Grid Authorized Signature (Division Technical Support Consultant) — Date

Minimum Requirements Document

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Attachment No.1
Planned Maintenance Schedules & Durations

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	**EI or D2**	**EI**
Location	50 Belver Avenue North Kingstown, RI 02852	**Application No.**	1999989
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Maintenance cost (Engine+Control) for KG-18

Year	Operating Hour	Maintenance Level	Expected Downtime (Days)	Main Works	Labour Man-Hour (hour)	Working hour for repair in work shop [hr]	Labour Charge by ***
1	2,000	A	1	Replacement of Spark Plug	12		
	4,000	A	1	Replacement of Spark Plug	12		
	6,000	B	2	Replacement of non-return valves	80		
	8,000	A	1	Replacement of Spark Plug ,battery	12		
2	10,000	A	1	Replacement of Spark Plug	12		
	12,000	C	12	Replacement of piston rings	600	45	
	14,000	A	1	Replacement of Spark Plug	12		
	16,000	A	1	Replacement of Spark Plug ,battery	12		
3	18,000	B	2	Replacement of non-return valves	80		
	20,000	A	1	Replacement of Spark Plug	12		
	22,000	A	1	Replacement of Spark Plug	12		
	24,000	D	14	Replacement of Crankpin and main bearings and valves,battery	1,120	18	
4	26,000	A	1	Replacement of Spark Plug	12		
	28,000	A	1	Replacement of Spark Plug	12		
	30,000	B	2	Replacement of non-return valves	80		
	32,000	A	1	Replacement of Spark Plug ,battery	12		
5	34,000	A	1	Replacement of Spark Plug	12		
	36,000	C	12	Replacement of piston rings	600	45	
	38,000	A	1	Replacement of Spark Plug	12		
	40,000	A	1	Replacement of Spark Plug ,battery	12		
6	42,000	B	2	Replacement of non-return valves	80		
	44,000	A	1	Replacement of Spark Plug	12		
	46,000	A	1	Replacement of Spark Plug	12		
	48,000	E	17	Replacement of piston crowns and thrust bearing ,battery	1,360	18	
7	50,000	A	1	Replacement of Spark Plug	12		
	52,000	A	1	Replacement of Spark Plug	12		
	54,000	B	2	Replacement of non-return valves	80		
	56,000	A	1	Replacement of Spark Plug ,battery	12		
8	58,000	A	1	Replacement of Spark Plug	12		
	60,000	C	12	Replacement of piston rings ,Cylinder controller and ignition device	600	45	
	62,000	A	1	Replacement of Spark Plug	12		
	64,000	A	1	Replacement of Spark Plug	12		
9	66,000	B	2	Replacement of non-return valves	80		
	68,000	A	1	Replacement of Spark Plug	12		
	70,000	A	1	Replacement of Spark Plug	12		
	72,000	D	14	Replacement of Crankpin and main bearings and valves ,battery	1,120	18	
10	74,000	A	1	Replacement of Spark Plug	12		
	76,000	A	1	Replacement of Spark Plug	12		
	78,000	B	2	Replacement of non-return valves	80		
	80,000	A	1	Replacement of Spark Plug ,battery	12		
11	82,000	A	1	Replacement of Spark Plug	12		
	84,000	C	12	Replacement of piston rings	600	45	
	86,000	A	1	Replacement of Spark Plug	12		
	88,000	A	1	Replacement of Spark Plug ,battery	12		
12	90,000	B	2	Replacement of non-return valves	80		
	92,000	A	1	Replacement of Spark Plug	12		
	94,000	A	1	Replacement of Spark Plug	12		
	96,000	F	17	Replacement of cylinder liners ,battery	1,360		
Sub Total					8,384	234	

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	**EI or D2**	**EI**
Location	50 Belver Avenue North Kingstown, RI 02852	**Application No.**	1999989
EEM:	**1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).**		

TABLE 6 – OPERATION / INSPECTION / MAINTENANCE REQUIREMENTS FOR YST CHILLERS

TURBINE MAINTENANCE SCHEDULE					
PROCEDURE	DAILY	WEEKLY	MONTHLY	ANNUALLY	3 YEAR
Visual Inspection (external damage, leaks)	X				
Check Oil Level in Reservoir and Governor	X				
Check for Unusual Vibration / Noise	X				
Check Oil Temperature and Pressure	X				
Observe seal steam venting	X				
Check Aux. Oil Pump Operation		X			
Check Refrigerant Levels		X			
Check Operation of all Shutdowns		X			
Check Shafts (free of Oil and Grease)		X			
Exercise Trip Valve		X			
Check Overspeed Governor			X		
Check Oil Return System Operation			X		
Check Operation of Motor Contactors in Power Panel			X		
Check Oil Heater Operation			X		
Check 3-Phase Voltage and Current Balance			X		
Verify Operation / Setting / Calibration of Safety Controls[1]			X		
Verify Condenser and Evaporator Water Flows			X		
Leak Check and Repair Leaks as Needed[1]			X		
Check Oil and Filter			X		
Remove / Clean Steam Strainer				X	
Check and Tighten All Electrical Connections				X	
Check Shaft Seals				X	
Check Thrust Bearing End Play				X	
Remove / Check Operation Sentinel Warning Valve				X	
Drain / Clean Oil Reservoir				X	
Drain / Clean Governor				X	
Perform Oil Analysis. Change as Required[1]				X	
Perform Refrigerant Analysis[1]				X	
Perform Vibration Analysis				X	
Perform Eddy Current Testing and Inspect Tubes[3]				X	
Clean Tubes				X	
Change Filter with Oil Change				X	
Check / Recalibrate Gauges				X	
Open / Inspect Turbine / Replace as Required					X
Rotor					X
Labyrinth Seals					X
Bearings					X
End Seals					X

7

NOTES:

For operating and maintenance requirements listed above, refer to appropriate service literature, contact your local YORK Service Office.

1. This procedure must be performed at the specified time interval by an Industry Certified Technician who has been trained and qualified to work on this type of YORK equipment. A record of this procedure being successfully carried out must be maintained on file by the equipment owner should proof of adequate maintenance be required at a later date for warranty validation purposes.
2. More frequent service may be required depending upon local operating conditions.
3. More frequent service may be required depending on water quality.

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

FORM 160.67-O2 (1105)

TABLE 6 (CON'T) – OPERATION / INSPECTION / MAINTENANCE REQUIREMENTS FOR YST CHILLERS

STEAM CONDENSER MAINTENANCE SCHEDULE						
PROCEDURE	DAILY	WEEKLY	MONTHLY	SEMI-ANNUALLY	ANNUALLY	3 YEAR
Visually Inspect for Leaks / Abnormal Noise	X					
Check Liquid Ring Seal on Relief Valve & Liquid Ring vacuum Pumps		X				
Check Conedsate Pump Operation / Seals			X			
Check Hotwell Liquid Level / Pump NPSH			X			
Lubricate the Hotwell Pump Bearing				X		
Inspect / Clean Tubes with Chiller Heat Exchangers					X	
Clean and Grease vacuum Pump Bearings						X

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

FORM 160.75-O1 (211)

YORK®

MAINTENANCE REQUIREMENTS FOR YORK YK CHILLERS

PROCEDURE	DAILY	WEEKLY	MONTHLY	YEARLY	OTHER
Record operating conditions (on applicable Log Form)	X				
Check oil levels	X				
Check refrigerant levels		X			
Check oil return system operation			X		
Check operation of motor starter			X		
Check sump heater and thermostat operation			X		
Check three-phase voltage and current balance			X		
Verify proper operation/setting/calibration of safety controls[1]			X		
Verify condenser and evaporator water flows			X		
Leak check and repair leaks as needed[1]			X		
Check and tighten all electrical connections				X	
Megohm motor windings				X	
Replace oil filter and oil return filter/driers				X	
Clean or backflush heat exchanger (VSD, SSS Applications)				X	
Replace starter coolant (VSD, SSS Applications)				X	
Replace or clean starter air filters if applicable				X[2]	
Perform oil analysis on compressor lube oil[1]				X	
Perform refrigeration analysis[1]				X	
Perform vibration analysis				X	
Clean tubes				X[2]	
Perform Eddy current testing and inspect tubes					2 - 5 Years
Lubricate motor	Refer to motor manufacturer's recommendations				

For operating and maintenance requirements listed above, refer to appropriate service literature, or contact your local YORK Service Office.

[1] This procedure must be performed at the specified time interval by an Industry Certified Technician who has been trained and qualified to work on this type of YORK equipment. A record of this procedure being successfully carried out must be maintained on file by the equipment owner should proof of adequate maintenance be required at a later date for warranty validation purposes.
[2] More frequent service may be required depending on local operating conditions.

LD10999

Minimum Requirements Document

Customer Name	**Toray Plastics (America), Inc.**	**EI or D2**	**EI**
Location	**50 Belver Avenue North Kingstown, RI 02852**	**Application No.**	**1999989**
EEM:	**1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).**		

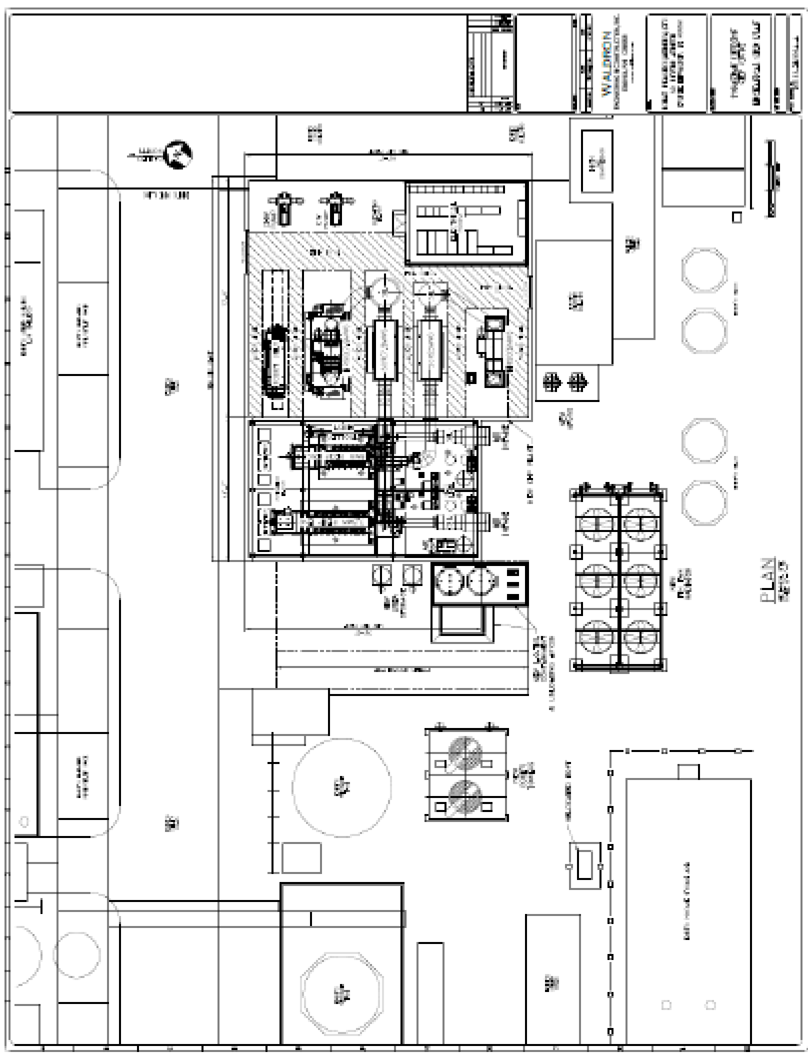
Attachment No.2
National Grid's Interconnection Requirements

Customer will ensure the proposed CHP System's design and construction will follow and adhere to all requirements and corresponding fees associated with and stated in Rhode Island Public Utilities Commission Tariff No.2078 – *Standards for Connecting Distributed Generation*.

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

Attachment No.3
Preliminary CHP System Drawings



Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		

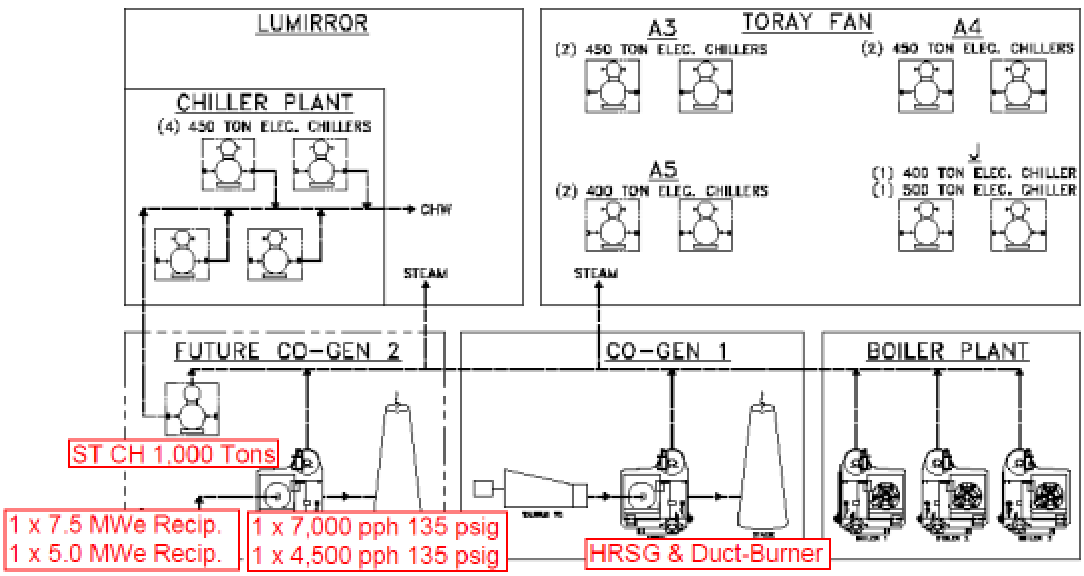
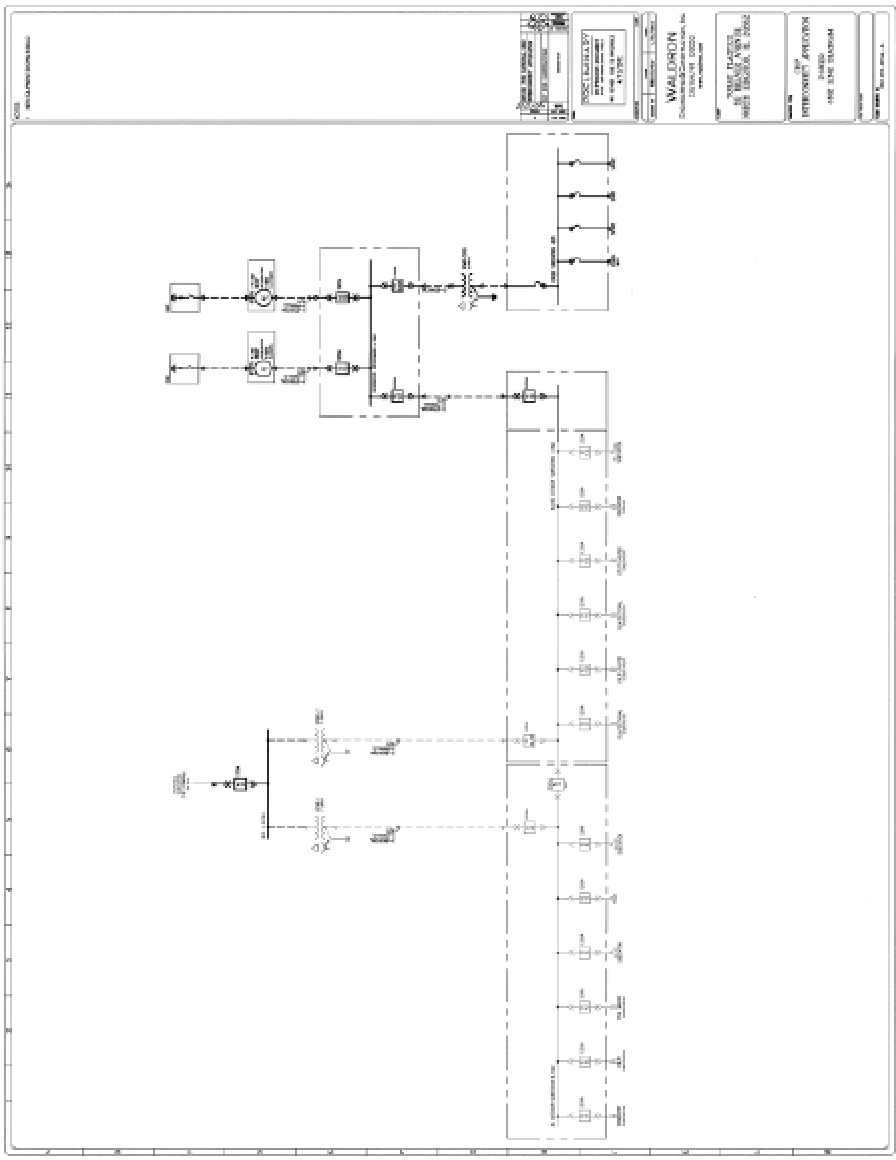


Figure 6 - Utility Infrastructure Schematic

Minimum Requirements Document

Customer Name	Toray Plastics (America), Inc.	EI or D2	EI
Location	50 Belver Avenue North Kingstown, RI 02852	Application No.	1999989
EEM:	1 x 7.5 MWe & 1 x 5.0 MWe nominally rated NG reciprocating engines with corresponding, individual 135 psig Steam HRSGs and Emission Control Systems, plus 1 x 1,000 Ton nominally rated Condensing Steam Turbine Centrifugal Chiller (135 psig Saturated Steam Supply).		



Appendix E: TA Study Proposal

(Partial)

WALDRON ENGINEERING & CONSTRUCTION, INC.

WALDRON

Proposal For

Toray Plastics (America), Inc.

CHP Conceptual Study

November 7, 2011

Waldron Engineering & Construction, Inc
37 Industrial Drive
Suite G-1
Exeter, NH 03833

WALDRON ENGINEERING & CONSTRUCTION, INC.

November 7, 2011

Charles Norman
Senior Buyer Corporate Purchasing
Toray Plastics (America), Inc.
50 Belver Ave.
North Kingston, RI 20852

RE: CHP Conceptual Study

Dear Mr. Norman:

Waldron Engineering and Construction, Inc. is pleased to submit herein our proposal to develop a CHP Study for your North Kingston facility. Waldron has developed a scope of services building on your Request for Proposals that will provide you with a complete concise analysis of the economic benefit that can be derived from installing a new CHP facility to serve the electrical loads of the Torayfan Division and the thermal loads of the site as a whole.

As you will see from this proposal, Waldron is well qualified to execute this study for Toray given our wealth of experience in the CHP market. Waldron has include the firm of ERM to our team to insure the correct scope of environmental permitting is identified in the study.

We are confident we have a solid understanding of your objectives and can deliver a quality syudy report that you can present to your management with confidence knowing that it has been based on thorough analysis and review. We thank you for this opportunity to present our proposal and hope you will select us for your project.

Sincerely,
Waldron Engineering & Construction, Inc.

Terence Waldron
Terence Waldron, P.E.
President

Waldron Engineering & Construction, Inc.

Table of Contents

Section 3 Project Scope of Work

- Project kick off meeting to gather data on the existing systems, points of interconnection and loads. Existing drawings will be gathered for reference material in the study. Access to the NGrid meter data for a typical year will be requires along with the boiler plant data for the same time frame.
- Develop an existing utility model that simulates the functioning of the existing Torayfan Division electrically and the entire site thermally. The model will consist of 8760 data in 15 minute intervals if available from NGrid. Verify the model against the utility bills for that year to insure accuracy.
- Compile a list of options available to serve the utilities defined in the model. Review the list with your staff prior to running up to three Future Case utility models.
- Run Future Case utility models to compare with existing for savings calculations.
- Utilize $/kw pricing to screen the options analyzed to determine if any have a strong enough business case for future consideration.
- Meet with your staff to review the findings.
- Bring one of the options forward for further refinement
- Develop a the following documentation to define the preferred option technically
  - System description with performance parameters
  - Equipment General Arrangement Drawing
  - Equipment List
  - ETAP model of the electrical system and HV one line
  - Heat and Material Balance for Winter, Summer and Spring/Fall Cases
- Identify Environmental permitting requirements
- Identify NGrid, State and Federal incentives that may be applicable
- Develop a construction cost that Toray can use as a not to exceed cost, maintenance and operations cost estimates for the final option. The construction cost estimate will be itemized for engineering, equipment, construction, commissioning, training and owners costs.
- Itemize the engineering budget into a cost proposal
- Price proposal for the NGrid Tech Analysis Study.
- Determine the simple payback and ROI using the construction, owners, maintenance, and operating cost estimates, utility savings calculated by the difference from the future case model and the existing case model, and all incentives available.
- Meet with your staff to review the detailed findings
- Compile the findings in a report to document the project.

Section 6 Commercial Terms

Waldron Engineering & Construction, Inc. will execute the scope of services listed in this proposal for a lump sum price of 38,400.

Commission 1-8

Request:

Do you anticipate that payment of the installation incentive will cause the Company to overspend its 2013 EEPP budget, and if so by what amount?

a) What impact will the anticipated overspending have on the 2014 EEP Charge?
b) Please provide the bill impact on a typical residential customer, assuming the anticipated overspending occurs.

Response:

Payment of the installation incentive will not take place until 2014. However, the historical practice (dating back to Docket 1939) for funding commitments has been to encumber current funds to cover the expected cost of projects that will not be completed until after the current program year. In the case of Toray, $6.5 million of commitment funding was not budgeted in 2013, but will need to be funded from the 2013 budget. At this early stage in the 2013 program year, it is difficult to determine how much, if any, overspending will occur. The Company has outlined several steps in Paragraph 24 of the Petition that it can take to mitigate potential overspending. In the event that the Company needs to spend the full budgets for all of the other programs to meet its 2013 savings targets, thereby resulting in the need to overspend the 2013 budget, the 2013 EEPP contains several mechanisms to manage the budget and any overspending, including oversight by the EERMC and the Commission.

(a) The magnitude of any upward pressure on the EEP charge in 2014 from the Toray commitment is uncertain. In the 2012-2014 Energy Efficiency and System Reliability Procurement Plan (the "Three Year Plan"), Docket 4284, the projected EEP charge for 2014 is $0.0098/kWh. As explained in Paragraph 26 of the Petition, while the overspending provisions of the 2013 EEPP allow for reconciling overspending in 2014, it is possible that overspending to fund the Toray commitment in 2013 will not have any upward impact on the EEP charge in 2014. The committed funds of $13.5 million will be carried over from 2013 into 2014 (see, for example, Table E-1 of the 2013 EEPP, which shows that commitments of approximately $1.4 million were carried into 2013 as a funding source). These funds will become part of the budget for 2014, which was projected to be approximately $88 million in the Three Year Plan. The Toray project's savings of 87,473 MWh are approximately 46% of the 2014 goal of 189,068 MWh. Therefore, 15% of the budget will achieve 46% of the electric energy savings, without collecting any new funds in 2014 to do so. The Company does not anticipate at this time

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for the EEP charge to be greater than $0.0098/kWh (as currently projected for 2014) and, in fact, it might be less than that.

The Company also notes that the practice of fully funding commitments in the current program year dates back to a time during which there was no legislative structure that established stable funding for energy efficiency. In that environment, it was not certain that funding would be available from one year to the next and it was important to set aside current funds to honor commitments made to customers for projects that would not be completed until the next year. In today's environment, the least cost procurement provisions of R.I.G.L. §39-1-27.7, which are in place through 2020, provide greater stability. In the event that the Commission were to waive the requirement for full funding of the commitment in 2013, this would enable the Company to commit the budgeted $7 million in 2013 and to pay the remaining $6.5 million of the incentive (in addition to the budgeted $7 million which would be carried over to 2014) from new funds collected in 2014, thereby mitigating any potential overspending as a result of the Toray project in 2013.

(b) At this time, the Company anticipates the bill impact in 2014 on a residential customer from any potential overspending in 2013 will be $0.

Prepared by or under the supervision of: Jeremy Newberger