Energy Conservation Project Commissioning Report

City of Guelph Material Recovery Facility

Rose Technology Inc.
5525 Eglinton Avenue West, Suite 100
Toronto, Ontario, M9C 5K5

February 9th, 2012

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1.0 Introduction and Summary

The Waste Recovery Facility at the City of Guelph sorts and ships recycled materials from the residential and commercial recycled waste collection of the City. Rose Technology (Rose) was contracted by the City to reduce energy use at the facility. The energy conservation measures that were installed included:

- Power factor correction
- Lighting retrofit
- Building automation system (BAS)

This report summarizes the commissioning of the energy conservation measures.

The scope of commissioning activities included the following major tasks:

- Develop a commissioning plan for each of the energy conservation measures.
- Periodic site review of installation to confirm methods of installation.
- Final site review of installation to confirm methods of installation, start-up of equipment and performance of retrofits.
- Preparation of deficiency lists, and correction follow-up.
- Review of Operations and Maintenance Manuals.
- Re-calculation of savings estimates based on installed conditions.
- Preparation of Commissioning Report

We confirm that the installations of the energy conservation measures are complete and operating effectively. Savings have been recalculated based on installed conditions. Current versus original savings are as follows:

Measure	Original Savings				
	Fuel (cu-m)	Electrical (kWh)	Demand (kW)	Other ($)	Total ($)
Repair Power Factor Correction	0	0	0.0	1,200	1,200
Building Automation System	173,652	334,076	0.0	0	99,062
HVAC Filter Pressure Tracking	0	0	0.0	5,000	5,000
Lighting	-186	54,432	13.1	1,850	6,896
Totals	**173,466**	**388,508**	**13**	**8,050**	**112,158**

Measure	Current Savings				
	Fuel (cu-m)	Electrical (kWh)	Demand (kW)	Other ($)	Total ($)
Repair Power Factor Correction	0	0	0.0	6,822	6,822
Building Automation System	144,449	263,711	0.0	0	83,445
HVAC Filter Pressure Tracking	0	0	0.0	5,000	5,000
Lighting	-187	54,521	13.3	1,850	6,916
Totals	**144,262**	**318,232**	**13**	**13,672**	**102,183**

The dollar value of the cost savings shown above for both original and current savings use the utility rates that were used in developing the Feasibility Study. These rates were used in order to make a fair comparison to the original estimate. Actual current savings levels based on current utility rates would be higher as utility rates have generally increased.

Original to current savings levels comparison:

- Current power factor savings are higher than estimated. The higher value is due to underestimating the power factor penalty that was being paid.

- Lighting savings are at estimate.

- Building automation savings are lower than the original estimate as some energy conservation measures were removed or scaled back. This reduction in measures was based on unfavorable information received from equipment manufacturers, or re-analysis of implementation strategies that would have created a non-sustainable working environment. For example, it was anticipated the two direct-fired makeup air units could be controlled by a variable speed drives; further research indicated with was not practical.

Details of the commissioning and savings calculations are found in the report.

2.0 Commissioning Reports

2.1 Power Factor Correction

Background:

A site visit was conducted on Friday, October 29th, 2010. The existing fixed 225 kVAr 600-volt PowerSpec conventional capacitor bank was checked, and had deteriorated to approximately 60 kVAr. The same capacitor bank had been checked in December 2008 and was measured at 68 kVAr, and in 2002 measured at 130 kVAr.

The following Hydro Billing Analysis Table 2.1.1 indicated the penalties that were paid in power factor in 12 months (February 2008 through January 2009) based on demand rate of $6.715/kW, and the amount of capacitance that would be required to eliminate power factor penalties at 0.90 of kVA with existing 60 kVAr capacitor in place.

Table 2.1.1 – Pre-Installation Power Factor Penalty

Year	Month	KVA	KW	Billing Demand .9 of KVA	Actual P.F.	P.F. Penalty	KVAR Req'd
2009	Jan	665	543	599	81.7%	$373	121
2008	Feb	624	538	562	86.2%	$158	56
2009	Mar	643	518	579	80.6%	$408	130
2009	Apr	648	511	583	78.9%	$485	151
2009	May	629	486	566	77.3%	$538	164
2008	Jun	573	443	516	77.3%	$488	149
2008	Jul	585	453	527	77.4%	$494	151
2008	Aug	604	464	544	76.8%	$534	162
2008	Sep	606	464	545	76.6%	$547	165
2008	Oct	581	475	523	81.8%	$322	105
2008	Nov	630	500	567	79.4%	$450	141
2008	Dec	679	544	611	80.1%	$451	143
						$5,246	
To Ensure	90 % PF Each Month, use			165	KVAR		

Based on the past years usage as indicated on the billing analysis above, a minimum of 165 kVAr was required to maintain a 90% power factor threshold. The kVAr requirements range from 56 to 165 kVAr per month over a year. Since there was presently a 60 kVAr of correction contributing to the system that need replacement, a minimum of 225 kVAr (60 kVAr + 165 kVAr) was required.

Installation:


Photo 1

Rose Technology installed a 250 kVAr, 600-volt automatic harmonically filtered capacitor bank on the existing housekeeping pad to the left of the main service board next to the 1,500 main service board (Photo 1) and the interior view of unit (Photo 2) with capacitor banks (silver cans) at bottom of photo, filter units (coils) seen in the middle of photo and automatic switching contact circuitry and fusing just behind and above filter units.


Photo 2

On May 4, 2011 commissioning inspection was conducted during MRF process operations and readings were taken from 250 kVAr Power-Survey onboard controller and metering display (Photo 3). Meter display readings were recorded on commissioning report and varied from 0.94 PF to 0.97 PF with all three steps of capacitor bank operational and activally working to correct power factor. Voltage, Amperage and Power readings were also taken from the meter display (see Table 2.1.2 and Table 2.1.3 below).

Table 2.1.2 – Power Correction Unit Meter

Measurement/Description	Readings
Service Feeder Voltage	604 volts
L1, L2, and L3 to Neutral Voltages	357 volts
Power Reading	375 kW
L1, L2 and L3 Amperage	403 amps

Table 2.1.3 - Active Power Factor Correction

Step #1 - On and Active	100 kVAr
Step #2 - On and Active	100 kVAr
Step #3 - On and Active	50 kVAr

Commissioning inspection also included review of equipment documentation, equipment nameplate data and warning label and was found to conform to manufacturer equipment specifications and with Rose Technology's design specifications (Photos 4, 5 and 6).

Field commissioning report can be found in Appendix A.

Savings Analysis:

A post-construction power factor penalty analysis was conducted as part of the commissioning. Analysis was based on 5-minute interval metering data downloaded by Guelph Hydro from the main electrical meter on-site. The interval data spanned 18-month period from May 1, 2010 to October 31, 2011. The power factor correction measure was completed and operational by May 1, 2011. The 18-month interval data period includes the 12-months prior to installation of power factor correction measure and the 6-months after installation.

Table 2.1.4 illustrates the power factor penalty estimated for the first 12-months before the power factor measure implementation and Table 2.1.5 illustrates the power factor penalty estimated for the 6-months after installation. As illustrated in these tables, the power factor

correction is working as expected by maintaining power factor near or above the 0.90 (90%) threshold for the whole site.

Table 2.1.4 Guelph MRF - Power Correction Analysis (Before Power Factor Correction Installation)

Year	Month	Actual KVA	Actual KW	Billing Demand .9 of KVA	Calculated P.F. (kW/kVA)	P.F. Penalty	Monthly Average P.F.
2010	May	752	606	677	80.6%	$478	85.8%
2010	Jun	750	601	675	80.1%	$471	85.5%
2010	Jul	755	613	679	81.2%	$421	86.4%
2010	Aug	772	622	695	80.5%	$464	86.5%
2010	Sep	706	559	635	79.2%	$484	86.9%
2010	Oct	684	577	615	84.4%	$244	89.4%
2010	Nov	765	628	689	82.1%	$386	88.7%
2010	Dec	808	689	728	85.2%	$245	90.1%
2011	Jan	811	686	730	84.6%	$277	90.1%
2011	Feb	850	713	765	83.9%	$331	90.7%
2011	Mar	844	716	760	84.8%	$277	90.1%
2011	Apr	801	637	721	79.5%	$533	86.5%
				Total Penalty Charge =		$4,581	

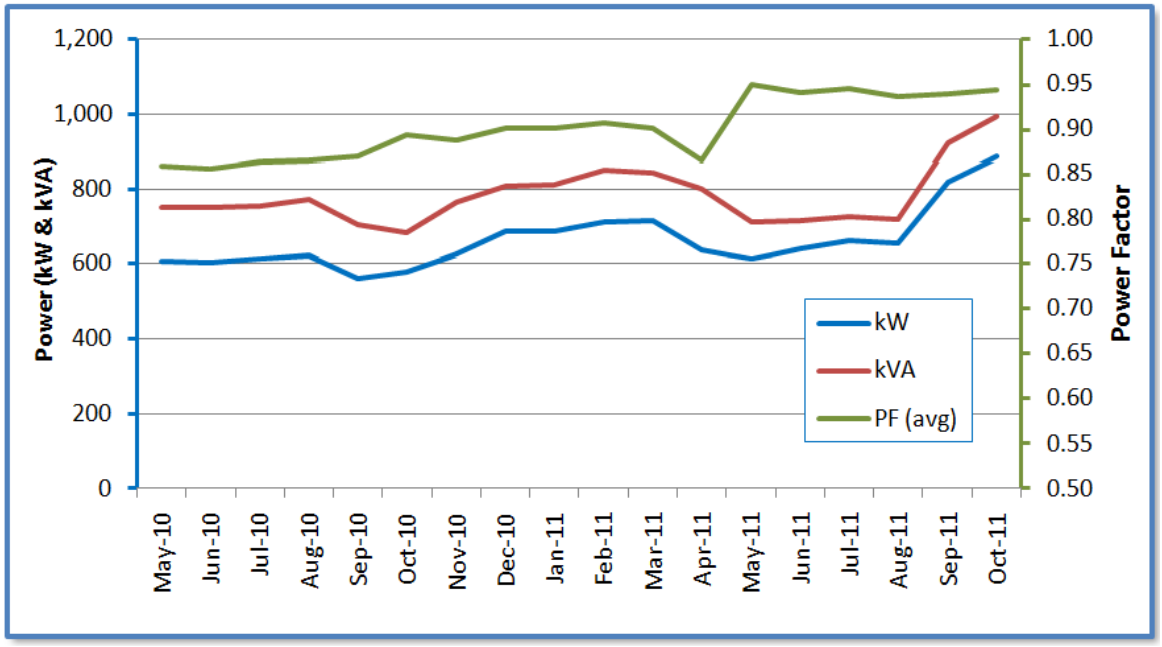
Table 2.1.5 Guelph MRF - Power Correction Analysis (After Power Factor Correction Installation)

Year	Month	Actual KVA	Actual KW	Billing Demand .9 of KVA	Calculated P.F. (kW/kVA)	P.F. Penalty	Monthly Average P.F.
2011	May	713	613	642	86.0%	$182	95.0%
2011	Jun	716	643	644	89.9%	$6	94.0%
2011	Jul	725	661	653	91.1%	$0	94.5%
2011	Aug	721	657	649	91.1%	$0	93.7%
2011	Sep	921	820	829	89.0%	$58	94.0%
2011	Oct	993	888	894	89.4%	$35	94.3%
				Total Penalty Charge =		$282	

As illustrated in above tables; power factor penalty has been reduced from an estimate of $2,532 for 1st six month period of May 1, 2010 to October 31, 2010 to a post-construction power factor penalty of $282 for May 1, 2011 to October 31, 2011 which represents an 89% reduction in potential penalty charges. The above PF analysis estimates were adjusted to reflect final electricity demand rate of $6.344/kW; which was established after the original power factor analysis was reported. The original analysis shown in Table 2.1.1 used a slightly higher demand rate of $6.715/kW.

The higher the nominal penalty estimated for May 2011 was due to power factor correction system initial self-adjustment and stabilization after start-up; it is assumed that power factor penalties for the proceeding months after October 2011 will be much less then first six (6) months. However new additions to the site's electrical load profile may vary results in the future.

Graph 1: Details the Electricity Peak Power and Average Power Factor Correction for the 18-months from May 2010 to October 2011.

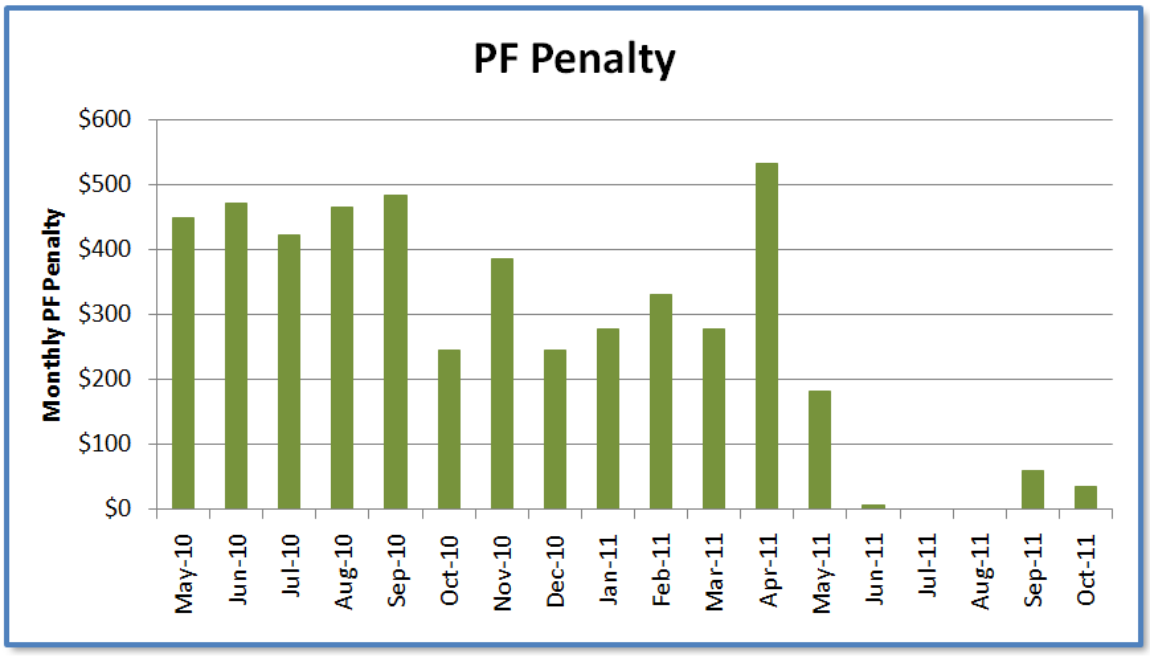


Note: Power Factor Correction Unit was activated on May 1, 2011 and for the following six (6) months the average monthly power factor PF (average) for the MRF site was above the 0.90 (90%) which is PUC power factor penalty threshold. Power factor was also stable throughout the MRF additions of two new 10 horse-power bailers and the addition of the new Compost Plant building in September 2011 to the site electrical load. The influence of new 107,600 SF Compost Plant additions can be seen in the graph with a sudden rise in electrical power (kW & KVA) for the period of September 2011 to October 2011 when load was brought on-line.

Based on using Guelph Hydro interval meter data received for eighteen months starting May 1, 2010 through to October 31, 2011 and projecting potential post-construction PFC savings into the future for a full year starting May 1, 2011 and ending April 30, 2012 (with six months of actual PF interval data); we have estimated a PF penalty savings of **$4,017 per year** allowing for the new Compost Plant PF penalty increase, or a savings of $4,392 per year discounting the Compost Plant PF penalty contribution. These savings are estimated using an electricity rate of $6.344 per kW; which was previously established by Rose in the MRF feasibility study.

As of May 1, 2011 Guelph Hydro has increase their electricity rates for General Services of 50kW to 1,000kW in size with accumulated service rate of $10.4832 per kW. If we were use this stated utility rate looking forward into the future; we estimate that savings will increase for the PFC measure to $6,822 per year with the Compost Plant PF penalty increase, or a savings of $7,377 per year discounting the Compost Plant PF penalty contribution.

Graph 2: Details the Power Factor Charges from May 2010 to October 2011.



Note: New 250 kVAr Power Factor Correction Unit was activated on May 1, 2011 and for the six(6) months following activation the PF penalty charges is estimated at **$282** for the period vs. **$4,581** for the previous 12-months.

Commissioning Remarks and Future Recommendations:

The metering interval data provided was based on meter the whole site electrical system. The causes of minor power factor penalties after the installation of new power factor correction system are caused by heavy electrical usage from other buildings connected to site main electrical service, and only during brief periods when MRF processes operations are at peak demand. The slight rise in power factor penalty in September 2011 and October 2011 were contributed to the new 2,500 Amp 600 Volt service for the Compost Plant coming online and the power factor correction system attempting to compensate for the additional load.

If the City of Guelph wishes to further eliminate power factor penalties altogether for the MRF site or if in future Guelph Hydro adopts high power factor penalty thresholds above 0.90 (90%); the City may wish to install additional power factor correction equipment in adjacent buildings to correct whole site power factor conditions. Possible candidate sites is the transfer station and wet waste building(s) which have large exhaust fan motor loads; which are known to cause lowered power factor conditions.

2.2 Lighting Retrofit Measure

Background:


Photo 7 - Before

The majority of the Material Recovery Facility (MRF) operation was lit with 400 watt High Pressure Sodium (HPS) industrial high-bay fixtures together with a small numbers of 250 watt HPS low-bay fixtures. The HPS fixtures were suspended from the open ceiling structure above the bailing equipment and bail storage sections and over the process conveyor section of the MRF. High Pressure Sodium light sources produced a golden-yellow monochromatic light which appeared dim in comparison to other white-light sources due to their poor colour rendering index characteristics of 20 to 22 CRI (see Photo 7).

Interviews were conducted by Rose's auditor with MRF maintenance staff and supervising staff to confirm operating hours for lighting systems and sort rooms and on lighting systems' observations and performance. Generally, observations were that HPS lamps had a poor colour rendering characteristics and a feeling of dim yellow-light when comparing HPS to fluorescent lighting found in sorting rooms or daylighting seen through skylights, and windows and open exterior doorways.

Installation:


Photo 8 - After

The MRF existing industrial lighting was a prime candidate for redesign with high efficiency 54 watt T5HO (High-Output) fluorescent lighting technology. The new T5HO fluorescent lamps featured increased colour rendering index of 85 CRI or better, increase lamp service life of 30,000 hours and better visual acuity to improve work space illumination and worker safety.

Rose proposed and implemented with MRF maintenance staff a lighting redesign of existing HPS lighting; by replacing the existing 400 watt HPS industrial high-bay fixtures with new six-lamp T5HO enclosed High-Output fluorescent high-bays and by replacing existing 250 watt HPS low-bay fixtures with 2-lamp enclosed vapour-tight luminaires (see Photo 8).

Existing occupancy sensor lighting controls were found in several sorting rooms with the exception of Residential Sorting room which had its original occupancy sensor removed when a second conveyer line was added. Several of these occupancy sensors were found in different levels of inoperable condition or bypassed by maintenance. Rose proposed and implemented with maintenance staff the replacement of old sensors with new dual technology occupancy sensor and the commissioning of new lighting controls. New occupancy sensors were also added to the Residential Sorting room, staff washrooms and in staff lunchroom.

Existing incandescent and compact fluorescent EXIT signs were also upgraded as part of Rose recommendations. Existing EXIT signs were retrofitted with new LED (Light Emitting Diode) retrofit kits or entirely replace with new LED EXIT signs. Existing EXIT signs with battery packs and emergency lighting heads were upgraded with LED retrofit kits.

Lighting is installed and operating correctly. Lighting Retrofit Field Commissioning Report can be found in Appendix B. The report includes sections; Lighting Measure Commissioning Report, Lighting Systems Verification Form, Lighting Illuminance Readings Verification Form, Lighting Controls Commissioning Report, and Lighting Deficiency List.

Light illumination levels were also taken by Rose of existing lighting systems at pre-construction stage and at the post-construction stage with new lighting after fully operational; lighting levels were taken at 3'-0" elevation above finished floor using a Minolta T-1 Illuminance Meter. Pre-construction and post-construction readings have been recorded on Lighting Floor Plan E-2a. Copy of drawing E-2a can also be found in Appendix B.

Lighting documentation manual was reviewed and found to be complete. Documentation was provided to the MRF Maintenance personnel on November 2011. Manuals are complete; including as-built drawings of current design, equipment instruction manuals and specifications sheets, and warranty procedures for all lighting equipment supplied.

Savings Analysis:

There are two components of energy used by lighting: power consumption and hours of use.

Power consumption is determined by estimates based on historical data, manufacturer's published data and specifications, and third-party laboratory performance testing of equipment, and by established Ontario Hydro lighting reference guidelines used by Ontario Power Authority Save-on-Energy program.

The hours of use per year for savings calculation is based on data collected during the auditing phase for the lighting system in the different areas of the facility, and through interviews of maintenance staff and occupants on typical operating hours, and an estimate of occupancy utilization for each area for lighting control saving estimates.

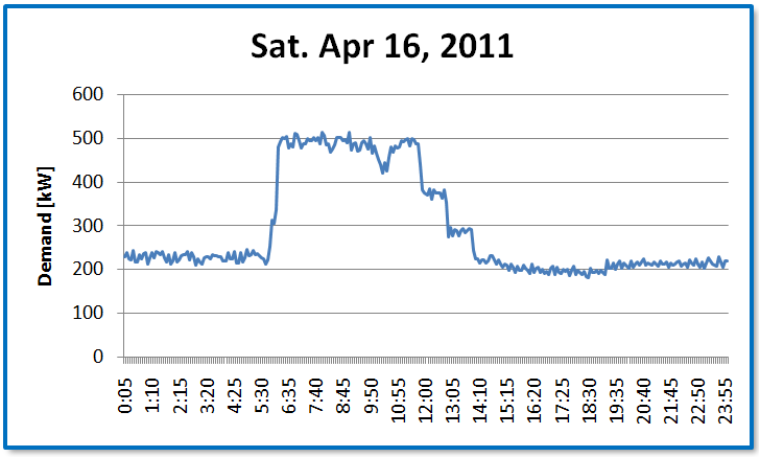
The lighting analysis assumed standard operating hours of 6:00 a.m. to 6:00 p.m. Monday to Friday for 250 days per year (less scheduled holidays), plus weekend operations for a maximum of 20-days per year. Weekend operation hours were assumed to be 7:00 a.m. to 3:00 p.m. for maintenance and MRF process recovery (make-up) for scheduled holidays.

Electrical profile analysis using 5-minute interval data downloaded from Guelph Hydro's main electric meter. Data confirmed weekday operations start between 5:00 a.m. to 6:00 a.m. in the morning and until 5:00 p.m. to 7:00 p.m. in the evenings depending on MRF activity. Weekend operations typically start around 6:00 a.m. and ran until 2:00 p.m. or 3:00 p.m. on some Saturdays. Furthermore, the analysis confirmed noticeable weekend activity for 19-Saturdays between May 1, 2010 and May 1, 2011, and for 13-Saturdays between May 1, 2011 and October 31, 2011. These findings further support our initial assumptions of weekday and weekend operating hours and were used in our post-construction savings analysis.

Table 2.2.1 - Typical operating hours used for lighting analysis:

Area	Hours of Use per Year
Bailing Area	3120
Process Conveyor Area	3120
Pre-Sort	3120
Pre-Commercial	3120
Residential Sort	3120
Commercial Sort	100
Secondary Sort	3120
Aluminum Recovery	2860
Manager's Office	1000
Meeting Room	500
Maintenance Shop	2860
Maintenance Office	3120
Electrical Rooms	3120
EXIT Signs	8760
All Night-light Circuits	8760

Graph 3: Example of Saturday hours of use for MRF



Note: Power is switched on at 5:30 a.m. and switched off at around 2:00 p.m.

Pre-construction and post-construction analysis and energy savings results are shown below. Cost savings are based on initial utility rates established at the Feasibility Study. The baseline year used in study was 2008 with an established electricity rate of $6.344 /kW for electricity demand, and 7.561 ¢/kWh for electricity consumption, and a natural gas rate of 42.5 ¢/m^3.

Table 2.2.2 Guelph MRF - Lighting Analysis (Before and After)

Measure	*Savings*				
	Fuel (cu-m)	*Electricity (kWh)*	*Demand (kW)*	*Other ($)*	*Total ($)*
Lighting (Before) Pre-Construction	*-186*	*54,432*	*13.1*	*$1,850*	*$6,895*
Lighting (After) Post-Construction	*-187*	*54,521*	*13.3*	*$1,850*	*$6,916*

Utility Rates	
Electricity ($/kWh)	*$0.076*
Electricity ($/kW)	*$6.344*
N. Gas ($/cu-m)	*$0.426*

As illustrated in above Table 2.2.2 lighting savings have increased based on minor changes done to the lighting system. Changes included replacement of one six-lamp T5HO luminaire with a three-lamp T5HO fixture by MRF Maintenance over catwalk area leading to Pre-Commercial Sorting Room and the addition of one 2-lamp fixture under sorting room open stairs in bailing area, and deletion of one occupancy sensor in Residential Sort room.

2.3 Building Automation System

Background:

The core mechanical HVAC systems in the Guelph MRF consist of:

- Seven Rooftop Package Units (RTUs), equipped with indirect gas heat and one or two stages of DX cooling.
- Two direct fired Make-Up Air units (MAUs); heat supplied with direct-fired burners.
- Eight Exhaust Fans (EFs), that remove air from the bailing and tipping areas.

Prior to the installation of the energy conservation measures, the equipment operated with only minimal controls in the form of simple room thermostats. These thermostats had no set back capability or disable functions, and therefore the systems ran continuously.

Analysis of the facility power quality audit shows that despite a stated operating schedule of 11 hours per day 5 days per week, the main power level never dropped below approximately 200 kW, which is a high level for an unoccupied facility.

To schedule and control the HVAC equipment, a Building Automation System (BAS) was installed to control all seven RTUs, both MUAs, all warehouse exhaust fans. Further, the electric baseboard heaters located in the washrooms and lunchroom are controlled.

Installation:

Make-up Air Units (MUA): The MUA units are required to provide ventilation air for both the tipping and bailing areas. These units operated continuously before the retrofit, with the heat being enabled anytime the outside air was below 64°F. Units are now scheduled to run during occupied times only, and heating is only enabled when the zone temperature is below 55°F during occupied periods, and 35°F during unoccupied periods. This schedule effectively eliminates unneeded heating and equipment operation, and results in both kWh and natural gas savings. This schedule will have no impact on the electrical demand savings, as the equipment is still operational during peak hours.

The safety interlock with of the MUA units with the exhaust fans (EF) has been maintained; so the failure of an EF will disable the respective MUA unit. An alarm system has been added to this; the BAS system monitors each of the exhaust fans and will alert maintenance or operational personal is the event of equipment failure.

The BAS system had been configured with trend logs to monitor key system parameters. In reviewing the trend logs, we can see the unit is operating as designed. The trend data for the operation of MUA 2/1 is shown below, for the week of January 4-10.

Table 2.3.1 - MUA Unit#2-1 Operation

1/4/2012	6:50:00	AM	On
1/4/2012	6:02:01	PM	Off
1/5/2012	6:50:00	AM	On
1/5/2012	6:02:01	PM	Off
1/6/2012	6:50:00	AM	On
1/6/2012	6:02:00	PM	Off
1/7/2012	6:50:00	AM	On
1/7/2012	3:02:00	PM	Off
1/9/2012	6:50:00	AM	On
1/9/2012	6:02:00	PM	Off
1/10/2012	6:50:00	AM	On
1/10/2012	6:02:01	PM	Off

Post Retrofit Weekly Hours: 63 Hours

It is noted that the MUA unit is now operating on schedule between the hours of 7:00 AM and 6:00 PM; whereas before the unit ran continuously. The operation of MUA Unit #2/2 is comparable to MUA Unit #2/1, and for brevity has not been included in this report.

The installation and operation of the HVAC controls on the MUA units was reviewed as part of the commissioning procedure. Any deficiencies with the hardware or operation were noted and corrected. Refer to the deficiency list for this history.

Rooftop Units: The seven rooftop packaged units, which provide both heating and cooling to offices and rooms in the tipping and bailing areas, are now controlled on the BAS. The programming will automatically switch from cooling to heating (a function that was manually controlled before retrofit) and will operated the units to maintain the space temperature between setpoints during occupied and unoccupied periods. The scheduling of these units has been setback during unoccupied periods. The BAS system has the functionality to override this setback with a push button located in each of the zones.

As with the MUA units, the RTUs have been configured with digital trend logs to monitor key system parameters. The trend data for the operation of RTU 3/2 is shown below, for the day of January 10, 2012. Along with the fan operation, the BAS monitors supply air temperature, outside air temperature, heating call, cooling call, fan status, and filter status. Due to the amount of data available, only one day of fan operation is included, which shows compliance with the provided schedule.

Table 2.3.2 - RTU 3/2 Operation

10/1/2012	5:00:12	AM	On
10/1/2012	7:00:12	AM	Off
10/1/2012	7:04:18	AM	On
10/1/2012	9:47:47	AM	Off
10/1/2012	9:54:07	AM	On
10/1/2012	10:06:08	AM	Off
10/1/2012	10:12:06	AM	On
10/1/2012	10:24:46	AM	Off
10/1/2012	10:31:07	AM	On
10/1/2012	10:41:37	AM	Off
10/1/2012	10:48:17	AM	On
10/1/2012	10:54:47	AM	Off
10/1/2012	11:01:07	AM	On
10/1/2012	11:35:47	AM	Off
10/1/2012	11:44:37	AM	On
10/1/2012	11:52:47	AM	Off
10/1/2012	11:59:27	AM	On
10/1/2012	12:06:07	PM	Off
10/1/2012	12:13:05	PM	On
10/1/2012	6:00:00	PM	Off

Post Retrofit Daily Hours: 12.25 Hours

Reviewing the data from the BAS trend logs, we notice that the unit cycles on and off during the occupied period, from 5:00 AM to 6:00 PM. This cycling is based on the zone demand. If the zone is satisfied, the unit will turn off unit the temperature setpoint drops below (of above) the zone temperature setpoint for the space. This is a change from original operation where the equipment ran continuously.

The operation of the other RTUs is comparable to RTU 3/2, and for brevity has not been included in this report.

A BAS commissioning guideline was produced before construction began to provide a scope of work for the installing subcontractors. The objectives of this plan are to document the actions and deliverables the subcontractor. The intent of the commissioning plan is to ensure, through testing, verification and documentation, that a complete and functional controls system is installed. Refer to Appendix C for Building Automation System – Commissioning Guide and Appendix D for Building Automation System - Field Commissioning Report.

The installation and operation of the HVAC controls on the RTU units was reviewed as part of the commissioning procedure. Any deficiencies with the hardware or operation were noted and corrected. Refer to the deficiency list for this history.

Baseboard heaters: There are a number of electric baseboard heaters installed in the MRF, specifcally in the mens's and women's bathroom, the hallway and in the lunch room. Before the BAS retrofit, these heaters operated with a line voltage thermostat, with not setpoint control or setback ability. The BAS system installed now controls the operation of these baseboard heaters. The temperture setpoint has been limited to 69F with a night setback of 50F. This control strategy eliminates unessesary operation.

The washroom exhaust fan works in conjuction with the electric baseboard heaters. The BAS system enables or disables these fans based on the building master schedule. This saves electrical power when the fan is disabled, and electical power from the electric heaters that no longer have to heat up cold makeup air.

Table 2.3.3 - Lunch Room Heater Operation

4/1/2012	7:00:10	AM	On
4/1/2012	6:00:00	PM	Off
5/1/2012	7:00:15	AM	On
5/1/2012	3:10:46	PM	Off
6/1/2012	7:00:15	AM	On
6/1/2012	12:20:02	PM	Off
7/1/2012	7:00:15	AM	On
7/1/2012	3:00:00	PM	Off
9/1/2012	4:33:24	AM	On
9/1/2012	6:00:00	PM	Off
10/1/2012	7:00:15	AM	On
10/1/2012	1:11:48	PM	Off

Post Retrofit Weekly Hours: 52.1 Hours

The setback operation of the heater can be observed during the morning of the January 9th. As well, the disable of the heater (due to achieving setpoint) can be observed on January 6th. The installation and operation of the HVAC controls on the Baseboard heater was reviewed as part of the commissioning procedure. Any deficiencies with the hardware or operation were noted and corrected. Refer to the deficiency list for this history.

Savings:

Make-up Air Units (MUA): Savings from the MUA units will be two-fold: The electric savings motors due to the reduced run-time of the MUAs and EFs, and the natural gas savings due to the reduced operational time on the on the burners. As this equipment is still operational during business hours, we anticipate no demand savings.

Table 2.3.4 – MUA BAS Savings

MUA# 2-1, 2-2, EF1-8	Usage and Savings			
	Fuel (cu-m)	Electricity (kWh)	Demand (kW)	Total ($)
Pre-Retrofit	321,563	341,007	0	
Post-Construction	190,015	208,487	0	
Utility Savings	131,548	132,520	0	$65,928

Rooftop Packaged A/C Units (RTU): Savings from the RTU units will be two-fold: The electric savings motors due to the reduced run-time of the supply fan return fan, and the natural gas savings due to the reduced operational time on the on the burners. As this equipment is still operational during business hours, we anticipate no demand savings.

Table 2.3.5 – RTU BAS Savings

RTU	Usage and Savings			
	Fuel (cu-m)	Electricity (kWh)	Demand (kW)	Total ($)
Pre-Retrofit	56,557	95,949	0	
Post-Construction	43,656	57,267	0	
Utility Savings	12,901	38,691	0	$8,408

Baseboard heaters and Washroom Exhaust Fan: Savings are computed based on an assumed heater capacity and a reduction in run-time achieved through scheduling and temperature setbacks, as well as electrical savings from reduced operation of the bathroom exhaust fans.

Table 2.3.6 – Baseboard Heaters and WR Exhaust Fan Savings

Baseboard heaters	Savings			
	Fuel (cu-m)	Electricity (kWh)	Demand (kW)	Total ($)
Pre-Retrofit	0	220,000	0	
Post-Construction	0	127,500	0	
Utility Savings	0	92,500	0	$9,109

APPENDIX A

POWER FACTOR CORRECTION
FIELD COMMISSIONING REPORT

City of Guelph Material Recovery Facility

Energy Management Contract
Commissioning Plan
Power Factor Correction

Project Manager:	Peter Daldoss	*Signature*
Commissioning Agent:	Lou Pascoa	*Signature*
Owner Representative:	Frank Merkley	*Signature*

Before Installation:

- Review design document. Identify any special requirements.
- Take photographs of existing situation.

After Installation:

- Take photographs of installed retrofit.
- Collect utility bills and calculate performance
- Verify that scope of work is complete and note deficiencies. Specifically note the following:
  - Confirm provision of 250 kVAr, 600 volt automatic harmonically filtered capacitor bank on the existing housekeeping pad to the left of the main service. Note serial number of equipment.
  - Confirm specification of capacitor bank as per shop drawings.
  - Wiring diagram on inside of enclosure.
  - Note that equipment has CSA and/or UL approval certification.
  - Three LED, one per phase, door mounted to indicate a low capacitance and/or blown fuse condition
  - The enclosure shall be NEMA or EEMAC rated, fabricated from 12 gauge cold rolled steel.
  - An internal grounding lug shall be provided in each cubicle.
  - Removable lifting eyes shall be provided.
  - Capacitor cells shall be accessible for visual inspection and replacement from the front
  - The enclosure door shall have a three point latch with key locking handle.
  - All wiring connections shall be mechanically fixed with nut or screw.

- Include for removal and disposal of existing 225 kVAr 600 volt Powerspec capacitor bank. ✓
- Nameplates and Identification
    - Special warning plates shall be applied to the enclosure for hazard alerting personnel. ✓
    - Nameplate ratings of the completed system shall be applied to the door of the enclosure. ✓
- Provide 5 copies of the documentation manuals (TO BE PROVIDED) → ELECTRONIC COPY.
- Warranty - One year warranty parts and labour and 3 year manufacturer's pro-rated cell warranty ✓

Commissioning Report to Include:

- Inspection notes
- Performance calculations.

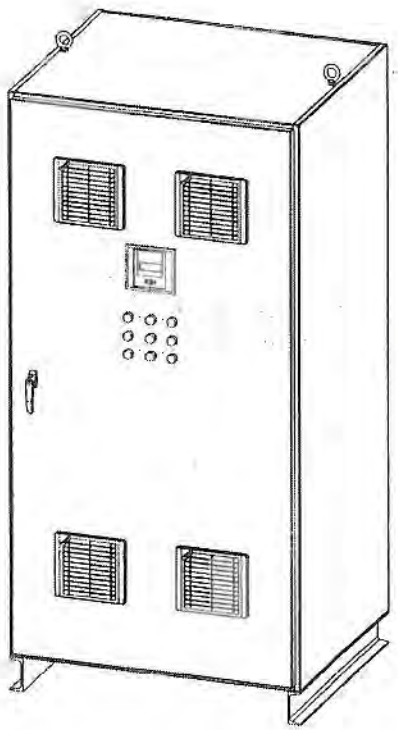
1. INSTALLATION CLEAN, ON EXISTING HOUSEKEEPING PAD.
2. PRESENT READING AT FRONT PANEL 0.97 PF WITH ALL 250 KVAR THREE CAPACITOR BANKS "ON" - STEP #1, #2, #3 -

604 V SERVICE FEEDER VOLTAGE 357 V to GROUND 375 KW. AT 403 AMPS	FRONT PANEL READINGS

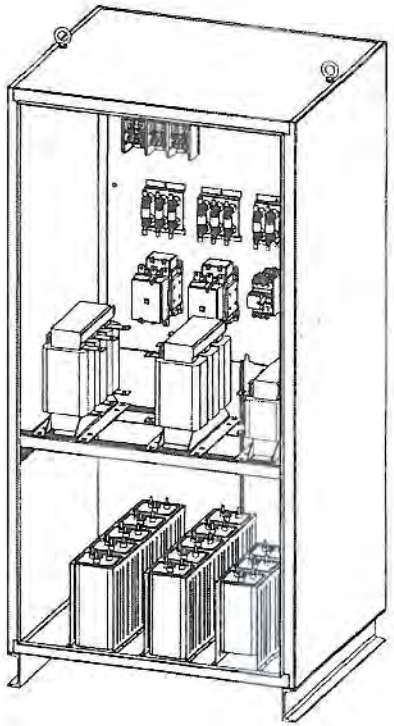
STEP #1 = 100 KVAR
STEP #2 = 100 KVAR
STEP #3 = 50 KVAR

3. Power factor without PF correction ~ .75 PF

1-P



OUTSIDE VIEW



DOOR(S) REMOVE

11/3/2011

FILTERED CAPACITOR BANK
250kVAR (2X100+1x50) @ 600V
PALP02506.3A0B01-B
SHORT CIRCUIT CURRENT: 50kA

GENERAL LAYOUT

Phone: (514) 333-8392
Fax: (514) 333-8395
Email: info@powersurvey.com

PROJECT: CITY OF GUELPH
POWER FACTOR SERVICES

P. 1of4

SCALE: N/A

REV.	DATE	BY
0	10-MAR-11	CL

APPROVED BY

Sylvain Lanoue
105183
QUÉBEC

APPROVED BY

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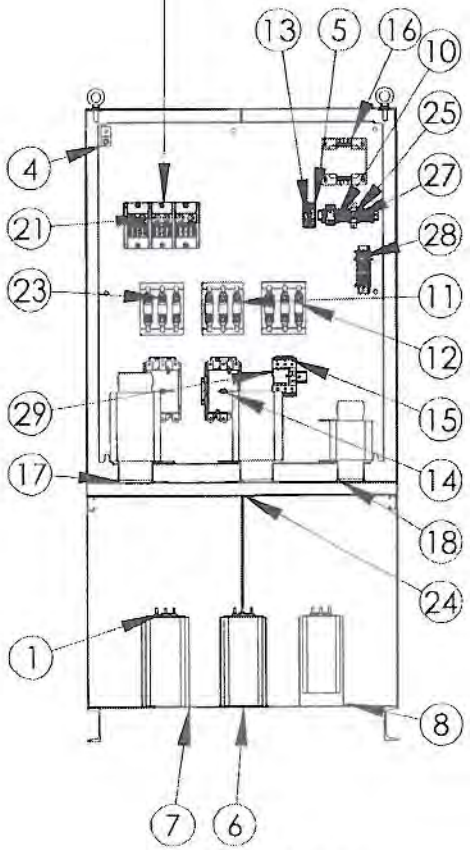
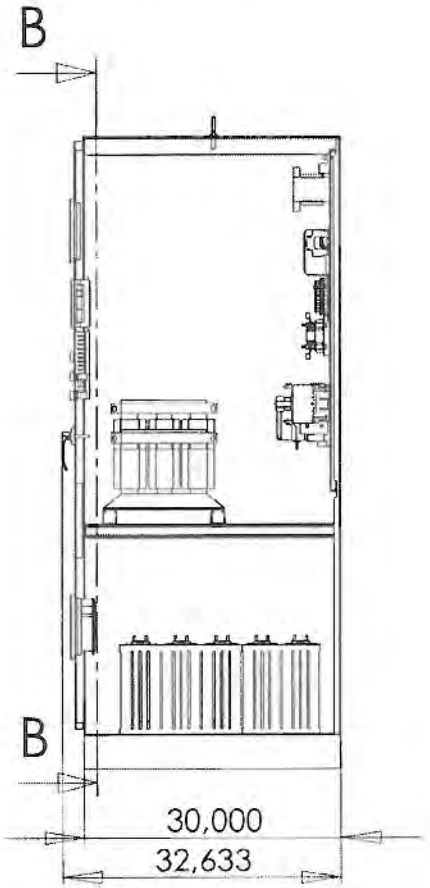
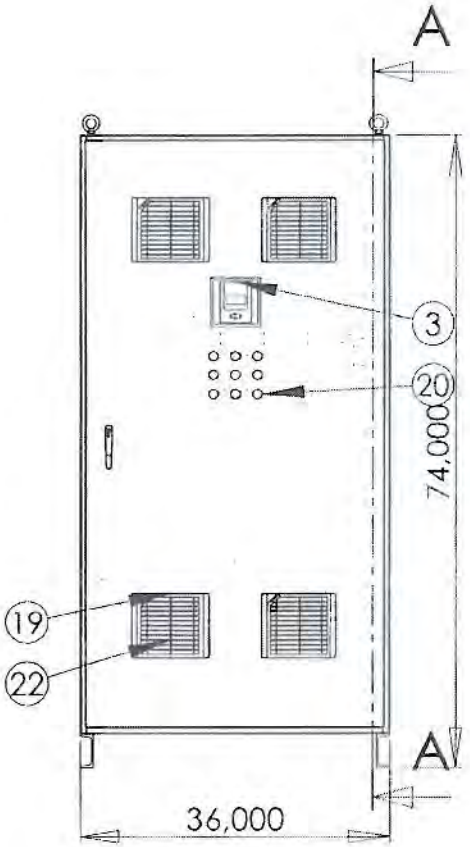
CABLE ENTRY: 2 x #4AWG-500MCM PER PHASE



CUT B-B



CUT A-A



4/3/2011

FILTERED CAPACITOR BANK
250kVAR (2X100+1x50) @ 600V
PALP02506.3/0801-B
SHORT CIRCUIT CURRENT: 50kA

LAYOUT

Phone: (514) 333-8392
Fax: (514) 333-8395
Email: info@powersurvey.com

PROJECT: CITY OF GUELPH
POWER FACTOR SERVICES

P. 2of4

SCALE: N/A		
REV.	DATE	BY
0	10-MAR-11	GL

APPROVED BY:

Sylvain Lanoue
105167
QUEBEC

APPROVED BY:

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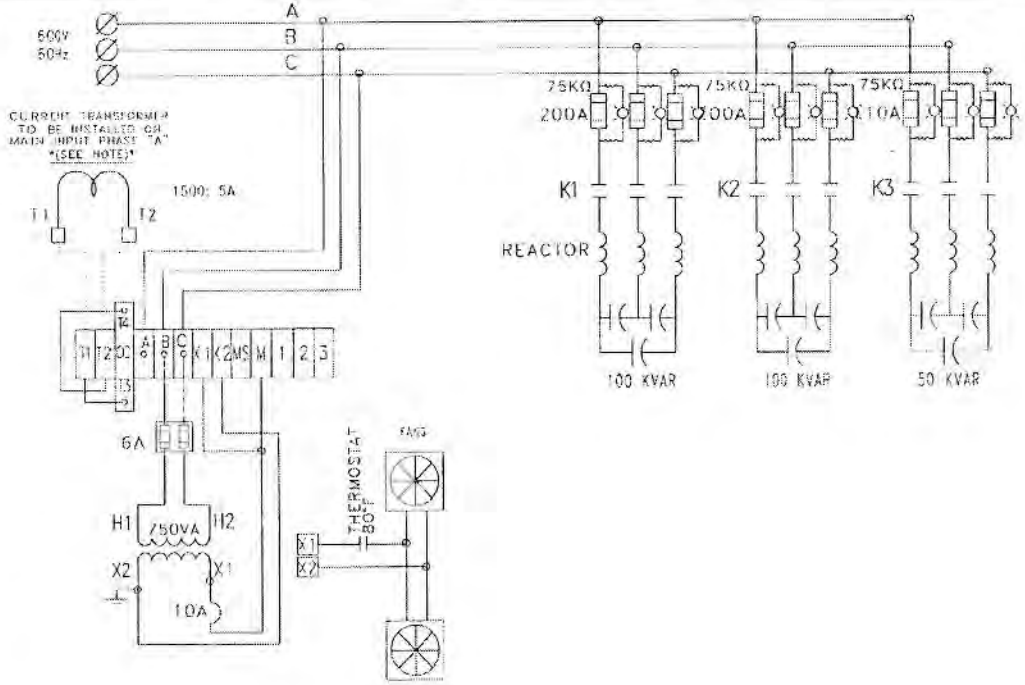

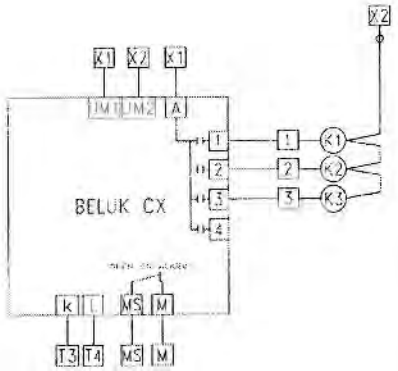

WARNING :
REVERSAL OF THE CT POLARITY
STEP 1) REMOVE THE GREEN SHORTING BLOCK BETWEEN T3 & T4
STEP 2) SWITCH T3 & T4 LEAD ON THE CONTROLLER SIDE
STEP 3) RE INSERT THE GREEN SHORTING BLOCK BETWEEN T3 & T4
NOTE:
IF THE GREEN SHORTING BLOCK IS INSERTED BETWEEN T3 & T4, THE CURRENT CIRCUIT IS OPEN.
IF THE GREEN SHORTING BLOCK IS REMOVED BETWEEN T3 & T4, THE CURRENT CIRCUIT IS CLOSED

BEFORE HANDLING CAPACITORS
* the capacitor could be charged
* for your own safety:
  1. switch off power to capacitor bank
  2. wait 1 minute before touching the capacitor terminal
  3. with a jumper, short-circuit the capacitor terminals between each phase.

NOTE! CT INSTALLATION
THE CURRENT TRANSFORMER MUST BE INSTALLED AT THE MAIN ENTRANCE FEEDIND THE TOTAL PLANT LOAD INCLUDING THE CAP BANK ON PHASE "A".

FILTERED CAPACITOR BANK
250kVAR (2X100+1x50) @ 600V
PALP02506.3/0B01-B
SHORT CIRCUIT CURRENT: 50kA

ELECTRICAL DIAGRAM

Phone: (514) 333-8392
Fax: (514) 333-8395
Email: info@powersurvey.com

PROJECT
CITY OF GUELPH
POWER FACTOR SERVICES

P. 3of4

REV.	DATE	BY
0	10-MAR-11	GL

SCALE: N/A

APPROVED BY:

Sylvain Lanoue
105167
QUEBEC

APPROVED BY:

11/3/11

ITEM NO.	QTY.	DESCRIPTION	MANUFACTURER	CAT. #
1	10	CAPACITOR 20kVAR @ 600V (HIGH HARMONIC APPLICATION)	AEROVOX	AMP0020I33S
2	3	CAPACITOR 16.7kVAR @ 600V (HIGH HARMONIC APPLICATION)	AEROVOX	AMP00167I33S
3	1	POWER FACTOR CONTROLLER, 4 STEPS	BELUK	BLR-CX-04R
4	1	MECHANICAL LUG 1x #6AWG-350MCM	BURNDY	KA31U
5	1	CONTROL FUSE BLOCK DOUBLE POLE, 600V	BUSSMAN	BC6032S
6	1	ENCLOSURE 70"H x 36"W x 30"D, NEMA 01	CUSTOM METAL	CMC01H70W36D30
7	2	CAPACITOR RACK (100 kVAr)	CUSTOM METAL	N/A
8	1	CAPACITOR RACK (50 kVAr)	CUSTOM METAL	N/A
9	1	DOCUMENT HOLDER	CUSTOM METAL	N/A
10	1	THERMOSTAT 120VAC, 15AMP, N.O.	DBK	FGT200
11	6	FUSE 200A, 600V, CLASS T FAST ACTING	EDISON	TJS200
12	3	FUSE 110A, 600V, CLASS T FAST ACTING	EDISON	TJS110
13	2	CONTROL FUSE 6A	EDISON	HCTR6
14	2	CONTACTOR	GE	CK75CA311J
15	1	CONTACTOR, PRE-INSERTION TYPE	GE	CSC55A310J
16	1	CONTROL POWER TRANSFORMER 600V-480V/120V, 750VA	HAMMOND POWER SOLUTIONS	SP750ACP
17	2	THREE PHASE IRON CORE REACTOR - 100kVAR@600V	HANS VON MANGOLDT	191073
18	1	THREE PHASE IRON CORE REACTOR - 50kVAR@600V	HANS VON MANGOLDT	191075
19	4	VENTILATION OPENING	HOFFMAN	TEP06
20	9	PILOT LIGHT, RED LED	LOVATO	8LP2T 1LE4
21	1	POWER DISTIBUTION BLOCK 2x #4AWG-500MCM	MARATHON	1453586
22	2	FAN 32W, 220CFM C/W FINGER GUARD PROTECTION (BOTTOM INSTALLATION)	NMB TECHNOLOGIES	5915PC-12T-B30
23	3	FUSE HOLDER 200A, 600V	POWER SURVEY	PS200T
24	2	CANSTRUT	POWER SURVEY	N/A
25	1	SINGLE POLE CONTROL BREAKER, 10A, 120V	SPRECHER SCHUH	L8-10/1/C
26	1	WIRE DUCT ON DOOR	T&B	TY-DUCT SERIES
27	1	FANS & PHASES TERMINAL STRIP	WEIDMULLER	SAK-SERIES TS35
28	1	DOOR COMPONNENTS TERMINAL STRIP	WEIDMULLER	SAK-SERIES TS35
29	1	DIN MOUNTING RAIL	WEIDMULLER	N/A
30	1	SPLIT CORE CURRENT TRANSFORMER: 1500:5A	ITI	601T152

Z:\dessins DWG\basse tension\CITY OF GUELPH\PALP02506.3-0B01-B\PALP 2x100+1x50 600v City of Guelph H70L36P30

FILTERED CAPACITOR BANK
250kVAR (2X100+1x50) @ 600V
PALP02506.3/0B01-B
SHORT CIRCUIT CURRENT: 50kA

BILL OF MATERIAL

Phone: (514) 333-8392
Fax: (514) 333-8395
Email: info@powersurvey.com

PROJECT
CITY OF GUELPH
POWER FACTOR SERVICES

P. 4of4

SCALE: N/A

REV.	DATE	BY
0	10-MAR-11	GL

APPROVED BY:

Sylvain Lanoue 105167 QUÉBEC

APPROVED BY:

APPENDIX B

LIGHTING RETROFIT
FIELD COMMISSIONING REPORT

Lighting Measures Commissioning Form

Project Name: **#1515 City of Guelph - Material Recovery Facility**

Address: 110 Dunlop Drive, Guelph, ON

Date: August 16, 2011

Commissioning Start Date: August 16/11

Commissioning Completion Date: August 16/11

Present During Commissioning:	Name	Telephone No.
Owner Respresentative(s):	Frank Merkley. xtn #2062	519-822-1260
	David Osborne xtn #2062	—11—
Contractor Respresentative(s):	David Osborne. xtn #2062	519-822-1260.
Rose Representative(s):	Lou Pascoa	647-789-2601

General Lighting Retrofit Measures

Item	Description	Yes	No	N/A
1	All Lighting Retrofit Work Complete as Per Specification	☑	☐	☐
2	All Retrofit Fixtures Cleaned *(Reflectors, Interiors and Lenses)*	☐	☐	☑
3	All New Material UL Listed and CSA/cUL Certified	☑	☐	☐
4	As-built Drawings Updated/Included and Provided to Rose	☑	☐	☐
5	Local Authority Electrical Safety Inspection Certificates Provided	☑	☐	☐
6	Material Waste and Recycling			
	a) Site Waste Disposal: Complete	☑	☐	☐
	b) All Cardboard and Packing Materials Recycling: Complete	☑	☐	☐
	c) Lamp Recycling: Complete and Report Provided	☐	☐	☑
	d) Ballast Recycling: Complete and Report Provided	☐	☐	☑
7	Deficiencies List Generated *Date:* August 16/11	☑	☐	☐
8	Deficiencies List Completed *Date:* November 14/11	☑	☐	☐
9	All Data and Related Forms/Report Included	☑	☐	☐
10	Sytems / Equipment Turned Over Operational	☑	☐	☐

Lighting Measures Commissioning Form

New Lighting Installation

Item	Description	Yes	No	N/A
11	New Luminaire Work Complete as Per Specification	☑	☐	☐
12	Final Unit Counts Submitted and Confirmed	☑	☐	☐
13	New Luminaire(s) Grounded as per NEC	☑	☐	☐
14	Ballast Dissconnect Installed *(on Feeds Over 150V AC)*	☑	☐	☐
15	Luminaire Installation Using NEC Approved Mounting Methods	☑	☐	☐
16	All Boxes, Panel(s) and Conduit Supported as per NEC	☑	☐	☐
17	All Box and Panel Covers Installed	☑	☐	☐

New Lighting Controls

Item	Description	Yes	No	N/A
18	**New Lighting Control Work Complete as Per Specification**	☑	☐	☐
19	**Ultrasonic Occupancy Sensors (12A-1)**			
	a) New Occupancy Sensors Work Complete as Per Specifications	☑	☐	☐
	- Time Delay Set (15 minutes)	☑	☐	☐
	- Sensitivity Adjustment Check for Workspace	☑	☐	☐
20	**Dual Technology Occupancy Control (12C-1)**			
	a) New Occupancy Sensors Work Complete as Per Specifications	☑	☐	☐
	- Manual Switching Test (*ON/OFF*)	☑	☐	☐
	- Time Delay Set (30 minutes)	☑	☐	☐
	- Sensitivity Adjustment Check for Workspace	☑	☐	☐
21	**Dual Technology Wall Switch Occupancy Control (12D-2)**	☑	☐	☐
	a) New Occupancy Sensors Work Complete as Per Specifications	☑	☐	☐
	- Manual Switching Test (*ON/OFF*)	☑	☐	☐
	- Time Delay Set (30 minutes)	☑	☐	☐
	- Sensitivity Adjustment Check for Workspace			
22		☐	☐	☐
		☐	☐	☐
		☐	☐	☐

Measure Sign Off

Item	Description	Yes	No
23	Final Retrofit Counts Submitted and Confirmed	☑	☐
24	Operations and Maintenance Manuals Submitted (Lighting)	☑	☐
25	Final Acceptance / Measure Signed Off	☑	☐

Lighting Measures Commissioning Form

Comments / Notes

1. South west Ring Room Exit Light Out. - David is going to check breaker okay. - circuit needs to be traced out for correct. - Existing Fixture not retrofitted.

2. Fixture south of skylight grids 4E - 4F found with 2-lamps disconnected or burnt-out. David & Ryan to replace lamps & check ballast connections.

3. Residential Sort lighting controls - David didn't install one occupancy sensor near south-east door leading to platform - David felt that sensor wasn't needed in this area. Surplus sensor to be used in PRE-COOL Sorting room since existing wall-switch sensors are not working.

4. As-built drawing to be generated by Rose from field mark-ups.

5. Operations and maintenance manual to be provided by Rose.

Acknowledged & Acceptance:

Electrical Contractor: _____ (Name) _____ (Date)

Rose Representative: L. Pascoe (Name) Aug. 16/11 (Date)

Commissioning Agent / Customer Representative: D. Ishore (Name) Aug 16/11 (Date)

Lighting Systems Verification Form

Project Name: **#1515 City of Guelph - Material Recovery Facility**
Address: 110 Dunlop Drive, Guelph, ON
Date: August 16/11

Item	Description	Date Checked	Comments
1	Verify quanities and types of fixtures installed coincide with contract documents.	Aug. 16/11	OK.
2	Check ballasts and lamps in various areas to ensure compliance contract documents.	—	N/A.
	a) Confirm compatibility of ballast-lamp combinations.	—	N/A.
3	Verify that luminaires are mounted as per plans and specifications		
	a) Verify layouts luminaire by type.	Aug 16	OK.
	b) Verify luminaire mounting height	↓	OK.
	c) Verify fastening methods of suspended luminaires	↓	OK.
	d) Verify T-bar supports for recessed luminaires	↓	N/A.
4	Verify wiring types for compliance with specifications and codes.	Aug 16	OK.
5	Check quantities, lengths and fastening of AC-90 or specified cables used.	—	N/A.
6	Check luminaires for damages, lamped and cleaned.	Aug 16	OK.
7	Verify connections to luminaires. (Spot Check)	Aug 16	OK.
8	Verify opration of all luminaires.	Aug 16	OK.
9	Verify luminaire switching as per plans.	Aug 16	OK.
10	Record locations of any burned out lamps.	Aug 16	2 lamp TF Grid. 4E to 4F.
11	Record illumination levels indoors (and outdoors if specified);		
	a) Illumination to be measured in several locations per area / room provide an average level calculation.	Aug. 16.	
	b) Illumination readings to be taken at 30" A.F.F. (900 mm).	↓	
	c) Submit the test results to Rose and Commissioning Agent.	↓	
	Note: Attached above mentioned test results to this Form if tests and measurements are applicable.	Aug 16	See Drawing. E-2

Remarks / Comments

Lighting Systems Verification Form

Remarks / Comments *(continued)*

Acknowledged:

Electrical Contractor: _____ *Name* _____ *Date*

Rose Representative: _____ *Name* _____ *Date*

Commissioning Agent / Customer Representative: _____ *Name* _____ *Date*

Lighting Illuminance Readings Verification Form

Project Name: **#1515 City of Guelph - Material Recovery Facility**
Address: 110 Dunlop Drive, Guelph, ON

Date: August 16/11

LIGHTING ILLUMINANCE READINGS

No.	Room / Area	Initial Lux (fc)	Final Lux (fc)	Comments
	See Drawing E-2a			
	For before & After light			
	Levels. taken a 1m A.F.F.			

Lighting Illuminance Readings Verification Form

LIGHTING ILLUMINANCE READINGS *(continued)*

No.	Room / Area	Initial Lux (fc)	Final Lux (fc)	Comments

Remarks / Comments *(continued)*

Acknowledged:

Electrical Contractor: _____ *Name* _____ *Date*

Rose Representative: G Pascon *Name* Aug. 16/11 *Date*

Commissioning Agent / Customer Representative: D Shaw *Name* Aug 16/11 *Date*

Lighting Controls Commissioning Report

Project Name: **#1515 City of Guelph - Material Recovery Facility**
Address: 110 Dunlop Drive, Guelph, ON

Date: August 16/11

No	Room / Area	Retrofit Code No.	Drawing No.	Type (PIR, ULT, SW)	Model No.	Time Delay Set (30 min.)	Confirmed (Yes/No)	Comments
1	RESIDENTIAL SORT	12C-1	E-3	Dual Tech.	DT-200	20 min	YES	
2	RESIDENTIAL SORT	12C-1	E-3	Dual Tech.	DT-200	20 min	YES	SENSOR RELOCATED.
3	RESIDENTIAL SORT	12C-1	E-3	Dual Tech	DT-200	N/A	N/A.	DAVE DELETED SENSOR.
4	COMM SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
5	COMM SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
6	SECONDARY SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
7	SECONDARY SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES.	SENSOR RELOCATED.
8	RING SORT.	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
9	RING SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES.	
10	PRE-SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
11	PRE-SORT	12C-1	E-3	Dual Tech	DT-200	20 min	YES	
12	MALE WASHROOM	12D-2	E-3	DT-SW	DT-100	20 min	YES	WALL-SWITCH SENSOR 347V
13	FEMALE WASHROOM	12D-2	E-3	DT-SW	DT-100	20 min	YES	WALL-SWITCH SENSOR 347V
14	LUNCHROOM	12A-1	E-3	ULT	WT-2200	20 min	YES	
15	LUNCH RM. KITCHEN	12A-1	E-3	ULT	WT-2200	20 min	YES	RELOCATED TO KITCHEN ENT.

Lighting Controls Commissioning Report

No	Room / Area	Retrofit Code No.	Drawing No.	Type *(PIR, ULT, SW)*	Model No.	Time Delay Set *(30 min.)*	Confirmed *(Yes/No)*	Comments

Remarks / Comments *(continued)*

Acknowledged:

Electrical Contractor: _____ *Name* _____ *Date*

Rose Representative: _____ *Name* _____ *Date*

Commissioning Agent / Customer Representative: _____ *Name* _____ *Date*

Lighting Deficiency List

Project Name: **#1515 City of Guelph - Material Recovery Facility**
Address: 110 Dunlop Drive, Guelph, ON
Date: AUGUST 16, 2011
List Updated on: November 14, 2011 By: L. PASCOA

No	Description	Status	Action Required	By Whom	Due Date	Initials When Complete
1	SP-15 FIXTURE AT GRID LOCATIONS.	OPEN	DAVID TO REPLACE LAMPS	MAINT.	NOV. 14/11	LP.
2	4F-4F FOUND WITH BURNT-OUT	CLOSED	& CHECK BALLAST CONNECT'N	(DAVE)		
3	LAMPS 2x T5HO					
4						
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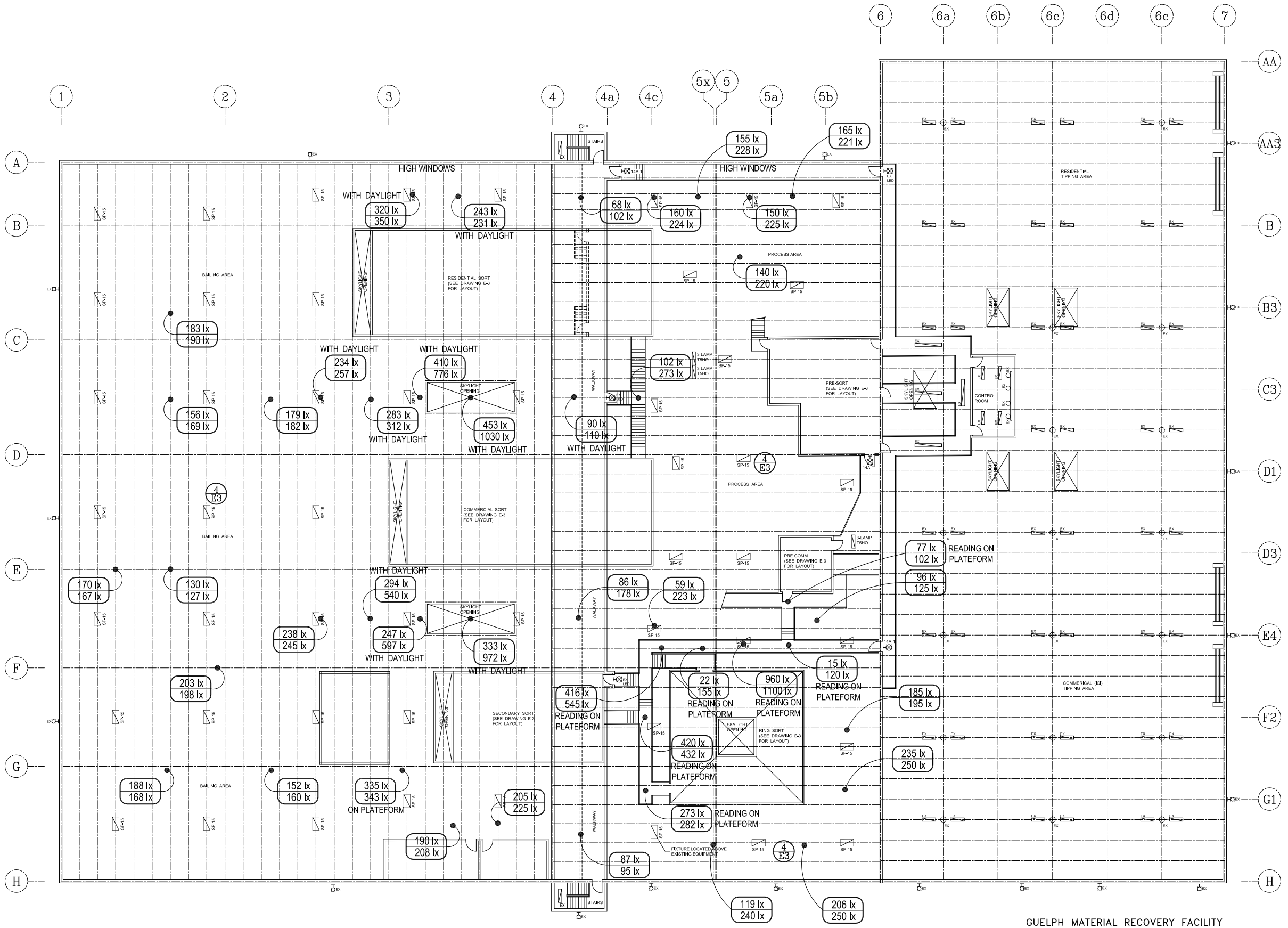

GUELPH MATERIAL RECOVERY FACILITY
UPPER LEVEL – LIGHTING PLAN

0 1m 5m 10m 15m

DRAWING NOTES

1. DRAWINGS SHALL BE READ IN CONJUCTION WITH ALL SECTIONS AND APPENDICES OF THE LIGHTING SUBCONTRACTOR SPECIFICATIONS FOR GUELPH MATERIAL RECOVERY FACILITY PROJECT #1515.
2. REFER TO DRAWING E-3 FOR GENERAL NOTES AND RETROFIT SCHEDULE.

Contractors shall verify all dimensions at the job.

No.	Revision	Date

LIGHTING LEGEND

- EX — EXISTING FLUORESCENT LUMINAIRE – TO REMAIN, RETROFIT AS DIRECTED
- New — NEW FLUORESCENT LUMINAIRE – RETROFIT AS DIRECTED
- WALL MOUNTED FLUORESCENT LUMINAIRE – RETROFIT AS DIRECTED
- EXISTING FLUORESCENT LUMINAIRE – TO BE REMOVED AND MAKE SAFE
- EX — EXISTING CEILING DOWNLIGHT OR HID LUMINAIRE – TO REMAIN AS FOUND
- EX — EXISTING WALL MOUNTED LUMINAIRE – TO REMAIN AS FOUND
- EX — INCANDESCENT LUMINAIRE – RETROFIT AS DIRECTED
- EX — EXISTING "EXIT" SIGN – CEILING OR WALL MOUNTED
- Remove — EXISTING LUMINAIRE – TO BE REMOVED AND MADE SAFE
- EX — EXISTING SINGLE POLE SWITCH
- EX — EXISTING DIMMER SWITCH
- New — NEW WALL SWITCH OCCUPANCY SENSOR – RETROFIT AS DIRECTED
- New — NEW DIMMER SWITCH SENSOR – RETROFIT AS DIRECTED
- NEW CEILING MOUNTED ULTRASONIC OCCUPANCY SENSOR – RETROFIT AS DIRECTED
- NEW CEILING MOUNTED PIR OCCUPANCY SENSOR – RETROFIT AS DIRECTED
- NEW WALL MOUNTED PIR OCCUPANCY SENSOR – RETROFIT AS DIRECTED
- NEW JUNCTION BOX C/W COVER TO POWER OCCUPANCY CONTROL
- NEW JUNCTION BOX C/W COVER AND OCCUPANCY POWER PACK OR SLAVE RELAY
- NEW DAYLIGHT SENSOR SKYLIGHT MOUNTED – RETROFIT AS DIRECTED
- CCT#1 — DENOTES LIGHTING CONTROL CIRCUIT NUMBER OR ZONE
- EX — EXISTING DEVICE OR FIXTURE TO REMAIN AS FOUND
- EM — DENOTES DEVICE ON EMERGENCY CIRCUIT TO REMAIN AS FOUND
- R#EM — REMOVE EXISTING FIXTURE AND MAKE CIRCUIT SAFE IF NOT REUSED
- 1/2Cr — DENOTES RETROFIT CODE – REFER TO RETROFIT SCHEDULE
- R#100 — DENOTES ROOM OR DOOR NUMBER
- New — PROVIDE NEW ACOUSTICAL CEILING TILE TO SIZE – MATCH EXISTING

96 lx / 125 lx — DENOTES LIGHT LEVELS TAKEN IN LUX PRE-CONSTRUCTION / DENOTES LIGHT LEVELS TAKEN IN LUX POST-CONSTRUCTION

AS-BUILT

No.	Issued	Date
3	LIGHTING AS-BUILTS	08/16/11
2	ISSUED FOR CONSTRUCTION	01/14/11
1	ISSUED FOR CLIENT APPROVAL	12/16/10

North

ROSE TECHNOLOGY INC.
5323 Eglinton Ave. West, Suite 100
Toronto, Ontario M9C 5K5
www.rosetechnology.com
Tel: 647-789-2601
Fax: 647-789-2557

Project
CITY OF GUELPH
Material Recovery Facility
Guelph, Ontario

Title
UPPER LEVEL
LIGHTING RETROFIT PLAN

Checked: L.P.	Date: NOV. 26, 2010	Revision:
Drawn: TBA	Scale: AS NOTED	
File Number: 1515	Dwg Number: E-2A	

APPENDIX C

BUILDING AUTOMATION SYSTEM COMMISSIONING GUIDE

Guelph MRF - Commissioning Procedure

1. During a typical commissioning procedure, the Building Automation System (BAS) subcontractors will sit with a representative from the General Contract in front of the active controls system.
2. A representative system from each type (rooftop unit, exhaust fan, MUA) will be reviewed in detail. If there are deficiencies that can be quickly resolved, another unit will be reviewed.
3. If during the commissioning procedure, a number of small deficiencies or any large deficiencies are noted, the commissioning testing will be completed but the commissioning exercise is deemed to have failed. At this point, the BAS subcontractor will return to site to correct the deficiencies, and another exercise will be scheduled.
4. With the GC representative overseeing the procedure, the BAS subcontract starts working through the list of actions, or operations, designed to simulate normal operation of the facility and equipment over a typical operational cycle. This is done by physically manipulating the inputs and sensors of the BAS system and then observing the resulting sequence.
5. If the operation is successful, (i.e. the results match the expectations) the operation is given a pass and we move to the next operation
6. Any unexpected results, or operations that are not applicable, are noted in the “Notes” section.

Rooftop Units (RTU)

There are a total of 7 rooftop package units installed on the three roof sections at the Guelph MRF. These units have a supply and return fan, an economizer, one (or two) stages of DX cooling, a heat enable and indirect-fired modulating gas heat. The economizer and modulating gas heat will remain under local control.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm. Occupied override available via pushbutton on thermostat
Occupied Setpoints: 75°F cooling setpoint, 69°F heating setpoint
Night heating override: 80°F cooling setpoint, 50°F heating setpoint

Notes: For the purposes of this report, we will look at two units picked randomly. It is assumed that if two units perform, that the rest of the units will be identical in operation.

RTU Number A/C 2-1

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the RTU system with Schedule off, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 81°F.	The supply and return (S&R) fans should start, followed shortly with the compressor call.	☑		
3	Move the room temperature back to the 72°F.	The compressor should disable, followed by the S&R fan disable after a minimum of 2 minutes.	☑		
4	Move the room temperature to 45°F.	The S&R fans should begin followed shortly with the call for heat.	☑		
5	Move the room temperature back to the 72°F.	The heat call should disable, followed by S&R fan disable after a minimum of 2 minutes.	☑		
6	Activate the 'Occupied Override' button	The S&R fans should start.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**

7	Set the Room temperature to 65°F.	This should trigger a call for heat.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		Dec.21, 2011. Override button pushed, not responding Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
9	Begin testing with the RTU in the unoccupied state with Schedule off.	Nothing on the system should be running.	☑		
10	Place the system in 'Occupied' by enabling the schedule	The S&R fans should start	☑		
11	Lower the room temperature to 65°F.	The system should change to for heating.	☑		
12	Raise the room temperature back to 72°F.	The call for heating should be removed.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
13	Raise the room temperature to 78°F	The system should call for cooling.	☑		
14	Removed second stage- this is internal to the unit.				Jan.12, 2012. Some A/C Units have two stages of cooling. This staging is being controlled with the unitary controls.
15	Lower the room temperature back to 72°F.	The system should disable the call for cooling.	☑		
16	With the system in the occupied status, set the room temperature to 78°F	Check the Fan status CT is on.	☑		

17	Disable the fan status manually to simulate a loss of amps on the RTU	The cooling call should be disabled. The BAS system should send an equipment failure alarm.	☑		
18	Place the Fan status in Auto	The system should resume normal operations	☑		
19	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
20	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
21	Simulate a loss of cooling event.	Unit should continue to operate, and a 'system' event should be generated	☑		
21	Simulate a loss of heating event.	Unit should continue to operate, and a 'system' event should be generated	☑		
22	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

RTU Number A/C 2-4

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the RTU system with Schedule off, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 81°F.	The supply and return (S&R) fans should start, followed shortly with the compressor call.	☑		
3	Move the room temperature back to the 72°F.	The compressor should disable, followed by the S&R fan disable after a minimum of 2 minutes.	☑		
4	Move the room temperature to 45°F.	The S&R fans should begin followed shortly with the call for heat.	☑		
5	Move the room temperature back to the 72°F.	The heat call should disable, followed by S&R fan disable	☑		

		after a minimum of 2 minutes.			
6	Activate the 'Occupied Override button	The S&R fans should start.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
7	Set the Room temperature to 65°F.	This should trigger a call for heat.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		Dec.21, 2011. Override button pushed, not responding Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
9	Begin testing with the RTU Schedule off.	Nothing on the system should be running.	☑		
10	Place the system in 'Occupied' by enabling the schedule	The S&R fans should start.	☑		
11	Lower the room temperature to 65°F.	The system should change to for heating.	☑		
12	Raise the room temperature back to 72°F.	The call for heating should be removed.	☑		
13	Raise the room temperature to 78°F	The system should call for cooling.	☑		
14	Removed second stage is internal		☑		Jan.12, 2012. Some A/C Units have two stages of cooling. This staging is being controlled with the unitary controls.
15	Lower the room temperature back to 72°F.	The system should disable the call for cooling. The S&R fans shall continue to run.	☑		

16	With the system in the occupied status, set the room temperature to 78°F	Check the Fan status CT is on.	☑		
17	Disable the fan status manually to simulate a loss of amps on the RTU	The cooling call should be disabled. The BAS system should send an equipment failure alarm.	☑		
18	Place the Fan status in Auto	The system should resume normal operations, and a 'return to normal' event should be generated.	☑		
19	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
20	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
21	Simulate a loss of cooling event.	Unit should continue to operate, and a 'system' event should be generated	☑		
21	Simulate a loss of heating event.	Unit should continue to operate, and a 'system' event should be generated	☑		
22	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

Makeup Air Units (MAU)

There are a total of 2 direct fired MAU units installed at the Guelph MRF; one installed on the Roof of the Tipping area, and one installed on a platform on the north end of the Bailing area. The supply fans on these units run during occupied periods, and heater is enabled based on space temperature. There are 8 rooftop exhaust fans that are hardwire interlocked to the MAU, so that if an exhaust fan fails, the associated MAU will shut down.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.
Occupied heating Setpoints: 55°F heating setpoint
Night Heating Setback: 35°F heating setpoint, 90°F Ventilation setpoint

Notes: For the purposes of this report, we will look at one units picked randomly. It is assumed that if this unit performs, the other unit will be identical in operation.

MAU Number 2/2

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the MUA system with schedule off, with average room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Enable two of the MUA unit overrides	MUA unit should change to "unoccupied override" and operate follow the applicable sequence.	☑		Dec.21, 2011. Unit currently not configured to operate when two RTU are enabled. **Jan. 12, 2011 – Corrected and operational.**
3	Disable one of the MUA overrides	MUA unit should change to "unoccupied" and operate follow the applicable sequence.	☑		Dec.21, 2011. Unit currently not configured to operate when two RTU are enabled. **Jan. 12, 2011 – Corrected and operational.**
4	Move the average of the room sensors to 30°F	The supply fans should start, followed by the BAS call for heating. The unit gas heat should then run, and the supply air temperature should increase. The exhaust fans serving the	☑		

		area (tipping, bailing) should start.			
5	Move the average of the room sensors to 50°F	The gas heat call should be removed. The supply fan should operate for a 2 minutes, then shut off.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
6	Move the average of the room sensors to 92°F	The supply fans should start. The exhaust fans serving the area (tipping, bailing) should start.	☑		
7	Begin testing the MUA system with schedule off, with average room temperature at 72°F.	Nothing on the system should be running.	☑		
8	Enable the schedule	The supply fans should start. The exhaust fans serving the area (tipping, bailing) should start.	☑		Dec.21, 2011. There is a long delay between the unit being enabled and the CT status showing operation. This is because the outside air dampers are opening.
9	Manually shut down one of the exhaust fans in the area being tested	MUA unit should immediately stop.	☑		Dec.21, 2011. The unit would shut down, but the heat was still being called by the BAS. **Jan. 12, 2011 – Corrected and operational.**
10	Move the average of the room sensors to 50°F	The BAS should call for heating. The unit gas heat should then run, and the supply air temperature should increase.	☑		
11	Disable the schedule	The gas heat call should be removed. The supply fan should operate for a few more minutes, and then stop.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger

					Jan. 12, 2011 – Corrected and operational.
12	Place the system in the occupied status	Check the Fan status CT is on.	☑		
13	Manually command a CT input on one of the exhaust fans to 'off'	The BAS system should send an equipment failure alarm.	☑		
14	Allow the CT input on one of the exhaust fans to return to 'auto'	A 'return to normal' event should be generated.	☑		
15	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
16	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
17	Simulate a loss of heating	Unit should continue to operate, and a 'system' event should be generated			Dec.21, 2011. These units do not have any functionality to sense a loss of heating. Operation N/A.
18	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

Baseboard Heating

There is a number of baseboard heater installed in the Guelph MRF. These heaters are as listed:

1. Men's Washroom
2. Women's Washroom
3. Hallway
4. Lunchroom

Each of these heaters has an independent temperature sensor, complete with override.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.
Occupied heating Setpoints: 55°F heating setpoint
Night Heating Setback: 35°F heating setpoint, 90°F Ventilation setpoint

Notes: For the purposes of this report, we will look at heater picked randomly. It is assumed that if this element performs, the other units will be identical in operation.

Lunchroom Electric Heater

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the system with Unoccupied mode, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 45°F.	The electric heating should turn on.	☑		
3	Move the room temperature back to the 72°F	The electric heating should turn off.	☑		
6	Set the Room temperature to 65°F. Set the Activate the 'Occupied Override button.	The electric heating should turn on.	☑		
7	Allow the occupied override time to elapse.	The electric heating should turn off.	☑		
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		

Washroom Exhaust

The Men's and Women's Washroom have exhaust fans that extract stale air during the occupied periods

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.

Notes: For the purposes of this report, we will look at fan picked randomly. It is assumed that if this element performs, the other unit will be identical in operation.

Women's Restroom Fan

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the system with Unoccupied mode.	The system should not be running.	☑		
2	Move system to Occupied mode.	The system should not be running.	☑		

9.11.1697.0

Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks: Wired	Tag	E-E	Software Checks: Cal.	Scale Range	Graph	Prog	Alarm	Commissioning Notes
Device 10100												
CO_2_TIPP NG 10100 AI1	0.60 ppm	AUTO	✓	✓	✓	✓	0	CO 4-20mA 0-200 ppm AIC	✓	✓		
N02_2_TIPPING 10100 AI2	0.03 ppm	AUTO	✓	✓	✓	✓	0	NO2 4-20mA 0-20 ppm AIC	✓	✓		
AC2-8_S 10100 BI4	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_FLT 10100 AI5	0.04 inH2O	AUTO	✓	✓	✓	✓	0	AC2-8 1-5V 0-1"WC	✓	✓		
AC2-8_SPT 10100 AI6	68.39 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-8_SAT 10100 AI7	60.37 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-4_S 10100 BI8	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_FLT 10100 AI9	0.08 inH2O	AUTO	✓	✓	✓	✓	0	AC2-4 1-5V 0-1"WC	✓	✓		
AC2-4_SPT 10100 AI10	58.25 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-4_SAT 10100 AI11	124.05 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
MUA2-2_S 10100 BI13	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-2_FLT 10100 AI14	0.01 inH2O	AUTO	✓	✓	✓	✓	0	MUA2-2 1-5V 0-1"WC	✓	✓		
MUA2-2_SPT1 10100 AI15	54.17 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
MUA2-2_SPT2 10100 AI16	46.82 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
EF2-1_S 10100 BI101	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-2_S 10100 BI102	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-3_S 10100 BI103	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-6_S 10100 BI106	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-8_S 10100 BI108	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_ENA 10100 BO1	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_HTG 10100 BO2	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_CLG 10100 BO3	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_ENA 10100 BO5	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_HTG 10100 BO6	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		

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Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range		Graph	Prog	Alarm
AC2-4_CLG 10100 BO7	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-2_ENA 10100 BO13	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-2_HTG_ENA 10100 BO14	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-1_C 10100 BO101	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-2_C 10100 BO102	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-3_C 10100 BO103	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-6_C 10100 BO106	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-8_C 10100 BO108	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
Device 10200												
EF2-9_S 10200 BI1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MWR_SPT 10200 AI2	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
FWR_SPT 10200 AI3	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
AC2-6_S 10200 BI4	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_FLT 10200 AI5	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-6 1-5V 0-1"WC		✓	✓	
AC2-6_SPT 10200 AI6	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
AC2-6_SAT 10200 AI7	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
MH_SPT 10200 AI8	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
VR_SPT 10200 AI9	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
ACS_S 10200 BI10	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_FLT 10200 AI11	1.00 inH2O	AUTO	✓	✓	✓	✓	0	ACS 1-5V 0-1"WC		✓	✓	
ACS_SPT 10200 AI12	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
ACS_SAT 10200 AI13	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
EF2-9_C 10200 BO1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MWR_HTR 10200 BO2	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
FWR_HTR 10200 BO3	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	

9.11.1697.0 (Continued from Page 2)

Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range		Graph	Prog	Alarm
AC2-6_ENA 10200 BO4	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_HTG 10200 BO5	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_CLG 10200 BO6	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
LR_HTR 10200 BO8	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
VR_HTR 10200 BO10	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_ENA 10200 BO11	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_HTG 10200 BO12	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_CLG 10200 BO13	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
Device 10300												
AC2-1_S 10300 BI1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-1_FLT 10300 AI2	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-1 1-5V 0-1"WC		✓	✓	
AC2-1_SPT 10300 AI3	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-1_SAT 10300 AI4	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-2_S 10300 BI5	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-2_FLT 10300 AI6	-1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-2 1-5V 0-1"WC		✓	✓	
AC2-2_SPT 10300 AI7	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-2_SAT 10300 AI8	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-3_S 10300 BI9	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-3_FLT 10300 AI10	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-3 1-5V 0-1"WC		✓	✓	
AC2-3_SPT 10300 AI11	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-3_SAT 10300 AI12	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
MUA2-1_S 10300 BI13	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-1_FLT 10300 AI14	1.00 inH2O	AUTO	✓	✓	✓	✓	0	MUA2-1 1-5V 0-1"WC		✓	✓	
MUA2-1_SPT1 10300 AI15	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
MUA2-1_SPT2 10300 AI16	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	

9.11.1697.0 (Continued from Page 3)

Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range	Graph	Prog	Alarm	
CO_1_BAILING 10300 AI101	1.28 ppm	AUTO	✓	✓	✓	✓	0	CO 4-20mA 0-200 ppm AIC	✓	✓		
NO2_1_BA LING 10300 AI102	0.38 ppm	AUTO	✓	✓	✓	✓	0	NO2 4-20mA 0-20 ppm AIC	✓	✓		
AC2-5_S 10300 BI103	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_FLT 10300 AI104	0.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-5 1-5V 0-1"WC	✓	✓		
AC2-5_SPT 10300 AI105	68.95 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-5_SAT 10300 AI106	70.37 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
ODA_T 10300 AI107	40.46 F	AUTO	✓	✓	✓	✓	3	Temperature 10K -35-240 d	✓	✓		
EF2-4_S 10300 BI108	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-5_S 10300 BI109	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-7_S 10300 BI110	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_ENA 10300 BO1	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_HTG 10300 BO2	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_CLG 10300 BO3	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_ENA 10300 BO5	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_HTG 10300 BO6	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_CLG 10300 BO7	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_ENA 10300 BO9	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_HTG 10300 BO10	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_CLG 10300 BO11	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-1_ENA 10300 BO13	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-1_HTG_ENA 10300 BO14	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_ENA 10300 BO101	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_HTG 10300 BO102	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_CLG 10300 BO103	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		

9.11.1697.0 (Continued from Page 4)

Descriptor / Object Reference	Value/Units	AUTO/MAN	COM	Hardware Checks: Wired	Tag	E-E	Software Checks: Cal.	Scale Range	Graph	Prog	Alarm	Commissioning Notes
EF2-4_C 10300 BO104	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		
EF2-5_C 10300 BO105	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		
EF2-7_C 10300 BO106	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		

Rose Technology - Guelph MRF - Project 1515 - Deficiency List

Project: **Guelph MRF**
Measure: **BAS Building Automation**
Updated: **Sept. 28, 2011**
Updated: **Nov. 14, 2011**
Updated: **Dec. 14, 2011**
Updated: **Jan. 12, 2012**
Updated: **Feb. 1, 2012**

No.	Deficiency Description	Action Required	Action By	Target Date	Status
1	Multiple areas: Electrical box removed from wall, paint where box removed does not match the rest of wall. ESC indicate they exchanged services with Guelph to removed the painting requirement.	Paint wall where box was removed to match existing paint color. Where electrical box or stat was removed from an office, prep wall before painting. Rose to confirm.	**Rose/Guelph**		Completed - Charraway - 1/12/12
2	Conduit penetrating block wall from lunchroom to hallway not sealed	Fill gap with fire caulk	**ESC**		Complete - Charraway 12/14/11
3	AC2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-8; MUA 2-2, 3-2. Filter differential pressure readings through BAS are not set up. Many of the filter static pressure read above zero when the fans are disabled.	Calibrate the 'zero' readings on the differential pressure sensors. This is best done at the sensor itself, if there is a offset adjustment.	**ESC**		Complete - Charraway 12/14/11
4	Stainless steel sensor mounted on incorrect electrical where the sensor stands out from the wall, creating a hazard	Remove existing electrical box and replace with box that will extend beyond the edges of the temperature sensor.	**ESC**		Complete - Charraway 12/14/11
5	Office area served by AC 2-8 has no temperature sensor in space, and no override sensor. As a result, the cooling is constantly enabled and the room is quite cold.	Confirm/Provide control to the rooms typical of the pre-retrofit condition.	**ESC**		Completed - Charraway - 1/12/12
6	Communication is problematic between BAS panels in electrical room 1 and 2. When logged into one electrical room, the panels in the other are not visible. This creates a problem when there is variable transfer (such as global calendars) between the panels, and may limit the customers ability to view the system.	Correct the communication deficiencies between the two electrical rooms	**ESC**		Complete - Charraway 12/14/11

7	Events have not been created for the filter status.	Create events for the filter status. Set up the status to trigger when the filters are dirty using the following action: 1. Calibrate the filter differential pressure reading to zero when not flow conditions (see 3 above). 2. Replace the filter media with new. 3. Enable fan and cover half of the filter area with cardboard. 4. Read the resulting pressure and set this up as the trigger point for the event.	**ESC**		Complete - Charraway 12/14/11
8	Original sequence called for continuous fan operation when schedule on. Currently, fan is called only when heating or cooling is required.	Set up a 'fan operation' binary variable that will change the fan control from can be manually overridden (from continuous on to intermittent operation) upon customer demand.	**ESC**		Complete - Charraway 12/14/11
9	Fan disables immediately after heat or cool call is removed. This seems to be an intermittent problem. During the site inspection the fans disabled directly after the heat/cool call was removed. This occurred in the presence of the Guelph staff.	Find the source of the intermittent problem, and correct. Run the fans for 3 minutes past the removal of the heat and cool call.	**ESC**		Completed - Charraway - 1/12/12
10	ACS unit labeled incorrectly. The unit should be labeled to match the unit designation on the rooftop package unit.	Correct all references to ACS to reflect the correct RTU (e.g.. AC2-5)	**ESC**		Complete - Charraway 12/14/11
11	Unit labeled 'ACS' is sending nuisance alarms when the cooling call is removed.	Confirm correction of this when No. 9 above is corrected.	**ESC**		Complete - Charraway 12/14/11
12	Space temperature in areas with electric heat only are set to a cooling minimum (restroom, hallways and lunchroom)	Ensure the electric heat does not inherit the cooling setpoint. Electric heat should not be enabled until the space temperature drops below the heating setpoint.	**ESC**		Complete - Charraway 12/14/11
13	No space temperature alarms/events in BAS.	Create events for the space temperature out-of-limits for all RTUs and MUA units.	**ESC**		Complete - Charraway 12/14/11
14	RTU AC2-2 status/call is reading opposite, i.e.. The unit is being called but the status is off. BAS does not indicated that heating or cooling have ever been called.	Resolve the unit call/status. Report if this is a mechanical deficiency. Confirm with Guelph that this unit is no longer functional.	**ESC**		Completed - Charraway - 1/12/12
15	RTU AC2-3 unit is being called to operate, but the unit will not start. Unsure as to why the unit is non-operational.	ESC to resolve the fan operation issue. Afterwards, Guelph to follow up with a HVAC contractor to determine why unit not functioning.	**Guelph**		Completed - Charraway - 1/12/12
16	BAS panel (10100) mislabeled as serving AC2-4, has spelling mistake, and indicates 'space pressurization' which is no longer a operational consideration.	Correct nomenclature	**ESC**		Complete - Charraway 12/14/11

17	NO2 sensor in bailing area is non-responsive. Sensor has not changed its reading levels since installation	Commission sensor. May request feedback from sensor manufacturer.	**ESC**		Complete - Charraway 12/14/11
18	No events created in BAS for CO, NO2 sensors in tipping and bailing areas.	Create events. One event for an instantaneous alarm. The other is for a TWA alarm. Rose to confirm events	**Rose**		Completed - Charraway - 1/12/12
19	No limit ranges for CO, NO2 sensors	Provide event trigger values.	**Rose**		Completed - Charraway - November 15
20	BAS computer/graphics not installed	Set up computer on site	**ESC**		Complete - Charraway 12/14/11
21	Training not completed.	Provide Rose indication of when training can commence, and provide training for customer	**ESC**		Completed - Charraway - 2/1/12
22	Global Calendar has not been set up; instead calendar object for each unit have been created.	Create a global calendar for customer input; this calendar shall transfer between each panel and each unit. Rose to confirm.	**Rose**		Completed - Charraway - 1/12/12
23	Calendar object does not disable the unit operation	Ensure that a calendar event will disable the unit operation. Rose to confirm.	**Rose**		Completed - Charraway - 1/12/12
24	AC2-4 has a heat call, but there is no heat from unit.	Confirm operation of heat on unit. Report if this is a mechanical deficiency.	**ESC**		Complete - Charraway 12/14/11
25	No BAS events for heating/cooling failure	Create events for each MUA unit to trigger if there is a call for heating or cooling and the unit does not produce heat or cool.	**ESC**		Complete - Charraway 12/14/11
26	NO2 sensor in tipping area is non-responsive. Sensor has not changed its reading levels since installation	Commission sensor. May request feedback from sensor manufacturer. Sensor for MUA 2/1 not functioning. Trend data was not available or confirm historical.	**ESC**		Completed - Charraway - 1/12/12
27	Exhaust fan disable did not appear to disable the MUA unit	Confirm operation of the safeties on the MUA units. Any exhaust fan failure should, by means of a hardwired safety, shut down the respective MUA unit. Rose to review.	**Rose**		Completed - Charraway - 1/12/12
28	Upon Startup of the BAS computer, or upon wakeup, the connection to the BAS take a long time.	The system was designed to be a Ethernet-enabled system, but currently the Guelph IT has not provided a drop. As a service to the customer, Implement any measure the can be implemented to temporarily reduce the lag between the computer wakeup and connection until the IT drop is provided	**ESC**		Complete - Charraway 12/14/11
29	Space temperature setpoint not reading correctly in the graphics	Correct link so that space temperature setpoint reflects the current.	**ESC**		Complete - Charraway 12/14/11
30	Flame graphic not working on OSA units	Correct animation	**ESC**		Complete - Charraway 12/14/11

31	MT Trend logs are inconsistent. For example, AC2-1 CLG trend should be a digital trend, but it is configured as an analog and not reading correctly	Review and correct the MT logs.	**ESC**		Complete - Charraway 12/14/11
32	List of users and accesses	ESC to provide 2 levels of access for the ORCAweb system, 'Operators' and 'Maintenance'. Prepare this before training proceeds.	**ESC**		Completed - Charraway - 1/12/12
33	Unit 2/1 calls for heat even though fan CT is off.	Ensure that heating and cooling is not being called if the fan CT fails to make.	**ESC**		Completed - Charraway - 1/12/12
34	Enable ORCAweb	Provide a static IP address for enabling the ORCAweb software. This is required for remote access.	**MRF**		
35	Sequence to enable the MUA when two RTU are enabled is not programmed.	Program sequence.	**ESC**		Completed - Charraway - 1/12/12
36	MUA 2-2 still calling for heat when fan status off - both on start up and shut down.	Correct call for heat. Heat should never be called when the fan status is off	**ESC**		Completed - Charraway - 1/12/12

APPENDIX D

BUILDING AUTOMATION SYSTEM
FIELD COMMISSIONING REPORT

Guelph MRF - Commissioning Procedure

1. During a typical commissioning procedure, the Building Automation System (BAS) subcontractors will sit with a representative from the General Contract in front of the active controls system.
2. A representative system from each type (rooftop unit, exhaust fan, MUA) will be reviewed in detail. If there are deficiencies that can be quickly resolved, another unit will be reviewed.
3. If during the commissioning procedure, a number of small deficiencies or any large deficiencies are noted, the commissioning testing will be completed but the commissioning exercise is deemed to have failed. At this point, the BAS subcontractor will return to site to correct the deficiencies, and another exercise will be scheduled.
4. With the GC representative overseeing the procedure, the BAS subcontract starts working through the list of actions, or operations, designed to simulate normal operation of the facility and equipment over a typical operational cycle. This is done by physically manipulating the inputs and sensors of the BAS system and then observing the resulting sequence.
5. If the operation is successful, (i.e. the results match the expectations) the operation is given a pass and we move to the next operation
6. Any unexpected results, or operations that are not applicable, are noted in the “Notes” section.

Rooftop Units (RTU)

There are a total of 7 rooftop package units installed on the three roof sections at the Guelph MRF. These units have a supply and return fan, an economizer, one (or two) stages of DX cooling, a heat enable and indirect-fired modulating gas heat. The economizer and modulating gas heat will remain under local control.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm. Occupied override available via pushbutton on thermostat
Occupied Setpoints: 75°F cooling setpoint, 69°F heating setpoint
Night heating override: 80°F cooling setpoint, 50°F heating setpoint

Notes: For the purposes of this report, we will look at two units picked randomly. It is assumed that if two units perform, that the rest of the units will be identical in operation.

RTU Number A/C 2-1

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the RTU system with Schedule off, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 81°F.	The supply and return (S&R) fans should start, followed shortly with the compressor call.	☑		
3	Move the room temperature back to the 72°F.	The compressor should disable, followed by the S&R fan disable after a minimum of 2 minutes.	☑		
4	Move the room temperature to 45°F.	The S&R fans should begin followed shortly with the call for heat.	☑		
5	Move the room temperature back to the 72°F.	The heat call should disable, followed by S&R fan disable after a minimum of 2 minutes.	☑		
6	Activate the 'Occupied Override' button	The S&R fans should start.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**

7	Set the Room temperature to 65°F.	This should trigger a call for heat.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		Dec.21, 2011. Override button pushed, not responding Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
9	Begin testing with the RTU in the unoccupied state with Schedule off.	Nothing on the system should be running.	☑		
10	Place the system in 'Occupied' by enabling the schedule	The S&R fans should start	☑		
11	Lower the room temperature to 65°F.	The system should change to for heating.	☑		
12	Raise the room temperature back to 72°F.	The call for heating should be removed.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
13	Raise the room temperature to 78°F	The system should call for cooling.	☑		
14	Removed second stage- this is internal to the unit.				Jan.12, 2012. Some A/C Units have two stages of cooling. This staging is being controlled with the unitary controls.
15	Lower the room temperature back to 72°F.	The system should disable the call for cooling.	☑		
16	With the system in the occupied status, set the room temperature to 78°F	Check the Fan status CT is on.	☑		

17	Disable the fan status manually to simulate a loss of amps on the RTU	The cooling call should be disabled. The BAS system should send an equipment failure alarm.	☑		
18	Place the Fan status in Auto	The system should resume normal operations	☑		
19	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
20	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
21	Simulate a loss of cooling event.	Unit should continue to operate, and a 'system' event should be generated	☑		
21	Simulate a loss of heating event.	Unit should continue to operate, and a 'system' event should be generated	☑		
22	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

RTU Number A/C 2-4

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the RTU system with Schedule off, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 81°F.	The supply and return (S&R) fans should start, followed shortly with the compressor call.	☑		
3	Move the room temperature back to the 72°F.	The compressor should disable, followed by the S&R fan disable after a minimum of 2 minutes.	☑		
4	Move the room temperature to 45°F.	The S&R fans should begin followed shortly with the call for heat.	☑		
5	Move the room temperature back to the 72°F.	The heat call should disable, followed by S&R fan disable	☑		

		after a minimum of 2 minutes.			
6	Activate the 'Occupied Override button	The S&R fans should start.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
7	Set the Room temperature to 65°F.	This should trigger a call for heat.	☑		Dec.21, 2011. Override button pushed, not responding **Jan. 12, 2011 – Corrected and operational.**
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		Dec.21, 2011. Override button pushed, not responding Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
9	Begin testing with the RTU Schedule off.	Nothing on the system should be running.	☑		
10	Place the system in 'Occupied' by enabling the schedule	The S&R fans should start.	☑		
11	Lower the room temperature to 65°F.	The system should change to for heating.	☑		
12	Raise the room temperature back to 72°F.	The call for heating should be removed.	☑		
13	Raise the room temperature to 78°F	The system should call for cooling.	☑		
14	Removed second stage is internal		☑		Jan.12, 2012. Some A/C Units have two stages of cooling. This staging is being controlled with the unitary controls.
15	Lower the room temperature back to 72°F.	The system should disable the call for cooling. The S&R fans shall continue to run.	☑		

16	With the system in the occupied status, set the room temperature to 78°F	Check the Fan status CT is on.	☑		
17	Disable the fan status manually to simulate a loss of amps on the RTU	The cooling call should be disabled. The BAS system should send an equipment failure alarm.	☑		
18	Place the Fan status in Auto	The system should resume normal operations, and a 'return to normal' event should be generated.	☑		
19	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
20	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
21	Simulate a loss of cooling event.	Unit should continue to operate, and a 'system' event should be generated	☑		
21	Simulate a loss of heating event.	Unit should continue to operate, and a 'system' event should be generated	☑		
22	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

Makeup Air Units (MAU)

There are a total of 2 direct fired MAU units installed at the Guelph MRF; one installed on the Roof of the Tipping area, and one installed on a platform on the north end of the Bailing area. The supply fans on these units run during occupied periods, and heater is enabled based on space temperature. There are 8 rooftop exhaust fans that are hardwire interlocked to the MAU, so that if an exhaust fan fails, the associated MAU will shut down.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.
Occupied heating Setpoints: 55°F heating setpoint
Night Heating Setback: 35°F heating setpoint, 90°F Ventilation setpoint

Notes: For the purposes of this report, we will look at one units picked randomly. It is assumed that if this unit performs, the other unit will be identical in operation.

MAU Number 2/2

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the MUA system with schedule off, with average room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Enable two of the MUA unit overrides	MUA unit should change to "unoccupied override" and operate follow the applicable sequence.	☑		Dec.21, 2011. Unit currently not configured to operate when two RTU are enabled. **Jan. 12, 2011 – Corrected and operational.**
3	Disable one of the MUA overrides	MUA unit should change to "unoccupied" and operate follow the applicable sequence.	☑		Dec.21, 2011. Unit currently not configured to operate when two RTU are enabled. **Jan. 12, 2011 – Corrected and operational.**
4	Move the average of the room sensors to 30°F	The supply fans should start, followed by the BAS call for heating. The unit gas heat should then run, and the supply air temperature should increase. The exhaust fans serving the	☑		

		area (tipping, bailing) should start.			
5	Move the average of the room sensors to 50°F	The gas heat call should be removed. The supply fan should operate for a 2 minutes, then shut off.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger **Jan. 12, 2011 – Corrected and operational.**
6	Move the average of the room sensors to 92°F	The supply fans should start. The exhaust fans serving the area (tipping, bailing) should start.	☑		
7	Begin testing the MUA system with schedule off, with average room temperature at 72°F.	Nothing on the system should be running.	☑		
8	Enable the schedule	The supply fans should start. The exhaust fans serving the area (tipping, bailing) should start.	☑		Dec.21, 2011. There is a long delay between the unit being enabled and the CT status showing operation. This is because the outside air dampers are opening.
9	Manually shut down one of the exhaust fans in the area being tested	MUA unit should immediately stop.	☑		Dec.21, 2011. The unit would shut down, but the heat was still being called by the BAS. **Jan. 12, 2011 – Corrected and operational.**
10	Move the average of the room sensors to 50°F	The BAS should call for heating. The unit gas heat should then run, and the supply air temperature should increase.	☑		
11	Disable the schedule	The gas heat call should be removed. The supply fan should operate for a few more minutes, and then stop.	☑		Dec.21, 2011. Unit is disabling the fan and heat at the same time. Fan needs to run for three minutes past the operation of the fan to cool down the heat exchanger

					Jan. 12, 2011 – Corrected and operational.
12	Place the system in the occupied status	Check the Fan status CT is on.	☑		
13	Manually command a CT input on one of the exhaust fans to 'off'	The BAS system should send an equipment failure alarm.	☑		
14	Allow the CT input on one of the exhaust fans to return to 'auto'	A 'return to normal' event should be generated.	☑		
15	Trigger the Filter Differential Pressure input.	The system should continue to operate, and send a Maintenance event.	☑		
16	Place the Filter Differential Pressure in Automatic	A 'return to normal' event should be generated.	☑		
17	Simulate a loss of heating	Unit should continue to operate, and a 'system' event should be generated			Dec.21, 2011. These units do not have any functionality to sense a loss of heating. Operation N/A.
18	Return all manual points to automatic, correct all system timers, and re-enable all alarms.	System should be ready for normal operation.	☑		

Baseboard Heating

There is a number of baseboard heater installed in the Guelph MRF. These heaters are as listed:

1. Men's Washroom
2. Women's Washroom
3. Hallway
4. Lunchroom

Each of these heaters has an independent temperature sensor, complete with override.

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.
Occupied heating Setpoints: 55°F heating setpoint
Night Heating Setback: 35°F heating setpoint, 90°F Ventilation setpoint

Notes: For the purposes of this report, we will look at heater picked randomly. It is assumed that if this element performs, the other units will be identical in operation.

Lunchroom Electric Heater

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the system with Unoccupied mode, with manual room temperature within at 72°F.	Nothing on the system should be running.	☑		
2	Move the room temperature to 45°F.	The electric heating should turn on.	☑		
3	Move the room temperature back to the 72°F	The electric heating should turn off.	☑		
6	Set the Room temperature to 65°F. Set the Activate the 'Occupied Override button.	The electric heating should turn on.	☑		
7	Allow the occupied override time to elapse.	The electric heating should turn off.	☑		
8	Allow the occupied override time to elapse.	The call for heat should be removed, followed by the call for S&R fans after a minimum of two minutes.	☑		

Washroom Exhaust

The Men's and Women's Washroom have exhaust fans that extract stale air during the occupied periods

Occupied Schedule: Monday to Friday; 7 am to 6 pm and Saturday; 7:30 am to 4 pm.

Notes: For the purposes of this report, we will look at fan picked randomly. It is assumed that if this element performs, the other unit will be identical in operation.

Women's Restroom Fan

Number	Operation - Unoccupied	Expectation	Yes	No	Notes
1	Begin testing the system with Unoccupied mode.	The system should not be running.	☑		
2	Move system to Occupied mode.	The system should not be running.	☑		

9.11.1697.0

Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks: Wired	Tag	E-E	Software Checks: Cal.	Scale Range	Graph	Prog	Alarm	Commissioning Notes
Device 10100												
CO_2_TIPP NG 10100 AI1	0.60 ppm	AUTO	✓	✓	✓	✓	0	CO 4-20mA 0-200 ppm AIC	✓	✓		
N02_2_TIPPING 10100 AI2	0.03 ppm	AUTO	✓	✓	✓	✓	0	NO2 4-20mA 0-20 ppm AIC	✓	✓		
AC2-8_S 10100 BI4	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_FLT 10100 AI5	0.04 inH2O	AUTO	✓	✓	✓	✓	0	AC2-8 1-5V 0-1"WC	✓	✓		
AC2-8_SPT 10100 AI6	68.39 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-8_SAT 10100 AI7	60.37 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-4_S 10100 BI8	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_FLT 10100 AI9	0.08 inH2O	AUTO	✓	✓	✓	✓	0	AC2-4 1-5V 0-1"WC	✓	✓		
AC2-4_SPT 10100 AI10	58.25 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-4_SAT 10100 AI11	124.05 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
MUA2-2_S 10100 BI13	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-2_FLT 10100 AI14	0.01 inH2O	AUTO	✓	✓	✓	✓	0	MUA2-2 1-5V 0-1"WC	✓	✓		
MUA2-2_SPT1 10100 AI15	54.17 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
MUA2-2_SPT2 10100 AI16	46.82 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
EF2-1_S 10100 BI101	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-2_S 10100 BI102	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-3_S 10100 BI103	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-6_S 10100 BI106	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-8_S 10100 BI108	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_ENA 10100 BO1	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_HTG 10100 BO2	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-8_CLG 10100 BO3	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_ENA 10100 BO5	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-4_HTG 10100 BO6	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		

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Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range		Graph	Prog	Alarm
AC2-4_CLG 10100 BO7	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-2_ENA 10100 BO13	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-2_HTG_ENA 10100 BO14	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-1_C 10100 BO101	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-2_C 10100 BO102	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-3_C 10100 BO103	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-6_C 10100 BO106	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
EF2-8_C 10100 BO108	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
Device 10200												
EF2-9_S 10200 BI1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MWR_SPT 10200 AI2	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
FWR_SPT 10200 AI3	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
AC2-6_S 10200 BI4	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_FLT 10200 AI5	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-6 1-5V 0-1"WC		✓	✓	
AC2-6_SPT 10200 AI6	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
AC2-6_SAT 10200 AI7	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
MH_SPT 10200 AI8	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
VR_SPT 10200 AI9	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
ACS_S 10200 BI10	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_FLT 10200 AI11	1.00 inH2O	AUTO	✓	✓	✓	✓	0	ACS 1-5V 0-1"WC		✓	✓	
ACS_SPT 10200 AI12	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
ACS_SAT 10200 AI13	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d		✓	✓	
EF2-9_C 10200 BO1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MWR_HTR 10200 BO2	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
FWR_HTR 10200 BO3	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	

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Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range		Graph	Prog	Alarm
AC2-6_ENA 10200 BO4	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_HTG 10200 BO5	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-6_CLG 10200 BO6	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
LR_HTR 10200 BO8	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
VR_HTR 10200 BO10	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_ENA 10200 BO11	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_HTG 10200 BO12	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
ACS_CLG 10200 BO13	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
Device 10300												
AC2-1_S 10300 BI1	On	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-1_FLT 10300 AI2	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-1 1-5V 0-1"WC		✓	✓	
AC2-1_SPT 10300 AI3	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-1_SAT 10300 AI4	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-2_S 10300 BI5	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-2_FLT 10300 AI6	-1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-2 1-5V 0-1"WC		✓	✓	
AC2-2_SPT 10300 AI7	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-2_SAT 10300 AI8	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-3_S 10300 BI9	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
AC2-3_FLT 10300 AI10	1.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-3 1-5V 0-1"WC		✓	✓	
AC2-3_SPT 10300 AI11	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
AC2-3_SAT 10300 AI12	240.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
MUA2-1_S 10300 BI13	Off	AUTO	✓	✓	✓	✓		On_Off BDC		✓	✓	
MUA2-1_FLT 10300 AI14	1.00 inH2O	AUTO	✓	✓	✓	✓	0	MUA2-1 1-5V 0-1"WC		✓	✓	
MUA2-1_SPT1 10300 AI15	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	
MUA2-1_SPT2 10300 AI16	-35.00 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 de		✓	✓	

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Descriptor / Object Reference	Value/Units	AUTO/ MAN	COM	Hardware Checks			Software Checks					Commissioning Notes
				Wired	Tag	E-E	Cal.	Scale Range	Graph	Prog	Alarm	
CO_1_BAILING 10300 AI101	1.28 ppm	AUTO	✓	✓	✓	✓	0	CO 4-20mA 0-200 ppm AIC	✓	✓		
NO2_1_BA LING 10300 AI102	0.38 ppm	AUTO	✓	✓	✓	✓	0	NO2 4-20mA 0-20 ppm AIC	✓	✓		
AC2-5_S 10300 BI103	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_FLT 10300 AI104	0.00 inH2O	AUTO	✓	✓	✓	✓	0	AC2-5 1-5V 0-1"WC	✓	✓		
AC2-5_SPT 10300 AI105	68.95 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
AC2-5_SAT 10300 AI106	70.37 F	AUTO	✓	✓	✓	✓	0	Temperature 10K -35-240 d	✓	✓		
ODA_T 10300 AI107	40.46 F	AUTO	✓	✓	✓	✓	3	Temperature 10K -35-240 d	✓	✓		
EF2-4_S 10300 BI108	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-5_S 10300 BI109	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
EF2-7_S 10300 BI110	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_ENA 10300 BO1	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_HTG 10300 BO2	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-1_CLG 10300 BO3	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_ENA 10300 BO5	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_HTG 10300 BO6	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-2_CLG 10300 BO7	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_ENA 10300 BO9	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_HTG 10300 BO10	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-3_CLG 10300 BO11	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-1_ENA 10300 BO13	On	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
MUA2-1_HTG_ENA 10300 BO14	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_ENA 10300 BO101	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_HTG 10300 BO102	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		
AC2-5_CLG 10300 BO103	Off	AUTO	✓	✓	✓	✓		On_Off BDC	✓	✓		

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Descriptor / Object Reference	Value/Units	AUTO/MAN	COM	Hardware Checks: Wired	Tag	E-E	Software Checks: Cal.	Scale Range	Graph	Prog	Alarm	Commissioning Notes
EF2-4_C 10300 BO104	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		
EF2-5_C 10300 BO105	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		
EF2-7_C 10300 BO106	On	AUTO	☑	✓	✓	✓		On_Off BDC	✓	✓		

Rose Technology - Guelph MRF - Project 1515 - Deficiency List

Project: **Guelph MRF**
Measure: **BAS Building Automation**
Updated: **Sept. 28, 2011**
Updated: **Nov. 14, 2011**
Updated: **Dec. 14, 2011**
Updated: **Jan. 12, 2012**
Updated: **Feb. 1, 2012**

No.	Deficiency Description	Action Required	Action By	Target Date	Status
1	Multiple areas: Electrical box removed from wall, paint where box removed does not match the rest of wall. ESC indicate they exchanged services with Guelph to removed the painting requirement.	Paint wall where box was removed to match existing paint color. Where electrical box or stat was removed from an office, prep wall before painting. Rose to confirm.	**Rose/Guelph**		Completed - Charraway - 1/12/12
2	Conduit penetrating block wall from lunchroom to hallway not sealed	Fill gap with fire caulk	**ESC**		Complete - Charraway 12/14/11
3	AC2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-8; MUA 2-2, 3-2. Filter differential pressure readings through BAS are not set up. Many of the filter static pressure read above zero when the fans are disabled.	Calibrate the 'zero' readings on the differential pressure sensors. This is best done at the sensor itself, if there is a offset adjustment.	**ESC**		Complete - Charraway 12/14/11
4	Stainless steel sensor mounted on incorrect electrical where the sensor stands out from the wall, creating a hazard	Remove existing electrical box and replace with box that will extend beyond the edges of the temperature sensor.	**ESC**		Complete - Charraway 12/14/11
5	Office area served by AC 2-8 has no temperature sensor in space, and no override sensor. As a result, the cooling is constantly enabled and the room is quite cold.	Confirm/Provide control to the rooms typical of the pre-retrofit condition.	**ESC**		Completed - Charraway - 1/12/12
6	Communication is problematic between BAS panels in electrical room 1 and 2. When logged into one electrical room, the panels in the other are not visible. This creates a problem when there is variable transfer (such as global calendars) between the panels, and may limit the customers ability to view the system.	Correct the communication deficiencies between the two electrical rooms	**ESC**		Complete - Charraway 12/14/11

7	Events have not been created for the filter status.	Create events for the filter status. Set up the status to trigger when the filters are dirty using the following action: 1. Calibrate the filter differential pressure reading to zero when not flow conditions (see 3 above). 2. Replace the filter media with new. 3. Enable fan and cover half of the filter area with cardboard. 4. Read the resulting pressure and set this up as the trigger point for the event.	**ESC**		Complete - Charraway 12/14/11
8	Original sequence called for continuous fan operation when schedule on. Currently, fan is called only when heating or cooling is required.	Set up a 'fan operation' binary variable that will change the fan control from can be manually overridden (from continuous on to intermittent operation) upon customer demand.	**ESC**		Complete - Charraway 12/14/11
9	Fan disables immediately after heat or cool call is removed. This seems to be an intermittent problem. During the site inspection the fans disabled directly after the heat/cool call was removed. This occurred in the presence of the Guelph staff.	Find the source of the intermittent problem, and correct. Run the fans for 3 minutes past the removal of the heat and cool call.	**ESC**		Completed - Charraway - 1/12/12
10	ACS unit labeled incorrectly. The unit should be labeled to match the unit designation on the rooftop package unit.	Correct all references to ACS to reflect the correct RTU (e.g.. AC2-5)	**ESC**		Complete - Charraway 12/14/11
11	Unit labeled 'ACS' is sending nuisance alarms when the cooling call is removed.	Confirm correction of this when No. 9 above is corrected.	**ESC**		Complete - Charraway 12/14/11
12	Space temperature in areas with electric heat only are set to a cooling minimum (restroom, hallways and lunchroom)	Ensure the electric heat does not inherit the cooling setpoint. Electric heat should not be enabled until the space temperature drops below the heating setpoint.	**ESC**		Complete - Charraway 12/14/11
13	No space temperature alarms/events in BAS.	Create events for the space temperature out-of-limits for all RTUs and MUA units.	**ESC**		Complete - Charraway 12/14/11
14	RTU AC2-2 status/call is reading opposite, i.e.. The unit is being called but the status is off. BAS does not indicated that heating or cooling have ever been called.	Resolve the unit call/status. Report if this is a mechanical deficiency. Confirm with Guelph that this unit is no longer functional.	**ESC**		Completed - Charraway - 1/12/12
15	RTU AC2-3 unit is being called to operate, but the unit will not start. Unsure as to why the unit is non-operational.	ESC to resolve the fan operation issue. Afterwards, Guelph to follow up with a HVAC contractor to determine why unit not functioning.	**Guelph**		Completed - Charraway - 1/12/12
16	BAS panel (10100) mislabeled as serving AC2-4, has spelling mistake, and indicates 'space pressurization' which is no longer a operational consideration.	Correct nomenclature	**ESC**		Complete - Charraway 12/14/11

17	NO2 sensor in bailing area is non-responsive. Sensor has not changed its reading levels since installation	Commission sensor. May request feedback from sensor manufacturer.	**ESC**		Complete - Charraway 12/14/11
18	No events created in BAS for CO, NO2 sensors in tipping and bailing areas.	Create events. One event for an instantaneous alarm. The other is for a TWA alarm. Rose to confirm events	**Rose**		Completed - Charraway - 1/12/12
19	No limit ranges for CO, NO2 sensors	Provide event trigger values.	**Rose**		Completed - Charraway - November 15
20	BAS computer/graphics not installed	Set up computer on site	**ESC**		Complete - Charraway 12/14/11
21	Training not completed.	Provide Rose indication of when training can commence, and provide training for customer	**ESC**		Completed - Charraway - 2/1/12
22	Global Calendar has not been set up; instead calendar object for each unit have been created.	Create a global calendar for customer input; this calendar shall transfer between each panel and each unit. Rose to confirm.	**Rose**		Completed - Charraway - 1/12/12
23	Calendar object does not disable the unit operation	Ensure that a calendar event will disable the unit operation. Rose to confirm.	**Rose**		Completed - Charraway - 1/12/12
24	AC2-4 has a heat call, but there is no heat from unit.	Confirm operation of heat on unit. Report if this is a mechanical deficiency.	**ESC**		Complete - Charraway 12/14/11
25	No BAS events for heating/cooling failure	Create events for each MUA unit to trigger if there is a call for heating or cooling and the unit does not produce heat or cool.	**ESC**		Complete - Charraway 12/14/11
26	NO2 sensor in tipping area is non-responsive. Sensor has not changed its reading levels since installation	Commission sensor. May request feedback from sensor manufacturer. Sensor for MUA 2/1 not functioning. Trend data was not available or confirm historical.	**ESC**		Completed - Charraway - 1/12/12
27	Exhaust fan disable did not appear to disable the MUA unit	Confirm operation of the safeties on the MUA units. Any exhaust fan failure should, by means of a hardwired safety, shut down the respective MUA unit. Rose to review.	**Rose**		Completed - Charraway - 1/12/12
28	Upon Startup of the BAS computer, or upon wakeup, the connection to the BAS take a long time.	The system was designed to be a Ethernet-enabled system, but currently the Guelph IT has not provided a drop. As a service to the customer, Implement any measure the can be implemented to temporarily reduce the lag between the computer wakeup and connection until the IT drop is provided	**ESC**		Complete - Charraway 12/14/11
29	Space temperature setpoint not reading correctly in the graphics	Correct link so that space temperature setpoint reflects the current.	**ESC**		Complete - Charraway 12/14/11
30	Flame graphic not working on OSA units	Correct animation	**ESC**		Complete - Charraway 12/14/11

31	MT Trend logs are inconsistent. For example, AC2-1 CLG trend should be a digital trend, but it is configured as an analog and not reading correctly	Review and correct the MT logs.	**ESC**		Complete - Charraway 12/14/11
32	List of users and accesses	ESC to provide 2 levels of access for the ORCAweb system, 'Operators' and 'Maintenance'. Prepare this before training proceeds.	**ESC**		Completed - Charraway - 1/12/12
33	Unit 2/1 calls for heat even though fan CT is off.	Ensure that heating and cooling is not being called if the fan CT fails to make.	**ESC**		Completed - Charraway - 1/12/12
34	Enable ORCAweb	Provide a static IP address for enabling the ORCAweb software. This is required for remote access.	**MRF**		
35	Sequence to enable the MUA when two RTU are enabled is not programmed.	Program sequence.	**ESC**		Completed - Charraway - 1/12/12
36	MUA 2-2 still calling for heat when fan status off - both on start up and shut down.	Correct call for heat. Heat should never be called when the fan status is off	**ESC**		Completed - Charraway - 1/12/12