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SECTION 1.0: EXECUTIVE SUMMARY

1.1 INTRODUCTION

NORESCO presents this Comprehensive Audit Report for consideration by Churchill County School District (CCSD) for the three selected facilities: Northside Elementary School, Churchill Junior High School and Churchill High School. This Comprehensive Audit Report was developed based on CCSD's Request for Proposal 2007-02, "Performance Contract for Energy Cost Savings".

NORESCO has developed this self-funding project within the State of Nevada legislation to meet your facility needs through operating budget reductions. The program NORESCO has included in this RFP response is based on information NORESCO gathered from the pre-bid meeting and subsequent site walks and was designed to provide CCSD with the greatest savings and solutions. It includes solutions to all of the items CCSD requested during the RFP process (see Table 2.3). This report does not include any "soft dollar" savings, labor savings or artificial savings that would negatively impact the on going operation of CCSD or not comply with the State of Nevada legislation.

As a result of this project, NORESCO will provide the following benefits to CCSD:

- A very limited risk turn-key solution with a full energy saving guarantee;
- No risk from pricing changes once the final energy agreement is approved;
- Facility upgrades with the lowest life cycle cost and greatest value to CCSD;
- Reduction in operating costs using energy more efficiently;
- Improved learning environment for students and staff (temperature, lighting and indoor air quality);
- Addresses the deferred maintenance issues, and implement capital improvements to replace aged and problematic equipment without capital improvement project (CIP) funds
- Improve safety in the facilities for students and staff;
- All work will be done to minimize disruption to CCSD students and staff
- Provide a project which is consistent with the NRS332, Nevada energy legislation process;
- A renewable energy project which serves a dual benefit of producing electricity and acting as an educational tool;
- Performance and Financial Guarantee options including annual savings reconciliation for the term of the debt service;
- Use local, Fallon-based contractors when ever possible to stimulate local economy, generate tax revenue and improved warranty service.

NORESCO has outlined two cash flow options; one with the maximum project scope (Table 2.4) and one with maximum project savings (Table 2.5). Together using *EntelliChoice*^{sm}, CCSD and

NORESCO can design a project to meet CCSD objectives for project content and excess savings available for the general fund.

Based on our analyses with the maximum project scope, for the three selected schools CCSD is currently spending over $580,000 annually for electricity, heating fuels and water/sewer. During the audit site survey, several potential projects were evaluated for the three schools. NORESCO analyzed each measure and is recommending the implementation of a comprehensive package of Energy Conservation Measures (ECMs) and infrastructure improvements. Based on current utility rates, the project will produce a total first year utility savings of over $160,000 as well as reduce lighting material cost and eliminate the Gymnasium heat pumps and associated cost for annual compressor failure, for a total annual savings of over $170,000. The savings produced by this project creates the annual revenue stream to fund the upgrades and efficiency improvements for CCSD. With this program, CCSD shall receive the operating cost savings to fund the upgrades described herein and have a cash flow of over $5,000 annually from current expenditures. The cumulative positive cash flow for the 15 year program is projected to exceed $140,000. Without this program, the District will continue to pay current utility expenditures escalated annually due to rate increases and would not obtain these facility upgrades and efficiency improvements. Table 1.1 provides a Financial Summary to CCSD for the three select schools:

Table 1.1 Financial summary

Description	Value
Project turnkey price	$2,436,540
Third party consultant fee	$50,000
Bond counsel	$7,500
Amount financed	$2,494,040
Utility incentive and rebates	$-
Capitalized construction interest	$8,326
Total amount financed	$2,502,366
15-year revenue	$2,869,912
15-year program cost	$2,727,829
Projected cumulative cash flow	$142,083
Term	15 years
Interest rate (QZAB)	0.5%

1.2 PROGRAM OBJECTIVES

The primary objective of this Program is to provide CCSD with a comprehensive energy solution that will:

- Provide excess savings above the cost of the debt service;
- Solutions to all of the required scope items from Section 1.4.3 of the RFP, see Table 2.3;
- Improve the learning environment for students and staff (temperature, lighting and indoor air quality);

- Address deferred maintenance issues, and implement capital improvements to replace aged and problematic equipment without capital improvement project (CIP) funds;
- Provide a project which is consistent with the NRS332 process;
- Include a renewable project;
- Limit the overall project risk to CCSD.

1.3 Environmental Benefits

There are environmental benefits associated with energy reduction projects. Less energy used means less power plant production and pollution into the air. The recommended project will achieve the following energy savings:

- Electricity Saved 906,384 kWh
- Natural Gas Saved 49,337 therms
- Water Saved 2,573,000 gallons

These savings, once achieved, will produce the following annual environmental benefits:

- 450 Tons of Carbon Dioxide Eliminated (CO2 Tons)
- 1,000 Kilograms of Sulfur Dioxide Eliminated (SO2 Kilograms)
- 1,350 Kilograms of Nitric Dioxide Eliminated (NOX Kilograms)

1.4 Closing

On behalf of the NORESCO project team; I would like to thank the following people with CCSD: Jim Sustacha, Mike Beachman, Mike Compagnoni, David Paul and Laurie Currie as well as Jess Franco from Celtic Energy, who were helpful in providing information necessary for the development of this report.

NORESCO is always available to answer questions about this Comprehensive Audit Report. Should you have any questions or comments please contact me at the address below:

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SECTION 2.0: FINANCIAL SUMMARY

NORESCO has completed the enclosed Comprehensive Audit Report as a first step in the development of a Guaranteed Energy Savings Contract (Performance Contract). The Performance Contract will enable the Churchill County School District (CCSD) to utilize their utility and operations budget to amortize the investment required to make building infrastructure improvements.

CCSD identified three schools for evaluation during this phase of the project: Northside Elementary School, Churchill County Junior High School and Churchill County High School. Several Energy Conservation Measures (ECMs) were identified that will provide significant energy savings and provide long-term maintenance and capital solutions. NORESCO is very careful in identifying ECMs and determining associated savings. Savings realism is the key to ensuring the financing and budget plan works for CCSD. The savings that result from implementing the energy conservation measures (ECMs) is used to amortize the project investment over a 15-year period of time. NORESCO is proposing a fifteen (15) year financing period as allowed by NRS332 and summarized below:

Table 2.1 Financial summary.

Description	Value
Project turnkey price	$2,436,540
Third party consultant fee	$50,000
Bond counsel	$7,500
Amount financed	$2,494,040
Utility incentive and rebates	$-
Capitalized construction interest	$8,326
Total amount financed	$2,502,366
15-year revenue	$2,869,912
15-year program cost	$2,727,829
Projected cumulative cash flow	$142,083
Term	15 years
Interest rate (QZAB)	0.5%

To fund the project cost, CCSD is planning to use Qualified Zone Academy Bonds (QZAB). For the purposes of presenting the financial benefits of the project, NORESCO has based its analysis on QZAB funding at an equivalent interest rate of 0.5%. Under the QZAB program, federal tax credits are provided to the bondholder in lieu of interest payments. A marginal interest rate of 0.5% is assumed to account for District internal costs of administering the financing program.

2.1 OVERVIEW

Project Cost and Savings Detail

The proposed project provides CCSD with an investment of approximately $2.4 Million in building infrastructure improvements that produce first year energy savings of about $170,000. ECM cost and savings information is provided in the following table:

Table 2.2 Project cost and savings.

ECM	Price	Savings	Simple Payback
1 – Lighting system improvements	$317,833	$33,448	9.5 years
2 – High bay luminaire replacement	$52,333	$5,586	9.4 years
3 – Lighting controls	$66,210	$7,139	9.3 years
5 – Upgrade building automation controls	$575,485	$36,516	15.8 years
6 – Optimize water source heat pump system	$420,844	$53,621	7.8 years
7 – Packaged unit replacement	$50,737	$2,382	21.3 years
8 – Replace heat pumps with packaged units	$239,525	$5,894	40.6 years
11 – Kitchen cooling upgrades	$88,035	($1,928)	N/A
12 – Window upgrades/replacements	$78,204	$1,872	41.8 years
13 – Building envelope improvements	$77,032	$2,017	38.2 years
14 – Water system improvements	$132,884	$13,429	9.9 years
15 – Photovoltaic system	$201,371	$2,466	81.7 years
16 – Facility operations management software	$73,616	$-	-
18 – Vending machine controls	$1,488	$933	1.6 years
20 – Network power management	$60,945	$8,186	7.4 years
Total	**$2,436,540**	**$171,561**	**14.2 years**

In addition to significant energy and operational savings, the ECMs listed above will provide additional benefits such as:

- Improve the teaching and learning environment for staff, teachers and students.
- Improve the efficiency of lighting, and heating, ventilating and air conditioning control (HVAC) systems.
- Optimize control of building systems such as lighting, HVAC, and computer networks.
- Provide a renewable energy project (ECM 15) that serves a dual benefit of producing electricity and acting as an educational tool.

- Accelerate standardization of equipment (lamps and ballasts, building automation systems) thereby reducing costs for labor and inventory of replacement parts.
- Provide an easy-to-use, web-based software system to streamline maintenance and repair activities, manage facility event scheduling, and track utility expenditures.
- Replace old and faulty equipment and systems with energy efficient, non proprietary equipment and systems.
- Provide a training and commissioning program for District personnel in energy conservation with supporting O&M manuals that include PM activities, descriptions, special tools, schedules and log sheets.
- Provide additional benefits that directly result from energy-related services and capital improvements, such as environmental protection, hazardous materials disposal, and improved indoor air quality.

The RFP specifically requested certain ECMs to be evaluated in the Comprehensive Audit Report. Each of the ECMs is included in the proposed project and will be installed by NORESCO. These ECMs are summarized in the table below with references for comparison purposes.

Table 2.3 ECMs requested in RFP.

Description	Table 2.2 Reference
Northside Elementary School	
Install occupancy sensor/lighting controls	Included with ECM 3
Replace windows	ECM 12
Churchill Junior High School	
Replace Gymnasium metal halide light fixtures with fluorescent fixtures	Included with ECM 2
Building envelope upgrades	Included with ECM 13
Churchill High School	
Replace Gymnasium/auto shop metal halide light fixtures with fluorescent fixtures	Included with ECM 2
Install vending machine controls	Included with ECM 18
Recommission and/or upgrade ground source heat pump HVAC system	ECM 6

2.2 PROJECT CASH FLOW

Table 2.4 on the following page represents the projected cash flow that will result from implementing the Performance Contract. The cash flow model represents the projections during the 15-year contract term required to amortize the investment in the building infrastructure upgrades. Several assumptions to arrive at the cash flow are summarized as follows:

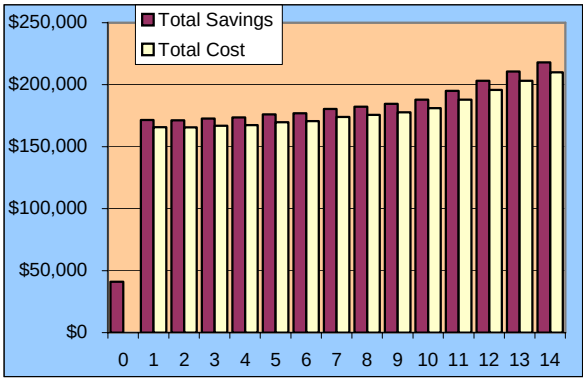
- The lease repayment period (15-year term) will commence at the completion of the project construction period, 8 months.
- The cost of interest capitalization during the 8-month construction period has been included.
- NORESCO has used annual rate projections for utilities as outlined in Section 2.5 to show the financial impact of fluctuating energy prices over the next 15 years.
- The lease payments were calculated to be escalated over the 15 year term to take advantage of utility rate increases and maximize solutions to the District.
- The project cash flow does not include the benefit of escrow earnings during the construction period.
- The project cash flow is based on the funded amount of approximately $2.5 million being placed in escrow at the beginning of construction.
- The lease payments are assumed to be monthly in arrears. Final payment structure to be determined at time of lease closing.
- The interest rate used to calculate the lease payments is 0.5% for the 15-year term based on QZAB funding.
- NORESCO did not use any labor O&M savings to fund this project. However, NORESCO feels confident that CCSD will realize significant labor O&M savings due to streamlined maintenance processes and reduced outsourced subcontracting costs. Equipment standardization, computer-based controls and software will facilitate these savings. Material savings resulting from avoided equipment replacement costs and new equipment warranties has been included.
- Measurement and verifications costs for years 1 through 15 has been included as an ongoing annual cost to the District. It is anticipated that the District will provide direction regarding final M&V scope, cost and reporting requirements prior to finalizing the Financial Grade Operational Audit.

The project represented in Table 2.4 and throughout this section demonstrates the maximum project scope that can be justified by savings and other avoided costs while maintaining a minimum positive cash flow on an annual basis. For comparison purposes, an alternate cash flow is presented in Table 2.5 that demonstrates significant additional positive cash flow with a reduced scope of work. To generate this table, projects were removed based on extended payback periods. These projects include ECM 7 – Packaged Unit Replacement, ECM 8 – Replace Heat Pumps with Packaged Units, ECM 11 – Kitchen Cooling Upgrades, ECM 12 – Window

Upgrades/Replacements, ECM 13 – Building Envelope Improvements, and ECM 15 – Photovoltaic System.

Table 2.4 Project cash flow (maximize project scope).

Year	Utility Savings	O&M Savings	Total Savings	Lease Payments	M&V Service	Total Cost	Net Cash Flow
0	$ 40,976	$ -	**$ 40,976**	$ -	$ -	**$ -**	**$ 40,976**
1	$ 164,697	$ 6,864	**$ 171,561**	$ 148,676	$ 17,112	**$ 165,788**	**$ 5,773**
2	$ 164,298	$ 6,996	**$ 171,294**	$ 148,090	$ 17,454	**$ 165,544**	**$ 5,750**
3	$ 165,482	$ 7,140	**$ 172,622**	$ 149,032	$ 17,803	**$ 166,835**	**$ 5,787**
4	$ 166,289	$ 7,284	**$ 173,573**	$ 161,944	$ 5,341	**$ 167,285**	**$ 6,288**
5	$ 168,680	$ 7,428	**$ 176,108**	$ 164,281	$ 5,448	**$ 169,729**	**$ 6,379**
6	$ 173,634	$ 3,420	**$ 177,054**	$ 165,087	$ 5,557	**$ 170,644**	**$ 6,410**
7	$ 177,016	$ 3,492	**$ 180,508**	$ 168,305	$ 5,668	**$ 173,973**	**$ 6,535**
8	$ 178,609	$ 3,552	**$ 182,161**	$ 169,787	$ 5,781	**$ 175,568**	**$ 6,593**
9	$ 180,806	$ 3,624	**$ 184,430**	$ 171,860	$ 5,897	**$ 177,757**	**$ 6,673**
10	$ 184,205	$ 3,696	**$ 187,901**	$ 175,088	$ 6,015	**$ 181,103**	**$ 6,799**
11	$ 191,365	$ 3,768	**$ 195,133**	$ 181,934	$ 6,135	**$ 188,069**	**$ 7,064**
12	$ 199,129	$ 3,852	**$ 202,981**	$ 189,370	$ 6,258	**$ 195,628**	**$ 7,353**
13	$ 206,684	$ 3,924	**$ 210,608**	$ 196,591	$ 6,383	**$ 202,974**	**$ 7,634**
14	$ 213,863	$ 4,008	**$ 217,871**	$ 203,460	$ 6,511	**$ 209,971**	**$ 7,900**
15	$ 221,049	$ 4,080	**$ 225,129**	$ 210,321	$ 6,641	**$ 216,962**	**$ 8,167**
TOTAL	**$ 2,796,784**	**$ 73,128**	**$ 2,869,912**	**$ 2,603,827**	**$ 124,003**	**$ 2,727,829**	**$ 142,083**

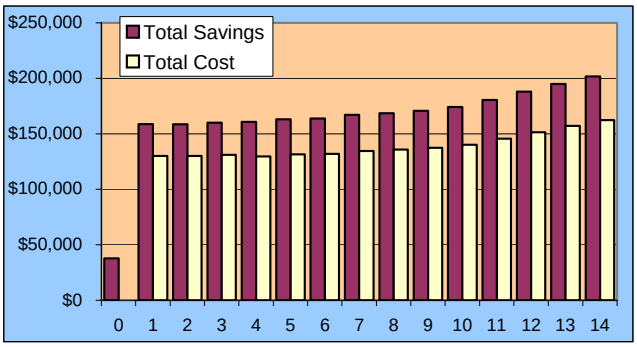


Project Turnkey Price:	**$ 2,436,540**
Third Party Consultant Fee:	**$ 50,000**
Bond Counsel	**$ 7,500**
Amount Financed:	**$ 2,494,040**
Utility Incentives & Rebates:	**$ -**
Capitalized Construction Interest:	$ 8,326
Total Amount Financed:	**$ 2,502,366**
Finance Rate:	**0.50%**

TRADE SECRET

Table 2.5 Project cash flow (maximize project savings).

Year	Utility Savings	O&M Savings	Total Savings	Lease Payments	M&V Service	Total Cost	Net Cash Flow
0	$ 37,893	$ -	**$ 37,893**	$ -	$ -	**$ -**	**$ 37,893**
1	$ 152,312	$ 6,540	**$ 158,852**	$ 114,612	$ 15,460	**$ 130,072**	**$ 28,780**
2	$ 151,964	$ 6,672	**$ 158,636**	$ 114,192	$ 15,769	**$ 129,962**	**$ 28,675**
3	$ 153,075	$ 6,804	**$ 159,879**	$ 114,933	$ 16,085	**$ 131,018**	**$ 28,861**
4	$ 153,831	$ 6,948	**$ 160,779**	$ 124,653	$ 4,825	**$ 129,478**	**$ 31,301**
5	$ 156,046	$ 7,080	**$ 163,126**	$ 126,451	$ 4,922	**$ 131,373**	**$ 31,753**
6	$ 160,627	$ 3,264	**$ 163,891**	$ 126,984	$ 5,020	**$ 132,004**	**$ 31,887**
7	$ 163,759	$ 3,324	**$ 167,083**	$ 129,455	$ 5,121	**$ 134,576**	**$ 32,507**
8	$ 165,256	$ 3,396	**$ 168,652**	$ 130,628	$ 5,223	**$ 135,851**	**$ 32,802**
9	$ 167,306	$ 3,456	**$ 170,762**	$ 132,231	$ 5,328	**$ 137,558**	**$ 33,204**
10	$ 170,456	$ 3,528	**$ 173,984**	$ 134,721	$ 5,434	**$ 140,155**	**$ 33,829**
11	$ 177,067	$ 3,600	**$ 180,667**	$ 139,975	$ 5,543	**$ 145,518**	**$ 35,149**
12	$ 184,231	$ 3,672	**$ 187,903**	$ 145,670	$ 5,654	**$ 151,324**	**$ 36,579**
13	$ 191,213	$ 3,744	**$ 194,957**	$ 151,218	$ 5,767	**$ 156,985**	**$ 37,972**
14	$ 197,843	$ 3,816	**$ 201,659**	$ 156,483	$ 5,882	**$ 162,365**	**$ 39,294**
15	$ 204,479	$ 3,900	**$ 208,379**	$ 161,760	$ 6,000	**$ 167,760**	**$ 40,619**
TOTAL	**$ 2,587,360**	**$ 69,744**	**$ 2,657,104**	**$ 2,003,967**	**$ 112,034**	**$ 2,116,001**	**$ 541,103**



Project Turnkey Price:	**$**	**1,862,002**
Third Party Consultant Fee:	**$**	**50,000**
Bond Counsel	**$**	**7,500**
Amount Financed:	**$**	**1,919,502**
Utility Incentives & Rebates:	**$**	**-**
Capitalized Construction Interest:	$	6,408
Total Amount Financed:	**$**	**1,925,909**
Finance Rate:		**0.50%**

TRADE SECRET

2.3 ECM COSTS

The performance contract will be a fixed price offering to Churchill County School District with single point responsibility for the duration of the project. Included in the fixed price offering are the following elements:

- Project development
- Energy savings calculations
- Savings and project cost guarantee
- Engineering and design
- Material and sub-contract labor procurement
- Construction management
- Commissioning
- Measurement and Verification
- System training

NORESCO has provided pricing breakout for each of the ECMs (Table 2.2) based on preliminary data identified during the site surveys and additional information provided by the District. During the Financial Grade Operational Audit, projects costs will be further developed and finalized resulting in a detailed proposal sufficient to justify project financing and approval. Under the Open Book pricing format, project cost components will identified and documented as summarized in Table 2.6 below.

Table 2.6 Project cost breakouts.

Description	Totals
NORESCO purchased material	$1,159,480
Subcontracted labor & material	$170,865
Disposal	$10,785
Audit, engineering and design	$167,697
Construction management	$163,284
Commissioning	$52,957
M&V	$ -
Proposal and project administration	$57,030
Travel	$43,762
Site conditions	$11,935
Contingency	$40,234
SUBTOTAL	**$1,878,368**
NORESCO overhead	$266,728
NORESCO profit	$231,039
Construction period interest	$19,892
Bonding and insurance	$36,534
Permitting	$3,978
Sales tax	$-
TOTAL PROJECT COST	**$2,436,540**

TRADE SECRET

It should be noted that the total cost for NORESCO to implement the project contains both fixed costs and variable costs. NORESCO's fixed costs have been apportioned across the entire project on a cost-weighted basis. Should CCSD desire to eliminate one or more of the recommended ECMs, NORESCO reserves the right to redistribute remaining project fixed costs among the remaining ECMs.

2.4 ECM SAVINGS

The economics of the project are based on the project cost and financing discussed in previous sections, and the revenue generated from project savings. Revenue will encompass the utility savings (electric, gas and water) resulting from the installation and operation of the energy and water conservation measures. In addition, Operations and Maintenance (O&M) savings associated with lighting materials and new HVAC system components will generate additional savings.

Energy Cost Savings

Energy cost savings are defined as the utility cost savings generated through implementation of the energy conservation measures. Each of the schools at CCSD is supplied utilities by the City of Fallon and Southwest Gas. Applicable rates from these utilities are applied to the engineering calculations as summarized below.

For the lighting, water and miscellaneous electrical ECMs, the cost reductions are determined by calculating the pre- and post-retrofit annual consumption for the equipment. Equipment information is collected during the site surveys, or estimated based on manufacturer's data or engineering assumptions. These equipment ratings are combined with operating data to calculate energy consumption baselines. The post-retrofit equipment consumption is then determined based on increased efficiencies and reduced operating hours. Customized spreadsheets are used to make the calculations.

Energy cost reductions resulting from HVAC, Building Envelope and Controls ECMs are calculated using spreadsheet calculations, local weather data, and building data collected from drawings and site surveys. For each school, an energy balance is calculated to correlate the field information (and resulting calculations) with utility billing information. For this Comprehensive Audit Report (RFP Phase), preliminary information was collected and compiled into the calculations. Building models and customized spreadsheets will be developed for the Financial-Grade Operational Audit. This process may include performance tests and installation of monitoring equipment to further refine the calibrated analysis. The modeling tools will use weather data applicable to the site evaluated, combined with equipment ratings, building characteristics, operating schedules and utility rates.

Operation and Maintenance Savings

NORESCO takes a conservative approach to savings on O&M budgets resulting from the energy efficiency improvements. Material savings resulting from equipment warranties or avoided ongoing repair costs can be documented and claimed as revenue to the project. New equipment is more reliable and restarts the life cycle compared to the existing equipment being replaced. New product warranties also provide a window of savings since repair and replacement costs can now be deferred.

O&M savings of $6,864 has been included starting in year one of the Project. This includes material savings from the lighting retrofit resulting from deferred maintenance/ replacement associated with the warranty of the new system as well as the extended life expectancy of the new equipment. O&M savings associated with lighting equipment discontinues at year 5 coinciding with the end of the warranty.

In addition, it is anticipated that additional savings will result from replacing troublesome heat pumps at the Churchill County High School Gymnasium and improving operation of the High School's water-source heat pump system. For the purposes of this preliminary analysis, O&M savings are calculated at 5% of energy savings and will result from the avoided replacement costs, warranty associated with the new systems, as well as the extended life expectancy of the new equipment.

Material and labor savings from upgrading the building control systems at the three schools may be realized. It should be noted that these new systems may also result in additional service contract costs to the District. O&M savings are not included from this project.

The District will also realize savings from implementation of facility operations management software. This software will streamline maintenance and repair activities, improve management facility event scheduling, and track utility expenditure. Savings from this software have not been included in the program.

2.5 RATE FORECAST

This section will describe the methodologies used to forecast electric and natural gas rates for the Churchill County School District. The intent is to document recently implemented rate changes as well as pending near-term rate increases for these utilities. Assumptions are then made to develop a price projection extending out to the end of the project financing term or cash flow model period, which in this case is 15 years. As utility prices increase over time, the cost savings resulting from energy efficiency measures increases accordingly. The intent is to capture all of the savings to which the District is entitled because increased savings equates to an increased scope of goods and services available to the District under this financing package.

Rate projection is a critical input to the financial cash projection for all energy savings. Churchill County School District is presently served by:

- Electric Service through City of Fallon Electric
- Natural Gas Services through Southwest Gas
- Other Services – City of Fallon (water/sewer), well or water rights, Self-Provided (solid waste).

Electric Service: The City of Fallon is currently a wholesale entity that is allowed to purchase energy through a variety of sources. Sierra Pacific Power Company provides transportation services, and depending on contractual arrangements may be providing full services to the City of Fallon as a "full requirements" wholesale customer. Because the City of Fallon is not regulated by the Nevada Public Utilities Commission, rate projections should be based on a more standardized approach than using typical utility projection techniques.

Natural Gas: Southwest Gas provides natural gas service to CCSD in accordance with published tariffs and rules. Southwest Gas is an investor owned utility that is regulated by the Nevada Public Utilities Commission.

Other Services: Other services including water, sewer, and waste are provided by the City of Fallon or others, and solid waste is actually self-provided by CCSD.

In order to establish a fair and balanced rate projection, the National Institute of Science and Technology (NIST) has documented information related to energy price indices. The use of the Consumer Price Index (CPI) provides a basic input to using the NIST rate formulation and provides a basic input to escalation for other services. The projections for the CCSD performance contracting project are summarized in Table 2.7 below.

Table 2.7 Rate projections.

Year	Electric $/kW/kWh	Natural Gas $/Therm	O&M Savings
0	100.00%	100.00%	100.0%
1	100.00%	101.01%	102.50%
2	100.00%	99.00%	102.50%
3	101.01%	100.00%	102.50%
4	100.00%	101.01%	102.50%
5	101.00%	102.00%	102.50%
6	102.97%	102.94%	102.50%
7	101.92%	101.90%	102.50%
8	101.89%	99.07%	102.50%
9	101.85%	100.00%	102.50%
10	101.82%	101.89%	102.50%
11	103.57%	104.63%	102.50%
12	103.45%	105.31%	102.50%
13	104.17%	103.36%	102.50%
14	103.20%	104.07%	102.50%
15	103.10%	103.91%	102.50%

This analysis represents best effort projection analysis at the time of this writing. As with most financial market projections, actual conditions may vary.

Electric Rate Projection

The electric rate projection is based on utilization of NISTR 85-3273-21 (Rev 04/06). For electric purposes, Table S-4 was utilized which provides input for Census Region 4. Since the Consumer Price Index Analysis for the West shows a 2.53% annual increase, a 3% inflation rate was used from Table S-4. The NIST documentation uses a base year of 2006 for indexing the escalation factors.

Natural Gas Rate Projection

The Natural Gas rate projection is based on utilization of NISTR 85-3273-21 (Rev 04/06). For natural gas purposes, Table S-4 was utilized which provides input for Census Region 4. Since the Consumer Price Index Analysis for the West shows a 2.53% annual increase, a 3% inflation rate was used from Table S-4. The NIST documentation uses a base year of 2006 for indexing the escalation factors.

Other Projections

Other savings (Water, Waste, etc) will be escalated at the 1995-2005 Consumer Price Index Average. For purposes of this project, the BLS Statistics for West Urban All Items was used to arrive at the 10 year average CPI increases between 1995 and 2005. The following table summarizes the CPI data for this period.

Table 2.8 Consumer Price Index Values.

Year	CPI Adjustment
1995	2.6%
1996	2.7%
1997	2.4%
1998	1.9%
1999	2.7%
2000	3.5%
2001	3.7%
2002	1.9%
2003	2.1%
2004	2.3%
2005	2.0%
1995/2005 Average	2.5%

SECTION 3.0: TECHNICAL SUMMARY

Three schools identified by CCSD for evaluation during this phase of the project represent a cross-section of building types and mechanical/electrical system configurations. These schools are summarized as follows:

Table 3.1 Facility list.

Building	Area (Sqft)
Northside Elementary School	45,436
Churchill County Jr. High School	140,594
Churchill County High School	215,988
Total	402,018

While CCSD has been successful at efficiently managing building operations and associated utility costs, several opportunities were identified to upgrade and improve existing building systems. These opportunities are focused on the efficiency of existing mechanical and electrical systems, controls, water and building envelope components.

Lighting systems represent a significant opportunity. NORESCO proposes to complete the upgrades previously initiated by CCSD. At completion of this proposed project, all District facilities will be operating with the most current technology of T8 lamps and electronic ballasts. This includes conversion of the high bay lighting in all gyms, shops, high bay areas and building exteriors. The new lighting systems will also facilitate the use of occupancy-based lighting controls.

In addition to creating energy savings, upgrading and optimizing the HVAC systems presents an opportunity for solving comfort and maintenance issues. Based on information provided by District staff, the water-source heat pump system at Churchill County High School struggles to maintain space temperatures during peak heating and cooling seasons. This causes the heat pumps to operate longer and harder than necessary. In addition, the heat pumps in the Gymnasium do not adequately condition this building and also operate longer than necessary creating maintenance and repair issues. These issues are addressed in NORESCO's proposed project. Combined with expansion and upgrade of the Building Automation System and several smaller ECMs, CCSD can expect to realize significant savings from HVAC system upgrades.

Building envelope improvements, interior water fixture upgrades, miscellaneous electrical improvements (vending machines, networked personal computers) and installation of a 10kW photovoltaic system will provide additional savings resulting in a comprehensive energy conservation and renewable energy project.

The following tables provide detailed summaries of the ECMs identified on a building-by-building basis, indicate the magnitude of the proposed energy savings strategies.

Table 3.2 EntelliChoice[sm] ECM matrix.				
ECM #	**ECM Description**	**Northside Elementary School**	**Churchill County Jr. High School**	**Churchill County High School**
1	Lighting system improvements	✓	✓	✓
2	High bay luminaire replacement		✱	✱
3	Lighting controls	✱	✓	✓
4	Daylighting controls			•
5	Upgrade building automation controls	✓	✓	✓
6	Optimize water source heat pump system			✱
7	Packaged unit replacement		✓	
8	Replace heat pumps with packaged units			✓
9	Fluid cooler VFD			✓
10	Economizer retrofit		•	
11	Kitchen cooling upgrades		✓	✓
12	Window upgrades/replacements	✱	•	
13	Building envelope improvements	•	✱	•
14	Water system improvements	✓	✓	✓
15	Photovoltaic system			✓
16	Facility operations management software (School Dude)			✓
17	Upgrade kitchen hot water booster heaters		•	•
18	Vending machine controls	✓	✓	✱
19	Miscellaneous electrical measures			•
20	Network power management	✓	✓	✓
21	Trash compaction	•	•	•
✓ Indicates project is currently included in 15-year program.				
✱ Indicates project is currently included in 15-year program and was identified in Section 1.4.3 of the RFP.				
• Indicates project is recommended but currently not included.				

Table 3.3 Building energy savings summary.					
		Electricity	Natural Gas	Water/Sewer	Totals
Northside Elementary School	Existing Annual Cost ($)	$33,707	$18,616	$8,786	$61,109
	Proposed Annual Savings ($)	$9,927	$2,846	$1,780	$14,554
	Reduction %	29%	15%	20%	24%
Churchill County Jr. High School	Existing Annual Cost ($)	$87,589	$58,570	$18,405	$164,564
	Proposed Annual Savings ($)	$16,799	$9,874	$1,881	$28,554
	Reduction %	19%	17%	10%	17%
Churchill County High School	Existing Annual Cost ($)	$240,021	$80,367	$38,929	$359,317
	Proposed Annual Savings ($)	$70,290	$46,497	$4,011	$120,797
	Reduction %	29%	58%	10%	34%
Year 2007 Totals	**Existing Annual Cost ($)**	**$361,317**	**$157,553**	**$66,120**	**$584,990**
Year 2007 Totals	**Proposed Annual Savings ($)**	**$97,016**	**$59,217**	**$7,672**	**$163,905**
	Reduction %	27%	38%	12%	28%
	Escalation	100.00%	101.01%	102.53%	
Year 2008 (Post Construction) TOTALS	**Proposed Annual Savings ($)**	**$97,016**	**$59,815**	**$7,866**	**$164,697**

Please note the significant natural gas savings at Churchill County High School. This is due to the recommendation of ECM6 – Optimize Water Source Heat Pump System. The existing central plant boilers are the primary consumer of natural gas at this school. This project will almost eliminate use of these boilers.

Table 3.4 ECM energy savings summary.

ECM Group	Building	Description	kW-mo	kW Cost	kWh	kWh Cost	Therms	Nat Gas Cost	KGal.	Water Cost	KGal.	Sewer Cost	Energy & Water Subtotal	O&M Subtotal $
1	Northside Elementary School	Lighting System Improvements	93	$ -	27,109	$ 3,680	(306)	$ (371)	-	$ -	-	$ -	$ 3,309	$ 273
1	Churchill County Jr. High School	Lighting System Improvements	59	$ 393	20,683	$ 1,933	(201)	$ (244)	-	$ -	-	$ -	$ 2,083	$ 164
1	Churchill County High School	Lighting System Improvements	913	$ 6,130	247,104	$ 23,099	(3,085)	$ (3,740)	-	$ -	-	$ -	$ 25,489	$ 2,129
2	Churchill County Jr. High School	High Bay Luminaire Replacement	70	$ 467	25,786	$ 2,411	(364)	$ (441)	-	$ -	-	$ -	$ 2,437	$ -
2	Churchill County High School	High Bay Luminaire Replacement	94	$ 633	32,946	$ 3,080	(465)	$ (564)	-	$ -	-	$ -	$ 3,149	$ -
3	Northside Elementary School	Lighting Controls	-	$ -	11,282	$ 1,532	-	$ -	-	$ -	-	$ -	$ 1,532	$ -
3	Churchill County Jr. High School	Lighting Controls	-	$ -	26,399	$ 2,468	-	$ -	-	$ -	-	$ -	$ 2,468	$ -
3	Churchill County High School	Lighting Controls	-	$ -	33,580	$ 3,139	-	$ -	-	$ -	-	$ -	$ 3,139	$ -
5	Northside Elementary School	Upgrade Building Automation Controls	-	$ -	14,405	$ 1,956	1,206	$ 1,462	-	$ -	-	$ -	$ 3,417	$ -
5	Churchill County Jr. High School	Upgrade Building Automation Controls	-	$ -	56,147	$ 5,249	5,405	$ 6,553	-	$ -	-	$ -	$ 11,802	$ -
5	Churchill County High School	Upgrade Building Automation Controls	-	$ -	130,781	$ 12,225	7,483	$ 9,072	-	$ -	-	$ -	$ 21,297	$ -
6	Churchill County High School	Optimize Water Source Heat Pump System	-	$ -	130,781	$ 12,225	31,801	$ 38,555	-	$ -	-	$ -	$ 50,780	$ 2,840
7	Churchill County Jr. High School	Packaged Unit Replacement	60	$ 401	7,954	$ 744	1,021	$ 1,238	-	$ -	-	$ -	$ 2,382	$ -
8	Churchill County High School	Replace Heat Pumps With Packaged Units	196	$ 1,318	26,156	$ 2,445	1,497	$ 1,814	-	$ -	-	$ -	$ 5,577	$ 317
11	Churchill County Jr. High School	Kitchen Cooling Upgrades	(81)	$ (544)	(4,500)	$ (421)	-	$ -	-	$ -	-	$ -	$ (965)	$ -
11	Churchill County High School	Kitchen Cooling Upgrades	(81)	$ (544)	(4,500)	$ (421)	-	$ -	-	$ -	-	$ -	$ (965)	$ -
12	Northside Elementary School	Window Upgrades/Replacements	48	$ -	6,398	$ 869	828	$ 1,004	-	$ -	-	$ -	$ 1,872	$ -
13	Churchill County Jr. High School	Building Envelope Improvements	50	$ 338	6,706	$ 627	868	$ 1,052	-	$ -	-	$ -	$ 2,017	$ -
14	Northside Elementary School	Water System Improvements	-	$ -	-	$ -	644	$ 781	597	$ 876	597	$ 949	$ 2,606	$ 194
14	Churchill County Jr. High School	Water System Improvements	-	$ -	-	$ -	1,497	$ 1,815	631	$ 925	631	$1,003	$ 3,744	$ 321
14	Churchill County High School	Water System Improvements	-	$ -	-	$ -	1,509	$ 1,829	1,345	$1,973	1,345	$2,139	$ 5,942	$ 622
15	Churchill County High School	Photovoltaic System	90	$ 604	19,909	$ 1,861	-	$ -	-	$ -	-	$ -	$ 2,466	$ -
16	Churchill County High School	Facilitiy Operations Management Software (School Dude)	-	$ -	-	$ -	-	$ -	-	$ -	-	$ -	$ -	$ -
18	Northside Elementary School	Vending Machine Controls	-	$ -	1,831	$ 249	-	$ -	-	$ -	-	$ -	$ 249	$ -
18	Churchill County Jr. High School	Vending Machine Controls	-	$ -	2,747	$ 257	-	$ -	-	$ -	-	$ -	$ 257	$ -
18	Churchill County High School	Vending Machine Controls	-	$ -	4,579	$ 428	-	$ -	-	$ -	-	$ -	$ 428	$ -
20	Northside Elementary School	Network Power Management	-	$ -	12,100	$ 1,643	-	$ -	-	$ -	-	$ -	$ 1,643	$ -
20	Churchill County Jr. High School	Network Power Management	-	$ -	26,500	$ 2,477	-	$ -	-	$ -	-	$ -	$ 2,477	$ -
20	Churchill County High School	Network Power Management	-	$ -	43,500	$ 4,066	-	$ -	-	$ -	-	$ -	$ 4,066	$ -
		TOTALS	**1,510**	**$ 9,196**	**906,384**	**$ 87,820**	**49,337**	**$ 59,815**	**2,573**	**$3,774**	**2,573**	**$4,092**	**$164,697**	**$ 6,861**

SECTION 4.0: BASE YEAR USE

4.1 ENERGY BASELINE

NORESCO analyzed the available data for electricity, natural gas, and water for the three Churchill County School District campuses. NORESCO developed the baseline reference for all fuels using the period of July 2005 to June 2006 and utilized this period as the baseline in the energy saving calculations. The baseline data is summarized in the table below.

Table 4.1 Baseline utility summary.

Campus	Electricity		Natural Gas (Therms)	Water/Sewer (Gallons)
	Demand (kW)	Usage (kWh)		
Churchill County High School	9,879	2,162,354	63,354	8,080,198
Churchill County Jr. High School	3,434	812,256	45,306	2,252,739
Northside Elementary School	1,142	281,831	11,898	2,439,770
Totals	**14,455**	**3,256,441**	**120,558**	**12,772,707**

Note: Demand values are the total sum of the monthly peak demand values.

The energy saving calculations are based on the above calculated baseline and on weather data provided by NOAA for Fallon, NV. Cost savings are based on the most recent marginal utility rates, which are summarized in Table 4.2.

Electric service for each of the campuses is currently provided by the City of Fallon. Service to the High School and Junior High School is billed on the Commercial OGS-1 tariff which includes a flat demand (kw) and flat energy (kWh) component. Service to Northside Elementary School is billed on the Commercial GS-1 tariff which uses an energy only pricing structure.

Natural gas service for each of the campuses is provided by Southwest Gas Company on the NG-22(L) tariff. The cost of natural gas fluctuates from month to month. The rate utilized in the cost savings calculations is based on the tariff in effect at the time the audit was initiated.

Water and sewer service for each of the campuses is provided by the City of Fallon. The rates used for water and sewer service are based on the most recent effective tariff.

Table 4.2 Utility rates.					
Building	Electricity		Natural Gas ($/Therm)	Water Service ($/kGal)	Sewer Service ($/kGal)
	Demand ($/kW)	Usage ($/kWh)			
Churchill County High School	$6.7116	$0.09348	$1.20025	$1.4305	$1.5508
Churchill County Jr. High School	$6.7116	$0.09348	$1.20025	$1.4305	$1.5508
Northside Elementary School	$.0.0000	$0.13576	$1.20025	$1.4305	$1.5508

Currently, the District spends approximately $584,990 annually on energy and water/sewer for the three campuses included in the scope of this proposal. The ages, conditions, and types of systems in each building vary greatly, and their varying energy intensities reflect these differences. The Churchill County High School uses approximately 63.5 kBtu per square foot annually, taking into account both electricity and natural gas. The Churchill County Junior High School and Northside Elementary School have relatively lower energy intensities of approximately 51.9 and 47.4 kBtu/ft2 respectively.

4.2 Facility Baseline Consumption

Once the baseline was established, a more detailed look at each individual building reflected the electric and natural gas consumption, and costs per square foot, which is used as a building performance indicator by NORESCO energy engineers. This information allows the engineers to identify energy-intensive buildings on a comparative basis, with other similar buildings NORESCO has successfully worked with over the last 20 years. The figures below provide graphical representations of the electric and fuel baseline consumption, and costs per square foot for each individual building.

Figure 4.1 Baseline kWh per square foot.

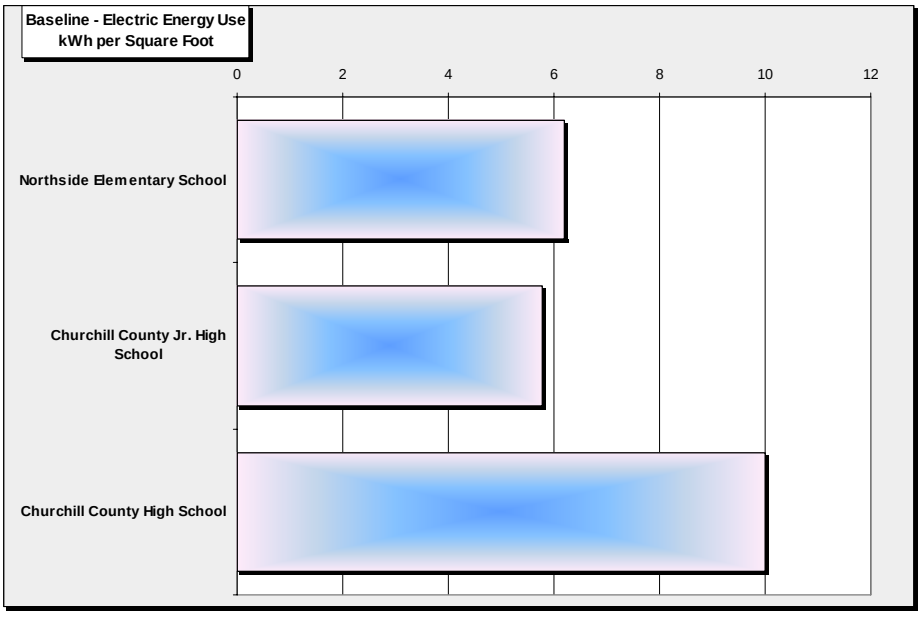


Figure 4.2 Baseline Mbtu's per square foot.

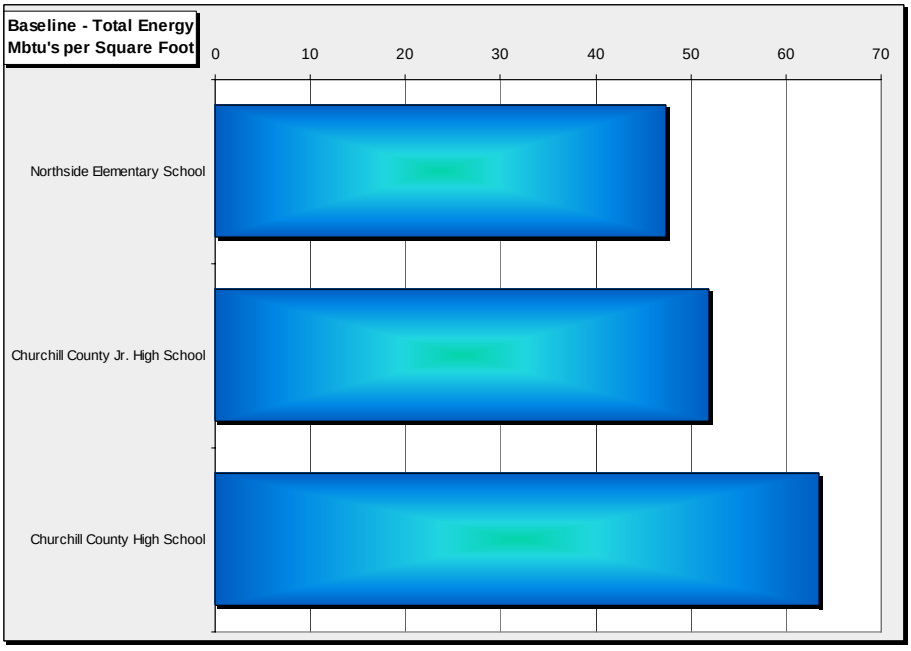
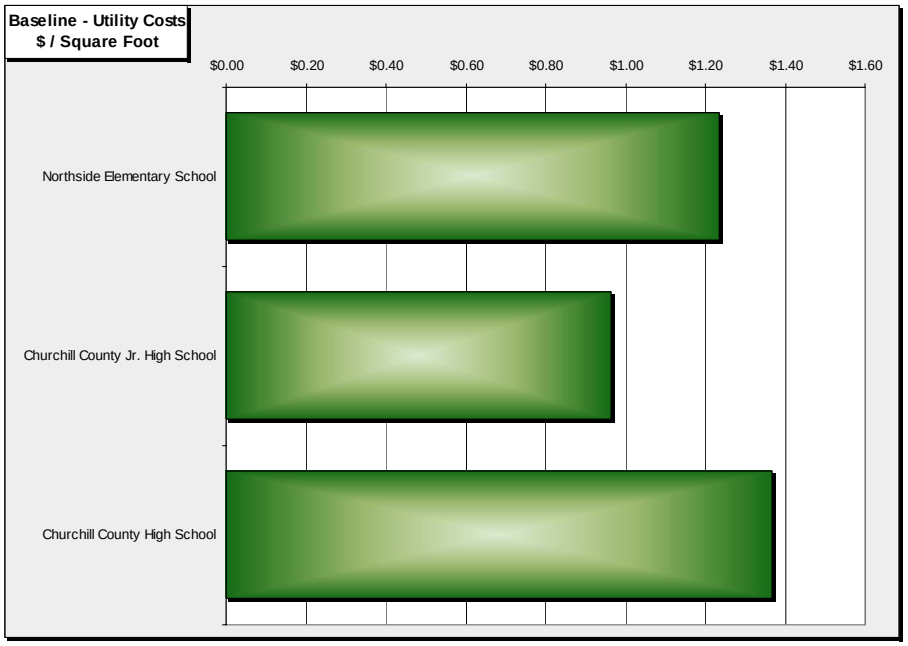


Figure 4.3 Baseline dollars per square foot.



In addition, NORESCO staff visited each of these buildings during the preliminary audit walkthrough. NORESCO engineers interviewed with facilities staff about occupancy, space utilization, conditions maintained and any existing problems. Observations of equipment conditions and other tell-tale signs of problems were recorded. Major equipment nameplate information was collected or gathered from design drawings. Finally, a preliminary review of the existing Energy Management System programs was conducted to help identify operating patterns.

Upon completion of this process, NORESCO examined the electric energy consumption for each building and performed a preliminary end-use analysis. Based on the information gathered, NORESCO engineers then determined the percentage of energy consumed for each end-use such as lighting, air conditioning, fan motors, pump motors, space heating, etc. The electric consumption was then reconciled with the baseline to ensure that any calculations were not overly aggressive. This "reality" check also serves to verify certain assumptions and our understanding of the buildings and their operation.

SECTION 5.0: ECM DESCRIPTIONS

ECM 1 – LIGHTING SYSTEM IMPROVEMENTS

5.1.1 OVERVIEW

Measure Summary

NORESCO has conducted a detailed audit of three Churchill County School District campuses, and has found that there is a significant opportunity for lighting system improvements. NORESCO proposes to install new energy efficient lighting fixtures, as well as modifying existing fluorescent fixtures to increase their efficiency.

Affected Areas

NORESCO proposes to provide lighting system improvements in the following areas:

- Churchill County High School
- Churchill County Junior High School
- Northside Elementary School

5.1.2 DETAILED DESCRIPTION

Existing System Description

The existing lighting systems at the Churchill County High School consist primarily of fluorescent fixtures with four-foot T12 lamps and magnetic ballasts. Approximately one-fourth of the fluorescent fixtures use more efficient 32-watt T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed acrylic troffers, and wall- or surface-mounted fixtures. There is also a large quantity of metal halide lamps throughout the campus and used mainly for exterior lighting.

The existing lighting systems at the Churchill County Junior High School consist primarily of fluorescent fixtures with four-foot 32-watt T8 lamps and electronic ballasts. Approximately 15% of the existing fixtures use less efficient T12 lamps and magnetic ballasts. The T12 fixtures are mainly located in classrooms B1-B5 and the Gymnasium locker rooms and weight room. The most common fluorescent fixture types are recessed troffers with acrylic lenses or deep cell parabolic louvers, and wall- or surface-mounted fixtures. There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used mainly for exterior lighting.

The existing lighting systems at the Northside Elementary School consist primarily of fluorescent fixtures. Approximately 60% of the fixtures use four-foot 32-watt T8 lamps and electronic ballasts. The remaining 40% of the fixtures with T12 lamps and magnetic or electronic ballasts are found mainly in the East and South wings of the building. The most common fluorescent fixture types are surface-mounted industrial and wrap lens fixtures. There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used mainly for exterior lighting.

Existing Deficiencies

Although the lighting systems in some areas of each of the campuses have been upgraded with more efficient lamps and ballasts, there are significant opportunities for further improvement. The existing T12 fluorescent lighting systems can be upgraded to the latest generation of energy efficient T8 lamps and electronic ballasts. There are also many opportunities to retrofit or replace existing HID fixtures with compact fluorescent lamps. The existing HID fixtures, although efficient, have a number of drawbacks, including poor color rendering and long re-strike times.

Proposed Improvements

In order to maximize the overall electric savings, NORESCO proposes to optimize the existing light systems in all facilities. This will include retrofitting and/or replacing a total of 2,450 lighting fixtures with more efficient T8 or compact fluorescent lamp technology.

Scope of Work

A full room-by-room detailed lighting audit report is included with this detailed energy audit. The report includes existing and proposed fixture types, quantities, and hours of operation for each area included in the energy audit. This information is based on actual site conditions.

Following is a brief description of the work to be undertaken in each area:

Churchill County High School

- The existing 2'x4' recessed fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power electronic ballast and a specular reflector. In many cases where two fixtures are mounted end-end or side-side, one (1) 4-lamp electronic ballast will be used to power all four lamps of both fixtures.
- The existing 2'x4' recessed fluorescent fixtures containing three (3) T12 lamps and magnetic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) low-power electronic ballast and a specular reflector.
- The existing 2'x2' recessed fluorescent fixtures containing two (2) T12 U-bend lamps and magnetic ballasts will each be retrofitted with (2) 17-watt T8 lamps, one (1) standard-power electronic ballast and a specular reflector.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power electronic ballast. Existing fixture styles include 1'x4' and 2'x4' recessed, 2'x4' surfaced box, 4' and 8' strip, wraparound, and vapor tight fixtures.

- The existing 8-foot industrial style fixtures containing T12 high output lamps and magnetic ballasts and located in shops will be retrofitted with six (6) 28-watt T8 lamps and high efficient low-power electronic ballasts.
- The incandescent vanity fixtures located in various restrooms will be replaced with new fixtures containing two (2) 17-watt T8 lamps and standard-power electronic ballasts.
- Other existing incandescent fixtures will be retrofitted or replaced with compact fluorescent lamps.
- The existing 400-watt HID pole-mounted fixtures located in the faculty and student parking lots will be replaced with new fluorescent fixtures containing two (2) 54-watt T5 lamps and electronic ballasts.
- The existing 100-watt HID recessed fixtures located on the building exteriors will each be retrofitted with one (1) 42-watt compact fluorescent lamp.
- The existing 150-watt and 175-watt HID wallpack fixtures located on the building exteriors will be replaced with new fixtures containing two (2) 32-watt compact fluorescent lamps.
- The existing 100-watt HID wall-mounted downlights on the exterior of the Main building will each be retrofitted with one (1) 42-watt mogul-based compact fluorescent lamp.
- The existing 250-watt HID fixtures located under the covered storage area of the Vocational Shops building will not be retrofit due to short operating hours.
- The existing fluorescent **fixtures containing T8 lamps will not be upgraded in this project.**

Churchill County Junior High School

- The existing 2'x4' recessed fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power electronic ballast and a specular reflector.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power electronic ballast. Existing fixture styles include 2'x4' recessed, 1'x4' surfaced box, 4' industrial, wraparound, and vapor tight fixtures.
- The incandescent vanity fixtures located in the coaches restrooms will be replaced with new fixtures containing two (2) 17-watt T8 lamps and standard-power electronic ballasts.
- Other existing incandescent fixtures will be retrofitted or replaced with compact fluorescent lamps.
- The existing 175-watt HID wallpack fixtures located on the building exteriors will be replaced with new fixtures containing two (2) 32-watt compact fluorescent lamps.
- The existing 100-watt and 150-watt HID recessed downlights on the exterior of the Main building will each be retrofitted with one (1) 42-watt mogul-based compact fluorescent lamp.

- The existing fluorescent **fixtures containing T8 lamps will not be upgraded in this project.**

Northside Elementary School

- The existing 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic or electronic ballasts and located in classrooms and the library will each be retrofitted with two (2) 28-watt T8 lamps, one (1) high-power electronic ballast and a specular reflector.
- The existing 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic or electronic ballasts and located in the lobby, one office and the kitchen storage room will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power electronic ballast and a specular reflector.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic or electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power electronic ballast. In many cases where two fixtures are mounted end-end, one (1) 4-lamp electronic ballast will be used to power all four lamps of both fixtures. Existing fixture styles include 1'x4' surface box, 4' strips, and wraparound fixtures.
- Existing incandescent fixtures will be retrofitted or replaced with compact fluorescent lamps.
- The existing 175-watt HID wallpack fixtures located on the building exteriors will be replaced with new fixtures containing two (2) 32-watt compact fluorescent lamps.
- The existing 100-watt HID recessed fixtures located on the building exteriors will each be retrofitted with one (1) 42-watt compact fluorescent lamp.
- The existing fluorescent **fixtures containing T8 lamps will not be upgraded in this project.**

Facility Impact

NORESCO will coordinate all work with the facility staff to minimize the impact on the building occupants.

5.1.3 INTEGRATION WITH EXISTING SYSTEMS AND OPERATIONS

Impact on Facility Operations and Performance

The work under this ECM will result in significant electrical energy savings. Where new fixtures are installed, the useful life of the lighting system will be increased significantly. Maintenance costs will also be lower, as replacement cycles will be reduced.

In addition, the recommended T-8 lamps contain 70 percent less mercury than existing lamps and have a higher Color Rendering Index (CRI) than those currently in use, resulting in an increase in light quality.

Special Operating Requirements

There are no special operating requirements associated with the lighting improvement measures.

5.1.4 EQUIPMENT INFORMATION

Manufacturer and Type

The proposed lighting equipment will be manufactured by one of the following corporations:

Lamps:

- **Phillips Lighting Co.**, 200 Franklin Square Dr., Somerset, NJ, 08875, (908) 563-3000.
- **Osram-Sylvania Inc.**, 100 Endicott St., Danvers, MA, 01923, (800) 544-4828.
- **General Electric Co.**, 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070.

Ballasts:

- **Advance Transformer Co.**, 10275 West Higgins, Rosemont, IL, 60018, (708) 390-5109
- **Howard Industries,** PO BOX 1590, Laurel, MS, 39441, (800) 956-3456.
- **General Electric Co.**, 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070.
- **Osram-Sylvania Inc.**, 100 Endicott St., Danvers, MA, 01923, (800) 544-4828.
- **Universal Lighting Prod. Gr.**, 26 Century Blvd., Nashville, TN, 1 (800) BALLAST

Fixtures:

- **Tristar Lighting,**1349 Ford Road, New Salem, PA, 19020, (215) 638-8180.
- **Lithonia Hi-Tek,** PO Box 72, Crawfordsville, IN, 47933, (317) 362-1837.
- **Simkar Corp.**, 700 Ramona Ave., Philadelphia, PA, 19120-4691, (215) 831-7700.
- **Thomas Lighting (Daybrite), Commercial & Industrial Div.**, 1015 S. Green St., Tupelo, MS, 38802, (601) 842-7212.
- **Crescent Lighting,** 120 East Gloucester Pike, Barrington, NJ, 08007, (609) 546-5000.

Reflectors:

- **Energy Planning Associates,** 148 Maritime Drive, Sanford, FL, 32771 (407) 302-0001.
- **Reflect-A-Light,** U.S. 17 North, Route 6, Box 800, Palatka, FL, 32177, (904)-328-1580.

Material Specifications

Low Mercury T8 Lamps: The new, medium bi-pin T8 lamps will be 4100k with up to 24,000 hours of average rated life and a Color Rendering Index of 85.

Ballasts: The UL, CBM and CSA certified lighting ballasts will be of the programmed or instant start type electronic ballast with a total harmonic distortion rating of less than 20%.

Compact Fluorescent Lamps: These UL and CSA certified lamps utilize high quality phosphors for outstanding Color Rendering Index (CRI) from 80 to 85. The lamp temperature ranges from 2,700 degrees Kelvin to 4,100 degrees Kelvin. Average rated life of the lamps is 10,000 hours.

Compact Fluorescent Fixtures: The new UL and CSA certified fixtures utilize heavy gauge post painted steel pans, durable two-pin thermoplastic sockets and socket clips for excellent lamp alignment and photometrics. Fixtures are either surface mount or designed for suspended ceiling or air handling plenums. All ballasts are factory tested.

Fluorescent Lighting Fixtures: The new fixtures will consist of heavy die-formed steel to insure uniformity and dimensional stability with a quality rust-resistant high-gloss white enamel paint. The paint is baked on at high temperatures to ensure durability. Fixtures are all approved by UL. Fixtures are constructed with convenient knock-outs for ease of installation in a wide variety of applications that can be mounted using many usual methods. Lenses are constructed of high quality extruded virgin acrylic with excellent UV resistance.

Reflectors: The reflectors are designed to maximize light output for even light distribution, ease of installation, and achieve ballast access without tools. Material form, fit and thickness requirements meet UL Standard 1570 requirements.

5.1.4 COMMISSIONING PROCEDURE

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.1.5 ENVIRONMENTAL ISSUES

As part of this ECM, all T12 fluorescent lamps containing mercury will be replaced with lamps containing 70 percent less mercury. All hazardous waste, including ballasts containing PCBs and lamps containing mercury, will be removed by NORESCO and recycled by certified companies.

5.1.6 MEASUREMENT AND VERIFICATION PLAN

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.1.7 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

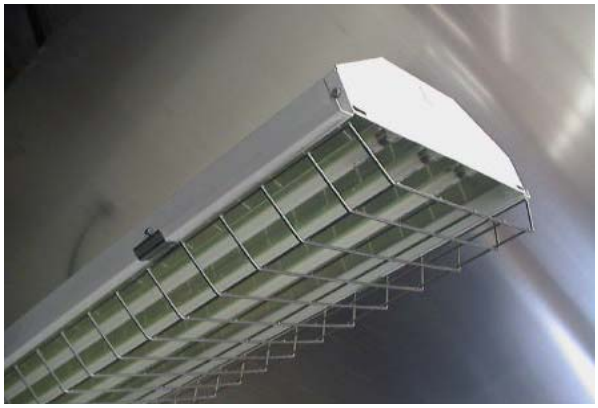
In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 2 – HIGH BAY LUMINAIRE REPLACEMENT

5.2.1 OVERVIEW

Measure Summary

NORESCO has conducted a detailed audit of three Churchill County School District campuses, and has found that there is a opportunity to upgrade existing high intensity discharge (HID) lighting systems. NORESCO proposes to replace existing high bay HID lighting systems with new energy efficient fluorescent lighting fixtures.



Affected Areas

NORESCO proposes to upgrade the high bay HID lighting systems in the following areas:

- Churchill County High School – Gymnasiums
- Churchill County High School – Auto Shop
- Churchill County Junior High School - Gymnasiums

5.2.2 DETAILED DESCRIPTION

Existing System Description

The existing lighting systems at the Churchill County High School gymnasiums and auto shop consist of high bay HID luminaires with 400 watt metal halide lamps and ballasts.

The existing lighting systems at the Churchill County Jr. High School gymnasiums consist of high bay HID luminaires with 400 watt metal halide lamps and ballasts.

Existing Deficiencies

The existing HID fixtures, although efficient, have a number of drawbacks, including poor color rendering and long re-strike times.

Proposed Improvements

NORESCO proposes to upgrade the efficiency and usability of lighting systems in areas using high bay HID luminaries by replacing them with new fixtures using energy efficient fluorescent T8 technology. This will include installing a total of 99 new lighting fixtures. The fluorescent technology does not require long re-strike and warm up times. Therefore, the lighting systems in these areas will allow for more frequent switching on/off and potentially multiple levels of light output.

Scope of Work

A full room-by-room detailed lighting audit was performed to develop the recommendations herein. The following information was collected during this process: existing and proposed fixture types, quantities, and hours of operation for each area. This information is based on actual site conditions.

Following is a brief description of the work to be undertaken in each area:

Churchill High School

- The existing high bay HID fixtures in the main Gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing eight (8) 28-watt T8 lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.
- The existing high bay HID fixtures in the small Gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing six (6) 28-watt T8 lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.
- The existing high bay HID fixtures in the auto shop containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing six (6) 28-watt T8 lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.

Churchill Junior High School

- The existing high bay HID fixtures in the main Gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing eight (8) 28-watt T8 lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.
- The existing high bay HID fixtures in the small Gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing six (6) 28-watt T8 lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.

Facility Impact

NORESCO will coordinate all work with the facility staff to minimize the impact on the building occupants.

5.2.3 INTEGRATION WITH EXISTING SYSTEMS AND OPERATIONS

Impact on Facility Operations and Performance

The work under this ECM will result in significant electrical energy savings. The new fixtures will extend the useful life of the lighting systems. Maintenance costs will also be lower, as replacement cycles will be reduced. The multiple lamps in the new fixtures will allow for several lamps to fail before the fixture requires maintenance versus the single lamps found in the existing fixtures.

The "instant on" fluorescent technology will allow for greater flexibility in controlling the lights in these areas, whether though manual user-based or automatic occupancy sensor or daylighting controls.

In addition, the recommended T-8 lamps have a higher Color Rendering Index (CRI) than the existing metal halide lamps, resulting in an increase in light quality.

Special Operating Requirements

There are no special operating requirements associated with the lighting improvement measures.

5.2.4 EQUIPMENT INFORMATION

Manufacturer and Type

The proposed lighting equipment will be manufactured by one of the following corporations:

Lamps:

- **Phillips Lighting Co.**, 200 Franklin Square Dr., Somerset, NJ, 08875, (908) 563-3000.
- **Osram-Sylvania Inc.**, 100 Endicott St., Danvers, MA, 01923, (800) 544-4828.
- **General Electric Co.**, 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070.

Ballasts:

- **Advance Transformer Co.**, 10275 West Higgins, Rosemont, IL, 60018, (708) 390-5109
- **Howard Industries,** PO BOX 1590, Laurel, MS, 39441, (800) 956-3456.
- **General Electric Co.**, 3135 Easton Turnpike, Fairfield, CT, 06828-0001, (941) 418-5070.
- **Osram-Sylvania Inc.**, 100 Endicott St., Danvers, MA, 01923, (800) 544-4828.
- **Universal Lighting Prod. Gr.**, 26 Century Blvd., Nashville, TN, 1 (800) BALLAST

Fixtures:

- **Tristar Lighting,** 1349 Ford Road, New Salem, PA, 19020, (215) 638-8180.
- **Lithonia Hi-Tek,** PO Box 72, Crawfordsville, IN, 47933, (317) 362-1837.
- **Simkar Corp.**, 700 Ramona Ave., Philadelphia, PA, 19120-4691, (215) 831-7700.
- **Thomas Lighting (Daybrite), Commercial & Industrial Div.**, 1015 S. Green St., Tupelo, MS, 38802, (601) 842-7212.
- **Crescent Lighting,** 120 East Gloucester Pike, Barrington, NJ, 08007, (609) 546-5000.

Material Specifications

Low Mercury T8 Lamps: The new, medium bi-pin T8 lamps will be 4100k with 20,000 hours of average rated life and a Color Rendering Index of 85.

Ballasts: The UL, CBM and CSA certified lighting ballasts will be of the programmed or instant start type electronic ballast with a total harmonic distortion rating of less than 20%.

Fluorescent Lighting Fixtures: The new fixtures will consist of heavy die-formed steel to insure uniformity and dimensional stability with a quality rust-resistant high-gloss white enamel paint. The paint is baked on at high temperatures to ensure durability. Fixtures are all approved by UL. Fixtures are constructed with convenient knock-outs for ease of installation in a wide variety of

applications that can be mounted using many usual methods. Lenses are constructed of high quality extruded virgin acrylic with excellent UV resistance.

5.2.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.2.6 Environmental Issues

As part of this ECM, all hazardous waste, including ballasts containing PCBs and lamps containing mercury, will be removed by NORESCO and recycled by certified companies.

5.2.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.2.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 3 – LIGHTING CONTROLS

5.3.1 OVERVIEW

Measure Summary

NORESCO has conducted a detailed audit of three Churchill County School District campuses, and has found that there is a significant opportunity for improvements to the lighting system controls. NORESCO proposes to install occupancy sensors to control the lighting fixtures in select classrooms, offices, conference rooms, workrooms, and gymnasiums, thereby minimizing unnecessary usage.

Affected Areas

NORESCO proposes to provide lighting system improvements in the following areas:

- Churchill County High School
- Churchill County Junior High School
- Northside Elementary School

5.3.2 DETAILED DESCRIPTION

Existing System Description

The existing lighting systems in all areas of each of the schools are controlled using manual wall switches.

Existing Deficiencies

Manual control of lighting systems relies on occupants and facility staff to turn lights off when rooms are not in use. Although periodic campaigns to remind staff and students of energy conservation issues can increase occupant awareness, energy savings can only be maximized through the use of automatic lighting control systems.

Proposed Improvements

In order to maximize the overall electric savings, NORESCO proposes to optimize the control of new and existing light systems in many areas at each of the facilities to minimize unnecessary operation during unoccupied hours. This will be accomplished through new occupancy-based controls installed in classrooms, offices, conference rooms, workrooms, and gymnasiums.

Scope of Work

A full room-by-room detailed lighting audit was performed to develop the recommendations herein. The following information was collected during this process: existing and proposed fixture types, quantities, and hours of operation for each area. This information is based on actual site conditions.

Following is a brief description of the work to be undertaken in each area:

Churchill County High School

- Nearly all classrooms will receive wall- or ceiling-mounted occupancy sensors to automatically turn off lights when the rooms are unoccupied for extended periods. Only the Home Economics (room 23) and Art (room V-6) classrooms will not receive occupancy sensors due to the odd shapes of these areas.
- Ten of the individual offices will receive wall-mounted occupancy sensors. In general, only offices with four or more light fixtures are included in the lighting controls project, as the savings is not great enough in rooms with fewer fixtures to justify the cost.
- Eleven areas used for administrative office type activities, such as, faculty lounges and work rooms, copy rooms, and the library work rooms will receive wall- or ceiling mounted occupancy sensors.
- The main and auxiliary gymnasiums will each receive wall- or ceiling-mounted occupancy sensors.
- The weight room in the Gymnasium building will receive wall- or ceiling-mounted occupancy sensors.
- The sensors will be tested and adjusted to assure correct operation at each location.

Churchill County Junior High School

- Each of the classrooms will receive wall- or ceiling-mounted occupancy sensors to automatically turn off lights when the rooms are unoccupied for extended periods.
- Six of the individual offices will receive wall-mounted occupancy sensors. In general, only offices with four or more light fixtures are included in the lighting controls project, as the savings is not great enough in rooms with fewer fixtures to justify the cost.
- Six areas used for administrative office type activities, such as, faculty lounges and work rooms, copy rooms, and the library work rooms will receive wall- or ceiling mounted occupancy sensors.
- The weight room in the Gymnasium building will receive wall- or ceiling-mounted occupancy sensors.
- The weight room in the Gymnasium building will receive wall- or ceiling-mounted occupancy sensors.
- The sensors will be tested and adjusted to assure correct operation at each location.

Northside Elementary School

- Each of the classrooms will receive wall- or ceiling-mounted occupancy sensors to automatically turn off lights when the rooms are unoccupied for extended periods.
- Three of the individual offices will receive wall-mounted occupancy sensors. In general, only offices with four or more light fixtures are included in the lighting controls project, as the savings is not great enough in rooms with fewer fixtures to justify the cost.
- Two faculty work rooms will receive wall- or ceiling mounted occupancy sensors.
- The multi-purpose room will receive wall- or ceiling-mounted occupancy sensors.
- The sensors will be tested and adjusted to assure correct operation at each location.

Facility Impact

NORESCO will coordinate all work with the facility staff to minimize the impact on the building occupants.

5.3.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The work under this ECM will result in significant electrical energy savings. The lighting controls will also extend the life of the lighting systems, due to the reduction in operating hours.

Special Operating Requirements

There are no special operating requirements associated with the lighting controls measures.

5.3.4 Equipment Information

Manufacturer and Type

The proposed lighting controls will be manufactured by one of the following corporations:

Sensors:

- **Hubbel,** 185 Plains Road, Milford, CT 06460-2420, (203) 882-4800
- **The Watt Stopper,** 2800 De La Cruz Blvd., Santa Clara, CA 95050, (408)-988-5331
- **Sensor Switch,** 10 Capital Drive, Wallingford, CT 06492, (203) 265-2842

Material Specifications

Occupancy Sensors: Occupancy sensors will be ceiling- or wall-mounted and may use ultrasonic or passive infrared technology. Turning lights off in unoccupied spaces provides savings by reducing electricity consumption, extending lamp life and reducing maintenance costs. All sensors and related components specified meet UL requirements.

5.3.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.3.6 Environmental Issues

There are no environmental issues associated with the lighting controls measure.

5.3.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.3.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 4 – DAYLIGHTING CONTROLS

5.4.1 OVERVIEW

Measure Summary

NORESCO has conducted a detailed audit of three Churchill County School District campuses, and has found that there is an opportunity for significant improvements to the lighting systems in the gymnasiums. NORESCO proposes to install skylights in each of the gymnasiums to introduce natural daylight, which will improve the light quality and daytime light levels. The light fixtures will automatically be controlled with daylight sensors when there is sufficient natural light present.

Affected Areas

NORESCO proposes to provide lighting system improvements in the following areas:

- Churchill County High School – Main & Auxiliary Gymnasiums
- Churchill County Junior High School – Main & Auxiliary Gymnasiums

5.4.2 DETAILED DESCRIPTION

Existing System Description

The existing lighting systems in each of the gymnasiums consist of high bay HID light fixtures. NORESCO proposes (ECM 2 – High Bay Luminaire Replacement) to replace the lighting systems with new fluorescent fixtures which will allow for daylight control.

Existing Deficiencies

Although the new fluorescent light fixtures proposed for the gymnasiums will improve the lighting quality, introducing natural daylight will provide an even greater improvement.

Proposed Improvements

Skylights will be installed to provide natural daylight. In order to maximize the overall electric savings, NORESCO proposes to control the light systems in the gymnasiums so the fixtures are turned off when there is sufficient natural light present.

Scope of Work

A full room-by-room detailed lighting audit report is included with this detailed energy audit. The report includes existing and proposed fixture types, quantities, and existing and proposed hours of operation for each area included in the energy audit. This information is based on actual site conditions.

Following is a brief description of the work to be undertaken in each area:

<u>Churchill County High School</u>

- Thirty-five (35) skylights will be installed through the roof of the main Gymnasium.
- Nine (9) skylights will be installed through the roof of the auxiliary Gymnasium.

- Daylight sensors and associated control units and wiring will be installed to control the fluorescent light fixtures when sufficient natural light is present.
- The sensors will be tested and adjusted to assure correct operation at each location.

Churchill County Junior High School

- Thirty (30) skylights will be installed through the roof of the main Gymnasium.
- Twelve (12) skylights will be installed through the roof of the auxiliary Gymnasium.
- Daylight sensors and associated control units and wiring will be installed to control the fluorescent light fixtures when sufficient natural light is present.
- The sensors will be tested and adjusted to assure correct operation at each location.

Facility Impact

NORESCO will coordinate all work with the facility staff to minimize the impact on the building occupants.

5.4.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The work under this ECM will result in electrical energy savings. The lighting controls will also extend the life of the lighting systems, due to the reduction in operating hours.

Special Operating Requirements

There are no special operating requirements associated with the daylighting controls measures.

5.4.4 Equipment Information

Manufacturer and Type

The proposed daylighting controls will be manufactured by one of the following corporations:

Sensors:

- **Hubbell,** 185 Plains Road, Milford, CT 06460-2420, (203) 882-4800
- **The Watt Stopper,** 2800 De La Cruz Blvd., Santa Clara, CA 95050, (408)-988-5331
- **Sensor Switch,** 10 Capital Drive, Wallingford, CT 06492, (203) 265-2842

Material Specifications

Occupancy Sensors: Occupancy sensors will be ceiling- or wall-mounted and may use ultrasonic or passive infrared technology. Turning lights off in unoccupied spaces provides savings by reducing electricity consumption, extending lamp life and reducing maintenance costs. All sensors and related components specified meet UL requirements.

5.4.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.4.6 Environmental Issues

There are no environmental issues associated with the daylighting controls measure.

5.4.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.4.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 5 – UPGRADE BUILDING AUTOMATION CONTROLS

5.5.1 OVERVIEW

Measure Summary

NORESCO proposes to upgrade the HVAC control systems at Northside Elementary School, Churchill County Jr. High and High Schools with new Invensys IA Direct Digital Controls (DDC). The new DDC system would communicate over the district's network to a front-end workstation with secured web enabled access.

Affected Areas

This project applies to all HVAC equipment at Northside Elementary School and specific locations within the Jr. High and High Schools. The Jr. High School locations include the 23 packaged rooftop units (North Wing – Library, Admin and Classroom Additions) currently using programmable thermostats, the Annex Building and the Cafeteria Building. The High School locations include all systems currently under power line carrier control including the Gymnasium, theater and shops.

5.5.2 DETAILED DESCRIPTION

Existing System Description

The Churchill County School District has standardized on Invensys IA controls. During the pre-bid meetings and site surveys, District staff requested that new or upgraded controls comply with the District controls standard. However, there are a number of legacy systems and stand-alone controls still in use. These systems are in need of an upgrade so that all of the DDC controls operate on a common platform. The following is a brief description of the controls currently in use at each location.

Northside Elementary – This school is equipped with older Microzone unitary controllers, Barber-Coleman Network 8000 controls. The DDC system extends to the zone level throughout the school and is used to control all of the packaged rooftop units as well as the split condensing/furnace units.

Churchill County Jr. High School – The Gymnasium and Cafeteria have been upgraded to Invensys I/A controls. Programmable thermostats control the 23 packaged units on the North Wing. The Annex Building is also under stand-alone control. Other portions of the school, including the Gymnasium and Science Wing are equipped with Tridium Java Application Control Engine (JACE) controls which provides system integration between devices that communicate via different protocols.

Churchill County High School – This school uses a combination of Network 8000 and power line carrier. In addition, portions of the campus have been upgraded with new I/A including the Auto and Vocational Shops and Math Building. The central plant is currently being upgraded to I/A.

The District's wide area network is accessible in each building. Generally, there is no available conduit between adjacent buildings on each campus.

The DDC systems are currently used to control building schedules and setpoints.

Existing Deficiencies

Northside Elementary –The Barber Coleman Network 8000 and Microzone controllers are obsolete and should be upgraded to new Invensys I/A as part of the district's larger effort to place all of the school on a common DDC platform. The existing DDC also lacks compressor amps, fan amps and discharge air temperature that are need for remote troubleshooting and diagnostics.

Churchill County Jr. High School – Unauthorized changes to the programmable thermostat schedules and setpoints have resulted in higher energy use. The seven-day schedules do not recognize local, state and federal holidays or vacation days. Therefore, the HVAC systems may run during unoccupied periods. For a typical public school, there are about 25 unoccupied days per year that would not be recognized by a programmable thermostat.

The lack of DDC controls on these units also prevents maintenance personnel from performing remote troubleshooting and diagnostics.

Churchill County High School – The power-line carrier system at the High School is obsolete. It is very limited in terms of its ability to perform advanced sequences of operation and other energy management functions. It has also reportedly been unreliable and susceptible to interference.

Proposed Improvements

Northside Elementary – NORESCO proposes to upgrade the existing Network 8000 with new I/A controllers. The Project includes new sensors, wiring and controllers as needed for a complete working system. NORESCO would include compressor amps, fan amps and discharge air temperature on all packaged units and split systems for remote troubleshooting and diagnostics. Additional energy savings would be gained by adding CO2, demand-based ventilation to the two packaged units that serve the multipurpose room.

Churchill County Jr. High School – The proposed measure would install new Invensys I/A controls on 23 rooftop-packaged units. The new system would be used to control the new mixed-air economizers to be installed under ECM 10. New DDC controls would also be provided for the annex buildings for the packaged units and split systems. New controls would also be provided for the upgraded kitchen make-up air unit to be installed under ECM 11.

Churchill County High School – NORESCO proposes to furnish and install new DDC devices to properly control the heat pumps that are currently controlled by the power line carrier system. It would also include new DDC devices to properly control the unit heaters and radiant heaters located in the auto shop. New DDC controls would be provided for the new packaged rooftop units to be installed on the Gymnasium under ECM 8. These controls would also include compressor amps, fan amps and discharge air temperature on all packaged units and split systems for remote troubleshooting and diagnostics. Additional energy savings would be gained by adding CO2, demand-based ventilation to the two packaged units to serve the Gymnasium. New controls would also be provided for the new kitchen make-up air unit to be installed under ECM 11.

Scope of Work

The following outline summarizes the steps required for installation of the DDC system.

- Furnish and install all conduit, sensors, controllers, relays, control panels, transformers, cable and wiring as needed for a complete functioning system. Reuse existing conduit, wire, panels and other devices to the extent practicable.
- Utilize the District's existing network for communications.
- Furnish all required documentation including, O&M manuals, control schematics, list of materials, logic diagrams, network riser diagrams, sequence of operation, points lists, etc.
- Provide construction management to ensure a professional installation.
- Provide start-up and commissioning of the new DDC systems to ensure that the DDC and control strategies operate as designed.
- Provide expert technical training.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed outdoors, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.5.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of the new system will result in reduced electric and natural gas energy use. Integration with the proposed DDC system will provide for proper damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.5.4 Equipment Information

Manufacturer and Type

All new controls will be manufactured by Invensys.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.5.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.5.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.5.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.5.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the controls manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

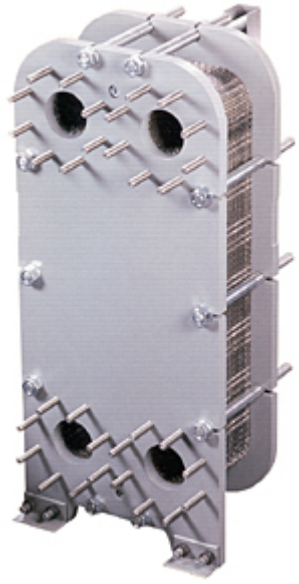
NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 6 – OPTIMIZE WATER SOURCE HEAT PUMP SYSTEM

5.6.1 OVERVIEW

Measure Summary



NORESCO proposes to connect the Churchill County High School water source heat pump circuit to the city's water system for thermal exchange. The proposed project would utilize city water for heat transfer so as to limit or eliminate the use of the school's boilers and cooling tower. The project would be similar to the water source heat pump systems currently operating in Ely, Nevada.

The project is contingent upon permitting and engineering and design issues. The technical and financial feasibility of this project would be established during the investment grade audit. An allowance of $25,000 was included for permitting and connection fees.

Affected Areas

This project applies to the Churchill County High School areas that are currently heated and cooled by the water source heat pump system. This includes the Math, Science and Vocational Buildings. Please note that the Gymnasium would be converted to packaged gas-electric rooftop units under ECM 8 – Replace Heat Pumps with Packaged Units. This project would also be coordinated with ECM 5 – Upgrade Building Automation Controls.

5.6.2 DETAILED DESCRIPTION

Existing System Description

The heating and cooling systems for these areas of the High School were originally built in 1988 and consist of over 70 Command Aire water source heat pumps. Typical units have a cooling capacity of about 54.2 to 56.6 MBH and a heating capacity of about 69.4 to 78.8 MBH. The Gymnasium units have a rating of approximately 35 tons. The original loop design temperature was 75°F for cooling and heating.

The central plant includes two natural gas fired AJAX boilers, each with a rating of 2,200,000 BTU output. The single cooling tower is a Baltimore Air Coil unit equipped with low and high-speed fan motors. There are two primary pumps each with a rating of 60 hp. The two cooling tower pumps are 20 hp each. The pumps are equipped with VFDs for soft start capability. The pumps typically operate at fixed speed. A plate and frame heat exchanger is used to isolate the primary loop from the cooling tower.

Existing Deficiencies

The Gymnasium heat pumps reportedly have trouble meeting the cooling and ventilation requirements of the building. The cooling tower was recently reconditioned. However, the loop temperatures can reach 76°F to 78°F during periods of high cooling loads. The Gymnasium typically operates for extended periods of time and is typically occupied from 6 a.m. to 10 p.m., six days per week. Therefore, the central plant equipment must operate to condition the Gymnasium even though most of the school is unoccupied.

The water treatment system and chemistry is reported to be effective.

Proposed Improvements

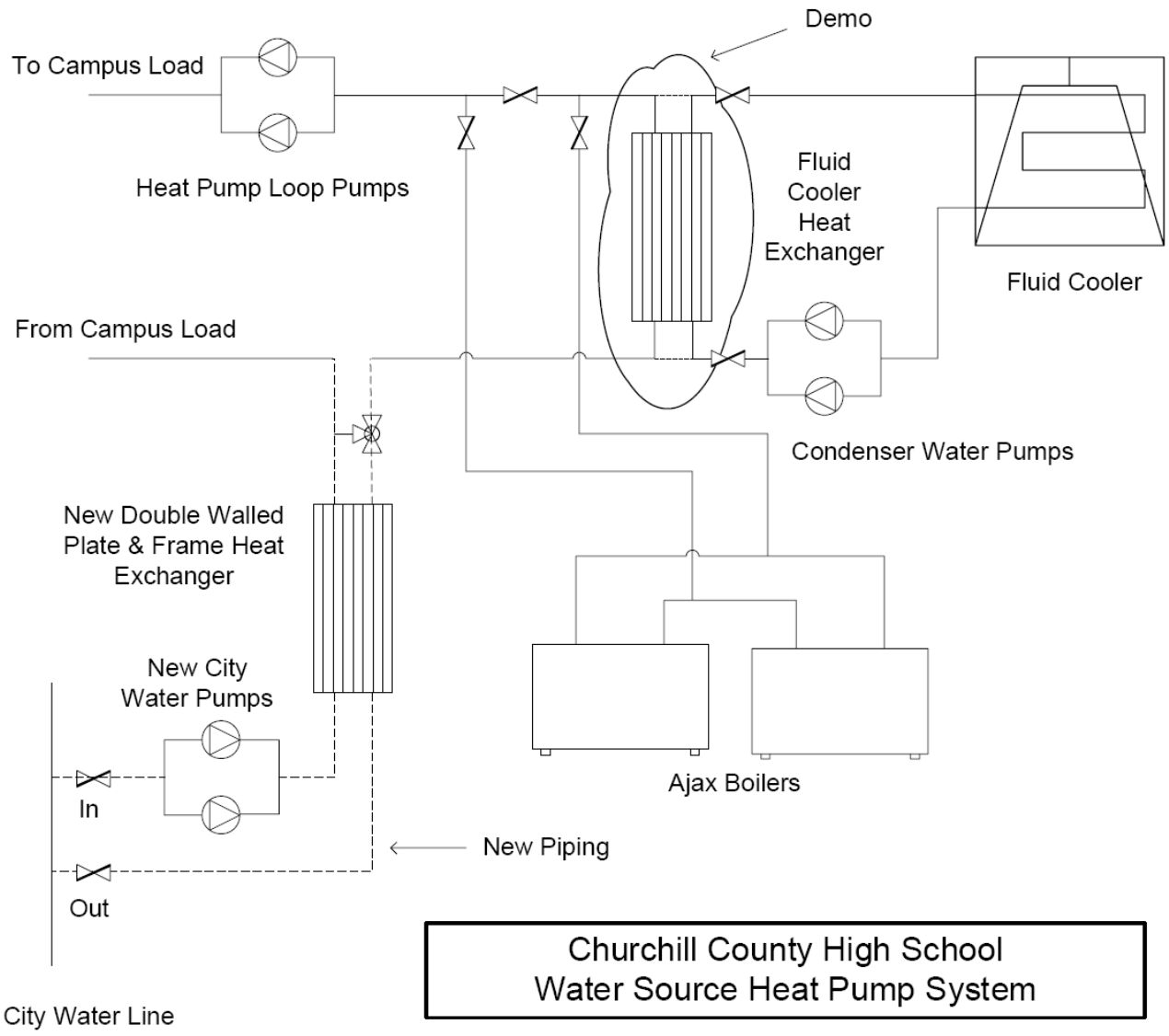
NORESCO proposes to connect the water source heat pump system to the city water system to facilitate thermal exchange. This is similar to a ground source system, except that it would utilize the thermal mass of the city water system to maintain loop temperature at or near about 55°F to 60°F. This concept has been successfully used at several facilities in Ely, Nevada.

The proposed system would require a supply and return tap to the water main of approximately 6 to 8 inch diameter. A double wall plate and frame heat exchanger would be used to isolate the heat pump loop from the city water system as required by code.

The existing fluid cooler heat exchanger would be removed. This would reduce the pressure drop and eliminate heat transfer losses across the heat exchanger leading to improved COP for the water source heat pumps. Circulating pumps would be installed to insure that proper system pressure is maintained and avoid being subject to fluctuations in city water pressure. Isolation valves would be installed to allow for the city water to be used exclusively to satisfy the campus heating and cooling needs year round. The boiler and fluid cooler could be drained down in summer and winter respectively yet available during times of extreme heat or cold.

During normal operation, the proposed system would bypass the boilers and cooling tower to provide "free-cooling" from the city water system's thermal mass. The boilers and cooling tower would remain in place for back up operation or extended periods with temperature extremes.

Figure 5.6.1 Proposed configuration of water source heat pump system.



Scope of Work

This project would be coordinated with the ECM 5 – Upgrade Building Automation Controls and the ECM 8 – Replace Heat Pumps with Packaged Units.

The scope of work for this ECM is as follows:

- Perform engineering and detailed design.

- Obtain required permits and interconnection agreements.
- Furnish all material and labor.
- Provide construction management.
- Provide start-up and commissioning services.
- Perform water-side test, adjust and balance.
- Conduct detailed training for facilities personnel.
- Furnish as-built drawings and manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed outdoors, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.6.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of the new system will result in reduced annual energy use, as well as reduced runtime on the heat pump compressors. Integration with the proposed DDC system will provide for proper damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.6.4 Equipment Information

Manufacturer and Type

The retrofit mechanical equipment would include underground piping, pumps, valves, sensors, heat exchangers and controls. The manufacturers have not yet been determined.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.6.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.6.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.6.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.6.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the controls manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 7 – PACKAGED UNIT REPLACEMENT

5.7.1 OVERVIEW

Measure Summary

NORESCO proposes to furnish and install three new high-efficiency packaged rooftop units located on the Industrial Arts (Annex) Building at Churchill County Jr. High School. The project will be coordinated with ECM 5 – Upgrade Building Automation Controls to provide for complete control of each packaged unit by the DDC system.

Affected Areas

NORESCO proposes to replace the three older Carrier units located on the southwest portions of the Annex Building.

5.7.2 DETAILED DESCRIPTION

Existing System Description

The existing Carrier units are reportedly old, inefficient, and have reached the end of useful life. Packaged rooftop units manufactured before 1990 typically have efficiencies in the range of 8.7 EER. This would be considered poor when compared to new high efficiency units with EER's of approximately 11.3.

Existing Deficiencies

The existing packaged units have reached their end of service life and should be replaced with new high efficiency units.

Proposed Improvements

NORESCO proposes to furnish and install three new high efficiency packaged gas/electric rooftop units (approximately 4 tons each). The new units would be equipped with mixed air economizers and DDC controls. The proposed units would be Lennox "L" series with an EER of 11.0 or higher.

Scope of Work

This project will be coordinated with the ECM 5 – Upgrade Building Automation Controls.

The scope of work for this ECM is as follows:

- Demolish and remove the existing units.
- Furnish and install roof curbs and/or curb adapters as needed.
- Furnish and install three new high efficiency units including all dampers, actuators, sensors and controls as needed to provide a complete working system.

- Properly connect and seal supply and return ductwork.
- Reuse the existing electrical equipment including wiring, conduit, circuit breaks and disconnects.
- Coordinate work with the DDC controls project to provide for the proper sequence of operation for the control each of the packaged units.
- Provide a complete set of as-built drawings and maintenance manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed on the roof, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.7.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of the new rooftop units will result in reduced annual energy use. Integration with the proposed DDC system will provide for proper outside air and mixed air damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.7.4 Equipment Information

Manufacturer and Type

The new packaged rooftop units would be manufactured by Lennox or equivalent. The controls would be Invensys or equivalent.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.7.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.7.6 Environmental Issues

No adverse environmental impacts are expected pending approval from the City Engineer. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.7.7 MEASUREMENT AND VERIFICATION PLAN

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.7.8 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 8 – REPLACE HEAT PUMPS WITH PACKAGED UNITS

5.8.1 OVERVIEW

Measure Summary

NORESCO proposes to replace five heat pumps on the High School Gymnasium with new high-efficiency packaged rooftop units. The project will be coordinated with the DDC controls project to provide for complete control of each packaged unit by the DDC system.

Affected Areas

This project is located on the Churchill County High School Gymnasium.

5.8.2 DETAILED DESCRIPTION

Existing System Description

There are five water source heat pumps that serve the Gymnasium building. Two of these units are 35-ton water source heat pumps. The locker room heat pumps include a preheat coil and heat recovery units. One unit serves the small gym. These heat pumps were originally installed in 1988.

This building typically operates from 6 a.m. to 10 p.m., six days per week.

Existing Deficiencies

The Gymnasium heat pumps reportedly do not have sufficient capacity to provide for heating, cooling and ventilation during peak load conditions. The central plant is also at peak capacity. Because the gym is used for extended periods, it is necessary to operate the central plant pumps, boilers or cooling tower even though the majority of the school may be unoccupied.

Proposed Improvements

NORESCO proposes to furnish and install five new high efficiency packaged gas/electric rooftop units. The new units would be equipped with mixed air economizers and DDC controls. The proposed units would be Lennox or equivalent.

NORESCO would also provide for a natural gas line extension to the Gymnasium building from the central plant.

The replacement of these heat pumps with new packaged units would reduce the load on the central plant and allow it to operate in the unoccupied mode when only the Gymnasium is in use and the other buildings are unoccupied.

Scope of Work

This project would be coordinated with the ECM 5 – Upgrade Building Automation Controls.

The scope of work for this ECM is as follows:

- Provide detailed engineering and design.
- Demolish and remove the existing units.
- Furnish and install roof curbs and/or curb adapters as needed.
- Furnish and install a natural gas extension to the gym.
- Furnish and install five new high efficiency units including all dampers, actuators, sensors and controls as needed to provide a complete working system.
- Properly connect and seal supply and return ductwork.
- Furnish and install all necessary electrical power including conduit, wiring, circuit breakers, disconnects, etc.
- Coordinate work with the DDC controls project to provide for the proper sequence of operation for the control each of the packaged units.
- Provide start-up and commissioning services
- Provide air-side test, adjust and balance.
- Provide a complete set of as-built drawings and maintenance manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed on the roof, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.8.3 INTEGRATION WITH EXISTING SYSTEMS AND OPERATIONS

Impact on Facility Operations and Performance

The installation of the new rooftop units will result in reduced annual energy use. Integration with the proposed DDC system will provide for proper outside air and mixed air damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.8.4 EQUIPMENT INFORMATION

Manufacturer and Type

The new packaged rooftop units would be manufactured by Lennox or equivalent. The controls would be Invensys or equivalent.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.8.5 COMMISSIONING PROCEDURE

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.8.6 ENVIRONMENTAL ISSUES

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.8.7 MEASUREMENT AND VERIFICATION PLAN

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.8.8 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 9 – FLUID COOLER VFD

5.9.1 OVERVIEW

Measure Summary

NORESCO proposes to install a variable frequency drive (VFD) on the cooling tower fan at Churchill County High School. This measure is provided as an alternate to the ECM 6 – Upgrade-Re-Commission Water Source Heat Pump System.

Affected Areas

This project affects the High School central plant and the water source heat pump system.

5.9.2 DETAILED DESCRIPTION

Existing System Description

The water source heat pump system is cooled using a Baltimore Air Coil T1662 fluid cooler. This cooling tower is designed to maintain a primary loop cooling setpoint temperature of 75°F. The unit is equipped with a two-speed fan. Under low load conditions the tower operates using the low speed setting. During periods of high load, the unit operates at the higher fan speed. The high-speed operation is designed to meet the cooling requirements at the peak design load. Typically, the load is lower than the design load so the combinations of cycling, low-speed and high-speed operation are used for capacity control.

Existing Deficiencies

The two-speed fan operation does provide energy savings when compared to a fan cycling and fixed speed operation. However, these savings could be improved by installing a VFD on the high-speed motor.

Proposed Improvements

NORESCO proposes to furnish and install a new VFD on the cooling tower fan. This VFD would precisely match the fan speed to the load. The VFD also provides a soft-start capability to reduce wear and tear on the unit during start-up.

During the detailed audit, NORESCO will verify that the fan motor is suitable for operation with the VFD. If necessary, the motor would be replaced with a high efficiency motor for inverter duty.

Scope of Work

This project would be coordinated with the ECM 5 – Upgrade Building Automation Controls.

The scope of work for this ECM is as follows:

- Provide detailed engineering and design.
- Furnish and install the VFD and motor (if needed).
- Furnish and install all sensors and controls as needed to provide a complete working system.
- Furnish and install all necessary electrical power including conduit, wiring, circuit breakers, disconnects, etc.
- Coordinate work with the DDC controls project to provide for the proper sequence of operation.
- Provide start-up and commissioning services.
- Provide a complete set of as-built drawings and maintenance manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed within the central plant, where impact on building occupants should be at a minimum. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.9.3 INTEGRATION WITH EXISTING SYSTEMS AND OPERATIONS

Impact on Facility Operations and Performance

The installation of the VFD will result in reduced annual energy use. Integration with the proposed DDC system will provide for proper speed and temperature control. The controls will also provide for remote diagnostics to ensure that the tower is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.9.4 Equipment Information

Manufacturer and Type

The new VFD would be manufactured by Danfoss-Graham, ABB or equivalent. The controls would be Invensys or equivalent.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.9.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.9.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.9.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.9.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

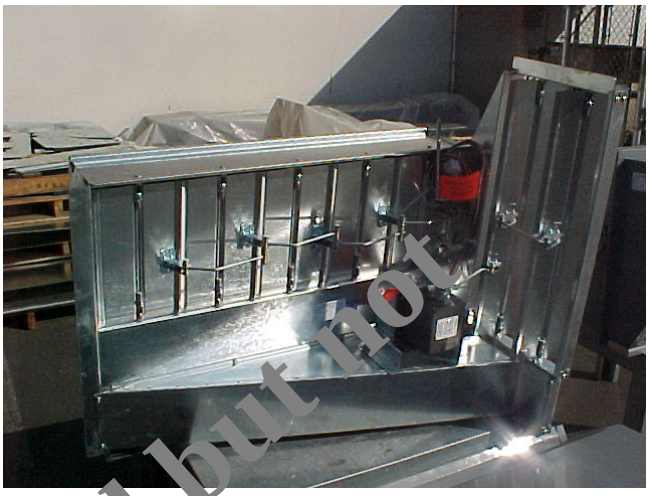
In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 10 – ECONOMIZER RETROFIT

5.10.1 OVERVIEW

Measure Summary

NORESCO proposes to furnish and install new mixed air economizers and controls on the packaged rooftop units located at the North Wing (rooms 103 - 160, 212 - 226) of Churchill County Jr. High School. The project will be coordinated with ECM 5 – Upgrade Building Automation Controls to provide for complete control of each packaged unit by the DDC system.



Affected Areas

NORESCO proposes to retrofit 23 Lennox GCS packaged units located on the rooftop of the North Wing. These units serve the new library, administration areas and classroom addition.

5.10.2 DETAILED DESCRIPTION

Existing System Description

Twenty-three packaged gas/electric rooftop units currently serve the new administration and classroom wing. These units were manufactured in 1996 and appear to be in good condition.

These units do not have economizers. The outside air volume is fixed so as to provide for minimum ventilation only. Each unit is equipped with a programmable thermostat to control the occupied and unoccupied temperature setpoints. However, the programmable thermostats have reportedly been tampered with so as to limit their energy savings.

Table 5.10.1 provides a list of the Lennox units to be retrofitted under this measure.

Table 5.10.1 Packaged rooftop units.

Unit	Lennox Model #	Room #
1	GCS16-413-100-10G	104
2	GCS16-413-100-10G	206
3	GCS16-413-100-10G	226
4	GCS16-513-125-6G	103
5	GCS16-513-125-6G	107
6	GCS16-513-125-6G	108
7	GCS16-513-125-6G	112
8	GCS16-513-125-6G	144

Table 5.10.1 Packaged rooftop units.		
Unit	**Lennox Model #**	**Room #**
9	GCS16-513-125-6G	159
10	GCS16-513-125-6G	160
11	GCS16-513-125-6G	208
12	GCS16-513-125-6G	216
13	GCS16-513-125-6G	223
14	GCS16-513-125-6G	224
15	GCS16-513-125-6G	225
16	GCS16-653-125-5G	118
17	GCS16-653-125-5G	1[illegible]
18	GCS16-653-125-5G	153
19	GCS16-653-125-5G	203
20	GCS16-653-125-5G	203
21	GCS16-653-125-5G	212
22	GCS16-653-125-5G	221
23	GCS16-653-125-5G	222

Existing Deficiencies

The existing packaged units do not have economizers and they are controlled by programmable thermostats. The lack of mixed air economizers does not allow the use of "free-cooling" when the outside air temperature is lower than the return air temperature. This also causes more wear and tear on the compressor, as it must run for longer periods of time to satisfy the cooling load.

Unauthorized personnel can easily change the programmable thermostat setpoints. Often this results in unnecessary heating or cooling the room. The thermostats can't be programmed for vacation or holiday periods. This results in unnecessary run time when the building is unoccupied.

Proposed Improvements

NORESCO proposes to retrofit each of the above units with new mixed air economizers. NORESCO will furnish and install all necessary dampers, actuators, sensors and controls as needed for a complete installation. The new dampers and controls will provide for "free-cooling" in the economizer mode. The outside air dampers will also be closed during unoccupied periods and during morning warm-up or cool-down. This method of damper control saves energy by reducing the energy needed to heat or cool the outside air during unoccupied periods.

Scope of Work

This project would be coordinated with ECM 5 – Upgrade Building Automation Controls.

The scope of work for this ECM is as follows:

- Furnish and install new economizers including all dampers, actuators, sensors and controls as needed to provide a complete working mixed air economizer.
- Coordinate the economizer retrofit with the DDC controls project to provide for the proper sequence of operation for the control each of the packaged units.
- Provide a complete set of as-built drawings and maintenance manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed on the roofs, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.10.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of the new economizers will result in reduced annual energy use, as well as reduced runtime on the air conditioning compressors. Integration with the proposed DDC system will provide for proper outside air and mixed air damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.10.4 Equipment Information

Manufacturer and Type

The retrofit mechanical equipment including dampers, hoods, etc would be manufactured by Lennox or a suitable aftermarket manufacturer including Micro Metals or equivalent. Invensys or equivalent would provide the required control elements.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.10.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.10.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.10.7 MEASUREMENT AND VERIFICATION PLAN

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.10.8 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the controls manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 11 – KITCHEN COOLING UPGRADES

5.11.1 OVERVIEW

Measure Summary

During the pre-bid site surveys, District staff indicated problems with air conditioning in the kitchens at Churchill Jr. and High Schools. NORESCO proposes to furnish and install new high efficiency make-up air units (MAUs) at the Jr. High School and High School Kitchens. These units would provide additional cooling, heating and ventilation within each kitchen.

Affected Areas

This measure applies to the Jr. High and High School kitchen facilities.

5.11.2 DETAILED DESCRIPTION

Existing System Description

The Jr. High School kitchen is equipped with a Reznor RGB-200 rooftop MAU. The unit was specified to deliver 2,000 cfm with a heating capacity of 200,000 (input) and a 12-inch evaporative media. The unit is ducted to the exhaust hood and the kitchen space. The exhaust fan also has a specified capacity of 2,025 cfm. The kitchen MAU is designed to provide 100 percent outside air.

Existing Deficiencies

Since the kitchen was remodeled it has reportedly had insufficient cooling. A review of the original design drawings showed that two units with 4,020 cfm were needed for the space and the hood. Further evaluation is needed during the detailed audit, but it appears that the existing MAU does not have enough capacity to serve both the hood and space cooling requirements. The evaporative cooler media has developed some scale formation that also reduces the effectiveness of the unit.

Proposed Improvements

The proposed improvement for this project would install one new additional MAU of approximately 2,000 cfm to specifically serve the kitchen space. The proposed units would utilize DX cooling with an indirect natural gas furnace. The DX cooling uses more energy than the evaporative cooler, but avoids water quality problems. The DX units also provide better temperature control.

Scope of Work

This project would be coordinated with the ECM M5 – Upgrade Building Automation Controls.

The scope of work for this ECM is as follows:

- Perform detailed engineering to determine the design heating and cooling loads.
- Furnish and install the new MAU(s) and exhaust fan(s).
- Furnish and install roof curbs and/or curb adapters as needed.
- Furnish and install controls.

- Furnish and install supply and return ductwork.
- Furnish and install all required electrical equipment including wiring, conduit, circuit breakers and disconnects.
- Coordinate work with the DDC controls project to provide for the proper sequence of operation for the control.
- Provide a complete set of as-built drawings and maintenance manuals.

Facility Impact

The majority of work under this ECM will be done during normal hours. Much of the necessary work will be performed on the roof, where impact on building occupants should be at a minimum. Any necessary work in occupied spaces will be performed at a time when the space is not in active use. NORESCO will coordinate all work with facility personnel to minimize the impact on the occupants and staff.

5.11.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of the new units will result in increased annual energy use. Integration with the proposed DDC system will provide for proper outside air and mixed air damper control, equipment scheduling and temperature setpoint control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.11.4 Equipment Information

Manufacturer and Type

The new MAU's would be manufactured by Reznor or equivalent. The controls would be Invensys or equivalent.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.11.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.11.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.11.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.11.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by the manufacturer's representative and will be conducted at the affected buildings using the actual controls components.

NORESCO will provide an O&M Manual for the new equipment including product data, system architecture, wiring diagrams, and an as-built system description, including sequence of operation and point list.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 12 – WINDOW UPGRADES/REPLACEMENTS

5.12.1 OVERVIEW

Measure Summary

The Request for Proposal (RFP) identified a requirement to consider replacing all appropriate windows at Northside Elementary School. The windows in question are generally comprised of columns of clear, single pane glazing, wood frame and operable window sashes. The window system is part of the original building construction. Many of the windows have gaps, which allow air to infiltrate through them. The existing window frames are also old and worn, with cracked or missing caulking, resulting in high outdoor air infiltration. This results in uncomfortably warm conditions during the summer months, especially in rooms on the southern and eastern sides of the building, and uncomfortably cold conditions in the winter months. Additionally, some pipe freezing has been experienced in the older exterior wing of the facility, primarily due to air infiltration.

Affected Areas

NORESCO recommends building envelope improvements at the following schools:

- Northside Elementary School – Window Replacement.

5.12.2 DETAILED DESCRIPTION

Existing System Description

As part of the walk-through and building review, some deficiencies in the existing building envelope were identified. Specifically:

- Northside Elementary School:
  - Almost all of the exterior windows are single pane. One newer wing of the school has dual pane windows.

Proposed Improvements

The following were identified as proposed improvements:

- Northside Elementary School:
  - Replace all exterior single pane windows, or install an interior single pane window cover to create an air space.

Scope of Work

Specific scope of work requirements for this ECM is:

- Identify the assumptions and inputs used for all savings calculations as part of the Financial Grade Operational Audit.
- Identify project costs and alternatives as part of the Financial Grade Operational Audit.
- Recommend economical projects for building envelope improvement at the facilities.

Facility Impact

A substantial improvement in occupant comfort and lower air infiltration would all be significant facility impacts. Reduced heating and cooling costs would be realized by implementing the recommendations.

5.12.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption and increased occupant conditions. Unnecessary heating and cooling costs would be eliminated.

Special Operating Requirements

No special operating requirements are associated with this ECM.

5.12.4 Equipment Information

Manufacturer and Type

Specific equipment type and manufacture to be determined as part of the Investment Grade Audit.

5.12.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.12.6 Environmental Issues

No environmental impacts are expected.

5.12.7 Customer Training

No customer training will be required.

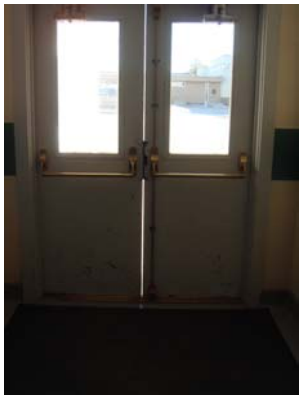
In the event CCSD needs warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 13 – BUILDING ENVELOPE IMPROVEMENTS

5.13.1 OVERVIEW

Measure Summary

The Request for Proposal (RFP) identified a minimum assessment of building envelope improvements including door replacement and insulation enhancement. This measure is separate from ECM 12 which provides the assessment of window replacements at Northside Elementary School.



Affected Areas

NORESCO recommends building envelope improvements at the following schools:

- Churchill County Junior High School – Door Replacement (see existing typical door at Gymnasium in picture above)
- Churchill County Junior High School – Install Insulation in Room 40)

5.13.2 DETAILED DESCRIPTION

Existing System Description

As part of the preliminary walk-through and building review, some deficiencies in the existing building envelope were identified. Specifically:

- Churchill County Junior High School:
  - There were older doors with significant air gaps and single pane windows.
  - Room 40 in the Annex Building (see adjacent picture) has no insulation below the roof. This room was originally a shop, but has been converted to typical classroom use. The rooms also has upgraded lighting and exposed duct.

Proposed Improvements

The following were identified as proposed improvements:

- Churchill County Junior High School:
  - Replace or adjust all exterior doors in older buildings such as the Cafeteria, Annex and Gymnasium.
  - Room 40 has mechanical equipment hanging from the rafters. It was determined that the best solution for these buildings would be installing batt-type insulation between the roof rafters and overlay with a foil foam insulation membrane for added R-Value, longevity and appearance. This would place the thermal boundary above any mechanical equipment located in the attic space and truly separate the space of the radiant heat and cold from the exterior.

Scope of Work

As detailed above, roof insulation, and door replacement or adjustment are recommended. Specific scope of work requirements for this ECM is:

- Identify the assumptions and inputs used for all savings calculations as part of the Financial Grade Operational Audit.
- Identify project costs and alternatives as part of the Financial Grade Operational Audit.
- Recommend economical projects for building envelope improvement at the facilities.

Facility Impact

A substantial improvement in occupant comfort would be the largest facility impact. Additional building envelope improvements would eliminate current problems with water pipes freezing, overall cold or hot conditions, and excessive air infiltration during windy conditions. Many of the existing occupants indicated problems with specific issues related to existing building envelope conditions.

5.13.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption and increased occupant conditions. Unnecessary heating and cooling costs would be eliminated.

Special Operating Requirements

No special operating requirements are associated with this ECM.

5.13.4 Equipment Information

Manufacturer and Type

Specific equipment type and manufacture to be determined as part of the Financial Grade Operational Audit.

5.13.5 Commissioning Procedure

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations.

5.13.6 Environmental Issues

No environmental impacts are expected.

5.13.7 Customer Training

No customer training will be required.

In the event CCSD needs warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 14 – WATER SYSTEM IMPROVEMENTS

5.14.1 OVERVIEW

Measure Summary

Although the unit price of water is relatively low, water and sewer charges clearly represent a significant cost for the Churchill County School District. NORESCO will implement a comprehensive list of water conversation measures at each building that will reduce the water usage per device (flush valve and lavatory sink).

Affected Areas

NORESCO proposes to provide water conservation measures in the following areas:

- Churchill County High School
- Churchill County Junior High School
- Northside Elementary School

5.14.2 DETAILED DESCRIPTION

Existing System Description

The existing water fixtures at the Churchill County High School include both standard and low flow valves and aerators. Approximately 80% of the water closet flush valves are standard 3.5 gallons per flush (gpf) units, and 40% of the urinal flush valves are standard 1.6 gpf units. One-half of the lavatory sinks do not use low flow aerators, or the existing aerators have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

The existing water fixtures at the Churchill County Junior High School include both standard and low flow valves and aerators. Approximately 45% of the water closet flush valves are standard 3.5 gallons per flush (gpf) units, and 40% of the urinal flush valves are standard 1.6 gpf units. Nearly all of the lavatory sinks do not use low flow aerators, or the existing aerators have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

The existing water fixtures at the Northside Elementary School include both standard and low flow valves and aerators. All of the water closet flush valves are standard 3.5 gallons per flush (gpf) units, and 60% of the urinal flush valves are standard 1.6 gpf units. Eighty percent of the lavatory sinks do not use low flow aerators, or the existing aerators have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

Existing Deficiencies

The majority of the water fixtures do not use low flow flush valves and aerators. The existing water consumption could be reduced by an estimated 20% through the installation of these low flow devices on the remaining water fixtures.

Proposed Improvements

NORESCO proposes to replace all conventional plumbing fixtures in the student, staff and public restrooms with new low-flow fixtures. This will include full replacement of water closets, including china and flushometer, as well as replacement of urinal flushometers, and installation of low flow aerators on the lavatory sink faucets.

Scope of Work

Churchill County High School

- The existing water closets with standard 3.5 gpf flush valves will be replaced with new low-flow 1.6 gpf flush valves. Fixtures will be replaced in nearly all the restrooms. Only the existing low-flow water closets in the newer locker room addition to the Gymnasium and remodeled section of the Science Building will not be replaced.
- The existing urinals with standard 1.6 gpf flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in the boys restrooms of the Vocational and Math Buildings, as well as the boys locker room of the Sports Locker Room.
- Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 1.0 gpm aerators.

Churchill County Junior High School

- The existing water closets with standard 3.5 gpf flush valves will be replaced with new low-flow 1.6 gpf flush valves. Fixtures will be replaced in all of the restrooms in the Gymnasium and the Classroom 40-44 building.
- The existing urinals with standard 1.6 gpf flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the restrooms in the Gymnasium and the Classroom 40-44 building.
- Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 1.0 gpm aerators. Only the lavatory sinks in the Classroom 40-44 building currently have low-flow aerators.

Northside Elementary School

- The existing water closets with standard 3.5 gpf flush valves will be replaced with new low-flow 1.6 gpf flush valves. All of the water closets will be replaced in each of the restrooms.

- The existing urinals with standard 1.6 gpf flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in the boys restrooms next to room 18 and room 30. The urinals in the boys restroom near the main office use timed valves and will not be retrofit.
- Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 1.0 gpm aerators. Only the lavatory sinks in the boys and girls restrooms near the main office currently have low-flow aerators.

The following table summarizes the quantities of plumbing fixtures that were identified during our initial walk-through of three Churchill County School District campuses. A more detailed building-by-building inventory will be developed as part of the Financial-Grade Operational Audit.

Table 5.14.1 Proposed low-flow water fixtures.

School	Toilets	Urinal	Sink
Churchill County High School	64	20	39
Churchill County Junior High	21	10	37
Northside Elementary School	30	8	25

Facility Impact

NORESCO will coordinate all work with the facility staff to minimize the impact on the building occupants.

5.14.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit not only from reduced water consumption, but also reduced energy consumption for water heating.

Special Operating Requirements

No special operating requirements are associated with this measure.

5.14.4 Equipment Information

Manufacturer and Type

NORESCO proposes to install new low-flow flushometers manufactured by Zurn, Sloan, or approved equal. New lavatory faucets will be manufactured by Symmons or approved equal. New china water closets will be manufactured by Toto, or approved equal.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed plumbing fixtures are expected to last over 15 years.

5.14.5 Commissioning Procedure

All newly installed equipment will be visually inspected by the NORESCO Project Manager and the installation technicians, with corroboration by facility personnel. Refer to Section 9.0, Preliminary Commissioning Plan for further details.

5.14.6 Environmental Issues

No adverse environmental impacts are expected.

5.14.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.14.8 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 15 – PHOTOVOLTAIC SYSTEM

5.15.1 OVERVIEW

Measure Summary

For purposes of establishing renewable energy as part of the overall energy efficiency project, the installation of a 10,000 watt photovoltaic system was assessed. The measure would generate over 19,000 KWH each year based on available solar radiation data for the area. As part of the walk-through for the schools, the High School was selected as the most appropriate location for the installation of this system.

NORESCO recommends the following miscellaneous improvements:

- CCSD High School – Installation of a 10,000 watt photovoltaic system.

It should be noted that no structural review is included with this assessment. An engineering review would likely be required to place the panels on the roof of the Gymnasium as recommended.

5.15.2 DETAILED DESCRIPTION

Existing System Description

There is no existing renewable system.

Proposed Improvements

The following were identified as proposed improvements:

- High School:
  - Install panels on roof of Gymnasium.
  - Integrate electrical output into existing electrical room with inverter and all required electrical interface equipment.
  - Commission system and test actual output.

Scope of Work

Specific scope of work requirements for this ECM are:

- Identify the assumptions and inputs used for all savings calculations as part of the Financial-Grade Operational Audit.
- Identify project costs and alternatives as part of the Financial-Grade Operational Audit.
- Recommend economical projects based on full analysis.

Facility Impact

There could be a facility impact due to the weight of the proposed system on the roof structure. A roof structural review is recommended by a qualified structural engineer.

5.15.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption, and would be providing an emissions free source of electrical energy to the school. The installation could be used as an educational feature for the students and faculty.

Special Operating Requirements

The proposed system would be fully integrated into the existing electrical system. With the size, it is unlikely that the system would ever provide electricity to the grid, but special operating and interconnection requirements would likely be required.

5.15.4 Equipment Information

Manufacturer and Type

Specific equipment type and manufacture to be determined as part of the Financial-Grade Operational Audit.

5.15.5 Commissioning Procedure

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations. A final performance test would also be provided.

5.15.6 Environmental Issues

The system is environmentally friendly and reduces overall emissions from power plants. The source of the energy is fully renewable and the output qualifies for renewable energy credits.

5.15.7 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 16 - FACILITY OPERATIONS MANAGEMENT SOFTWARE

5.16.1 OVERVIEW

Measure Summary

NORESCO proposes to implement a software package to assist with management and reporting of facility operations, maintenance, and utilities. NORESCO has partnered with SchoolDude to provide Churchill County School District a suite of web-native tools for operations management that are designed specifically for the educational environment. SchoolDude's technology requires no servers, licenses, data backup or software upgrades. The District will use the existing computer(s), web browser, and reliable internet connection to integrate with the facility operations solutions proposed. Additional features of this software are described below.

5.16.2 DETAILED DESCRIPTION

Proposed Improvements

NORESCO proposes to implement three SchoolDude tools summarized as follows:

MaintenanceDirect™ is a work management tool that helps streamline the work order process from request to completion.

Table 5.16.1 MaintenanceDirect™ features and benefits.

Features	Benefits
Enables requesters to submit work requests and check the status of requests online	Improves productivity and efficiency by reducing data entry and phone calls for work requests
Features enhanced routing with programmable logic to manage and automate approval and assignment	Improves customer service by automating communication and feedback with requesters
Allows technicians to receive and complete work assignments online	Quickly generates simple and detailed reports on work order status, costs and more
Records labor and purchase transactions	Saves time and money by streamlining workflow
Includes interactive calendar for resource scheduling – displays corrective, PM and event-related work by all employees or individuals	Integrates with FSDirect to automatically generate work orders for preventive maintenance and event startup

UtilityDirect™ is a web-native utility management and reporting tool that audits, tracks and analyzes utility consumption and costs to identify savings opportunities.

Table 5.16.2 UtilityDirect™ features and benefits.	
Features	**Benefits**
Tracks and monitors bills for electric, fuel oil, propane, water, natural gas, sewer, trash/waste, telephone and more	Helps improve efficiency by identifying utility waste, cost problems and billing errors
Enables simple comparison and analysis of utility billing data	Reduces utility costs by identifying savings opportunities
Provides an audit trail for tracking savings opportunities	Provides powerful usage and cost analysis with customizable reports and graphs
Allows simple cost comparisons between similar buildings	Allows you to check bills for accuracy prior to payment
Analyzes variables that impact month to month energy usage	Allows export of utility data to any spreadsheet

FSDirect™ is a web-native facility usage scheduling tool for managing educational facility usage requests, tracking event schedules, and accounting for usage expenses.

Table 5.16.3 FSDirect™ features and benefits.	
Features	**Benefits**
Enables event requesters to check facility availability and submit usage request online	Maximizes after-hours facility usage
Displays scheduled events on an interactive calendar	Reduces time required to manage facility schedules
Tracks facility usage costs and automatically generates invoices	Easily and accurately indicates availability for quick reference
Automatically routes usage requests to approval managers	Documents facility usage costs to help justify rental rates and improve cost recovery
Automatically emails event setup requirements to event service providers	Improves coordination with support resources (i.e. HVAC, custodial or setup requirements)
Easily schedules recurring events at regular and irregular intervals	Improves community relations with groups who use facilities

5.16.3 EQUIPMENT INFORMATION

Manufacturer and Type

NORESCO proposes to provide the software developed by the following:

- **SchoolDude.com** 113 Edinburgh South Suite 200 Cary, NC 27511 Phone: 919-816-8237

5.16.4 COMMISSIONING PROCEDURE

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that the software has been installed and web links established in accordance with manufacturers' recommendations.

5.16.5 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 17 – UPGRADE KITCHEN HOT WATER BOOSTER HEATERS

5.17.1 OVERVIEW

Measure Summary

This measure proposes the replacement of existing electric water heater boosters in kitchens with natural gas booster heaters. Two booster heaters were identified as potential candidates for replacement. Use of natural gas, typically provides better economics because of the higher heating content for natural gas as compared to electricity.

NORESCO recommends the following miscellaneous improvements:

- Churchill County High School – Replace existing electric kitchen dishwasher booster heater with equivalent natural gas unit.
- Churchill County Jr. High School – Replace existing electric kitchen dishwasher booster heater with equivalent natural gas unit.

5.17.2 DETAILED DESCRIPTION

Existing System Description

The existing units were observed to be approximately 13.5 kW electric booster heaters. The operation of the units was based on typical school operation and need.

Proposed Improvements

The following were identified as proposed improvements:

- High School:
  - Replace the electric booster heater with a natural gas heater.
  - Install all appropriate gas equipment and service.
- Junior High:
  - Replace the electric booster heater with a natural gas heater.
  - Install all appropriate gas equipment and service.

Scope of Work

Specific scope of work requirements for this ECM are:

- Identify the assumptions and inputs used for all savings calculations as part of the Financial-Grade Operational Audit.
- Identify project costs and alternatives as part of the Financial-Grade Operational Audit.
- Recommend economical projects based on full analysis.

Facility Impact

There could be a facility impact due to the weight of the proposed system on the roof structure. A roof structural review is recommended by a qualified structural engineer.

5.17.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The installation of natural gas booster heaters will reduce overall energy use at each facility. Impact to kitchen operations is expected to be minimal, if any.

Special Operating Requirements

As with any new equipment, the maintenance staff will require training to become familiar with the new equipment. Training is included within our scope of services.

5.17.4 Equipment Information

Manufacturer and Type

Specific equipment type and manufacturer to be determined as part of the Financial-Grade Operational Audit.

Useful Life of Equipment

All materials installed under this measure will have a warranty of at least one (1) year. With proper maintenance, the proposed control devices are expected to last over 15 years.

5.17.5 Commissioning Procedure

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations. A final performance test would also be provided.

5.17.6 Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in reduced environmental impacts from power plant and boiler plant emissions.

5.17.7 Measurement and Verification Plan

NORESCO uses the International Performance Measurement & Verification Protocol (IPMVP) guidelines, which are also endorsed by the Federal Energy Management Program (FEMP). For this measure NORESCO will utilize the methodology described in Section 7.0, Measurement and Verification Plan.

Performance Compliance Measurement

As part of the start-up and commissioning process, the capability of the new equipment after retrofit to provide the required service in accordance with the specifications will be documented.

5.17.8 CUSTOMER TRAINING

Customer training will be provided for the system interface and equipment.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 9.0, Project Management Plan.

ECM 18 – VENDING MACHINE CONTROLS

5.18.1 OVERVIEW

Measure Summary

There are many electricity consuming devices located throughout the Churchill County School District Buildings. Some of these devices can be controlled to conserve energy. This ECM, through its sensor devices, will apply occupancy based controls to reduce the energy consumption of non-critical loads such as vending machines.

Affected Areas

NORESCO recommends installing vending machine controllers in the following schools:

- Churchill County High School
- Churchill County Jr. High School
- Northside Elementary School

5.18.2 DETAILED DESCRIPTION

Existing System Description

The occupancy of the various spaces throughout the buildings varies during a typical day. Despite this variation in occupancy, the facility has a great many electrical devices that operate all of the time. In particular, vending machines are located in each of the facilities, offering snacks and beverages to the students and staff. In the High School especially, there are numerous beverage coolers running round the clock, while the building is typically only occupied from 7 am to 5 pm, Monday through Friday. Also at the High School, some of the existing vending machines are already equipped with a vending machine control device.

Existing Deficiencies

A typical cold drink machine will consume over 4,000 kWh annually, resulting in a utility cost of over $100 per machine per year.

Proposed Improvements

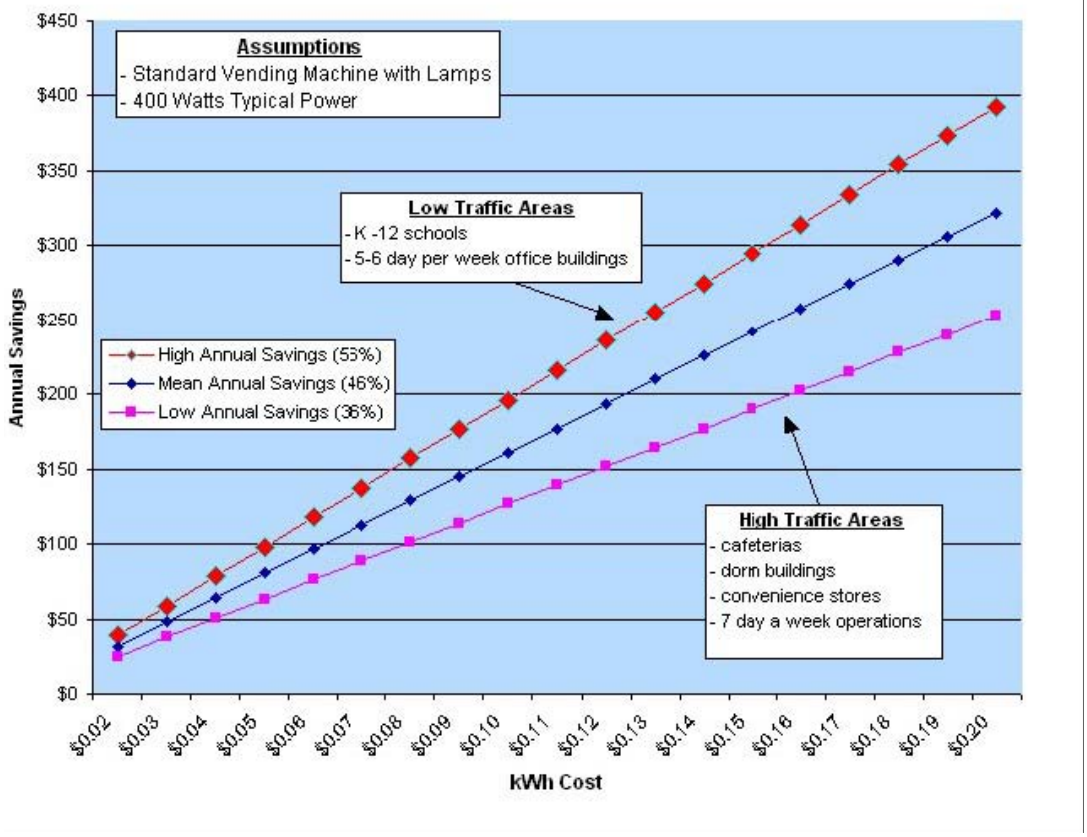
In order to minimize the unnecessary operation of electrical devices, NORESCO will install controllers on all vending machines without controls located in the High School, the Junior High School, and Northside Elementary School.

Scope of Work

On refrigerated cold drink machines, NORESCO will install VendingMiser™ controllers.

Utilizing a passive infrared (PIR) sensor, the device completely powers down a vending machine when the area surrounding it is unoccupied. Once powered down, the unit will monitor the room's temperature and use this information to automatically re-power the vending machine at one- to three-hour intervals, independent of occupancy, to ensure that the vended product stays cold.

Figure 5.18.1 Annual savings.



The VendingMiser™ also monitors electrical current used by the vending machine. This ensures that the unit will never power down a vending machine while the compressor is running, so a high head pressure start never occurs. In addition, the current sensor ensures that every time the vending machine is powered up, the cooling cycle is run to completion before again powering down the vending machine.

This controller is approved by both the Coca Cola Company and the Pepsi Corporation for use on their machines.

Facility Impact

The plug load controllers described above are easily installed and virtually transparent to tenants and staff. The vending machine controllers are installed separate of the machine, and implementation will occur during working hours. A period of three weeks will be required to ensure proper calibration of the sensors.

5.18.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption. Unnecessary run hours and, therefore, energy consumption will be reduced with no interruption of normal building activities.

Special Operating Requirements

Vending machine controls will not be installed in machines holding ice cream or dairy products, machines with programmable controllers or any machine that is leased and subject to a yearly agreement.

5.18.4 EQUIPMENT INFORMATION

Manufacturer and Type

NORESCO will install vending machine controls manufactured by the following:

- **USA Technologies** 100 Deerfield Lane, Suite 140 Malvern, PA 19355
  Phone: 800.633.0340/610.989.0340 Fax: 610.989.0344

5.18.5 COMMISSIONING PROCEDURE

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations.

5.18.6 ENVIRONMENTAL ISSUES

No environmental impacts are expected.

5.18.7 CUSTOMER TRAINING

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 19 – MISCELLANEOUS ELECTRIC IMPROVEMENTS

5.19.1 OVERVIEW

Measure Summary

Some miscellaneous electrical improvements were identified for the three schools at Churchill County School District. As part of the walk-thru and drawing review, the following concepts were developed:

Kiln Sitter

Hand Dryer

- Each school utilizes older hand dryers rated at an average of 1,500 watts per unit. There was observed one unit per bathroom at all three schools.
- There is a Kiln at the High School art area that could benefit from time control technology.
- All three schools had older refrigerators that could be cost effectively replaced with newer energy efficient units.

NORESCO recommends the following miscellaneous improvements:

- Churchill County High School – Replace older refrigerators, replace hand dryers, install kiln controls.
- Churchill County Junior High School – Replace older refrigerators and replace hand dryers.
- Northside Elementary School – Replace older refrigerators and replace hand dryers.

5.19.2 DETAILED DESCRIPTION

Existing System Description

The existing systems consist of:

- Older hand dryers were observed. Nameplate information indicated these are typically 1,500 watt units. They were also observed to stay on an average of 60 seconds.
- Older refrigerators were observed. From nameplate information gathered, these do not meet "Energy Star" requirements.
- The High School kiln does not have time/temp control features.

Proposed Improvements

The following were identified as proposed improvements:

- Northside Elementary:
  - Replace all hand dryers with new units rated at 1,300 watts and with a 15 second time shut-off.
  - Replace all older refrigerators.
- Junior High School:
  - Replace all hand dryers with new units rated at 1,300 watts and with a 15 second time shut-off.
  - Replace all older refrigerators.
- High School:
  - Replace all hand dryers with new units rated at 1,300 watts and with a 15 second time shut-off.
  - Replace all older refrigerators.
  - Install "Kiln-Sitter" as control for existing kiln

Scope of Work

Specific scope of work requirements for this ECM is:

- Identify the assumptions and inputs used for all savings calculations as part of the Financial-Grade Operational Audit.
- Identify project costs and alternatives as part of the Financial-Grade Operational Audit.
- Recommend economical projects based on full analysis.

Facility Impact

There would be no building impact for this ECM. The kiln control could be added during periods where the kiln was not required. The other items would be replaced in accordance with school schedules to avoid any facility impacts.

5.19.3 Integration with Existing Systems and Operations

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption.

Special Operating Requirements

The "Kiln-Sitter" requires no special operating requirements, but would need to be set to the specific parameters for the operation of the existing kiln.

5.19.4 Equipment Information And Savings Methodology

Manufacturer and Type

Specific equipment type and manufacture to be determined as part of the Financial-Grade Operational Audit.

5.19.5 Commissioning Procedure

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations.

5.19.6 Environmental Issues

No environmental impacts are expected.

5.19.7 Customer Training

The facility maintenance staff will be provided with comprehensive hands-on training. The training will be provided by NORESCO staff or manufacturer's representatives, as applicable, and will be conducted at District facilities.

NORESCO will provide an O&M Manual for the new equipment including product data and warranty procedures.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ECM 20 – NETWORK POWER MANAGEMENT

5.20.1 OVERVIEW

Measure Summary

NORESCO recommends installing new power management software on the servers Churchill County High School, Churchill County Junior High School, and Northside Elementary School. The new software will reduce electricity consumption by safely putting Microsoft Window-based computers into low-power states.

5.20.2 DETAILED DESCRIPTION

Existing System Description

The surveyed schools in total contain a large number of computer workstations. The Churchill County School District reported that a total of 821 computers would be available for implementation of this measure. As is typical of most offices and computer labs, the computers are used on an intermittent basis. Also, they are only used during the hours that each building is occupied. No uniform method was identified to place computers in low-power states to ensure efficient energy consumption while maintaining proper function of the network and computers.

Proposed Improvements

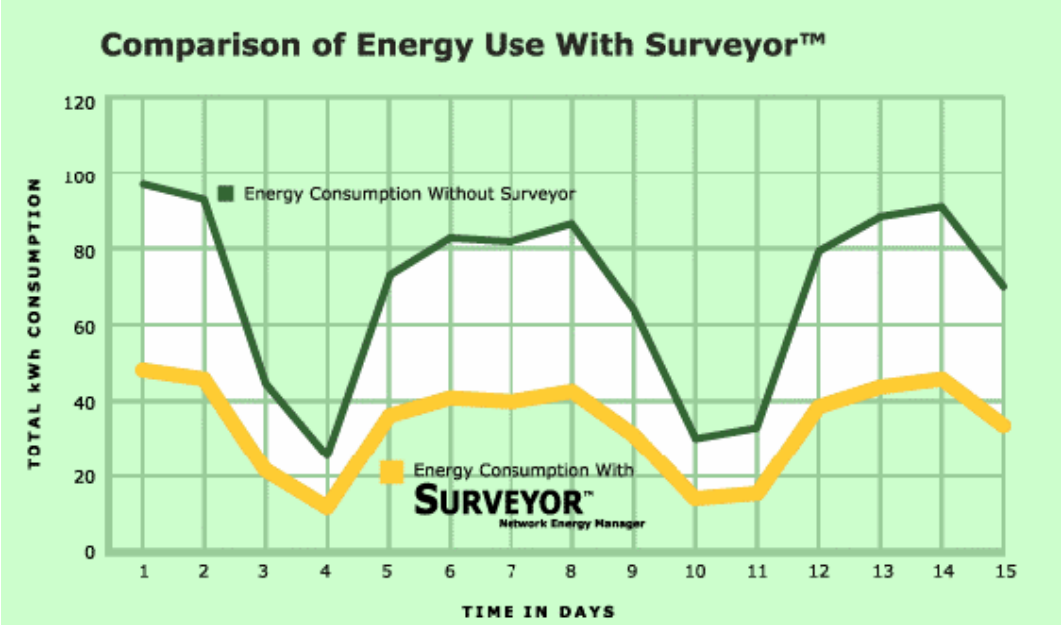
NORESCO will provide a uniform software solution to this problem. The software will be server based and under the control of the District information systems (IS) staff. District IS staff will have network-level control over system power states.

In order to minimize the unnecessary electricity consumption, NORESCO proposes to install Surveyor™ network energy management software on all networked computers located in the affected buildings. This software will enable control of computer power settings and will setup profiles for individual or groups of computers. Profiles may include user-friendly day or night power settings (i.e. sleep, shutdown, standby or hibernate) for monitors and computers, or scheduled events such as software upgrades or backups.

Surveyor measures the energy consumed by the networked computer workstations and centrally manages their power settings through a network-wide interface. The energy consumption of the network can then be examined to determine user behavior and practices, quantify energy waste, and establish appropriate energy use scheduling strategies. The workstation power settings can be remotely controlled so power management policies can be easily adjusted and consistently maintained. Using Surveyor will result in annual savings of approximately 100 to 300 kWh per

workstation. The following graph shows the energy consumption of a typical computer workstation with and without Surveyor.

Figure 5.20.1



Scope of Work

The scope of work will include:

- Purchase and installation of software for all building servers
- Training in the use of the software for the Information Systems staff
- Five years of included maintenance from the software provider

5.20.3 INTEGRATION WITH EXISTING SYSTEMS AND OPERATIONS

Impact on Facility Operations and Performance

The facility will benefit from reduced energy consumption. Unnecessary run hours and, therefore, energy consumption will be reduced with no interruption of normal system activities.

Special Operating Requirements

No special operating requirements are associated with this ECM.

5.20.4 EQUIPMENT INFORMATION

Manufacturer and Type

NORESCO will install the Surveyor software manufactured by the following:

- **Verdiem** – Power Management for PC Networks; Verdiem Corporation; 1525 Fourth Avenue, Suite 700; Seattle, WA 98101; (206) 838-2800

5.20.5 COMMISSIONING PROCEDURE

This ECM will be thoroughly inspected by NORESCO's commissioning team in order to ensure that it has been installed in accordance with design documents and manufacturers' recommendations.

5.20.6 ENVIRONMENTAL ISSUES

No environmental impacts are expected.

5.20.7 CUSTOMER TRAINING

Training in the use of the software for the Information Systems staff will be provided.

In the event CCSD needs further training, warranty or service work, NORESCO provides a toll free 24-hour customer service number. Once a call is received it is routed to the appropriate department for immediate response. For further details, refer to Section 8.0, Project Management Plan.

ADDITIONAL MEASURES CONSIDERED

BOILER REPLACEMENT

The High School central plant has two natural gas fired Ajax W series water-tube boilers with an output rating of 2,200,000 BTUH. The boilers are piped in a parallel configuration. Each boiler is equipped with a powered burner. These boilers had a new efficiency rating of approximately 80 percent.

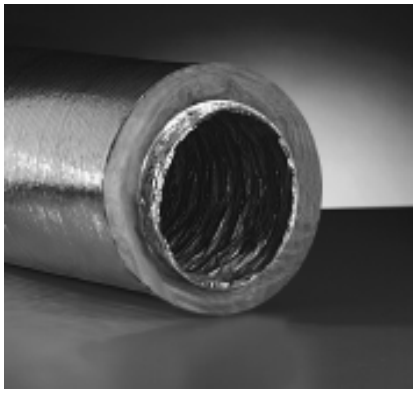
These boilers have reportedly had a history of maintenance problems that have been corrected with repairs and operating procedures. Each unit appears to be in good condition.

The existing boilers typically have a rated new efficiency in the range of 80% when they operate under steady state conditions. These boilers have significant stand-by losses when they are used at partial load or with night setback temperature controls.

Both boilers are candidates for replacement with new, high-efficiency boilers.

NORESCO proposes to replace each large boiler with two new high efficiency packaged boilers. This improves staging capability to meet partial load and reduces stand-by losses. This also provides increased redundancy. The new high efficiency boilers range from 88% to as high as 98% efficiency for condensing units. NORESCO recommends that this measure be considered in more detail during the Financial-Grade Operational Audit.

REBALANCE AIR DISTRIBUTION AT THE MAIN (MINNIE BLAIR) BUILDING



NORESCO proposes to evaluate and restore proper airflow to the zones located in the Minnie Blair Building. This measure includes a detailed engineering evaluation, the potential relocation of supply and return ductwork, grills and diffusers and airside test, adjust and balance.

The Minnie Blair Building was initially designed with HVAC systems serving an open space. The remodeling of the interior spaces included new walls and partitions. This typically results in zones that may have too much or too little heating, cooling and/or ventilation. Often in this situation, zone temperature sensors are located in areas that are not served by the HVAC equipment.

The HVAC systems including the supply and return ductwork, grills, diffusers and temperature sensors may not be ideally suited for the new interior spaces. This can lead to overheated and/or under cooled spaces and inadequate ventilation. During the Financial-Grade Operational Audit, it is proposed to perform a detailed engineering design review of the existing ductwork and zones. The analysis should establish appropriate airflows for each zone. Possible recommendations may include reconfiguration of ductwork and zoning to optimize the existing HVAC systems.

BUILDING ENVELOPE IMPROVEMENTS

In addition to the building envelope improvements identified at Churchill County Junior High School (ECM 13), the following potential improvements were also identified:

- Northside Elementary School:
  - The interior roof space only has approximately 3" of fiberglass bat insulation.
  - All the exterior doors either need to be replaced or adjusted. The older doors have a single pane window that also creates security concerns. These older doors had an average of 1/2" of air gap between the door and the frame. Further, some had large gaps below the door as well.

- Churchill County Junior High School:
  - The older buildings have single pane windows. The adjacent picture shows a typical existing window at the Annex.
- High School:
  - There were older doors that needed adjustment or replacement.

During the Financial-Grade Operational Audit, it is proposed to perform a detailed engineering design review of the existing building envelope and its impact on occupant comfort and operation of the heating and cooling systems. Possible recommendations may include adjustment or replacement of doors and installation of a minimum of 6" of insulation in the interior roof space.

GROUND-SOURCE HEAT PUMP SYSTEM

NORESCO considered, but does not recommend the use of a "ground-coupled" or "ground-sourced" heat pump conversion for the High School. A typical ground-sourced system would use a closed loop of buried piping to connect to the building loop. The buried piping is usually installed in a grid of vertical boreholes up to 300 feet in depth. Alternately, a system of surface trenches can be used to bury the piping. The heat pump loop water is then circulated through the ground loop to absorb or reject heat for the building. The length of buried pipe varies with climate, soil and building load. Typically, 150 to 250 feet of bore are required per ton of cooling.

Typical costs for the ground-coupled system are in the range of $5 per foot of installed piping. This translates to an initial capital cost or approximately $1,000 per ton given an average capacity requirement of 200 ft per ton. Asphalt and concrete repair, landscaping, electrical, pumping and land acquisition are possible additional costs. This system may also necessitate replacement of heat pumps throughout the school due to larger operating temperature range of the water loop with the ground-sourced system. Therefore, the proposed city water connection (ECM 6) provides a much lower initial investment. It also conserves land space for uses other than the ground loop.

REHABILITATE ROOF AT MAIN (MINNIE BLAIR) BUILDING

During a survey of the roof on the Main Building at Churchill County High School, it was noted that that the existing roofing system has deteriorated and has potential issues such as leakage and low solar reflectivity. Currently the building has a built-up roof system comprised of a series of base sheets and ply sheets, as well as a modified bitumen cap sheet. These are applied in hot asphalt and, over time, deteriorate through adverse elements resulting in leaks. In the near term, repair of the problematic area and reseal of the entire surface with a bitumen cap sheet is recommended. Also, since the existing roof only has a solar reflectance of approximately 5% - 10%, it is also recommended to apply a white cool roof coating. This will increase the surface reflectance to about 60%. This can be accomplished by two primary types of cool roofing products on the market: protective paints and coatings, and single-ply roofing systems. Reflective paints and coatings, based on either acrylic or elastomeric chemistry, can be an effective short-term solution for reducing energy costs. However, most facility owners are looking for long-term, low-maintenance solution and opt for a complete single-ply roofing system.

TRASH COMPACTION

NORESCO evaluated CCSD's process for waste disposal at each of the three schools. Currently, CCSD rents the waste containers at each school for a minimal cost and operates a District-owned truck for hauling and dumping the waste. The waste is dumped at the local landfill at an approximate cost of $250 per week. This equates to an annual cost of approximately $10,000 (40 weeks per year accounting for summer break). Typically, installation of trash compactors is economical when waste is collected on a daily basis by a traditional waste management company. Use of the compactors will reduce the frequency of pickup resulting in cost savings. Since CCSD performs this task internally, including the compacting of waste in the District-owned truck, savings from installation of compactors will be minimal. If CCSD is interested in this project, NORESCO can investigate during the Financial-Grade Operational Audit. This analysis could include evaluation of avoided capital costs for future replacement or upgrade of the existing trash hauling truck.

SECTION 6.0: REBATES, INCENTIVES AND STATE AID

6.1 OVERVIEW

NORESCO is committed to procuring on behalf of the Churchill County School District (CCSD) the maximum financial incentives available through various utility and state government programs. NORESCO has evaluated four funding sources that may be available as subsidization to the CCSD project:

- Solar Generations PV Rebate Program
- USDA Renewable Energy Systems Program
- Clean Renewable Energy Bonds
- Sierra Pacific Surebet Program

Solar Generations PV Rebate Program

The Solar Generations PV Rebate Program is administered by Sierra Pacific and Nevada Power on behalf of the Nevada Task Force on Energy Conservation and Renewable Energy. Providing CCSD has a facility within the Sierra Pacific territory, the Solar Generations PV Rebate Program may be available. Program Year 4 for projects installed between July 1, 2007 and June 30, 2008 has ended. Program Year 5 includes projects for implementation between July 1, 2008 and June 30, 2009. The Program will begin accepting applications on August 1, 2007. Providing program details for Program Year 5 do not change, the CCSD may be eligible for up to $150,000 in incentives which are based upon the implementation of a PV system of 30 kW AC or greater.

USDA Renewable Energy Systems Program

Section 9006 of the 2002 Farm Bill requires the US Department of Agriculture to create a program to make direct loans, loan guarantees, and grants to agricultural producers and rural businesses to purchase renewable-energy systems and make energy-efficiency improvements. This program is known as the Renewable Energy Systems and Energy Efficiency Improvements Program. The maximum grant award of eligible project costs is 25% of eligible project costs up to $500,000 for renewable energy projects and up to $250,000 for energy efficiency improvements. Total project incentives cannot exceed $750,000. Eligible renewable energy projects include wind, solar, biomass, and geothermal projects.

Clean Renewable Energy Bonds (CREBs)

CREBs were created by the Energy Policy Act of 2005 and are administered by the Internal Revenue Service (IRS). CREBs are financing arrangements that pay a portion of the interest in the form of tax credits to the investor/lender and are available for certain renewable projects (solar, wind, biomass, landfill gas, etc) used in the generation of electricity by municipalities or cooperatives. Applications for program year 2007 are due in April. Congress has renewed the program for 2008. Rules and regulations should be released soon. It is anticipated that $1.2 billion will be available. Providing, a solar project is implemented at the CCSD, this alternative means of financing may be available.

Sierra Pacific Surebet Program

The City of Fallon provides utilities to the CCSD. Providing CCSD has a facility within the Sierra Pacific territory, the Sierra Pacific Sure Bet Program may be available. Incentives for the 2007 program year are yet to be released. However, if funding levels have not changed from the 2006 program year, incentives of up to $100,000 may be available depending on which ECMs are implemented. This program provides prescriptive incentives for lighting, cooling, motors, refrigeration and VendingMisers. Custom incentives are available for economizers, HID lighting, VFDs, controls, daylighting, solar water heating, thermal energy storage, building envelopment, and any retrofit that can verifiably reduce peak demand an/or energy consumption.

Typically, NORESCO will assume the responsibility of delivering utility incentive rebates for projects during the Detailed Energy Audit phase that can be submitted and receive pre-approval before construction. NORESCO will help prepare all forms and applications necessary to apply for the utility incentives and state building aid, and facilitate all pre and post inspections, as required for the processing of incentive payments.

6.2 SUMMARY OF REBATES, INCENTIVES AND STATE AID WHICH MAY BE AVAILABLE TO CCSD

Table 6.1 Summary of rebates, incentives and state aid.

Program Sponsor	Program	Current Status	Projected Rebates, Incentives, State Aid
Sierra Pacific and Nevada Power	Solar Generations PV Rebate	Soon to be Released	Up to $150,000
US Department of Agriculture	Renewable Energy Systems	Active	25% of qualifying project cost
Internal Revenue Services	CREBs	Soon to be Released	Tax exempt financing of project cost
Sierra Pacific	Sure Bet	Soon to be Released	Up to $100,000

SECTION 7.0: MEASUREMENT & VERIFICATION PLAN

7.1 INTRODUCTION

In order to ensure energy savings are realized with Energy Conservation Measures (ECMs) at Churchill County School District (CCSD), NORESCO has developed a Measurement and Verification Plan (M&V) for implementation. Measurement and Verification Plans are recognized by the energy services and engineering industries as the most appropriate means for ensuring energy savings and conformance to the 2002 International Performance Measurement and Verification Protocol (IPMVP). This will provide CCSD with the assurance that the M&V is in accordance with the requirements of the Agreement and recognized industry standards.

Computing energy savings is the core to a successful energy conservation program. The process starts by establishing an energy baseline that will be used to calculate and verify energy savings. An energy baseline is established from historic utility consumption, field collected data and engineering analysis and can be at the facility, building or equipment level. The historic utility consumption data is used to build consumption and demand profiles for the facility. During the audit, engineering data is collected to help establishing the baseline consumption. The collected data includes name plate data, equipment and systems types, kW and kWh spot measurements (as needed), and short term monitoring of energy consumption and use patterns. The collected data is then used to evaluate the baseline energy consumption for the facility and for each energy conservation measure (ECM) using engineering analysis, baseline conditions and engineering assumptions at the building or equipment level.

Energy savings calculations also mirror the measurement and verification (M&V) process. An M&V plan, which includes the parameters that will be measured, the measurement time period, the energy savings calculation methodology, savings adjustment methodology, and the measurement equipment, is established and developed to fit the specific energy conservation measure that is being evaluated. Each plan must meet one of the International Performance Measurement and Verification Protocol (IPMVP) options criteria. The M&V plan for each ECM is chosen carefully to meet the IPMVP requirements, and to establish an accurate timeline.

NORESCO's Measurement &Verification (M&V) plan to meet the needs of Churchill County School District (CCSD) is based on a cost benefit analysis that balance the cost of the M&V protocols with the achieved savings in order to make sure the costs do not outweigh the savings benefit to CCSD. NORESCO places great emphasis on the measurement of results and takes great pride in the performance of our past projects. Ultimately, NORESCO wants to agree upon an M&V plan that will clearly measure the results and protect CCSD from under-performing projects. Since CCSD is in effect paying for the Measurement & Verification system and reports, NORESCO feels the plan should be clear, concise and cost-effective.

As an important part of the Financial-grade Operational Audit, the M & V plan must be developed in a method that assures compliance with recognized standards, provides cost effective measurement methods, and has proper inspection, review, and documentation standards. The steps in this process are summarized as follows:

- Develop the project scope including identification of Energy Conservation Measures (ECMs), savings calculations and methods, utility rates, and implementation schedule.

- Determine the most appropriate M&V method.
- Determine the costs and benefits of M & V methods.
- Based on discussions with the customer and/or technical reviewers, develop consensus on reporting and measurement requirements.
- Provide a comprehensive M & V plan that documents all calculations, assumptions, allowed adjustments, and clearly defines all reporting requirements.

Integral to NORESCO's M&V plan is the guarantee of savings for three (3) years following completion of construction. The current typical practice for performance contracting is to verify performance immediately following construction, then provide inspection and reporting only for the remainder of the financing term. Persistence of savings is of utmost important considering CCSD's financial commitment to the project. Three years of measurement and verification following construction will ensure proposed equipment upgrades and operational adjustments are well established, and any adjustments are documented and tracked.

Following the initial three-year period, NORESCO has included annual services and fees for inspection and reporting of project progress. CCSD can elect to stop the process or adjust M&V and associated reporting at its discretion.

The remainder of this section describes the proposed M&V plan for the measures identified for the Comprehensive Audit Report. It is anticipated that as the measures are developed in detail during the next phase of the project, the District may provide additional requirements to be incorporated into a final M&V plan.

NORESCO designs its M&V plans for all projects based on the International Performance Measurement and Verification Protocol (IPMVP) - the most current industry standard. The following table outlines the four IPMVP Options for CCSD's consideration:

Table 7.1 IPMVP options.

Options	Description	How Savings are Calculated
A	Performance factors are determined with spot or short-term measurements and operational factors are stipulated based on analysis of historical data or spot/short-term measurements. Performance factors and proper operation are measured or checked on a pre-determined schedule.	Engineering calculations using spot or short-term measurements, manufacturer's data, computer simulations, and/or historical data.
B	Savings are determined by short-term or continuous energy measurements taken at the device or system level. Both performance and operations factors are monitored.	Engineering calculations using metered data.
C	After project completion, savings are determined at the building or facility level using current year and historical utility meter or sub-meter data.	Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.
D	Savings are determined through simulation of facility components and/or the whole facility.	Calibrated energy simulation/ modeling; calibrated with utility billing data and/or end-use metering.

In order to maximize the amount of investment that CCSD can make in its building infrastructure with this guaranteed savings program, NORESCO has provided a M&V plan that focus cost and effort on the specific ECMs with greatest impact to savings, while verifying the efficiency of the equipment installed.

The table on the following page contains a description and summary of the M&V protocols that NORESCO proposes to use for the verification of project savings. IPMVP Option A, B and D protocol are recommended for ECMs that contribute significantly to the overall savings for the project.

Projects with relatively low savings are recommended for stipulation. While IPMVP does not recognize stipulation of savings as a recognized option, it does have merit in some situations. Stipulation will only be applied to proposed measures that are relatively small in savings and/or implementation costs, and where the cost to implement an IPMVP option will eliminate an ECM from consideration.

7.2 PROJECT M&V PLAN

Table 7.2 Summary of M&V descriptions.

ECM # and Description	Utility Category Affected	Baseline M&V	Post Installation M&V	Duration of Monitoring	Other Stipulated Variables
ECM #1 – Lighting System Improvements (Option A) **ECM #2 – High Bay Luminaire Replacement (Option A)** **ECM #3 – Lighting Controls (Option A)**					
Installation of energy efficient lighting system including new and retrofitted lighting fixtures, occupancy sensors, and daylighting.	- Electric Demand - Electrical Consumption	Measure fixture wattage and operating hours on a representative sample of each selected fixture type. Calculate baseline usage based on stipulated values for daylighting and occupancy sensors.	Measure fixture wattage and operating hours on a representative sample of each selected fixture type. Verified savings will be adjusted to reflect final quantities and pre- and post retrofit fixture wattage measurements. Calculate post implementation usage based on stipulated values for occupancy sensors.	Years 1 through 3 of performance contract.	Hours of operation, Demand Savings Coincidence Factor, and Energy Savings Utilization Factor.
ECM #5 – Upgrade Building Automation Controls (Option A)					
Install a new energy management system with Direct Digital Controls. Optimize schedules and incorporate features such as optimum start/stop, room temperature set-point control, scheduled start/stop, and economizer controls.	- Electric Demand - Electrical Consumption - Natural Gas Consumption	Survey of mechanical systems and interviews with facility personnel to establish baseline occupied and unoccupied hours and temperatures. Calculate baseline usage based on stipulated operating hours and temperature setpoints.	Commissioning of EMS hardware and software. Verify that proposed strategies are operating as intended (i.e., unoccupied setback schedules and temperatures). Calculate post implementation usage based on stipulated operating hours and temperature setpoints.	Years 1 through 3 of performance contract.	Weather data, building loads, HVAC equipment efficiency, airflow, occupancy schedule, and hours of operation.
ECM #6 – Optimize Water Source Heat Pump System (Option D)					

Table 7.2 Summary of M&V descriptions.					
ECM # and Description	**Utility Category Affected**	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
Install new heat exchanger and water loop connected to city's water system for thermal exchange. Limit or eliminate use of school's boilers and cooling tower.	- Electrical Consumption - Natural Gas Consumption	Calculate baseline usage based on a calibrated building model for this facility.	Calculate post-installation energy use by updating the building model and re-calibrating to post-installation utility data.	Years 1 through 3 of performance contract.	Weather data, building loads, HVAC equipment efficiency, airflow, occupancy schedule, hours of operation, and temperature setpoints.
ECM #7 – Replace Packaged Units (Stipulated)					
Replace existing packaged units with new high efficiency units.	- Electrical Consumption - Natural Gas Consumption	Calculate baseline usage based on stipulated values.	Calculate post implementation usage based on stipulated values.	Post-installation, verify equipment installed as intended and operating as designed.	Weather data, building loads, HVAC equipment efficiency.
ECM #8 – Replace Heat Pumps with Packaged Units (Option D)					
Replace water source heat pumps with new gas/electric packaged units.	- Electrical Consumption - Natural Gas Consumption	Calculate baseline usage based on a calibrated building model for this facility.	Calculate post-installation energy use by updating the building model and re-calibrating to post-installation utility data.	Years 1 through 3 of performance contract.	Weather data, building loads, HVAC equipment efficiency, airflow, occupancy schedule, hours of operation, and temperature setpoints.
ECM #11 – Kitchen Cooling Upgrades (Stipulated)					
Install new kitchen make-up air units	- Electric Consumption - Natural Gas Consumption	Calculate baseline usage based on stipulated values.	Calculate post implementation usage based on stipulated values.	Post-installation, verify equipment installed as intended and operating as designed.	Weather data, building loads, steam loads, HVAC equipment efficiency.
ECM #12 – Window Upgrades/Replacements (Stipulated) **ECM #13 – Building Envelope Improvements (Stipulated)**					
Replace and/or retrofit windows with energy efficient	- Electric Consumption - Natural Gas	Calculate baseline usage based on stipulated	Calculate post implementation usage based on stipulated	Post-installation, verify equipment	Weather data, building loads, HVAC equipment

Table 7.2 Summary of M&V descriptions.					
ECM # and Description	**Utility Category Affected**	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
alternates. Insulate above ceilings.	Consumption	values.	values.	installed as intended and operating as designed.	efficiency, materials' thermal properties.
ECM #14 – Water System Improvements (Option A)					
Installation of water conserving devices.	- Natural Gas Consumption - Water and Sewer Consumption	Measure baseline fixture consumption on a representative sample of devices.	Measure post-retrofit fixture consumption on a representative sample of devices.	Years 1 through 3 of performance contract.	Number of occupants, occupancy schedule, fixture use per day, and temperatures.
ECM #15 – Photovoltaic System (Modified A)					
Install 10kW photovoltaic system.	- Electric Consumption	Not applicable.	Calculate post implementation electricity generation based on a performance measurement of the PV system to verify kW output.	Years 1 through 3 of performance contract.	Full load hours of system.
ECM #18 – Vending Machine Controls (Stipulated)					
Install occupancy-based controls to optimize controls of lighting, fans and compressors in vending machines.	- Electric Consumption - Natural Gas Consumption	Calculate baseline usage based on stipulated values.	Calculate post implementation usage based on stipulated values.	Post-installation, verify equipment installed as intended and operating as designed.	Vending equipment ratings and efficiency.
ECM #20 – Network Power Management (Option A)					
Install software to monitor and optimize sleep modes in networked personal computers.	- Electric Consumption - Natural Gas Consumption	Calculate baseline usage based quantity of PCs, and baseline data analysis using the recommended software.	Calculate post implementation usage based on post-installation monitoring and reporting utilizing the network power management software.	Years 1 through 3 of performance contract.	District agrees to maintain power management strategies and provide software reports in a timely fashion.

It should be noted that several additional ECMs were evaluated for recommendation, but are currently not included in the program due to financial considerations or mutual exclusivity with another ECM. For informational purposes, these ECMs are listed below:

- ECM 4 – Daylighting Controls

- ECM 9 – Fluid Cooler VFD
- ECM 10 – Economizer Retrofit
- ECM 17 – Upgrade Kitchen Hot Water Booster Heaters
- ECM 19 – Miscellaneous Electrical Measures

ECM 16 – Facility Operations Management Software is not considered an Energy Conservation Measure and therefore is not included in the M&V plan.

SECTION 8.0: CONSTRUCTION MANAGEMENT APPROACH

NORESCO believes that communication is ultimately important in a successful project. The CCSD project will have an on-site Project Manager (PM) supervised by the Manager of Construction Services. Both the PM and Manager of Construction will participate in the Financial-Grade Operational Audit with the CCSD decision makers. NORESCO's Manager of Construction Services, Michael Raizer, will ensure continuity from initial project design through construction, commissioning and system turnover. Mr. Raizer will be responsible for the accomplishment of all of the key elements required - ensuring a successful project implementation and performance of the improvements. He will select and assign a NORESCO PM for the CCSD project based on his understanding of the unique project requirements and his knowledge of the capabilities and experience of NORESCO's project management staff.

This experienced professional will be responsible for the accomplishment of all of the key elements required to ensure successful project implementation and performance of the improvements. The PM will schedule all project meetings including an initial kick off meeting with CCSD personnel. During the kick off meeting NORESCO recommends that CCSD and NORESCO personnel review the project objectives, timelines and obligations of each party to ensure the project success. Specific discussion items for the kick off meeting include, but are not limited to:

- Review of the Scope of Work and Preliminary Project Schedule
- Project contact information for customer, NORESCO and any subcontractors
- Security issues, access to all areas included in scope of work
- Work hours for site personnel and contractor staff
- Site Safety Plan
- Customer requirements for all subcontracting personnel accessing the campus
- Hazardous areas in the facility
- A plan to handle hazardous materials that may be affected
- Required permits (confined space, Hot work, local building, State Public Works , etc.)
- Customer concerns, NORESCO concerns
- Anticipated project impacts during construction (what can you expect)
- Staging areas, trailers, material storage, lockable space
- Discussion of any unique site specific requirements such as keeping dumpsters off of sidewalks to avoid damage because steam and/or condensate piping is immediately underneath
- Discussions of any requirements which may effect students

Once all ECM designs and specifications are developed, reviewed, and receive final approval, the PM will then begin the implementation of the project in a collaborative effort with the site

personnel. Project management procedures employed by NORESCO minimally include the following:

- PM directs the subcontractors work schedules based on coordination meetings with customer.
- PM requires sub-contractor(s) to submit status reports (daily, weekly).
- PM conducts weekly/Bi-weekly construction meetings unless directed otherwise by CCSD personnel. Updates include work completed and schedule "look aheads" to keep the customer informed of the next affected areas.
- PM generates Meeting Minutes from the weekly construction meeting and distributes electronically to CCSD Project Team. In order for these minutes to become accepted by the team, NORESCO requests a positive response from a CCSD representative within five business days of transmittal unlike the standard practice which is to accept no response as acceptance as fact.
- PM schedules informal kick-off meetings with a representative for each affected building and coordinates future work with this individual as the "primary point of contact" for that facility.
- PM requires all NORESCO and sub-contractor personnel to wear identification badges, or other required form of identification, when on the building premises.
- PM tracks all material and labor on a daily and weekly basis and reports project progress to NORESCO Management via Percent Complete Reporting this same information is used for accounting and invoicing the customer.
- PM inspects work during site visits and reviews work with contractor. All deficiencies and punch list items are noted at this time. As soon as practical following these walk-throughs a timeline is established and provided to the customer for completion of open items.
- PM documents all changes to the work and receives appropriate approvals before initiating any changes to the scope of work.
- PM red lines documents and generates the project "As-Builts", which are provided to the customer in the project turnover package.
- PM coordinates all commissioning and initiates training procedures.
- PM oversees the preparation of all O&M documentation.

All punch list issues will be resolved prior to final acceptance of the project by site staff. Completed as-built drawing, O&M manuals, and any other pertinent documents will be submitted and approved as part of the commissioning and turnover. All such procedures outlined in the Energy Services Agreement (ESA) will be strictly observed. Temporary facilities established at the site will be removed, and all aspects of the facility restored to their original condition.

Several construction management tasks are worth special note, since they are key to a smooth implementation phase. The following describes NORESCO's approach to specific tasks in managing design/build construction activities that will ensure that the final product meets the design intent with seamless communications between the NORESCO construction team and CCSD.

8.1 DESIGN/ENGINEERING REVIEW

A successful installation depends on a well thought-out project approach specifically the project design and engineering review. The approach at NORESCO is for a total team approach when it comes to Design and Engineering.

- After the *EntelliChoice*^{SM} sessions, CCSD and NORESCO will have selected the best energy measures for the project.
- During the design phase, NORESCO will hold internal weekly design review meetings with the selected engineering firms to manage the design and schedule deliverables.
- During the design and engineering, all documents will be reviewed by the NORESCO PM team, internal enginneerings and energy auditors to keep with the intent of the ECM.
- PM will set up 30%/60%/90% design review meetings with the CCSD.
- PM will involve CCSD in the review of project submittals.
- PM will ensure all CCSD operational concerns are incorperated into the design where feasible.
- PM will meet with the Nevada State Public Works and Fire Marshall where applicable.
  - The NORESCO project manager will meet and review the project with the State Fire Marshall addressing design issues and code requirements as a result of the project.
  - The NORESCO project manager will meet with the State Nevada Public Works Department prior to the project moving forward to get them up to speed and address simultaneous project they may have going on at the same time. The Project Manager will also coordinate with NSPW to ensure a timely review of design documents by NSPW or the states 3rd party design review.
- The PM will work closely with Celtic Energy during the Design and Engineering phase of the project for review and comments if requested by the CCSD.
- NORESCO will provide a copy of as-builts to the CCSD in the form of hard and soft copy.

8.2 COMMUNICATION

Successful project site management depends on effective communication between the customer and NORESCO. NORESCO's site management approach emphasizes frequent streamlined communication as the basis of effective project management to minimize disruption to CCSD operations. NORESCO shall ensure that CCSD staff is consulted appropriately on all significant issues in a timely and efficient manner. A lead NORESCO staff member will be designated for communication with specific customer team members during each phase of the work to ensure that customer representatives are not overwhelmed by separate communications from multiple team members.

Project communications will primarily rely on weekly project meetings and minutes of these meetings representing the project record. Additional communications are issued as needed by the

Senior Project Manager or the Project Developer. Additional communications would involve activities such utility interruptions required for interconnections, milestones verifications and commissioning witness testing to name a few. More frequent e-mail updates can also be provided at the request of CCSD.

8.3 SCHEDULING

NORESCO and its subcontractors rely on Microsoft Project, as well as self-developed databases and spreadsheets, to carefully schedule and track the performance of projects. All project related documentation and correspondence is maintained and organized in a standardized fashion within a "job folder" housed on NORESCO's network. NORESCO's Project Managers will also rely on our real-time project cost management database to ensure the project remains on-time and on-budget.

Key milestones, such as obtaining permits and host facility approvals, are given equal weight within the project schedule with more labor intensive tasks, since they can impact the overall project duration. Scheduling and frequent auditing for compliance with the anticipated project construction plan is a major focus of the NORESCO construction management staff. Deviations from the schedule are quickly detected and swift corrective action taken as necessary to restore the schedule. The careful attention to scheduling allows for anticipation of delays and development of a work around plan to minimization of their effects. The project scheduling documentation is readily available to CCSD for auditing, review and comment as frequently as necessary for your comfort.

Along with general project scheduling, NORESCO and its subcontractors are able to make maximum use of the scheduling process to generate:

- Projected drawing schedules
- Manpower utilization schedules
- "Value earned" profiles for establishment of percent completion payments
- Purchasing schedules
- Design schedules
- Submittal/approval schedules
- Testing, balancing, and commissioning schedules
- Maintenance schedules

The sequence and timing of subcontractor efforts is carefully tracked, especially when there is interdependence between trades. The construction site manager or his assignee will keep daily logs of personnel on site, changes or directions issued, and construction activity completed.

NORESCO knows from experience how critical timing is to the successful completion of a performance contract. NORESCO's construction management process therefore incorporates careful tracking of the following time-related elements:

- Subcontractor pre-qualification process is completed prior to final design to allow them maximum input into the design and construction process and fully integrate their skills and experience with the other team members early on.

- Project management techniques are used to track purchase and delivery of materials and key milestones such as obtaining permits and host facility approvals. They also ensure that adequate manpower and resources are available when they are needed.
- Sequence and timing of subcontractor efforts are carefully tracked, especially when there is interdependence between trades.
- A flowchart is developed early on, defining the relationships between the parties and identifying roles and responsibilities, communication channels, and sign-off or quality control authority of each team member.
- Progress meetings are convened on a regular basis, both within the NORESCO team and with the facility in order to manage properly and keep all interested parties informed of critical dates.
- A commissioning plan is reviewed with all subcontractors before construction is underway so they know what will be required of them regarding start-up, performance testing, training, and documentation. Commissioning can then proceed smoothly and in parallel with construction activities, without causing delays.

For NORESCO, each of these tools are essential to aiding our project managers in effective project management, scheduling and forecasting project issued before they become a reality.

A preliminary project schedule is included as an attachment to this report.

8.4 SAFETY

At NORESCO safety is of the highest priority. It is the first of five "value drivers" or metrics that NORESCO uses to gauge the overall performance of our company on an ongoing basis. As an energy services industry leader, NORESCO has worked on numerous local projects and are familiar with local code compliance. Prior to beginning construction, NORESCO's safety coordinator, Kimberly Payson, will develop a site safety and health plan specifically tailored to the job site and the work to be performed.

NORESCO's project managers are responsible for the strictest level of adherence to safety codes to ensure the safety of all employees, subcontractors, CCSD and other site personnel. NORESCO's contract administrators and project managers have attended a recent OSHA Voluntary Compliance Outreach Program personally conducted in house by Ms. Payson who is an OSHA authorized trainer. In the regular project management meetings that will take place throughout ECM installation safety will be among the primary topics.

Not only is job site safety our highest priority, but also the safety of students and staff. NORESCO employees undergo stringent background investigations during the hiring process to ensure the team member will exemplify NORESCO's highest standards, work ethics and integrity. As part of the subcontractor selection process, NORESCO will run background checks on each prospective subcontractor and use the findings as part of the selection criteria. NORESCO in partnering with CCSD, will only subcontract work to those with the highest regard for safety.

The bottom line in this regard is that NORESCO doesn't just talk about safety, but rather it is an integral part of our culture and daily business practices. Our core assumption is that all incidents are preventable and NORESCO's intent is to maintain the safest possible environment and avoid the human tragedy and costly delays that could result from safety breaches.

8.5 SUBCONTRACTOR MANAGEMENT

NORESCO will utilize the services of local subcontractors when ever possible for the construction of ECMs at CCSD. NORESCO has an excellent track record of subcontracting work for energy performance contracts. The reasons for this success lie in NORESCO's strong management of these subcontractors and their solid qualifications and experience. Once the type and scope of ECM installations are defined, NORESCO selects the best subcontractors available to meet project needs.

Final selection of subcontractors (with the exception of MWBE participants) will be reserved until after the contract is awarded to NORESCO. Naturally, NORESCO will present the qualifications and references of the selected subcontractors for review by CCSD prior to commencement of any work.

There are several reasons why NORESCO proposes to make the final selection of subcontractors after the contract is awarded. First, subcontractors can be best selected when the scope of the project is well defined. Second, if a commitment to a subcontractor is made at this stage of the process, the advantage of competitive bidding is lost. Third, if a subcontractor is selected too far in advance of implementation, personnel changes may affect the subcontractor's ability to perform and their position as the best value and most qualified option.

For this project NORESCO, in consultation with CCSD, will develop an expanded list of suitable local subcontractors as well as the best expertise from wherever for bidding on the intended work. NORESCO will check references and past performance histories of any vendors, suppliers or subcontractors not directly familiar to NORESCO.

All subcontractors used under the project will be subject to CCSD approval.

Bid Specifications

Thorough, tightly written bid specifications are essential to the management of subcontractors. A loose specification is an invitation for future disputes, and contractors will provide more expensive bids if they must speculate about vaguely described activities. A tight bid spec not only facilitates the implementation of the bid process and project construction, but also attracts professional contractors seeking to work with professional clients.

Competitive Bidding

The competitive bid process ensures price competition that reduces NORESCO's and CCSD's costs, formalizes the contracting process and forces contractors to more carefully consider the bid specifications. This process typically results in a more accurate bid. Subcontractors have less leverage to try to reduce the quality of a job in a competitive bid situation and less time is spent in contract negotiations because the terms and conditions are specified in the bid package. The competitive bid process will also offer a good opportunity to review subcontractor qualifications prior to a contractor being selected, thereby reducing the possibility of the rejection of a subcontractor after a contract is signed. The selection of subcontractors will be made on the basis of capabilities, quality, service and value instead of simply lowest price, and will be based on the preferences of CCSD and NORESCO.

As one of the largest energy service companies, with hundreds of projects successfully completed for State, Federal and Local Government entities, NORESCO is frequently required to

meet MWBE subcontracting goals. As a contractor to the federal government, including various branches of the military, Army Corps of Engineers, Environmental Protection Agency, Department of Energy and the Department of Housing and Urban Development (HUD), NORESCO is frequently called upon to certify and demonstrate our commitment to utilizing the services of minority and woman owned business enterprises. For example, for our Energy Savings Performance Contracts with the United States Air Force, NORESCO maintains and adheres to a subcontracting plan that states in part that "It is NORESCO's policy, consistent with Public Laws 99-661 and 100-180, that Small Business Concerns ("SBC"), Small Disadvantaged Business Concerns ("SDBC"), Women-Owned Small Business Concerns ("WOSBC"), Historical Black Colleges and Universities ("HBCU") and/or Minority Institutions ("MI") be provided with the maximum practicable opportunity to participate as NORESCO's subcontractors, particularly in regards to contracts let by Federal, State or local agencies."

NORESCO is committed to meeting or exceeding CCSD's goals for providing business opportunities to small and disadvantaged businesses.

Well-Structured Subcontractor Agreements

NORESCO utilizes well-structured contract provisions to protect not only itself, but also CCSD. Necessary insurance and bond requirements are included in the contract. NORESCO typically specifies a 10% retainage provision as well and adhering to the Nevada State requirements to ensure the prompt completion of any punch list items. Partial payments are made only upon demonstrated completion of the work of the same value. A one-year warranty on parts and labor is generally the norm. For larger projects, NORESCO will require liquidated damages if project performance does not meet specifications, or if work is late. These funds will help mitigate some of the problems associated with the subcontractor's failure to complete the project. Moreover, if there is a question about a subcontractor's ability to perform a large contract, the size of an initial project may be limited in order to test the contractor's capabilities. All terms and conditions for contractors and subcontractors prescribed by CCSD will be included in the contract.

Quality Control in Subcontractor Management Including OSHA Compliance

Subcontractor management involves more than finding a good contractor and signing a contract. NORESCO actively manages the construction process to ensure a high quality project that is finished on time. NORESCO engineers, constructors, and operations specialists assigned to the project meet prior to commencement of construction, and review all aspects of the job including compliance with OSHA and other applicable regulations.

Thereafter, this team meets weekly to confirm that work is on schedule, plan contingencies, and document compliance with OSHA and other regulations. Both construction problems and sub-project completions are well documented to determine any needed corrective action or for payments, respectively. Likewise, NORESCO and CCSD will meet regularly to compare notes on the project's progress and the performance of subcontractors. All required reports on subcontractors' progress and performance will be forwarded to CCSD in a timely fashion. The final subcontractor payment will be withheld until the punch list items are complete and the system is installed properly.

8.6 TRAINING

Facility staff training is an integral part of a performance contract and empowers State staff to work effectively with NORESCO to ensure the installed ECMs deliver improved comfort, reliability, and guaranteed energy savings on a sustained basis. In that regard, NORESCO will develop a comprehensive performance based training program for both supervisory and field personnel. The training will be delivered by NORESCO engineers, project managers, safety coordinators, and manufacturer's representatives.

Training will be delivered on-site using actual ECM equipment and NORESCO staff will be available during the contract duration to answer your questions as they arise. Training for complex technologies may also include factory visits, specialized classes off-site, and visits to other locations where the technologies are already operating. Course materials will include as-built drawings, equipment specifications and the operation and maintenance plans and manuals.

Before completion of construction, a training plan for each ECM will be submitted to CCSD for review. The plan will include a description of the topics to be covered, the allotted time for each topic, and the expected audience (the number of staff expected to attend and their experience). Training materials will be made available for review in advance. NORESCO recommends that the facility designate at least one operator and a back-up person to attend each training session. Clear demarcation of NORESCO and facility staff responsibilities will be stressed with potential for overlaps ensured for redundant coverage of critical functions.

Operation and maintenance manuals will be developed by NORESCO and will contain step-by-step methods for operating systems and individual components, detailing the location of the items, their function, and characteristics, as well as component relationships. The Project Manager will be supported directly by the NORESCO O&M Team, which is staffed by sixty-five facility management professionals. They provide centralized technical expertise, as well as management and administrative resources that have been customized for facility operations.

Maintenance manuals will provide necessary component detail and illustration, indicating arrangements and locations. The manuals will clearly prescribe the manufacturer's recommended schedule for preventative maintenance, seasonal maintenance requirement, and expected frequencies of maintenance. Emergency repair procedures will also be included.

Both operating and maintenance manuals will include all necessary manufacturers' details, service manuals, and a part lists. The NORESCO Construction Team will provide all necessary installation data and documentation. The manuals will be bound and clearly marked, tabbed, and indexed. Where applicable, documentation will be provided in an electronic format. This allows for on-site processing, queries, and incorporation into facility work order scheduling system as appropriate.

To keep a record of ongoing maintenance activities, log sheets (both electronic and hard copy) will be provided in the maintenance manuals. The log sheets will have entry spaces to show all necessary details of the work performed, when it was performed, and by whom.

NORESCO trainers will provide, or arrange for, comprehensive instruction on the operation, equipment optimization, troubleshooting, maintenance, and repair of equipment and systems modified or installed under each ECM.

For major equipment installed as part of ECM implementation, training may be supplemented with an instructional session by the equipment vendors. The session would include maintenance requirements, emergency and emergency shut-down procedures, technical functions, and warranty provisions for their equipment. Where appropriate, field training will be scheduled at the manufacturer's training facility.

Instruction will include a classroom phase, conducted prior to completion of ECM installation, and a practical application phase, conducted after successful startup and testing. The O&M plans and manuals for each ECM, along with supplemental materials, will be used and instruction on their use provided. In some cases, NORESCO may videotape the training sessions for future use. NORESCO has found this to be an effective, low-cost method to ensure that new personnel receive some of the benefits of the initial training, and reduces the cost of any follow-up training. The training NORESCO will provide is not a generic "one size fits all" proposition. It will be highly customized based upon the nature and complexity of each measure.

Additional Owner Training Opportunities

Depending upon the type of facility in which the performance contract is undertaken, it may be appropriate for NORESCO to provide training to other building occupants in addition to the facility management staff. In many instances NORESCO may propose a more comprehensive educational program to inform all occupants within the subject facilities about the purpose and benefits of the performance contract, how they will be affected by the performance contract, and how their behavior is integral to or can supplement the savings achieved on a sustained basis. NORESCO introduces specific behavior modifications that will enhance the achieved savings. To supplement NORESCO's technical measures, our education and awareness program will be of an appropriate scale to provide a rapid payback for itself through energy savings.

SECTION 9.0: PRELIMINARY COMMISSIONING PLAN

9.1 OVERVIEW

Purpose of the Commissioning Plan

The purpose of the construction phase commissioning plan is to:

Provide direction for the commissioning process during construction, particularly providing resolution for issues and providing details that cannot be, or were not, fully developed during design, such as scheduling, participation of various parties of this particular project, actual lines of reporting and approvals, coordination, etc.

Commissioning Scope

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved beginning in the engineering design phase, documenting the intent of the proposed ECMs and continuing through construction, acceptance and the warranty period with actual verification of performance.

Commissioning during the construction of this project is intended to achieve the following specific objectives, according to the contract documents:

- Ensure that equipment associated with applicable ECMs has been installed to achieve the energy savings calculated in the Financial-Grade Operational Audit Report.
- Ensure that applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors.
- Verify and document proper performance of equipment and systems.
- Ensure that O&M documentation left on site is complete.
- Ensure that the Owner's operating personnel are adequately trained.

Commissioned Systems

The following sample ECMs are identified to demonstrate the commissioning process that will be implemented for this project. A complete commissioning report will be developed for all selected ECMs, as part of the Financial-Grade Operational Audit Report. Each School, ECM, and/or piece of equipment will have its own individual commissioning documents.

Table 9.1 Sample ECM commissioning by building.		
Building	**ECM**	**ECM Description**
Northside Elementary School, Churchill County Jr. High School, Churchill County High School	Lighting System Improvements	Lighting System, High Bay Luminaire Replacement, Lighting Controls, Daylighting Controls
Northside Elementary School, Churchill County Jr. High School, Churchill County High School	Upgrade/Retro-Commission Building Automation Controls	Energy Management System with Direct Digital Control
Northside Elementary School, Churchill County Jr. High School	Window Upgrades/Replacements	Upgrade and/or Replacement of older single-pane windows
Northside Elementary School, Churchill County Jr. High School, Churchill County High School	Water System Improvements	Water Conservation for Interior Fixtures
Northside Elementary School, Churchill County Jr. High School, Churchill County High School	Vending Machines	Vending Machine Power management
Churchill County Jr. High School, Churchill County High School	HVAC Replacement	Replacement of HVAC Roof Top Units.
Churchill County High School	Ground Source Heat Pump	Re-commission and Expand

Forms

Detailed commissioning forms for the ECMs listed above are located immediately following this narrative.

9.2 ROLES AND RESPONSIBILITIES

Team Members

The members of the Commissioning team consist of the NORESCO Project Manager, NORESCO Commissioning Agent, the Owner's Project Manager, the mechanical contractor, electrical contractor, controls contractor, any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/ engineer is also a member of the Commissioning team.

General Management Plan

In general, the NORESCO Project Manger coordinates the Commissioning activities and reports to the Owner's Project Manager. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. Refer to the management protocols section below.

General Descriptions of Roles

General descriptions of the Commissioning roles are as follows:

NORESCO Project Manager:

- Performs construction observation, coordinates Commissioning activities with Commissioning Agent and contractors, and assists in resolving problems.

NORESCO Commissioning Agent:

- Facilitates the Commissioning process. Signs-off on performance. Performs construction observation, approves O&M manuals and assist in resolving problems.

Mechanical Contractor, Electrical Contractor & other Sub Contractors:

- Performs prefunctional testing, demonstrates proper system installation performance and integrates Commissioning into the construction process and schedule.

Owner's Project Manager:

- Facilitates, participates and supports the Commissioning process and gives final approval of the Commissioning work.

Manufacturers:

- Provide documentation to facilitate the Commissioning work and perform contracted startup services where applicable.

9.3 COMMISSIONING PROCESS

This section sequentially details the Commissioning process by Commissioning task or activity.

Commissioning Scoping Meeting

A Commissioning scoping meeting is planned and conducted by the NORESCO Project Manger after signature of the Energy Performance Contract (EPC). In attendance are respective representatives of NORESCO, the Owner, and the mechanical, electrical, and controls Subcontractors. At the meeting, Commissioning parties are introduced and the Commissioning process reviewed. Management and reporting lines are also determined. Also covered are the general list of each party's responsibilities, the party responsible for developing the startup plan for each piece of equipment, and the proposed Commissioning schedule. The outcome of the meeting is increased understanding by all parties of the Commissioning process and their respective responsibilities.

Submittals and Documentation

The NORESCO Project Manager provides all Subcontractors responsible for commissioned equipment with Commissioning documentation requirements for their respective equipment and systems. This data request typically coincides with the normal engineering submittal process. At minimum, this equipment data includes installation and start-up procedures, O&M data, and performance data.

Prefunctional Checklists, Tests and Startup

Prefunctional checklists (PC) are important to ensure that the equipment and systems are hooked up and operational and that functional performance testing may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout by the Contractor. In general, the prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels OK, fan belt tension, labels affixed, gauges in place, sensor calibration, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). The word "prefunctional" refers to "before functional testing". Prefunctional checklists augment and are combined with the manufacturer's start-up checklist.

Contractors typically already perform some of the prefunctional checklist items the Commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. This project requires that the procedures be documented in writing by the installing technician. The NORESCO Commissioning agent will witness a representative sample of all prefunctional tests. In most cases a 10% sample of all newly installed equipment will be chosen for a prefunctional test verification.

Execution of Functional Testing Procedures

Overview and Process

The NORESCO Commissioning Agent and Project Manager schedule functional tests, and coordinate testing with affected Subcontractors. Prior to performing functional testing, the NORESCO Commissioning Agent verifies that all prefunctional checklists have been submitted with the necessary signatures, confirming that the system is ready for functional testing. The NORESCO Commissioning Agent oversees, witnesses and documents the functional testing of all equipment and systems chosen for testing according to the Commissioning Plan. The Subcontractors execute the tests with the NORESCO Commissioning Agent. In some cases such as with Energy Management Systems (EMS), the Commissioning process will include multiple layers of functional testing. The purpose of layering the EMS Commissioning is to verify that the EMS is functioning as designed on a global level including processes such as communications, graphics, alarming, trending, point sharing and loop tuning.

Deficiencies and Retesting

The NORESCO Commissioning Agent documents the results of the test or gathers test results from the appropriate Subcontractors. Corrections of minor deficiencies identified are made during the tests at the discretion of the NORESCO Commissioning Agent. The NORESCO Commissioning Agent records the results of the test on the procedure or test form. Deficiencies or non-conformance issues are noted and reported to the NORESCO Project Manager. Subcontractors correct deficiencies, notify the NORESCO Project Manager and certify that the appropriate correction was made. The NORESCO Project Manager shall schedule retesting. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between the NORESCO Commissioning Agent, Project Manager and the Subcontractor.

Facility Staff Participation

The Owner's facilities operating staff are encouraged to attend and participate in the testing process.

Sampling

Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. These items are typically lighting, water fixtures and

steam traps where a sample of fixtures can be commissioned to demonstrate the proper working condition. The sampling for Commissioning will be the same sampling plan as used for the M&V plan.

O&M Manuals and Warranties

The NORESCO Commissioning Agent and Project Manager review the O&M manuals, documentation and redline as-builts for systems that were commissioned. The NORESCO Project Manager also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated.

Training and Orientation of Owner Personnel

Owner training and orientation on equipment and systems provided by the Contractor is reviewed and signed off by the NORESCO Commissioning Agent and/or Project Manager. Owner training and orientation of equipment will be consistent with specific training plan outlined in each ECM Commissioning document. In particular, the controls contractor will provide brief training on controls in the same session with the mechanical training for equipment controlled by the building automation system.

When the training is complete, the Contractor provides a copy of a record of individuals trained to the NORESCO Project Manager and the Owner Project Manager. The Owner Project Manager and NORESCO Project Manager review and make final approval by signing the record.

STANDARD COMMISSIONING PROCEDURE FOR LIGHTING UPGRADES

PROJECT NAME: _____

BUILDING NAME: _____

BUILDING ADDRESS: _____

General Notes:

1. This is a generic test procedure for high efficient lighting that were installed under the Energy Services Agreement between NORESCO and Bridgewater Correctional Complex.
2. In all sections, note any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies. Attach all retest data sheets.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. This procedure does not take the place of the manufacturer's recommended checkout and startup procedures or report.
5. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.
6. It is not necessary to repeat any tests or observations that are documented in other commissioning procedures, but refer to those documents where relevant.
7. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
8. Contractors assigned responsibility for sections of this procedure shall be responsible to see that any items by their subcontractors are completed and verified.

1. Submittal/Approvals

Submittal. The submitted equipment and systems integral to them are complete and operational. The following checklist items are complete and have been verified by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This commissioning procedure is submitted for approval.

Electrical Contractor	Date	General Contractor	Date
_____	_____	_____	_____

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

Commissioning Agent	Date	Owner's Representative	Date
_____	_____	_____	_____

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Manufacturer's cut sheets						
Performance data						
AS-Built audit						
Warranty						
O&M manuals						

- ***Documentation complete as per contract documents for given trade..... ___ YES ___ NO***

3. Model verification

[Contr = _____]

1 = as submitted, 2 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
Ballast						
Manuf.	1					
	2					
Model #	1					
	2					
Serial #	2					
Volts/phase	1					
	2					
Amperage	1					
	2					
Lamps						
Manuf.						
Wattage						

- ***The equipment installed matches the specifications for given trade ..... ___ YES ___ NO***

4. Installation Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
General Installation						
Ballast Nameplate intact and readable						
Maintenance access acceptable						
Fixture Securely mounted						
Lens Cleaned						
Lamps installed						
Lamp holders intact						
Proper grounding installed						
Electrical and Controls						
Fixtures operate properly with existing switches						
Existing Controls continue to work as designed						
Final						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Lighting AS-Built Completed with this checklist attached						

- ***The checklist items of Part 4 are all successfully completed for given trade.…___ YES ___ NO***

STANDARD COMMISSIONING PROCEDURE FOR ENERGY MANAGEMENT SYSTEM

PROJECT NAME: _____

BUILDING NAME: _____

BUILDING ADDRESS: _____

General Notes:

1. This is a generic test procedure for the energy management systems that were installed under the Energy Services Agreement between NORESCO and Bridgewater Correctional Complex.
2. In all sections, note any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies. Attach all retest data sheets.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. This procedure does not take the place of the manufacturer's recommended checkout and startup procedures or report.
5. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.
6. It is not necessary to repeat any tests or observations that are documented in other commissioning procedures, but refer to those documents where relevant.
7. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
8. Contractors assigned responsibility for sections of this procedure shall be responsible to see that any items by their subcontractors are completed and verified.

1. Submittal / Approvals

Submittal. The submitted equipment and systems integral to them are complete and operational. The following checklist items are complete and have been verified by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This commissioning procedure is submitted for approval.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____		
General Contractor	Date		

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Manufacturer's cut sheets						
Approved copy of controls system specification						
Performance data						
Installation and startup manual and plan						
Approved copy of controls drawings are complete and on-site including:						
Sequences of operation of each system including operating and control strategy and setpoints						
Control loop diagrams						
I/O point lists						
Schematics and wiring diagrams						
Graphic layout of each system						
O&M manuals						

- ***Documentation complete as per contract documents for given trade..... ___ YES ___ NO***

3. Prefunctional Equipment Verification

[Contr = _____]

1 = as submitted, 2 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
Manuf.	1					
	2					
Model #	1					
	2					

- ***The equipment installed matches the specifications for given trade ..... ___ YES ___ NO***

4. Functional Equipment Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
General Installation						
Central network hardware installed						
Architecture of control panels matches drawings						
Access to all DDC equipment adequate						
Environmental conditions in accordance to Mfg. requirements						
Interface with LAN and WAN functional						
Framed instructions mounted in or near control panel						
Components properly labeled (on inside and outside of panel)						
Control components piped and/or wired to labeled terminal strips						
DDC connection made to labeled terminal strip(s) as shown on drawings						
Control wiring and tubing labeled at all terminations, splices and junctions						
Field mounted wiring diagrams installed						
Spare point capacity meets specification requirements						
Compressed air available to panel (if required)						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Pneumatic tubing identified, pressure tight and properly supported						
Factory start-up and check-out complete						
Communications established between user interface and network						
Communications established between user interface and primary controller						
Communications established between primary controllers and their respective secondary controllers						
Controller(s) programmed date and time correct						
Electrical and Controls						
Panels installed and labeled						
Wiring complete						
Field wiring in accordance with submitted drawings/specifications						
Fuse installed and ratings correct for connected equipment						
Low voltage connections to input/output points identified						
Power supplies properly sized and connected						
Conduit, plenum-rated cable and flex connections installed correctly						
High and low voltage cable in separate conduits						
Shielded wiring used on electronic sensors						
Battery backup in place and operable						
Each DDC panel has its own dedicated power supply circuit						
Specified point-to-point checks have been completed and documentation record submitted for this system						
Software						
Verify operator graphical interface is installed as specified and functional						
Operator graphical interface is able to monitor and supervise control of all points						
Operator graphical interface allows operator to add new points and edit the system database						
Operator graphical interface allows operator to access all control units						
Operator graphical interface allows operator to enter programmed start/stop time schedules						
Operator graphical interface allows operator to view all alarms and messages						
Operator graphical interface allows operator to modify existing control programs in all control units						
Operator graphical interface allows operator to upload/download programs, databases, etc. as specified						
Have the required schedules been implemented?						
Have the required monitoring points been programmed including Psuedo points and calculated points required for performance monitoring and preventative maintenance						
Is the trend data being sampled at the proper time intervals required						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Specified sequences of operation and operating schedules have been implemented with all variations documented						
Final						
Startup report completed with this checklist attached						
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent						
Training provided on hardware components						
Operator training provided on graphical interface, software and interfacing with EMS system.						

- ***The checklist items of Part 4 are all successfully completed for given trade. .... ___ YES ___ NO***

STANDARD COMMISSIONING PROCEDURE FOR VENDING MACHINE CONTROLS

PROJECT NAME: _____

BUILDING NAME: _____

BUILDING ADDRESS: _____

General Notes:

1. This is a generic test procedure for the vending machine controllers that were installed under the Energy Services Agreement between NORESCO and Bridgewater Correctional Complex.
2. In all sections, note any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies. Attach all retest data sheets.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. This procedure does not take the place of the manufacturer's recommended checkout and startup procedures or report.
5. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.
6. It is not necessary to repeat any tests or observations that are documented in other commissioning procedures, but refer to those documents where relevant.
7. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
8. Contractors assigned responsibility for sections of this procedure shall be responsible to see that any items by their subcontractors are completed and verified.

1. Submittal / Approvals

Submittal. The submitted equipment and systems integral to them are complete and operational. The following checklist items are complete and have been verified by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This commissioning procedure is submitted for approval.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Manufacturer's cut sheets						
Performance data						
Installation plan						
O&M manuals						

- ***Documentation complete as per contract documents for given trade..... ___ YES ___ NO***

3. Prefunctional Equipment Verification

[Contr = _____]

1 = as submitted, 2 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
Manuf.	1					
	2					
Model #	1					
	2					

- ***The equipment installed matches the specifications for given trade ..... ___ YES ___ NO***

4. Functional Equipment Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
General Installation						
Validate that the sensor can "see" a person at or approaching the vending machine.						
Power down the first time only after installation approximately two minutes after the area around the machine is vacant and the compressor is determined to be not running. As an alternative, covering the occupancy sensor will allow validation of the power down operation if so desired. Following this initial power down, the VendingMiser will operate with standard time-outs.						
Final						
Startup report completed with this checklist attached						
Training						

- ***The checklist items of Part 4 are all successfully completed for given trade.___ YES ___ NO***

STANDARD COMMISSIONING PROCEDURE FOR WINDOWS

PROJECT NAME: _____

BUILDING NAME: _____

BUILDING ADDRESS: _____

General Notes:

1. This is a generic test procedure for the windows that were installed under the Energy Services Agreement between NORESCO and Bridgewater Correctional Complex.
2. In all sections, note any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies. Attach all retest data sheets.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. This procedure does not take the place of the manufacturer's recommended checkout and startup procedures or report.
5. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.
6. It is not necessary to repeat any tests or observations that are documented in other commissioning procedures, but refer to those documents where relevant.
7. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
8. Contractors assigned responsibility for sections of this procedure shall be responsible to see that any items by their subcontractors are completed and verified.

1. Submittal / Approvals

Submittal. The submitted equipment and systems integral to them are complete and operational. The following checklist items are complete and have been verified by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This commissioning procedure is submitted for approval.

_____ _____
General Contractor Date

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____ _____ _____ _____
Commissioning Agent Date Owner's Representative Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
Manufacturer's cut sheets							
Performance data							
Installation plan							
O&M manuals							

- ***Documentation complete as per contract documents for given trade..... ___ YES ___ NO***

3. Prefunctional Equipment Verification

[Contr = _____]

1 = as submitted, 2 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
Manuf.	1					
	2					
Model #	1					
	2					

- ***The equipment installed matches the specifications for given trade ..... ___ YES ___ NO***

4. Functional Equipment Checks

Check if Okay. Enter comment or note number if deficient.

Check	Equip Tag->						Contr.
General Installation							
Validate that the existing window opening is structurally sound							
Validate the window is sized properly to fit in the existing opening and level							
Inspect the caulk and sample water test for infiltration							
Validate the window opens according to design							
Validate windows and work area has been cleaned							
Final							
Startup report completed with this checklist attached							

- ***The checklist items of Part 4 are all successfully completed for given trade. .....___ YES ___ NO***

STANDARD COMMISSIONING PROCEDURE FOR GROUND SOURCE HEAT PUMPS

PROJECT NAME: _____

BUILDING NAME: _____

BUILDING ADDRESS: _____

General Notes:

1. This is a generic test procedure for the heat pumps that were installed under the Energy Services Agreement between NORESCO and Bridgewater Correctional Complex.
2. In all sections, note any responses that indicate deficiencies (i.e. responses that don't meet the criteria for acceptance). Acceptance requires correction and retest of all deficiencies. Attach all retest data sheets.
3. This Commissioning Procedure does not address fire and life safety or basic equipment safety controls.
4. This procedure does not take the place of the manufacturer's recommended checkout and startup procedures or report.
5. To ensure that this Commissioning Procedure will not damage any equipment or affect any equipment warranties, have the equipment manufacturer's representative review all test procedures prior to execution.
6. It is not necessary to repeat any tests or observations that are documented in other commissioning procedures, but refer to those documents where relevant.
7. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor.
8. Contractors assigned responsibility for sections of this procedure shall be responsible to see that any items by their subcontractors are completed and verified.

1. Submittal / Approvals

Submittal. The submitted equipment and systems integral to them are complete and operational. The following checklist items are complete and have been verified by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This commissioning procedure is submitted for approval.

_____	_____	_____	_____
Mechanical Contractor	Date	Controls Contractor	Date
_____	_____	_____	_____
Electrical Contractor	Date	Sheet Metal Contractor	Date
_____	_____		
General Contractor	Date		

Approvals. This filled-out checklist has been reviewed. Its completion is approved with the exceptions noted below.

_____	_____	_____	_____
Commissioning Agent	Date	Owner's Representative	Date

2. Requested documentation submitted

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Manufacturer's cut sheets						
Performance data						
Installation and startup manual and plan						
Sequences and control strategies						
O&M manuals						

- ***Documentation complete as per contract documents for given trade..... ___ YES ___ NO***

3. Prefunctional Equipment Verification

[Contr = _____]

1 = as submitted, 2 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
	1					
Manuf.	2					
	1					
Model #	2					
Serial #	2					
Rated						
Cool Cap.	2					
Rated						
Heat Cap.	2					
	1					
COP	2					
	1					
SEER	2					

- ***The equipment installed matches the specifications for given trade ..... ___ YES ___ NO***

4. Functional Equipment Checks

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
General Installation						
Nameplate intact and readable						
Maintenance access acceptable						
Securely mounted						
Casing condition: dents, cracks, leaks						
Drainage under unit per manufacturer's instructions?						
No unusual noise or vibration						
Electrical connections tight						
Room thermostat/sensor location is satisfactory						
Ductwork appears tight, with no obvious leaks						
Ductwork insulation appears in good condition where visible						
Fan belt tension & condition okay						
Fan rotation correct						
Fan blades clean & in good condition						

Check if Okay. Enter comment or note number if deficient.

Check Equip Tag->						Contr.
Electrical and Controls						
Starter overload breakers installed and correct size						
Control system interlocks hooked up and functional						
Fan motor volts, rated						
Fan motor FLA, rated						
All control devices and wiring complete						
Cooling/Heating water pumps operating properly						
Installation strainers removed/cleaned						
Water supply/return temperature/flow within manufacturer's recommended range						
Specified point-to-point checks have been completed and documentation record submitted for this system						
Air Conditioning and Heating						
Refrigerant charge per manufacturer's recommendations						
Sight glass indicates no moisture						
Head pressure & superheat within manufacturer's recommended range						
Thermal expansion valve bulbs attached firmly to suction lines, and adequately insulated						
Piping installed per manufacturer's specification						
Piping insulated per manufacturer's specification						
Condensate piping trapped properly & drained to outside or floor drain						
Final						
Startup report completed with this checklist attached						
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent						
Operator training						

- ***The checklist items of Part 4 are all successfully completed for given trade.....___ YES ___ NO***