Financial-Grade Operational Audit

Submitted to:
Churchill County School District
Fallon, Nevada

Submitted by:

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Section 1.0
Executive Summary

INTRODUCTION

NORESCO presents the Churchill County School District (the District) a Financial-Grade Operational Audit (FGA) Report for Churchill County School District's approval.

This report was developed with the assistance of District staff to improve the learning environment for students and meet facility infrastructure improvement needs through operating budget reductions. The Project is based on information gathered from site audits and analyses, and was designed to provide the District the greatest value of savings and solutions. It includes solutions to the priority items requested by the District. This report does not include any "soft dollar" savings, labor savings or artificial savings that would negatively affect the District's ongoing operation. This report is consistent with Nevada Revised Statue (NRS) 332 for Nevada school districts.

This Program will provide the following benefits to the District:

- Improved working environment for students, teachers and staff (temperature, lighting and indoor air quality).
- Upgrade lighting systems and standardize lighting material in all District facilities
- Replace portions of the Building Control System that in the next two years will no longer be supported by the manufacturer.
- A limited risk, turn-key solution, with a full energy savings guarantee from NORESCO.
- No risk from pricing increases once the final Performance-Based Contract and scope of work is signed.
- Facility upgrades with the lowest life cycle cost and greatest value to the District.
- Reduction in future operating costs using energy more efficiently.
- Addresses deferred maintenance issues, and implement capital improvements to replace aged and problematic equipment without capital improvement project (CIP) funds.
- Provides a Project which is consistent with the Nevada Revised Statute (NRS) 332.
- Provides performance and financial guarantees including annual savings reconciliation for the term of the performance period.
- Use of local, Churchill County-based contractors where possible to stimulate local economy, generate tax revenue and improve warranty service.
- Provide the District certification through the U.S. Department of Energy's Energy Star Program for qualified buildings.

An energy baseline was developed from the assessment of the District's building profile and historical useage. This energy baseline is the foundation for the calculation of energy savings and selection of the energy measures contained in the Energy Efficiency Upgrade and Infrastructure Improvement Project. Based on our analyses, the current (2006) electricity, natural gas and water/sewer costs for the District are just over $1M annually. During the site survey, several potential energy conservation measures (ECMs) were evaluated for economic and technical feasibility. The team (NORESCO, District and

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Celtic Energy) analyzed each measure. Outlined in this report are the recommended energy measures for implementation. The Energy Conservation Measure list includes:

- Comprehensive upgrade of lighting systems including high bay areas (Gymnasiums) and lighting controls.
- Implementation of HVAC controls and commissioning at the High School, Numa Elementary and the Cottages.
- Installation of new rooftop packaged units (RTUs) at the High School Gym.
- Piping and controls modifications to the water source heat pump system at the High School.
- Upgrade of building envelope at E.C. Best and West End Elementary Schools.
- Comprehensive retrofit of interior water fixtures at the majority of the schools.
- Replacement of selected transformers at the High School.
- Installation of software to control power consumption of personal computers.

NORESCO has outlined a 15-year self-funding Project (see Table 2.5 in Section 2, Financial Summary). Based on current utility rates, the Project will produce a total first year utility and O&M savings of $230,876. The Project will actually generate additional savings due to reduced staff time required to maintain the new equipment, however these savings have not been included in the financial analysis as they are difficult to quantify. The energy savings produced by this project creates the annual revenue stream to fund the upgrades and efficiency improvements for the District. With this Project, the District will generate operating cost savings to fund the upgrades described herein and a projected cumulative positive cash flow for the 15 year Project in excess of $500,000. Without this Project, the District will continue to pay current utility expenditures escalated annually due to rate increases and will not obtain these facility upgrades and efficiency improvements. Table 1.1 provides a financial summary for the District.

Table 1.1. Financial summary.

Description	Value
Project turnkey price	$2,792,423
Third Party Engineer	$55,848
Asbestos Allowance	$25,000
Bond Counsel, Financial Services	$35,000
QZAB Financing	($1,708,271)
Installment Purchase Agreement (IPA) Financing	($1,200,000)
Total amount funded (IPA + QZAB)	$2,908,271
15-year Energy Savings	$4,242,336
15-year Project Cost	$3,721,313
Projected Cumulative Cash Flow	$521,023
Term	15 years
IPA Interest Rate	4.75%

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PROJECT OBJECTIVES

The objective of this Project was to provide the District with a comprehensive energy solution that will:

- Provide savings to pay for the project debt service as well as the applicable Qualified Zone Academy Bonds (QZAB).
- Improve the 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 that is consistent with the Nevada Revised Statue (NRS) 332.
- Limit the overall project risk to the District.

CLOSING

On behalf of the NORESCO project team, we would like to thank the District Director of Finance Jim Sustacha, Maintenance Manager Mike Beachman, Lead HVAC Technician Mike Compagnoni and Lead Electrician Martin Pattengale, who were extremely helpful in providing information necessary for the development of this report.

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

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Section 2.0
Financial Summary

INTRODUCTION

NORESCO has completed the enclosed Financial-Grade Operational Audit (FGA) Report as a first step in the development of a guaranteed Energy Savings 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.

Several energy conservation measures (ECMs) were identified that will provide significant energy savings and provide long-term maintenance and capital solutions. NORESCO identifies ECMs and associated savings in a manner which assures CCSD the stated savings resulting from this Project will be realized. Savings realism is the key to ensuring the financing and budget plan works for CCSD. The savings that result from implementing the ECMs is used to amortize the Project investment over a 15-year period of time. NORESCO is proposing a 15-year financing term as allowed by Nevada Revised Statute (NRS) 332.

To offer CCSD the most comprehensive and economical Project, NORESCO obtained material and labor quotes from several subcontractors. NORESCO obtained quotes from finance companies to ensure CCSD receives the lowest possible interest rate in order to finance this transaction.

The Project as defined in the financial summary below is offered as a not to exceed fixed price Performance-Based Contract. In addition, the open book reconciliation process will return Project savings to CCSD, or permit CCSD to install additional facility solutions. NORESCO will honor the Project turnkey price as defined in Table 2.1 providing the Performance-Based Contract is executed before December 1, 2007. The lease agreement terms will need to be agreed upon between CCSD and the Leasing Agent by December 15, 2007 in order to lock in the interest rate.

Table 2.1. Financial summary.

Description	Value
Project turnkey price	$2,792,423
Third Party Engineer	$55,848
Asbestos Allowance	$25,000
Bond Counsel, Financial Services	$35,000
QZAB Financing	($1,708,271)
Installment Purchase Agreement (IPA) Financing	($1,200,000)
Total Amount Funded (IPA + QZAB)	$2,908,271
15-year Energy Savings	$4,242,336
15-year Project Cost	$3,721,313
Projected Cumulative Cash Flow	$521,023
Term	15 years
IPA Interest rate	4.75%

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To fund the Project, CCSD is using a combination of Qualified Zone Academy Bonds (QZAB) and an Installment Purchase Agreement. The Installment Purchase Agreement is necessary to pay for key energy savings measures at facilities that do not qualify for QZAB funding. Without these measures the energy savings would be lower and not fully repay the QZAB funds used for other facilities. QZAB funds have already been obtained by CCSD, while the Installment Purchase Agreement will be procured from a third party. Funds from both sources will be repaid from savings generated by this Project. For the purposes of presenting the financial benefits of the Project, NORESCO has based its analysis on third party funding of the Installment Purchase Agreement at an equivalent interest rate of 4.75%. This is an indicative rate based on current market conditions and is subject to change depending on the timing of lease agreement execution by CCSD.

OVERVIEW

The Project provides CCSD with an investment of $2,792,423 in building infrastructure improvements that produce a first year utility and O&M savings of $230,876 as noted in Table 2.2.

Table 2.2 Project cost and savings.

ECM	Price	Savings	Simple Payback
Lighting System Upgrades	$971,805	$100,250	9.7 years
High Bay Lighting Upgrades	$79,373	$9,658	8.2 years
Lighting Controls Improvements	$22,060	$2,857	7.7 years
Building Automation Controls Upgrades	$882,759	$48,476	18.2 years
Replace Heat Pumps with Packaged Units	$475,320	$14,186	33.5 years
Cooling Tower Fan VFD Installations	$55,589	$1,909	29.1 years
Building Envelope Improvements	$29,572	$5,961	5 years
Interior Water Fixture Retrofits	$129,812	$13,038	10 years
Transformer Replacements	$64,105	$8,039	8 years
Network Power Management	$82,028	$26,502	3.1 years
TOTAL	$2,792,423	$230,876	12.1 years

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

- Improving the learning environment for students.
- Improving the efficiency of lighting, and heating, ventilating and air conditioning control (HVAC) systems.
- Optimizing control of building systems such as lighting, HVAC, energy management system and computer networks.
- Standardizing equipment (lamps and ballasts, building automation systems) thereby reducing costs for labor and inventory of replacement parts.

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- Replacing old and faulty equipment and systems with energy efficient, non proprietary equipment and systems.
- Providing a training and commissioning program for CCSD personnel in energy conservation with supporting O&M manuals that include PM activities, descriptions, special tools, schedules and log sheets.
- Providing additional benefits that directly result from energy-related services and capital improvements, such as environmental protection, hazardous materials disposal, and improved indoor air quality.

ENVIRONMENTAL BENEFITS

There are environmental benefits associated with energy reduction projects. Less energy used means less power plant production resulting in environmental benefits from reductions in greenhouse gas emissions. These energy savings and environmental benefits will also assist CCSD in qualifying for the U.S. Department of Energy's Energy Star certification program (see Section 6). The recommended Project will achieve the following energy savings.

Table 2.3. Energy savings.

Type of Energy	Amount of Savings
Electricity	1,605,618 kWh
Natural Gas	8,111 therms
Water	3,878 gallons

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

Table 2.4. Environmental benefits.

Tons of carbon dioxide eliminated (CO_2 tons)	1,835
Tons of sulfur dioxide eliminated (SO_2 kilograms)	4,281
Tons of nitric dioxide eliminated (NO_X kilograms)	4,008
Equivalent number of cars removed from the road	320
Equivalent acreage of trees planted	500

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PROJECT CASHFLOW

Table 2.5 represents the projected cash flow that will result from implementing the Project. 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, nine months.
- The QZAB repayment period will follow the schedule already established by CCSD. The first payment will occur on December 1, 2007. An additional nine payments will take place each year on December 1 over the first nine years of the Project (December 2008 through December 2016)
- The cost of interest capitalization during the nine-month construction period is included in the interest rate.
- NORESCO has used annual rate projections for utility costs as outlined in Table 2.9 to show the financial impact of fluctuating energy prices over the next 15 years.
- The lease and QZAB payments were calculated to be escalated over the Project year term to coincide with expected utility rate increases and maximize solutions to the CCSD.
- The Project cash flow does not include the benefit of escrow earnings during the construction period. This benefit will accrue to the CCSD and can be used to either reduce lease payment obligations or fund additional improvements.
- The Project cash flow is based on the funded amount of $2,908,271 being placed in escrow at lease inception and prior to starting construction.
- The lease payments are assumed to be monthly in arrears. Final payment structure to be determined at time of lease closing.
- 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 lighting equipment replacement costs and new equipment warranties has been included.

Measurement and verification reporting costs for years 1 through 5 have been included as an ongoing annual cost to CCSD which will be invoiced annually in advance and is separate from the construction costs financed with the lease.

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Table 2.5. Project cash flow for Churchill County School District.

	CCSD Fiscal Year	Utility Savings	O&M Savings	Total Savings	Installment Purchase Agreement Payments Note	QZAB Payments Note (5)	Annual M&V	Total Cost	Net Cash Flow
Note (1)	2007/08	$ 19,431	$ -	**$ 19,431**	$ -	$ 16,223	$ -	**$ 16,223**	**$ 3,207**
Note (2)	2008/09	$ 225,574	$ 8,066	**$ 233,640**	$ 44,297	$ 176,528	$ 9,608	**$ 230,433**	**$ 3,207**
	2009/10	$ 233,118	$ 8,308	**$ 241,426**	$ 59,063	$ 169,355	$ 9,801	**$ 238,219**	**$ 3,207**
	2010/11	$ 238,385	$ 8,557	**$ 246,942**	$ 59,063	$ 174,675	$ 9,997	**$ 243,735**	**$ 3,207**
	2011/12	$ 240,870	$ 8,814	**$ 249,684**	$ 59,063	$ 177,217	$ 10,197	**$ 246,477**	**$ 3,207**
	2012/13	$ 245,525	$ 9,078	**$ 254,603**	$ 59,063	$ 181,933	$ 10,400	**$ 251,396**	**$ 3,207**
	2013/14	$ 252,359	$ -	**$ 252,359**	$ 59,063	$ 190,089	$ -	**$ 249,152**	**$ 3,207**
	2014/15	$ 259,217	$ -	**$ 259,217**	$ 59,063	$ 196,947	$ -	**$ 256,010**	**$ 3,207**
	2015/16	$ 270,404	$ -	**$ 270,404**	$ 59,063	$ 208,134	$ -	**$ 267,197**	**$ 3,207**
	2016/17	$ 279,443	$ -	**$ 279,443**	$ 59,063	$ 217,173	$ -	**$ 276,236**	**$ 3,207**
	2017/18	$ 288,492	$ -	**$ 288,492**	$ 193,700	$ -	$ -	**$ 193,700**	**$ 94,792**
	2018/19	$ 293,218	$ -	**$ 293,218**	$ 238,578	$ -	$ -	**$ 238,578**	**$ 54,640**
	2019/20	$ 302,298	$ -	**$ 302,298**	$ 238,578	$ -	$ -	**$ 238,578**	**$ 63,720**
	2020/21	$ 311,372	$ -	**$ 311,372**	$ 238,578	$ -	$ -	**$ 238,578**	**$ 72,794**
	2021/22	$ 322,639	$ -	**$ 322,639**	$ 238,578	$ -	$ -	**$ 238,578**	**$ 84,061**
	2022/23	$ 331,744	$ -	**$ 331,744**	$ 238,578	$ -	$ -	**$ 238,578**	**$ 93,166**
Note (3)	2023/24	$ 85,424	$ -	**$ 85,424**	$ 59,645	$ -	$ -	**$ 59,645**	**$ 25,779**
Note (4)	**TOTAL**	**$ 4,199,513**	**$ 42,823**	**$ 4,242,336**	**$ 1,963,039**	**$ 1,708,271**	**$ 50,003**	**$ 3,721,313**	**$ 521,023**

Project Turnkey Price:	**$ 2,792,423**
Third Party Engineer (2% of Project Turnkey Price):	**$ 55,848**
Asbestos Allowance:	**$ 25,000**
Bond Counsel, Financial Services:	**$ 35,000**
QZAB Financing:	**$ 1,708,271**
Capitalized Construction Interest:	**$ -**
Installment Purchase Agreement (IPA) Financing:	**$ 1,200,000**
IPA Finance Rate:	**4.75%**

Note (1): Fiscal year 2007/08 includes construction period savings through June 2008.
Note (2): Fiscal year 2008/09 includes three months of construction period savings (Jul - Sep 2008) plus nine months of annual savings and lease payments starting October 2008 through June 2009.
Note (3): Fiscal year 2023/24 includes three months of savings and lease payments ending September 2023.
Note (4): The total program runs for 15 years starting October 2008 and ending September 2023.
Note (5): The first QZAB payment occurs December 1, 2007. QZAB will be repaid by December 1, 2016.

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Table 2.5 on the previous page has been aligned to match CCSD's fiscal year (July through June). To correlate the construction period and annual utility and O&M savings to the CCSD fiscal year, adjustment calculations were made and are summarized in Table 2.6 below. Please note the following clarifications:

- Fiscal year 2007/08 includes six months of the construction period starting in January 2008 and continuing through June 2008.
- Fiscal year 2008/09 includes three months of the construction period (Jul-08 through Sep-08) and nine months of the Project Performance Period (Oct-08 through Jun-09).
- Fiscal year 2023/24 includes three months of the Project Performance Period (Jul-23 through Sep-23).
- The entire Performance Period runs 15 years from October- 2008 through September-2023.

Table 2.6 Annual Savings To Cash Flow Reconciliation.

CCSD Fiscal Year	Description	Annual Utility Savings	Annual O&M Savings	Total Annual Savings	Savings Applied to Cash Flow
2007/08	Annual savings as calculated for fiscal year 2007/08 (construction period). Savings applied to cash flow are pro-rated construction period savings for ECMs completed through June 2008.	$223,045	$7,831	$230,876	$19,431
2008/09	Annual savings adjusted per rate projections for fiscal year 2008/09 (Year 1). Savings applied to cash flow: (1) Annual savings pro-rated for nine months remaining in fiscal year (Oct-08 to Jun-09) following completion of construction. (2) Plus construction period savings from July-08 through Sep-09.	$227,973	$8,066	$236,039	$233,640
2009/10	Annual savings adjusted per rate projections.	$233,118	$8,308	$241,426	$241,426
2010/11	Annual savings adjusted per rate projections.	$238,385	$8,557	$246,942	$246,942
2011/12	Annual savings adjusted per rate projections.	$240,870	$8,814	$249,684	$249,684
2012/13	Annual savings adjusted per rate projections.	$245,525	$9,078	$254,603	$254,603
2013/14	Annual savings adjusted per rate projections.	$252,359		$252,359	$252,359
2014/15	Annual savings adjusted per rate projections.	$259,217		$259,217	$259,217
2015/16	Annual savings adjusted per rate projections.	$270,404		$270,404	$270,404
2016/17	Annual savings adjusted per rate projections.	$279,443		$279,443	$279,443
2017/18	Annual savings adjusted per rate projections.	$288,492		$288,492	$288,492
2018/19	Annual savings adjusted per rate projections.	$293,218		$293,218	$293,218
2019/20	Annual savings adjusted per rate projections.	$302,298		$302,298	$302,298
2020/21	Annual savings adjusted per rate projections.	$311,372		$311,372	$311,372
2021/22	Annual savings adjusted per rate projections.	$322,639		$322,639	$322,639
2022/23	Annual savings adjusted per rate projections.	$331,744		$331,744	$331,744
2023/24	Annual savings adjusted per rate projections for fiscal year 2023/24. Pro-rated for three months into fiscal year (Jul-23 to Sep-23).	$341,696		$341,696	$85,424

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ECM COSTS

The performance contract will be a fixed price offering to CCSD with single point responsibility for the duration of the Project. In addition, the open book reconciliation process will return Project savings to CCSD, or permit CCSD to install additional facility solutions. NORESCO has provided pricing breakout for each of the ECMs (Table 2.2) based on data identified during the detailed site surveys and additional information provided by the District. Under the Open Book pricing format, Project cost components are identified and documented as summarized in Table 2.7 below.

Table 2.7 Project cost breakouts.

Description	Totals
NORESCO purchased material and turnkey subcontracts	$1,363,753
Subcontracted labor	$151,719
Disposal	$16,358
Audit	$81,718
Engineering and design	$118,717
Construction management	$149,561
Commissioning	$49,019
Measurement & Verification	$38,296
Training and Warranty Service	$30,637
Proposal and project administration	$35,232
Travel	$64,795
Site conditions	$12,152
SUBTOTAL	**$2,111,956**
Contingency	$52,799
NORESCO overhead	$299,898
NORESCO fee	$259,771
Construction period interest	$20,296
Bonding and insurance	$43,645
Permitting	$4,059
Sales tax	$0
TOTAL PROJECT COST	**$2,792,423**

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It should be noted that the total cost for NORESCO to implement the Project contains both fixed costs and variable costs. 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.

ECM SAVINGS

The economics of the Project are based on the financing and Project cost as demonstrated in Tables 2.5 and 2.7, and the revenue generated from Project savings. Revenue will encompass the utility savings (electric, gas and water/sewer) resulting from the installation and operation of the electric, gas and water/sewer measures. 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 ECMs. CCSD utilities are supplied by the following:

Table 2.8. Churchill County School District utility suppliers.

Utility Company	Type of service
City of Fallon	Electricity
Southwest Gas	Natural Gas
City of Fallon	Water/Sewer

Applicable rates from these utilities are applied to the engineering calculations as summarized below in Table 2.9 Utility Rates. For the lighting and miscellaneous electrical ECMs, the cost reductions are determined by calculating the pre- and post-retrofit annual consumption of the equipment. Equipment information was collected during the site surveys and quantified based on manufacturer's data and 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 and are located in Appendix A.

Energy cost reductions resulting from HVAC, Building Envelope and EMS controls ECMs are calculated using customized spreadsheet calculations, local weather data, and building data collected from the drawings and site surveys. For the CCSD, an energy balance is calculated to correlate the field information (and resulting calculations) with the utility billing information provided by CCSD and its utility suppliers. For this FGA Report, this process also included performance tests and installation of monitoring equipment to further refine the calibrated analysis. Inputs to the building analysis models also included weather data applicable to the site evaluated, combined with equipment ratings, building characteristics, operating schedules and utility rates.

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Table 2.9 Utility Rates				
Facility	**$/kW**	**$/kWh**	**$/Therm**	**$/kgal**
Churchill County High School	$2.3974	$0.1240	$1.2008	$2.9813
Churchill Junior High School	$6.7116	$0.0935	$1.2008	$2.9813
E.C. Best Elementary	$0.0000	$0.1358	$1.2008	$2.9813
Lahontan Elementary	$6.7116	$0.0935	$1.2008	$2.9813
Northside Elementary	$0.0000	$0.1358	$1.2008	$2.9813
Numa Elementary	$6.7116	$0.0935	$1.2008	$2.9813
West End Elementary	$6.7116	$0.0935	$1.2008	$1.4305
Cottages	$0.0000	$0.1358	$1.3036	$2.9813
District Office	$0.0000	$0.1358	$1.3036	$1.4305
Transportation	$0.0000	$0.1358	$1.4559	$2.9813
Maintenance	$0.0000	$0.1358	$1.3036	$2.9813
Warehouse	$0.0000	$0.1358	$1.3036	$0.0000

OPERATION AND MAINTENANCE SAVINGS

NORESCO takes a conservative approach to savings from operations and maintenance (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 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 $7,831 has been calculated and included as part 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 School Gymnasium and improving the operation of the High School's water-source heat pump system. For conservatism, O&M savings from these modifications has not been included in the Project.

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RATE FORECAST

The rate forecast will describe the methodologies used to forecast utility rates for CCSD. 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 ECMs increases accordingly. The intent is to capture all of the savings to which CCSD is entitled because increased savings equates to an increased scope of goods and services available to CCSD under this financing package.

Rate projection is a critical input to the financial cash projection for all energy savings. CCSD 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 Standards 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 2.10 below.

Table 2.10 Rate projections.

Year	Electric $/kW/kWh	Natural Gas $/Therm	Water, O&M Savings
0	102.35%	100.00%	102.50%
1	102.35%	99.00%	102.50%
2	102.35%	100.00%	102.50%
3	102.35%	100.00%	102.50%
4	100.96%	100.96%	102.50%
5	101.90%	101.90%	102.50%

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Table 2.10 Rate projections.			
Year	Electric $/kW/kWh	Natural Gas $/Therm	Water, O&M Savings
6	102.80%	102.80%	102.50%
7	102.73%	102.73%	102.50%
8	104.42%	104.42%	102.50%
9	103.39%	103.39%	102.50%
10	103.28%	103.28%	102.50%
11	101.59%	101.59%	102.50%
12	103.13%	103.13%	102.50%
13	103.03%	103.03%	102.50%
14	103.68%	103.68%	102.50%
15	102.84%	102.84%	102.50%

ELECTRIC RATE PROJECTION

The electric rate projection for years 5-15 is based on utilization of NISTIR 85-3273-22 (Rev 05/07). 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 2007 for indexing the escalation factors. For informational purposes, Table S-4 in included in Appendix E of this report.

Paragraph 3, page 2 of NISTIR 85-3273-22 states that, "Contractors to Federal Agencies are encouraged to seek energy price projections from their local utility to use in place of the DOE/EIA regional projections". NORESCO has chosen to substitute projections for years 1-4 that are based on the local electric supply conditions for the City of Fallon.

The City of Fallon procures a majority of its electricity supply through a contract with the Utah Associated Municipal Power Systems (UAMPS) which expires December 31, 2007. It is anticipated that the City will procure a new electric supply agreement through UAMPS or another competitive supplier by the end of 2007, and that the new cost per unit will be higher than the existing price due to increased wholesale power costs. This projection assumes that the new agreement will have a 4-year term and will be structured with small annual cost increases spread over the term to prevent a large initial increase. This projection assumes that the consumption based component of the tariff will increase by 2.5% each year (2008 - 2011).

This projection also assumes that the electric demand charges mainly represent the City of Fallon costs to build and maintain the distribution system that delivers electricity from the point of delivery from the transmission provider (Sierra Pacific) to end use customers. In years 1-4, these demand charges are escalated by 1.27% each year which is 50% of the average annual CPI increase for the West Region.

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NATURAL GAS RATE PROJECTION

The natural gas rate projection is based on utilization of NISTIR 85-3273-22 (Rev 05/07). 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 2007 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 2.11 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%

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Section 3.0
Technical Summary

OVERVIEW

NORESCO performed a comprehensive evaluation of the building systems at CCSD facilities with specific emphasis on the building envelope, plumbing, electrical, mechanical and associated control systems. This effort included all CCSD facilities representing a cross-section of building types and building system configurations. The complete list of facilities in summarized in Table 3.1 below.

Table 3.1 Facility list.

Building	Area (Sqft)
Churchill County High School	215,908
Churchill County Jr. High School	140,594
E.C. Best Elementary School	67,959
Lahontan Elementary School	55,988
Northside Elementary School	45,436
Numa Elementary School	70,000
West End Elementary School	40,295
The Cottages	8,800
Administration	6,233
Transportation	8,000
Maintenance	9,980
Warehouse	7,000
TOTAL	676,193

CCSD has been proactive in addressing energy conservation through a variety of efforts over the past five years. This has included effective management of existing building controls systems to minimize use of heating and cooling systems where possible. In addition, lighting systems at parts of West End Elementary School, Northside Elementary School and the Junior High School have been retrofitted with energy efficient components.

The purpose of this report is to identify and evaluate remaining opportunities for reducing utility and maintenance costs, and implement recommended projects through an energy performance contract. The efforts associated with this report have identified significant additional opportunities. A summary of the opportunities identified is summarized in this section and the remainder of this report.

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Lighting Retrofit and Controls. Retrofit of the lighting systems represents a significant opportunity for energy savings. NORESCO proposes to complete the upgrades previously initiated by CCSD. At completion of this proposed project, CCSD facilities will operate with current T8/T5 lamp and electronic ballast technology with improved color rendition, lumen maintenance and overall light quality. In addition, ongoing maintenance will significantly improve due to standardization of lamp and ballast types.

NORESCO proposes to optimize the existing light systems throughout the entire District. This will include retrofitting and/or replacing of over 8,000 lighting fixtures with more efficient T8 or compact fluorescent lamp technology. Although some of the existing fixtures already use 32 watt T8 lamps and electronic ballasts, new, more efficient technologies will be used to increase the efficiency of these light systems and standardize lighting materials.

This project also includes replacement of high-bay lighting systems in the gyms and multi-purpose rooms at the High School, Jr. High School, E.C. Best and Lahontan Elementary Schools with new fixtures using energy efficient fluorescent T5 technology. The new lighting systems in these locations will be capable of switching on instantaneously. This will permit the use of occupancy-based controls to minimize use of lighting systems when these areas are not occupied.

Heating and Cooling Systems. In addition to creating energy savings, upgrading and optimizing the heating, ventilation, and air conditioning (HVAC) systems presents an opportunity for solving comfort and maintenance issues. Based on input from CCSD, the focus of NORESCO's evaluation was on the water-source heat pump system at the High School. This system operates overtime to condition the Gym and Theatre, and the system has difficulty maintaining indoor temperatures during extreme weather. NORESCO will replace the heat pumps at the High School Gymnasium with new packaged units. This project will disconnect this building from the water-source heat pump system resulting in a reduction of load and operating hours on this system. CCSD will realize reduced electrical energy consumption and improved comfort conditions through the implementation of this project.

Building Automation System (BAS). NORESCO proposes to upgrade the BAS at the High School with new TAC/Invensys I/A direct digital controls, the CCSD standard for new installations. This project will complete the installation of the TAC/Invensys I/A system at the two largest schools in the District. At the High School, this includes upgrading the BAS at the Gym, Theatre, Central Plant and Minnie Blair Building. In addition, the systems at Numa Elementary and the Cottages will be optimized for maximum energy savings.

Many of the building controls at the District are older and nearing the end of their useful life. In addition, some components will no longer be supported by the manufacturer within the next two years. By upgrading these systems at the facilities noted above, the District will have achieve energy savings, improve comfort, and provide systems that can be supported and maintained into the future.

Remote access to the new control system will be provided though a web-based system, which uses a standard web browser as an interface. The central operator workstation will communicate from school to school over CCSD's existing communication network. CCSD will be responsible for the communication link on the Energy Management System (EMS). This system will also allow override capabilities for teachers on their desktop computers.

Variable Frequency Drive for Cooling Tower (High School Water-Source Heat Pump System). NORESCO will install variable frequency drives (VFDs) on the cooling tower at the High School. The VFDs will precisely match the fan speed to the load. The VFDs also provides a soft-start capability to reduce wear and tear on the unit during start-up. This project

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combined with the other modifications (note above) to the High School water-source heat pump system will improve the performance of this system and provide improved comfort for students and staff.

Building Envelope. Improvement of the building envelope represents a significant opportunity to improve the indoor comfort of the facilities and contribute to a healthy learning environment. NORESCO proposes to improve the building envelope E.C. Best and West End Elementary Schools. The doors at these schools will be upgraded with weather-stripping, caulking (door jambs), and other repairs to eliminate air gaps and associated heat loss at entrances to the buildings.

Additional Projects. This comprehensive project includes additional Energy Conservation Measures (ECM's) summarized as follows:

- ⇒ Retrofit of interior faucets, urinals and toilets with low-consumption water devices in select schools.
- ⇒ Replacement of seven electrical transformers at the High School.
- ⇒ Installation of software to optimally control the power consumption of personal computers (PC's) throughout the District.

The following tables summarize the results of the analysis performed for Churchill County School District. The information provided in each table is summarized as follows:

- ⇒ Table 3.2 Energy Conservation Matrix. This table lists all ECM's evaluated for this project, and identifies those selected for implementation based on the financial criteria identified by CCSD and mandated by NRS 332.
- ⇒ Table 3.3 Project Savings Summary. This table illustrates the savings for each recommended ECM and is summarized by energy type and annual dollar savings.
- ⇒ Table 3.4 Facility Savings Summary. This table illustrates the savings for each CCSD facility and is summarized based on the recommended ECMs.
- ⇒ Table 3.5 ECM Savings Summary. This table illustrates the savings for each ECM at each CCSD facility.

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Table 3.2 Energy Conservation Measure Matrix.												
	Churchill County HS	Churchill County Jr. HS	E.C. Best ES	Lahontan ES	Northside ES	Numa ES	West End ES	The Cottages	Admini-stration	Transpor-tation	Mainte-nance	Ware-house
Lighting System Upgrades	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Bay Lighting System Upgrades	✓	✓	✓	✓								
Lighting Controls Improvements	✓	✓	✓	✓								
Building Automation Controls Upgrade	✓	•	•	•	•	✓	•	✓	•	•	•	
Water Source Heat Pump System Optimization	•					•						
Packaged Unit Replacements		•					•		•		•	
Replace Heat Pumps with Packaged Units	✓											
Cooling Tower Fan VFD Installations	•					•						
Kitchen Cooling Upgrades	•	•										
Transportation Building Heater Replacement										•		
Window Upgrades/Replacements		•	•		•		•					
Building Envelope Improvements		•	✓		•		✓					

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Table 3.2 Energy Conservation Measure Matrix.												
	Churchill County HS	Churchill County Jr. HS	E.C. Best ES	Lahontan ES	Northside ES	Numa ES	West End ES	The Cottages	Admini-stration	Transpor-tation	Mainte-nance	Ware-house
Interior Water Fixture Retrofits	•	✓	✓	•	✓	✓	✓	•	•	•	•	•
Exterior Water System Improvements	•											
Photovoltaic System Installation	•											
Greenhouse Lighting System Installation	•											
Transformer Replacements	✓											
High Efficiency Motor Installations	•											
Network Power Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electrical Rate Schedule Change	•		•									
Facility Operations Management Software	•	•	•	•	•	•	•	•	•	•	•	•
Waste Disposal and Recycling Program	•	•	•	•	•	•	•	•	•	•	•	•
Change for Savings Program	•	•	•	•	•	•	•	•	•	•	•	•
✓ Indicates project is currently included in 15-year program.												
• Indicates project is recommended but currently not included.												

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Table 3.3 Project savings summary.							
ECM	Electricity (kW-mo)	Electricity (kWh)	Natural Gas (therms)	Water/Sewer (kgal)	Utility Savings	O&M Savings	Total Savings
Lighting System Upgrades	2,775	779,602	(8,408)	-	$92,419	$7,831	$100,250
High Bay Lighting Upgrades	252	86,880	(1,029)	-	$9,658	$0	$9,658
Lighting Controls Improvements	-	25,229	-	-	$2,857	$0	$2,857
Building Automation Controls Upgrades	-	285,367	12,088	-	$48,476	$0	$48,476
Replace Heat Pumps with Packaged Units	-	99,246	1,322	-	$14,186	$0	$14,186
Cooling Tower Fan VFD Installations	-	15,036	-	-	$1,909	$0	$1,909
Building Envelope Improvements	-	18,817	3,148	-	$5,961	$0	$5,961
Interior Water Fixture Retrofits	-	-	990	3,878	$13,038	$0	$13,038
Transformer Replacements	-	63,334	-	-	$8,039	$0	$8,039
Network Power Management	-	232,107	-	-	$26,502	$0	$26,502
TOTAL	3,027	1,605,618	8,111	3,878	$223,045	$7,831	$230,876

Please note that the annual savings are calculated based on current utility rates. Please refer to Tables 2.5 and 2.6 for a description of projected future utility rate increases and how these values correlate with the financial summary.

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Table 3.4 Facility Savings Summary.					
Energy Savings Summary					
Building	**Annual kW/mo**	**Electricity kWh**	**Natural Gas Therms**	**Wtr & Swr Kgal**	**Total Dollars**
Churchill County High School	1,241.0	794,885	6,338	0	$111,552
Churchill County Jr. High School	513.5	200,653	(1,317)	1,025	$24,276
E.C. Best Elementary School	344.0	142,433	762	683	$22,793
Lahontan Elementary School	352.0	125,617	(1,222)	0	$12,969
Northside Elementary School	152.0	66,090	(301)	878	$11,505
Numa Elementary School	190.0	152,056	789	501	$18,331
West End Elementary School	100.0	58,578	1,384	791	$10,370
Cottages	35.0	19,067	2,057	0	$5,331
Administration	25.0	13,943	(89)	0	$1,821
Transportation	25.0	10,799	(97)	0	$1,359
Maintenance	39.0	12,058	(125)	0	$1,513
Warehouse	10.0	9,439	(67)	0	$1,224
TOTAL	**3,026.5**	**1,605,618**	**8,111.1**	**3,878.0**	**$223,045**
% SAVINGS	**15.0%**	**32.1%**	**3.7%**	**10.5%**	**21.6%**
Energy Savings %					
Building	**Annual kW/mo**	**Electricity kWh**	**Natural Gas Therms**	**Wtr & Swr Kgal**	**Total Dollars**
Churchill County High School	18%	41%	10%	0%	**31%**
Churchill County Jr. High School	15%	24%	-3%	46%	**15%**
E.C. Best Elementary School	15%	34%	3%	5%	**18%**
Lahontan Elementary School	20%	39%	-8%	0%	**17%**
Northside Elementary School	9%	25%	-2%	35%	**20%**
Numa Elementary School	7%	23%	3%	18%	**15%**
West End Elementary School	8%	26%	9%	56%	**20%**
Cottages	- -	32%	35%	0%	**27%**
Administration	- -	20%	-4%	0%	**14%**
Transportation	- -	13%	-12%	0%	**7%**
Maintenance	- -	28%	-3%	0%	**12%**
Warehouse	- -	13%	-1%	0%	**8%**
TOTAL	**15%**	**32%**	**4%**	**10%**	**22%**

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Table 3.5 ECM Savings Summary.								
Building	ECM	Electricity (kW-mo)	Electricity (kWh)	Natural Gas (therms)	Water/ Sewer (kgal)	Utility Savings	O&M Savings	Total Savings
Churchill County High School	Lighting System Upgrades	1,163	324,597	(3,441)	-	$39,925	$2,676	$42,601
Churchill County Jr. High School	Lighting System Upgrades	458	119,421	(1,306)	-	$13,004	$1,491	$14,495
E.C. Best Elementary School	Lighting System Upgrades	304	86,291	(885)	-	$10,927	$856	$11,783
Lahontan Elementary School	Lighting System Upgrades	274	71,187	(905)	-	$7,606	$696	$8,302
Northside Elementary School	Lighting System Upgrades	152	46,191	(456)	-	$5,870	$590	$6,460
Numa Elementary School	Lighting System Upgrades	190	50,020	(584)	-	$5,390	$744	$6,134
West End Elementary School	Lighting System Upgrades	100	30,133	(311)	-	$3,197	$397	$3,594
Cottages	Lighting System Upgrades	35	12,800	(142)	-	$1,594	$78	$1,672
Administration	Lighting System Upgrades	25	10,230	(89)	-	$1,305	$60	$1,365
Transportation	Lighting System Upgrades	25	10,205	(97)	-	$1,277	$56	$1,333
Maintenance	Lighting System Upgrades	39	11,464	(125)	-	$1,430	$132	$1,562
Warehouse	Lighting System Upgrades	10	7,063	(67)	-	$894	$55	$949
Churchill County High School	High Bay Lighting Upgrades	78	26,529	(304)	-	$3,193	$0	$3,193
Churchill County Jr. High School	High Bay Lighting Upgrades	56	20,490	(239)	-	$2,054	$0	$2,054
E.C. Best Elementary School	High Bay Lighting Upgrades	40	14,920	(169)	-	$1,870	$0	$1,870
Lahontan Elementary School	High Bay Lighting Upgrades	78	24,941	(317)	-	$2,541	$0	$2,541
Churchill County High School	Lighting Controls Improvements	-	9,780	-	-	$1,241	$0	$1,241
Churchill County Jr. High School	Lighting Controls Improvements	-	9,064	-	-	$867	$0	$867
E.C. Best Elementary School	Lighting Controls Improvements	-	3,181	-	-	$442	$0	$442
Lahontan Elementary School	Lighting Controls Improvements	-	3,204	-	-	$307	$0	$307
Churchill County High School	Building Automation Controls Upgrades	-	200,824	8,760	-	$36,010	$0	$36,010

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Table 3.5 ECM Savings Summary.								
Building	ECM	Electricity (kW-mo)	Electricity (kWh)	Natural Gas (therms)	Water/ Sewer (kgal)	Utility Savings	O&M Savings	Total Savings
Numa Elementary School	Building Automation Controls Upgrades	-	80,949	1,129	-	$9,100	$0	$9,100
Cottages	Building Automation Controls Upgrades	-	3,594	2,199	-	$3,366	$0	$3,366
Churchill County High School	Replace Heat Pumps with Packaged Units	-	99,246	1,322	-	$14,186	$0	$14,186
Churchill County High School	Cooling Tower Fan VFD Installations	-	15,036	-	-	$1,909	$0	$1,909
E.C. Best Elementary School	Building Envelope Improvements	-	8,786	1,470	-	$2,986	$0	$2,986
West End Elementary School	Building Envelope Improvements	-	10,031	1,678	-	$2,975	$0	$2,975
Churchill County Jr. High School	Interior Water Fixture Retrofits	-	-	228	1,025	$3,406	$0	$3,406
E.C. Best Elementary School	Interior Water Fixture Retrofits	-	-	346	683	$2,502	$0	$2,502
Northside Elementary School	Interior Water Fixture Retrofits	-	-	155	878	$2,869	$0	$2,869
Numa Elementary School	Interior Water Fixture Retrofits	-	-	244	501	$1,824	$0	$1,824
West End Elementary School	Interior Water Fixture Retrofits	-	-	17	791	$2,437	$0	$2,437
Churchill County High School	Transformer Replacements	-	63,334	-	-	$8,039	$0	$8,039
Churchill County High School	Network Power Management	-	55,539	-	-	$7,050	$0	$7,050
Churchill County Jr. High School	Network Power Management	-	51,678	-	-	$4,944	$0	$4,944
E.C. Best Elementary School	Network Power Management	-	29,255	-	-	$4,065	$0	$4,065
Lahontan Elementary School	Network Power Management	-	26,285	-	-	$2,515	$0	$2,515
Northside Elementary School	Network Power Management	-	19,899	-	-	$2,765	$0	$2,765
Numa Elementary School	Network Power Management	-	21,087	-	-	$2,018	$0	$2,018
West End Elementary School	Network Power Management	-	18,414	-	-	$1,762	$0	$1,762
Cottages	Network Power Management	-	2,673	-	-	$371	$0	$371
Administration	Network Power Management	-	3,713	-	-	$516	$0	$516
Transportation	Network Power Management	-	594	-	-	$83	$0	$83

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Table 3.5 ECM Savings Summary.								
Building	ECM	Electricity (kW-mo)	Electricity (kWh)	Natural Gas (therms)	Water/ Sewer (kgal)	Utility Savings	O&M Savings	Total Savings
Maintenance	**Network Power Management**	-	594	-	-	$83	$0	$83
Warehouse	**Network Power Management**	-	2,376	-	-	$330	$0	$330
	TOTAL	3,027	1,605,618	8,111	3,878	$223,045	$7,831	$230,876

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Section 4.0
Baseline Utility Analysis

ENERGY BASELINE

NORESCO analyzed the available data for electricity, natural gas, and water for each of the Churchill County School District (CCSD) facilities over the calendar years 2004 through 2006. It should be noted that CCSD implemented energy conservation strategies over this timeframe, and the results of these efforts are represented in the 2006 utility data. For this reason, NORESCO developed the baseline reference for all utilities from calendar year 2006 and utilized this data as the baseline in the utility saving calculations. The baseline data is summarized in Table 4.1.

Table 4.1. Baseline utility summary.

Facility	Electricity		Natural Gas (Therms)	Water & Sewer (Gallons)
	Demand (kW-Mo)	Energy (kWh)		
Administration	0	70,240	2,294	136,226
Churchill County High School	6,954	1,948,600	63,520	7,481,553
Churchill Jr. High & Lahontan Valley H.S.	3,414	836,800	47,087	2,223,826
Cottages	0	59,545	5,837	1,261,203
E.C Best	2,250	417,025	25,049	13,414,729
Lahontan Elementary	1,788	319,000	14,729	5,280,207
Maintenance	0	43,280	4,274	452,847
Northside Elementary	1,731	262,240	12,892	2,495,478
Numa Elementary	2,814	670,200	24,473	2,794,012
Transportation	0	81,480	786	114,145
Warehouse	0	73,577	4,575	19,418
West End Elementary	1,276	227,200	15,105	1,421,260

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Table 4.1. Baseline utility summary.				
Facility	Electricity		Natural Gas (Therms)	Water & Sewer (Gallons)
	Demand (kW-Mo)	Energy (kWh)		
Total	**20,227**	**5,009,187**	**220,621**	**37,094,903**

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 National Oceanic Atmospheric Administration (NOAA) for Fallon, NV. Cost savings are based on the most recent marginal utility rates, which are summarized in the table below.

Electric service for each of the facilities is currently provided by the City of Fallon. Service to the Junior High School, Lahontan Elementary, Numa Elementary and West End Elementary is billed on the Large Commercial tariff which includes a flat demand (kw) and flat energy (kWh) component. Service to E.C. Best Elementary, Northside Elementary, the Cottages School and the miscellaneous non-school facilities is billed on the Small Commercial tariff which uses an energy only pricing structure. Service to the High School is provided through one account billed on the Large Commercial tariff and two accounts billed on the Small Commercial tariff.

Natural gas service for each of the campuses is provided by Southwest Gas Company. Each of the facilities is billed on the NG-22(S), NG-22(M) or NG-22(L) tariff – or a combination of those tariffs. 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	Water	Sewer
	Demand ($/kW)	Usage ($/kWh)	Gas ($/Therm)	Service $/kGal)	Service ($/kGal)
Administration	$0.0000	$0.13576	$1.30358	$1.4305	$0.0000
Churchill County High School	$2.3974	$0.12402	$1.20081	$1.4305	$1.5508
Churchill Jr. High School	$6.7116	$0.09348	$1.20081	$1.4305	$1.5508
Cottages	$0.0000	$0.13576	$1.30358	$1.4305	$1.5508
E.C Best	$0.0000	$0.13576	$1.20081	$1.4305	$1.5508
Lahontan Elementary	$6.7116	$0.09348	$1.20081	$1.4305	$1.5508

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Table 4.2. Utility rates.					
Building	Electricity		Natural	Water	Sewer
	Demand ($/kW)	Usage ($/kWh)	Gas ($/Therm)	Service $/kGal)	Service ($/kGal)
Maintenance	$0.0000	$0.13576	$1.30358	$1.4305	$1.5508
Northside Elementary	$0.0000	$0.13576	$1.20081	$1.4305	$1.5508
Numa Elementary	$6.7116	$0.09348	$1.20081	$1.4305	$1.5508
Transportation	$0.0000	$0.13576	$1.44594	$1.4305	$1.5508
Warehouse	$0.0000	$0.13576	$1.30358	$0.0000	$0.0000
West End Elementary	$6.7116	$0.09348	$1.20081	$1.4305	$0.0000

Based on current utility rates and consumption of utilities during the 2006 calendar year, the District spends $1,033,384 for electricity, natural gas and water/sewer. Table 4.3 summarizes the annual cost of utilities for each school and the entire District. Over the period of 2004 through 2006, the District reduced electricity and natural gas consumption across most facilities due to lighting retrofits at Northside Elementary, West End Elementary, and portions of the Junior High School. In addition, the District reduced operating hours of exterior lighting systems and implemented additional controls on heating and cooling systems at Lahontan and Numa Elementary Schools. The year 2006 is the first complete year when the impacts of these efforts could be observed, and was therefore chosen as the baseline year for utilities consumption.

Table 4.3 also summarizes the Energy Use Index (EUI) for each school. The EUI at the K-12 schools range from a low of $1.17 at Churchill County Jr. High School to a high of $1.86 at E.C. Best Elementary. This difference can be primarily attributed to more efficient HVAC and lighting systems at the Jr. High School. The ages, conditions, and types of systems in each building vary greatly, and their varying energy intensities reflect these differences.

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Table 4.3. Annual utility cost.						
Building	Electricity	Natural Gas	Water/Sewer	Annual Total	Square Footage (sf)	EUI ($/sf)
Administration	$9,536	$2,990	$406	$12,932	6,233	$2.07
Churchill County High School	$258,344	$76,276	$22,305	$356,925	215,908	$1.65
Churchill Jr. High School	$101,137	$56,543	$6,630	$164,310	140,594	$1.17
Cottages	$8,084	$7,609	$3,760	$19,453	8,800	$2.21
E.C. Best Elementary	$56,615	$30,079	$39,993	$126,688	67,959	$1.86
Lahontan Elementary	$41,820	$17,687	$15,742	$75,249	55,988	$1.34
Maintenance	$5,876	$5,572	$1,350	$12,797	9,980	$1.28
Northside Elementary	$35,602	$15,481	$7,440	$58,522	45,436	$1.29
Numa Elementary	$81,537	$29,387	$8,330	$119,254	70,000	$1.70
Transportation	$11,062	$7,721	$340	$19,123	8,000	$2.39
Warehouse	$9,989	$5,964	$ -	$15,953	7,000	$2.28
West End Elementary	$29,803	$18,138	$4,237	$52,178	40,295	$1.29
TOTAL	$649,404	$273,447	$110,533	$1,033,384	676,193	$1.53

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.

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Figure 4.1
Baseline kWh per Square Foot

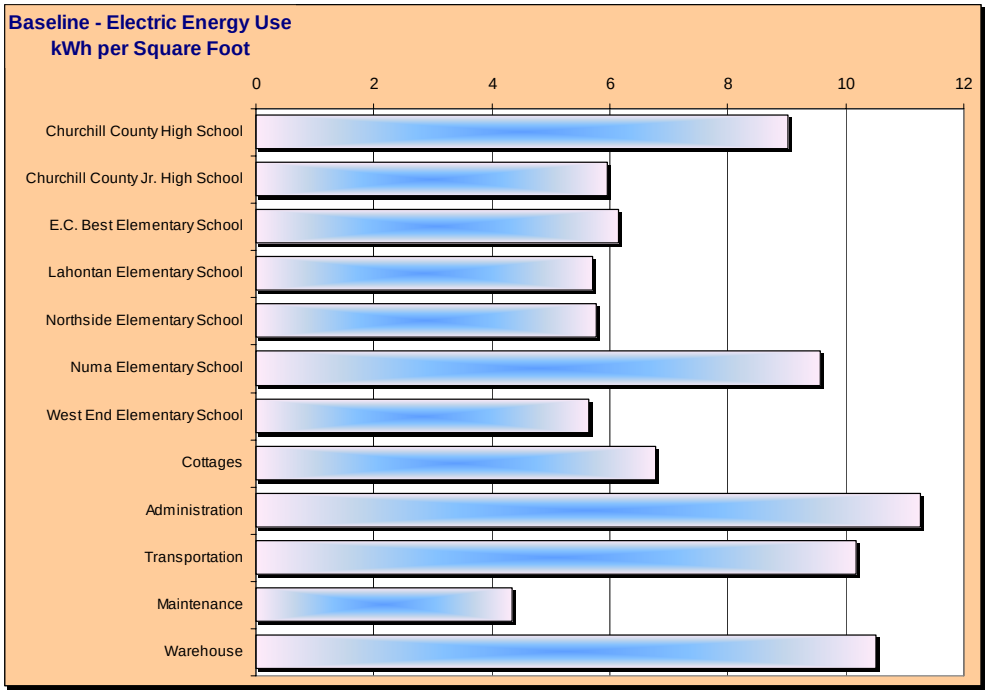

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Figure 4.2
Baseline MBtu's per Square Foot

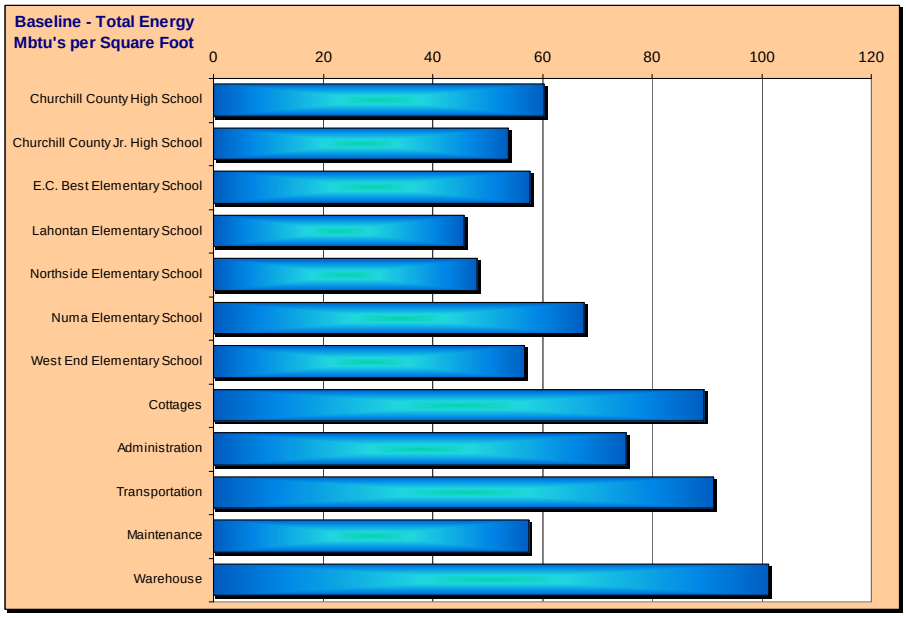
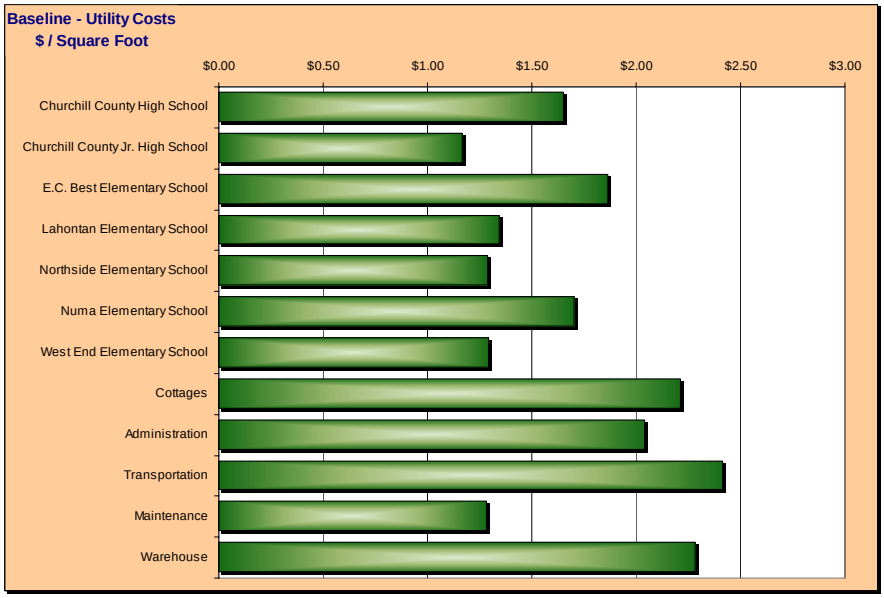


Figure 4.3
Baseline Dollars per Square Foot



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In addition, NORESCO staff visited each of these buildings during the investment grade audit. 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. Spot field measurements were taken and electrical and mechanical equipment metered to determine equipment loads and runtime. Finally, a 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 detailed 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.

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Section 5.0
Energy Conservation Measures (ECM)

INTRODUCTION

NORESCO has evaluated a comprehensive range of Energy Conservation Measures (ECM's) for the Churchill County School District (CCSD) and identified $2,792,423 in energy conservation improvements resulting in a total annual energy and maintenance savings potential of $230,876. In compiling the list of opportunities, our goal was to present CCSD with a comprehensive list of ECMs that is best aligned with the mission and long-range master plans of the CCSD. As a result, we have identified a list of investment opportunities.

Table 5.1 demonstrates ECMs recommended in this project. This list is an illustration of NORESCO's attention to detail and comprehensiveness in evaluating ECMs. It shows a comprehensive energy conservation project at the CCSD. A full detailed savings analysis was performed to develop the recommendations herein and is located in Appendix A. Additional ECMs were evaluated, but are currently not included because they exceed the financial terms required under this program. To meet the ongoing energy and operational requirements of CCSD, NORESCO recommends these ECMs be installed and funded through a different funding source.

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Table 5.1. ECM matrix.

Table 3.2 Energy Conservation Measure Matrix.												
	Churchill County HS	Churchill County Jr. HS	E.C. Best ES	Lahontan ES	Northside ES	Numa ES	West End ES	The Cottages	Admini-stration	Transpor-tation	Mainte-nance	Ware-house
Lighting System Upgrades	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
High Bay Lighting System Upgrades	✓	✓	✓	✓								
Lighting Controls Improvements	✓	✓	✓	✓								
Building Automation Controls Upgrade	✓	•	•	•	•	✓	•	✓	•	•	•	
Water Source Heat Pump System Optimization	•					•						
Packaged Unit Replacements		•					•		•		•	
Replace Heat Pumps with Packaged Units	✓											
Cooling Tower Fan VFD Installations	✓					•						
Kitchen Cooling Upgrades	•	•										
Transportation Building Heater Replacement										•		
Window Upgrades/Replacements		•	•		•		•					
Building Envelope Improvements		•	✓		•		✓					
Interior Water Fixture Retrofits	•	✓	✓	•	✓	✓	✓	•	•	•	•	•
Exterior Water System Improvements	•											
Photovoltaic System Installation	•											
Greenhouse Lighting System Installation	•											
Transformer Replacements	✓											
High Efficiency Motor Installations	•											
Network Power Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Electrical Rate Schedule Change	•		•									
Facility Operations Management Software	•	•	•	•	•	•	•	•	•	•	•	•
Waste Disposal and Recycling Program	•	•	•	•	•	•	•	•	•	•	•	•
Change for Savings Program	•	•	•	•	•	•	•	•	•	•	•	•
✓ Indicates project is currently included in 15-year program.												
• Indicates project is recommended but currently not included.												

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PROPOSED ENERGY CONSERVATION MEASURES (ECM)

LIGHTING SYSTEM UPGRADES

Spiral Compact Fluorescent Lamp

NORESCO has conducted a detailed audit of each of the Churchill County School District facilities, 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. The following are descriptions of existing lighting system at each of the Churchill County School District facilities.

Churchill County High School

The existing lighting systems at the Churchill County High School campus 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.

Churchill County Junior High School

The existing lighting systems at the Churchill County Junior High School campus consist primarily of fluorescent fixtures with four-foot 32-watt T8 lamps and electronic ballasts. The lighting systems in several areas were upgraded to T8 lamps and electronic ballasts within the last year. Approximately one-third of the existing fixtures use less efficient T12 lamps and magnetic ballasts.

E.C. Best Elementary School

The existing lighting systems at the E.C. Best Elementary School consist primarily of fluorescent fixtures with four-foot and eight-foot T12 lamps and magnetic ballasts. The most common fluorescent fixture types are surface-mounted or pendant-mounted wrap lens fixtures and recessed troffers with acrylic lenses.

There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used for exterior lighting.

Lahontan Elementary School

The T12 fixtures are mainly located in the Lahontan Valley High School Building, classrooms B1-B5, and in the locker rooms and weight room in the gymnasium building.

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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 located in walk-in cooler and freezer.

Northside Elementary School

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 lighting systems in several areas were upgraded to T8 lamps and electronic ballasts within the last year. 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.

Numa Elementary School

The existing lighting systems at the Numa Elementary School consist primarily of fluorescent fixtures with four-foot 32-watt T8 lamps and electronic ballasts. The most common fluorescent fixture types are recessed troffers with acrylic lenses or deep cell parabolic louvers, and pendant-mounted direct/indirect fixtures. Metal halide lamps are used in the hallways and for exterior lighting.

West End Elementary School

The existing lighting systems at the West End Elementary School consist primarily of fluorescent fixtures. Approximately 80% of the fixtures use four-foot 32-watt T8 lamps and electronic ballasts. The lighting systems in several areas were upgraded to T8 lamps and electronic ballasts within the last year. The remaining 20% of the fluorescent fixtures with T12 lamps and magnetic ballasts are found mainly in the hallways, office areas, storage rooms and two classrooms. The most common fluorescent fixture types are surface- or pendant-mounted wrap lens fixtures, and pendant-mounted direct/indirect fixtures. There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used mainly for exterior lighting.

Cottage School

The existing lighting systems at the Cottage School consist primarily of fluorescent fixtures with four-foot and eight-foot T12 lamps and magnetic ballasts. The most common fluorescent fixture types are surface-mounted fixtures with acrylic lenses or open strip fixtures. There are also a large quantity of incandescent lamps in hallways, restrooms and storage rooms.

Administration

The existing lighting systems at the Administration buildings consist primarily of fluorescent fixtures. Approximately one-third of the fixtures in the Main Office building use four-foot 32-watt T8 lamps and electronic ballasts. The remaining fixtures still use T12 lamps and magnetic ballasts. The fluorescent fixtures in the Business Office building use 32-watt T8 lamps and electronic ballasts. Many of the ballasts in that facility have dimming capability and are controlled using bi-level switches. The most common fluorescent fixture types are recessed troffers with acrylic lenses or deep cell parabolic louvers. There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used mainly for exterior lighting.

Transportation

The existing lighting systems at the Transportation building consist primarily of fluorescent fixtures with four-foot and eight-foot T12 lamps and magnetic or electronic ballasts. The most common fluorescent fixture types are surface-mounted

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wrap-lens fixtures, recessed troffers with acrylic lenses or open strip fixtures. There is a small quantity of incandescent lamps in miscellaneous areas and metal halide lamps used mainly for exterior lighting.

Maintenance

The existing lighting systems at the Maintenance building consist primarily of fluorescent fixtures with four-foot and eight-foot T12 lamps and magnetic ballasts. The most common fluorescent fixture types are recessed troffers with acrylic lenses or industrial hood fixtures. There is a small quantity of metal halide lamps used for exterior lighting.

Warehouse

The existing lighting systems at the Warehouse consist primarily of fluorescent fixtures. Approximately 85% of the fixtures use 4-foot and 8-foot T12 lamps and magnetic or electronic ballasts. The remaining 15% of the fluorescent fixtures with 32-watt T8 lamps and electronic ballasts are found in one section of the warehouse. The most common fluorescent fixture types are open strip or industrial hood fixtures and surface-mounted wrap lens fixtures. There is a small quantity of incandescent and metal halide lamps used for exterior lighting.

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 8,299 lighting fixtures with more efficient T8, T5 or compact fluorescent lamp technology. Although some of the existing fixtures already use 32 watt T8 lamps and electronic ballasts, new, more efficient technologies will be used to further increase the efficiency of the light systems.

A full room-by-room detailed lighting audit is included with this report. 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- or standard power electronic ballast and a specular reflector.
- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-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 pendant-mounted fluorescent fixtures with up and down light containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with three (3) 28-watt T8 lamps and one (1) low-power, electronic ballast.

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- 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 fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic 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, wraparound, and vapor tight fixtures.
- The existing fluorescent fixtures containing one (1) T12 lamp and magnetic ballasts will each be retrofitted with one (1) 28-watt T8 lamp and one (1) low-power, electronic ballast. In many cases where two or three fixtures are mounted end-end, one (1) multi-lamp, electronic ballast will be used to power all 2 or 3 lamps of adjacent fixtures. Existing fixture styles include 4' strip and surface-mounted wrap lens 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 standard-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 100-watt HID recessed fixtures located on the building exteriors will each be retrofitted with one (1) 42-watt compact fluorescent lamp.
- 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 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.

Churchill County Junior High School

- Many of 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 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found in the classrooms and hallways of the Lahontan Valley High School Building will each be retrofitted with four (4) 28-watt T8 lamps and one (1) 4-lamp low-power, electronic ballast. The existing fixtures are "ice tray" type.
- The existing 2'x4' fluorescent fixtures containing four (4) T8 lamps and electronic ballasts and located in classrooms will each be retrofitted with two (2) 28-watt T8 lamps, one (1) high-power, electronic ballast and a specular reflector. Existing fixture styles include 2'x4' recessed and 2'x4' surface box fixtures.
- The existing 2'x4' fluorescent fixtures containing four (4) T8 lamps and electronic ballasts and located in locker rooms and storage rooms will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector. Existing fixture styles include 2'x4' recessed and 2'x4' surface box fixtures.

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- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector. Existing fixture styles include 2'x4' recessed and 2'x4' surface box fixtures.
- The existing pendant-mounted fluorescent fixtures with up and down light containing two (2) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- 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.
- Many of the existing fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic 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, 4' strips, wraparound, and vapor tight fixtures.
- The existing fluorescent fixtures in the Cafeteria/Kitchen building that were recently upgraded with 32-watt T8 lamps and electronic ballasts will be relamped with (2) 28-watt T8 lamps. The existing electronic ballasts will be used to operate the new lamps.
- 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.

E.C. Best Elementary School

- The existing 2'x4' recessed fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found in classrooms and offices will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector.
- The existing 2'x4' recessed fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found hallways and storage rooms will each be retrofitted with two (2) 28-watt T8 lamps and one (1) standard-power, electronic ballast.
- The existing 8-foot fixtures containing two (2) 8-foot T12 lamps and magnetic ballasts will each be replaced with new 8-foot fixtures using four (4) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- The existing 8-foot fixtures containing four (4) 8-foot T12 lamps and magnetic ballasts will each be replaced with new 8-foot fixtures using four (4) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- Many of the existing older fluorescent wrap lens fixtures containing two (2) T12 lamps and magnetic ballasts and found in classrooms, office areas and restrooms will each be replaced with new fixtures using two (2) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- Other existing fluorescent wrap lens 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.
- The existing 1'x2' fluorescent fixtures containing two (2) 2-foot T12 lamps and magnetic ballasts will each be retrofitted with two (2) 17-watt T8 lamps and one (1) low-power, electronic ballast.

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- The existing fluorescent fixtures containing one (1) T12 lamp and magnetic ballast and found in the hallways will each be retrofitted with one (1) 28-watt T8 lamp and one (1) low-power, electronic ballast.
- The existing incandescent porcelain socket and drum type fixtures in the restrooms will each be replaced with new drum fixtures using two (2) 13-watt 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 50-watt HID wallpack fixtures located on the exterior of the portable classroom building will be replaced with new fixtures containing one (1) 26-watt compact fluorescent lamp.

Lahontan Elementary 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 2'x4' fluorescent wrap lens fixtures containing four (4) T12 lamps and magnetic ballasts and found in the offices will each be retrofitted with four (4) 28-watt T8 lamps and one (1) 4-lamp low-power, electronic ballast.
- 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) 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' recessed, wraparound and 4' strip fixtures.
- The existing 2'x2' recessed fluorescent fixtures containing two (2) T12 U-lamps and magnetic ballasts will each be retrofitted with three (3) 17-watt T8 lamps, one (1) low-power, electronic ballast and a specular reflector.
- The existing 8-foot fluorescent strip fixture containing two (2) 8-foot T12 lamps will be replaced with a new fixture using two (2) 28-watt T8 lamps and a low-power, electronic ballast.
- The existing incandescent lamps in the walk-in cooler and freezer will each be replaced with 20-watt compact fluorescent lamps.

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 2'x4' fluorescent fixtures containing four (4) T8 lamps and electronic ballasts 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' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector.

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- 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.
- Many of the existing fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- The existing fluorescent fixtures in classrooms 1-14 were recently upgraded with 32-watt T8 lamps and electronic ballasts. These fixtures will be retrofitted with two (2) 28-watt T8 lamps operated on the existing ballasts.
- 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.

Numa Elementary School

- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts and located in classrooms, offices, the library and kitchen will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power electronic ballast and a specular reflector.
- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts and located in hallways and storage rooms will each be retrofitted with two (2) 28-watt T8 lamps, one (1) low-power electronic ballast and a specular reflector.
- The existing pendant-mounted fluorescent fixtures with up and down light containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with three (3) 28-watt T8 lamps and one (1) standard-power, electronic ballast.
- The existing fluorescent fixtures containing two (2) 32-watt T8 lamps and 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 2'x4' recessed, 1'x4' recessed, wraparound and 4' strip fixtures.
- The existing wall-mounted fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic ballasts and located in the gymnasium will each be retrofitted with two (2) 28-watt T8 lamps and one (1) standard-power, electronic ballast.
- The existing wall-mounted fluorescent fixtures containing two (2) 25-watt T8 lamps and electronic ballasts and located in the gymnasium will each be retrofitted with two (2) 25-watt T8 lamps and one (1) standard-power, electronic ballast.
- The existing incandescent lamps in the walk-in cooler and freezer will each be replaced with 20-watt compact fluorescent lamps.
- The existing 70-watt HID wallpack fixtures located on the building exteriors will be retrofitted with 23-watt compact fluorescent lamps.

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West End Elementary School

- The existing 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and located in office areas and the faculty lounge will each be retrofitted with two (2) 28-watt T8 lamps, one (1) low-power, electronic ballast and a specular reflector.
- The existing 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and located in classrooms will each be retrofitted with four (4) 28-watt T8 lamps and low-power, electronic ballasts.
- The existing 2'x4' fluorescent fixtures containing four (4) T8 lamps and electronic ballasts and found in the kitchen and one office will each be retrofitted with four (4) 28-watt T8 lamps and low-power, electronic ballasts.
- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector.
- The existing pendant-mounted fluorescent fixtures with up and down light in classrooms 2-13 will not be upgraded due to the unusually small ballast enclosures. New high-efficiency ballasts would not fit within the existing ballast enclosures.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power, electronic ballast. Existing fixture styles include 1'x4' surface box, 4' strips, and wraparound fixtures.
- The existing fluorescent wraparound fixtures containing two (2) 32-watt T8 lamps and electronic ballasts and found in the art classroom, library and multi-purpose room will each be retrofitted with two (2) 28-watt T8 lamps and low-power, electronic ballasts. 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.
- The existing fluorescent wraparound fixtures in classrooms 14 through 25 were recently upgraded with 32-watt T8 lamps and electronic ballasts. These fixtures will be retrofitted with two (2) 28-watt T8 lamps operated on the existing ballasts.
- The existing fluorescent wraparound fixtures containing two (2) 32-watt T8 lamps and electronic ballasts and found in areas not previously described will be retrofitted with (2) 28-watt T8 lamps and low-power, electronic ballasts.
- The existing incandescent drum type fixtures in the paper storage room will each be replaced with new drum fixtures using two (2) 13-watt compact fluorescent lamps.
- The existing wall-mounted incandescent fixtures found on the building exterior will each be replaced with new wallpack fixtures using two (2) 13-watt compact fluorescent lamps.
- 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.

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Cottage School

- The existing 8-foot fixtures containing two (2) 8-foot T12 lamps and magnetic ballasts will each be replaced with new 8-foot fixtures using four (4) 28-watt T8 lamps and one (1) low-power, electronic ballast.
- The existing 2'x4' fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts will each be retrofitted with four (4) 28-watt T8 lamps, one (1) low-power, electronic ballast and a specular reflector.
- The existing fluorescent wrap lens 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.
- The existing incandescent drum type fixtures in the restrooms and lobbies will each be replaced with new drum fixtures using two (2) 13-watt compact fluorescent lamps.
- The existing incandescent porcelain socket fixtures in the toilet rooms and storage rooms will each be replaced with new drum fixtures using two (2) 13-watt compact fluorescent lamps.
- Other existing incandescent fixtures will be retrofitted or replaced with compact fluorescent lamps.

Administration – Main Office

- The existing 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, one (1) 4-lamp, electronic ballast will be used to power all four lamps of both fixtures. Existing fixture styles include 2'x4' recessed and surface-mount, and 1'x4' wraparound fixtures.
- The existing 2'x4' recessed fluorescent fixtures located in the breakroom and containing three (3) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector.
- The existing 2'x4' recessed fluorescent fixtures containing three (3) 32-watt T8 lamps and electronic ballasts and controlled with bi-level switches will not be retrofitted. The 28-watt T8 lamps will not operate properly on the existing ballasts and new dimming ballasts are prohibitively expensive.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic ballasts and found in the office areas will each be retrofitted with (2) 28-watt T8 lamps and standard-power electronic ballasts. 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.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic ballasts and found in the hallways will each be retrofitted with (2) 28-watt T8 lamps and low-power electronic ballasts.
- The existing fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic ballasts and found in the restrooms will each be retrofitted with (2) 28-watt T8 lamps and low-power electronic ballasts.
- The existing fluorescent fixture containing one (1) T12 lamp and a magnetic ballast will be retrofitted with (1) 28-watt T8 lamp and a low-power, electronic ballast.
- The existing wall-mounted incandescent fixtures found on the exterior of the building will each be replaced with new wallpack fixtures using one (1) 32-watt compact fluorescent lamp.
- Other existing incandescent fixtures will be retrofitted or replaced with compact fluorescent lamps.

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Administration

- The existing fluorescent fixtures in this facility will not be upgraded. Most of the existing fixtures contain 32-watt T8 lamps and dimming electronic ballasts controlled with bi-level switches. The 28-watt T8 lamps will not operate properly on the existing ballasts and new dimming ballasts are prohibitively expensive.
- The existing 70-watt HID fixtures found on the exterior of the building will each be retrofitted with 23-watt compact fluorescent lamps.

Transportation

- The existing 2'x4' recessed fluorescent fixtures containing four (4) T12 lamps and electronic ballasts and found in the second floor lounge 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 (2) 28-watt T8 lamps and low-power electronic ballasts. 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' wraparound and 4' strip fixtures.
- The existing 8-foot fluorescent fixtures containing two (2) 8-foot T12 lamps and magnetic ballasts will each be retrofitted with conversion kits to use four (4) 28-watt T8 lamps and low-power, electronic ballasts.
- 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.

Maintenance

- 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 1'x4' wraparound fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found in the stain room will each be retrofitted with four (4) 28-watt T8 lamps, and one (1) low-power, electronic ballast.
- The existing fluorescent fixtures containing two (2) T12 lamps and magnetic ballasts will each be retrofitted with (2) 28-watt T8 lamps and low-power electronic ballasts. Existing fixture styles include 1'x4' wraparound, 4' strip, and 4' industrial hood fixtures.
- The existing 8-foot fluorescent fixtures containing two (2) 8-foot T12 lamps and magnetic ballasts will each be retrofitted with conversion kits to use four (4) 28-watt T8 lamps and standard-power, electronic ballasts.
- 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.

Warehouse

- The existing 2'x4' wraparound fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found in the warehouse will each be retrofitted with two (2) 28-watt T8 lamps, one (1) high-power, electronic ballast and a specular reflector.
- The existing 1'x4' wraparound fluorescent fixtures containing four (4) T12 lamps and magnetic ballasts and found in the office will each be retrofitted with two (2) 28-watt T8 lamps and one (1) low-power, electronic ballast.

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- The existing 1'x4' wraparound fluorescent fixtures containing four (4) T12 lamps and electronic ballasts and found in the offices will each be retrofitted with two (2) 28-watt T8 lamps, one (1) standard-power, electronic ballast and a specular reflector.
- The existing 8-foot fluorescent fixtures containing two (2) 8-foot T12 lamps and magnetic ballasts will each be retrofitted with conversion kits to use four (4) 28-watt T8 lamps and standard-power, electronic ballasts.
- The existing 8-foot fluorescent fixtures containing two (2) 32-watt T8 lamps and electronic ballasts will each be retrofitted with two (2) 28-watt T8 lamps and low-power, electronic ballasts.
- The existing wall-mounted incandescent fixtures found on the exterior of the building will each be replaced with new wallpack fixtures using two (2) 32-watt 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.

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. Material standardization will reduce the need to inventory several types of lighting components resulting in lower warehousing costs and easier responses to lamp and ballast service calls.

In addition, the recommended T8 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.

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:

- Lithonia Hi-Tek, PO Box 72, Crawfordsville, IN, 47933, (317) 362-1837.
- Simkar Corp., 700 Ramona Ave., Philadelphia, PA, 19120-4691, (215) 831-7700.

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- 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.
- Amerillum, 2835 La Mirada Drive, Vista, CA, 92081, (877) 727-7675

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.
- Amerillum, 2835 La Mirada Drive, Vista, CA, 92081, (877) 727-7675

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 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.

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. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

HIGH BAY LIGHTING SYSTEM UPGRADES

High Bay Fixture

Similar to the Lighting System Upgrades ECM, NORESCO identified a unique conversion opportunity at all the gymnasiums, shops and multipurpose rooms throughout the District. The high bay lighting systems can be replaced with new energy efficient fluorescent lighting fixtures resulting in significant improvements to energy efficiency, lighting quality, and ongoing maintenance.

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 Junior High School gymnasiums consist of high bay HID luminaires with 400 watt metal halide lamps and ballasts.

The existing lighting systems at the E.C. Best Elementary School gymnasium consist of high bay HID luminaires with 400 watt metal halide lamps and ballasts.

The existing lighting systems at the Lahontan Elementary School lunch room consist of high bay HID luminaires with 400 watt metal halide lamps and ballasts.

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 T5 technology. This will include installing a total of 142 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.

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
- E.C Best Elementary School – Gymnasium
- Lahontan Elementary School – Lunch Room

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A full room-by-room detailed lighting audit is included with this report. The report includes existing and proposed fixture types, quantities, and hours of operation for each area included in the energy audit. This will include removing the existing fixtures and installing a total of 142 new lighting fixtures with more efficient T5 compact fluorescent lamp technology.

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

Churchill County 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 six (6) 54-watt T5HO 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 four (4) 54-watt T5HO 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 four (4) 54-watt T5HO lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.

Churchill County 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 six (6) 54-watt T5HO 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 four (4) 54-watt T5HO lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.

E.C. Best Elementary School

- The existing high bay HID fixtures in the gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing four (4) 54-watt T5HO lamps and high power electronic ballasts. The new fixtures will include wire guards to protect against damage.

Lahontan Elementary School

- Twenty-three (23) of the existing high bay HID fixtures in the gymnasium containing 400 watt metal halide lamps and ballasts will be replaced with new fluorescent fixtures containing four (4) 54-watt T5HO lamps and high power electronic ballasts. The other eight (8) existing fixtures will be removed, as they are located very close to other fixtures and not needed to provide adequate illumination. The new fixtures will include wire guards to protect against damage.

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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 controls.

In addition, the recommended T5 lamps have a higher Color Rendering Index (CRI) than the existing metal halide lamps, resulting in an increase in light quality.

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:

- 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.
- Amerillum, 2835 La Mirada Drive, Vista, CA, 92081, (877) 727-7675

Material Specifications

Low Mercury T5 Lamps: The new, medium bi-pin T5 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%.

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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.

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. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

LIGHTING CONTROLS IMPROVEMENTS

Occupancy Sensor

NORESCO has conducted a detailed audit of each of the Churchill County School District facilities, and has found that there is an opportunity for improvements to the lighting system controls. NORESCO proposes to install occupancy sensors to control the lighting fixtures in select gymnasiums and multi-purpose rooms.

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

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. Due to the long re-strike time of the existing high bay lighting systems, these systems are often left operating when the areas are not occupied.

NORESCO proposes to optimize the control of new light systems in the gymnasiums and multi-purpose rooms of select facilities to minimize unnecessary operation during unoccupied hours. This will be accomplished through new occupancy-based controls. These controls are designed to work with the proposed new high efficiency fluorescent lighting systems.

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

- Churchill County High School
- Churchill County Junior High School
- E.C. Best Elementary School
- Lahontan Elementary School

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.

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

Churchill County High School and Junior High School

- The main and auxiliary gymnasiums will each receive occupancy sensors mounted to the body of each new fluorescent fixture as included with the ECM – High Bay Lighting System Upgrades.
- The sensors will be tested and adjusted to assure correct operation at each location.

E.C. Best Elementary School

- The gymnasium will receive occupancy sensors mounted to the body of each new fluorescent fixture as included with the ECM – High Bay Lighting System Upgrades.
- The sensors will be tested and adjusted to assure correct operation at each location.

Lahontan Elementary School

- The multi-purpose room will receive occupancy sensors mounted to the body of each new fluorescent fixture as included with the ECM – High Bay Lighting System Upgrades.
- The sensors will be tested and adjusted to assure correct operation at each location.

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.

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 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.

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

BUILDING AUTOMATION CONTROLS UPGRADE

Building Controls Systems

NORESCO proposes to upgrade building automation and control systems with new TAC/Invensys I/A Direct Digital Controls (DDC). The new DDC system will communicate over the district's wide area network to a front-end workstation with secured web enabled access.

The Churchill County School District has standardized on Invensys I/A controls. 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 DDC controls operate on a common platform. The following is a brief description of the controls currently in use at each location.

EC Best, Northside, West End and Lahontan Elementary Schools are equipped with Barber-Coleman Network 8000 GCM's and field devices. The DDC systems extend to the zone level throughout each school and are used to control all of the packaged rooftop units as well as the split condensing/furnace units. The Barber Coleman Network 8000 GCM's are obsolete and should be upgraded to new TAC/Invensys I/A UNC 520's as part of the District's larger effort to place all of the schools on a common DDC platform.

Numa Elementary School currently has Network 8000 field devices and an Invensys I/A UNC controller at the building level.

The gymnasium and the cafeteria at the Jr. High School have been upgraded to Invensys I/A controls. Programmable thermostats control the 23 packaged units on the north wing. The annex buildings are also under stand-alone control. Other portions of the building, including the gym and science wing, are equipped with Invensys compatible Tritium Jace controls. Unauthorized changes to the programmable thermostat schedules and set points 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 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.

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Churchill County High School uses a combination of Network 8000 and power-line carrier controls. In addition, portions of the campus have been upgraded with new I/A controls, including the classroom portions of the auto and vocational shops and the math building. The central plant is currently being upgraded to I/A controls. 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.

The old and new Administration Buildings utilize programmable thermostats, the Maintenance and Transportation Shops utilize a combination of manual and programmable thermostats, and the Cottage School utilizes manual thermostats. These buildings have the same limitations identified at the Jr. High School mentioned above.

NORESCO investigated the potential to replace all of the existing Barber-Coleman Network 8000 DDC systems and components. The costs of this approach exceed the financial terms required under this program. NORESCO evaluated and identified alternative control upgrades that would improve the overall performance and reliability of the DDC systems. The intent of the NORESCO proposal is to eliminate the obsolete Signal program and migrate all of the facilities to a common Enterprise Server platform. The front-end workstation would also be equipped with Workplace Tech software to help district personnel diagnose and troubleshoot HVAC and DDC system issues.

The proposed upgrades are described below:

Churchill County High School

NORESCO proposes new DDC devices as follows:

- Furnish and install new I/A DDC controls for the new gymnasium packaged rooftop units. This includes the installation of CO2 based "demand" controlled ventilation for the two units serving the gymnasium.
- Remove the power line carrier heat pump controls and replace with new DDC controls.
- Replace the Network 8000 LCM units in the following locations:
    - PMZ's in Minnie Blair
    - Theater
    - RTU's on the Gym
    - Central Plant
- Modify valving and controls to isolate buildings from the water source heat pump circulation loop. Integrate with upgraded Building Automation System.
- Modify sequence of operations to include demand controlled ventilation, economizer control, optimized start-stop, occupied-unoccupied setpoint control, domestic hot water recirculation pump control.
- Provide a graphic page for classrooms where new controls are installed to allow teacher adjustment to room setpoints (+/- 2^{o}).
- Verify system operation, functionality and confirm all operation at the new Enterprise Server.
- Complete start-up and calibration of the control system including operator training.

Numa Elementary School

NORESCO proposes upgrades to the existing system described as follows:

- Reuse the existing Network 8000 field devices and UNC controller.

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- Install new tamper-proof space sensors in the conditioned spaces.
- Modify sequence of operations to include economizer control, optimized start-stop, occupied-unoccupied setpoint control.
- Provide a graphic page for each classroom to allow teacher adjustment to room setpoints (+/- 2°)
- Verify system operation, functionality and confirm all operation at the new Enterprise Server.
- Complete start-up and calibration of the control system including operator training. Optimize the control sequence for maximum efficiency.

Cottage School

New programmable thermostats will serve all of the HVAC units on this facility. Program sequence of operations to include occupied-unoccupied setpoint control.

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 set-point control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Equipment Information

Manufacturer and Type

NORESCO has based its proposal around the installation of the following equipment:

- TAC/Invensys, 3600 Pammel Creek Rd., La Crosse, WI 54601, (608)787-2000

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

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REPLACE HEAT PUMPS WITH PACKAGED UNITS

High Efficiency Rooftop Unit

NORESCO proposes to replace eight heat pumps on the high school gymnasium with new high-efficiency packaged rooftop units. The project will be coordinated with the Building Automation Controls Upgrades ECM to provide for complete control of each packaged unit by the DDC system.

There are eight water source heat pumps that serve the gymnasium building. Two of these units are 35-ton water source heat pumps. The other units serve the locker rooms, lobby, and offices. These heat pumps were originally installed in 1988. These units run for an extended period of time for athletic training and events. The building typically operates from 6 a.m. to 10 p.m., six days per week. Table 5.5 provides a summary of the existing gymnasium units.

Table 5.5. High School Gymnasium heat pumps.

Qty	Location	Building	Unit I.D.	Manufacturer	Model No.	Capacity
1	High School	Gymnasium	HP-33	Command Aire	SWPH514EA	5 Tons
1	High School	Gymnasium	HP-34	Command Aire	RUUP 3544	35 Tons
1	High School	Gymnasium	HP-35	Command Aire	RUUP 3544	35 Tons
1	High School	Gymnasium	HP-36	Command Aire	RUUP 1544	15 Tons
1	High School	Gymnasium	HP-37	Command Aire	RUUP 844	8 Tons
1	High School	Gymnasium	HP-38	Command Aire	RUUP 604	6 Tons
1	High School	Gymnasium	HP-39	Command Aire	RUUP 1044	10 Tons
1	High School	Gymnasium	HP-40	Command Aire	SWPH614EA	6 Tons

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The gymnasium heat pumps reportedly do not have sufficient capacity to provide for cooling and ventilation during peak load conditions. The central plant is also at or above peak capacity. Because the gymnasium 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. These units are also more than twenty years old and are running beyond their normal service life.

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

The project will also include increasing the size of the existing natural gas line from 1" to 2" feeding the Gym and extending it to serve the new units on the gymnasium roof.

The replacement of these heat pumps with new packaged units will 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.

The scope of work for this ECM is as follows:

1. Provide detailed engineering and design.
2. Demolish and remove the existing units.
3. Furnish and install roof curbs and/or curb adapters as needed.
4. Coordinate with SW Gas to increase existing service to feed the gym facilities.
5. Furnish and install a natural gas extension to the gym.
6. Furnish and install eight new high efficiency units including all dampers, actuators, sensors and controls as needed to provide a complete working system.
7. Properly connect and seal supply and return ductwork.
8. Furnish and install all necessary electrical power including conduit, wiring, circuit breakers, disconnects, etc.
9. Coordinate work with the DDC controls project to provide for the proper sequence of operation for the control each of the packaged units.
10. Provide start-up and commissioning services
11. Provide air-side test, adjust and balance.

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 set-point control.

Equipment Information

Manufacturer and Type

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

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Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

COOLING TOWER FAN VFD INSTALLATION

Variable Frequency Drive

NORESCO proposes to install two new variable frequency drives (VFDs) and energy efficient motors on the cooling tower fans at Churchill County High School. This measure is provided as an alternate to the Water Source Heat Pump System Optimization ECM.

The water source heat pump system at the Churchill County High School is cooled using a Baltimore Air Coil T1662 cooling tower. This cooling tower is designed to maintain a primary loop cooling set-point temperature of 75°F. The unit is equipped with two 15 hp low speed fans and two 40 hp high speed fans. 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.

The two-speed fan operation does provide some 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. The cycling of the fans leads to increased wear and tear on the belts and other drive components.

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This project affects the central plant cooling tower and the water source heat pump system located at Churchill County High School. NORESCO proposes to furnish and install two new VFDs and energy efficient motors on the cooling tower fans. The VFDs will precisely match the fan speed to the load. The VFDs also provides a soft-start capability to reduce wear and tear on the unit during start-up. The scope of work for this ECM is as follows:

1. Provide detailed engineering and design.
2. Furnish and install two new VFDs and energy efficient motors.
3. Furnish and install all sensors and controls as needed to provide a complete working system.
4. Furnish and install all necessary electrical power including conduit, wiring, circuit breakers, disconnects, etc.
5. Coordinate work with the DDC controls project to provide for the proper sequence of operation.
6. Provide start-up and commissioning services

Impact on Facility Operations and Performance

The installation of the VFDs and energy efficient motors 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.

Equipment Information

Manufacturer and Type

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

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

BUILDING ENVELOPE IMPROVEMENTS

The schools in the Churchill County School District have significant sources of air infiltration. Many of the exterior doors in the buildings have significant gaps between the door and the jamb and between the door and sill. Some of the older doors do not close completely. In addition, the weather-stripping on even the newest doors is still inadequate to properly minimize infiltration. Infiltration can be caused by pressure differences due to wind, chimney (or stack) effect and mechanical systems, and is therefore the single largest source of heat loss or gain through a buildings envelope.

NORESCO proposes to install new, heavy-duty weather-stripping on single and double-width doors which will seal much more completely when closed than they do currently. NORESCO will only install weather-stripping where it makes the most sense; we focus primarily on large gaps and openings that allow significant infiltration. Installation of the weather-stripping will also include caulking of the carrier to the jamb and doorframe caulking, adjustment of closures, latches, and replacement of hinges, and sill repair, if applicable. The primary benefit of this measure is reducing unnecessary heat loss and improving comfort for those near the doors or drafty areas.

Table 5.8 below summarizes the proposed scope of work associated with weatherizing the doors.

Table 5.8. Weatherization scope of work.

School	Total Doors for Weatherization
EC Best	48
West End	53
Total	101

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The scope of work for this ECM is summarized as follows:

- Remove and replace weather-stripping on doors where existing weather-stripping does not form a complete seal. Installed weather-stripping shall be a closed cell sponge neoprene strip, 3/16" x 1/2". Weather-stripping shall be No. 312 as manufactured by Zero Weather-stripping Company or approved equal and
- Caulking – provide caulking where required. Caulking shall be one (1) component urethane non-sag (gun grade) material applied per the manufacturer's instructions. Caulking shall be by Sonolastic NPI, Sika Chemical Corp. or approved equal.
- Replace door sweeps on all doors where the existing sweeps are worn down or non existent
- Replace hinges on doors to allow for proper alignment and closure where required.
- Fasteners to be compatible to materials to which they come into contact. Cadmium plated fasteners shall be used on all exterior applications.

Impact on Facility Operations and Performance

There will be no negative impact on existing equipment and systems.

The new weather-striping system will be configured to fit properly and closely match the existing conditions. The most notable impact of this measure will be improved comfort along the perimeter of the building. In winter, building occupants will experience warmer temperatures near the doors.

Equipment Information

Manufacturer and Type

NORESCO proposes to install batt insulation manufactured by Owens Corning or equivalent.

- Owens Coring
  http://www.owenscorning.com/

NORESCO plans to install weather-stripping by the following manufacturer or equivalent:

- 3M, 3M Center, St. Paul, MN 55144
  http://www.3m.com/US/.
- Zero Weather-Stripping Co., 415 Concord Ave., Bronx, NY, 10455
  http://www.zerointernational.com/index.html

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Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

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INTERIOR WATER FIXTURE RETROFITS

Low Flow Water Fixture

Although the unit price of water is relatively low, water and sewer charges clearly represent a significant cost for the Churchill County School District (CCSD). NORESCO will implement a comprehensive list of water conversation measures at each building that will reduce the water usage and energy used for water heating.

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 percent through the installation of these low flow devices on the remaining water fixtures. NORESCO proposes to replace or retrofit the conventional plumbing fixtures in the student, staff and public restrooms with new low-flow fixtures. This will include 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. The following is a description of the existing conditions and the work to be undertaken in each area:

Churchill County Junior High School

The existing water fixtures at the Churchill County Junior High School include both standard and low flow valves and aerators. Approximately 45 percent of the water closet flush valves are standard 3.5 gpf units, and 50 percent of the urinal flush valves are standard 1.6 gpf units. Sixty 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.

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 2.5 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 0.5 gpm aerators. Only the lavatory sinks in the Classroom 40-44 building currently have low-flow aerators.

E.C. Best Elementary School

The existing water fixtures at the E.C. Best Elementary School include both standard and low flow valves and aerators. Approximately 33 percent of the water closet flush valves are standard 3.5 gpf units, and 45 percent of the urinal flush valves are standard 1.6 gpf units. All of the lavatory sinks use aerators that have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

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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 restrooms and in the locker room.

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the boys' restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

Northside Elementary School

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 gpf units, and 60 percent of the urinal flush valves are standard 1.6 gpf units. Seventy 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.

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

The existing urinals with standard 2.5 gpf flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in the boy's restrooms next to room 18 and room 30. The urinals in the boy's 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 0.5 gpm aerators.

Numa Elementary School

The existing water fixtures at the Numa Elementary School include both standard and low flow valves and aerators. All of the water closet flush valves are low flow 1.6 gpf units, and all of the urinal flush valves are standard 1.6 gpf units. Eighty percent of the lavatory sinks use existing aerators that have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the boys' and men's restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

West End Elementary School

The existing water fixtures at the West End Elementary School include both standard and low flow valves and aerators. Nearly all of the water closet flush valves are standard 3.5 gpf units, and all of the urinal flush valves are standard 1.6 gpf units. Twenty-five 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.

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 restrooms and in toilet rooms.

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the boys' restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

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Table 5.9 summarizes the quantities of plumbing fixtures that were identified for retrofit or replacement as part of this project.

Table 5.9. Proposed low-flow water fixtures.			
School	**Toilets**	**Urinal**	**Sink**
Churchill County Junior High	34	28	37
E.C. Best Elementary School	13	18	33
Northside Elementary School	21	14	17
Numa Elementary School	0	10	28
West End Elementary School	22	10	5
Total	90	80	120

Impact on Facility Operations and Performance

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

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.

Environmental Issues

No adverse environmental impacts are expected.

TRANSFORMER REPLACEMENT

Typical Transformer

NORESCO proposes to replace existing 480 volt to 208/120 volt step-down transformers in the High School with high efficiency transformers. The new transformers impose lower electrical core and coil losses resulting in lower electricity consumption and building internal heat gains.

The following table summarizes the existing transformers considered for this ECM.

Table 5.10. Existing transformers.

Unit	School	Location	Manuf.	kVA
1	**High School**	Gym (Outside)	GE	75.0
2	**High School**	Closet by Kitchen	Westinghouse	75.0
3	**High School**	Cafeteria	Westinghouse	75.0
4	**High School**	By Bathroom	Westinghouse	45.0
5	**High School**	Central Plant Build Electric	Westinghouse	75.0
6	**High School**	Vocational Elec	ITE	300.0
7	**High School**	Science	ITE	112.5

The existing step-down transformers convert 480 volt AC electricity to 208 volts in order to serve plug loads and lighting. These transformers were installed during original building construction and are standard grade transformers with typical core losses of 15 to 20% at low loads. The transformers are energized 24 hours per day and 365 days per year.

The existing transformers are not the most electrically efficient ones on the market. A transformer converts electrical energy from one voltage to another. The transformer primary voltage is applied to one set of conductor windings, which transfers energy to the magnetized core. In turn, the core imparts energy to the secondary voltage windings. The step-down ratio is determined by the ratio of the number of turns in the windings. All transformers suffer from electrical energy losses on the system due to impedances caused by the components.

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NORESCO proposes to install high efficiency transformers in place of the identified existing transformers. The new transformers will result in electrical energy savings due to reduced core loss (also known as no load loss) and coil loss (load loss). High efficiency transformers in this capacity range have cores made of low-loss silicon steel with copper windings. These transformers are energy efficient throughout the load range of the transformer and, most importantly, high efficiency is maintained at lower transformer loading levels. The transformer manufacturers have reduced the no-load losses of silicon steel transformers by over 60 percent in the last 30 years. Additional energy savings will result by reducing the cooling loads associated with heat from the transformers.

NORESCO is not claiming dollar savings due to preserved electronic components from improved power quality. Though this is an added benefit, it is difficult to verify and guarantee.

Impact on Facility Operations and Performance

The work performed under this ECM will be done during a time when the building electrical service can be shut down. NORESCO will coordinate all work with school personnel to minimize the impact on the students and staff. The new transformers will achieve savings from the increased transformer efficiency and reduced cooling load. The new transformers will also reduce harmonic distortion creating better power quality.

Equipment Information

Manufacturer and Type

The transformers will be three phase dry type 480 volt primary (Delta) with a 208/120 volt secondary (wye) rated for 60 Hz. Conductors will be copper or aluminum throughout. All transformers will be floor mounted in locations near the existing transformers. New transformers will have a minimum of 115°C rise rating with a 220°C UL component recognized insulation system. Transformer enclosures will be NEMA 1 ventilated cabinet conforming with ANSI-C57.12.50 suitable for an indoor installation. New transformers will be GE TP1 Series, Acme Electric D Series or equal. .

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

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NETWORK POWER MANAGEMENT

Computer Room Application

NORESCO recommends installing new power management software for the personal computers (PCs) throughout Churchill County School District. The new software will reduce electricity consumption by safely putting Microsoft Window-based computers into low-power states.

The surveyed schools contain a large number of computer workstations. The Churchill County School District reported that a total of 1,563 PC's and monitors are in operation and 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.

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 throughout the District. 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.

Pricing for this ECM includes initial installation of the software package plus five years of maintenance and support.

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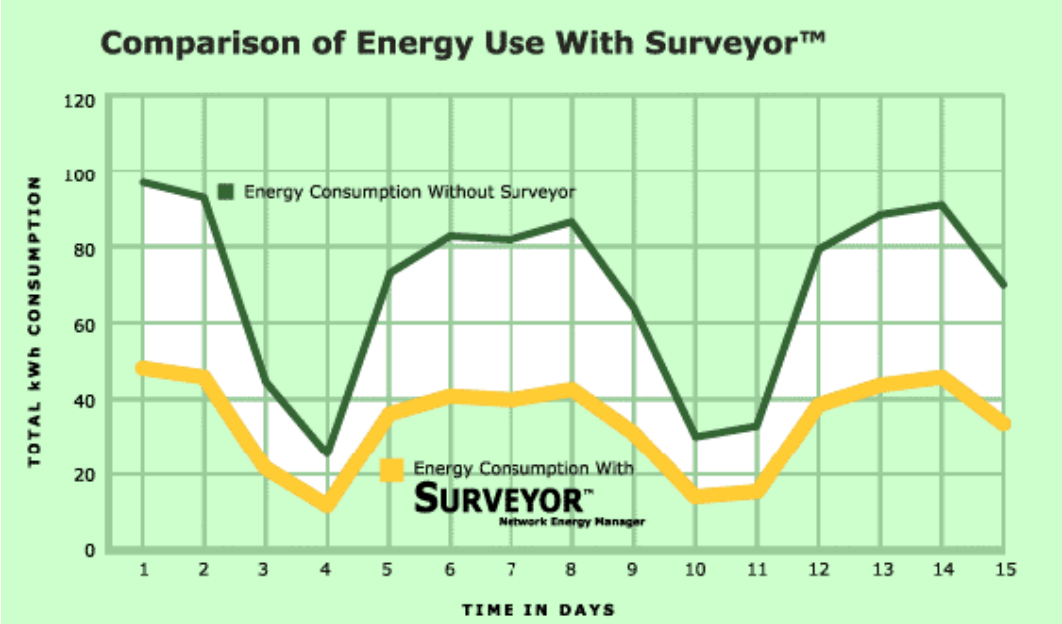
Figure 5.4



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.

Equipment Information

Manufacturer and Type

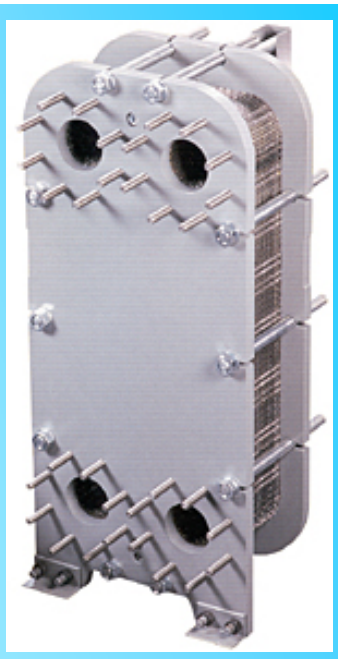
NORESCO will install the Surveyor software manufactured by the following:

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

Environmental Issues

There are no adverse environmental issues associated with this ECM. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

WATER SOURCE HEAT PUMP SYSTEM OPTIMIZATION



Water Source Heat Pump System, Plant and Frame Heat Exchanger

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

The heat pump systems at the Churchill County High School were originally built in 1988, with renovations and additions made in the 1990's. The system includes approximately 78 Command Aire and Trane 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 78.2 MBH. Each of the gymnasium units has a rating of approximately 35 tons. The original loop design temperature was 75°F for cooling and heating.

The central plant at the High School 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.

Although many new buildings at the High School have been added to the campus, the central plant boiler and cooling tower capacities have not been increased to meet the additional loads. The cooling tower was recently reconditioned; however, the loop temperatures can reach 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 even though other portions of the campus are unoccupied. The gymnasium heat pumps reportedly have trouble meeting the cooling and ventilation requirements of the building. There are no isolation control valves on any individual building or heat pump coil throughout the campus. Therefore, if one zone requires cooling or heating, the central plant must operate and pump water throughout the entire campus. This is an extremely inefficient pumping arrangement.

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The existing water source heat pumps are equipped with standard range coils that operate between 65°F heating and 85°F cooling. These coils would not be capable of operating when the city water supply temperature drops below 69°F. Therefore, the heat pumps must be replaced as part of this project.

These water source heat pumps located throughout the campus are approaching 20 years of age. Although the units are continuing to work, they have reached the end of their service life and may need to be replaced with new high efficiency heat pumps designed for lower loop temperatures.

It was noted that individual heat pumps can operate when the boilers or cooling tower scheduled off. During the heating season, this may cause the loop temperature to drop too far to allow for normal warm up as the boilers cannot maintain the 65°F minimum loop temperature. This causes some heat pumps to turn off until the loop temperature reaches 65°F or more. This mode of operation may increase the amount of heating energy needed to bring the building up to the occupied heating set-point temperature.

Numa Elementary School also utilizes a water source heat pump system for heating and cooling. It is equipped with approximately 75 units ranging from 1.5 to 15 tons of capacity. These units were manufactured by Mammoth, Inc. and are equipped with extended range coils with an operating temperature range from 20 °F to 110°F. The normal loop temperature is 75°F.

The central plant at Numa Elementary School includes two natural gas Rite Model 250WG boilers, with ratings of 2,520 and 2,552 MBH. The single cooling tower is an Evapco unit equipped with a 7.5 hp low speed and a 40 hp high-speed fan motor. There are two Armstrong primary pumps each with a rating of 20 hp. The two Armstrong cooling tower pumps are 25 hp each. An Armstrong plate and frame heat exchanger is used to isolate the primary loop from the cooling tower. All of the central plant equipment was installed in 1998 and is in good condition.

The heat pumps at Numa Elementary School are relatively new and are in good condition. They are equipped with extended range coils suitable for use over the range of city water source supply temperatures. All of the central plant equipment is in good condition. The heat pump loop experiences severe water hammer during start up of the pumps. Therefore, to prevent damage to the system, the 60 hp loop pumps are run 24/7. This is very inefficient when there is no need for heating or cooling during unoccupied periods.

The water treatment systems and chemistry is reported to be good at both locations. The Invensys central plant controls are also in good condition at both locations.

NORESCO proposes to connect both of the water source heat pump systems 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 the loop temperature at or near 60°F to 65°F. This concept has been successfully used at several facilities in Ely, Nevada.

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

During normal operation the proposed system will bypass the boilers and cooling towers to provide “free-cooling” from the city water system’s thermal mass. The boilers and cooling towers will remain in place for back up operation or extended

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temperature extremes. If required, the central plant can be used to augment the city water system as a hybrid water source heat pump system.

NORESCO also proposes to replace the water source heat pumps at the high school with new high efficiency extended range units. NORESCO proposes to install DDC controlled building isolation valves to reduce pump load when specific buildings are unoccupied. The existing VFDs will be equipped with differential pressure inputs to automatically maintain the required fixed rate of flow for those heat pumps that are required to run.

As part of this project, NORESCO will also install variable frequency drives on the pumps serving the Numa heat pump loop to help prevent water hammer. This will enable the pumps to be shut down during unoccupied periods.

Table 5.2 provides a summary of the proposed new heat pumps for the high school. The proposed units are Carrier premium efficiency units (or approved equivalent) with extended range coils. Please note that this table is for reference purposes and the unit capacities are subject to change during the engineering and design phase of the project.

Evaluated but not Included

Table 5.2. Proposed water source heat pumps

Item	Qty	Building	Unit I.D.	Manufacturer	Model No.		Tons
1	1	Auto Shop	HP53	Carrier	50RHS	036	3.0
2	1	Auto Shop	HP59	Carrier	50RHS	060	5.0
3	1	Auto Shop	HP60	Carrier	50RHS	036	3.0
4	1	Auto Shop	HP61	Carrier	50RHS	024	2.0
5	1	Auto Shop	HP62	Carrier	50RHS	015	1.3
6	1	Industrial Arts	HP1	Carrier	50RHS	060	5.0
7	1	Industrial Arts	HP10	Carrier	50RHS	060	5.0
8	1	Industrial Arts	HP11	Carrier	50RHS	060	5.0
9	1	Industrial Arts	HP12	Carrier	50RHS	060	5.0
10	1	Industrial Arts	HP13	Carrier	50RHS	060	5.0
11	1	Industrial Arts	HP14	Carrier	50RHS	030	2.5
12	1	Industrial Arts	HP15	Carrier	50RHS	030	2.5
13	1	Industrial Arts	HP16	Carrier	50RHS	030	2.5
14	1	Industrial Arts	HP17	Carrier	50RHS	060	5.0
15	1	Industrial Arts	HP18	Carrier	50RHS	060	5.0
16	1	Industrial Arts	HP2	Carrier	50RHS	060	5.0

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Table 5.2. Proposed water source heat pumps							
Item	Qty	Building	Unit I.D.	Manufacturer	Model No.		Tons
17	1	Industrial Arts	HP3	Carrier	50RHS	060	5.0
18	1	Industrial Arts	HP4	Carrier	50RHS	060	5.0
19	1	Industrial Arts	HP5	Carrier	50RHS	060	5.0
20	1	Industrial Arts	HP6	Carrier	50RHS	060	5.0
21	1	Industrial Arts	HP69	Carrier	50RHS	015	1.5
22	1	Industrial Arts	HP7	Carrier	50RHS	060	5.0
23	1	Industrial Arts	HP70	Carrier	50RHS	030	2.5
24	1	Industrial Arts	HP71	Carrier	50RHS	036	3.0
25	1	Industrial Arts	HP72	Carrier	50RHS	042	3.5
26	1	Industrial Arts	HP8	Carrier	50RHS	060	5.0
27	1	Industrial Arts	HP9	Carrier	50RHS	060	5.0
28	1	Math	HP41	Carrier	50RHS	042	3.5
29	1	Math	HP42	Carrier	50RHS	042	3.5
30	1	Math	HP43	Carrier	50RHS	060	5.0
31	1	Math	HP44	Carrier	50RHS	042	3.5
32	1	Math	HP45	Carrier	50RHS	036	3.0
33	1	Math	HP46	Carrier	50RHS	036	3.0
34	1	Math	HP47	Carrier	50RHS	060	5.0
35	1	Math	HP48	Carrier	50RHS	036	3.0
36	1	Math	HP49	Carrier	50RHS	036	3.0
37	1	Math	HP50	Carrier	50RHS	036	3.0
38	1	Math	HP51	Carrier	50RHS	036	3.0
39	1	Math	HP52	Carrier	50RHS	036	3.0
40	1	Math	HP53	Carrier	50RHS	060	5.0
41	1	Math	HP54	Carrier	50RHS	042	3.5

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Table 5.2. Proposed water source heat pumps							
Item	Qty	Building	Unit I.D.	Manufacturer	Model No.		Tons
42	1	Math	HP55	Carrier	50RHS	042	3.5
43	1	Math	HP56	Carrier	50RHS	042	3.5
44	1	Math	HP57	Carrier	50RHS	042	3.5
45	1	Science	HP19	Carrier	50RHS	042	3.5
46	1	Science	HP20	Carrier	50RHS	042	3.5
47	1	Science	HP21	Carrier	50RHS	042	3.5
48	1	Science	HP22	Carrier	50RHS	042	3.5
49	1	Science	HP23	Carrier	50RHS	030	2.5
50	1	Science	HP24	Carrier	50RHS	060	5.0
51	1	Science	HP25	Carrier	50RHS	060	5.0
52	1	Science	HP26	Carrier	50RHS	060	5.0
53	1	Science	HP27	Carrier	50RHS	060	5.0
54	1	Science	HP28	Carrier	50RHS	042	3.5
55	1	Science	HP29	Carrier	50RHS	042	3.5
56	1	Science	HP30	Carrier	50RHS	060	5.0
57	1	Science	HP31	Carrier	50RHS	042	3.5
58	1	Science	HP32	Carrier	50RHS	042	3.5
59	1	Science Addition	HP58	Carrier	50RTG	060	5.0
60	1	Science Addition	HP59	Carrier	50RTG	060	5.0
61	1	Science Addition	HP60	Carrier	50RTG	060	5.0
62	1	Science Addition	HP61	Carrier	50RTG	060	5.0
63	1	Science Addition	HP62	Carrier	50RTG	060	5.0
64	1	Science Addition	HP63	Carrier	50RTG	060	5.0
65	1	Science Addition	HP64	Carrier	50RTG	060	5.0
66	1	Science Addition	HP65	Carrier	50RTG	060	5.0

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Table 5.2. Proposed water source heat pumps							
Item	Qty	Building	Unit I.D.	Manufacturer	Model No.		Tons
67	1	Science Addition	HP66	Carrier	50RTG	060	5.0
68	1	Science Addition	HP67	Carrier	50RTG	060	5.0
69	1	Science Addition	HP68	Carrier	50RTG	060	5.0
70	1	Theater	HP1	Carrier	50RTG		
71	1	Theater	HP2	Carrier	50RTG		
72	1	Theater	HP3	Carrier	50RHS	060	5.0

Table 5.3 provides a summary of the proposed new pumps and plate and frame heat exchangers. Please note that this table is for reference purposes and the unit capacities are subject to change during the engineering and design phase of the project.

Table 5.3. Numa Elementary and Churchill County High School pumps and heat exchangers.	
Numa Elementary School	
HX-2	Plate and frame heat exchanger, double wall, to cool 720 gpm from 86.5F to 76F using 720 gpm of 70F city cooling water. 10 ft maximum pressure drop both sides, 304 stainless steel, 100 psig operating pressure, 150 psig test pressure, 200F max temperature. ASME labeled.
P3, P4	Two pumps each rated at 20 Hp, 460 VAC, 3Ph. 60 Hz, 720 gpm @ 85 ft.
Churchill County High School	
HX-2	Plate and frame heat exchanger, double wall, to cool 1,100 gpm from 86.5F to 76F using 1,100 gpm of 70F city cooling water. 10 ft maximum pressure drop both sides, 304 stainless steel, 100 psig operating pressure, 150 psig test pressure, 200F max temperature. ASME labeled.
P3, P4	Two pumps each rated at 20 Hp, 460 VAC, 3Ph. 60 Hz, 1,100 gpm @ 40 ft.

Evaluated but not included

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

The scope of work for this ECM is as follows:

1. Perform engineering and detailed design.
2. Obtain required permits and interconnection agreements.
3. Perform all necessary trenching, excavation and backfill.
4. Restore all exterior surfaces to their original condition.

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5. Furnish all material and labor for all piping and heat pump replacement work.
6. Provide construction management.
7. Provide start-up and commissioning services.
8. Perform water-side test, adjust and balance.
9. Conduct detailed training for facilities personnel.

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

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 optimized equipment scheduling and temperature set-point control. The controls will also provide for remote diagnostics to ensure that each unit is operating correctly.

Equipment Information

Manufacturer and Type

The reconfigured mechanical system will include new underground piping from the City to tie back to the existing Central Plant. The city interconnection will require the installation of two isolation valves to be furnished by NORESCO and installed in to the water main by the City. NORESCO will then provide all necessary supply and return underground piping and isolation valves and check valves. In addition to this piping, NORESCO will install new heat exchangers, pumps, valves, sensors and controls required to run the new system while the existing system will be shut down for back up. The new heat pumps shall be equipped with extended range coils and shall be ASHRAE 90.1 and Energy Start compliant. The variable frequency drives shall be ABB or approved equal.

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

Evaluated but not Included

PACKAGE UNIT REPLACEMENTS

High Efficiency Packaged Unit

NORESCO proposes to furnish and install new high-efficiency packaged rooftop units. Control of the units will be optimized based on implementation of the Building Automation Controls Upgrades ECM.

Many of the existing packaged rooftop units are old, inefficient, and have reached their end of life. Areas of particular concern include the Jr. High School's old annex, maintenance shop and the administration buildings. These units have been used for over twenty years and have been operating well beyond their normal service life. Packaged rooftop units manufactured before 1990 typically had 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.

The units located at the Jr. High School Classroom and Office Addition (North Wing) were identified for replacement as these units were manufactured in 1991, however they do not have economizers and they are controlled with programmable thermostats. The units located at West End Elementary were manufactured in 1991 and were identified for replacement based on their service life and lower efficiency.

Evaluated but not included

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Table 5.4 provides a summary of the units included within this measure.

Table 5.4. Existing package units.

Item	Qty	Location	Building	Unit I.D.	Manufacturer	Model No.	Capacity (Tons)
1	1	Jr. High School	Old Annex	AC-1	Day & Night	N/A	4 (est)
2	1	Jr. High School	Old Annex	AC-2	Day & Night	N/A	4 (est)
3	1	Jr. High School	Old Annex	AC-3	Day & Night	N/A	4 (est)
4	1	Jr. High School	Old Annex	AC-4	Day & Night	N/A	4 (est)
5	1	Jr. High School	North Wing	118	Lennox	GCS16-653-125-5G	5
6	1	Jr. High School	North Wing	142	Lennox	GCS16-653-125-5G	5
7	1	Jr. High School	North Wing	153	Lennox	GCS16-653-125-5G	5
8	2	Jr. High School	North Wing	203	Lennox	GCS16-653-125-5G	5
9	1	Jr. High School	North Wing	212	Lennox	GCS16-653-125-5G	5
10	1	Jr. High School	North Wing	221	Lennox	GCS16-653-125-5G	5
11	1	Jr. High School	North Wing	222	Lennox	GCS16-653-125-5G	5
12	1	Jr. High School	North Wing	103	Lennox	GCS16-513-125-6G	4
13	1	Jr. High School	North Wing	107	Lennox	GCS16-513-125-6G	4
14	1	Jr. High School	North Wing	108	Lennox	GCS16-513-125-6G	4
15	1	Jr. High School	North Wing	112	Lennox	GCS16-513-125-6G	4
16	1	Jr. High School	North Wing	144	Lennox	GCS16-513-125-6G	4
17	1	Jr. High School	North Wing	159	Lennox	GCS16-513-125-6G	4
18	1	Jr. High School	North Wing	160	Lennox	GCS16-513-125-6G	4
19	1	Jr. High School	North Wing	208	Lennox	GCS16-513-125-6G	4
20	1	Jr. High School	North Wing	216	Lennox	GCS16-513-125-6G	4
21	1	Jr. High School	North Wing	223	Lennox	GCS16-513-125-6G	4
22	1	Jr. High School	North Wing	224	Lennox	GCS16-513-125-6G	4
23	1	Jr. High School	North Wing	225	Lennox	GCS16-513-125-6G	4
24	1	Jr. High School	North Wing	104	Lennox	GCS16-413-100-10G	3
25	1	Jr. High School	North Wing	206	Lennox	GCS16-413-100-10G	3
26	1	Jr. High School	North Wing	226	Lennox	GCS16-413-100-10G	3
27	1	Administration	Old Building	RTU-1	Carrier	N/A	4 (est)
28	1	Administration	Old Building	RTU-2	Carrier	584AP03600AC	3 (est)
29	1	Administration	Old Building	RTU-3	Carrier	N/A	4 (est)
30	1	Administration	New Building	RTU-4	BDP	580CPV072150AEMA	6 (est)

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Table 5.4. Existing package units.							
Item	**Qty**	**Location**	**Building**	**Unit I.D.**	**Manufacturer**	**Model No.**	**Capacity (Tons)**
31	**1**	**Administration**	New Building	New Mini Split	TBD		1 (est)
32	**1**	**Administration**	New Building	New Mini Split	TBD		1.5 (est)
33	**1**	**Maintenance Shop**	Offices	AC-1	Day & Night	N/A	4 (est)
34	**1**	**Maintenance Shop**	Offices	AC-2	Day & Night	N/A	4 (est)
35	**1**	**West End**	Front Office	AC-1E	Lennox	GCS1[illegible]-513-125-y	4
36	**1**	**West End**	25	AC-13A	Lennox	GCS[illegible]-513-125-y	4
37	**1**	**West End**	24	AC-13B	Lennox	GCS16-513-125-y	4
38	**1**	**West End**	23	AC-13C	Lennox	GCS16-513-125-y	4
39	**1**	**West End**	22	AC-13D	Lennox	GCS16-513-125-y	4
40	**1**	**West End**	21	AC-13E	Lennox	GCS16-513-125-y	4
41	**1**	**West End**	20	AC-14	Lennox	GCS16-513-125-y	4
42	**1**	**West End**	19	AC-1[illegible]	Lennox	GCS16-513-125-y	4
43	**1**	**West End**	18	AC-12F	Lennox	GCS16-513-125-y	4
44	**1**	**West End**	17	AC-12E	Lennox	GCS16-513-125-y	4
45	**1**	**West End**	16	AC-12D	Lennox	GCS16-513-125-y	4
46	**1**	**West End**	15	AC-12C	Lennox	GCS16-513-125-y	4
47	**1**	**West End**	14	AC-12B	Lennox	GCS16-513-125-y	4
48	**1**	**West End**	Conference Room	AC-12A	Lennox	GCS16-513-125-y	4
49	**1**	**West End**	Front Office	AC-11	Lennox	GCS16-513-125-y	4
50	**1**	**West End**	5	AC-1A	Lennox	GCS16-513-125-y	4
51	**1**	**West End**	9	AC-7	Lennox	GCS16-513-125-y	4
52	**1**	**West End**	4	AC-1B	Lennox	GCS16-513-125-y	4
53	**1**	**West End**	Fish Bowl	AC-9	Lennox	GCS16-513-125-y	4
54	**1**	**West End**	3	AC-1C	Lennox	GCS16-513-125-y	4
55	**1**	**West End**	11	AC-10A	Lennox	GCS16-513-125-y	4
56	**1**	**West End**	12	AC-10B	Lennox	GCS16-513-125-y	4
57	**1**	**West End**	2	AC-1D	Lennox	GCS16-513-125-y	4
58	**1**	**West End**	13	AC-10C	Lennox	GCS16-513-125-y	4

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Table 5.4. Existing package units.							
Item	**Qty**	**Location**	**Building**	**Unit I.D.**	**Manufacturer**	**Model No.**	**Capacity (Tons)**
59	**1**	**West End**	Multipurpose Room	AC-3A	Lennox	GCS16-1603-270-4y	13
60	**1**	**West End**	Multipurpose Room	AC-3B	Lennox	GCS16-1603-270-4y	13
61	**1**	**West End**	10	AC-8	Lennox	GCS16-261-50-1p	2
62	**1**	**West End**	8	AC-6	Lennox	GCS16-413-100-7y	3
63	**1**	**West End**	6	AC-4	Lennox	GCS16-311-75-1p	2.5
64	**1**	**West End**	7 (Teacher's Lounge)	AC-5	Lennox	GCS16-311-75-1p	2.5
65	**1**	**West End**	Library	AC-16A	Lennox	GCS16-653-125-3y	5
66	**1**	**West End**	Library	AC-16B	Lennox	GCS16-653-125-3y	5
67	**1**	**West End**	Library	AC-16C	Lennox	GCS16-653-125-3y	5

Evaluated but not Included

All of the packaged units listed above have reached their end of service life and should be replaced with new high efficiency units. Many of the older units are difficult and expensive to operate and maintain. The Jr. High School units do not have economizers or DDC control, and are operated inefficiently when compared to new units with higher efficiency ratings and controls.

NORESCO proposes to furnish and install 68 new high efficiency packaged gas/electric rooftop units as shown in Table 5.4 (Line item 8 includes two units). The new units will be equipped with mixed air economizers and DDC controls. The proposed units will be Lennox "L" series with an EER of 11.0 or higher. The new units will be ASHRAE 90.1 and Energy Star compliant.

The scope of work for this ECM is as follows:

1. Demolish and remove the existing units.
2. Furnish and install roof curbs and/or curb adapters as needed.
3. Furnish and install new high efficiency units including all dampers, actuators, sensors and controls as needed to provide a complete working system.
4. Properly connect and seal supply and return ductwork.
5. Reuse the existing electrical equipment including wiring, conduit, circuit breaks and disconnects.
6. Coordinate work with the existing and proposed DDC controls to provide for the proper sequence of operation for the control each of the packaged units.

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Impact on Facility Operations and Performance

The installation of the new rooftop units will result in reduced annual energy use. Integration with the DDC system will provide for proper outside air and mixed air damper control, equipment scheduling and temperature set-point control. All of these measures will help improve indoor air quality, temperature control, and comfort for students and faculty.

Equipment Information

Manufacturer and Type

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

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

Evaluated but not Included

KITCHEN COOLING UPGRADES

High Efficiency Make-up Air Unit

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 will provide additional cooling, heating, and ventilation within each kitchen.

The Jr. High School kitchen is equipped with a Reznor RGB-2[illegible]0 rooftop MAU. The unit delivers 2,000 CFM with a heating capacity of 200,000 (input) and a 12-inch cell deck evaporative cooler. 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.

Since the Jr. High School's kitchen was remodeled it has reportedly had insufficient cooling. A review of the original design drawings showed that two units with 4,020 CFM capacity were needed for cooling the space and the exhaust hood. 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.

The High School kitchen is not equipped with any type of cooling system and uses fans for ventilation and exhaust only. The lack of cooling at the High School kitchen results in a hot and uncomfortable work environment.

The proposed improvement for this project will install one new additional MAU of approximately 2,000 CFM to specifically serve the Jr. High School's kitchen space. The project will also install one new MAU of approximately 4000 CFM for the High School's kitchen space. The proposed units will 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.

Evaluated but not included

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The scope of work for this ECM is as follows:

1. Perform detailed engineering to determine the design heating and cooling loads.
2. Furnish and install the new MAU(s) and exhaust fan(s).
3. Furnish and install roof curbs and/or curb adapters as needed.
4. Furnish and install controls.
5. Furnish and install supply and return ductwork.
6. Furnish and install all required electrical equipment including wiring, conduit, circuit breakers and disconnects.
7. Coordinate work with the DDC controls project to provide for the proper sequence of operation for the control.

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 set-point control.

Equipment Information

Manufacturer and Type

The new MAU's will be Reznor or equivalent. The controls will be Invensys or equivalent.

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

Evaluated but not Included

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TRANSPORTATION BUILDING HEATER REPLACEMENT

Lennox Heating System

NORESCO proposes to furnish and install a new natural gas heating system at the District's Transportation Building.

The Transportation Shop is currently heated with a fuel oil fired furnace. The unit is located on the shop floor and is ducted throughout the shop areas. Table 5.6 provides details on the unit.

Table 5.6. Transportation shop furnace	
Location	Transportation
Building	Shop
Manufacturer	Applied Air Systems, Inc.
Model No	021FN-65
Capacity	750,000 BTUH Input

Evaluated but not Included

This unit currently burns fuel oil. The unit uses a large amount of valuable floor and wall space that cannot be used for other productive purposes. The unit has also reached the end of its service life.

NORESCO proposes to furnish and install five new high efficiency unit heaters with a combined capacity equal to or greater than the existing unit. Four units would be located near the ceiling of the shop near each corner of the space. The fifth unit would be located in the wash bay.

Each heater would be equipped with a programmable thermostat that has a door interlock. The purpose of the interlock is to turn off the unit heater if the door remains open for an extended period of time, (typically 5 minutes).

Natural gas service will be extended from the gas meter to each of the individual units.

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The scope of work for this ECM is as follows:

1. Provide detailed engineering and design.
2. Demolish and remove the old oil furnace and ductwork.
3. Furnish and install the unit heaters, programmable thermostats, door interlocks, and natural gas pipe extensions.
4. Furnish and install all necessary electrical power including conduit, wiring, circuit breakers, disconnects, etc.
5. Churchill County School District will remove and dispose of the existing fuel oil tank serving the heating system.
6. Provide start-up and commissioning services.

Impact on Facility Operations and Performance

The installation of the unit heaters will result in reduced annual energy use. The new units will also provide for redundancy where none currently exists with the singe furnace. The additional of door interlocks and programmable thermostats would provide additional savings. Conversion to natural gas will reduce operation and maintenance costs and exhaust emissions from the old fuel oil furnace.

Equipment Information

Manufacturer and Type

The new unit heaters would be manufactured by Lennox or equivalent.

Environmental Issues

No adverse environmental impacts are expected. This project will eliminate the use of fuel oil for the existing heating system, and the potential for leaks or spills associated with its use. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

Evaluated but not Included

WINDOW UPGRADES/REPLACEMENTS

Jr. High School Cafeteria

West End Elementary School

The maintenance staff at CCSD emphasized the need for repair, upgrade, and/or replacement on the windows in multiple schools. During the site visit, NORESCO validated this concern. The existing exposed windows at Churchill County School District are comprised mostly of windows with fixed, single pane glazing, aluminum frames and operable window sashes. Most of the windows are part of the original building construction and many of the frames have gaps allowing air to infiltrate into classrooms. Infiltration is a particular problem at many of the schools, where the existing original window frames are past their useful life.

Based on existing conditions and the constructability issues surrounding each window project, NORESCO has identified four schools for installation of high efficiency windows:

- EC Best Elementary School
- Northside Elementary School
- West End Elementary School
- CCSD Junior High School (All buildings on campus except new addition)

The existing glazing is inefficient, with a U-factor of about 1. This allows a substantial amount of heat to transfer out through the glass during the winter months, and into the space during summer months. Therefore, this glazing system allows much of the sun's radiant heat to penetrate, making building occupants uncomfortable in perimeter areas.

Table 5.7 provides a list of the windows identified for replacement under this project.

Table 5.7. Window replacement scope of work.

School	Number of Windows to be Replaced	Window Area [ft^2]
EC Best	112	1,466
Northside	105	2,411
West End	174	4,027
JHS	220	4,894
Totals	611	12,798

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NORESCO proposes to replace the existing window system in the buildings with a new energy efficient design. The new windows will be comprised of double-pane, low emissivity ("low-e") glazing with new interior and exterior vinyl trim. The glazing will be tinted to improve shading properties and aesthetic appeal, and the facility personnel will be consulted regarding tinting color options.

The new glazing will have a U-factor of 0.35, which will reduce the conduction heat transfer considerably. The glazing will have a shading coefficient of 0.41. Compared to the existing glazing, with a shading coefficient of 1.0, the new glazing will reduce the solar radiant heat gain by about 59%.

Apart from energy savings, implementation of this measure will improve the aesthetic appeal of these buildings remarkably. The occupants will benefit from improved comfort, especially when seated near the windows. The new interior aluminum trim will improve the interior aesthetics of the windows as well.

The proposed windows shall meet the following minimum requirements:

- Transmittance % Daylight – 37, Solar – 17, UV – 50
- Reflectance exterior, Daylight – 47, Solar – 50
- Winter Night Time U-Value - 0.30
- Summer Day Time U-Value - 0.33
- Shading Coefficient - 0.41
- Relative Heat Gain - 60 (BTU's/Hr/ft²)

The scope of work for this ECM is summarized as follows:

1. Remove or retrofit existing windows and install new vinyl or Aluminum high-performance rated windows. Larger openings will require Aluminum due to vinyl sizing limitations.
2. Provide and install, double-pane, low-e glazing
3. New glazing shall utilize existing window openings and shall be secured with new vinyl framing
4. On larger areas with walls of glass, the upper panels will be an opaque glass to reduce light and heat penetration
5. New frames (interior and exterior) shall be vinyl with thermal break.
6. All edges of the new window system adjacent to the surrounding construction shall be caulked in sufficient quantities with a high-grade commercial sealant, to form a weather tight seal.
7. Dispose of all old windows and other construction debris.

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Impact on Facility Operations and Performance

The most notable impact of this measure will be improved comfort along the perimeter of the building. In winter, building occupants will experience warmer temperatures near the glass surface. In summer, reductions in both solar gains and glare will be appreciated.

The new window system will be configured with in-fill panels, glazing sections and operable window sashes to fit properly and closely match the existing conditions. The new window system will have operable window sashes equipped with screens, and will operate in a similar fashion to the existing system.

Equipment Information

Manufacturer and Type

NORESCO plans to install window glazing by Anderson, Viracon, Southwall, Hurd, Alside or an equivalent manufacturer.

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

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EXTERIOR WATER SYSTEM IMPROVEMENTS

The existing canal irrigation system located to the south of the football field at Churchill County High School provides low cost water for irrigation of the football field and soccer field at present (See Figure 5.1 below). The system is tied to the City of Fallon water system at the north end of the football field. When the system was constructed, the irrigation piping was extended beyond the football field and stubbed up. The intent at that time was to extend the irrigation system to the existing east irrigation system to improve costs for overall irrigation.

NORESCO recommends the extension of the irrigation system from the existing stub near the football field to the irrigation system located directly to the East at the High School. In addition, a fan temperature control device will be installed on the variable speed drive (VFD) at the irrigation pump house.

NORESCO proposes to implement the following scope of work associated with this project:

- Extend the irrigation system piping approximately 300 feet to the east and tie it into an existing irrigation system.
- Install a backflow preventive device on the City connection to this system to allow irrigation from either source.
- Rely 100% on water from the Canal/City system. Remove the existing water meter for East Irrigation and eliminate district water to irrigate the fields. This would reduce overall costs and eliminate the need for the backflow preventative device at the interconnection location.
- Coordinate removal of meter with City of Fallon and verify adjustment to water/sewer bill.

Currently there are two 29 watt fans inside the VFD control box. These operate 24 hours a day when the VFD is "on line". NORESCO proposes to install a simple thermostat control device to the fans inside the VFD control cabinet to run fans only when temperatures are above design conditions specified by the VFD manufacturer.

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Impact on Facility Operations and Performance

If the east irrigation meter is removed, there may be requirements to manage the number of stations when using the City water system for irrigation from the field area. District maintenance personnel indicated there were problems with water pressure when more than one station is irrigated, so there may be a requirement to either manage the number of stations, or add a station to accommodate the east irrigation extension.

There should be the positive impact of extended fan life with installation of controls on the VFD fan.

Equipment Information

Manufacturer and Type

Required control elements will be Invensys or equivalent.

Water extension to utilize specified piping and interconnection devices in accordance with local city and state standards.

Environmental Issues

No adverse environmental impacts are expected. Energy savings will result in environmental benefits from reductions in greenhouse gas emissions.

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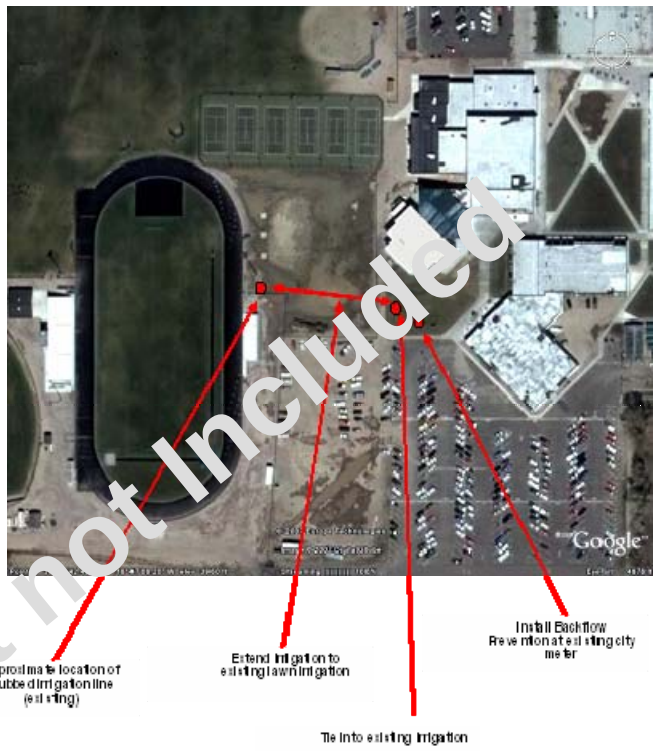
Figure 5.1. CCSD Irrigation Extension Project



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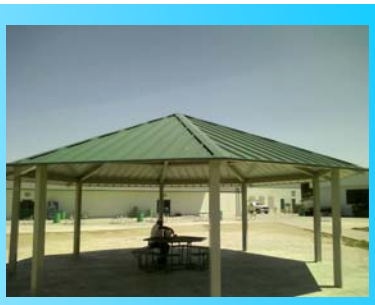
PHOTOVOLTAIC SYSTEM INSTALLATION



Demonstration Site for PV Installation

NORESCO recommends the installation of a project demonstrating the benefits of renewable technology for Churchill County School District. While installation of a photovoltaic system for interconnection and supply is not economically feasible, a small demonstration unit will provide educational opportunities for CCSD. The following photovoltaic system installation is recommended:

- Install a small photovoltaic system on the existing gazebo structure at Churchill County High School.
- The system will demonstrate how PV energy captured by the panels, converted from DC to AC and tied into the schools electrical system at the Science Building.
- Possibly utilize the students and teachers as part of a learning environment for construction, installation, and commissioning under the guidance of NORESCO.
- Tie the system via wireless communications to the Science Building and provide a system output monitoring device. The system can further be tied into an existing personal computer (PC) for educational purposes.

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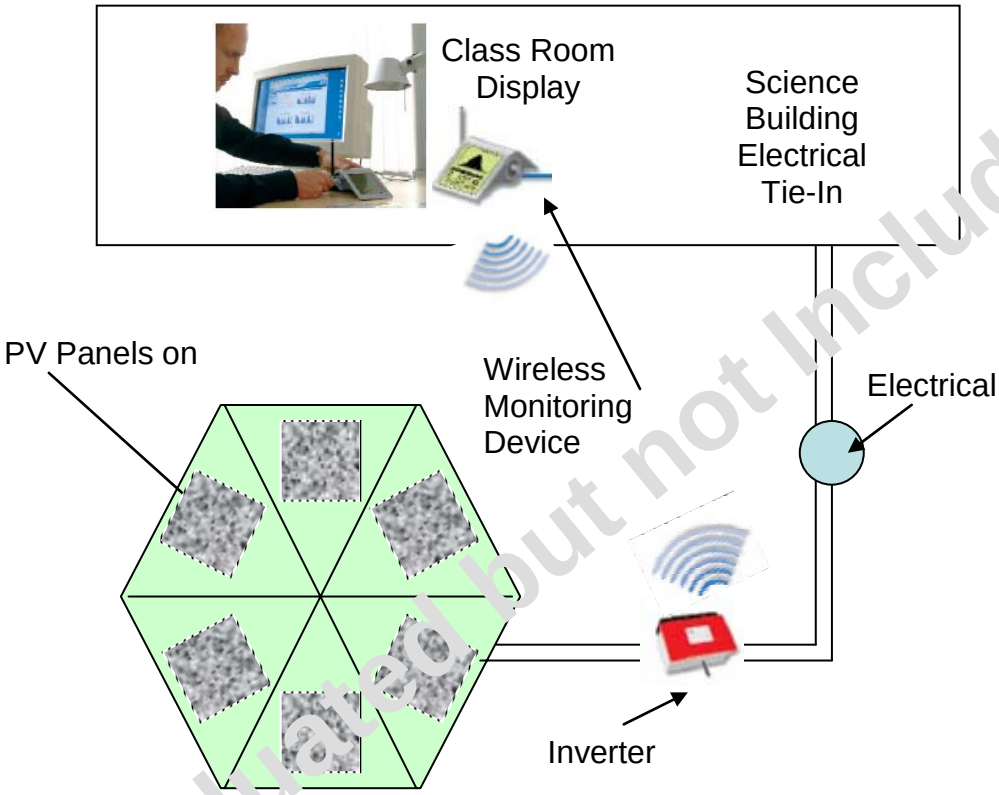
The following diagram provides a conceptual layout of the proposed project.

Figure 5.2. PV System conceptual layout.



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NORESCO proposes to implement the following scope of work:

- Install solar panels on the Gazebo roof panels. Each roof panel can be used to demonstrate the output of individual panels based on orientation to the sun depending on the final design.
- Solar panels will be framed or thin-film type, and will be secured to Gazebo to prevent movement and damage
- Solar panels will be rated for a system up to 500watts
- The solar panels', breakers, inverter, and wiring will be sized and in accordance with recognized codes and standards. Adequate electrical protection will be provided.
- Install one radio transmitter and receiver to provide download of solar output information to remote location. Install display device capable of providing data on the system.

Impact on Facility Operations and Performance

The demonstration facility should be integrated with student activities at the gazebo and be used for educational purposes. This project can also be integrated with renewable energy curriculum material as proposed with the ECM – Change for Savings Program.

Equipment Information

Manufacturer and Type

All panels and equipment will meet UL listing requirements and NEC specifications.

Environmental Issues

The system should be used to expand educational opportunities and understanding the benefits of renewable energy sources on the environment.

Evaluated but not included

GREENHOUSE LIGHTING SYSTEM INSTALLATION

Existing Greenhouse at High School

NORESCO recommends the greenhouse lighting system be improved to include appropriate artificial lighting for growing purposes.

Currently, the greenhouse does not have artificial lighting for growing purposes. There are two (2) halogen lights that are located in the center of the structure and provide access lighting only. The lighting is fed from an electrical panel located near the entrance door.

NORESCO proposes to implement the following scope of work:

- Install sixteen (16) fluorescent fixtures over the eight grow tables. Each fixture will contain two fluorescent lamps suitable for this application
- The fixtures will utilize Sylvania Gro-Lux growth lamps which will provide the necessary lighting vital for plant growth.
- Install two (2) electrical circuits, including breakers, wire, and light switches to feed the new fixtures.
- Replace two (2) halogen fixtures with compact fluorescent fixtures.
- A sketch of the proposed system is included in Figure 5.3 below.

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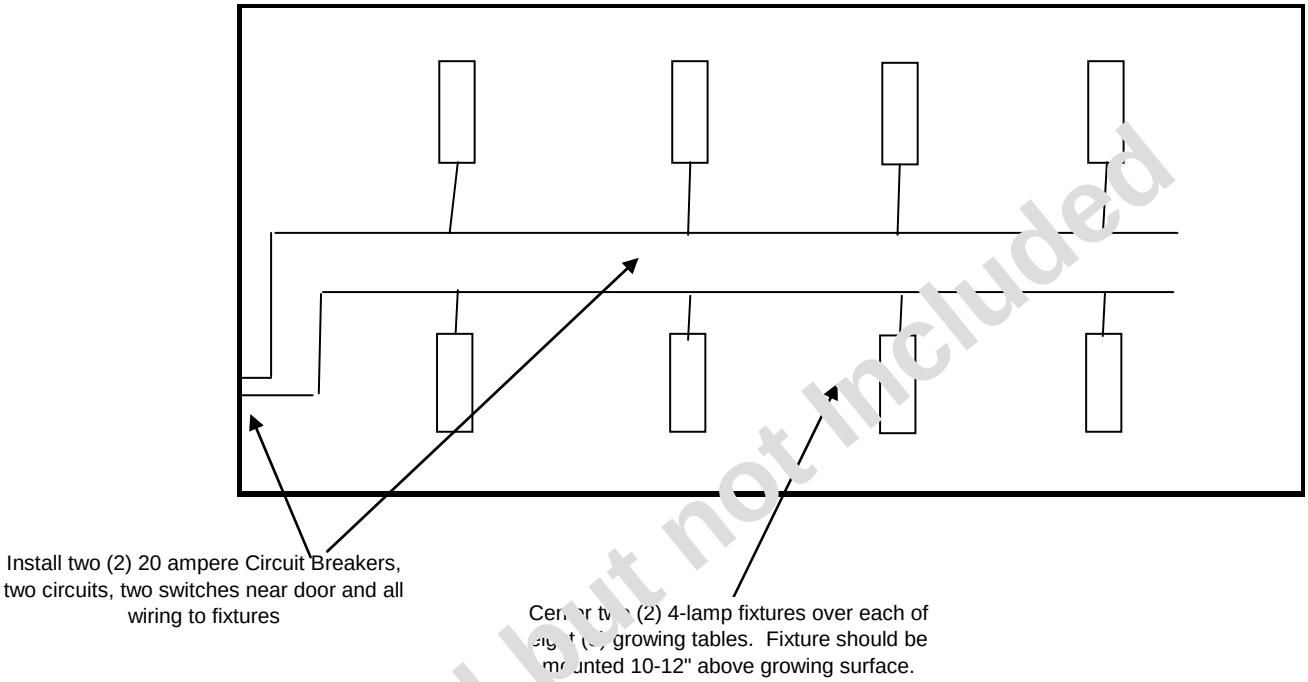
Figure 5.3. Proposed greenhouse lighting system installation.



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Impact on Facility Operations and Performance

During the installation, the facility may be impacted. This will include workers in the greenhouse during installation of the lighting fixtures and electrical infrastructure, and an outage for connection to the existing source of supply.

Please note the District requested that NORESCO investigate using existing 1,000 watt metal halide grow fixtures. NORESCO does not recommend using these existing fixtures for the following reasons:

- Initial installation costs will be significantly more expensive. Each fixture will require its own circuit resulting in additional wiring, conduit, circuit breakers, and installation of a new distribution panel.
- Ongoing maintenance costs will be significantly higher due to high costs of the 1,000 watt metal halide lamps (approximately $75 - $100 each).
- Annual electricity costs will be approximately $2,500, compared to $500 for the proposed system.

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) 418-507[illegible]

Ballasts:

- Advance Transformer Co.,·10275 West Higgins, Rosemont, IL, 60018, (708) [illegible]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[illegible] (800) BALLAST

Fixtures:

- 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.
- Amerillum, 2835 La Miranda Drive, Vista, CA, 92081, (877) 727-7675

Material Specifications

T12 Lamps: The new, medium bi-pin T12 lamps will be 3400k with up to 20,000 hours of average rated life and a Color Rendering Index of 85, and specifically designed for growing applications.

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 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

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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.

Environmental Issues

There are no adverse environmental issues associated with this ECM.

Evaluated but not Included

FACILITY OPERATIONS MANAGEMENT SOFTWARE

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.

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 5.11. 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

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

Table 5.12. 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 5.13. 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

Pricing for this ECM includes initial installation and setup of the SchoolDude modules identified above and use of the system for five years. Following Year 5, the District will be responsible for ongoing renewal fees.

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Impact on Facility Operations and Performance

There will be a positive impact on Operations due to automation and streamlining of the facility repair work order process. By automating the processing of work orders, maintenance staff will more effectively respond to requests for facility repairs.

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: 919-816-8227

Environmental Issues

There are no adverse environmental issues associated with this ECM.

Evaluated but not Included

CHANGE FOR SAVINGS PROGRAM

NORESCO's holistic approach toward performance contracting leverages the complex interaction between people and their environment to promote district members' participation in the energy efficiency process. To achieve the optimal benefit from newly installed high efficiency equipment and systems, in addition to generating added energy savings, NORESCO will create a custom-tailored "Changing for Savings" Program. This program is comprised of three components: (1) Awareness-Communication; (2) Green Schoolhouse Energy Education; and (3) Behavior Change Training. Using the inherent opportunity to "go green" within performance contracting, the Changing for Savings Program instills and sustains a culture of energy efficiency within the Churchill County School District (CCSD).

This measure is a cognitive-social based program that promotes cultural change by reinforcing energy conserving behaviors while discouraging energy wasting behaviors. It relies on a tested and proven process. The process assesses attitudes, social norms, control perceptions, knowledge, behaviors, and other aspects of energy use among teachers, staff, and students. Assessing these factors allows NORESCO to custom-tailor a program specifically for CCSD. Our program has multiple associated individual, organizational, and community benefits in addition to reducing energy consumption. These benefits occur while enhancing the educational learning experience and increasing CCSD sustainability.

Utilizing archival data, individual meetings, focus groups, and a behavioral survey, our program is designed to use existing mechanisms for targeting impactful energy wasting behaviors. It is also structured to enhance energy consumption knowledge and promote other energy efficiencies. Teachers and staff are often the logical focal group to participate in this program. Influential change agents are then trained in the use of seven behavioral change tools to effect targeted behavior change. The objective is to initiate and sustain an ever increasing culture of energy efficiency. Concurrently, hands-on educational activities for students, often created from the building retrofits themselves, strengthen and enhance academic learning. In this way, students also participate in the performance contract, while utilizing project-based instruction and tools to become better Earth stewards at an impressionable age. From a homework assignment, students bring family and community into the energy efficiency process, too. This holistic approach impacts all stakeholders within the CCSD through a well-received initiative – that of saving money and energy while upgrading existing structures – paid from energy savings.

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A brief description of CCSD's custom-tailored Changing for Savings Program follows.

Changing for Savings Program #1: Awareness-Communication

The Awareness-Communication component begins by informing all CCSD members about the purpose and benefits of the project, communicating the changes that can be expected resulting from the project, and providing a means for questions, concerns, and/or suggestions to be addressed directly to the project manager. Our process includes face-to-face meetings, lectures-workshops, and use of web sites, newspapers, and other communications media. Next, we disseminate information about the benefits of the project on a larger scale. This information is designed to enhance both internal and external perceptions of CCSD, which can lead to multiple positive outcomes. Communicating CCSD's enhanced environmentalism and stewardship of the Earth's resources, along with its increased competitiveness (due to decreased operating costs) can bolster confidence that organizational members are employed by a sustainable organization. In essence, because reducing pollution, decreasing natural resource consumption, and increasing operational efficiency are so universally well received, NORESCO wants to communicate this project's activities to the widest possible audience.

The goals of NORESCO's Awareness-Communication component are to:

- Inform members of CCSD's efforts to reduce operating costs, conserve natural resources, and provide more comfortable facilities.
- Ensure that those who will be affected by the changes are well informed and have had their views and issues addressed.
- Present an opportunity for interested individuals to interact or to incorporate sections of this program into their work and/or educational experience.
- Raise awareness of CCSD's energy consumption and conservation efforts through custom-designed promotional media while encouraging everyone to reduce personal energy use.
- Provide updates, changes, current status, and impacts of the ECM benefits and savings to an interested and aware audience.
- Generate awareness and recognition of CCSD's energy conservation activities and accomplishments to a regional and state-wide audience.

Changing for Savings Program #2: Green Schoolhouse Energy Education

The Green Schoolhouse Energy Education component makes use of the buildings' energy efficient retrofit activity occurring in an educational setting. Infusing green values in students at the same time the buildings in which they learn are becoming energy efficient is an exciting opportunity to engage students in the energy efficiency process. Utilizing hands-on, project-based instruction and tools will motivate students toward achieving a deeper understanding of what it means to be energy conscious. Similar to the old adage, "Let your actions speak for you;" NORESCO lets the buildings "speak" to the students. When students discover first-hand the impact of lighting upgrades, insulated windows, and automatically adjusted temperatures with set points, they realize that they are living in a daily lesson of what it means to be energy efficient.

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The goals of NORESCO's Energy Education component are to:

- Incorporate CCSD's existing conservation activities (i.e., recycling, student energy patrol, green team) into the Awareness-Communication activities.
- Offer components of the project to interested teachers, students, and clubs to facilitate conservation activities and enhance educational processes.
- Place energy and emission reduction displays on site at visible locations describing a specific ECM, how it functions, and how this ECM benefits CCSD students, teachers, staff, and the community at large.
- Create hands-on learning activities for students of all ages utilizing actual old and new technologies within their buildings.
- Provide educational classroom workshops describing in detail the benefits of specific ECMs for specific buildings.
- Create a "homework" activity that allows students to display and enhance their newly-learned energy efficiency knowledge, while possibly saving their parents money on their home energy bill.
- Assist and enhance the existing CCSD green curriculum.

Evaluated but not Included

Changing for Savings Program #3: Behavior Change Training

The Behavior Change Training component consists of a scientifically rigorous and well-documented process that is implemented in conjunction and cooperation with CCSD staff. First, a focal group is chosen who can influence a substantial amount of the District's energy consumption. Next, a Human Behavior Energy Audit collects data regarding energy consuming behaviors, knowledge, and the facilitators and barriers driving these behaviors. (A description of the Human Behavior Energy Audit and findings is included in Appendix F).

After data analysis, specific behaviors are targeted for change, guided by the enhanced understanding of environmental attitudes, social systems, control perceptions and knowledge of energy use among members of the CCSD community at large and the focal group specifically. Targeted behavior change and organization-wide supporting actions, in combination with the Awareness-Communication and Energy Education components, initiate and sustain this behavior change. Hence, a culture of energy efficiency that minimizes greenhouse gas emissions and maximizes CCSD's energy savings is established. A summary description of the Changing for Savings Program and a suggested timeline follow.

The goals of NORESCO's Behavior Change Training component are to:

- Incorporate CCSD's existing conservation activities and the Changing for Savings Program components into the focal group's daily activities.
- Target for change impactful energy consumption behaviors.
- Legitimize the focal group's influence in persuading others to change their energy wasting behaviors.
- Create awareness of the focal group's accomplishments to further generate widespread behavior change.

- Promote and recognize the focal group's individual members as energy efficiency leaders, while encouraging additional conservation activities.

Changing for Savings Program Implementation Schedule

December 2007

- Create and distribute initial announcement of the project to all organizational members, complete with a general overview, specific details of the ECMs, projected schedules, savings and benefits, and contact information for additional questions and/or issues.
- Meet with representative members @ 30-minute meetings to explain the ECMs and purpose of the project, solicit support and ideas, address questions and issues, put a face on the project, and leave contact information.
- Initiate a web-based energy survey to collect information relating to energy efficiency for the purpose of developing an energy efficiency campaign/program.
- Identify specific ECMs to highlight in the Green Schoolhouse Energy Education component.

January 2008

- Create and distribute a press release announcing the initial performance contract and/or write an article for CCSD school newsletters.
- Augment and incorporate CCSD existing energy conservation activities into press announcements and other promotional activities.
- Assist interested members in augmenting existing environmental activities or creating new ones.
- Work with CCSD school web site personnel to create a continuing information section or "box" displaying energy saved, pollution and emission reductions, scheduled changes, etc.
- Design, implement, and assess a custom-tailored Behavior Change Training program aimed at reducing energy consumption among the custodial staff.
- Create custom-tailored information kits: fact sheet, calendar, suggested action timeline, conservation posters, prompts/reminders, incentives, and promotionals. Create a "Champion" packet for emerging leaders to champion the conservation cause.
- Construct a display and/or other materials promoting NORESCO-led physical changes (e.g., before-after pictures for lighting, projected savings, emission reductions, etc.).

September 2008

- Post-survey a representative sample of focal group members.
- Analyze post program global and specific attitudes, social norms, perceived behavioral control, volitional energy consuming behaviors, motivational factors, barriers, future improvements, program satisfaction, and other suggestions.
- Write and submit recognition/award documents as appropriate.

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- Write report: executive summary, introduction, methodology, key findings, future directions and suggested modifications and appendices.

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ADDITIONAL PROJECTS EVALUATED (NOT INCLUDED)

BUILDING AUTOMATION CONTROLS UPGRADE

NORESCO investigated the potential to replace all of the existing Barber-Coleman Network 8000 DDC systems and components. Upgrades at the High School, Numa Elementary and the Cottages meet the financial criteria of this project and are included in the scope of work. Building Automation Controls Upgrades at the remaining CCSD facilities exceed the financial terms required under this program. However, many of the critical components for these systems are obsolete and will not be supported by the manufacture and support service companies within the next 1 to 2 years. Subsequently, CCSD will need to upgrade these systems shortly. The scope for these upgrades is described below:

Churchill County Junior High School

NORESCO proposes new DDC devices as follows:

- Furnish and install new LON Network thermostats on 23 rooftop packaged units.
- Furnish and install new LON Network thermostats for control of the HVAC systems located in the old and new annex buildings.
- Furnish and install new CO2 sensors and ventilation controls for the existing cafeteria units.

Northside, E.C. Best, West End and Lahontan Elementary Schools

NORESCO proposes to reuse the existing Network 8000 field devices and replace the existing GCM's with a new Invensys UNC controller. The upgrades are described as follows:

- Furnish and install new TSM space sensors
- Furnish and install a new UNC 520 to replace the GCM unit.
- Reuse the existing Network 8000 field devices.
- Furnish and install relays as need to control the DHW pumps.
- Provide a graphics page to allow teachers to adjust their room setpoints from their classroom computer.
- Modify the sequence of operation to incorporate Optimized Start-Stop, Occupied and Unoccupied setpoint control, and any other sequence upgrades that may be needed.

Administration

The programmable thermostats will be replaced with new LON communicating thermostats for proper control of the four existing packaged units. The Enterprise Server will be programmed for communication to the new LON thermostats.

Maintenance and Transportation

New programmable thermostats will serve all of the HVAC units on these buildings. The thermostats located in the Transportation Shop will be interlocked with the high bay doors to prevent the heaters from running if a door for that space is left open.

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BUILDING ENVELOPE IMPROVEMENTS

Northside Elementary School and Churchill County Jr. High School were also investigated for Building Envelope Improvements. These improvements provide relatively small energy savings, but will provide improvements to student and staff comfort. Many of the exterior doors in the buildings have significant gaps between the door and the jamb and between the door and sill. Some of the older doors do not close completely. In addition, the weather-stripping on even the newest doors is still inadequate to properly minimize infiltration. Infiltration can be caused by pressure differences due to wind, chimney (or stack) effect and mechanical systems, and is therefore the single largest source of heat loss or gain through a building envelope.

Additionally, during warm weather at Northside Elementary School, the attic insulation allows excessive heat gain causing comfort issues during these times of the year. The insulation in the ceilings or roofs at Northside Elementary, the Old Annex at the Junior High School, and in the auditorium of the Old High School is not adequate for energy efficiency.

The proposed improvements at these two schools are identified in the following table.

Table 5.14. CCSD Building envelope upgrade opportunities.

School	Total Doors for Weatherization	Insulation
Northside	41	X
Junior High School	65	X
Total	106	

The scope of work for this ECM is summarized as follows:

- Remove and replace weather-stripping on doors where existing weather-stripping does not form a complete seal. Installed weather-stripping shall be a closed cell sponge neoprene strip, 3/16" x 1/2". Weather-stripping shall be No. 312 as manufactured by Zero Weather-stripping Company or approved equal and
- Caulking – provide caulking where required. Caulking shall be one (1) component urethane non-sag (gun grade) material applied per the manufacturer's instructions. Caulking shall be by Sonolastic NPI, Sika Chemical Corp. or approved equal.
- Replace door sweeps on all doors where the existing sweeps are worn down or non existent
- Replace hinges on doors to allow for proper alignment and closure where required.
- Fasteners to be compatible to materials to which they come into contact. Cadmium plated fasteners shall be used on all exterior applications.

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NORESCO proposes to install insulation in the attic spaces at Northside Elementary and at the Junior High (Old Annex and inside the auditorium of the Old High School).

- Furnish all labor, equipment materials and appliances necessary to performing all operations in connection with installing specified insulation (ENERGYSTAR qualified batt-type rated at R-30 or higher).
- Re-install existing insulation as appropriate and install new insulation on top.
- Install new insulation in accordance with manufacturer's instructions.

INTERIOR WATER FIXTURE RETROFITS

NORESCO investigated the potential to implement Interior Water Fixture Retrofits at all CCSD facilities. Upgrades at the Jr. High School, E.C. Best, Northside, Numa and West End Elementary Schools meet the financial criteria of this project and are included in the scope of work. Interior Water Fixture Retrofits at the remaining CCSD facilities exceed the financial terms required under this program. However, implementing this ECM at the remaining District facilities will reduce the water usage and energy used for water heating.

The majority of the water fixtures at these remaining facilities do not use low flow flush valves and aerators. The existing water consumption could be reduced by an estimated 20 percent through the installation of these low flow devices on the remaining water fixtures. If implemented by CCSD, this ECM will replace or retrofit the conventional plumbing fixtures in the student, staff and public restrooms with new low-flow fixtures. This will include 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. The following is a description of the existing conditions and the work to be undertaken in each area:

Churchill County High School

The existing water fixtures at the Churchill County High School include both standard and low flow valves and aerators. Approximately 80 percent of the water closet flush valves are standard 3.5 gallons per flush (gpf) units, and 60 percent 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 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 – 2.5 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 0.5 gpm aerators.

Churchill County Junior High School

The existing water fixtures at the Churchill County Junior High School include both standard and low flow valves and aerators. Approximately 45 percent of the water closet flush valves are standard 3.5 gpf units, and 50 percent of the urinal flush valves are standard 1.6 gpf units. Sixty 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.

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.

Evaluated but not Included

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The existing urinals with standard 2.5 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 0.5 gpm aerators. Only the lavatory sinks in the Classroom 40-44 building currently have low-flow aerators.

Lahontan Elementary School

The existing water fixtures at the Lahontan Elementary School include both standard and low flow valves and aerators. All of the water closet flush valves are standard 3.5 gpf units, and all of the urinal flush valves are standard 1.6 gpf units. Sixty percent of the lavatory sinks use existing aerators that have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

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 restrooms and toilet rooms.

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the boys' and men's restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

The Cottages

The existing water fixtures at the Cottage School include both standard and low flow valves and aerators. All of the water closet flush valves are standard 3.5 gpf units, and the urinal flush valves are shared among multiple fixtures or use automatic timers. Forty 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.

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

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in all of the boys' and men's restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

Administration

The existing water fixtures at the Administration Building include both standard and low flow valves and aerators. All of the water closet flush valves are standard 3.5 gpf units. Fifty 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.

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 the restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

Maintenance

The existing water fixtures at the Maintenance Building include standard valves and aerators. All of the water closet flush valves are standard 3.5 gpf units, and all of the urinal flush valves are standard 1.6 gpf units. All of the lavatory sinks use aerators that have a higher flow rate (2.0 – 2.5 gpm) than currently available units.

Evaluated but not included

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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 the restrooms.

The existing urinals with standard 2.5 flush valves will be retrofitted with new low-flow 1.0 gpf flush valves. The new valves will be installed in one of the restrooms.

Lavatory sink faucets without aerators or with aerators providing 2.0 gpm or higher flow rates will be equipped with low-flow 0.5 gpm aerators.

Table 5.15 summarizes the quantities of plumbing fixtures that were identified for the remaining CCSD facilities.

Table 5.15. Proposed low-flow water fixtures.

School	Toilets	Urinal	Sink
Churchill County High School	83	52	54
Cottages School	15	[illegible]	6
Lahontan Elementary School	47	19	30
Administration/District Office	4	0	3
Maintenance Building	4	2	4
Total	153	82	97

Evaluated but not included

HIGH EFFICIENCY MOTOR INSTALLATION

NORESCO evaluated the replacement of several motors with high efficiency motors. These motors are summarized in the following table.

Table 5.16. High efficiency motor installation.

School	Motor Description	Horsepower
High School	Cooling Tower Fan	40
High School	Cooling Tower Fan	40
Numa	Cooling Tower Fan	40
Numa	Cooling Tower Fan	40
High School	Heat Supply Pump	60
High School	Heat Supply Pump	60
High School	Condenser Pump	20
High School	Condenser Pump	20

Based on the analysis performed for this measure, the simple payback period is in excess of twenty years. This is primarily due to difficult installation conditions associated with the cooling towers resulting in higher costs, and low operating run hours resulting in reduced savings.

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ELECTRICAL RATE SCHEDULE CHANGE

The District is provided electrical service by the City of Fallon under two rate schedules:

- Small commercial rate at $0.13576/kWh
- Large commercial rate (> 50kW) at $0.09348/kWh and $6.7166/kW

NORESCO evaluated the electric billing information and identified three accounts (2 at High School, 1 at E.C. Best) with monthly demand greater than 50kW and stilled billed under the small commercial rate. Unfortunately, the City of Fallon requires that a facility only be served by one electric meter to qualify for the large commercial rate. Since the High School and E.C. Best are each served by multiple meters, the City will not permit the change in rate schedules.

WASTE DISPOSAL PROGRAM

Currently the School District has its own waste collection system consisting of an older garbage truck with compaction. CCSD transports the waste to a local transfer station. For purposes of the analysis, CCSD provided an inventory, estimated annual fuel costs, annual maintenance costs, and current waste dump fees. Total annual fees are estimated at over $12,000 as summarized in Table 5.17.

Table 5.17. Existing waste disposal fees.

Description	Amount	Units	Unit Cost	Annual Cost
Fuel	1,200	Gallons	$2.21	$2,652
Maintenance	N/A	N/A	$1,172	$1,172
Vehicle Fees	N/A	N/A	$200	$200
Transfer Fees	38	Trips	$225	$225
Total Annual Cost				**$12,754**

Evaluated but not Included

Please note the annual cost summarized above does not include District internal labor costs, or future costs of replacing the District garbage truck. The estimated cost of purchasing a used truck is approximately $100,000, or $25,000 to $30,000 annually if financed over five years.

One alternative to using internal District resources is to have the City of Fallon perform garbage disposal services. Based on a preliminary analysis of City rates, the annual cost of using City of Fallon garbage disposal service is in the range of $200,000 to $300,000. Annual costs will be in the low end of this range if compactors are used to reduce the quantity of pickups.

There is no question that the current scenario has the lowest annual cost, and benefits the District. Based on discussions with District staff, the existing garbage truck functions well and can operate for many years with proper maintenance. If and when the District requires the purchase of a new garbage truck, the City of Fallon option should be re-evaluated based on current economic conditions. At that time, the costs of a recycling program should also be considered.

Section 6.0
ENERGY STAR Program

OVERVIEW

By performing the energy system upgrades proposed in this report by NORESCO, Churchill County School District can expect that multiple schools will qualify for ENERGY STAR certification. The certification is a symbol of energy efficiency that is awarded to facilities that are among the top 25 percent of energy efficient buildings in the entire nation.

Earning the ENERGY STAR is evidence of your social responsibility to the community and your district's commitment to reduce its impact on the environment. By displaying the ENERGY STAR, a school shows that it is one of the top performing schools for energy efficiency nationwide. On average, ENERGY STAR certified buildings use about 35 percent less energy than average buildings - in some cases up to 50 percent less! This certification sends the message to students and parents of the community that the district values the environment, responsible energy use, and prudent financial policies that maintain the best occupant comfort levels and minimized operating costs. The ENERGY STAR program allows for continuous performance tracking which can be used to justify future energy system improvements to the district which will increase the ENERGY STAR rating and reduce operating costs.

Being a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy, the EPA helps highlight your achievements within your organization and to the public. Each year in January or early February, EPA releases information about buildings that have earned the prestigious ENERGY STAR to the press and involves organizations with buildings that have earned the ENERGY STAR in its media activities. Within the ENERGY STAR buildings program, it is also possible to earn public recognition as an ENERGY STAR Partner or Leader, or to earn a nationally recognized Partner of the Year Award.

ABOUT THE PROGRAM

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping us all save money and protect the environment through energy efficient products and practices since 1992. Results are already adding up. Americans, with the help of ENERGY STAR, saved enough energy in 2006 alone to avoid greenhouse gas emissions equivalent to those from 25 million cars — all while saving $14 billion on their utility bills.

ENERGY STAR buildings are rated based on a comparison of energy use with other, similar types of buildings. In this case the energy usage of schools in Churchill County School District would be compared with the energy usage of other K-12 schools throughout the nation. The basis of the criteria is benchmarking building energy consumption on a scale of 1 to 100. Buildings that are among the top 25 percent nationwide in terms of energy performance (earning a benchmarking score of 75 or

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greater) and maintain an indoor environment that conforms to industry standards can qualify to receive the ENERGY STAR label for buildings. The existing building and utility data is used to establish a baseline rating of energy performance and the post-improvement utility bills will demonstrate the improved performance. By improving the performance to a rating of 75 or greater for a specific school, it may qualify for an ENERGY STAR certification.

NORESCO tracked existing and proposed energy performance for all of the Churchill County School District facilities using the Environmental Protection Agency and the Department of Energy's web-based software tool called "ENERGY STAR Portfolio Manager". This tool provides an independent building rating that allows an owner to see how their school performs against national standards. Should the school qualify, the owner can apply for an Energy Star Label and receive recognition for the energy efficiency of their school. To be eligible to receive an energy performance rating on EPA's Portfolio Manager, K-12 Schools must meet the following criteria:

1. At least 50% or more of the facility's gross floor area (not including Garages and Parking Lots) must be comprised of an eligible space.
2. The gross floor area must be greater than or equal to 5,000 square feet, but no more than 1,000,000 square feet.
3. The facility must have been occupied for at least 8 of the last 12 months.
4. The floor area of all Computer Data Center space(s) cannot exceed 10% of the total building space (not including Garages and Parking Lots).
5. The floor area for all "Other" space types cannot be greater than 10% of the facility's gross floor area. Gross floor area includes the floor area for all space types excluding Garages and Parking Lots.
6. The floor area of all Garages cannot exceed 100% of the gross floor area of the entire facility.
7. The facility must be operating 35 or more hours per week.
8. The facility must contain at least 1 student, but no more than 1,000,000 students.
9. The facility must contain at least 1 personal computer, but no more than 250,000 personal computers.
10. At least 11 full consecutive calendar months of user-entered energy data must be present for all active energy meters in the facility. If there is more than one energy meter, these months must be overlapping.
11. No individual electrical meter entry can be greater than 65 days during the 12 month evaluation period.
12. At least 11 full consecutive calendar months of user-entered space attribute data must be present for at least one primary space in the building.

Once a school is deemed eligible, the following information, in addition to utility data, is required for performance analysis of a K-12 School Space:

- Zip code
- Gross floor area
- Weekly operating hours
- Number of students
- Number of months in operation
- Percent of the gross floor area of this space that is air-conditioned

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- Percent of the gross floor area of this space that is heated
- Number of personal computers
- Presence or absence of on-site cooking facilities
- Presence or absence of mechanical ventilation

This is the data that is used to compare the school with other schools around the nation that are different in terms of the local climate, size, operation, occupancy, and installed equipment.

Once the rating of 75 or higher has been met, a Professional Engineer must verify the Statement of Energy Performance (stamped/embossed and signed) that each of the indoor environment criteria requirements have been met. These criteria are the control of indoor air pollutants, adequate ventilation, thermal conditions, and adequate illumination. This Professional Engineer must be licensed in the state where the building is located.

SAMPLE ENERGY PERFORMANCE ANALYSIS

The ENERGY STAR portfolio manager bases energy performance on utility (electric, gas, water) data collected over time. The program automatically establishes a baseline benchmark of building performance from the existing utility data. After energy system improvements are implemented the new utility bills must be entered into the program to track the improved performance. Once the performance reaches the top 25 percentile the building may qualify for certification.

A great feature of the portfolio manager software is that it allows for the tracking of data from several meters. If different buildings at the same site, such as the gym at the junior high school, receive upgraded energy using equipment their performance can be tracked separately.

After performing the energy savings calculations for all the suggested energy conservation measures, NORESCO used the portfolio manager software to determine the pre and post construction performance of Churchill County Schools. A three year average of monthly energy usage (electric and gas) was developed based on the utility data that was provided from 2004-2006. This was the utility data, used side by side with building size and occupancy data, that portfolio manager used to develop its own baseline rating of each school. The actual performance rating of each school will depend on its actual future utility bills. In lieu of future utility data, NORESCO input proposed energy usage based on the three year average less the proposed savings for each month. The results of the portfolio manager analysis are summarized for three schools in the following table:

Table 6.1. Sample rating results.

School	Baseline Rating	Post Retrofit Rating
Churchill County High School	48	78
Churchill County Junior High School	70	80
Lahontan Elementary School	81	90

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This table shows that there is room for improvement throughout the range of schools from oldest to newest. Based on the preliminary ratings of these schools NORESCO believes that others may also be eligible for ENERGY STAR certification and the benefits it confers upon the recipient.

STEPS TO CERTIFICATION

Table 6.2. ENERGY STAR certification steps.

Step	Status
1. Determine if the building meets the eligibility requirements.	Completed
2. Login to Portfolio Manager and enter the existing data to establish the baseline rating	Completed
3. Login to Portfolio Manager and enter the post-retrofit data to establish the upgraded rating (to be complete by December 2009).	To be completed
4. Determine if the building achieves a rating of 75 or above.	To be completed
5. Determine if the building meets industry standards for comfort and indoor air quality. A Professional Engineer must verify the Statement of Energy Performance (stamped/embossed and signed) that each of the indoor environment criteria requirements have been met. This Professional Engineer must be licensed in the state where the building is located. Exception: Professional engineers employed by the Federal government may evaluate any buildings located in the United States that are owned or primarily occupied by the Federal government. Contractors and consultants to the Federal government, however, are not covered by the exception.	To be completed
6. Read and understand the ENERGY STAR Identity Guidelines.	To be completed
7. Mail the signed Letter of Agreement and signed and stamped Statement of Energy Performance (SEP) to EPA (postmarked within 120 days of the Period Ending Date). Please note: an official Letter of Agreement will be provided for download in Portfolio Manager. Do not mail to EPA a Letter of Agreement that displays a watermark that reads SAMPLE. Please do not use company letterhead to print the Letter of Agreement.	To be completed

NOTE: ENERGY STAR is awarded for a specific year. A building that has earned the ENERGY STAR becomes eligible to reapply one year after the last energy data included in the SEP submitted as part of the previous year's application.

ENERGY STAR Label for Buildings

c/o SRA International, Inc.

3434 Washington Blvd.

Arlington, VA 22201

Section 7.0
Measurement and Verification

OVERVIEW

NORESCO has developed a site specific Measurement and Verification (M&V) plan for Churchill County School District based on a cost benefit analysis that balances the costs associated with M&V protocols compliance to the overall savings benefit to the District. NORESCO places great emphasis on the measurement of results and takes pride in the performance of our past projects. Ultimately, we want to agree upon an M&V plan that will clearly measure the results and protect the District from under-performing projects. Because the District is in effect paying for M&V, we feel the plan should be simple to understand and cost effective. The purpose of the M&V plan is to determine the change in overall energy (electricity, natural gas and water/sewer) costs that have resulted from the energy savings project. In general, the energy savings will be calculated by comparing the energy and water usage based on the procedures defined in the M&V plan with a projection of what would have been consumed if no conservation had been undertaken. The dollar savings will be calculated based on the Table 7.3, Base Utility Rates. NORESCO designs its M&V plans for all projects based on the International Performance Measurement and Verification Protocol (IPMVP), the most current industry standard. Table 7.1 outlines the four IPMVP Options.

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 annually.	Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data.
B	Savings are determined by field measurement of the energy use of the system to which the ECM was applied, separate from the energy use of the rest of facility. Short-term or continuous energy measurements are taken throughout the post-retrofit period.	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.

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To maximize the amount of investment that the District can make in its building infrastructure with this program, NORESCO has provided an M&V plan with minimal cost impact while still verifying the efficiency of the equipment installed. This program is tailored specifically to the recommended ECMs.

This M&V plan provides a detailed description of the calculation of energy savings, and provides the documentation for verification of energy savings following implementation of the ECMs. This M&V plan is part of an attachment (Attachment DD: Financial-Grade Operational Audit) to the Performance-Based Contract. The Performance-Based Contract includes the definitions and terms associated with this M&V plan.

M&V DEFINITIONS

The following M&V definitions are described in the Performance-Based Contract:

- Accumulated Energy Savings
- Accumulated Realized Savings
- Base Utility Rates
- Commissioning Plan
- Energy Conservation Measure (ECM)
- Facilities
- Fiscal Year
- Initial Commissioning and Post-Installation M&V Report
- Final Commissioning and Post-Installation M&V Report
- IPMVP
- Measurement and Verification Plan (M&V Plan)
- Measured and Verified Savings (M&V Savings)
- Operating Cost Savings (OC Savings)
- Performance Period
- Stipulated Savings

M&V TERMS

The following M&V terms are defined in the Performance-Based Contract:

- ECM/OCS Measures (Section 4 of Performance-Based Contract)
- Operation (Section 5 of Performance-Based Contract)
- ECM/OC Savings and Commissioning Report (Section 6 of Performance-Based Contract)
- Savings Coverage/Guarantee (Section 7 of Performance-Based Contract)
- General Annual Report (Section 8 of Performance-Based Contract)

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ACCUMULATED ENERGY SAVINGS

Table 7.2 includes the annual electricity, natural gas and water/sewer savings for the ECMs included in this program, and defines the Accumulated Energy Savings. The methods described in this M&V Plan will be used to determine the Accumulated Realized Savings. Accumulated Realized Savings will be reported in the Final Commissioning and Post-Installation M&V Report and compared to the Accumulated Energy Savings per the requirements of the Performance-Based Contract.

Table 7.2 Accumulated Energy Savings.

ECM	Electricity (kW-mo)	Electricity (kWh)	Natural Gas (therms)	Water/ Sewer (kgal)
Lighting System Upgrades	2,775	779,602	(8,408)	-
High Bay Lighting Upgrades	252	86,880	(1,029)	-
Lighting Controls Improvements	-	25,229	-	-
Building Automation Controls Upgrades	-	285,367	12,088	-
Replace Heat Pumps with Packaged Units	-	99,246	1,322	-
Cooling Tower Fan VFD Installations	-	15,036	-	-
Building Envelope Improvements	-	18,817	3,148	-
Interior Water Fixture Retrofits	-	-	990	3,878
Transformer Replacements	-	63,334	-	-
Network Power Management	-	232,107	-	-
ACCUMULATED ENERGY SAVINGS	3,027	1,605,618	8,111	3,878

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BASE UTILITY RATES

The utility rates used for calculating annual cost savings are presented in Table 7.3. These rates are applied to the ECM savings at each facility to determine annual cost savings.

Table 7.3 Base Utility rates

Facility	Electricity		Natural	Water/Sewer
	Demand ($k/kW)	Usage ($/kWh)	Gas ($/Therm)	Service ($/kGal)
Churchill County High School	$2.3974	$0.1240	$1.2008	$2.9813
Churchill Jr. High & Lahontan Valley H.S.	$6.7116	$0.09348	$1.20081	$2.9813
E.C Best	$6.7116	$0.09348	$1.20081	$2.9813
Lahontan Elementary	$6.7116	$0.09348	$1.20081	$2.9813
Northside Elementary	$0.0000	$0.13576	$1.20081	$2.9813
Numa Elementary	$6.7116	$0.09348	$1.20081	$2.9813
West End Elementary	$6.7116	$0.09348	$1.20081	$1.4305
Cottages	$0.0000	$0.13576	$1.30358	$2.9813
Administration	$0.0000	$0.13576	$1.30358	$1.4305
Transportation	$0.0000	$0.13576	$1.44594	$2.9813
Maintenance	$0.0000	$0.13576	$1.30358	$2.9813
Warehouse	$0.0000	$0.13576	$1.30358	$0.0000

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PROJECT M&V PLAN

NORESCO will perform verification tasks during the installation and commissioning phases of the implementation in order to inspect, validate and quantify each ECM included in this M&V plan. Following construction, the Final Commissioning Report will be issued and provide a summary of M&V activities and ECM performance. This report will document the Measured and Verified Savings (M&V Savings).

In addition, an Annual Report will be completed for the first 5 years of the Performance Period. The Annual Report will consist of a high-level utility data review and field inspections of a representative sample of measures to validate that the savings are persisting as described in the Final Commissioning Report. During the field inspection, any issues relating to equipment performance or operating procedures that impact savings will be documented and shared with CCSD. If warranted, NORESCO will provide maintenance procedure updates to reinforce the original training provided at the project close out.

Table 7.4 contains a summary of the M&V methodology that NORESCO intends to document the M&V Savings.

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Table 7.4: Churchill County School District – M&V Plan Summary				
ECM List and Description	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
Lighting System Upgrades, High Bay Lighting System Upgrades (Option A)				
Installation of energy efficient lighting system including new and retrofitted lighting fixtures	Stipulate fixture wattage for the lamp/ballast combinations identified during the site survey. Monitor operating hours of classrooms in use during summer school and first two weeks of school. Evaluate and apply results of monitoring to applicable areas.	Stipulate fixture wattage for new lamp/ballast combinations. Operating hours determined from during baseline conditions. Verified savings will be adjusted to reflect final quantities and pre- and post retrofit fixture wattage measurements.	Post-construction verification of savings. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	Baseline and Post Installation Fixture Wattages, Extrapolation of Sampled Operating Hours, Demand Savings Coincidence Factor.
Lighting Controls Upgrades (Option A)				
Installation of occupancy sensors	The baseline for the occupancy sensors will be based on the post-installation energy use for the High Bay Lighting System Upgrades.	Post-installation operating hours determined from baseline operating hours and agreed upon Operating Hours Reduction Factor of 25%. Verified savings will be adjusted to reflect final quantities of occupancy sensors.	Post-construction verification of savings. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	Baseline and Post Installation Fixture Wattages, Extrapolation of Sampled Operating Hours, Operating Hours Reduction Factor.
Building Automation Controls Upgrades (Option A)				

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Table 7.4: Churchill County School District – M&V Plan Summary				
ECM List and Description	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
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.	Survey of mechanical systems and interviews with facility personnel to establish baseline occupied and unoccupied hours and temperatures. Monitor maintained temperature setpoints for classrooms in use during summer school and first two weeks of school. Extrapolate to remaining classrooms. Verify calculated baseline usage based on sampled temperature setpoints. Calibrate to annual utility consumption.	Commissioning of EMS hardware and software. Verify that proposed strategies are operating as intended (i.e., unoccupied setback schedules and temperatures). Monitor maintained setpoints for same classrooms measured during baseline conditions. Verify calculated post implementation usage based on sampled setpoints (Standards of Operation).	Post-construction verification of savings. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	Weather data, building loads, HVAC equipment efficiency, airflow, occupancy schedule, and hours of operation.
Replace Heat Pumps with Packaged Units (Stipulated) **Cooling Tower Fan VFD Installations (Stipulated)** **Building Envelope Improvements (Stipulated)**				

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Table 7.4: Churchill County School District – M&V Plan Summary				
ECM List and Description	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
Various mechanical and building envelope projects.	Calculate baseline usage based on stipulated values.	Calculate post installation usage based on stipulated values.	Post-construction, verify equipment installed as intended and operating as designed. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	Weather data, building loads, HVAC equipment efficiency.
Interior Water Fixture Retrofits (Option A)				
Installation of water conserving devices for interior plumbing fixtures.	Measure baseline fixture consumption on a representative sample of devices.	Measure post-retrofit fixture consumption on a representative sample of devices. Verified savings will be adjusted to reflect final quantities and pre- and post retrofit fixture measurements.	Post-construction verification of savings. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	Number of occupants, occupancy schedule, and fixture use per day.
Transformer Replacements (Option A)				

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Table 7.4: Churchill County School District – M&V Plan Summary				
ECM List and Description	**Baseline M&V**	**Post Installation M&V**	**Duration of Monitoring**	**Other Stipulated Variables**
Replacement of selected distribution transformers at Churchill County High School.	Calculate baseline usage based on stipulated values.	Calculate post installation usage based on stipulated values.	Post-installation, verify equipment installed as intended and operating as designed.	Equipment efficiency, load factors and operating hours.
Network Power Management (Option A)				
Install Verdiem software to monitor and optimize sleep modes in networked personal computers.	Calculate baseline usage based on quantity of PCs and monitors, and manufacturers data on energy use; and baseline operating hour data analysis as calculated by Verdiem software.	Calculate post-installation usage based on quantity of PCs and monitors, and manufacturers data on energy use per baseline data. Verified savings will be adjusted to reflect final PC quantity. Post-installation operating hour data analysis as calculated by Verdiem software.	Post-construction verification of savings. Inspection, equipment verification and reporting for years 1 through 5 of financing term.	District agrees to maintain power management strategies; and provide access to network resources for the purpose of obtaining data for Verdiem software reports.

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LIGHTING SYSTEM UPGRADES
HIGH BAY LIGHTING SYSTEM UPGRADES

SAVINGS VERIFICATION METHODOLOGY

The energy savings from this ECM result from upgrading older lighting components with new energy efficient lighting components. The savings are calculated and fully documented in the Appendix A of this report.

Table 7.5 demonstrates the lighting system operations hours that were used to calculate energy consumption of existing and post-retrofit lighting systems. Please note that loggers were installed on representative lighting systems and the results of this process are included in Appendix E. This information was used to validate operating hours of the most common areas (classrooms, gym, cafeterias, hallways) and, where indicated in Table 7.5, was used in the calculation of energy consumption of existing and post-retrofit lighting systems. These calculations also utilized the information in Table 7.6 (Pre Wattage per Fixture) and Table 7.7 (Post-Wattage per Fixture). Tables 7.5, 7.6 and 7.7 represent the primary data utilized in the lighting calculations. This information was reviewed and accepted by the District and 3rd Party Engineer during the meeting on September 19, 2007.

Table 7.5 Lighting system operations hours

Facility	Room	Hours	Period	HPD	DPY	Comments	Extra HPD	Extra DPY	Annual Hours	Logger Hours	Peak Demand Factor
ALL	Administrative Office Areas (reception areas, open office areas, copy rooms, workrooms)	7:00AM - 5:00PM	Mon-Fri	10	250				2,500	n/a	95%
ALL	Bathrooms (smaller toilet rooms)	Intermittent On/Off	Mon-Fri	4	183				732	n/a	50%
ALL	Cafeterias/Lunch Rooms	7:00AM - 5:00PM	Mon-Fri	10	180	Special Events	6	30	1,980	2,580	90%
High School/Jr. High	Classrooms	7:00AM - 4:00PM	Mon-Fri	9	180	Cleaning	1	180	1,800	1,772	80%
Elementary/ Cottage	Classrooms	7:00AM - 3:00PM	Mon-Fri	8	180	Cleaning	1	180	1,620	1,772	80%
ALL	Conference Rooms	Intermittent On/Off	Mon-Fri	5	250				1,250	n/a	50%
ALL	Multi-Purpose/ Gymnasiums	7:00AM - 5:00PM	Mon-Fri	10	200	Extra Curricular	4	125	2,500	2,945	90%
ALL	Hallways	6:00AM - 6:00PM	Mon-Fri	12	250				3,000	2,197	95%
ALL	Janitor's Rooms	2:00PM - 6:00PM	Mon-Fri	4	250				1,000	n/a	50%
ALL	Kitchens	5:00AM - 2:00PM	Mon-Fri	9	180				1,620	n/a	90%
ALL	Libraries	7:00AM - 4:00PM	Mon-Fri	9	180	Cleaning	1	180	1,800	n/a	95%

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Table 7.5 Lighting system operations hours											
Facility	Room	Hours	Period	HPD	DPY	Comments	Extra HPD	Extra DPY	Annual Hours	Logger Hours	Peak Demand Factor
ALL	Lobbies / Emergency Lights	12:00AM - 12:00AM	Mon-Sun	24	365				8,760	n/a	100%
ALL	Locker rooms	7:00AM - 3:00PM	Mon-Fri	8	180	Extra Curricular	3	200	2,040	n/a	80%
ALL	Lounges (faculty lounges, faculty workrooms, break rooms)	8:00AM - 4:00PM	Mon-Fri	8	180				1,440	n/a	80%
ALL	Mechanical Rooms	Intermittent On/Off	Mon-Fri	2	260				520	n/a	20%
ALL	Offices (individual, private offices)	7:00AM - 5:00PM	Mon-Fri	10	250	Off when unoccupied	-2	250	2,000	n/a	80%
ALL	Outside (exterior lighting on timers)	6:00PM - 12:00AM	Mon-Sun	6	365				2,190	n/a	0%
ALL	Restrooms (larger, multi-stall restrooms)	7:00AM - 5:00PM	Mon-Fri	10	250				2,500	2,801	80%
ALL	Shops (woodshops, metal shops, etc)	7:00AM - 3:00PM	Mon-Fri	8	250				2,000	n/a	80%
ALL	Storage Rooms	Intermittent On/Off	Mon-Fri	2	260				520	n/a	20%
Lahontan Valley H.S.	2nd Floor (seldom used)	Intermittent On/Off	Mon-Fri	1	100				100	n/a	10%

Table 7.6 demonstrates the pre lighting wattage per fixture type that was used to calculate energy consumption of existing lighting systems.

Table 7.6 Pre wattage per fixture			
Pre Code	Qty	Existing Description	Watts
CFDRUM22/32	6	Compact Fluorescent Drum 1-22 & 1-32 watt Circleline Lamps	60
CFDRUM32	1	Compact Fluorescent Drum 1-32 watt Circleline Lamp	35
CFLDL213	2	Compact Fluorescent Downlight 2-13 watt	30
CFLDL218	34	Compact Fluorescent Downlight 2-18 watt	40
CFLDL226	4	Compact Fluorescent Downlight 2-26 watt	58
FDI132T8	20	Direct/Indirect 1 x 3, 2-lamp, 25 Watt T8, Pendant/Cable Hung	48
FDI142T8	71	Direct/Indirect 1 x 4, 2-lamp, 32 Watt T8, Pendant/Cable Hung	60
FDI143T8	167	Direct/Indirect 1 x 4, 3-lamp, 32 Watt T8, Pendant/Cable Hung	84

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Table 7.6 Pre wattage per fixture			
Pre Code	**Qty**	**Existing Description**	**Watts**
FDI144EE	239	Direct/Indirect 1 x 4, 4-lamp, 34 Watt E.S., Pendant/Cable Hung	148
FDI184TEE	29	Direct/Indirect 1 x 8, 4-lamp, 34 Watt E.S., Pendant/Cable Hung	148
FI142EE	38	Fluorescent Industrial 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FI142T8	195	Fluorescent Industrial 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FI162SE	1	Fluorescent Industrial 1 x 6, 2-Lamp, 60 Watt Standard Lamp	144
FI182EE	92	Fluorescent Industrial 1 x 8, 2-Lamp, 60 Watt E.S. Lamp	144
FI182HE	60	Fluorescent Industrial 1 x 8, 2-Lamp HO, 95 Watt ES Lamp	215
FI182TT8	7	Fluorescent Industrial 1 x 8, 2-Lamp, 32 Watt T8 Lamp	60
FI184TEE	11	Fluorescent Industrial 1 x 8, 4-Lamp, 34 Watt E.S. Lamp	148
FI184TT8	24	Fluorescent Industrial 1 x 8, 4-Lamp, 32 Watt T8 Lamp	110
FS141EE	22	Fluorescent Strip 1 x 4, 1-Lamp, 34 Watt E.S. Lamp	44
FS142EE	57	Fluorescent Strip 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FS142T8	28	Fluorescent Strip 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FS181EE	14	Fluorescent Strip 1 x 8, 1-Lamp, 60 Watt E.S. Lamp	85
FS182EE	41	Fluorescent Strip 1 x 8, 2-Lamp, 60 Watt E.S. Lamp	144
FS182TEE	27	Fluorescent Strip 1 x 8, 2-Lamp, 34 Watt E.S. Lamp	74
FS184TEE	1	Fluorescent Strip 1 x 8, 4-Lamp, 34 Watt E.S. Lamp	148
FSM142EE	11	Fluorescent Surface Mount 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FSM142T8	1	Fluorescent Surface Mount 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FSM184TEE	12	Fluorescent Surface Mount 1 x 8, 4-Lamp, 34 Watt E.S. Lamp	148
FSM242T8	1	Fluorescent Surface Mount 2 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FSM243T8	10	Fluorescent Surface Mount 2 x 4, 3-Lamp, 32 Watt T8 Lamp	84
FSM244EE	37	Fluorescent Surface Mount 2 x 4, 4-Lamp, 34 Watt E.S. Lamp	148
FSM244T8	41	Fluorescent Surface Mount 2 x 4, 4-Lamp, 32 Watt T8 Lamp	110
FSM446T8	4	Fluorescent Surface Mount 4 x 4, 6-Lamp, 32 Watt T8 Lamp	168
FT142EE	203	Fluorescent Troffer 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FT142T8	195	Fluorescent Troffer 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FT222T8	6	Fluorescent Troffer 2 x 2, 2-Lamp, 17 Watt T8 Lamp	30
FT222U6EE	90	Fluorescent Troffer 2 x 2, "U6" 2-Lamp, 35 Watt E.S. Lamp	74
FT222U6SE	85	Fluorescent Troffer 2 x 2, "U6" 2-Lamp, 40 Watt Standard Lamp	90
FT223T8	5	Fluorescent Troffer 2 x 2, 3-Lamp, 17 Watt T8 Lamp	46
FT242EE	1086	Fluorescent Troffer 2 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FT242T8	204	Fluorescent Troffer 2 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FT243EE	122	Fluorescent Troffer 2 x 4, 3-Lamp, 34 Watt E.S. Lamp	118
FT243T8	1421	Fluorescent Troffer 2 x 4, 3-Lamp, 32 Watt T8 Lamp	84
FT244EE	1037	Fluorescent Troffer 2 x 4, 4-Lamp, 34 Watt E.S. Lamp	148
FT244EE-EL	9	Fluorescent Troffer 2 x 4, 4-Lamp, 34 Watt E.S. Lamp, Electronic Ballast	122
FT244T8	94	Fluorescent Troffer 2 x 4, 4-Lamp, 32 Watt T8 Lamp	110
FVT142EE	3	Fluorescent Vapor Tight 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FVT142T8	103	Fluorescent Vapor Tight 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FVT182TEE	4	Fluorescent Vapor Tight 1 x 8, 2-Lamp, 34 Watt E.S. Lamp	74
FW122SE	4	Fluorescent Wrap 1 x 2, 2-Lamp, 20 Watt Standard Lamp	50

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Table 7.6 Pre wattage per fixture			
Pre Code	**Qty**	**Existing Description**	**Watts**
FW141EE	45	Fluorescent Wrap 1 x 4, 1-Lamp, 34 Watt E.S. Lamp	44
FW142EE	544	Fluorescent Wrap 1 x 4, 2-Lamp, 34 Watt E.S. Lamp	74
FW142EE-EL	108	Fluorescent Wrap 1 x 4, 2-Lamp, 34 Watt E.S. Lamp, Electronic Ballast	62
FW142T8	573	Fluorescent Wrap 1 x 4, 2-Lamp, 32 Watt T8 Lamp	60
FW143EE	1	Fluorescent Wrap 1 x 4, 3-Lamp, 34 Watt E.S. Lamp	118
FW144EE	151	Fluorescent Wrap 1 x 4, 4-Lamp, 34 Watt E.S. Lamp	148
FW144EE-EL	13	Fluorescent Wrap 1 x 4, 4-Lamp, 34 Watt E.S. Lamp, Electronic Ballast	122
FW144T8	17	Fluorescent Wrap 1 x 4, 4-Lamp, 32 Watt T8 Lamp	110
FW182EE	353	Fluorescent Wrap 1 x 8, 2-Lamp, 60 Watt E.S. Lamp	144
FW182SE	7	Fluorescent Wrap 1 x 8, 2-Lamp, 75 Watt Standard Lamp	174
FW182TEE	68	Fluorescent Wrap 1 x 8, 2-Lamp, 34 Watt E.S. Lamp	74
FW182TT8	9	Fluorescent Wrap 1 x 8, 2-Lamp, 32 Watt T8 Lamp	60
FW184EE	3	Fluorescent Wrap 1 x 8, 4-Lamp, 60 Watt E.S. Lamp	288
FW184TT8	3	Fluorescent Wrap 1 x 8, 4-Lamp, 32 Watt T8 Lamp	110
FW244EE	9	Fluorescent Wrap 2 x 4, 4-Lamp, 34 Watt E.S. Lamp	148
FW244EE-EL	1	Fluorescent Wrap 2 x 4, 4-Lamp, 34 Watt E.S. Lamp, Electronic Ballast	122
HPMHPS150	2	HID High Pressure Sodium Pole Mount, 150 watt	175
HPMHPS400	20	HID High Pressure Sodium Pole Mount, 400 watt	440
HPMMH1500	62	HID Metal Halide Pole Mount, 1500 watt	1500
HPMMH400	44	HID Metal Halide Pole Mount, 400 watt	440
HRRMH100	6	HID Metal Halide Recessed Round, 100 watt	120
HRRMH250	6	HID Metal Halide Recessed Round, 250 watt	290
HRRMH70	69	HID Metal Halide Recessed Round, 70 watt	90
HRRMV100	9	HID Mercury Vapor Recessed Round, 100 watt	0
HRSHPS175	75	HID High Pressure Sodium Recessed Square, 175 watt	200
HRSMH100	26	HID Metal Halide Recessed Square, 100 watt	120
HRSMH250	10	HID Metal Halide Recessed Square, 250 watt	290
HRSMH70	12	HID Metal Halide Recessed Square, 70 watt	90
HRSMV100	38	HID Mercury Vapor Recessed Square, 100 watt	120
HSMH400	2	HID Metal Halide Surface Mount, 400 watt	440
HSMH70	20	HID Metal Halide Surface Mount, 70 watt	90
HSPMH250	9	HID Metal Halide Single Point (pendant) Mount, 250 watt	290
HSPMH400	150	HID Metal Halide Single Point (pendant) Mount, 400 watt	440
HWHPS50	1	HID High Pressure Sodium Wall Mount, 50 watt	70
HWHPS70	2	HID High Pressure Sodium Wall Mount, 70 watt	90
HWMH100	25	HID Metal Halide Wall Mount, 100 watt	120
HWMH175	112	HID Metal Halide Wall Mount, 175 watt	200
HWMH400	8	HID Metal Halide Wall Mount, 400 watt	440
HWMV100	5	HID Mercury Vapor Wall Mount, 100 watt	120
ICH75	10	Incandescent China Hat, 75 watt	75
ID150	1	Incandescent Downlite, 6" can, 150 watt	150

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Table 7.6 Pre wattage per fixture			
Pre Code	**Qty**	**Existing Description**	**Watts**
ID2/75	2	Incandescent Downlite, 2 75 watt, 150 watt	150
ID200	37	Incandescent Downlite, 200 watt	200
ID75	4	Incandescent Downlite, 75 watt	75
IDRUM2/60	6	Incandescent Drum, 2-60 watt	120
IDRUM2/75	19	Incandescent Drum, 2-75 watt	150
IDRUM75	12	Incandescent Drum, 75 watt	75
IGLOBE75	10	Incandescent Globe, Pendant Mount, 75 watt	75
IJ75	18	Incandescent Jar 75 watt	75
IK150	1	Incandescent Keyless, Surface (box) Mount, 150 watt	150
IK300	1	Incandescent Keyless, Surface (box) Mount, 300 watt	300
IK75	33	Incandescent Keyless, Surface (box) Mount, 75 watt	75
IRSQ2/60	1	Incandescent Recessed Square 2-60 watt	120
IRSQ75	46	Incandescent Recessed Square 75 watt	75
ITRAC25	6	Incandescent Trac Light, 25 watt	25
IW150	3	Incandescent Wall Mount, 150 watt	150
IW2/150	1	Incandescent Wall Mount, 2-150 watt	300
IW2/75	17	Incandescent Wall Mount, 2-75 watt	150
IW75	43	Incandescent Wall Mount, 75 watt	75
QTZ500	3	Quartz, Knuckle Mount, 300 watt	500
Total	8870		

Table 7.7 demonstrates the post lighting wattage per fixture type that was used to calculate energy consumption of proposed lighting systems.

Table 7.7 Post wattage per fixture.			
Post Code	**Qty**	**Existing Description**	**Watts**
A-PLC142UE	64	Custom Wallpack Retrofit Kit, 1-42 watt CFL	45
CFL-15-SI	12	One Compact Fluorescent, 15 watt, single piece, screw in	15
CFL-15-SI (2)	10	Two Compact Fluorescent, 15 watt, single piece, screw in for Enclosed fixture	30
CFL-20-SI	105	One Compact Fluorescent, 20 watt, single piece, screw in	20
CFL-20-SI-PAR (2)	1	Two Compact Fluorescent, PAR, 20 watt, single piece, screw in	40
CFL-23-SI	31	One Compact Fluorescent, 23 watt, single piece, screw in	23
CFL-23-SI (rewire)	34	One Compact Fluorescent, 23 watt, single piece, screw in, rewire around HID ballast	23

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Table 7.7 Post wattage per fixture.			
Post Code	**Qty**	**Existing Description**	**Watts**
CFL-27-SI-R40	1	One Compact Fluorescent R40, 27 watt, single piece, screw in	27
CFL-42-SI-MOGUL	5	One Compact Fluorescent, 42 watt, single piece, screw in, Mogul base (wire around existing ballast)	42
DND	571	Do Not Do (no retrofit proposed)	n/a
FLBBC8-232L	2	Retrofit, Strip fixture 1x8 , Ballast Cover Conversion, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
FLBBC8-432L	28	Retrofit, Strip fixture 1x8 , Ballast Cover Conversion, 4-28 watt T8 Lamps, Electronic LBF Ballast	84
FLBBC8-432S	18	Retrofit, Strip fixture 1x8 , Ballast Cover Conversion, 4-28 watt T8 Lamps, Electronic SBF Ballast	95
FLBBC8-632L	10	Retrofit, Strip fixture 1x8 , Ballast Cover Conversion, 6-28 watt T8 Lamps, Electronic LBF Ballast	126
FLBBC8-632S	46	Retrofit, Strip fixture 1x8 , Ballast Cover Conversion, 6-28 watt T8 Lamps, Electronic SBF Ballast	143
FLBO132L	54	Retrofit, Fluorescent Luminaire, 1-28 watt T8 Lamp, Electronic LBF Ballast	22
FLBO132L-T2	12	Retrofit, Fluorescent Luminaire, 1-28 watt T8 Lamp, Electronic LBF Ballast, Tandem Two Fixtures	21
FLBO132L-T3	3	Retrofit, Fluorescent Luminaire, 1-28 watt T8 Lamp, Electronic LBF Ballast, Tandem Three Fixtures	21
FLBO217L	10	Retrofit, Fluorescent Luminaire, 2-17 watt T8 Lamps, Electronic LBF Ballast	26
FLBO225S	20	Retrofit, Fluorescent Luminaire, 2-25 watt T8 Lamps, Electronic SBF Ballast	42
FLBO232L	2104	Retrofit, Fluorescent Luminaire, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
FLBO232L-T2	544	Retrofit, Fluorescent Luminaire, 2-28 watt T8 Lamps, Electronic LBF Ballast, Tandem Wire Two Fixtures	42
FLBO232S	117	Retrofit, Fluorescent Luminaire, 2-28 watt T8 Lamps, Electronic SBF Ballast	48
FLBO232S-T2	188	Retrofit, Fluorescent Luminaire, 2-28 watt T8 Lamps, Electronic SBF Ballast, Tandem Wire Two Fixtures	47.5
FLBO332L	36	Retrofit, Fluorescent Luminaire, 3-28 watt T8 Lamps, Electronic LBF Ballast	63
FLBO332S	47	Retrofit, Fluorescent Luminaire, 3-28 watt T8 Lamps, Electronic LBF Ballast	72
FLBO432L	340	Retrofit, Fluorescent Luminaire, 4-28 watt T8 Lamps, Electronic LBF Ballast	84
FLBO432S	22	Retrofit, Fluorescent Luminaire, 4-28 watt T8 Lamps, Electronic SBF Ballast	95
FLBR14-232H	80	Retrofit, Fluorescent 1x4 Luminaire, Reflector Kit, 1-28	65

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Table 7.7 Post wattage per fixture.			
Post Code	**Qty**	**Existing Description**	**Watts**
		watt T8 Lamp, Electronic HBF Ballast	
FLBR14-232S	28	Retrofit, Fluorescent 1x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic SBF Ballast	48
FLBR22-217S	90	Retrofit, Fluorescent 2x2 Luminaire, Reflector Kit, 2-17 watt T8 Lamps, Electronic SBF Ballast	30
FLBR22-317L	85	Retrofit, Fluorescent 2x2 Luminaire, Reflector Kit, 3-17 watt T8 Lamps, Electronic LBF Ballast	39
FLBR24-232H	84	Retrofit, Fluorescent 2x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic HBF Ballast	65
FLBR24-232L	105	Retrofit, Fluorescent 2x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
FLBR24-232L-T2	60	Retrofit, Fluorescent 2x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic LBF, Tandem Wire	42
FLBR24-232S	2041	Retrofit, Fluorescent 2x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic SBF Ballast	48
FLBR24-232S-T2	436	Retrofit, Fluorescent 2x4 Luminaire, Reflector Kit, 2-28 watt T8 Lamps, Electronic SBF, Tandem Wire	47.5
FLBR4-132L	1	Retrofit, Fluorescent 1x4 Luminaire, Reflector Kit, 1-28 watt T8 Lamp, Electronic LBF Ballast	22
FLBR44-432L	4	Retrofit, Fluorescent 4x4 Luminaire, Reflector Kit, 4-28 watt T8 Lamps, Electronic LBF Ballast	84
FLBSR4-232L	14	Retrofit, Fluorescent 1x4 Strip/Industrial Luminaire, Specular Reflector Kit, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
FLBSR8-432S	56	Retrofit, Fluorescent 1x8 Strip/Industrial Luminaire, Specular Reflector Kit, 4-28 watt T8 Lamps, Electronic SBF Ballast	95
FLO232S	555	Relamp Only, 2-28 watt T8 Lamp, With Existing Electronic SBF Ballast	48
NFCFL126S	1	New Vandal resistant CFL Luminaire, 1-26 watt Lamp	28
NFCFL132S	4	New Vandal resistant CFL Luminaire, 1-32 watt Lamp	34
NFCFL213S	39	New Drum or Vandal resistant CFL Luminaire, 2-13 watt Lamps	30
NFCFL226S	8	New Drum or Vandal resistant CFL Luminaire, 2-26 watt Lamps	60
NFCFL232S	120	New Vandal resistant CFL Luminaire, 2-32 watt Lamps	68
NFHB4-632H	77	High Bay Chain/Surface Mount Luminaire, 6-28 watt T8 Lamps, Electronic HBF Ballast	194
NFHB4-832H	65	High Bay Chain/Surface Mount Luminaire, 8-28 watt T8 Lamps, Electronic HBF Ballast	252
NFW2-217S	8	New 2' Corner Mount Fixture, 2-17 watt T8 Lamps, Electronic SBF Ballast, White reflector	27
NFW4-132L	1	New 4' Wrap Luminaire, 1-28 watt T8 Lamp, Electronic	22

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Table 7.7 Post wattage per fixture.			
Post Code	**Qty**	**Existing Description**	**Watts**
		LBF Ballast	
NFW4-232H	8	New 4' Wrap Luminaire, 2-28 watt T8 Lamps, Electronic HBF Ballast	65
NFW4-232L	59	New 4' Wrap Luminaire, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
NFW8-232L	1	New 8' Wrap Luminaire, 2-28 watt T8 Lamps, Electronic LBF Ballast	42
NFW8-432L	395	New 8' Wrap Luminaire, 4-28 watt T8 Lamps, Electronic LBF Ballast	84
Remove	10	Remove Existing Luminaire	0
Total	**8870**		
Total w/o DND	**8299**		

CALCULATION METHODOLOGY

For each line item in the inventory, the verified demand and energy savings will be calculated using the following equations:

$$DS_{LTG} = (FW_{BASE} \times N_{BASE} - FW_{POST} \times N_{POST}) \times PDF \times 10 \text{ months/year}$$
$$ES_{LTG} = (FW_{BASE} \times N_{BASE} - FW_{POST} \times N_{POST}) \times H_{BASE}$$

Where:

DS_{LTG} = Annual Demand Savings (kW)
ES_{LTG} = Annual Energy Savings (kWh)
FW_{BASE} = Baseline Fixture Wattage (kW/fixture)
N_{BASE} = Baseline Fixture Quantity
H_{BASE} = Baseline Annual Operating Hours
FW_{POST} = Post-installation Fixture Wattage (kW/fixture)
N_{POST} = Post-installation Fixture Quantity
PDF = Peak Demand (Coincidence) Factor

Annual hours of operation will be the values identified in Table 7.5 and shown for each entry in the comprehensive lighting audit (Appendix A). The total verified electric energy and demand savings are the sum of the energy and demand savings for each line item in the inventory. Interactive heating and cooling effects are calculated using the following equations:

$$ES_{CLG} = ES_{LTG} \times SC \times SF \times EFF_{CLG} \times ICCF$$
$$NGP_{HTG} = ES_{LTG} \times SC \times SF \times EFF_{HTG} \times HFCF$$

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Where:

ES_{CLG} = Annual Interactive Cooling Energy Savings (kWh)

NGP_{HTG}= Annual Interactive Heating Natural Gas Penalty (therms)

SC = Space Conditioned, as a percentage of the total floor area

SF= Season Factor, ratio of cooling or heating months divided by 12 months per year

EFF_{CLG} = Cooling System Efficiency (kW/ton)

EFF_{HTG} = Heating System Efficiency

ICCF = Interactive Cooling Conversion Factor

= 3413 BTUs per kWh divided by 12,000 BTU-hr/ton

HFCF = Heating Fuel Conversion Factor

= 0.03412 therms per kWh for Natural Gas

= 1.0 kWh per kWh for Electricity

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE MEASURES

Baseline

Table 7.6 – Pre Wattage per Fixture identifies the fixture power for the existing lighting system. These values are standard for the lighting industry and are stipulated and agreed to by CCSD and NORESCO.

NORESCO also measured Baseline Annual Operating Hours for representative areas. Data loggers were placed in representative spaces; the data from the loggers was used to determine the run hours for these spaces. This data is summarized in Table 7.5 and is used in the lighting calculations. The compiled list of readings from these loggers is included in Appendix E.

Post-Installation

After completion of the proposed retrofits, NORESCO will field verify that new lighting equipment is in accordance with the scope and specifications outlined in this report. Verified savings will be based on actual quantities and types of lighting material installed. Installed fixture quantities will be adjusted as required based on the as-built lighting audit. Accumulated Energy Savings will be adjusted to reflect final fixture quantities.

Table 7.7 – Post Wattage Per Fixture identifies the fixture power for the proposed lighting system. Lighting operating hours are as indicated in Table 7.5. The values identified in these tables for fixture wattage, operating hours and peak demand factor are stipulated and agreed to by CCSD and NORESCO.

Annual

NORESCO will inspect a random sample of 10% of the fixtures installed to verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

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LIGHITNG CONTROLS IMPROVEMENTS

SAVINGS VERIFICATION METHODOLOGY

The energy savings from the lighting controls will result from automatically turning off lights in unoccupied spaces. The savings are calculated and fully documented in Appendix A. Tables 7.5, 7.6 and 7.7 represent the primary data utilized in the lighting calculations for this ECM. This information was reviewed and accepted by the District and 3rd Party Engineer during the meeting on September 19, 2007.

The controlled hours of operation are based on the typical reduction in hours of at least 25% that have been achieved in gymnasiums and multi-purpose rooms at similar educational facilities.

CALCULATION METHODOLOGY

For each line item in the inventory, the verified demand and energy savings will be calculated using the following equations:

$$ES_{OCC} = FW_{POST} \times N_{POST} \times (H_{BASE} - H_{POST})$$

Where

ES_{OCC} = Annual Occupancy Sensor Energy Savings (kWh)
FW_{POST} = Post-installation Fixture Wattage (kW/fixture)
N_{POST} = Post-installation Fixture Quantity
OHRF = Operating Hours Reduction Factor (25%)
H_{BASE} = Baseline Annual Operating Hours
H_{POST} = Post-Installation Operating Hours
$= H_{BASE} \times (1 - OHRF)$

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE PROCEDURES

Baseline

The baseline for this ECM is the post-installation conditions for the High Bay Lighting system Upgrade. Table 7.7 – Post Wattage Per Fixture identifies the fixture power for the proposed lighting system. These values are standard for the lighting industry and are stipulated and agreed to by CCSD and NORESCO.

Baseline operating hours for this ECM are based on the measured Baseline Annual Operating Hours for representative areas from the High Bay Lighting System Upgrade. This data is summarized in Table 7.5 and is used in the lighting calculations. The compiled list of readings from these loggers is included in Appendix E.

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Post-Installation

After completion of the proposed retrofits, NORESCO will field verify that new lighting controls are installed and operating in accordance with the scope and specifications outlined in this report. Verified savings will be based on actual quantities and types of lighting material installed. Installed fixture quantities will be adjusted as required based on the as-built lighting audit. Accumulated Energy Savings will be adjusted to reflect final fixture quantities.

Post-Installation Annual Operating Hours are based on a stipulated reduction of 25% to the Baseline Annual Operating Hours.

Annual

NORESCO will inspect a random sample of 10% of the fixtures installed to verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

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UPGRADE BUILDING CONTROLS

SAVINGS VERIFICATION METHODOLOGY

Upgrade of the building controls and implementing strategies for energy savings will result optimization of District resources and improvement of indoor air quality. The savings for this ECM are calculated and fully documented in Appendix A. Table 7.8 – Standards of Operation and Comfort provides the key data utilized in the savings calculations for this ECM. This information was reviewed and accepted by the District and 3rd Party Engineer during the meeting on September 19, 2007.

CALCULATION METHODOLOGY

The savings for the ECM - Upgrade Building Controls are calculated based on ASHRAE bin weather data analysis that includes US Air Force weather data for Fallon NAS and the temperature setpoints identified in Table 7.8 – Standards of Operation and Comfort. Efficiencies are based on manufacturer's data for existing and new equipment. Specific control strategies are identified below. Calculations for each building where this ECM is recommended are included in Attachment A:

Demand Ventilation Control modulates the outdoor air damper based on the carbon dioxide level sensed in the return air stream. The savings are estimated based on weather data, the estimated percentage of occupied time and number of people (percent of maximum occupancy).

Economizer Control reduces mechanical cooling loads by increasing outdoor air introduced by air handlers when the outdoor temperature is between the discharge temperature setpoint and the return air temperature.

Heating Setback savings (natural gas or electricity) are based on a bin analysis employing local temperature data, a heat load calculation done for each building or group of similar buildings, existing and proposed occupancy schedules, and both existing and proposed occupied and unoccupied heating setpoint temperatures.

Cooling Setforward savings (electricity) are done similarly, using existing and proposed occupied and unoccupied cooling setpoint temperatures.

Soft Start Controls for Water Source Heat Pump (WSHP) Circulation Pumps savings are based on controlling the operation of the WSHP circulation pumps. Variable frequency drives (VFDs) will be installed on the WSHP circulation pumps at Numa Elementary School. The pumps will continue to operate at constant speed but the VFD's will eliminate water hammer problems. This will permit the pumps to be shut down during unoccupied periods.

Domestic Hot Water (DHW) Recirculation Pump savings are based on reducing the time period when DHW recirculation pumps are operating. Integrating the pumps with the new Direct Digital Control (DDC) system will provide control and eliminate reheat of water circulating in unoccupied buildings.

Optimal Start/Stop savings have two components: Fan electric savings are based on the total fan electric load (kW) being controlled, and the existing and proposed operating hours. Heating savings are based on avoiding the need to heat outdoor air, calculating using a bin analysis employing local temperature data, the minimum outdoor air introduced by each air handler, and the occupied temperature setpoint of the associated spaces.

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Total energy savings are the sum of savings calculated for each of the control strategies. Upon successful commissioning and verification to the setpoints in Table 7.8 – Standards of Operation and Comfort, M&V Savings will be based on the savings calculations documented in Attachment A. CCSD changes to temperature setpoints will result in recalculation of M&V Savings. Accumulated Energy Savings reported in the Final Commissioning and Post-Installation M&V Report will be adjusted to reflect final post-installation temperature setpoints.

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE PROCEDURES

Baseline

Table 7.8 – Standards of Operation and Comfort identifies the temperature setpoints for each CCSD facility. Existing conditions are based on detailed site surveys and the setpoints currently maintained by existing controls equipment.

NORESCO also measured baseline conditions by placing data loggers in representative spaces; the data from the loggers was used to measure the maintained temperatures and run hours for these spaces. This data verified the information summarized in Table 7.8. The compiled list of readings from these loggers is included in Appendix E. These setpoints were used in the baseline calculations for this ECM.

Post-Installation

NORESCO will perform the commissioning of the hardware and software and field verify that equipment is operating in accordance with Table 7.8 – Standards of Operation and Comfort, and the controls strategies identified above.

Annual

NORESCO will inspect a random sample of 10% of the controls installed to verify that the equipment installed continues to operate as intended. This will include confirmation that proposed strategies are operating as intended (i.e., unoccupied setback schedules and temperatures). Deficiencies and/or modifications will be identified and described in the Annual Report.

STANDARDS OF OPERATION

Table 7.8 – Standards of Operation and Comfort documents equipment operating characteristics for the purpose of developing baseline energy use and energy efficient upgrade profiles.

- Mechanical Systems: The temperature settings and equipment schedules for the building, zones, and/or other equipment to be affected by the ECMs. The existing temperature settings and equipment schedules are used in the development and calibration of the existing system baseline energy use model/analysis. The proposed temperature settings and equipment schedules are used in the development of the proposed system energy use model/analysis, and the associated savings

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Table 7.8 Standards of Operation and Comfort						
Area Served	EXISTING			PROPOSED		
	Equipment Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures	Occupied Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures
CC High School						
Entire Campus	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Gymnasium	M-S 6:30 a.m. to 9:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-S 6:30 a.m. to 9:30 p.m.	69ºF/58ºF	75ºF/90ºF
I/A and Auto Shop Unit Heaters Manual T'stats	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
CC Junior HS						
JHS & Office Wing Prog T'stats	M-F 7:00 a.m. to 3:30 p.m.	72ºF/72ºF	72ºF/72ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Library Prog T'stats	M-F 7:00 a.m. to 3:30 p.m.	72ºF/72ºF	72ºF/72ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Gym	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Science Wing	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Lahontan Valley High School						
Old High School	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF

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Table 7.8 Standards of Operation and Comfort						
Area Served	EXISTING			PROPOSED		
	Equipment Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures	Occupied Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures
Cafeteria	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
New Annex	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Old Annex	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
EC Best ES						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Lahontan ES						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Northside ES						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Numa ES						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
West End ES						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Cottage School						

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Table 7.8 Standards of Operation and Comfort						
Area Served	EXISTING			PROPOSED		
	Equipment Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures	Occupied Schedule	Heating Occupied/ Unoccupied Temperatures	Cooling Occupied/ Unoccupied Temperatures
All Buildings Prog T'stats	M-F 7:00am to 5:00pm	72ºF/72ºF	74ºF/90ºF	M-F 7:00 a.m. to 4:00 p.m.	69ºF/58ºF	75ºF/90ºF
Administration Bldgs						
Admin Prog T'stats	M-F 6:00am to 5:00pm	72ºF/72ºF	72ºF/72ºF	M-F 7:00 a.m. to 4:00 p.m.	69ºF/58ºF	75ºF/90ºF
Business & HR Prog T'stats	M-F 7:00am to 4:00pm	72ºF/72ºF	72ºF/72ºF	M-F 7:00 a.m. to 4:00 p.m.	69ºF/58ºF	75ºF/90ºF
Transportation Dept.						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Maintenance Dept.						
Entire Building	M-F 6:00 a.m. to 4:00 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 6:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF
Warehouse						
Entire Building	M-F 7:00 a.m. to 3:30 p.m.	70ºF/60ºF	74ºF/90ºF	M-F 7:00 a.m. to 3:30 p.m.	69ºF/58ºF	75ºF/90ºF

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REPLACE HEAT PUMPS WITH PACKAGED UNITS

SAVINGS VERIFICATION METHODOLOGY

This ECM calculates the heating and cooling energy savings associated with the replacement of water source heat pumps with packaged gas heat/electric cooling rooftop units at the Churchill County High School Gymnasium. Extended operating hours at the Gymnasium results in longer operation of the WSHP central plant. Energy savings will result from disconnecting the Gymnasium from the WSHP system serving the remainder of the High School, and installing new energy efficient equipment dedicated to heating and cooling the Gymnasium.

CALCULATION METHODOLOGY

The savings for the ECM – Replace Heat Pumps with Packaged Units are calculated based on ASHRAE bin weather data analysis that includes US Air Force weather data for Fallon NAS and the temperature setpoints identified in Table 7.8 – Standards of Operation and Comfort. Efficiencies are based on manufacturer's data for existing and new equipment. Specific savings strategies are identified below. Calculations for each building where this ECM is recommended are included in Attachment A:

$$NGS = NGH_{EXIST} – NGH_{PROP}$$
$$ES = (EH_{EXIST} – EH_{PROP}) + (EC_{EXIST} - EC_{PROP})$$

Where:

NGS = Annual Natural Gas Savings (therm)
ES = Annual Electricity Savings (kWh)
NGH_{EXIST} = Existing Natural Gas annual use, Heating
NGH_{PROP} = Proposed Natural Gas annual use, Heating
EH_{EXIST} = Existing Electricity annual use, Heating
EH_{PROP} = Proposed Electricity annual use, Heating
EC_{EXIST} = Existing Electricity annual use, Cooling
EC_{PROP} = Proposed Electricity annual use, Cooling

Natural gas and electricity annual consumption required for heating are calculated using the following equations:

$$NGH_{EXIST} = HL / BE$$
$$EH_{EXIST} = (HL / COP) + (PP \times BH)$$
$$NGH_{PROP} = HL / HE_{RTU}$$
$$EH_{PROP} = FP \times BH$$

Where:

HL = Heat Load as calculated in Attachment A

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BE = Boiler Efficiency stipulated at 80% with a 10% degradation factor applied based on assessment of equipment type and date of manufacture

COP = Coefficient of Performance for water source heat pump system, stipulated at 4.0 with a 10% degradation factor based on assessment of manufacturer data.

PP = Pump Power per nameplate data and as calculated in Attachment A

BH = Bin Hours as calculated based on Fallon NAS weather data.

HE_{RTU} = Heating Efficiency of new rooftop packaged units (RTU) as identified in manufacturer's data

FP = Fan Power per nameplate data and as calculated in Attachment A

Electricity annual consumption required for cooling is calculated using the following equations:

$$EC_{EXIST} = (CL \times CE_{WSHP}) + [(CPP + CTFP + CPP_{WSHP}) \times BH]$$

$$EC_{PROP} = (CL \times CE_{RTU}) + (FP_{RTU} \times BH)$$

Where:

CL = Cooling Load as calculated in Attachment A

CE_{WSHP} = Cooling Efficiency of Water Source Heat Pumps stipulated at 1.09 kW/ton with a 10% degradation factor based on assessment of equipment type and date of manufacture

CPP = Condenser Pump Power per nameplate data and as calculated in Attachment A

CTFP = Cooling Tower Fan Power per nameplate data and as calculated in Attachment A

CPP_{WSHP} = Circulation Pump Power at WSHP central plant per nameplate data and as calculated in Attachment A

BH = Bin Hours as calculated based on Fallon NAS weather data.

CE_{RTU} = Heating Efficiency of new rooftop packaged units (RTU) as identified in manufacturer's data

FP_{RTU} = Fan Power of new rooftop packaged units (RTU) as calculated in Attachment A using manufacturer's data

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

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PERFORMANCE COMPLIANCE PROCEDURES

Baseline

Baseline calculations are based on existing conditions identified during detailed site surveys, setpoints currently maintained by existing controls equipment, and manufacturer's data for existing equipment efficiencies.

Post-Installation

NORESCO will field verify that the new equipment is properly installed and commissioned. M&V Savings for this ECM are stipulated and based solely on the engineering calculations included in Attachment A.

Annual

NORESCO will inspect the new equipment and verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

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COOLING TOWER FAN VFD INSTALLATIONS

SAVINGS VERIFICATION METHODOLOGY

This ECM calculates the electrical savings associated with the installation of variable frequency drives (VFD's) on cooling tower fan motors at Churchill County High School. Energy savings are attributed to the reduction of fan speed with cooling load.

CALCULATION METHODOLOGY

The savings for the ECM – Cooling Tower Fan VFD Installations are calculated based on ASHRAE bin weather data analysis that includes US Air Force weather data for Fallon NAS and the temperature setpoints identified in Table 7.8 – Standards of Operation and Comfort. Calculations for each building where this ECM is recommended are included in Attachment A:

$$ES = EU_{EXIST} - EU_{PROP}$$

Where:

EU_{EXIST} = Existing Electricity annual use

EU_{PROP} = Proposed Electricity annual use

Existing and proposed electricity annual consumption are calculated using the following equations:

$$EU_{EXIST} = CH \times CT \times FkW$$

$$EU_{PROP} = CH \times FkW \times CL\text{^}3$$

Where:

CH = Annual cooling hours

CT = Cooling tower cycle time, based on % cooling load

FkW = Cooling tower fan power (kW), based on both cooling tower fans with load factors stipulated at 85%

CL = Cooling load as it relates to required VFD % speed

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

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BUILDING ENVELOPE IMPROVEMENTS

SAVINGS VERIFICATION METHODOLOGY

This ECM calculates the heating and cooling savings associated with the elimination of building air leakage by installing weather stripping around doors. The amount of air, in CFM, that needs to be conditioned due to leakage is determined by the equation.

CALCULATION METHODOLOGY

The savings for the ECM – Building Envelope Improvements are calculated based on ASHRAE bin weather data analysis that includes US Air Force weather data for Fallon NAS and the temperature setpoints identified in Table 7.8 – Standards of Operation and Comfort. Efficiencies are based on manufacturer's data for existing and new equipment. Calculations for each building where this ECM is recommended are included in Attachment A:

$$ES = EU_{EXIST} - EU_{PROP}$$
$$NGS = NGU_{EXIST} - NGU_{PROP}$$

Where

ES = Annual Electricity Savings
NGS = Annual Natural Gas Savings
EU_{EXIST} = Existing Electricity annual use
EU_{PROP} = Proposed Electricity annual use
NGU_{EXIST} = Existing Natural Gas annual use
NGU_{PROP} = Proposed Natural Gas annual use

Existing and proposed annual energy annual savings are calculated using the following equations:

$$NGS = DP \times CW \times HSWS \times WD \times 5280 / 60 \times 1.08 \times HDH / 100{,}000 / Heff$$
$$ES = DP \times CW \times CSWS \times WD \times 5280 / 60 \times 1.08 \times CDH / 12{,}000 \times Ceff$$

Where

ES = Annual Electricity Savings (kWh)
NGS = Annual Natural Gas Savings (Therms)
DP = Existing total door perimeter
CW = Average door perimeter crack width, stipulated based on existing door conditions
HSWS = Average heating season wind speed based on weather data analysis (MPH)
CSWS = Average cooling season wind speed based on weather data analysis (MPH)

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WD = Wind diversity based on building orientation, stipulated to be 50%
HDH = Heating degree hours based on weather data analysis
CDH = Cooling degree hours based on weather data analysis
Heff = Existing heating efficiency based on assessment of equipment type and date of manufacture
Ceff = Existing cooling efficiency (kW/ton) based on assessment of equipment type and date of manufacture

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE PROCEDURES

Baseline

Baseline calculations are based on existing conditions identified during detailed site surveys, setpoints currently maintained by existing controls equipment, and manufacturer's data for existing equipment efficiencies.

Post-Installation

NORESCO will field verify that the new equipment is properly installed and commissioned. M&V Savings for this ECM are stipulated and based solely on the engineering calculations included in Attachment A.

Annual

NORESCO will inspect the new equipment and verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

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INTERIOR WATER FIXTURE RETROFITS

SAVINGS VERIFICATION METHODOLOGY

The interior water retrofit retrofits throughout CCSD will consist of installation of water conserving devices for interior plumbing fixtures and will reduce the water usage of CCSD facilities.

CALCULATION METHODOLOGY

The M&V Savings for the ECM – Interior Water Fixture Retrofits are calculated based on the following formulas. Calculations for each building where this ECM is recommended are included in Attachment A:

For each toilet or urinal[1]:

$$WS = (GPF_{BASE} \times GPF_{POST}) \times [FPY / 1000 \text{ (gal/kgal)}]$$

Where

WS = Water Savings (kgal/year)

GPF_{BASE} = Baseline Water Use per flush (gal/flush)

GPF_{POST} = Post-Installation Water Use per flush (gal/flush)

FPY = Flushes Per Year (flushes/yr)

Showers & Lavatories[2]:

Water Savings = (Baseline GPM x New GPM) x Minutes per Year

Natural Gas Savings = (Water Savings x Temperature Differential)/Efficiency

$$WS = (GPM_{BASE} \times GPM_{POST}) \times USE /1000 \text{ (gal/kgal)}$$

$$NGS = (WS \times TD \times 8{,}340 \text{ Btu/}^{o}\text{F-gal})/ (EFF \times 100{,}000 \text{ Btu/therm})$$

Where:

WS = Annual Water Savings (kgal/year)

NGS = Annual Natural Gas Savings (therms/year)

GPM_{BASE}= Baseline Water Use (gal/min)

GPM_{POST} = Post-Installation Water Use (gal/min)

USE = Fixture Use (minutes/yr)

EFF = DHW Efficiency (%)

Fixture use values will be the values identified in the engineering calculations for this ECM included in Attachment A, and will remain fixed for the term of the contract.

[1] GPF= Gallons per flush

[2] GPM=Gallons per minute

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Water usage is calculated based on the following parameters:

Occupants

- Total number of building occupants
- Operating Days per Year
- Toilet Use (# of Flushes/Day)
- Lavatory Use (Minutes/Use and # of Uses/Day)

General

- Cold Water Temp (°F)
- Hot Water Temp (°F)
- DHW Efficiency (%)
- Total # of Flush Valves
- Baseline Toilet Gallons/Flush (GPF)
- New Toilet Gallons/Flush (GPF)
- Baseline Urinal Gallons/Flush (GPF)
- Proposed Urinal Gallons/Flush (GPF)
- Baseline Lavatory Gallons/Flush (GPM)
- Proposed Lavatory Gallons/Flush (GPM)

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE PROCEDURES

Baseline

NORESCO also measure baseline (pre-retrofit) fixture water consumption on a representative sample of devices up to a maximum of 5% of total devices.

Post-Installation

After completion of the proposed retrofits, NORESCO will field verify that new equipment is in accordance with the scope and specifications outlined in this report. NORESCO will measure post-retrofit water consumption of the same fixtures measured during baseline conditions. M&V savings will be based on actual quantities and types of material installed, and will be adjusted to reflect pre-retrofit and post-retrofit water usage measurements.

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Annual

NORESCO will inspect a random sample of 10% of the fixtures installed to verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

TRANSFORMER REPLACEMENTS

SAVINGS VERIFICATION METHODOLOGY

NORESCO recommends the replacement of dry type step down transformers at the High School. The replacement will reduce overall system electrical losses as identified in the description below. The ECM includes replacement of existing 480 volt to 208/120 volt transformers. The parameters used to determine the baseline and post energy usage are:

CALCULATION METHODOLOGY

The savings for the ECM – Transformer Replacements are calculated based on the nameplate data for the transformers identified at Churchill County High School. Calculations for each building where this ECM is recommended are included in Attachment A:

$$ES = TL_{EXIST} - TL_{PROP}$$

Where:

TL_{EXIST} = Existing Annual Transformer Losses (kWh)

TL_{PROP} = Propose Annual Transformer Losses (kWh)

Existing and proposed electricity annual consumption are calculated using the following equations:

$$TL_{EXIST} = (1 - EFF_{EXIST}) \times TR \times LF \times PF$$
$$TL_{PROP} = (1 - EFF_{PROP}) \times TR \times LF \times PF$$

Where:

EFF_{EXIST} = Rated efficiency of existing transformer (% per nameplate)

EFF_{PROP} = Rated efficiency of proposed transformer (% per nameplate)

TR = Transformer size rating (kVA per nameplate)

LF = Load factor of transformer (stipulated at 70%)

PF = Power factor of transformer (stipulated at 90%)

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

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PERFORMANCE COMPLIANCE PROCEDURES

Baseline

Baseline calculations are based on existing conditions identified during detailed site surveys, and manufacturer's nameplate data.

Post-Installation

NORESCO will field verify that the new equipment is properly installed and commissioned. NORESCO will commission the transformers and will document the actual input and output voltage and current to confirm that they are within manufacturer's specifications. These measurements will be performed for three transformers. CCSD and NORESCO agree that if these measurements confirm that the transformers are operating as intended, the transformers will be deemed to be operating at the rated efficiency (EFF_{PROP}) as identified by the manufacturer.

M&V Savings for this ECM are calculated based on the baseline and post-installation performance compliance procedures, and as documented by the engineering calculations included in Attachment A.

Annual

NORESCO will inspect the new equipment and verify that the equipment installed continues to operate as intended. Deficiencies and/or modifications will be identified and described in the Annual Report.

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NEWTWORK POWER MANAGEMENT

SAVINGS VERIFICATION METHODOLOGY

The installation of software to monitor and optimize sleep modes in networked personal computers and associated controls modifications and will reduce the water usage of school District. The parameters used to determine the baseline and post energy usage are:

- Quantity of personal computers (PCs) including central processing units (PCUs) and monitors:
- Hours of operation in each power mode

CALCULATION METHODOLOGY

The savings for the ECM – Network Power Management are calculated based on the quantity of PCs, the power consumed by the PCs in each sleep state, and the length of time operating in each and the . Efficiencies are based on manufacturer's data for existing and new equipment. Calculations for each building where this ECM is recommended are included in Attachment A:

$$ES = EU_{EXIST} - EU_{PROP}$$

Where

$$EU_{EXIST} = (SPM \times (PA \times HA + PL \times HL + PO \times HO) / 7) \times 365 / 1000 + ((1 - SPM) \times (PA \times (HA + HL) + PO \times HO) / 7) \times 365 / 1000$$

EU_{PROP} = same as EU_{EXIST} with software controls in place

Where

PA = Average active mode power for CPU or monitor (Watts)
PL = Average low-power mode power for CPU or monitor (Watts)
PO = Average off mode power for CPU or monitor (Watts)
HA = Hours of operation in active mode for CPU or monitor (hours/week)
HL = Hours of operation in low-power mode for CPU or monitor (hours/week)
HO = Hours of operation in off mode for CPU or monitor (hours/week)
SPM = Power-management-enable rate for CPU or monitor (%)
365 = Days per year
7 = Days per week

To determine savings, the software will capture the baseline annual energy consumption (EU_{EXIST}) for each PC at CCSD. The software will then modify one or more of the variables (HA, HL, HO and SPM) to determine the post-installation annual energy consumption (EU_{PROP}). The constants in this equation (PA, PL and PO) are determined based on manufacturer's

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data for the PCs at CCSD. The variables in the equation will be determined by the software based on baseline and post-installation analyses.

Since the M&V Savings calculated by the software will not be known until four to six weeks following the installation, a conservative estimate of annual savings has been included in this report. This value is calculated as follows:

$$ES_{ESTIMATED} = QPC \times ES_{PC}$$

Where
QPC = Quantity of PCs in the District = 1,563
ES_{PC} = Annual Energy Savings per PC = 149 kWh

The quantity of PCs was provided by CCSD's Information Technology (IT) provider and is stipulated. The Annual Energy Savings per PC is based results from previous installations by the software provider at educational facilities. See Attachment A for backup calculations and documentation.

SAVINGS SUMMARY

See Table 7.3 – Accumulated Energy Savings

PERFORMANCE COMPLIANCE PROCEDURES

Baseline

Baseline calculations are based on actual quantity of PCs and associated make and model number as provided by CCSD's IT provider. Baseline energy consumption for a representative sample of PCs will be validated during the initial phase of the software installation. During this phase, the software will monitor the variables (HA, HL, HO, SPM) in the equation summarized above.

Post-Installation

NORESCO will field verify that the software is properly installed and is enforcing the recommended strategies. M&V Savings for this ECM will be calculated by the software based on the formula above ($ES = EU_{EXIST} - EU_{PROP}$), based on continuous monitoring of the variables and the resultant calculations. The annual savings calculated and reported by the software will be the M&V savings.

Annual

NORESCO will inspect the operation of the new software and verify that it continues to operate as intended. Annual savings, as well as any deficiencies and/or modifications, will be identified and described in the Annual Report.

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Section 8.0
Project Management Plan

OVERVIEW

NORESCO believes that communication is of the utmost importance for a successful project. The Churchill County School District (CCSD) project will have an on-site Project Manager (PM) supervised by the Manager of Construction Services. 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 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 project success. Specific discussion items for the kick off meeting include, but are not limited to:

- Review of the scope of work and project schedule
- Project contact information for CCSD, NORESCO and any subcontractors
- Security issues and 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 affected hazardous materials, if any
- Required permits (confined space, welding work, local building, Local Public Works, etc.)
- Customer concerns, NORESCO concerns
- Anticipated project impacts during construction (what CCSD can 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 affect students and staff

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Once all ECM designs and specifications are developed, reviewed, and final approval received, the PM will then begin the implementation of the project in a collaborative effort with site personnel. Project management procedures employed by NORESCO include, but are not limited to the following:

- PM directs the subcontractors work schedules based on coordination meetings with customer.
- PM requires subcontractors 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 the CCSD Project Team. In order for these minutes to become accepted by the team, NORESCO requests a positive response from the CCSD representative within five business days of transmittal
- 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 subcontractor 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 walkthroughs, 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.
- 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 drawings, O&M manuals, and any other pertinent documents will be submitted and approved as part of 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.

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DESIGN/ENGINEERING REVIEW

A successful installation depends on a well thought-out project approach, specifically project design and engineering review. Design and engineering is approached by NORESCO as a total team approach.

- 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 design and engineering, all documents will be reviewed by the NORESCO PM Team, internal engineering and energy auditors to maintain 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 incorporated into the design where feasible.
- PM will meet with required inspectors where applicable.
- NORESCO will provide a copy of as-builts to CCSD in the form of hard and soft copy.

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COMMUNICATION

Successful project site management depends on effective communication between CCSD 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 daily variably communications as needed by the Senior Project Manager or the Project Developer. Additional communications would involve activities such utility interruptions required for interconnections, milestone verifications and commissioning witness testing to name a few. More frequent e-mail updates can also be provided at the request of CCSD.

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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 minimize their effects. The project scheduling documentation is readily available to CCSD for auditing, review and comment as frequently as requested by CCSD.

Along with general project scheduling, NORESCO and its subcontractors will 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 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.

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- 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 project schedule is included in Appendix B.

SAFETY

For 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's team for CCSD has worked on numerous local projects and is 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 CCSD students and staff, NORESCO employees, and subcontractors. 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 each team member will exemplify NORESCO's highest standards, work ethics and integrity.

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.

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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 design scope of ECM installation is defined, NORESCO selects the best subcontractors available to meet project needs.

Final selection of subcontractors 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 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 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.

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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 Minority and Women owned Business Enterprises (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 MWBE. 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."

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 subproject 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.

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TRAINING

Facility staff training is an integral part of a performance contract and empowers 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 CCSD 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 parts list. 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 the 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.

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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.

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Section 9.0
Commissioning Plan

OVERVIEW

PURPOSE OF THE COMMISSIONING PLAN

The purpose of the construction phase commissioning plan is to identify the requirements required for the proper operation of each energy conservation measure (ECM) as well as execution of the Measurement and Verification (M&V) requirements during implementation and post construction.

COMMISSIONING SCOPE

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and CCSD's operational needs. This is achieved during the engineering design phase through documenting the intent of the proposed ECMs, and continues through construction to final 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 CCSD's operating personnel are adequately trained.
- Track and ensure that required inspections are completed, where applicable.

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COMMISSIONED SYSTEMS

Table 9.1 identifies the ECMs that fall under the commissioning process to be implemented for this project. Appendix C contains individual commissioning specifications that apply to each ECM or technology.

Table 9.1. ECM commissioning.

ECM	Commissioning Specification (Appendix C)
Lighting System Upgrades	1 - Lighting Systems
High Bay Lighting System Upgrades	1 - Lighting Systems
Lighting Controls Upgrades	2 - Lighting Controls
Building Automation Controls Upgrades	3 - Building Automation Controls Upgrades
Replace Heat Pumps with Packaged Units	5 - Air Handling Unit (AHU) Installation
Cooling Tower Fan VFD Installations	6 - Variable Frequency Drive (VFD) Installation
Building Envelope Improvements	8 - Building Envelope Improvements
Interior Water Fixture Retrofits	9 - Water Conservation Retrofits
High Efficiency Motor Installation	11 – Electrical Motor Replacement
Transformer Replacements	12 – Dry Type Transformer Replacement

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ROLES AND RESPONSIBILITIES

TEAM MEMBERS

The members of the Commissioning Team consist of the NORESCO Project Manager, NORESCO Commissioning Agent, the CCSD Project Manager, the mechanical contractor, electrical contractor, controls contractor, and any other installing subcontractors or suppliers of equipment. CCSD'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 CCSD 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:

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 assists in resolving action items.

Mechanical Contractor, Electrical Contractor & other Sub Contractors:

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

CCSD 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.

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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, CCSD, 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 is 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 a 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 startup 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 5% - 10% sample of all newly installed equipment will be chosen for prefunctional test verification.

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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 CCSD'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.

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TRAINING AND ORIENTATION OF CCSD PERSONNEL

CCSD 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. CCSD 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 CCSD Project Manager. The CCSD Project Manager and NORESCO Project Manager review and make final approval by signing the record.

For a complete description of NORESCO provided training, refer to Section 8.0 – Project Management Plan.

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Section 10.0
Warranty

OVERVIEW

NORESCO will provide warranties for each ECM implemented in the construction scope of work. NORESCO warrants that machinery, equipment, materials, systems, supplies and other items comprising the Work that are supplied by NORESCO will:

- Conform to the specifications stated in this report to be new, except as otherwise specified or agreed to in advance by CCSD, and of good quality.
- Conform to industry standard tolerances for defects in design, material, and workmanship.
- Be furnished in accordance with Applicable Law.

NORESCO also warrants that any design documents, operating manuals, and other documentation provided by NORESCO and any Subcontractors will be prepared in accordance with Good Practices, complete, accurate and may be relied upon by CCSD for operation and maintenance of the facility. Pursuant with the scope of work in Section 5 and the Schedule in Appendix B of this report, the construction phase of the project is scheduled to be completed no later than agreed upon by CCSD and NORESCO. At that time all warranty related issues will be handled as presented in this document.

WARRANTY TERM

NORESCO warranties remain in effect for a period of one (1) year following the date of each ECM's Certification of Substantial Completion. NORESCO will transfer the manufacturer warranties for all equipment and components installed to CCSD upon the achievement of Substantial Completion. In some instances, warranty periods on equipment may extend beyond the one year period. A complete ECM warranty summary is provided in Table 10.1.

Table 10.1. CCSD expected equipment service life.

Equipment	Warranty Period	Expected Service Life (years)	Reference
Lighting System Improvements	Lamps: three (3) years parts, Ballasts: five (5) years parts and labor	20+, Ballasts 7, Lamps	Manufacturer
High Bay Lighting Upgrades	Lamps: three (3) years parts, Ballasts: five (5) years parts and labor	20+, Ballasts 7, Lamps	Manufacturer
Lighting Controls Improvements	One (1) year parts and labor	15 – 20	ASHRAE
Building Automation Controls Upgrades	One (1) year parts and labor	15 – 20	ASHRAE
Replace Heat Pumps with Packaged Units	One (1) year parts and labor Compressors: five (5) years parts	15 – 20	ASHRAE
Cooling Tower Fan VFD Installations	One (1) year parts and labor	15 – 20	ASHRAE
Building Envelope Improvements	One (1) year parts and labor	15 – 25	Estimated

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Table 10.1. CCSD expected equipment service life.			
Equipment	**Warranty Period**	**Expected Service Life (years)**	**Reference**
Interior Water Fixture Retrofits	One (1) year parts and labor	15 – 25	Estimated
Transformer Replacements	One (1) year parts and labor	15 – 20	IEEE
Network Power Management	One (1) year parts and labor	15 – 25	Estimated

TRAINING AND WARRANTIES

Before completion of construction, training for each ECM will take place to ensure CCSD facility personnel understand what is required for the safe and efficient operation of the newly installed equipment as well and the maintenance requirements. As part of this comprehensive training, NORESCO will advice the CCSD of the Warranty Service Process. For further explanation of NORESCO provided training of installed ECMs, refer to Section 8.0, Project Management Plan.

WARRANTY SERVICE CALL PROCESS

NORESCO maintains a nationwide toll-free 24-hour phone line for service and warranty emergencies. All service and warranty calls go through this service number in order to accurately track the progress of all calls to completion. To process a warranty and/or service request, operators obtain this information from the caller:

NORESCO's Business Numbers and Operating Hours:

Regular Business Hours: Monday through Friday
8:00am to 5:00pm Eastern Standard Time

24 Hour Emergency Service
In case of Emergencies, please contact the Operations Department at
(877) NORESCO or 877-667-3726
Call will be dispatched immediately

Operations Department Numbers:
24 Hours / 7 days a week
Toll Free Nationwide: (877) NORESCO or (877) 667-3726
Service Fax Number: (508) 870-1732

INCOMING WARRANTY AND SERVICE REQUEST PROCEDURE

In order to process a warranty and/or service request properly, the following information will be needed; this will allow Operations to better assign the call to the appropriate Warranty Lead person:

- Name of person placing the call.
- Phone number where they can be reached.
- Location of facility and specific area (if applicable).
- Description of the problem or service needed.
- What was done by customer, before call was placed?
- When did the problem start?

Once all pertinent information has been received, a call slip number will be assigned; this will allow NORESCO to track the progress of the call. CCSD will be given this number for reference, if they need to call on the status of the request. The call will be evaluated and assigned to the appropriate person. Operations will then stay in touch with all parties, until request has been resolved. Once the call is resolved, the status of the call slip will be closed.

Upon completion of the construction phase the warranty service call process shall be as follows.

Step 1). Internal notification to the CCSD Facility Department of equipment outage or failure.

Step 2). The CCSD Facility Department confirms that work was performed by NORESCO and is still within the warranty period for NORESCO then notifies NORESCO Warranty Service Line.

Step 3). NORESCO Warranty Service Line will assign the ticket to a Warranty Lead Person to verify that work was performed by NORESCO and is still within the warranty period for NORESCO.

Step 4). If the work is still within the NORESCO' warranty period, NORESCO will resolve the outage in a timely manner. Keep in mind that certain service work requires time to resolve (i.e. high areas requiring lifts or scaffolding, scheduling conflicts with occupants, long-lead material, etc.).

Step 5). NORESCO Warranty Lead Person will notify the CCSD Facility Department of the warranty resolution.

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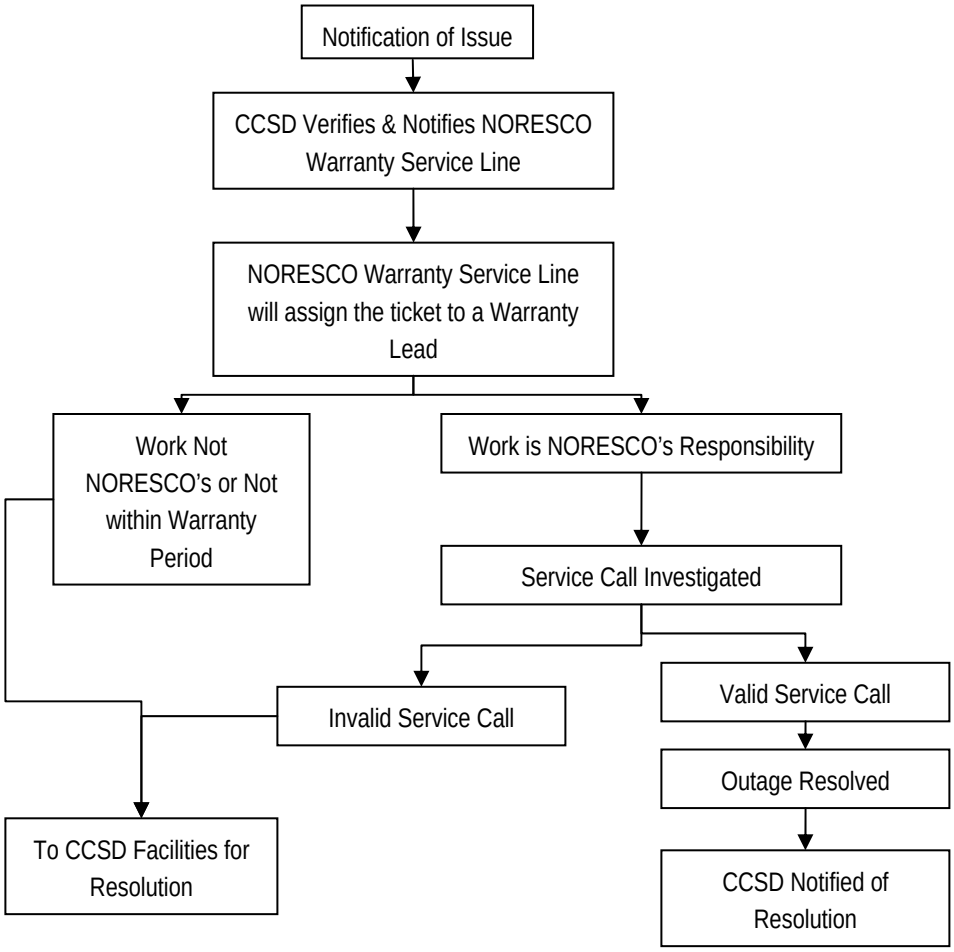
Figure 10.1. Warranty process summary



ACCESS TO AREAS

In order to resolve service calls in a timely manner it is essential that access is granted to all required areas. CCSD shall supply NORESCO and/or its delegates all necessary keys, access cards, alarm codes and/or escort as required to complete the work in a given area.

O&M DOCUMENTATION FOR SCOPE VERIFICATION

It is important to note that NORESCO and its suppliers will not warrant any work that was not performed by NORESCO. In some cases there may be buildings or areas within a facility in which NORESCO performed work but certain pieces of equipment where not retrofitted (e.g. existing T-8 fixtures, existing LED Exits, dimming fixtures, etc.). Please refer to the detailed backup to determine what work was performed by NORESCO at each location.

Shortly after the completion of the construction phase of the project, NORESCO will provide CCSD with an O&M Manual which includes a summary report for each building and the certificate of completion for each ECM. In addition, the detailed backup will be provided to CCSD describing where work was performed in each building and what type of retrofit was performed.

INVALID CALLS

Invalid service calls result from a service request wherein the cause of the outage is determined to be something other than faulty workmanship or faulty material on the part of NORESCO's work. If a service call is determined to be an invalid service call the following rates may be charged to CCSD.

Hourly Rate: $100/hour (1hour minimum)

Service Equipment / Subcontractors: Actual Cost of any expenses incurred by NORESCO

Trip Charges: Actual Cost as applicable

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