STATE OF NEW MEXICO

NEW MEXICO STATE UNIVERSITY
PROFESSIONAL SERVICES CONTRACT #_____
For Energy Performance Contracting

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STATE OF NEW MEXICO

NEW MEXICO STATE UNIVERSITY
PROFESSIONAL SERVICES CONTRACT #_____
For Energy Performance Contracting

THIS AGREEMENT is made and entered into by and between the REGENTS OF NEW MEXICO STATE UNIVERSITY, hereinafter referred to as the "Agency," and **AMERESCO, INC.**, hereinafter referred to as the "Contractor," and is effective as of the date set forth below upon which it is executed by the Agency .

RECITALS

WHEREAS, Agency owns and operates the Project Site(s), and is in need of energy cost saving equipment and services designed to save energy and associated energy costs at said Project Sites; and

WHEREAS, Agency has been authorized to enter into a third party financing agreement for all professional services, equipment and construction for the purchase and installation of energy and water cost savings measures, collectively referred to as the "Work" (as hereinafter defined); and

WHEREAS, Contractor has developed or become knowledgeable about certain procedures for controlling energy and water consumption through services provided and equipment installed and maintained at project sites similar in scope and scale of Agency; and

WHEREAS**,** Contractor was selected after a determination that its proposal was the most advantageous to Agency pursuant to a Request for Proposal and contract for the Investment Grade Audit and Project Development Proposal (as hereinafter defined); and

WHEREAS, Contractor has made an assessment of the utility consumption characteristics of the Project Site(s) and existing Equipment described in Schedule Q (Description of Project Site(s)), which was delivered to Agency as an Investment-Grade Energy Audit Report which Agency has approved and is attached as Appendix D; and

WHEREAS, Agency desires to retain Contractor to purchase, install and service certain energy and water cost savings equipment and to provide other services and strategies described in the attached Schedules, for the purpose of achieving energy and water cost reductions within Project Site(s), as more fully described herein; and

WHEREAS, Agency is authorized under the New Mexico Constitution and state law, Chapter 6, Article 23, New Mexico Statutes Annotated (NMSA) 1978, to enter into this Contract for the purposes set forth herein.

NOW, THEREFORE, in consideration of the mutual promises and covenants contained herein, and intending to be legally bound hereby, Agency and Contractor hereto covenant and agree that the following Schedules, Exhibits and Appendices are attached hereto (or will be, as provided in this Contract) and are made a part of this Contract by reference.

IT IS AGREED BETWEEN THE PARTIES:

1. Definitions.

A. "Commencement Date" means the date described in Section 6 (Commencement Date);

B. "Contract" or "Agreement" means this Energy Performance Contract and all Schedules, Exhibits, and Appendices attached hereto;

C. "Contract Sum" means the sum of all materials, labor, auditing, design, engineering, project construction management fees, overhead, profit, contingency, subcontracted services related to the Project but in no event shall the Contract Sum exceed the amount specified in Section 3B hereof;

D. "Energy and Cost Savings Guarantee" means the guarantee on Schedule A (Savings Guarantee) that is achieved as a result of the installation and operation of the Equipment and provision of services provided for in this Contract and in accordance with the Savings Calculation Formula as set forth in Schedule C (Savings Measurement and Verification (M&V) Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements). The Energy and Cost Savings Guarantee is referred to as the "Guarantee of Energy Savings" in Schedule A;

E. "Energy Cost Savings" means the savings as provided in Schedule A (Savings Guarantee);

F. "Equipment" or "ECM" or "Energy Conservation Measure" means the material goods enumerated in Schedule R (Equipment to be Installed by Contractor) that is now, or hereafter from time to time, attached hereto and incorporated herein by reference, together and with any and all additions, modifications, attachments, replacements and parts thereof;

G. "Event of Default" means those events described in Sections 65 (Events of Default by Contractor) and 64 (Events of Default by Agency) hereof;

H. "Guarantee Insurance" means the policy of insurance issued for the benefit of Contractor naming Agency as additional insured to support the Energy and Cost Savings Guarantee of Contractor;

I. "Guarantee Year" has the meaning set forth in Schedule A;

J. "Interim Period" means the period from contract execution until the Commencement Date;

K. "Investment Grade Audit" means a study by the Contractor selected for a particular energy performance contracting project, which includes detailed descriptions of the improvements recommended for the project, the estimated costs of the improvements and the

utility and operations and maintenance cost savings projected to result from the recommended improvements;

L. "Payment Bond" means the payment bond in the form of Exhibit II hereto;

M. "Performance Bond" means the performance bond in the form of Exhibit I hereto;

N. "Project Site(s)" means the facilities of the Agency in need of energy saving equipment and services designed to reduce consumption and associated costs at said Project Site(s) and at which Contractor shall install the ECMs; the Project Sites for the initial phase of this contract are set forth on Schedule Q (Description of Project Site(s) and Schedule R, Table D.01 Energy Conservation Measure Matrix.

O. "Qualified Provider" means the Contractor, which is a business experienced in the design, implementation and installation of energy or water conservation measures and who meets the experience qualifications developed by the Energy, Minerals and Natural Resources Department (EMNRD) of the State of New Mexico for energy conservation measures or the Office of the State Engineer for water conservation measures;

P. "Representative" has the meaning set forth in Section 15;

Q. "Substantial Completion" means the stage in the progress of the Work where the Work is sufficiently complete in accordance with the Contract Documents so that the Agency can utilize and take beneficial use of the Work for its intended use or purpose.

R. "Surety" means the surety issuing the Payment Bond and Performance Bond;

S. "Work" means the installation of the Equipment, materials, and performance of professional services and construction services for the project at Agency's Project Site, as described by this Agreement and attachments.

2. Scope of Work.

Contractor shall:

A. perform and complete the Work at the Agency's Project Site, as defined and described in this Agreement and the attached Schedules, Exhibits, and Appendices;

B. provide the Equipment, together with installation and other services as provided herein, as in Schedule R (Equipment to be Installed by Contractor) based upon the terms and conditions set forth in Schedule S (Construction and Installation Schedule);

C. provide the Work and all related services identified in Schedule R (Equipment to be Installed by Contractor) and the services detailed in Schedule BB (Contractor's Maintenance Responsibilities) and Schedule J (Compensation to Contractor for Annual Services);

D. supervise and direct the Work and shall be responsible for the engineering, design, and quality control; construction means, methods, techniques, sequences, and procedures; and for coordinating all portions of the Work under this Contract; and

E. comply with all federal, state, and local government laws, codes, and regulations

in effect at the time the Agreement is fully executed.

3. Compensation.

A. **[Reserved]**

B. The total amount payable to the Contractor under this Agreement, including gross receipts tax and expenses, shall not exceed **Fifteen Million Seven Hundred Thirty Four Thousand Three Hundred Six dollars ($15,734,306)** as set forth in Schedule H (Final Project Cost & Project Cash Flow Analysis). This amount is a maximum price and not a guarantee; the final price may be lower at closeout. Payment terms are described in Schedule I (Financing Agreement and Payment Schedule).

C. Contractor shall submit detailed monthly invoices in accordance with Section 11. With respect to each invoice and payment application submitted under Section 11, if the Agency finds that the Work for which payment was requested does not meet the requirements of this Agreement, then within thirty days after receipt of Contractor's payment application it shall provide the Contractor a letter of exception explaining the defect or objection to the services, and outlining steps the Contractor may take to provide remedial action. Upon certification by the Agency that the services have been received and accepted, payment shall be tendered to the Contractor within thirty days after receipt of Contractor's payment application. If payment is made by mail, the payment shall be deemed tendered on the date it is postmarked.

D. Due to the current pricing volatility of raw materials (i.e. copper, steel, PVC, fuel, and wire insulation) required to produce and transport cable, PVC products, equipment and pipes containing steel, copper and similar products, Contractor reserves the right to adjust material pricing of this proposal to reflect only the actual cost increases in such products that take place from the date of the project price was submitted to the Agency and the actual date a Notice to Proceed was issued by the Agency, allowing for the procurement of such materials. In the event that an "economic conditions" Change Order is required, copies of all relevant supplier pricing schedules will be provided to the Agency and the Change Order would only represent the actual cost increases to Contractor. Contractor will make every effort to mitigate the impact of economic conditions charges, however, if such price increases cannot be avoided, it will either result in a project price increase or a decrease in the project size.

4. Term.

A. THIS AGREEMENT SHALL NOT BECOME EFFECTIVE UNTIL APPROVED BY ALL APPROPRIATE STATE AGENCIES.

B. Subject to the following sentence, this Contract shall be effective upon its execution and the term shall continue for thirteen (13) years beginning with the Commencement Date unless sooner terminated under Section 5. The Contract shall be effective and binding upon the parties immediately upon its execution, and the period from contract execution until the Commencement Date shall be known as the "Interim Period". All energy savings achieved during the interim period will be fully credited to the Agency.

5. Termination.

A. Termination. This Agreement may be terminated by the Agency after the Commencement Date upon written notice delivered to the Contractor at least ten (10) days prior to the intended date of termination. Upon such termination, Contractor's obligations hereunder, including without limitation the Energy and Cost Savings Guarantee shall also terminate. Notwithstanding the foregoing, this Agreement may be terminated upon written notice to the Contractor if the Contractor is in default under Section 37 beyond notice and cure periods or if, during the term of this Agreement, the Contractor or any of its officers, employees or agents is indicted for fraud, embezzlement or other crime due to misuse of state funds or due to the Appropriations paragraph herein. THIS PROVISION IS NOT EXCLUSIVE AND DOES NOT WAIVE THE AGENCY'S OTHER LEGAL RIGHTS AND REMEDIES CAUSED BY THE CONTRACTOR'S DEFAULT/BREACH OF THIS AGREEMENT.

B. Termination Management. Immediately upon receipt by the Contractor of notice of termination of this Agreement, the Contractor shall: 1) not incur any further obligations for salaries, services or any other expenditure of funds under this Agreement without written approval of the Agency; 2) comply with all directives issued by the Agency in the notice of termination as to the performance of work under this Agreement; and 3) take such action as the Agency shall reasonably direct for the protection, preservation, retention or transfer of all property titled to the Agency and records generated under this Agreement. Any non-expendable personal property or equipment provided to or purchased by the Contractor with contract funds shall become property of the Agency upon termination and upon payment therefore and shall be submitted to the Agency as soon as practicable. Agency shall pay Contractor for all Work performed up until the date of termination.

6. Commencement Date.

A. The Commencement Date shall be the first day of the month after the month in which all schedules are in final form and accepted by Agency, and Contractor shall have delivered a Notice to Agency that it has installed and commenced operating all of the Equipment specified in **Schedule R (Equipment to be Installed by Contractor)** and in accordance with the provisions of **Schedule S (Construction and Installation Schedule)** and **Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment);** and Agency has inspected and accepted said installation and operation as evidenced by the Certificate of Acceptance as set forth in **Exhibit VI (Agency Certificate of Acceptance—Installed Equipment).**

B. Upon Substantial Completion of an ECM, Contractor shall deliver to Agency a substantial completion certificate in the form of Exhibit VIII (Certificate of Substantial Completion) with respect to such ECM. Within five business days after receipt of each Certificate of Substantial Completion, Agency shall complete, execute and deliver to Contractor each such Certificate of Substantial Completion. The Substantial Completion Certificate may also include a list of items ("**Punch List**"), which require completion or correction. Notwithstanding anything to the contrary in **Sections 6 and 11 (Purchase and Sale;**

Commencement Date and Terms; Interim Period), the Commencement Date shall not occur and the Agency shall not be required to accept the Work under this Contract unless and until all Equipment installation for the Project Site(s) is Substantially Completed by Contractor in accordance with the terms and conditions of this Contract. Agency shall have ten (10) days after notification by the Contractor to inspect and accept the Equipment. Agency reserves the right to reject the Equipment if installation fails to meet reasonable standards of workmanship, does not comply with applicable building codes, or is otherwise not in compliance with this Contract. Contractor shall not be paid retainage until after the punch list is completed and Contractor has satisfied any and all claims for labor and materials and the Certificate of Acceptance has been signed. The Certificate of Acceptance will not be unreasonably withheld by the Agency.

C. Compensation payments due to Contractor for on-going services under this Contract are set forth in **Schedule J (Compensation to Contractor for Annual Services).**

7. Performance Measures. [NOT APPLICABLE]

8. Contractor is Qualified Provider.

Contractor is certified as a Qualified Provider by EMNRD to perform the Work, pursuant to Sections 6-23-2E and 6-23-5 NMSA 1978 and as shown by Exhibit III (EMNRD Certification of Contractor as Qualified Provider).

9. Investment-Grade Energy Audit Report and Project Development Proposal.

Contractor has provided the complete Investment-Grade Energy Audit Report and Project Development Proposal of the Project Site(s), as set forth in Appendix D (Investment-Grade Energy Audit and Project Proposal Contract) and dated January 31, 2014. The Investment-Grade Energy Audit Report includes all energy conservation measures agreed upon by Agency and Contractor for implementation in the Work. The guaranteed energy savings of energy conservation measures stated in the Investment-Grade Energy Audit Report appear to be accurately estimated and reasonable and are certified by EMNRD, as shown in Exhibit IV (EMNRD Certification of Guaranteed Energy Savings).

10. Schedules, Exhibits and Appendices.

Contractor has provided and Agency has approved the following Schedules, Exhibits and Appendices, copies of which are attached hereto (or will be as provided for in the Contract), set forth in their entirety and made a part of this Contract by reference.

A. Schedules

Savings Guarantee

Schedule A	Energy and Cost Savings Guarantee
Schedule B	Baseline Energy Consumption; Methodology to Adjust Baseline
Schedule C	Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements

Schedules D-G *NA*

Payments and Schedule

Schedule H	Final Project Cost & Project Cash Flow Analysis
Schedule I	Financing Agreement and Payment Schedule
Schedule J	Compensation to Contractor for Annual Services
Schedule K	Rebates, Incentives and Grants
Schedules L-P	*NA*

Design and Construction Phase

Schedule Q	Description of Project Site(s)
Schedule R	Equipment to be Installed by Contractor
Schedule S	Construction and Installation Schedule
Schedule T	Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment
Schedule U	Standards of Comfort
Schedule V	Contractor's Training Responsibilities
Schedules W-AA	*NA*

Post-Construction

Schedule BB	Contractor's Maintenance Responsibilities
Schedule CC	Agency's Maintenance Responsibilities
Schedule DD	Facility Maintenance Checklist
Schedules EE-II	*NA*

Administration

Schedule JJ	Alternative Dispute Resolution Procedures
Schedules KK	Current and Known Capital Projects at Facility
Schedules LL-OO	*NA*

Optional Schedules

Pre-Existing Service Contracts
Energy Savings Projections
Facility Changes Checklist

B. Exhibits

Exhibit I	Performance Bond
Exhibit II	Labor and Material Payment Bond
Exhibit III	EMNRD Certification of Contractor as Qualified Provider
Exhibit IV	EMNRD Certification of Guaranteed Energy Savings
Exhibit V	Agency Approval of Contracts and Agreements
Exhibit VI	Agency Certificate of Acceptance—Installed Equipment
Exhibit VII	Equipment Warranties
Exhibit VIII	Certificate of Substantial Completion
Exhibit IX	Notice to Proceed

Optional Exhibits

Manifest of Ownership
Minority and Woman-Owned Business Certification
Certification that Financing Term is no Longer than the Aggregated Equipment Lifetime
Record of Reviews by Agency

C. Appendices

Appendix A RFP for Contractor Solicitation (Pre-qualification Phase; Final Selection Phase)
Appendix B Contractor Proposal (Pre-qualification Phase; Final Selection Phase)
Appendix C Investment-Grade Energy Audit and Project Development Contract
Appendix D Investment-Grade Energy Audit Report

11. Purchase and Sale.

A. NOT USED

B. Upon Contractor's receipt of a Notice to Proceed and evidence of the closing of the Agency's subordinate lien system revenue bonds issued to fund the Project, Contractor shall be responsible to pay for all labor, materials, equipment, tools, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution and completion of the Work.

C. For each month during the construction period, Agency shall make monthly progress payments to Contractor based upon the percentage of the construction and equipment procurement completed at the end of each month as shown on the monthly invoice. Contractor shall be paid the same percentage of the Contract Sum as such percentage of completion. Following the end of each month during the construction period, Contractor shall submit detailed monthly invoice payment application to Agency together with a list in sufficient detail to reasonably identify construction and equipment procurement during such month. Within thirty (30) days after receipt of such invoice, Agency shall pay or cause to be paid to Contractor the amount due under such invoice.

D. The Agency acknowledges that, prior to the execution of this Agreement, Contractor conducted a detailed energy audit and prepared the Investment Grade Audit Report in anticipation of payment therefore under this Agreement. Accordingly, full payment for the work performed in connection with the Investment Grade Audit Report shall be billed in connection with the first application for payment and shall be paid in accordance with the provisions of this Agreement, except no retention shall be deducted from the payment for the Investment Grade Audit Report. The first application for payment shall also include the actual costs for the purchase of a Payment and Performance Bond and mobilization costs, which costs shall also not be subject to retention. Mobilization costs shall be limited to an amount not greater than 5% of the total contract value, shall be itemized, and shall be limited to those costs incurred at the Project Site. As used in this paragraph D "mobilization costs" means an advance of a portion of the total Project cost.

E. Payments due to Contractor in accordance with the provisions of this Agreement, which are not paid when due, shall bear interest at a rate of twelve percent (12%) annually, or the legal prevailing interest rates in the place in which the Project is located, whichever is lower, from the date the payment was due until paid.

12. Energy Usage Records and Data.

Agency has furnished and shall continue to furnish (or authorize its energy suppliers to furnish) during the Term of this Contract to Contractor or its designee, upon its request, all of its records and complete data concerning energy and water usage and related maintenance for the Project Site(s).

13. Location and Access.

Contractor acknowledges that there exists sufficient space on the Project Site(s) for the installation and operation of the Equipment. Agency shall take reasonable steps to protect such Equipment from harm, theft and misuse during the term of this Contract. Agency shall provide access to the Project Site(s) for Contractor to perform any function related to this Contract during regular business hours, or such other reasonable hours as may be requested by Contractor and acceptable to the Agency. Contractor shall be granted immediate access to make emergency repairs or corrections as it may, in its discretion, determine are needed. The Contractor's access to Project Site(s) to make emergency repairs or corrections as it may determine are needed shall not be unreasonably restricted by the Agency. Contractor shall immediately notify the Agency when emergency action is taken and follow up with written notice within three (3) business days specifying the action taken, the reasons therefore, and the impact upon the Project Site(s), if any.

14. Permits and Approvals.

Agency shall use its best efforts to assist Contractor in obtaining all necessary permits and approvals for installation of the Equipment. In no event shall Agency, however, be responsible for payment of any permit fees. The Equipment and the operation of the Equipment by Contractor shall at all times conform to all federal, state and local code requirements. Contractor shall furnish copies of each permit or license which is required to perform the work to the Agency before the Contractor commences the portion of the work requiring such permit or license.

15. Coordination During Installation.

The Agency and Contractor shall coordinate the activities of Contractor's Equipment installers with those of the Agency, its employees, and agents. Contractor shall not commit or permit any act which will interfere with the performance of business activities conducted by the Agency or its employees without prior written approval of the Agency.

Ameresco and Agency shall each appoint one or more representatives (each, a "Representative") who shall be the primary point of contact for construction matters. Each Representative(s) may be replaced from time to time by a party, with written notice of such replacement to the other party.

The initial Ameresco Representative shall be:

Name:	James Reedy
Title:	Director – Construction
Address:	60 E. Rio Salado Parkway Suite 1001 Tempe, AZ 85281
Telephone:	508-598-4510
Cell Phone:	775-846-5125
Fax:	508-598-3380
Email:	jreedy@ameresco.com

The initial Agency Representative shall be:

Name:	Glen Haubold
Title:	Associate VP for Facilities
Address:	MSC3545 New Mexico State University PO Box 30001 Las Cruces, NM 88003-8001
Telephone:	575-646-2101
Cell Phone:	575-202-6257
Fax:	575-646-6432
Email:	ghaubold@nmsu.edu

16. <u>Construction Schedule; Equipment Installation.</u>

Construction and Equipment installation shall proceed in accordance with the preliminary construction schedule approved by Agency and attached as Schedule S (Construction and Equipment Installation Schedule). Subject to Agency's instructions to Contractor and access to the Project Site(s), Contractor shall use diligent efforts to install the Equipment in accordance with the schedule set forth on Schedule S subject to excusable delays which are outside of Contractor's control, it being acknowledged by Agency that Contractor does not control the Project Site(s). Contractor shall update the installation schedule during construction for any mutually agreed upon changes.

17. <u>Systems Startup and Equipment Commissioning.</u>

The Contractor shall conduct a thorough and systematic performance test of each element and total system of the installed Equipment in accordance with the procedures specified in Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment) and prior to acceptance of the project by the Agency as specified in Exhibit VI (Certificate of

Acceptance—Installed Equipment). Testing shall be designed to determine if the Equipment is functioning in accordance with both its published specifications and the Schedules to this Contract, and to determine if modified building systems, subsystems or components are functioning properly within the new integrated environment. The Contractor shall provide notice to the Agency of the scheduled test(s) and the Agency and/or its designees shall have the right to be present at any or all such tests conducted by Contractor and/or manufacturers of the Equipment. The Contractor shall be responsible for correcting and/or adjusting all deficiencies in systems and Equipment operations that may be observed during system commissioning procedures as specified in Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment). The Contractor shall be responsible for correcting and/or adjusting all deficiencies in Equipment operation that may be observed during system testing procedures. Prior to Agency acceptance Contractor shall also provide Agency with reasonably satisfactory documentary evidence that the Equipment installed is the Equipment specified in Schedule R (Equipment to be Installed by Contractor) or Agency may observe that the Equipment installed is the Equipment specified in Schedule R.

18. Equipment Warranties.

Contractor warrants that all Equipment sold and installed as part of this Contract is new, will be materially free from defects in materials or workmanship, will be installed properly in a good and workmanlike manner, and will function properly for a period of one (1) year from the date of the Substantial Completion for the particular energy conservation measure ("ECM"), if operated and maintained in accordance with the procedures established per building. Substantial Completion with respect to an ECM does not occur until the ECM has been commissioned, accepted, and Exhibit VIII (Certificate of Substantial Completion) is fully executed. Any warranties which exceed contractor's one (1) year warranty shall be assigned to the Agency.

A. After the warranty period, Contractor shall have no responsibility for performing maintenance, repairs, or making manufacturer warranty claims relating to the Equipment, except as provided in Schedule BB (Contractor's Maintenance Responsibilities).

B. Contractor further agrees to assign to Agency all available manufacturer's warranties relating to the Equipment and to deliver such written warranties which shall be attached and set forth as Exhibit VII (Equipment Warranties). During the one-year warranty period, Contractor shall pursue rights and remedies against the manufacturers under the warranties on behalf of Agency in the event of Equipment malfunction or improper or defective function, and defects in parts, workmanship and performance. Contractor shall, during the warranty period, notify the Agency whenever defects in Equipment parts or performance occur, which give rise to such rights and remedies and those rights and remedies are exercised by Contractor. During this one-year period, the cost of any damage to the Equipment, including damage to property and equipment of the Agency or the Project Site(s), due to Contractor's failure to pursue warranty rights under the Equipment Warranties, shall be borne solely by Contractor.

C. All warranties, to the extent transferable, shall be transferable and extend to the Agency. The warranties shall specify that only new, not reconditioned, parts may be used and

installed when repair is necessitated by malfunction. All extended warranties shall be addressed as the property of the Agency and appropriately documented and titled.

D. Notwithstanding the above, nothing in this Section shall be construed to alleviate/relieve the Contractor from complying with its obligations to perform under all terms and conditions of this Contract and as set forth in all attached Schedules.

E. **EXCEPT AS EXPRESSLY SET FORTH HEREIN OR AN EXHIBIT ATTACHED HERETO, CONTRACTOR HAS MADE AND MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE) WITH RESPECT TO THE WORK.**

19. Standards of Comfort.

During the term of this Contract, Contractor and Agency will maintain, according to Schedule BB (Contractor's Maintenance Responsibilities) and Schedule CC (Agency's Maintenance Responsibilities), and operate the Equipment in a manner that will provide the standards of comfort and levels of operation as described in Schedule U (Standards of Comfort).

20. Environmental Requirements, Excluded Material and Activities; Changed Site Conditions.

Agency recognizes that in connection with the installation and/or service or maintenance of Equipment at Agency's Project Site(s), Contractor may encounter, but is not responsible for, any work relating to (i) asbestos, materials containing asbestos, or the existence, use, detection, removal, containment or treatment thereof; (ii) fungus (any type of form of fungi, including mold or mildew, and myotoxins, spores, scents or by-products produced or released by fungi); (iii) incomplete or damaged work or systems or code violations that may be discovered during or prior to the work of this agreement; or (iv) pollutants, hazardous wastes, hazardous materials, contaminants other than those described in this Section below (collectively "Hazardous Materials"), or the storage, handling, use, transportation, treatment, or the disposal, discharge, leakage, detection, removal, or containment thereof. The materials and activities listed in the foregoing sentence are referred to as "Excluded Materials and Activities." Agency agrees that if performance of Work involves any Excluded Materials and Activities, Agency will perform or arrange for the performance of such Work and shall bear the sole risk and responsibility therefore. In the event Contractor discovers Hazardous or Excluded Materials, Contractor shall immediately cease work, remove all Contractor personnel or subcontractors from the site, and notify the Agency. The Agency shall be responsible to handle such Materials at its expense. Contractor shall undertake no further work on the Project Site(s) except as authorized by the Agency in writing. Notwithstanding anything in this Contract to the contrary, any such event of discovery or remediation by the Agency shall not constitute a default by the Agency. In the event of such stoppage of work by Contractor, the time for completion of Work will be automatically extended by the amount of time of the work stoppage and any additional costs incurred by Contractor as a result will be added by Change Order.

Contractor shall be responsible for any hazardous or other materials, including, without limitation, those listed in this section that it may bring to the Project Site(s).

Contractor shall give Agency prompt written notice if it encounters (i) subsurface or otherwise concealed conditions at the Project Sites which differ materially from those stated in the Agreement or in representations, reports and studies made or provided by the Agency, or (ii) unknown physical conditions of an unusual nature, which are not foreseeable or which differ materially from those ordinarily found to exist in connection with the performance of services substantially similar in nature to the Work to be performed under this Agreement, and which materially differ from those which are generally recognized as inherent in construction activities. The Agency and Contractor shall jointly explore value engineering opportunities in order to overcome the cost and schedule impact of any concealed site conditions encountered, with the intention of executing an appropriate Change Order that addresses changes in the Work, adjustments in the contract amount and changes to the schedule.

21. Polychlorinated Biphenyl (PCB) Ballasts; Mercury Lamps.

A. Contractor shall enter into an agreement with an approved PCB ballast disposal company that will provide an informational packet, packing receptacles and instructions, labels and shipping materials, transportation, and recycling or incineration services for PCB ballasts. All capacitors and asphalt potting compound materials removed from Agency's PCB ballasts will be incinerated in a federally approved facility. After proper disposal, a Certificate of Destruction will be provided by the approved facility to Agency. Contractor's responsibility shall be for the proper and legal management of any of Agency's PCB ballasts removed as a result of the installation of the Equipment and shall be limited only until said PCB ballasts are loaded onto an approved PCB ballast disposal Contractor's vehicle for transportation.

B. Contractor shall enter into an agreement with an approved lamp disposal company, who will provide approved containers, materials required to label, transportation, recycling or incineration in accordance with EPA requirements, and a copy of the manifest.

C. Agency agrees to sign manifests of ownership for all PCB ballasts and mercury lamps removed from the Project Site(s).

22. Training by Contractor.

The Contractor shall conduct the training program described in Schedule V (Contractor's Training Responsibilities) hereto. The Contractor shall provide ongoing training whenever needed with respect to Equipment that has been updated or altered by Contractor, including upgraded software. Such training shall be provided at no charge to the Agency and shall have no effect on prior acceptance of Equipment installation.

23. Equipment Service, Actions by Contractor.

Contractor shall provide all service, repairs, and adjustments to the Equipment installed under terms of this Contract pursuant to Schedule BB (Contractor's Maintenance Responsibilities). Agency shall incur no cost for Equipment service, repairs, and adjustments, except as set forth in Schedule J (Compensation to Contractor for Annual Services), provided, however, that when the

need for maintenance or repairs principally arises due to the negligence or willful misconduct of the Agency or any employee or other agent of Agency, and Contractor can so demonstrate such causal connection, Contractor may charge Agency for the actual cost of the maintenance or repair insofar as such cost is not covered by any warranty or insurance proceeds.

24. Malfunctions and Emergencies.

A. Agency shall use its best efforts to notify the Contractor or its designated subcontractors within 24 hours after the Agency's actual knowledge and occurrence of: (i) any malfunction in the operation of the Equipment or any preexisting energy related equipment that might materially impact upon the Guaranteed of Energy Savings, (ii) any interruption or alteration to the energy supply to the Project Site(s), or (iii) any alteration or modification in any energy-related equipment or its operation.

B. Where Agency exercises due diligence in attempting to assess the existence of a malfunction, interruption, or alteration it shall be deemed not at fault in failing to correctly identify such conditions as having a material impact upon the Guarantee of Energy Savings. Agency shall notify Contractor within twenty-four (24) hours upon its having actual knowledge of any emergency condition affecting the Equipment. Any telephonic notice of such conditions by Agency shall be followed within three business days by written notice to Contractor from Agency. If Agency unreasonably delays in so notifying Contractor of a malfunction or emergency, and the malfunction or emergency is not otherwise corrected or remedied, Contractor may charge Agency for its loss, due to the delay, associated with the guaranteed savings under this Contract for the particular time period, provided that Contractor is able to show the direct causal connection between the delay and the loss.

C. The Contractor shall provide a written record of all service work performed. This record will indicate the reason for the service, description of the problem and the corrective action performed.

25. Actions by Agency.

Agency shall not move, remove, modify, alter, or change in any way the Equipment or any part thereof without the prior written approval of Contractor except as set forth in Schedule CC (Agency's Maintenance Responsibilities). Notwithstanding the foregoing, Agency may take reasonable steps to protect the Equipment if, due to an emergency, it is not possible or reasonable to notify Contractor before taking any such actions. In the event of such an emergency, Agency shall take reasonable steps to protect the Equipment from damage or injury and shall follow instructions for emergency action provided in advance by Contractor. Agency agrees to maintain the Project Site(s) in good repair and to protect and preserve all portions thereof which may in any way affect the operation or maintenance of the Equipment.

26. Modification of Equipment.

During the Term of this Contract, Agency will not, without the prior written consent of Contractor, affix or install any accessory Equipment or device on any of the Equipment if such

addition will change or impair the originally intended functions, value or use of the Equipment without Contractor's prior written approval, which shall not be unreasonably withheld.

27. Upgrade or Alteration of Equipment.

A. Contractor shall at all times have the right, subject to Agency's prior written approval, which approval shall not be unreasonably withheld, to change the Equipment, revise any procedures for the operation of the Equipment or implement other energy saving actions in the Project Site(s), provided that: (i) the Contractor complies with the standards of comfort and services set forth in Schedule U (Standards of Comfort) herein; (ii) such modifications or additions to, or replacement of the Equipment, and any operational changes, or new procedures are necessary to enable the Contractor to achieve the guaranteed energy and cost savings at the Project Site(s) and; (iii) any cost incurred relative to such modifications, additions or replacement of the Equipment, or operational changes or new procedures shall be the responsibility of the Contractor.

B. All modifications, additions or replacements of the Equipment or revisions to operating or other procedures shall be described in a supplemental Schedule(s) to be provided to the Agency for approval, which shall not be unreasonably withheld, provided that any replacement of the Equipment shall, unless otherwise agreed, be new and have equal or better potential to reduce energy consumption at the Project Site(s) than the Equipment being replaced. All replacements of and alterations or additions to the Equipment shall become part the Equipment described in Schedule R (Equipment to be Installed by Contractor) and shall be covered by the provisions and terms of **Section 16 (Construction Schedule; Equipment Installation).** Contractor will provide updates to any software during construction, which is necessary to successful completion of an ECM. Contractor will provide updates to MyEnergyPro for the term of the contract.

28. Material Change Defined.

A. A "Material Change" shall include any change in or to the Project Site(s), whether structural, operational or otherwise in nature which reasonably could be expected, in the judgment of the Agency, to increase or decrease annual energy consumption in accordance with the provisions and procedures set forth in Schedule B (Baseline Energy Consumption; Methodology to Adjust Baseline) and Schedule C (Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements) by at least 2 % of the aggregate consumption of the buildings within the Contractor's scope of work after adjustments for climatic variations.

B. Actions by the Agency which may result in a Material Change include, but are not limited to, the following:

i) manner of use of the Project Site(s) by the Agency; or
ii) hours of operation for the Project Site(s) or for any Equipment or energy using systems operating at the Project Site(s); or

iii) Permanent changes in the Standard of Comfort and service parameters set forth in Schedule U (Standards of Comfort); or

iv) occupancy of the Project Site(s); or

v) structure of the Project Site(s); or

vi) types and quantities of Equipment used at the Project Site(s) or

vii) modification, renovation or construction at the Project Site(s); or

viii) the Agency's failure to provide maintenance of and repairs to the Equipment in accordance with Schedule CC (Agency's Maintenance Responsibilities); or

ix) any other conditions other than climate affecting energy use at the Project Site(s) including but not limited to the replacement, addition or removal of energy and water consuming devices whether plug in or fixed assets,

x) casualty or condemnation of the Project Site(s) or Equipment, or

xi) changes in utility provider or utility rate classification, or

xii) any other conditions other than climate affecting energy or water use at the Project Site(s).

xiii) Modifications, alterations or overrides of the energy management system schedules or hours of operation, set back/start up or holiday schedules.

29. Reported Material Changes; Notice by Agency.

The Agency shall use its best efforts to deliver to the Contractor a written notice describing all actual or proposed Material Changes in the Project Site(s) or in the operations of the Project Site(s) at least thirty (30) days before any actual or proposed Material Change is implemented or as soon as is practicable after an emergency or other unplanned event. Notice to the Contractor of Material Changes which results because of a bona fide emergency or other situation which precludes advance notification shall be deemed sufficient if given by the Agency within ten (10) calendar days after having actual knowledge that the event constituting the Material Change occurred or was discovered by the Agency to have occurred.

30. Other Adjustments.

As agreed in **Section 29 (Reported Material Changes; Notice by Agency)** Agency will alert Contractor of Materials Changes as known. Both parties have a vested interest in meeting the guaranteed savings of the Contract. As such, the Contractor shall work with Agency to investigate, identify and correct any changes that prevent the guaranteed savings from being realized. As a result of such investigation, Contractor and Agency shall determine what, if any, adjustments to the baseline will be made in accordance with the provisions set forth in Schedule B (Baseline Energy Consumption; Methodology to Adjust Baseline) and Schedule C (Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements). Any disputes between the Agency and the Contractor concerning any such adjustment shall be resolved in accordance with the provisions of Schedule JJ (Alternative Dispute Resolution Procedures) hereto.

31. Corrective Action; Accuracy of the Services.

A. Contractor shall perform all tasks/phases under the Contract, including construction and installation of the Equipment in such a manner so as not to harm the structural integrity of the buildings or their operating systems. Contractor shall repair and restore to its original condition any area of damage caused by Contractor's performance under this Contract. The Agency reserves the right to review the work performed by Contractor and to direct Contractor to take certain corrective action if, in the opinion of the Agency, the structural integrity of the Project Site(s) or its operating system is or will be harmed. All costs associated with such corrective action to damage caused by Contractor's performance of the work shall be borne by Contractor.

B. Contractor shall remain responsible for the professional and technical accuracy of all services performed, whether by the Contractor or its subcontractors or others on its behalf, throughout the term of this Contract.

32. Annual Reporting Requirements; Annual ENERGY STAR Rating.

At the end of each Guarantee Year during the guarantee period as specified in Schedule A (Savings Guarantee) and no later than ninety (90) days after receiving all utility billing and other data reasonably requested by Contractor, the Contractor shall complete and submit the data required in Schedule C (Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements). The Contractor shall provide an ENERGY STAR rating value for each eligible facility for each year of the guarantee period if applicable.

33. Other Documents.

This Contract incorporates herein and makes a part hereof the entire Request for Proposal and Project Development Proposal, labeled Appendix A and B, respectively. Notwithstanding, the provisions of this Contract and the attached Schedules and Exhibits shall govern in the event of any inconsistencies between the Contract and the Appendices including without limitation the Investment-Grade Energy Audit Report.

34. Energy and Cost Savings Guarantee.

Contractor has formulated and, subject to the adjustments provided for in Sections 28, 29 and 30 (Material Changes), has guaranteed the annual level of energy cost savings to be achieved as a result of the installation and operation of the Equipment and provision of services provided for in this Contract in accordance with the methods of savings measurement and verification as set forth in Schedule C (Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements). The Energy and Cost Savings Guarantee is set forth in annual increments for the term of the Contract beginning on the Commencement Date as specified in Schedule A (Savings Guarantee) and has been structured by the Contractor to be sufficient to cover any and all annual payments required to be made by the Agency as set forth in Schedule J (Compensation to Contractor for Annual Services), Schedule I (Financing Agreement and Payment Schedule) and necessary to procure the guarantee and all payment and performance bonds. The Energy and Cost Savings Guarantee is subject to Agency performing its maintenance and other obligations under this Agreement.

35. Annual Review and Reimbursement/Reconciliation.

A. Energy-related cost savings shall be measured and/or calculated as specified in Schedule C (Savings Measurement and Verification Plan; Post-Retrofit M&V Plan; Annual M&V Reporting Requirements) and a report provided within ninety (90) days of the end of the Guarantee Year after Contractor receives all utility billing and other operational data such as ECM trends logs reasonably requested by Contractor for the previous Guarantee Year for each anniversary of the Commencement Date.

B. Annual Energy Cost Savings shall exceed annual payments each and every year while this Contract is in effect. In the event the Energy Cost Savings achieved during a Guarantee Year are less than the Energy and Cost Savings Guarantee as defined in Schedule A (Savings Guarantee), Contractor shall pay the Agency an amount equal to the deficiency. In addition, Contractor may, upon agreement of the Agency and Contractor, at Contractor's sole expense, install additional ECM(s), or modifications that are mutually agreed to by Agency in order to achieve the applicable Energy and Cost Savings Guarantee.

C. The Contractor shall remit such payments to the Agency within thirty (30) days of written notice by the Agency of such monies due. Excess savings in any guarantee year will be retained by Agency and will not be allocated to shortfalls in savings in other years. In no event shall credit for excess Guaranteed Energy Cost Savings be used to satisfy saving guarantees in any other year(s) of the Contract.

36. Contractor Compensation and Fees.

Contractor has structured the Energy and Cost Savings Guarantee referred to in Section 34 above, to be sufficient to include any and all annual payments required to be made by the Agency in connection with financing/purchasing the Equipment to be installed by Contractor under this Contract as set forth in Schedule I (Financing Agreement and Payment Schedule). Actual energy and operations savings achieved by Contractor through the operation of Equipment and performance of services by Contractor shall be sufficient to cover any and all annual fees to be paid by Agency to Contractor for the provision of services as set forth and in accordance with the provisions of Schedules J (Compensation to Contractor) and BB (Contractor's Maintenance Responsibilities).

37. Billing Information Procedure.

Payments due to Contractor shall be made as specified in Section 11.

38. Payment.

Notwithstanding any contrary payment terms in any Schedule, Agency shall pay Contractor within thirty (30) days of receipt of Contractor's undisputed invoice as described in Section 11. If Agency disputes an invoice, Agency shall notify Contractor of such dispute within seven (7) days after receipt of invoice.

39. Effective Date of Payment Obligation.

Notwithstanding the above provisions, Agency shall not be required to begin any payments to Contractor under this Contract for post-construction Measurement and Verification services, or any other on-going services, unless and until all Equipment installation is completed by Contractor in accordance with the provisions of Section 16 (Construction Schedule; Equipment Installation) and Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment), and accepted by Agency as evidenced by the signed Certificate of Acceptance as set forth in Exhibit VI (Certificate of Acceptance—Installed Equipment), and unless and until said Equipment is fully and properly functioning.

40. Open Book Pricing.

Open book pricing will be required, such that the Contractor shall fully disclose all costs of materials and labor purchased and subcontracted by the Contractor and a list of hourly rates and position descriptions for labor or services provided by the Contractor. Estimates for number of hours required for the Project and deviations of these budgeted hours shall require prior written approval by the owner or shall not be paid. Contractor shall maintain cost accounting records on authorized Work performed under actual costs for labor and material, or other basis requiring accounting records. Contractor shall afford Agency access to these records and preserve them for a period of three (3) years after final payment. The pricing methodology and individual cost markups disclosed during preliminary contract negotiations will be expected to be applied, providing the scope and size of the Project remain the same as assumed when markups were disclosed.

41. Ownership of Certain Proprietary Property Rights.

Agency shall not, by virtue of this Contract, acquire any interest in any formulas, patterns, devices, secret inventions or processes, copyrights, patents, other intellectual or proprietary rights, or similar items of property which are or may be used in connection with the Equipment. The Contractor shall grant to the Agency a perpetual, irrevocable royalty-free license for any and all software or other intellectual property rights necessary for the Agency to continue to operate, maintain, and repair the Equipment in a manner that will yield Guaranteed Energy Cost Savings for the specified contract term. Contractor shall not be liable for providing new versions of software or other enhancements if or unless such new versions or enhancements are necessary to achieve the Energy and Cost Savings Guarantee. Contractor shall provide updates to MyEnergyPro for the term of the Contract in accordance with Section 27(B).

42. Ownership of Existing Equipment.

Ownership of the equipment and materials presently existing at the Project Site(s) at the time of execution of this Contract shall remain the property of the Agency even if it is replaced or its operation made unnecessary by Work performed by Contractor pursuant to this Contract. If applicable, Contractor shall advise the Agency in writing of all equipment and materials to be replaced at the Project Site(s) and the Agency shall within five (5) business days designate in

writing to the Contractor which equipment and materials that should not be disposed of off-site by the Contractor. It is understood and agreed to by both the Contractor and the Agency that the Agency shall be responsible for and designate the location and storage for any equipment and materials that should not be disposed of off-site. The Contractor shall be responsible for the disposal of all equipment and materials designated by the Agency as disposable off-site in accordance with all applicable laws and regulations regarding such disposal.

43. Damages to Equipment or Property.

Contractor shall be responsible for any damage to the Equipment or other property on the Project Site(s) caused by Contractor or its subcontractors.

44. Liabilities.

Neither party shall be liable for any special, incidental, indirect, punitive or consequential damages, arising out of or in connection with this Contract. Further, the liability of either party under this Contract shall not exceed the Contract Sum in the aggregate.

45. Appropriations.

The terms of this Agreement are contingent upon sufficient appropriations and authorization being made by the Legislature of New Mexico for the performance of this Agreement. If sufficient appropriations and authorization are not made by the Legislature, this Agreement shall terminate on the last day of the fiscal year for which appropriations were made, without penalty or expense to the Agency of any kind whatsoever, except as to the portions of payments herein agreed upon for which Agency and/or other funds shall have been appropriated and budgeted or are otherwise available, and upon written notice being given by the Agency to the Contractor. The Agency's decision as to whether sufficient appropriations are available shall be accepted by the Contractor and shall be final. If the Agency proposes an amendment to the Agreement to unilaterally reduce funding, the Contractor shall have the option to terminate the Agreement or to agree to the reduced funding, within thirty (30) days of receipt of the proposed amendment.

46. Status of Contractor.

The Contractor and its agents and employees are independent contractors performing professional services for the Agency and are not employees of the State of New Mexico. The Contractor and its agents and employees shall not accrue leave, retirement, insurance, bonding, use of state vehicles, or any other benefits afforded to employees of the State of New Mexico as a result of this Agreement. The Contractor acknowledges that all sums received hereunder are reportable by the Contractor for tax purposes, including without limitation, self-employment and business income tax. The Contractor agrees not to purport to bind the Agency unless the Contractor has express written authority to do so, and then only within the strict limits of that authority.

47. Subcontracting.

The Contractor shall not subcontract any portion of the services to be performed under this Agreement without the prior written approval of the Agency, not to be unreasonably withheld, conditioned or delayed. Agency shall approve or provide reasons for disapproval within two business days after request therefor. Agency shall designate in writing to Contractor the Agency representatives authorized to accept Change Orders, authorize approvals and manage the Project.

48. (Section Intentionally Deleted).

49. Confidentiality.

Any confidential information provided to or developed by the Contractor in the performance of this Agreement shall be kept confidential and shall not be made available to any individual or organization by the Contractor without the prior written approval of the Agency. Contractor's systems, methods, means and methodologies of evaluating, implementing, and performing under this Agreement shall be considered confidential. When any request for disclosure of such information is made under the New Mexico Inspection of Public Records Act , Agency shall provide prompt notice to Contractor so that Contractor may have the opportunity to object; such approval shall not be reasonably withheld.

50. Product of Service -- Copyright.

All materials developed or acquired by the Contractor under this Agreement shall become the property of the Agency and shall be delivered to the Agency no later than the termination date of this Agreement or payment therefore. Nothing developed or produced, in whole or in part, by the Contractor under this Agreement shall be the subject of an application for copyright or other claim of ownership by or on behalf of the Contractor.

51. Conflict of Interest; Governmental Conduct Act.

The Contractor warrants that it presently has no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance or services required under the Agreement. The Contractor certifies that the requirements of the Governmental Conduct Act, Sections 10-16-1 through 10-16-18, NMSA 1978, regarding contracting with a public officer or state employee or former state employee have been followed.

52. Amendment.

This Agreement shall not be altered, changed or amended except by instrument in writing executed by the parties hereto.

53. Merger.

This Agreement incorporates all the Agreements, covenants and understandings between the parties hereto concerning the subject matter hereof, and all such covenants, Agreements and understandings have been merged into this written Agreement. No prior Agreement or

understanding, oral or otherwise, of the parties or their agents shall be valid or enforceable unless embodied in this Agreement.

54. Penalties for violation of law.

The Procurement Code, Sections 13-1-28 through 13-1-199, NMSA 1978, imposes civil and criminal penalties for its violation. In addition, the New Mexico criminal statutes impose felony penalties for illegal bribes, gratuities and kickbacks.

55. Equal Opportunity Compliance.

The Contractor agrees to abide by all federal and state laws and rules and regulations, and executive orders of the Governor of the State of New Mexico, pertaining to equal employment opportunity. In accordance with all such laws of the State of New Mexico, the Contractor assures that no person in the United States shall, on the grounds of race, religion, color, national origin, ancestry, sex, age, physical or mental handicap, or serious medical condition, spousal affiliation, sexual orientation or gender identity, be excluded from employment with or participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity performed under this Agreement. If Contractor is found not to be in compliance with these requirements during the life of this Agreement, Contractor agrees to take appropriate steps to correct these deficiencies.

56. Applicable Law.

The laws of the State of New Mexico shall govern this Agreement, without giving effect to its choice of law provisions. Venue shall be proper only in a New Mexico court of competent jurisdiction in accordance with Section 38-3-1 (G) NMSA 1978. By execution of this Agreement, Contractor acknowledges and agrees to the jurisdiction of the courts of the State of New Mexico over any and all lawsuits arising under or out of any term of this Agreement.

57. Insurance.

Contractor shall purchase and maintain statutory limits of Worker's Compensation, and Public Liability and Automobile Liability insurance approved by NMSU at the time of contract award. The Regents of New Mexico State University shall be included as a loss payee and/or additional insured. Public Liability and Automobile Liability insurance shall include at least the following coverage:

Commercial General Liability, $1,000,000 per occurrence

Professional Liability, $1,000,000 per occurrence

Employee Dishonesty Insurance (Fidelity Bond), $1,500,000 per occurrence

Automobile Liability Insurance, Per State Statute

Contractor shall furnish Agency annually at the beginning of each contract year a Certificate of Insurance evidencing such coverage as respects Contractor's operation on the Project Site(s). A copy of the certificate shall be forwarded to New Mexico State University, Central Purchasing & Risk Management Office, P.O. Box 30001, MSC 3890, Las Cruces, NM 88003-8001.

58. Workers Compensation.

The Contractor agrees to comply with State laws and rules applicable to workers compensation benefits for its employees. If the Contractor fails to comply with the Workers Compensation Act and applicable rules when required to do so, this Agreement may be terminated by the Agency.

59. Records and Financial Audit.

The Contractor shall maintain detailed time and expenditure records that indicate the date; time, nature and cost of services rendered during the Agreement's term and effect and retain them for a period of three (3) years from the date of final payment under this Agreement. The records shall be subject to inspection by the Agency, the Department of Finance and Administration and the State Auditor. The Agency shall have the right to audit billings both before and after payment. Payment under this Agreement shall not foreclose the right of the Agency to recover excessive or illegal payments.

60. Indemnification.

The Contractor shall defend, indemnify and hold harmless the Agency and the State of New Mexico from all actions, proceedings, claims, demands, costs, damages, reasonable attorneys' fees and all other liabilities and expenses of any kind for personal injury or property damage to third parties to the extent caused by the negligence of the Contractor, its officers, employees, servants, subcontractors or agents. In the event that any action, suit or proceeding related to the services performed by the Contractor or any officer, agent, employee, servant or subcontractor under this Agreement is brought against the Contractor, the Contractor shall, as soon as practicable but no later than fourteen (14) days after it receives notice thereof, notify the legal counsel of the Agency and the Risk Management Division of the New Mexico General Services Department by certified mail.

61. Invalid Term or Condition.

If any term or condition of this Agreement shall be held invalid or unenforceable, the remainder of this Agreement shall not be affected and shall be valid and enforceable.

62. Enforcement of Agreement.

A party's failure to require strict performance of any provision of this Agreement shall not waive or diminish that party's right thereafter to demand strict compliance with that or any other provision. No waiver by a party of any of its rights under this Agreement shall be effective unless express and in writing, and no effective waiver by a party of any of its rights shall be

effective to waive any other rights.

63. Conditions Beyond Control Of The Parties.

If a party ("performing party") shall be unable to reasonably perform any of its obligations under this Contract due to Force Majeure, this Contract shall at the other party's option (i) remain in effect but said performing party's obligations shall be suspended until the said events shall have ended; or, (ii) if the parties cannot reasonably resume performance under this Contract within ninety (90) days after the Force Majeure ends, the other party may terminate this Contract upon ten (10) days notice to the performing party, in which event neither party shall have any further liability to the other except that Contractor shall be paid for all work performed up through the date of termination.

(a) Neither party shall be in default of its obligations under this Agreement (excepting the obligation to pay moneys when due) to the extent its inability to perform results from Force Majeure, as defined in subsection (b) of this Section 63; provided, however, that an event of Force Majeure shall not relieve a party of its obligations that arise prior to the occurrence of the event. Contractor will be entitled to have the Work schedule extended on account of the Force Majeure. The party affected by Force Majeure shall give written notice of the occurrence giving rise to the Force Majeure to the other party within five (5) business days following the start of the occurrence. The affected party shall exercise all due diligence to overcome an event of Force Majeure causing a delay to its performance.

(b) For the purposes hereof, "**Force Majeure**" means any cause or causes beyond the reasonable control of the party which, as a result thereof, is unable to perform its obligations, including, without limitation, the following: an act of God; explosion; fire; flood; drought; epidemic; earthquake; storm; riot; insurrection; blockage; war, act of terrorism or other hostilities; strike; lockout or other industrial disturbance (even if such labor difficulty may have been avoided or may be settled by acceding to the demands of the party in dispute); act or restraint of governmental authority, whether valid or invalid, and action or inaction by any such authority which causes the lapse of necessary governmental authorizations, permits, license, certificates or approvals; shortage of supplies; utility power outages; interruption or curtailment of transmission or distribution of power; material breakage of or accidents to, machinery or equipment; and any other cause or event, whether foreseen or unforeseeable, which is reasonably beyond the control of the party claiming Force Majeure and which the affected party is not able to overcome by the exercise of reasonable diligence, provided that no party will be required to settle any strike, lockout or other industrial disturbance on terms which in its sole discretion are unsatisfactory.

64. Events of Default by Agency.

A. Each of the following events or conditions shall constitute an "Event of Default" by Agency:

i) any failure by Agency to pay Contractor any sum due for a service and maintenance period of more than 10 days after written notification by Contractor that Agency is delinquent in making payment and provided that Contractor is not in default in its performance under the terms of this Contract; or

ii) any other material failure by Agency to perform or comply with the terms and conditions of this Contract, including breach of any covenant contained herein, provided that such failure continues for 30 days after notice to Agency demanding that such failures to perform be cured or if such cure cannot be effected in 30 days, Agency shall be deemed to have cured default upon the commencement of a cure within 30 days and diligent subsequent completion thereof within sixty days;

iii) any representation or warranty furnished by Agency in this Contract which was false or misleading in any material respect when made

iv) Agency goes into receivership or makes an assignment for the benefit of creditors or a petition is filed by or against Agency under any bankruptcy, insolvency or similar law and such petition is not dismissed within sixty (60) days.

65. <u>Events of Default by Contractor.</u>

A. Each of the following events or conditions shall constitute an "Event of Default" by Contractor:

i) the standards of comfort and service set forth in Schedule U (Standards of Comfort) are not provided due to failure of Contractor to properly design and install, the Equipment except that such failure, if corrected or cured within 14 days after written notice by Agency to Contractor demanding that such failure be cured, shall be deemed cured for purposed of this Contract.

ii) any representation or warranty furnished by Contractor in this Contract is false or misleading in any material respect when made;

iii) [deleted];

iv) provided that the operation of the facility is not adversely affected in which case Contractor shall have a fourteen day cure period, any failure by Contractor to perform or comply with the terms and conditions of this Contract, including breach of any covenant contained herein except that such failure, if corrected or cured within 30 days after written notice by the Agency to Contractor demanding that such failure to perform be cured, shall be deemed cured for purposes of this Contract unless such failure cannot be completely cured within thirty days, in which case a default shall exist only if Contractor does not commence and diligently cure such failure as soon as possible;

v) any lien or encumbrance upon the equipment by any subcontractor, laborer or material vendor of Contractor is filed and not discharged or bonded over within thirty days;

vi) the filing of a bankruptcy petition whether by Contractor or its creditors against Contractor which proceeding shall not have been dismissed within ninety (90) days of its filing, or an involuntary assignment for the benefit of all creditors or the liquidation of Contractor.

vii) failure by the Contractor to pay any amount due the Agency or perform any obligation under the terms of this Contract or the Energy and Cost Savings Guarantee as set forth in Schedule A (Savings Guarantee).

66. <u>Remedies upon Default by Agency.</u>

If an Event of Default by Agency occurs, Contractor may, without a waiver of other remedies

which exist in law or equity, exercise any remedies available at law or in equity or other appropriate proceedings including bringing an action or actions from time to time for recovery of amounts due and unpaid by Agency, and/or for damages which shall include all costs and expenses reasonably incurred in exercise of its remedy.

67. Remedies Upon Default by Contractor.

In the Event of Default by Contractor, Agency may exercise any remedies at law or equity, or institute other proceedings, including, without limitation, bringing an action or actions from time to time for specific performance, and/or for the recovery of amounts due and unpaid and/or for damages, which shall include all costs and expenses reasonably incurred.

68. Assignment.

The Contractor shall not assign or transfer any interest in this Agreement or assign any claims for money due or to become due under this Agreement without the prior written approval of the Agency.

69. Assignment by Contractor.

The Contractor may, with prior written approval of the Agency, which consent shall not be unreasonably withheld, delegate its duties and performance under this Contract, and/or utilize contractors, provided that any assignee(s), delegee(s), or contractor(s) shall fully comply with the terms of this Contract. Notwithstanding the provisions of this paragraph, the Contractor shall remain jointly and severally liable with its assignees(s), or transferee(s) to the Agency for all of its obligations under this Contract.

70. Assignment by Agency.

Agency may transfer or assign this Contract and its rights and obligations herein to a successor or purchaser of the Buildings or an interest therein. The Agency shall remain jointly and severally liable with its assignees or transferees to the Contractor for all of its obligations under this Contract.

71. Representations and Warranties.

A. Each party warrants and represents to the other that:

i) it has all requisite power, authority, licenses, permits, and franchises, corporate or otherwise, to execute and deliver this Contract and perform its obligations hereunder;

ii) its execution, delivery, and performance of this Contract have been duly authorized by, or are in accordance with, its organic instruments, and this Contract has been duly executed and delivered for it by the signatories so authorized, and it constitutes its legal, valid, and binding obligation;

iii) its execution, delivery, and performance of this Contract will not breach or

violate, or constitute a default under its charter, bylaws and/or organizational documents or any law; or

iv) it has not received any notice, nor to the best of its knowledge is there pending or threatened any notice, of any violation of any applicable laws, ordinances, regulations, rules, decrees, awards, permits or orders which would materially and adversely affect its ability to perform hereunder.

72. <u>Additional Representations of the Parties.</u>

A. Agency hereby warrants, represents and promises that:

i) it has provided or shall provide timely to Contractor, all records relating to energy usage and energy-related maintenance of Project Site(s) requested by Contractor and the information set forth therein is, and all information in other records to be subsequently provided pursuant to this Contract will be true and accurate in all material respects; and

ii) it has not entered into any leases, contracts or Contracts with other persons or entities regarding the leasing of energy efficiency equipment or the provision of energy management services for the Project Site(s) or with regard to servicing any of the energy related equipment located in the Project Site(s). Agency shall provide Contractor with copies of any successor or additional leases of energy efficiency equipment and contracts for management or servicing of preexisting equipment at Project Site(s) which may be executed from time to time hereafter within 15 days after execution thereof.

B. Contractor hereby warrants, represents and promises that before commencing performance of this Contract:

i) it shall have become licensed or otherwise permitted to do business in the State of New Mexico.

ii) it shall have provided proof and documentation of required insurance and bonds pursuant to this Contract;

iii) it shall make available, upon reasonable request, all documents relating to its performance under this Contract, including all contracts and subcontracts entered into;

iv) it shall use qualified subcontractors who are qualified, licensed and bonded in this state to perform the work so subcontracted pursuant to the terms hereof;

v) the Equipment will meet or exceed the provisions set forth in Section 17 (Systems Start Up and Equipment Commissioning) and in Schedule T (Systems Start-Up and Commissioning; Operating Parameters of Installed Equipment).

vi) the Equipment is or will be compatible with all other Project Site(s) mechanical and electrical systems, subsystems, or components with which the Equipment interacts, and that, as installed, neither the Equipment nor such other systems, subsystems, or components will materially adversely affect each other as a direct or indirect result of Equipment installation or operation;

vii) it is financially solvent, able to pay its debts as they mature and possessed of sufficient working capital to complete the Work and perform its obligations under this Contract.

73. Construction Performance and Payment Bonds, Labor and Material Payment Bonds.

Such executed bonds are incorporated herein by reference as **Exhibit I (Performance Bond)** and **Exhibit II (Labor and Material Payment Bond, if applicable).**

The parties acknowledge that the Payment and Performance Bond under this Agreement are issued under the following conditions:

Provided, however, notwithstanding any provisions to the contrary set forth in this Agreement, Contractor and Surety shall not be liable to the Agency or any third party with respect to any and all claims, demands, losses, damages, cost and expenses, whether based on tort, warranty, strict liability, professional liability, contribution or otherwise, and with respect to any and all indemnification obligations specified in this Agreement for loss of profits or revenue, or for incidental, special, punitive, exemplary, indirect or consequential damages of any kind.

Contractor will provide a standard warranty of one (1) year following the Substantial Completion date of construction for the project, which will include material and installation. Warranties which extend beyond that time period will be provided by either the subcontractor(s) or material suppliers/manufacturers and will be assigned to the Agency. Upon termination of the standard one (1) year warranty, Contractor will assign all subcontractor and material supplier/manufacturer warranties to the Agency. Subsequently, the Performance Bond shall cover only the physical completion of the construction work. It is further understood that the Performance Bond does not cover, whatsoever, any maintenance, operational and/or service requirements, promises, guarantees including performance guarantees, savings and/or efficiency guarantees, or similar type requirements, subject to the sole exception of the aforementioned one (1) year warranty from the date of physical substantial completion of the construction work covering solely defects in materials and workmanship. The Surety assumes no liability for any additional warranty, guaranty, maintenance, operational or service aspect of the contract

74. Further Documents.

The parties shall execute and deliver all documents and perform all further acts that may be reasonably necessary to effectuate the provisions of this Contract**.**

75. Methods of Operation by Agency.

The parties acknowledge and agree that the Energy and Cost Savings on Schedule A would not likely be achieved unless certain procedures and methods of operation designed for energy and water conservation shall be implemented, and followed by Agency on a regular and continuous basis.

76. Agency's Maintenance Responsibilities.

Agency agrees that it shall adhere to, follow and implement the energy conservation procedures and methods of operation to be set forth on Schedule CC (Agency Maintenance

Responsibilities), to be attached hereto and made a part hereof after Agency's approval, such approval not to be unreasonably withheld, conditioned or delayed.

77. Inspection of Project Site(s).

Agency agrees that Contractor shall have the right once a month, with prior notice, to inspect Project Site(s) to determine if Agency is complying, and shall have complied with its obligations as set forth in **Section 76 (Agency's Maintenance Responsibilities).** For the purpose of determining Agency's said compliance, the checklist to be set forth at **Schedule DD (Facility Maintenance Checklist)** as completed and recorded by Contractor during its monthly inspections, shall be used to measure and record Agency's said compliance. Agency shall make the Project Site(s) available to Contractor for and during each monthly inspection, and shall have the right to witness each inspection and Contractor's recordation on the checklist. Agency may complete its own checklist at the same time. Contractor agrees to not interfere with the Agency operations during any monthly inspection.

78. Waiver Of Liens.

Contractor shall obtain and furnish to Agency a Waiver of Liens from each vendor, material manufacturer and laborer in the supply, installation and servicing of each piece of Equipment. Such lien waivers will be provided to Agency upon Agency's request.

79. Conflicts of Interest.

Conflicts of interest relating to this Contract are strictly prohibited. Except as otherwise expressly provided herein, neither party hereto nor any director, employee or agent of any party hereto shall give to or receive from any director, employee or agent of any other party hereto any gift, entertainment or other favor of significant value, or any commission, fee or rebate in connection with this Contract. Likewise, neither party hereto nor any director, employee or agent of either party hereto, shall without prior notification thereof to the other party enter into any business relationship with any director, employee or agent of the other party or of any affiliate of the other party, unless such person is acting for and on behalf of the other party or any such affiliate. A party shall promptly notify the other party of any violation of this section and any consideration received as a result of such violation shall be paid over or credited to the party against whom it was charged. Any representative of any party, authorized by that party, may audit the records of the other party related to this Contract, upon reasonable notice and during regular business hours including the expense records of the party's employees involved in this Contract, upon reasonable notice and during regular business hours, for the sole purpose of determining whether there has been compliance with this section.

80. Notices.

Any notice required to be given to or approval granted by either party by this Agreement shall be in writing and shall be delivered in person, by courier service or by U.S. mail, either first class or certified, return receipt requested, postage prepaid, as follows:

To the Agency:

New Mexico State University
MSC 3545
Las Cruces, NM 88003-8001
Attn: Associate Vice President of Facilities

To the Contractor: Ameresco, Inc.
60 E. Rio Salado Parkway, Suite 1001
Tempe, AZ 85281
Attention: Vice President

With a copy to: Ameresco, Inc.
111 Speen Street, Suite 410
Framingham, MA 01701
Attention: General Counsel

New Mexico State University
MSC 3UGC
PO Box 30001
Las Cruces, NM 88003
Attn: General Counsel

81. Non-Substitution.

In the event of a termination of this contract due to the non-appropriation of funds or in the event this Contract is terminated by Contractor due to a default by the Agency, the Agency agrees, to the extent permitted by state law, not to purchase, lease, rent, borrow, seek appropriations for, acquire or otherwise receive the benefits of any of the same and unique services performed by Contractor under the terms of this Contract for a period of three-hundred sixty five (365) calendar days following such default by Agency, or termination of this Contract due to non-appropriations.

82. Authority.

If Contractor is other than a natural person, the individual(s) signing this Agreement on behalf of Contractor represent and warrant that he or she has the power and authority to bind Contractor, and that no further action, resolution, or approval from Contractor is necessary to enter into a binding contract. (I've encountered some situations where there was a question whether the person signing had authority; having the contractor assure the agency the person signing has authority creates an argument the agency has no obligation to check.

83. Change Orders.

(a) A Change Order is a written document, prepared by Contractor and signed by both parties to this Agreement (and where required by Agency's financing, the lender or financing agent or any other required governmental entity on behalf of Agency, if necessary), which signifies an agreement between Contractor and the Agency for a change of the following: (i) changes in the Work; (ii) if appropriate, an adjustment to the Contract Sum; or (iii) an adjustment to Schedule S.

(b) If the Agency requests a proposal from Contractor for a change in the Work, and subsequently elects not to proceed with the change, a Change Order shall be issued to reimburse Agency for any costs reasonably incurred for estimating services, design services and preparation of proposed revisions to the Agreement. No change in the Work (including design estimates) shall be performed by Contractor until the Agency has first signed a written Change Order. Contractor shall provide those costs prior to proceeding with the Work and the estimate shall include all related costs.

(c) If Contractor and the Agency agree to an adjustment of the Contract Sum and the contract schedule, such an agreement shall be effective immediately, providing that Agency has confirmed such an agreement and writing and shall be confirmed in writing by Agency, followed by the preparation and execution of a Change Order.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the date of signature.

AGENCY:
New Mexico State University

By: _____ Date:_____
Name:

By: _____ Date:_____
Agency's Legal Counsel –Certifying legal sufficiency

CONTRACTOR:
Ameresco, Inc.

By: _____ Date: _____
Name:
Title:

The records of the Taxation and Revenue Department reflect that the Contractor is registered with the Taxation and Revenue Department of the State of New Mexico to pay gross receipts and compensating taxes.

ID Number: **00-000000-00-0**

By: _____ Date:_____
Taxation and Revenue Department

SCHEDULE A. SAVINGS GUARANTEE

1. Savings Guarantee

1.1 **(a)** Contractor hereby represents and warrants to Agency that the amount of the annual energy cost savings (calculated in accordance with Exhibit A) shall equal or exceed the "***Guaranteed Savings***" (as specified in Table below), in each Guarantee Year (the "***Guarantee of Energy Savings***").

Year	Guaranteed Annual Energy Savings	Stipulated Annual Operation & Maintenance Savings	Total Annual Guaranteed Savings
1	$ 1,250,653	$ 66,009	$ 1,316,662
2	$ 1,287,734	$ 67,989	$ 1,355,723
3	$ 1,325,916	$ 70,029	$ 1,395,945
4	$ 1,365,229	$ 72,129	$ 1,437,358
5	$ 1,405,708	$ 74,293	$ 1,480,001
6	$ 1,447,387	$ 76,522	$ 1,523,909
7	$ 1,490,302	$ 78,818	$ 1,569,120
8	$ 1,534,490	$ 81,182	$ 1,615,672
9	$ 1,579,987	$ 83,618	$ 1,663,605
10	$ 1,626,834	$ 86,126	$ 1,712,960
11	$ 1,675,069	$ 88,710	$ 1,763,779
12	$ 1,724,735	$ 91,371	$ 1,816,106
13	$ 1,775,874	$ 94,112	$ 1,869,986

Year	Guaranteed Annual Demand Savings (kW)	Guaranteed Annual Electricity Savings (kWh)	Guaranteed Annual Natural Gas Savings (Decatherms)
1	18,466	2,144,573	8,706
2	18,466	2,144,573	8,706
3	18,466	2,144,573	8,706
4	18,466	2,144,573	8,706
5	18,466	2,144,573	8,706
6	18,466	2,144,573	8,706
7	18,466	2,144,573	8,706
8	18,466	2,144,573	8,706
9	18,466	2,144,573	8,706
10	18,466	2,144,573	8,706
11	18,466	2,144,573	8,706
12	18,466	2,144,573	8,706
13	18,466	2,144,573	8,706

For purposes of the Guarantee of Energy Savings, the following assumptions and provisions shall apply:

(i) Calculation of the annual energy cost savings, inclusive of energy savings and operational and maintenance cost savings, shall be performed under, and governed by, the methods, formulas, and procedures described in Schedule C.

(ii) As it relates to the annual energy cost savings and the Guarantee of Energy Savings, the term "Guarantee Year" shall mean the consecutive twelve (12) month period beginning with the first day of the month following the date of the Agency Certificate of Acceptance – Installed Equipment, and each similar twelve (12) month period thereafter.

(iii) The unit prices, including the escalation thereof, to be used to calculate the annual energy cost savings for the purposes of the Guarantee of Energy Savings are described in Schedule C.

(iv) The Guarantee of Energy Savings herein is subject to Agency performing its maintenance and other obligations under this Agreement. If Agency fails to perform, or fails to properly perform, its obligations under this Agreement or interferes with, or permits any person to take any action which, in the reasonable opinion of Contractor, prevents the achievement of the annual energy cost savings under the Guarantee of Energy Savings, then Contractor must immediately notify the Agency and provide the Agency 10 days to rectify the deficiency. If the Agency cannot rectify the situation for any reason, Contractor and the Agency may agree to may equitably adjust the annual energy cost savings during the period wherein savings were affected to reflect the same. Contractor's rights in this section shall not be in limitation of any other rights it possesses under this Agreement.

(b) Contractor will perform and submit to Agency a guarantee reconciliation ("***Guarantee Reconciliation***") upon the later of (i) one hundred twenty (120) days after each Anniversary Date and (ii) sixty (60) days after Agency delivers to Contractor all utility billing and other data necessary for Contractor's completion of the Guarantee Reconciliation. The Guarantee Reconciliation will include a calculation of the Annual Energy Cost Savings achieved in relation to the Guaranteed Savings for the period being reconciled.

(c) Contractor hereby guarantees that if the annual energy cost savings realized by Agency as of any Anniversary Date, as detailed in the Guarantee Reconciliation, is less than the Guaranteed Savings as of such Anniversary Date, then Contractor may make modifications to the energy conservation measures in order to meet the Guaranteed Savings in future Guarantee Years. Contractor will pay to Agency that amount by which the Guaranteed Savings exceeds the actual annual energy cost savings, such payment to be made within sixty (60) days after the date of the Guarantee Reconciliation.

1.2 Agency Role and Responsibility. The guarantee of energy savings is subject to Agency performing the following functions:

(i) Operations: Agency shall operate the ECMs in accordance with the manufacturers' recommendations and any supplemental procedures supplied to Agency by Contractor.

(ii) Maintenance: Agency shall, at its expense, repair, operate and maintain the Equipment in good working order during the Term. Agency shall, at its expense, repair and maintain (i) the equipment and all other components which comprise the ECM and (ii) all other equipment which is attached thereto and/or is integral to the proper functioning of the ECMs.

(iii) Malfunctions: Agency shall notify Contractor immediately in the event of any malfunction in the operation of the ECMs or the Equipment installed.

(iv) Protection of ECM: Except in the case of emergency, Agency shall not remove, move, alter, turn off or otherwise significantly affect the operation of the equipment installed hereunder or the operation of the ECMs, or any individual part thereof, without the prior written approval of Contractor, which approval shall not be unreasonably withheld. After receiving Contractor's written approval, Agency shall proceed as instructed. Agency shall act reasonably to protect the ECMs from damage or injury, if, due to an emergency, it is not reasonable to notify Contractor

before acting. Agency agrees to protect and preserve the facility envelope and the operating condition of all ECMs, mechanical systems, and other energy consuming systems located on the Project Site(s).

(v) Measurement System: Agency shall not alter, move, modify or otherwise change the measurement and verification system or any component thereof without the prior written consent of Contractor unless such action is in accordance with operating procedures provided by Contractor.

(vi) Insurance and Risk of Loss or Damage: Without limiting any of its obligations or liabilities under this Agreement, Agency shall, at its expense, provide and maintain at all times during the Term, sufficient insurance against the loss or theft of or damage to the ECMs, the related equipment and all components installed hereunder, for the full replacement value thereof. Agency's insurance shall be primary for any and all property damage during the performance of the work hereunder. Agency may elect to "self insure".

Agency assumes all risk of loss of or damage to the ECMs from any cause whatsoever except to the extent that such loss or damage was caused by the negligence of Contractor. Upon damage to any item of the Equipment installed hereunder or the ECMs, Agency shall promptly notify Contractor and immediately place the same in good repair with the proceeds of any insurance received applied to the cost of such repair. If Agency determines that any item of the ECMs are lost, stolen, confiscated, destroyed or damaged beyond repair, Agency shall replace the same with like equipment in good repair in a timely fashion.

If at any time after the date of the Final Delivery and Acceptance Certificate and after Agency's complete payment to Contractor, any fire, flood, other casualty, or condemnation renders a majority of the Agency's property incapable of being occupied and renders the ECMs or the equipment installed hereunder inoperable and, in the case of a casualty, the affected portion of such ECMs or equipment is not reconstructed or restored within one hundred twenty (120) days from the date of such casualty, Contractor and/or Agency may terminate this Agreement by delivery of a written notice to the other Party. Upon such termination, Agency shall pay Contractor any amounts, or pro-rata portions thereof, accrued under Section 3.

(vii) Alteration: Agency shall not move, alter or change the ECMs in any way that causes a reduction in the level of efficiency or savings generated by any ECM or the equipment installed hereunder without obtaining Contractor's prior written approval which shall not be unreasonably withheld.

1.3 Contractor and the Agency may agree to make adjustments to the savings calculations for any of the following:

a. Changes in utility rates
b. Changes in the number of days in the utility billing cycle
c. Changes in facility temperature
d. Significant changes in the weather

SCHEDULE B.

(i) B.1. BASELINE ENERGY CONSUMPTION

B. Base Year Energy Use

Base year energy usage at the campus was determined by analyzing utility information recorded from April 2010 to October 2013. Due to the continuity of utility information, sub-metered data, weather and typical operations, the twelve month period from September 2011 through August 2012 was selected as the baseline energy consumption interval.

B.1 Electric Service

The El Paso Electric Company (EPEC) provides the electric utility service to the Las Cruces campus. To supplement the service, the campus utilizes a natural gas-fired co-generation facility to produce a significant portion of the electric consumption and demand. A summary of the electric demand, consumption, and utility cost is presented in Table B.1 below

Table B.1. Electric Energy Demand, Consumption, and Cost

Month	Utility Electric				Cogeneration Electric		Total Campus Electric	
	Demand (kW)	Consumption (kWh)	Demand Cost ($)	Total Cost ($)	Demand (kW)	Consumption (kWh)	Demand (kW)	Consumption (kWh)
Jan	9,316	2,882,343	70,801	177,624	4,696	3,192,279	14,012	6,083,938
Feb	9,140	3,560,586	69,464	210,067	4,640	2,771,002	13,780	6,340,728
Mar	10,584	4,028,474	80,438	235,652	4,416	2,671,752	15,000	6,710,810
Apr	11,442	4,351,650	86,959	242,116	4,400	2,839,000	15,842	7,202,092
May	9,372	4,416,555	71,227	213,219	4,416	2,836,192	13,788	7,262,119
Jun	8,690	4,291,784	68,400	325,213	4,400	2,917,192	13,090	7,217,666
Jul	10,710	4,716,787	81,396	465,222	5,152	3,031,982	15,862	7,759,479
Aug	10,131	5,059,788	76,995	471,975	4,384	2,875,202	14,515	7,945,121
Sep	10,916	5,094,560	82,961	540,900	4,504	3,089,762	15,420	8,195,238
Oct	9,123	4,385,685	69,334	307,825	4,520	3,282,410	13,643	7,677,218
Nov	7,558	3,452,821	68,400	191,119	4,584	3,100,874	12,142	6,561,253
Dec	6,668	2,785,944	68,400	200,642	4,864	3,254,356	11,532	6,046,968
Total/Max	**11,442**	**49,026,976**	**$894,775**	**$3,581,574**	**5,152**	**35,862,003**	**15,862**	**85,002,629**

EPEC provides electricity under Rate 26 State University Rate. As indicated in Table B.1, the annual electric utility costs are approximately $3.6 million. The demand charges associated with the costs are estimated at $900,000. Reference Table B.2 for the costs associated with this rate.

Table B.2. Rate 26 State University Rate (Electric)

Demand Charge/ Billing kW	Energy Charge/ kWh		On-Peak Period
	On-Peak	Off-Peak	
$7.60	$0.2412	$0.0486	Jun-Sep 12:00 PM-6:00 PM (MDT)

The tariff also includes a minimum qualifying expected demand of 9,000 kW and an effective minimum billing demand of 9,000 kW resulting in set demand costs.

For example, during the baseline period months of June, November, and December, the facility demand was less than 9,000 kW; however the monthly demand charge remained fixed at $68,400. This amount is equal to the minimum billing demand of 9,000 kW times the demand charge of $7.60 per billing demand kW.

The central utility facility on campus houses the cogeneration plant. The plant includes a natural gas-fired turbine with a nominal capacity of 4.5 MW and an attached heat recovery steam generator (HRSG). The combined equipment can produce up to 45 percent of the Las Cruces campus peak electricity demand and provide approximately 22,000 pounds per hour of steam at 100 pounds per square inch. The cogeneration plant provides an estimated 35 million kWh of the campus's annual electric energy consumption of 85 million kWh (reference Table B.1).

B.2 Gas Service

The Las Cruces Utilities provides two natural gas services: industrial (low pressure) and high volume (high pressure). The costs for both services are presented in Table B.3.

Industrial service is distributed from a single utility meter to individual buildings and associated university sub meters. High volume service is dedicated to the central utility plant (CUP) with two meters for the cogeneration turbine and a single additional meter for the steam boilers. As indicated in Table B.3, the annual natural gas utility costs are estimated at $3.3 million. Approximately 90 percent of these costs are associated with central plant utility production of steam and electricity.

Table B.3. Natural Gas Energy Consumption and Cost

Month	Industrial Service (low pressure)		High Volume Service (high pressure)		Total	
	Dth	Cost ($)	Dth	Cost ($)	Dth	Cost ($)
Jan	10,756	52,148	44,276	290,672	180,528	342,820
Feb	8,942	35,388	41,147	244,048	158,631	279,436
Mar	6,048	14,942	32,823	206,238	119,566	221,180
Apr	2,488	8,970	38,695	211,475	93,682	220,445
May	1,438	5,533	37,573	204,984	91,651	210,517
Jun	792	5,548	38,438	207,615	84,254	213,163
Jul	796	5,855	38,921	226,874	85,747	232,729
Aug	863	7,277	38,113	226,310	96,420	233,587
Sep	1,161	10,504	41,666	264,170	104,509	274,674
Oct	1,644	27,488	42,261	283,154	130,566	310,642
Nov	4,573	63,751	38,538	324,000	178,072	387,751
Dec	11,029	63,305	42,743	302,230	203,136	365,535
Total	**50,530**	**300,709**	**475,194**	**$2,991,770**	**1,526,762**	**$3,292,479**

Table B.4 details the charges associated with the natural gas services. The rates include qualifications ranges of 16,000- to 125,000-Dth/year consumption for industrial service and a minimum of 125,000 Dth/year for high volume service

Table B.4. Natural Gas Service Rates

Charge	High Volume Service	Industrial Service
Access/Month	$1,043	$859
Service Volume/Dth	$0.29	$1.02
Cost of Gas Volume/Dth	$5.16	

B.3 Baseline Utility Costs

Figure B.1 summarizes the baseline annual utility cost for the Las Cruces Campus. The annual utility costs are divided between natural gas and electric energy. $3.6 million (52 percent) is attributed to electric energy and $3.3 million (48 percent) is attributed to natural gas.

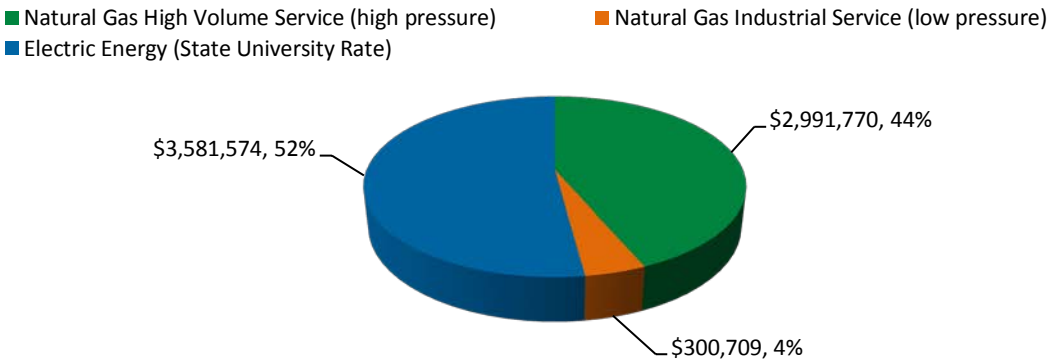

Figure B.1. Baseline Period Energy Expenditures (September 2011 – August 2012)

B.4 Baseline Adjustments

There have been a number of recent facility changes and building additions to the Las Cruces campus affecting energy consumption that are not considered in the base year energy usage. The addition of the satellite chiller plant, modifications to the primary and CHW pumping systems, the new turbine driven chiller, the new center for performing arts, and other improvements are expected to result in a large change in campus energy load.

Projects with significant quantifiable effects on the baseline energy consumption are estimated in Table B.5 below. Note that although the effect of the satellite chilled water plant addition is significant, it is included as an energy savings measure and therefore should not be included in any baseline adjustment calculation.

Table B.5. Baseline Adjustments

Baseline Adjustment Description	Electric Demand kW	Total Electric Energy kWh	HP+LP NATURAL GAS dekatherms
Monagle Residence Hall – Off line	-182	-754,408	-1,485
Chamisa Village II - Occupation	2,476	480,529	Not Available
Center for the Performing Arts - Occupation	2,243*	940,584*	Not Available
Additional Well 16 Pumping	4,560*	3,328,800*	0
Absorption Chiller Replacement w/Steam Chiller	-913*	-675,000*	0
Satellite Chilled Water Plant Addition	Included in Energy Savings Calculations		
Total Baseline Adjustment	**8,184**	**3,320,504**	**-1,485**

*Projected based on partial year's operations.

SCHEDULE C. SAVINGS MEASUREMENT AND VERIFICATION PLAN; POST-RETROFIT M&V PLAN; ANNUAL M&V REPORTING REQUIREMENTS

C. Draft Measurement and Verification Plan

The long-term success of any comprehensive energy efficiency program depends on the development of an accurate, successful M&V plan. The main objective is to develop a cost effective plan that quantifies and verifies the performance results of the ECMs. Ameresco applies industry standard M&V protocols that have been developed in response to the need for reliable and consistent measurement practices.

The following reference is used for the development of M&V procedures for this project:

- Efficiency Valuation Organization. International Performance Measurement & Verification Protocol (IPMVP). September 2010.
- The protocols also help to allocate various risks associated with achieving energy cost savings and allowing risk reduction and better risk management. The M&V options description, provided herein, was developed by summarizing the IPMVP and contains excerpts taken from that document. The benefits of the protocols include:
  - Defining the role of verification in energy contracts and implementation
  - Discussing procedures, with varying levels of accuracy and cost, for verifying:
    - Baseline and project installation conditions and
    - Long-term energy savings performance.
  - Providing techniques for calculating "whole-facility" savings, individual technology savings and stipulated savings
  - Providing procedures that are consistent, industry accepted, impartial and reliable
  - Providing procedures for the investigation and resolution of disagreements related to performance issues

The general approach to determining energy savings in these plans involves comparing the energy use of the retrofitted system before installation of the ECM (baseline) and after installation of the ECM (post-retrofit). In general:

Energy Savings = Baseline Energy Use – Post Retrofit Energy Use

The IPMVP protocols have defined four M&V options (Options A through D) that meet the needs of a wide range of performance contracts and provide suggested procedures for baseline development and post-retrofit verification. These M&V options are flexible and reflect the considerations previously mentioned. The options are summarized in Table C.1.

Table C.1. Measurement and Verification Options

M&V Option	How Savings Are Calculated	Typical Applications
Option A: Partially Measured Retrofit Isolation		
Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was applied; separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous of the error they may introduce. Partial measurement means that some but not all parameter(s) may be stipulated, if the total impact of possible stipulation error(s) is not significant to the resultant savings. Careful review of ECM design and installation will ensure that stipulated values fairly represent the probable actual value. Stipulations should be shown in the M&V Plan along with analysis of the significance of the error they may introduce.	Engineering calculations using short-term or continuous post-retrofit measurements and stipulations.	Lighting retrofit where power draw is measured periodically. Operating hours of the lights are stipulated.
Option B: Retrofit Isolation		
Savings are determined by field measurement of the energy use of the systems to which the ECM was applied; separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Engineering calculations using short-term or continuous measurements	Application of controls to vary the load on a constant speed pump using a variable speed drive. Electricity use is measured by a kWh meter installed on the electrical supply to the pump motor. In the base year, this meter is in place for a week to verify constant loading. The meter is in place throughout the post-retrofit period to track variations in energy use.
Option C: Whole Facility (Bill Comparison)		
Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.	Multifaceted energy management program affecting many systems in a building. Energy use is measured by the gas and electric utility meters for a 12-month base year period and throughout the post-retrofit period.

M&V Option	How Savings Are Calculated	Typical Applications
Option D: Calibrated Simulation (Calibrated Building Modeling)		
Savings are determined through simulation of the energy use of components or the whole facility. Simulation routines must be demonstrated to adequately model actual energy performance measured in the facility. This option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-use metering.	Multifaceted energy management program affecting many systems in a building but where no base year data are available. Post-retrofit period energy use is measured by the gas and electric utility meters. Base year energy use is determined by simulation using a model calibrated by the post-retrofit period utility data.

Table C.2 shows a summary of the proposed M&V plans for the project. Detailed description of the plan for each ECM subsequently follows. The results of the M&V services will be reported to NMSU on an annual basis. All specific protocols in the plans must be explained to and accepted by NMSU before construction on the project can begin. If NMSU does not agree with the protocols used to verify the savings, there is potential for significant disagreement once verification efforts begin.

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Table C.2. Measurement and Verification Summary Matrix

ECM Description	IPMVP Option	Baseline M&V Requirements	Post Retrofit M&V Requirements	Measurement and Metering	Stipulated Variables	Performance Period M&V Requirements
ECM 1: Interior Lighting	A	Measurement of input power of select existing light fixtures. Measurement of run hours of select existing light fixtures.	Measurement of input power of select new light fixtures.	Short-term metering of power consumption on select light fixtures. Short-term metering of select fixtures run hours. Number of selected fixtures must be statistically significant.	Baseline and post-retrofit fixture power draw. Baseline and post-retrofit fixture run hours.	Annual inspection on a percentage of retrofitted light fixtures.
Included in ECM 1: Interior Lighting Controls	A	Measurement of run hours of select light fixtures without controls.	Measurement of run hours of select light fixtures with controls.	Short-term metering of fixtures run hours with and without controls. Number of selected fixtures must be statistically significant.	Baseline fixture power draws from ECM 1. Baseline and post-retrofit fixture run hours.	Annual inspection on a percentage of retrofitted light controls.
Included in ECM 1: Vending Machine Controls	A	Measurement of baseline power measurement of select vending machines.	Measurement of vending machine run hours with controls installed.	Short-term metering of select vending machines power consumption. Short-term metering of select vending machines run hours.	Baseline and post-retrofit power consumption and run hours.	Annual inspection on vending miser operation.
ECM 2: Exterior Lighting	A	Measurement of input power of select existing light fixtures. Measurement of run hours of select existing light fixtures.	Measurement of input power of select new light fixtures.	Short-term metering of power consumption on select light fixtures. Short-term metering of select fixtures run hours. Number of selected fixtures must be statistically significant.	Baseline and post-retrofit fixture power draw. Baseline and post-retrofit fixture run hours.	Annual inspection on a percentage of retrofitted light fixtures.

ECM Description	IPMVP Option	Baseline M&V Requirements	Post Retrofit M&V Requirements	Measurement and Metering	Stipulated Variables	Performance Period M&V Requirements
ECM 3: Exterior Pole Mounted Lighting	A	Measurement of input power of select existing light fixtures. Measurement of run hours of select existing light fixtures.	Measurement of input power of select new light fixtures.	Short-term metering of power consumption on select light fixtures. Short-term metering of select fixtures run hours. Number of selected fixtures must be statistically significant.	Baseline and post-retrofit fixture power draw. Baseline and post-retrofit fixture run hours.	Annual inspection on a percentage of retrofitted light fixtures.
ECM 6: Retrocommissioning	A	Document baseline operating parameters from calibrated baseline model based on rCx issues log. See detailed description for parameter list.	EMS trending of economizer operating parameters. See detailed description for parameter list.	Configure EMS for 15 minute trending and monthly archiving of selected equipment parameters.	Modeled baseline parameter values, and measure isolation parameters. See detailed description for parameter list.	Annual sample inspection of modified components. Bin-analysis calculation of energy savings. See detailed description for calculation procedure.
ECM 7: Variable Air Volume Retrofit	A	Document baseline AHU operating parameters from calibrated baseline model. See detailed description for parameter list.	EMS trending of AHU operating parameters. See detailed description for parameter list.	Configure EMS for 15 minute trending and monthly archiving of selected equipment parameters.	Modeled baseline parameter values, and measure isolation parameters. See detailed description for parameter list.	Annual sample inspection of modified components. Bin-analysis calculation of energy savings. See detailed description for calculation procedure.
ECM 10: Economizer Upgrade or Repair	A	Document baseline economizer operating parameters from calibrated baseline model. See detailed description for parameter list.	EMS trending of economizer operating parameters. See detailed description for parameter list.	Configure EMS for 15 minute trending and monthly archiving of selected equipment parameters.	Modeled baseline parameter values, and measure isolation parameters. See detailed description for parameter list.	Annual sample inspection of modified components. Bin-analysis calculation of energy savings. See detailed description for calculation procedure.
ECM 12: Chilled Water Pump Bypass	A	Document baseline AHU chilled water coil and chilled water pump operating parameters from calibrated baseline model. See detailed description for	EMS trending of AHU chilled water coil and chilled water pump operating parameters. See detailed description for parameter list.	Configure EMS for 15 minute trending and monthly archiving of selected equipment parameters.	Modeled baseline parameter values, and measure isolation parameters. See detailed description for parameter	Annual sample inspection of modified components. Bin-analysis calculation of energy savings. See detailed description for calculation

ECM Description	IPMVP Option	Baseline M&V Requirements	Post Retrofit M&V Requirements	Measurement and Metering	Stipulated Variables	Performance Period M&V Requirements
		parameter list.			list.	procedure.
ECM 26: Satellite Plant Energy Savings	A	Document baseline central utility plant operating parameters from calibrated baseline model. See detailed description for parameter list.	EMS trending of central and satellite utility plant operating parameters. See detailed description for parameter list.	Configure EMS for 15 minute trending and monthly archiving of selected equipment parameters.	Modeled baseline parameter values, and measure isolation parameters. See detailed description for parameter list.	Annual sample inspection of modified components. Compile and calculate total monthly energy consumption for central and satellite utility plants. See detailed description for calculation procedure.
ECM 28: My Energy Pro – Ops PRO	N/A	None. There are no savings associated with this measure.	None.	None.	None.	None.
ECM 29: Mt Energy PRO – Optimization Model	N/A	None. There are no savings associated with this measure.	None.	None.	None.	None.

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ECM 1: Interior Lighting

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations with one-time representative measured values, resulting in measured verification of performance. With the chosen method, hours of operation are agreed to. Post installation fixture wattages will be determined from one-time after spot measurements of representative fixture types.

Under this measurement plan, Ameresco assumes performance risk for the operation of the new fixtures. We will perform equipment measurements to verify that the performance of the installed equipment will operate at the levels defined in the IGA (power output at stated conditions). This will be established by measuring a percentage of fixtures (either individual fixtures or on a given lighting circuit) of the same lamp/ballast combination as defined in the Project Specific M&V Plan as shown in the technical appendix. If the lighting systems do not perform as proposed, Ameresco will either change the systems or compensate the customer. For the site operating hours, Ameresco has no control over the hours of operation of the facility and cannot be reasonably requested to assume the risk for this variable. Therefore, the customer and Ameresco will agree to the run hours for the life of the contract as shown for the existing and proposed hour codes identified in the Lighting Usage Assumptions for NMSU provided in the technical appendix.

Cooling savings and heating penalty from lighting retrofit will be verified through the lamp/ballast electricity reduction. Ventilation rate, cooling/heating period and cooling/heating equipment efficiencies will be stipulated based upon the plant eQUEST model's results.

Energy Savings Calculation Methodology

> Savings Algorithm

$$Savings = LightingSavings - Heat + Cool$$

$$LightingSavings = DemandSavings + EnergySavings$$

$$DemandSavings = BaselineDemand - PostDemand$$

$$EnergySavings = BaselineEnergy - PostEnergy$$

$$BaselineDemand = \sum_{buildings} \sum_{fixtures} \left(kW_{Base} \times Months \times {}^{\$}/_{kW} \right)$$

$$PostDemand = \sum_{buildings} \sum_{fixtures} \left(kW_{retro} \times Months \times {}^{\$}/_{kW} \right)$$

$$BaselineEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Base} \times Hrs_{Base} \times {}^{\$}/_{kWh} \right)$$

$$PostEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Retro} \times Hrs_{Base} + {}^{\$}/_{kWh} \right)$$

Where:

kW_{Base}	=	Baseline fixture kW
kW_{Retro}	=	Post-retrofit fixture kW
Hrs	=	Baseline fixture operating hours
$/kW	=	Unit cost of electric demand, per baseline
$/kWh	=	Unit cost of electric energy, per baseline

> Metering Plan

As part of the monitoring services under this agreement, Ameresco will measure the post-installation fixture input power for 10 percent of the representative fixtures at the time of commissioning and if the total sample values result in savings within 10 percent of the IGA savings, no change will be made. If the total sample values are not within 10 percent, Ameresco will either take corrective action for them to be within this limit or will use the measured values.

As part of the monitoring services, Ameresco will perform a yearly site inspection of ECM 1. The observations during this inspection will be made part of the Annual Reconciliation Report. No long-term monitoring or inspections are included as part of ECM 1.

Interior Lighting Controls

Interior Lighting Controls are included within the ECM1 scope. The M&V protocol for interior lighting controls is based on the recommendations of IPMVP Option A. Option A includes engineering calculations with one-time representative measured values, resulting in measured verification of performance. Under this M&V plan, fixture wattages will be determined from one-time spot measurements from ECM 1. Baseline run hours of the fixtures will be stipulated, but post-retrofit run hours will be verified with short-term logging. There will be no demand savings for interior lighting controls.

Cooling savings and heating penalty from lighting retrofit will be verified through the kWh electricity reduction also. As in ECM 1, ventilation rate, cooling/heating period and cooling/heating equipment efficiencies will be stipulated.

Energy Savings Calculation Methodology

> Savings Algorithm

$$Savings = EnergySavings - Heat + Cool$$

$$EnergySavings = BaselineEnergy - PostEnergy$$

$$BaselineEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Retro} \times Hrs_{Base} \times {}^{\$}/_{kWh} \right)$$

$$PostEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Retro} \times Hrs_{Retro} + {}^{\$}/_{kWh} \right)$$

Where:

kWBase	=	Baseline fixture kW
kWRetro	=	Post-retrofit fixture kW
HrsBase	=	Baseline fixture operating hours
HrsRetro	=	Post-retrofit fixture operating hours
$/kW	=	Unit cost of electric demand, per baseline
$/kWh	=	Unit cost of electric energy, per baseline

> Metering Plan

Power consumption measurements of the fixtures are covered under ECM 1. The fixtures Wattage used will be the wattage after lamp/ballast retrofit to avoid double counting. Fixtures run hours after lighting controls installation will be trended with short-term loggers.

As part of the monitoring services, Ameresco will perform a yearly site inspection of ECM 1. The observations during this inspection will be made part of the Annual Reconciliation Report. No long-term monitoring or inspections are included as part of ECM 1.

Vending Machine Controls

Vending Machine Controls are included within the ECM 1 scope. The M&V protocol for this measure is based on IPMVP Option A. For Option A, electric power draw of the vending machines will be measured for the select types of machines, and this kW draw is stipulated to be the same before and after controller installation. Run hours of the machines will be measured with short-term metering for both before and after retrofit. These measured run hours are then used in the calculation to verify the energy savings. There are no peak demand savings for ECM 20.

Energy Savings Calculation Methodology

> Savings Algorithm

$$EnergySavings = BaselineEnergy - PostEnergy$$

$$BaselineEnergy = \sum_{Machines}(kW \times Hrs_{Base}) \times {}^{\$}/_{kWh}$$

$$PostEnergy = \sum_{Machines}(kW \times Hrs_{Post}) \times {}^{\$}/_{kWh}$$

Where:

kW	=	Vending machine kW
HrsBase	=	Base operating hours
HrsPost	=	Post-retrofit operating hours
$/kWh	=	Unit cost of electrical energy per baseline

> Metering Plan

Ameresco will log the average power consumption of a sample of units. The baseline and post-installation run hours will be determine by short-term metering. As part of the monitoring services under this agreement, Ameresco will perform a yearly site inspection of the vending machine controls. The observations during this inspection will be made part of the Annual Reconciliation Report.

ECMs 2 and 3: Exterior Lighting and Exterior Pole Mounted Lighting

The M&V protocol for these measures is based on IPMVP Option A. Option A includes engineering calculations with one-time representative measured values, resulting in measured verification of performance. With the chosen method, hours of operation are agreed to. Post installation fixture wattages will be determined from one-time after spot measurements of representative fixture types.

Under this measurement plan, Ameresco assumes performance risk for the operation of the new fixtures. We will perform equipment measurements to verify that the performance of the installed equipment will operate at the levels defined in the IGA (power output at stated conditions). This will be established by measuring a percentage of fixtures (either individual fixtures or on a given lighting circuit) of the same lamp/ballast combination as defined in the Project Specific M&V Plan as shown in the technical appendix. If the lighting systems do not perform as proposed, Ameresco will either change the

systems or compensate the customer. For the site operating hours, Ameresco has no control over the hours of operation of the facility and cannot be reasonably requested to assume the risk for this variable. Therefore, the customer and Ameresco will agree to the run hours for the life of the contract as shown for the existing and proposed hour codes identified in the Lighting Usage Assumptions for NMSU provided in the technical appendix.

Energy Savings Calculation Methodology

> Savings Algorithm

$$Savings = LightingSavings - Heat + Cool$$

$$LightingSavings = DemandSavings + EnergySavings$$

$$DemandSavings = BaselineDemand - PostDemand$$

$$EnergySavings = BaselineEnergy - PostEnergy$$

$$BaselineDemand = \sum_{buildings} \sum_{fixtures} \left(kW_{Base} \times Months \times {}^{\$}/_{kW} \right)$$

$$PostDemand = \sum_{buildings} \sum_{fixtures} \left(kW_{retro} \times Months \times {}^{\$}/_{kW} \right)$$

$$BaselineEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Base} \times Hrs_{Base} \times {}^{\$}/_{kWh} \right)$$

$$PostEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{\text{Retro}} \times Hrs_{Base} + {}^{\$}/_{kWh} \right)$$

Where:

kW_{Base}	=	Baseline fixture kW
kW_{Retro}	=	Post-retrofit fixture kW
Hrs	=	Baseline fixture operating hours
$/kW	=	Unit cost of electric demand, per baseline
$/kWh	=	Unit cost of electric energy, per baseline

> Metering Plan

As part of the monitoring services under this agreement, Ameresco will measure the post-installation fixture input power for 10 percent of the representative fixtures at the time of commissioning and if the total sample values result in savings within 10 percent of the IGA savings, no change will be made. If the total sample values are not within 10 percent, Ameresco will either take corrective action for them to be within this limit or will use the measured values.

As part of the monitoring services, Ameresco will perform yearly site inspections of ECM 2 and 3. The observations during this inspection will be made part of the Annual Reconciliation Report. No long-term monitoring or inspections are included as part of ECM 2 and 3.

Exterior Lighting Controls

Exterior Lighting Controls are included within specified fixtures in the ECM 2 and ECM 3 scope. The M&V protocol for exterior lighting controls is based on the recommendations of IPMVP Option A. Option A includes engineering calculations with one-time representative measured values, resulting in measured verification of performance. Under this M&V plan; fixture wattages will be determined from one-time spot measurements from ECM 2 and 3. Baseline run hours of the fixtures will be stipulated, but post-retrofit run hours will be verified with short-term logging. There will be no demand savings for interior lighting controls.

Energy Savings Calculation Methodology

> Savings Algorithm

$$Savings = EnergySavings - Heat + Cool$$

$$EnergySavings = BaselineEnergy - PostEnergy$$

$$BaselineEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Retro} \times Hrs_{Base} \times {}^{\$}/_{kWh} \right)$$

$$PostEnergy = \sum_{buildings} \sum_{fixtures} \left(kW_{Retro} \times Hrs_{Retro} + {}^{\$}/_{kWh} \right)$$

Where:

kWBase	=	Baseline fixture kW
kWRetro	=	Post-retrofit fixture kW
HrsBase	=	Baseline fixture operating hours
HrsRetro	=	Post-retrofit fixture operating hours
$/kW	=	Unit cost of electric demand, per baseline
$/kWh	=	Unit cost of electric energy, per baseline

> Metering Plan

Power consumption measurements of the fixtures are covered under ECM 2 and 3. The fixtures Wattage used will be the wattage after lamp/ballast retrofit to avoid double counting. Fixtures run hours after lighting controls installation will be trended with short-term loggers.

As part of the monitoring services, Ameresco will perform a yearly site inspection of ECM 2 and 3. The observations during this inspection will be made part of the Annual Reconciliation Report. No long-term monitoring or inspections are included as part of ECM 2 and 3.

ECM 6: Retro-Commissioning

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations of energy consumption of modified systems based on both measurement and stipulation of

system input variables. Stipulated input variables are chosen to account and correct for interaction with concurrent implemented measures.

Under this measurement plan, Ameresco assumes performance risk for modified system components and their associated sequences of operation. Ameresco will perform equipment measurements and implement energy management system trends to verify that the performance of the installed equipment will operate according to the Schedule R measure descriptions.

For water and air temperature related rCx issues, heat transfer savings at the heating and cooling coils will be calculated based on the measured and stipulated values. Chilled water and steam input will be converted into central plant electric and natural gas energy consumption using stipulated conversion indices. The calculated energy savings will be normalized to account for weather variations between the weather file used for the stipulated baseline consumption and weather concurrent to the evaluation period.

For fan and pump related rCx issues, electric energy consumption and demand savings will be based on pre and post measured or trended power consumption, and measured and/or stipulated operating hours.

Energy Savings Calculation Methodology

The exact scope of the retro-commissioning measure will be determined by the rCx process undertaken during measure implementation. The specific calculation methodology will be determined once the scope of the rCx issues have been determined. Below is a sample calculation for how the energy savings for potential rCx measures will be measured and verified

> Pre-Retrofit Parameters

RCx Issue: Leaking Steam Coil Valve

Pre-retrofit baseline performance parameters are defined by a calibrated building energy simulation model. Output parameters from the model used to define the baseline performance for this measure include the following:

A. Hourly Cold Deck Airflow fraction of total airflow (CFM)

B. Hourly Hot Deck Airflow fraction of total airflow (CFM)

C. Hourly Mixed Air Temperature

D. Hourly Outdoor Air Temperature

E. Hourly Hot Deck Discharge Air Temperature

F. Hourly Cold Deck Discharge Air Temperature

G. Hourly Chilled Water Pump electric energy demand

Parameters A, B, and C will be further defined as functions of parameter D (i.e. f(OAT) = hot deck airflow fraction) for use in Bin analysis of pre-retrofit heating and cooling coil performance.

Parameter G will be further defined as a function of parameter F for use in Bin analysis of pre-retrofit chilled water pump energy consumption.

The following parameter will be spot measured pre-retrofit:

H. Total system airflow

> Post-Retrofit Parameters

Post-retrofit coil performance parameters are defined by EMS trend data (15 min interval):

D. Outdoor Air Temperature

E. Hot Deck Discharge Air Temperature

F. Cold Deck Discharge Air Temperature

Parameters E and F will be also be defined as a function of parameter D for use in Bin analysis of post-retrofit heating and cooling coil performance.

In order to account for interactions with other implemented measures, post-retrofit values for parameters A, B, C, D, and G are stipulated to be equal to pre-retrofit values.

> Utility Consumption Indices

Utility Consumption indices will be used to convert heating and cooling energy consumption at the cooling coil to electric and natural gas energy consumption at the central plant. The utility savings indices are based on the results of the calibrated whole campus energy simulation model. For this measure, these values are stipulated in Table C-3.

Table C-3: Utility Consumption Indices

		Electric Demand kW	Off Peak Electric Energy kWh	On Peak Electric Energy kWh	HP+LP NATURAL GAS dekatherms
Parameter Mark		I	J	K	L
M	Cooling Energy (Ton-hours)	0.000411	0.10294	0.001383	
N	Heating Energy (klbstm)				0.604331

> Savings Analysis

The energy savings will be calculated using a modified bin-analysis method. Weather bins based on the base model weather file, with a maximum of 3-degree weather bins will be compiled. The weather bins will be segregated into on peak and off peak hours. For both the pre and post conditions, the base model weather bins will be used in order to normalize the energy savings calculations relative to weather.

For each weather bin, sensible energy consumption, and chilled water pump energy consumption will be calculated on a pre and post basis using the following equations

$$\text{Heating (kblstm)} = (0.98 \times (H \times (B)) \times (C - (E))) / (881{,}000)$$

$$\text{Cooling (tons)} = (0.98 \times (H \times (A)) \times (C - (F))) / (12{,}000)$$

$$\text{Chilled Water Pump (kW)} = G$$

The inputs for parameter C will be the result of the f(D) function for mixed air temperature unique to the pre and post cases.

The input for parameter G will be the result of the f(F) function for chilled water pump demand for the pre-retrofit case, where F is the cold deck supply temperature for the post retrofit case.

The total energy consumption for the pre and post case will be the following:

O. Electric Energy Demand (kW): (M x I) + max(G)

P. Off Peak Electric Energy (kWh): (M x J) + (G x off peak bin hours)

Q. On Peak Electric Energy (kWh): (M x K) + (G x on peak bin hours)

R. Natural Gas (dekatherms): N x L

The energy savings will be the difference between parameters O thru R for the pre and post cases.

Metering Plan

As part of the monitoring services under this agreement, Ameresco will require continuing access to NMSU's energy management system for the purpose of initiating and intermittent download of data trends for the post retrofit parameters defined above. NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. Additional associated parameters, not used in the measured savings calculation, may also be trended for diagnostic purposes. Ameresco will periodically download and archive the data off-site throughout the evaluation period, defined for this measure as four months from August 1 through November 30 of each evaluation year.

NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. In addition, NMSU will be required to notify Ameresco of any prolonged EMS outages that may result in trend data loss.

As part of the monitoring services, Ameresco will perform a yearly site inspection of this ECM. The observations during this inspection will be made part of the Annual Reconciliation Report.

ECM 7: Variable Air Volume Retrofit

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations of energy consumption of modified systems based on both measurement and stipulation of system input variables. Stipulated input variables are chosen to account and correct for interaction with concurrent implemented measures.

Under this measurement plan, Ameresco assumes performance risk for modified system components and their associated sequences of operation. Ameresco will perform equipment measurements and implement energy management system trends to verify that the performance of the installed equipment will operate according to the Schedule R measure descriptions.

For chilled water and steam savings, heat transfer savings at the heating and cooling coils will be calculated based on the measured and stipulated values. Chilled water and steam input will be converted into central plant electric and natural gas energy consumption using stipulated conversion indices. The calculated energy savings will be normalized to account for weather variations between the weather file used for the stipulated baseline consumption and weather concurrent to the evaluation period.

For fan and pump related energy savings, electric energy consumption and demand savings will be based on pre and post measured or trended power consumption, and measured and/or stipulated operating hours.

Energy Savings Calculation Methodology

> Pre-Retrofit Parameters

Pre-retrofit baseline performance parameters are defined by a calibrated building energy simulation model. Output parameters from the model used to define the baseline performance for this measure include the following:

A. Hourly Cold Deck Airflow fraction of total airflow (CFM)

B. Hourly Hot Deck Airflow fraction of total airflow (CFM)

C. Hourly Mixed Air Temperature

D. Hourly Outdoor Air Temperature

E. Hourly Hot Deck Discharge Air Temperature

F. Hourly Cold Deck Discharge Air Temperature

G. Hourly Total System Airflow

H. Hourly Fan Power

I. Hourly Chilled Water Pump electric energy demand

Parameter H will be further defined as the sum of air handling unit supply, and return/relief fans.

Parameters A, B, G, H and I will be further defined as functions of parameter D (i.e. f(OAT) = hot deck airflow fraction) for use in bin analysis.

Parameter I will be further defined as a function of parameter F for use in Bin analysis of the chilled water pump energy consumption.

> Post-Retrofit Parameters

Post-retrofit performance parameters are defined by EMS trend data (15 min interval):

A. Cold Deck Airflow fraction of total airflow (CFM)

B. Hot Deck Airflow fraction of total airflow (CFM)

D. Outdoor Air Temperature

E. Hourly Hot Deck Discharge Air Temperature

F. Hourly Cold Deck Discharge Air Temperature

G. Hourly Total System Airflow

H. Hourly Fan Power

I. Hourly Chilled Water Pump electric energy demand

Parameters A and B will be further defined as the average of a sample of terminal units

Parameters A, B, E, F, and G will be also be defined as a function of parameter D for use in Bin analysis.

Parameter H will be further defined as the sum of air handling unit supply, and return/relief fans.

Parameter H will also be defined as a function of parameter G for use in bin analysis

Parameter I will be further defined as a function of parameter F for use in bin analysis chilled water pump energy consumption.

In order to account for interactions with other implemented measures, post-retrofit values for parameters C are stipulated to be equal to pre-retrofit values.

> Utility Consumption Indices

Utility Consumption indices will be used to convert heating and cooling energy consumption at the cooling coil to electric and natural gas energy consumption at the central plant. The utility savings indices are based on the results of the calibrated whole campus energy simulation model. For this measure, these values are stipulated in Table C-4.

Table C-4: Utility Consumption Indices

		Electric Demand kW	Off Peak Electric Energy kWh	On Peak Electric Energy kWh	HP+LP NATURAL GAS dekatherms
	Parameter Mark	J	K	L	M
N	Cooling Energy (Ton-hours)	0.001055	0.538715	0.093226	
O	Heating Energy (klbstm)				-0.21548

> Savings Analysis

The energy savings will be calculated using a modified bin-analysis method. Weather bins based on the base model weather file, with a maximum of 3-degree weather bins will be compiled. The weather bins will be segregated into on peak and off peak hours. For both the pre and post conditions, the base

model weather bins will be used in order to normalize the energy savings calculations relative to weather.

For each weather bin, sensible energy consumption, chilled water pump energy consumption, and fan energy consumption will be calculated on a pre and post basis using the following equations:

Heating (kblstm) O: = (0.98 x (G x (B)) x (C – (E))) / (881,000)

Cooling (tons) N: = (0.98 x (G x (A)) x (C – (F))) / (12,000)

Fan Power (kW) = H

Chilled Water Pump (kW) = I

The inputs for parameter C will be the result of the f(D) function for mixed air temperature for the pre-retrofit case.

The inputs for parameters A, B, E, and F will be the result of f(D) functions unique to the pre and post retrofit cases.

The input for parameter I will be the result of the f(F) functions for chilled water pump demand unique to the pre and post retrofit cases.

The inputs for parameter H will be the result of the f(G) function for mixed air temperature for the pre-retrofit case.

The total energy consumption for the pre and post cases will be the following:

S. Electric Energy Demand (kW): (N x J) + max(H+I)

T. Off Peak Electric Energy (kWh): (N x K) + ((H+I) x off peak bin hours)

U. On Peak Electric Energy (kWh): (N x L) + ((H+I) x on peak bin hours)

V. Natural Gas (dekatherms): (O x M)

The energy savings will be the difference between parameters S thru V for the pre and post cases.

Metering Plan

As part of the monitoring services under this agreement, Ameresco will require continuing access to NMSU's energy management system for the purpose of initiating and intermittent download of data trends for the post retrofit parameters defined above. NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. Additional associated parameters, not used in the measured savings calculation, may also be trended for diagnostic purposes.

Ameresco will periodically download and archive the data off-site throughout the evaluation period, defined for this measure as four months from August 1 through November 30 of each evaluation year.

NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. In addition, NMSU will be required to notify Ameresco of any prolonged EMS outages that may result in trend data loss.

As part of the monitoring services, Ameresco will perform a yearly site inspection of this ECM. The observations during this inspection will be made part of the Annual Reconciliation Report.

ECM 10: Economizer Upgrade and Repair

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations of energy consumption of modified systems based on both measurement and stipulation of system input variables. Stipulated input variables are chosen to account and correct for interaction with concurrent implemented measures.

Under this measurement plan, Ameresco assumes performance risk for modified economizer components and the associate sequence of operation. Ameresco will perform equipment measurements and implement energy management system trends to verify that the performance of the installed equipment will operate according to the Schedule R measure descriptions. Heat transfer saving at the heating and cooling coils will be calculated based on the measured and stipulate values. Chilled water and steam input will be converted into central plant electric and natural gas energy consumption using stipulated conversion indices. The calculated energy savings will be normalized to account for weather variations between the weather file used for the stipulated baseline consumption and weather concurrent to the evaluation period.

Energy Savings Calculation Methodology

> Pre-Retrofit Parameters

Pre-retrofit baseline economizer performance parameters are defined by a calibrated building energy simulation model. Output parameters from the model used to define the baseline performance for this measure include the following:

A. Hourly Cold Deck Airflow fraction of total airflow (CFM)

B. Hot Deck Airflow fraction of total airflow (CFM)

C. Hourly Mixed Air Temperature

D. Hourly Outdoor Air Temperature

E. Average Hot Deck Discharge Air Temperature (average of hourly data)

F. Average Cold Deck Discharge Air Temperature (average of hourly data)

Parameters A, B, and C will be further defined as functions of parameter 4 (i.e. f(OAT) = hot deck airflow fraction) for use in Bin analysis of pre-retrofit economizer performance.

The following parameter will be spot measured pre-retrofit:

G. Total system airflow

> Post-Retrofit Parameters

Post-retrofit economizer performance parameters are defined by EMS trend data (15 min interval):

C. Mixed Air Temperature

D. Outdoor Air Temperature

Parameter C will be further defined as a function of parameter D for use in Bin analysis of post-retrofit economizer performance.

In order to account for interactions with other implemented measures, post-retrofit values for parameters A, B, D, E, and F are stipulated to be equal to pre-retrofit values.

> Utility Consumption Indices

Utility Consumption indices will be used to convert heating and cooling energy consumption at the cooling coil to electric and natural gas energy consumption at the central plant. The utility savings indices are based on the results of the calibrated plant energy simulation model. For this measure, these values are stipulated in Table C-5.

Table C-5: Utility Consumption Indices

		Electric Demand kW	Off Peak Electric Energy kWh	On Peak Electric Energy kWh	HP+LP NATURAL GAS dekatherms
Parameter Mark		I	J	K	L
M	Cooling Energy (Ton-hours)	0.001082	1.385394	.005568	
N	Heating Energy (klbstm)				0.005143

> Savings Analysis

The energy savings will be calculated using a modified Bin-analysis method. Weather BINs based on the base model weather file, with a maximum of 3-degree weather bins will be compiled. The weather bins will be segregated into on peak and off peak hours. For both the pre and post conditions, the base model weather bins will be used in order to normalize the energy savings calculations relative to weather.

For each weather bin, heating and cooling coil sensible energy consumption will be calculated on a pre and post basis using the following equation:

Cooling (tons) M: = (0.98 x (G x (A or B)) x (C – (E or F))) / (12,000)

Heating (kblstm) N: = (0.98 x (G x (A or B)) x (C – (E or F))) / (881,000)

The inputs for parameter C will be the result of the f(D) function for mixed air temperature unique to the pre and post cases.

The total energy consumption for the pre and post case will be the following:

O. Electric Energy Demand (kW): (M x bin hours) x I

P. Off Peak Electric Energy (kWh): (M x bin hours x J)

Q. On Peak Electric Energy (kWh): (M x bin hours x K)

R. Natural Gas (dekatherms): N x bin hours x L

The energy savings will be the difference between parameters O thru R for the pre and post cases.

Metering Plan

As part of the monitoring services under this agreement, Ameresco will require continuing access to NMSU's energy management system for the purpose of initiating and intermittent download of data trends for the post retrofit parameters defined above. NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. Additional associated parameters, not used in the measured savings calculation, may also be trended for diagnostic purposes. Ameresco will periodically download and archive the data off-site throughout the evaluation period, defined for this measure as four months from August 1 through November 30 of each evaluation year.

NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. In addition, NMSU will be required to notify Ameresco of any prolonged EMS outages that may result in trend data loss.

As part of the monitoring services, Ameresco will perform a yearly site inspection of this ECM. The observations during this inspection will be made part of the Annual Reconciliation Report.

ECM 12: Chilled Water Bypass

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations of energy consumption of modified systems based on both measurement and stipulation of system input variables. Stipulated input variables are chosen to account and correct for interaction with concurrent implemented measures.

Under this measurement plan, Ameresco assumes performance risk for modified system components and their associated sequences of operation. Ameresco will perform equipment measurements and implement energy management system trends to verify that the performance of the installed equipment will operate according to the Schedule R measure descriptions.

For chilled water and steam savings, heat transfer savings at the heating and cooling coils will be calculated based on the measured and stipulated values. Chilled water and steam input will be converted into central plant electric and natural gas energy consumption using stipulated conversion indices. The calculated energy savings will be normalized to account for weather variations between the weather file used for the stipulated baseline consumption and weather concurrent to the evaluation period.

For fan and pump related energy savings, electric energy consumption and demand savings will be based on pre and post measured or trended power consumption, and measured and/or stipulated operating hours.

Energy Savings Calculation Methodology

> Pre-Retrofit Parameters

Pre-retrofit baseline performance parameters are defined by a calibrated building energy simulation model. Output parameters from the model used to define the baseline performance for this measure include the following:

A. Hourly Cold Deck Airflow fraction of total airflow (CFM)

B. Hourly Mixed Air Temperature

C. Hourly Outdoor Air Temperature

D. Hourly Cold Deck Discharge Air Temperature

E. Hourly Total System Airflow

F. Hourly Chilled Water Pump electric energy demand

Parameters A, B, D, and E will be further defined as functions of parameter C (i.e. f(OAT) = cold deck airflow fraction) for use in bin analysis.

Parameter F will be further defined as a function of parameter D for use in bin analysis of the chilled water pump energy consumption.

> Post-Retrofit Parameters

Post-retrofit performance parameters are defined by EMS trend data (15 min interval):

A. Cold Deck Airflow fraction of total airflow (CFM)

C. Outdoor Air Temperature

D. Cold Deck Discharge Air Temperature

E. Total System Airflow

F. Chilled Water Pump electric energy demand

Parameter A will be further defined as the average of a sample of terminal units.

Parameters A, D, E, and F will be also be defined as a function of parameter C for use in bin analysis.

In order to account for interactions with other implemented measures, post-retrofit values for parameter B are stipulated to be equal to pre-retrofit values.

> Utility Consumption Indices

Utility Consumption indices will be used to convert heating and cooling energy consumption at the cooling coil to electric and natural gas energy consumption at the central plant. The utility savings indices are based on the results of the calibrated whole campus energy simulation model. For this measure, these values are stipulated in Table C-6.

Table C-6: Utility Consumption Indices

		Electric Demand kW	Off Peak Electric Energy kWh	On Peak Electric Energy kWh	HP+LP NATURAL GAS dekatherms
Parameter Mark		J	K	L	M
N	Cooling Energy (Ton-hours)	-0.00097	2.01641	0.168018	-0.0089

> Savings Analysis

The energy savings will be calculated using a modified bin-analysis method. Weather bins based on the base model weather file, with a maximum of 3-degree weather bins will be compiled. The weather bins will be segregated into on peak and off peak hours. For both the pre and post conditions, the base model weather bins will be used in order to normalize the energy savings calculations relative to weather.

For each weather bin, sensible energy consumption, chilled water pump energy consumption, and fan energy consumption will be calculated on a pre and post basis using the following equations:

$$\text{Cooling (tons) N:} = (0.98 \times (E \times (A)) \times (B - (D))) / (12{,}000)$$

$$\text{Chilled Water Pump (kW)} = F$$

The inputs for parameter B will be the result of the f(C) function for mixed air temperature for the pre-retrofit case.

The inputs for parameters A, D, E, and F will be the result of f(C) functions unique to the pre and post retrofit cases.

The total energy consumption for the pre and post cases will be the following:

S. Electric Energy Demand (kW): (N x J) + max(F)

T. Off Peak Electric Energy (kWh): (N x K) + (F x off peak bin hours)

U. On Peak Electric Energy (kWh): (N x L) + (F x on peak bin hours)

V. Natural Gas (dekatherms): (N x M)

The energy savings will be the difference between parameters S thru V for the pre and post cases.

Metering Plan

As part of the monitoring services under this agreement, Ameresco will require continuing access to NMSU's energy management system for the purpose of initiating and intermittent download of data trends for the post retrofit parameters defined above. NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. Additional associated parameters, not used in the measured savings calculation, may also be trended for diagnostic purposes. Ameresco will periodically download and archive the data off-site throughout the evaluation period, defined for this measure as four months from August 1 through November 30 of each evaluation year.

NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. In addition, NMSU will be required to notify Ameresco of any prolonged EMS outages that may result in trend data loss.

As part of the monitoring services, Ameresco will perform a yearly site inspection of this ECM. The observations during this inspection will be made part of the Annual Reconciliation Report.

ECM 26: Satellite Plant Energy Savings

The M&V protocol for this measure is based on IPMVP Option A. Option A includes engineering calculations of energy consumption of modified systems based on both measurement and stipulation of system input variables. Stipulated input variables are chosen to account and correct for interaction with concurrent implemented measures.

Under this measurement plan, Ameresco assumes performance risk of the energy performance aspects of the satellite plant operation. Ameresco will perform equipment measurements and implement energy management system trends to verify that the performance of the installed equipment will operate according to the Schedule R measure descriptions. Electric and natural gas energy consumption savings will be calculated as the difference between stipulated pre-retrofit values, and the post-retrofit measured and monitored values. The calculated energy savings will be normalized to account for weather variations between the weather file used for the stipulated baseline consumption and weather concurrent to the evaluation period.

Energy Savings Calculation Methodology

> Pre-Retrofit Parameters

The pre-retrofit baseline is defined by a calibrated campus energy simulation model. This model includes the central utility plant as configured during the baseline period (September 2011 – August 2012). Hourly data output parameters from the model used to define the baseline performance for this measure include those shown in Table C-7.

Table C-7: ECM 26 Pre-Retrofit Model Hourly Data Parameters– Central Utility Plant

Central Utility Plant	
Plant Component	Electric Energy Demand (kW)
Primary Chilled Water Pumps	
CHWP1	A
CHWP2	B
CHWP3	C
Chlr2a (2(2StageAbs) Pump	D
Secondary Chilled Water Pumps	
CHW Loop Pump	E
Condenser Water Pumps	
CWP1	F
CWP2	G
CWP3	H
ACWP3	I
ACWP4	J
Electric Chillers	
CUP CH1	K
CUP CH2	L
CUP CH3	M
Absorption Chillers	
Chiller2a (2 StageAbs)	N
Chiller2b (2StageAbs)	O
Cooling Towers	
CT1	P
CT2	Q
CT3	R
Plant Component	Secondary Loop Cooling Load (Ton-hours)
Secondary CHW Loop	S

The hourly data output for these parameters will be compiled into monthly electric Off Peak/On Peak energy consumption and peak demand. The secondary chilled water loop data will be reserved for correcting the post-retrofit data to account for interactive affects with other implemented energy conservation measures.

> Post-Retrofit Parameters

Post-retrofit central and satellite plant consumption are defined by EMS trend data (15 min interval) parameters shown in Tables C-8 and C-9.

Table C-8: ECM 26 Post-Retrofit EMS Trend Parameters – Central Utility Plant

Central Utility Plant	
Plant Component	Electric Energy Demand (kW)Parameter
Primary Pumps	
CHWP1	A
CHWP2	B
CHWP3	C
Steam CHWP4	T
Thermal Storage Charging Pumps	
Chrg-1	U
Chrg-2	V
Secondary Chilled water Pumps	
CHW Loop Pump	E
Condenser Water Pumps	
CWP1	F
CWP2	G
CWP3	H
Steam CWP4	W
Electric Chillers	
CUP CH1	K
CUP CH2	L
CUP CH3	M
Steam Turbine Chiller	
Steam Chiller-4	X
Cooling Tower Fans	
CT1	P
CT2	Q
CT3	R
Steam CT4	Y
	Secondary Loop Cooling Load
Secondary CHW Loop Load	
CUP_Campus_Flow_Total (GPM)	Z
CUP_CHWS_Temeprature (deg F)	AA
CUP_CHWR_Temperature (deg F)	BB
Steam Chiller Load (Ton-Hrs)	CC

Table C-9: ECM 26 Post-Retrofit EMS Trend Parameters – Satellite Utility Plant

Satellite Utility Plant	
Plant Component	Electric Energy Demand (kW)Parameter
Primary Pumps	
CHWP 11	DD
CHWP 12	EE
CHWP 13	FF
Ice Storage Glycol Pump	
GLYP-1	GG
GLYP-2	HH
Condenser Water Pumps	
SPCWP1	II
SPCWP2	JJ
SPCWP3	KK
Electric Chillers	
Duplex Chiller 6	LL
Glycol Chiller	MM
Cooling Tower Fans	
SPCT1	NN
SPCT2	OO
SPCT3	PP
	Satellite Plant Secondary Loop Load
Satellite Plant Secondary CHW Loop Flow (GPM)	QQ
Satellite Plant Loop CHWS (deg F)	RR
Satellite Plant CHWR (deg F)	SS

The interval data points for electric demand in Tables C-8 and C-9 will be compiled into monthly total coincident electric energy peak demand and Off Peak/On Peak consumption for the evaluation period defined for this measure as four months from August 1 through November 30 of each evaluation year.

The total electric energy consumption and demand will be further defined as a function of total secondary loop loads as calculated from parameters Z, AA, BB, CC, QQ, RR, SS. The load calculations are as follows:

Post Retrofit Central Plant Chilled Water Load ZZ: = sum((500 x Z x (BB - AA)), CC)

Post Retrofit Satellite Plant Chilled Water Load AAA: = 500 x QQ x (SS – RR)

Total Post Retrofit Chilled Water Load BBB: = ZZ + AAA

In order to account for interaction with other implemented measures, the post-retrofit chilled water loads will be stipulated to be equal to the pre-retrofit values.

> Savings Analysis

The energy savings will be calculated as a simple difference in energy consumption.

The pre-retrofit energy consumption will be calculated for each month as follows:

Pre Retrofit Peak Demand (kW) TT: = max(sum(Table F-4 parameter values))

Pre Retrofit (On and Off Peak) Electric Energy Consumption (kWh) UU: = sum(Table F-4 parameter values)

The post- retrofit energy consumption will be calculated as follows:

Post Retrofit Peak Demand (kW) VV: = XX x S

Post Retrofit Peak Demand per Ton hour XX: = (max(sum(Table F-5, Table F-6 parameter values)))/BBB

(On and Off Peak) Post Retrofit Energy Consumption (kWh) WW: = YY x S

Post Retrofit Energy Consumption per Ton hour YY: = (max(sum(Table F-5, Table F-6 parameter values)))/BBB

The energy savings will be calculated as the following:

Electric Peak Demand Savings = TT – VV

(On and Off Peak) Electric Energy Consumption Savings = UU – WW

Metering Plan

As part of the monitoring services under this agreement, Ameresco will require continuing access to NMSU's energy management system for the purpose of initiating and intermittent download of data trends for the post retrofit parameters defined above. NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. Additional associated parameters, not used in the measured savings calculation, may also be trended for diagnostic purposes. Ameresco will periodically download and archive the data off-site throughout the evaluation period, defined for this measure as four months from August 1 through November 30 of each evaluation year.

NMSU will be required to maintain the trends established by Ameresco for the purposes of Measurement and Verification. In addition, NMSU will be required to notify Ameresco of any prolonged EMS outages that may result in trend data loss.

As part of the monitoring services, Ameresco will perform a yearly site inspection of this ECM. The observations during this inspection will be made part of the Annual Reconciliation Report.

PAYMENTS SCHEDULES

SCHEDULE H. FINAL PROJECT COST & PROJECT CASH FLOW ANALYSIS

PROJECT CASH FLOW

Project Proforma (January 29, 2014) - 13 Year Project Performance Term + Construction
New Mexico State University

Initial Project Costs:	
Detailed Energy Audit	$ 659,459
Implementation Costs	$ 14,131,898
New Mexico Gross Receipts Tax (6.375%)	$ 942,949
Total Initial Project Costs	**$ 15,734,306**
Cost of Issuance	**$ 115,000**
Underwriters Discount	**$ 12,000**
Additional Proceeds	**$ 3,694**
Net Project Costs	**$ 15,865,000**
Construction Period Interest	**$ -**
Total Amount Financed	**$ 15,865,000**

Financial Assumptions	
Term of Project (years)	13.0 yrs
Term of Financing (years)	13.0 yrs
Estimated Financing Rate	3.02%
Payments per Year (frequency)	12
Discount Rate	3.02%
Energy Escalation rate (annual)	2.97%
O&M Savings Escalation rate (annual)	3.00%
M&V Cost Escalation Rate (annual)	3.00%
Project Simple Payback	12.30

Proforma			Year										
	Initial Values	FY-15 Constructon	FY-16	FY-17	FY-18	FY-19	FY-20	FY-21	FY-22	FY-23	FY-24	FY-25
1 Projected Annual Energy Cost Savings	$ 981,045	$ -	$ 1,010,133	$ 1,040,083	$ 1,070,922	$ 1,102,675	$ 1,135,369	$ 1,169,033	$ 1,203,695	$ 1,239,384	$ 1,276,132	$ 1,313,969
2 Projected Annual Cost Savings from the Satellite Plant	$ 368,553	$ 245,702	$ 379,481	$ 390,732	$ 402,317	$ 414,246	$ 426,529	$ 439,175	$ 452,197	$ 465,604	$ 479,409	$ 493,624
3 Guaranteed Energy Cost Savings	$ 882,941	$ -	$ 909,120	$ 936,075	$ 963,830	$ 992,407	$ 1,021,832	$ 1,052,129	$ 1,083,325	$ 1,115,446	$ 1,148,519	$ 1,182,572
4 Guaranteed Energy Savings from the Satellite Plant	$ 331,698	$ -	$ 341,533	$ 351,659	$ 362,086	$ 372,822	$ 383,876	$ 395,258	$ 406,977	$ 419,044	$ 431,468	$ 444,262
5 O&M Savings	$ 64,086	$ -	$ 66,009	$ 67,989	$ 70,029	$ 72,129	$ 74,293	$ 76,522	$ 78,818	$ 81,182	$ 83,618	$ 86,126
6 Utility Rebates (Note 4)		$ -	$ 1,459,216									
7 Total Project Savings (Line 3 + Line 4 + Line 5 + Line 6)	**$ 1,278,725**	**$ -**	**$ 2,775,878**	**$ 1,355,723**	**$ 1,395,945**	**$ 1,437,358**	**$ 1,480,001**	**$ 1,523,909**	**$ 1,569,120**	**$ 1,615,672**	**$ 1,663,605**	**$ 1,712,960**
8 Payments for Financing Equipment		$ 480,454	$ 2,599,123	$ 1,175,099	$ 1,212,147	$ 1,252,383	$ 1,290,656	$ 1,326,966	$ 1,371,313	$ 1,408,395	$ 1,453,363	$ 1,500,915
9 Energy Savings Guarantee Insurance	$ 60,732	$ -	$ 62,533	$ 64,387	$ 66,296	$ 68,261	$ 70,285	$ 72,369	$ 74,515	$ 76,725	$ 78,999	$ 81,342
10 Payments for Measurement and Verification Services	$ 59,642	$ -	$ 61,431	$ 63,274	$ 65,172	$ 67,127	$ 69,141	$ 71,215	$ 73,351	$ 75,552	$ 77,819	$ 80,154
11 MyEnergyPro™ - OpsPRO Annual Service	$ 2,900	$ -	$ 2,987	$ 3,077	$ 3,169	$ 3,264	$ 3,362	$ 3,463	$ 3,567	$ 3,674	$ 3,784	$ 3,898
12 Total Payments	**$ 123,274**	**$ 480,454**	**$ 2,726,074**	**$ 1,305,837**	**$ 1,346,784**	**$ 1,391,035**	**$ 1,433,444**	**$ 1,474,013**	**$ 1,522,746**	**$ 1,564,346**	**$ 1,613,965**	**$ 1,666,309**
13 Net Annual Benefit From Guaranteed Savings		**$ (480,454)**	**$ 49,804**	**$ 49,886**	**$ 49,161**	**$ 46,323**	**$ 46,557**	**$ 49,896**	**$ 46,374**	**$ 51,326**	**$ 49,640**	**$ 46,651**
14 Net Annual Benefit From Projected Savings		**$ (234,752)**	**$ 188,764**	**$ 192,967**	**$ 196,484**	**$ 198,015**	**$ 202,747**	**$ 210,717**	**$ 211,963**	**$ 221,825**	**$ 225,194**	**$ 227,410**
15 Cumulative Cash Flow from Guaranteed Savings	**$ 151,424**	**$ (480,454)**	$ (430,650)	$ (380,765)	$ (331,604)	$ (285,281)	$ (238,723)	$ (188,827)	$ (142,454)	$ (91,128)	$ (41,488)	$ 5,163
16 Cumulative Cash Flow from Projected Savings	**$ 2,562,670**	**$ (234,752)**	$ (45,988)	$ 146,980	$ 343,463	$ 541,479	$ 744,225	$ 954,942	$ 1,166,905	$ 1,388,730	$ 1,613,924	$ 1,841,334
17 Net Present Value of Cash Flow from Guaranteed Savings FY 15 to FY 28	**$ 34,821**											
18 Net Present Value of Cash Flow from Projected Savings FY 15 to FY 28	**$ 1,970,013**											

Proforma	Year			
Line #	FY-26	FY-27	FY-28	Totals
1 Projected Annual Energy Cost Savings	$ 1,352,928	$ 1,393,043	$ 1,434,346	$ 15,741,712
2 Projected Annual Cost Savings from the Satellite Plant	$ 508,260	$ 523,330	$ 538,846	$ 6,159,452
3 Guaranteed Energy Cost Savings	$ 1,217,635	$ 1,253,738	$ 1,290,912	$ 14,167,540
4 Guaranteed Energy Savings from the Satellite Plant	$ 457,434	$ 470,997	$ 484,962	$ 5,322,378
5 O&M Savings	$ 88,710	$ 91,371	$ 94,112	$ 1,030,908
6 Utility Rebates (Note 4)	$ -	$ -	$ -	$ 1,459,216
7 Total Project Savings (Line 3 + Line 4 + Line 5 + Line 6)	**$ 1,763,779**	**$ 1,816,106**	**$ 1,869,986**	**$ 21,980,042**
8 Payments for Financing Equipment	$ 1,545,900	$ 1,593,318	$ 1,638,018	$ 19,848,050
9 Energy Savings Guarantee Insurance	$ 83,753	$ 86,237	$ 88,794	$ 974,496
10 Payments for Measurement and Verification Services	$ 82,559	$ 85,036	$ 87,587	$ 959,418
11 MyEnergyPro™ - OpsPRO Annual Service	$ 4,015	$ 4,135	$ 4,259	$ 46,654
12 Total Payments	**$ 1,716,227**	**$ 1,768,726**	**$ 1,818,658**	**$ 21,828,618**
13 Net Annual Benefit From Guaranteed Savings	**$ 47,552**	**$ 47,380**	**$ 51,328**	**$ 151,424**
14 Net Annual Benefit From Projected Savings	**$ 233,671**	**$ 239,018**	**$ 248,647**	**$ 2,562,670**
15 Cumulative Cash Flow from Guaranteed Savings	**$ 52,715**	$ 100,096	$ 151,424	
16 Cumulative Cash Flow from Projected Savings	**$ 2,075,005**	$ 2,314,023	$ 2,562,670	

Notes:

1 This cash flow reflects an estimated financing rate of 3.02%. The actual rate will increase or decrease based on market conditions and customer credit rating at the time of bond issuance.

2 Revenues are based on current utility rate structures and usage information provided for purposes of this project.

3 The performance and payment bonds apply only to the installation portion of the contract and do not apply in any way to energy savings guarantees, payments or maintenance provisions, except that the performance bond shall guarantee that the installation will be free of defective materials and workmanship for a period of 12 months following completion and acceptance of the work

4 The amount of the utility rebate(s) are not guaranteed. The final rebate amount will be determined by the utility company.

5 NMSU will make an interest payment of $480,454 to the lender during FY 15 prior to the completion of construction and commencement of the performance period.

6 Energy Cost Savings will begin to accrue during the construction period as the retrofits are installed.

Building	ECM Number	ECM Title	Annual kW Savings	Annual kWh Savings (On Peak)	Annual kWh Savings: Winter On & Off Peak Summer Off Peak	Annual Electric Dollar Savings	Annual Natural Gas Savings (dtherm)	Annual Natural Gas Dollar Savings	Operation & Maintenance Savings	Total Savings		Total Cost	Utility Rebate	Simple Payback
Project Summary - All Buildings														
	1	Interior Lighting	17,827.2	588,333	4,997,179	$472,812	658	$4,119	$59,075	$536,006		$4,703,529	$670,262	7.5
	2	Exterior Lighting	56.0	10	203,234	$10,143	0	$0	$4,123	$14,266		$294,934	$24,387	19.0
	3	Exterior Pole Mounted Lighting	26.5	0	96,706	$4,795	0	$0	$888	$5,683		$1,336,816	$11,605	233.2
	6	Retro-Commissioning	1,507.1	45,919	979,384	$69,532	11,453	$71,698	$0	$141,230		$2,201,811	$123,037	14.7
	7	Variable Air Volume Retrofit	4,544.6	203,429	2,509,047	$187,561	-2,398	-$15,008	$0	$172,553		$3,469,299	$325,498	18.2
	10	Economizer Upgrade or Repair	1,077.6	2,043	1,468,659	$96,642	-46	-$284	$0	$96,358		$488,609	$176,485	3.2
	12	Chilled Water Bypass	874.0	77,366	988,837	$80,006	-155	-$971	$0	$79,035		$1,429,554	$127,942	16.5
	26	Satellite Plant Energy Savings	-5,395.0	1,465,759	660,343	$367,551	160	$1,002	$0	$368,553		$0	$0	0.0
	28	MyEnergyPro™ - OpsPRO	0.0	0		$0	0	$0	$0	$0		$55,194	$0	
	29	MyEnergyPro™ - DashPRO	0.0	0		$0	0	$0	$0	$0		$29,318	$0	
	30	MyEnergyPro™ - Optimization Model	0.0	0		$0	0	$0	$0	$0		$122,834	$0	
Project Summary - All Buildings			**20,518.1**	**2,382,859**	**11,903,390**	**$1,289,042**	**9,674**	**$60,556**	**$64,086**	**$1,413,684**		**$14,131,898**	**$1,459,216**	**9.0**

Compensation to ESCO:

Construction Phase (Invoices will be based on construction progress):

Technical Energy Audit:	$ 659,459
Implementation Costs:	$14,1**3**1,**898**
New Mexico Gross Receipts Tax:	$ 942,949
Total Construction Phase Compensation to ESCO:	$15,734,306

Implementation Costs will be determined based on the Direct Construction Costs as shown in the following table. This price structure will be used to calculate the cost of any changes to the scope of work directed by the Agency.

Costs, Markups and Fees – Cost for performing the Investment Grade Audit (IGA) and Contractor markups and fees for pre-defined categories in the construction and performance phases shall be as listed below.

Categories of Markup	% Markup	% Markup Application
Overhead	**12%**	**Markup applied on categories below.**
Profit	**9%**	**Markup applied on categories below.**

Category of Fee	Fee Amount	Remarks
IGA & Project Development	**$0.095 per Square Foot**	**One time**
Arrangement of Project Financing	**0%**	**Included in IGA & Project Development Fee above**
Engineering and Design	**9% of Direct Costs**	**Stipulated, one time**
Performance & Payment Bond	**1.5% of Direct Costs**	**Stipulated, one time**
Construction Management	**8% of Direct Costs**	**Stipulated, one time**
Commissioning	**2% of Direct Costs**	**Stipulated, one time**
Monitoring & Verification at Construction	**1% of Direct Costs**	**Stipulated, one time**
Monitoring & Verification during the Performance Period	**Per M&V Plan**	**Annual**
Training	**1% of Direct Costs**	**Stipulated one time**
Legal Services	**1% of Direct Costs**	**Stipulated one time**
Warranty Service	**2% of Direct Costs**	**Stipulated, one time**
Maintenance on Installed Measures	**Per Project Maintenance Plan**	**Annual**
Travel	**1% of Direct Costs**	**Stipulated, one time**
Contingency	**7% of Direct Costs**	**Stipulated, one time.**

Direct Costs – Direct Project Costs ("**Direct Costs**") consist of labor, equipment and material required to perform the defined scope of work. It also includes the job site costs, subcontractor bond costs, permits, temporary services and utilities, disposal of materials, subcontracted design engineering, safety and security measures, subcontracted field supervision, subcontractor quality control, subcontractor administrative submittals for the Project and subcontractor overhead and profit for the project.

SCHEDULE I. FINANCING AGREEMENT AND PAYMENT SCHEDULE

This schedule will be completed when the lending firm is selected and the terms of the lending agreement are finalized.

SCHEDULE J. COMPENSATION TO ESCO FOR ANNUAL SERVICES

Compensation to ESCO during Guarantee Years:

Year	M&V	Guarantee Insurance	MyEnergy Pro Annual Service	TOTAL CHARGES
1	$ 61,431	$ 62,533	$ 2,987	**$ 126,951**
2	$ 63,274	$ 64,387	$ 3,077	**$ 130,738**
3	$ 65,172	$ 66,296	$ 3,169	**$ 134,637**
4	$ 67,127	$ 68,261	$ 3,264	**$ 138,652**
5	$ 69,141	$ 70,285	$ 3,362	**$ 142,788**
6	$ 71,215	$ 72,369	$ 3,463	**$ 147,047**
7	$ 73,351	$ 74,515	$ 3,567	**$ 151,433**
8	$ 75,552	$ 76,725	$ 3,674	**$ 155,951**
9	$ 77,819	$ 78,999	$ 3,784	**$ 160,602**
10	$ 80,154	$ 81,342	$ 3,898	**$ 165,394**
11	$ 82,559	$ 83,753	$ 4,015	**$ 170,327**
12	$ 85,036	$ 86,237	$ 4,135	**$ 175,408**
13	$ 87,587	$ 88,794	$ 4,259	**$ 180,640**

M&V fees will be invoiced after delivery of the annual Measurement and Verification Report.

Guarantee Insurance fees will be invoiced on the Anniversary Date at the beginning of each Guarantee Year.

MyEnergyPro™ Annual Service fees will be invoiced at the end of each Guarantee Year.

The cost of any additional services requested by the Agency will be negotiated between the parties at the time of the request.

SCHEDULE K – REBATES, INCENTIVES, AND GRANTS

K. Utility Incentives

El Paso Electric

The El Paso Electric (EPE) SCORE Plus Program provides support to participating entities that complete energy efficiency projects resulting in electric energy savings. The upgrades include air conditioning, insulation, lighting, variable frequency drives, pumps, etc. CLEAResult Consulting is the company selected by EPE to serve as the Program Implementer for the 2013 SCORE Plus Program. The incentive for eligible energy efficiency measures is currently $0.12 per kWh reduced. All of the ECMs proposed by Ameresco including ECM 1 Interior Lighting, ECM 2 Exterior Lighting, ECM 3 Exterior Pole Mounted Lighting, ECM 6 Retro commissioning, ECM 7 VAV Retrofit, ECM 10 Economizer Upgrade or Repair, and ECM 12 Chilled Water Pump Bypass would be eligible for this incentive.

EPE has filed a new incentive rate for 2014 with the New Mexico Public Regulation Commission of $0.12 per kWh. This new incentive rate has been approved by the New Mexico Public Regulation Commission.

NMSU and Ameresco have been working with representatives from EPE and CLEAResults to establish program eligibility criteria, define ECM scope and energy savings and estimate rebate amounts. NMSU has filed a Letter of Intent to participate with EPE in the SCORE Plus Program. Ameresco will continue to work with NMSU, EPE and CLEAResult to help maximize the available rebates. However, rebate amounts are determined by EPE and therefore, Ameresco does not guarantee the rebate amounts.

No natural gas savings incentives or rebates have been identified at this time.

SCHEDULE Q. DESCRIPTION OF PROJECT SITE(S); PRE-EXISTING EQUIPMENT INVENTORY

The following are examples of the type of information that will be included for each building that will receive retrofits under this contract. All buildings will be included in the final contract.

34 - Foster Hall

Year	1930, 1935, 1969, 2005
Square Feet	98,084
Floors	4

Building Description

Foster Hall houses the Biology and Agriculture Departments, and includes a wide variety of functional spaces including classrooms, offices, and laboratories. Typical building occupancy at Foster Hall consists of approximately 600 students daily during spring and fall semesters. Summer semester at Foster Hall is low use with a considerable decrease in building occupancy. The building was originally constructed in 1930, with major additions in 1935, 1969, and 2005. The original 1930-35 sections include roughly 23,000 sq. ft. with two floors above ground with a basement floor partially below grade. The envelop consists of 16" steel reinforced concrete foundation walls, 12 inch reinforced concrete walls with a cement stucco finish, and a plaster interior finish. The windows are double-hung operable units with fixed sashes, metal frames, single panes and no thermal breaks. The roof is pitched, with clay tile and wood sheathing over an un-insulated attic space.

The 1969 addition includes roughly 41,000 sq. ft. with basement and three-story additions to the south of the original 1930-35 structure. The envelop consists of 6"-16" reinforced concrete foundation walls, 8" un-insulated concrete masonry unit walls with cement stucco exterior finish and painted interior finish, and precast concrete walls with smooth interior and textured exterior finishes. The windows are in-operable single pane, metal frame units with neutral grey glass and no thermal breaks. The roof consists of gravel over 2" of rigid insulation over precast concrete tees.

The 2005 addition includes 29,000 sq. ft. with basement and 3 story additions to the south and west of the 1969 structure. The envelope consists of exterior stucco finish, ½" gypsum sheathing, R-19 batt insulation, and 3" airspace. The interior is finished with painted 5/8" gypsum sheathing. The windows are inoperable double-paned metal-framed units with thermal breaks. The roofing consists of a pitched perimeter construction of concrete tiles over ½" plywood sheathing, 2-1/2" rigid insulation, and a metal

deck. The interior roof construction includes built-up roofing with an adhered membrane finish over 2-1/2" rigid insulation and a 4" concrete deck.

Foster Hall's existing equipment schedule includes a 24/7 fan schedule for AHUs 1-4, MAU-1, and fan coil zones. Occupied and unoccupied cooling and heating temperatures for AHUs 1-4 range from 71˚F to 75˚F. Further, MAU-1 spans from 61˚F for cooling occupied and unoccupied; to 70˚F for heating occupied and unoccupied. Additionally, fan coil zones at Foster measure 74˚F for occupied and unoccupied heating and cooling.

HVAC Systems

The HVAC systems at Foster Hall include central air handling systems with hot water and chilled water coils, zone air terminal units, and zone fan-coil units with auxiliary fresh air supply. The HVAC systems at Foster Hall are served from the central plant chilled water and steam systems, with hot water provided via steam-to-hot water heat exchangers.

The north and west wings of the 1930-35 section are conditioned by four-pipe fan-coils with three speed fan motors. Each unit has hot and chilled water coils with pneumatic two-way valves. Ventilation for these spaces is provided by a dedicated 100% outdoor air make-up air handling unit (MAU-1) with a constant speed fan, hot water coil, and chilled water coil. The associated zone thermostats are stand-alone electronic units with on/off, fan speed, and thermostatic control.

The east wing second and third floor corridors and stairwells of the 1930-35 section are conditioned by AHU-1. AHU-1 is a 100% outdoor air, constant volume unit with a VFD equipped supply fan, steam and chilled water coils and direct digital control (DDC) two-way valves.

The ground, first and second floors of the east 1930-35 section, and the ground and first floors of the 1969 section are conditioned by a large built-up AHU (AHU-4). AHU-4 is located in the 1969 ground floor mechanical room, and is a dual-duct, constant volume unit. It has hot water and chilled water coils, each with a two-way valve, two supply fans, and two relief fans. During the 2005 addition and renovation, one relief fan was abandoned in place, heat recovery wheels were removed, and the fan motors retrofitted with variable frequency drives (VFD) for re-balancing. The AHU-4 controls have all been converted to DDC. There are two cooling coils but the temperature control valve only serves one of the two coils so the remaining coil is uncontrolled. The controls associated with the AHU-4 zones are also pneumatic.

The third and fourth floors of the 1969 section are conditioned by AHU-2. AHU-2 is located on the roof of the 1969 addition and is a single duct variable air volume unit. It

has hot water and chilled water coils, each with a two-way a two-way valve, and single supply and relief fans. The supply and relief fan motors are equipped with VFD, and modulate to maintain a static pressure setpoint within the VAV duct distribution system. Each zone served by AHU-2 has a VAV air terminal unit with hot water re-heat coils. All controls associated with AHU-2, including the associated zone terminal controls are DDC.

The all four floors of the 2005 section are conditioned by AHU-3, whose configuration and zone terminals are identical to AHU-2. See Table Q.1 for a detailed schedule of the Foster Hall AHU.

Seven constant speed exhaust fans provide general, laboratory, and restroom exhaust. The general and restroom exhaust fans operate based on the building occupancy schedule. The laboratory exhaust fans operate continuously. See Table Q.1 for a detailed schedule of the Foster Hall AHU.

Chilled water for the Foster Hall cooling systems provided by the campus central chilled water loop. Chilled water is distributed to these systems by a single, constant volume chilled water pump. The chilled water pump is enabled based on AHU chilled water valve position as a proxy for cooling demand. Foster Hall is not equipped with a chilled water pump bypass or a modulating control valve on the return loop.

Hot water for the Foster Hall AHU and FCU heating coils, and re-heat coils is provided by steam-to-hot water heat exchanger. Steam is provided by the campus steam loop, with and the heating hot water supply temperature setpoint is controlled by modulating steam control valves. The supply temperature setpoint is reset according to outside air temperature. Heating hot water is distributed throughout the building by a variable volume hot water pump with a VFD controlled motor. A hot water generator is used to transfer heat from steam to the building's heating water and domestic hot water systems. See Table Q.1 for a detailed schedule of Foster Hall hot water and chilled water distribution equipment.

This building is equipped with Schneider/TAC DDC system for operation of the chilled water system, hot water system and each air handler.

Table Q.1. Building HVAC Schedule

Equipment	Quantity	Rating		Service
AHU-1	1	14,650	CFM	1930-35 Second Floor Stair, Corridor
AHU-2	1	30,000	CFM	1969 Third and Fourth Floors
AHU-3	1	36,000	CFM	2005 All Floors
AHU-4	1	51,800	CFM	1930-35 First Floor East Wing, 1969 First and Second Floor
MUA-1	1	7,000	CFM	1930-35 All Floors, North and West wings
HE-1	1	500	CFM	Hood Exhaust
HE-2,3	2	10,100	CFM	Hood Exhaust

GE-1A	1	6,700	CFM	1930-35 General Exhaust
GE-1B	1	8,800	CFM	1930-35 General Exhaust
GE-2	1	47,000	CFM	1970 General Exhaust
Hood Exhaust	6	5,700	CFM	1930-35 Hood Exhaust
EF-1	1	1,710	CFM	Toilet Exhaust
FCU-1 thru 99	99	160 – 1,000	CFM	1930-35 North and West wings
CHW Pump	1	10 HP	553 GPM, 40 ft. hd.	CHW Loop
HHW Pump	2	5 HP	244 GPM, 41 ft. hd.	HW Loop

Notes:

HP = horsepower
MBH = 1,000 BTUH

GPM = gallons per minute

Ft. hd. = feet of head

CFM = cubic feet per minute (air)

Lighting Systems

The predominant lighting used throughout Foster Hall includes:

- Classrooms – 4’ 3 lamp 32w T8 Indirect fixtures
- Hallways – 4’ 2 lamp 28w T8 parabolic fixtures
- Labs – 4’ 3 lamp 32w T8 Industrial fixtures and 1x4 2 lamp 40w box fixtures
- Offices – 1x4 2 lamp 40w box fixtures and 2x4 3 and 4 lamp 32w T8 fixtures
- Restrooms – 4’ 2 lamp 32w T8 Indirect fixtures
- Exterior – 50w, 100w, and 175w Metal Halide wall mount fixtures and 27w CFL wallpack fixtures.

Plug Load Equipment

The building has a variety of plug load equipment operating. Offices typically have a computer with a flat screen monitor and a printer. Laboratories are equipped with a wide variety of test and measurement instruments and test fixtures. Other plug loads including copiers, fax machines, water coolers and vending machines are in use. Detailed plug load survey results are available in the technical appendix.

Plumbing Systems

Not in scope of work.

397 - John Whitlock Hernandez Hall

Year	1988
Square Feet	44,107
Floors	2

Building Description

The John Whitlock Hernandez Hall is also known as Engineering Complex II (EC-II). Typical building occupancy at EC-II consists of approximately 400 students daily during spring and fall semesters. Summer semester at EC-II is low use with a considerable decrease in building occupancy. The building is comprised primarily of metal stud exterior walls with 6" of fiberglass batt insulation. The exterior finish is synthetic stucco on 1.5 inch rigid insulation over ½ inch exterior gypsum board. Floors are concrete slab on grade. The roof surface is a modified bitumen membrane over 3 inch rigid isocyanurate insulation on metal decking. Windows are primarily 1" insulated fixed glazing with bronze tint. This building serves the civil, agricultural and geological engineering departments and includes classrooms, offices, storage rooms, laboratories, restrooms, and other miscellaneous rooms.

HVAC Systems

The HVAC systems at EC-II are served from the central plant chilled water and steam systems. Chilled water is piped and pumped from the central chilled water campus loop to HVAC systems using the building's chilled water pump. There is one 3 HP chilled water pump equipped with a VFD. There are two-way chilled water control valves and the pump maintains a single static pressure setpoint. EC-II is not equipped with a chilled water pump bypass or a modulating control valve on the return loop. A hot water generator is used to transfer heat from steam to the building's heating water and domestic hot water systems. Condensate is returned to the central plant via an automatic steam trap, (APT) and a condensate return unit (CRU). There is one 3/4 HP hot water pump equipped with a VFD

and the heating control vales are 2-way valves. The chilled and hot water pumps both have standard efficiency motors.

There are two AHU's that are used to serve the building. These include an eight-zone constant volume multizone system and a dual duct VAV system. Both units are located in the EC-II penthouse.

The Pace multizone unit (AHU-1) is used to serve the laboratory areas throughout the building. This unit is equipped with DDC controls and field devices. The unit's airfoil supply fan produces 15,500 CFM at 2.75" static pressure and is equipped with a 15 HP standard efficiency supply fan motor. The airfoil return fan is equipped with a 5 HP standard efficiency motor. Both motors are located within the airflow. According to the as-built drawings the design cooling capacity is 518.7 MBH and the design heating capacity is 249.6 MBH. Each of the eight zones is controlled by a single DDC actuator. This unit is also equipped with a mixed air economizer, however during the site visit it was noted that the unit was running in the economizer mode but the relief dampers were closed. This indicates that retro commissioning may be beneficial.

The Pace dual duct VAV air handler (AHU-2) serves the balance of the building including the common areas, classrooms and offices. This unit is equipped with DDC controls and field devices. AHU-2 uses the mechanical penthouse as its return air plenum. The unit consists of two separate fan units for cold and hot deck supplies. The cold deck supply fan (SF-1) is equipped with a 25 HP high efficiency motor with modulating VFD control. The hot deck supply fan (SF-2) is equipped with a 20 HP high efficiency motor with modulating VFD control. Both fans are airfoil design and the motors are located within the air flow. AHU-2 has 2-way cooling and heating valves. According to the as-built drawings the design cooling capacity is 745.2 MBH and the design heating capacity is 317.6 MBH. The cooling design air flow is 25,450 CFM and the heating design airflow is 16,970 CFM at with 4.0" static pressure. This unit is equipped with a mixed air economizer.

All of the 39 dual duct terminal mixing boxes on this air handler are pneumatically controlled.

This building is equipped with Schneider/TAC DDC system for operation of the chilled water system, hot water system and each air handler. The DDC system does not extend to the zone level on AHU-2 where all of the terminal boxes have pneumatic actuators. Standard DDC functions including equipment schedules, economizer control, hot and cold deck reset, chilled water static pressure control, fan static pressure control and other sequences are employed.

Table Q.2. Building HVAC Schedule

Equipment	Quantity	Rating		Service
CHW Pump	1	3	HP	CHW Loop
HHW Pump	1	3/4	HP	HW Loop
AHU-1	1	518.7	MBH	Laboratories
AHU-2	1	745.2	MBH	Classrooms, Offices

Notes:

HP = horsepower
MBH = 1,000 BTUH

Lighting Systems

The predominant lighting used throughout John Whitlock Hernandez Hall includes:

- Classrooms – 2x4 4 lamp 40w T12 prismatic fixtures
- Hallways – 100w Metal Halide recessed cans, 4' 2 lamp 40w T12 prismatic fixtures, 4' 2 lamp 40w T12 cove fixtures and 2x4 4 lamp 40w T12 prismatic fixtures
- Labs – 4' 2 lamp 40w T12 wrap fixtures
- Offices – 2x4 4 lamp 40w T12 prismatic fixtures
- Restrooms – 4' 2 lamp 40w T12 cove fixtures
- Exterior – 100w Metal Halide recessed cans and 50w Metal Halide wall pack fixtures

Plug Load Equipment

The building has a variety of plug load equipment operating. Offices typically have a computer with a flat screen monitor and a printer. Laboratories are equipped with a wide variety of test and measurement instruments and test fixtures. Other plug loads including copiers, fax machines, water coolers and vending machines are in use. Detailed plug load survey results are available in the technical appendix.

Plumbing Systems

Not in scope of work.

SCHEDULE R. EQUIPMENT TO BE INSTALLED BY ESCO

R. Energy Conservation Measures

This section outlines the detailed recommendations for the ECMs that comprise this project. We have included a description of the existing conditions, the proposed changes as outlined in the energy savings analysis, provided a detailed scope of work and documented the impact these measures will have on the facilities.

The construction costs include the engineering design costs, permit costs, construction management fees, warranty, training, commissioning and for the project as a whole and the individual contractor costs for each ECM. These costs are based on the terms and conditions included in the contract.

Table R-1 Energy Conservation Measure Matrix *(Part 1 of 4)*

Building #		187	244	551	188	010	032	033	035	056	060	172	278	288	386	389
ECM Description	Campus Wide	Chemistry Building	Gerald Thomas Hall	Skeen Hall	Gardiner Hall	Goddard Hall	Young Hall	Kent Hall	William B. Conroy Honors Center	Dove Hall	Dan W. Williams Hall	Hadley Hall	Branson Library	Guthrie Hall	Business Complex Building	Music Building
Interior Lighting		X	X	X		X	X	X	X	X	X	X	X	X	X	X
Exterior Lighting		X	X	X		X	X	X		X	X	X	X	X	X	X
Exterior Pole-Mounted Lighting	X															
DDC Retrofit																
Fume Hood Controls																
Retro-Commissioning		X		X		X	X						X	X	X	X
Variable Air Volume Retrofit							X						X	X	X	X
HVAC Upgrade or Replacement																
Heat Recovery																
Economizer Upgrade or Repair		X	X			X	X						X	X	X	X
Premium Efficiency Motors																
CHW Bypass		X	X	X			X	X	X		X	X	X			X
Variable Flow Pumping																
Domestic Hot Water																
Mechanical Insulation																
Building Envelope																
Trash Compaction																
Computer Power Management																
Natural Gas Delivery Consolidation																
CHW System Economizer																
Peak Saving Generator																
CUP Condenser Water Optimization																
Boiler Blowdown Economizer																
Heat Exchanger Leakage																

Table R-1 Energy Conservation Measure Matrix *(Part 2 of 4)*

Building #	269	059	164	246	363	368	391	541	397	079	080	083	185	260	285	126
ECM Description	OFS Central Heating Plant	Cogeneration Facility	Neale Hall	Small Animal Research Lab	Engineering Complex I	Knox Hall	Science Hall	Ed and Harold Foreman Engineering Complex EC-3	John Whitlock Hernandez Hall EC-2	Rhodes-Garrett-Hamiel RES Hall	Rhodes-Garrett-Hamiel RES Hall	Milton Hall	Rhodes-Garrett-Hamiel RES Hall	Monagle Residence Hall	Corbett Center	Computer Center
Interior Lighting	X		X	X	X	X	X	X	X			X				X
Exterior Lighting	X		X	X	X	X	X	X	X			X				X
Exterior Pole-Mounted Lighting																
DDC Retrofit																
Fume Hood Controls																
Retro-Commissioning					X			X	X			X				
Variable Air Volume Retrofit							X		X			X				
HVAC Upgrade or Replacement																
Heat Recovery																
Economizer Upgrade or Repair					X		X	X	X			X				
Premium Efficiency Motors																
CHW Bypass					X	X	X		X			X				
Variable Flow Pumping																
Domestic Hot Water																
Mechanical Insulation																
Building Envelope																
Trash Compaction																
Computer Power Management																
Natural Gas Delivery Consolidation																
CHW System Economizer																
Peak Saving Generator																
CUP Condenser Water Optimization																
Boiler Blowdown Economizer																
Heat Exchanger Leakage																

Table R-1 Energy Conservation Measure Matrix *(Part 3 of 4)*

Building #	154	251	287	321	330	341	342	468	034	189	190	263	301	585	184	225
ECM Description	Garcia Annex	Natatorium	O'Donnell Hall	JAMES B. Delamater Activity Center	New Mexico Dept. Of Agriculture	DACC, Main	Memorial Stadium & Locker Room Field House	Coca Cola Weight Training Facility	Foster Hall	Jett Hall	Jett Annex	PSL, Clinton P. Anderson Hall	Thomas & Brown Hall	JORNADA USDA EXP. Range HQ (Wooton Hall)	Breland Hall	Astronomy Building
Interior Lighting	X	X		X	X	X			X			X		X	X	X
Exterior Lighting		X			X	X			X			X			X	X
Exterior Pole-Mounted Lighting																
DDC Retrofit																
Fume Hood Controls																
Retro-Commissioning									X						X	X
Variable Air Volume Retrofit									X						X	X
HVAC Upgrade or Replacement																
Heat Recovery																
Economizer Upgrade or Repair									X				X		X	X
Premium Efficiency Motors																
CHW Bypass									X						X	X
Variable Flow Pumping																
Domestic Hot Water																
Mechanical Insulation																
Building Envelope																
Trash Compaction																
Computer Power Management																
Natural Gas Delivery Consolidation																
CHW System Economizer																
Peak Saving Generator																
CUP Condenser Water Optimization																
Boiler Blowdown Economizer																
Heat Exchanger Leakage																

Table R-1 Energy Conservation Measure Matrix (Part 4 of 4)

Building #	248	261	276	364	365	461	590	275	284	338	604	605	60A	632	643	644
ECM Description	Regents Row	Student Health Center	Walden Hall	Clara Belle Williams Hall	Speech Building	Zuhl Library	Health and Social Services Building	Garcia Residence Hall	Pan American Center	Educational Services Center	Pinon Hall	Chamisa Village	Dan W. Williams Hall Annex	Barnes & Nobel	NMDA Addition	Chilled Water Plant
Interior Lighting	X	X	X	X	X	X	X		X	X			X		X	X
Exterior Lighting			X			X	X		X	X			X		X	
Exterior Pole-Mounted Lighting																
DDC Retrofit																
Fume Hood Controls																
Retro-Commissioning				X	X	X	X									X
Variable Air Volume Retrofit				X	X											
HVAC Upgrade or Replacement																
Heat Recovery																
Economizer Upgrade or Repair				X	X	X	X									
Premium Efficiency Motors																
CHW Bypass	X			X	X	X	X									
Variable Flow Pumping																
Domestic Hot Water																
Mechanical Insulation																
Building Envelope																
Trash Compaction																
Computer Power Management																
Natural Gas Delivery Consolidation																
CHW System Economizer																
Peak Saving Generator																
CUP Condenser Water Optimization																
Boiler Blowdown Economizer																
Heat Exchanger Leakage																

ECM 1: Interior Lighting

General Description

> ECM Summary

For each building identified in the ECM Matrix, Ameresco proposes to replace the existing interior lighting systems with new high efficiency lamps and ballasts and replace obsolete fixtures as needed. Retrofitting and replacing the existing fixtures with more efficient ones will reduce peak demand and electricity consumption at NMSU. At the same time, it will also reduce cooling requirements caused by less heat emissions from the lamps. Conversely, there will be some increased heating required during the winter although there is interaction with the steam cooling systems associated with the central plant. The cooling and heating interactions have been accounted for in the savings calculations. Ameresco proposes to install automatic lighting controls in specific locations. Installing the occupancy sensors will reduce the operating hours of the lighting systems and consequently save energy.

> Existing Conditions

The existing interior lighting systems include a wide mix of older T12 lighting systems and T8 lighting systems, along with incandescent, HID, and compact fluorescent (CFL) technologies throughout the campus along with some newly upgraded LED lamps and fixtures. There are some interior lighting controls; however the frequency of these devices varies among the buildings. These lighting systems are detailed in the room-by-room survey results provided in the technical appendix.

Recommended Modifications

Ameresco's approach is to standardize the proposed lighting system whenever practical. Recommended modifications are detailed below.

- Retrofit or Replace the existing 34W/40W T12 Magnetic Ballast fixtures with Premium 28W T8 800 Series Lamps and High Efficiency Multi-Volt Instant Start Electronic Ballasts. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Retrofit or Replace the existing 32W T8 / Electronic Ballast fixtures with Premium 28W T8 800 Series Lamps and High Efficiency Multi-Volt Instant Start Electronic Ballasts. Ballast output will be tailored to each specific location to obtain recommended light levels.
- De-lamp specific interior linear T12 or T8 fixtures and retrofit with Premium 28W T8 800 Series Lamps, High Efficiency Multi-Volt Instant Start Electronic Ballasts and Troffer/Strip/Industrial Reflector Kits, as applicable. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Retrofit or Replace all fixtures with 8 foot lamps (Slim-line, HO, and VHO) utilizing 4 foot Premium 28W T8 800 Series Lamps, High Efficiency Multi-Volt Instant Start Electronic Ballasts, and Conversion Strip or Industrial Kits. All egg crate type fixtures will be replaced with new wrap fixtures. Ballast output will be tailored to each specific location to obtain recommended light levels.

- Retrofit/Convert U lamp fixtures utilizing 2 foot Premium15W T8 800 Series Lamps, High Efficiency Multi-Volt Instant Start Electronic Ballast, and Troffer Reflector Kits. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Re-Lamp existing biax fixtures with energy saving biax lamps or Retrofit to fixtures utilizing 2 foot Premium 15W T8 800 Series Lamps, High Efficiency Multi-Volt Instant Start Electronic Ballasts, and Troffer Reflector Kits (there are some applications that the existing biax fixtures won't accept a 2 foot lamp and therefore a new fixture or a re-lamp only will be the appropriate upgrade). Zuhl Library and NMSU Barnes & Noble Bookstore have new Volumetric Fixtures proposed for the existing biax fixtures. These new Volumetric Fixtures will utilize 28W T8 800 Series Lamps and High Efficiency Multi-Volt Instant Start Electronic Ballasts. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Retrofit Incandescent lamps with screw in LED lamps or CFL lamps (dimming fixtures will be retrofitted with Screw in or Plug in LED lamps). Residence Halls will be retrofit with CFL lamps; all other areas will be LED.
- Relamp existing Compact Fluorescent fixtures with 4 Pin Plug In lamps with energy saving 4 Pin Plug In lamps.
- Replace interior HID (Mercury Vapor, Metal Halide or High Pressure Sodium) fixtures with either new LED fixtures or linear fluorescent fixtures utilizing Premium 28W T8 800 Series lamps or Premium Energy Saving T5HO lamps-depending on application, resulting in longer life products and instant on lighting.
- Retrofit interior HID (Metal Halide) fixtures with Pulse Start Metal Halide lamp and ballast kits (particularly relating to Sports Lighting and Sporting areas-Pan Am Center Seating and Natatorium.
- Install LED technology in certain applications – All Incandescent and CFL Exit Signs and All Recessed Cans.
- Existing screw in CFL lamps and CFL 2 pin plug in lamps are EXCLUDED from the scope of work.

Ameresco's survey has documented areas with existing lighting occupancy controls, however we have found that there is an opportunity to install more lighting occupancy controls in areas that currently do not have them. Lighting occupancy controls will be used to turn off unnecessary lighting fixtures when the space is vacant. Data Loggers were placed in areas of the facilities to understand the hours of operation and the potential of lighting waste (lights operating but no one is in the room). Most common room types for lighting occupancy controls are listed Restrooms and Hallways on the room-by-room scope. Ceiling and Wall mount sensors will be proposed based on application. Vending Machine controls are also included in our proposed upgrades. Vending Machine controls eliminate the unnecessary illumination of vending machine signage during unoccupied times for beverage and snack machines using infrared sensing technology. When used on chilled beverage dispensers, the controls are configured to save energy without compromising product quality and will cycle the units on occasionally to maintain beverage temperature. The controller is external to the machine and does not require vendor maintenance.

The proposed interior lighting controls are identified below:

- Install wired lighting occupancy controls in listed areas of the facilities – please see lighting audit room-by-room for detail.
- Install Vending Machine Controls on Snack and Soda Vending Machines.

Detailed Project Scope

The scope of work includes installation or retrofit of approximately 40,350 fixtures in buildings shown on the ECM Matrix. This measure will include the installation of the lamps, ballasts, reflectors, and fixtures needed for a complete project. A complete room-by-room list of the entire lighting project is provided in the appendices.

The lighting control project includes the installation of approximately 930 controls at various locations throughout the buildings. The controller installation will include the installation of the control, wiring, and sensors needed for a complete installation. A complete list of occupancy sensor type and locations is provided in the appendices.

The project scope of work includes:

- Surveying the existing lighting fixtures for pre-existing damage to the fixture housing or wiring
- Reporting any damage to NMSU for correction
- Replacing any damaged or broken lamp sockets that are still being used. In the event of de-lamping any fixtures, all of the unused lamp sockets will be removed from the fixtures
- Cleaning all inside surfaces of the light fixtures
- Painting surfaces or repairing/replacing ceiling tile because of the removal of old fixtures
- Cleaning up work area and disposing of any construction debris in Ameresco-supplied waste bins and remove from site
- Complying with applicable local, state, and federal codes.

Exclusions to the scope of work include:

- Sampling, testing, or removing asbestos or lead
- Repairing existing damaged or faulty electrical equipment and wiring
- Upgrading electrical distribution system to meet current electrical codes
- Replacing any lenses
- Stamping and signing engineering plans and specifications. The work will be performed using the room by room audit in the appendix.

Ameresco has included lamp and ballast recycling and disposal in the project scope of work. Recycling certificates will be provided to NMSU for all recycled material. PCB ballasts will be disposed of using the appropriate containers and hazardous material handling procedures.

Energy Savings Proposed

Ameresco performed detailed lighting calculations to determine the energy savings associated with the project. The energy savings will result from the operation of more efficient fixtures. Direct electricity savings are associated with the reduced lamp wattages. Indirect savings are associated with a reduced cooling load. Table R-2 summarizes the energy savings associated with this project.

Table. R-2. Energy Savings Associated with ECM 1

Annual Savings	Units
5,585,513	kWh
1,485.6	kW
658	DTh, Natural Gas
$476,931	Utility Cost Savings

> Energy

Detailed calculations for energy and cost savings for ECM-1 are provided in the appendices. Energy savings for the retrofits are determined by comparing the baseline existing kW and kWh with the proposed kW and kWh. Total cost savings from lighting retrofit is then calculated from the energy savings and the baseline energy cost for the buildings.

kW Savings = existing kW – proposed kW

kWh Savings = existing kWh – proposed kWh

kW $ Savings = kW savings x Demand Cost

kWh $ Savings = kWh savings x Energy Cost

Existing energy usage for lighting is calculated from the number of existing light fixtures at the buildings and their rated wattages. Existing operating hours of the fixtures are extrapolated from run hour logger data obtained during the TEA. The data was obtained by installing a light logger at representative fixtures throughout the buildings. The technical appendix shows a summary list of lighting run hours by room type that are used in the calculations. Complete results from the logger data are provided in technical appendix as well.

Energy savings for the occupancy sensors are determined by reducing the run hours of the proposed lamps and ballasts. Total cost savings are then calculated from the energy savings and the baseline energy cost for the buildings.

kWh Savings = proposed kW x (existing hours – proposed hours)

kWh $ Savings = kWh savings x Energy Cost

> Maintenance

Maintenance savings are based on material costs only. Ameresco is proposing using extended life lamps, which will increase the time between burnouts. Delamping overlit areas and the installation of reflectors will reduce the total number of lamps and ballasts installed on campus which will reduce

maintenance cost. The interior environment will be enhanced through the upgrade of the lighting systems by providing a lighting system that reliably illuminates the common areas, thereby providing a more inviting atmosphere. The maintenance savings for ECM 1 is $59,075 per year.

Replacing the old equipment will reduce internal labor associated with maintaining and operating the lighting equipment. These savings are not included in the calculation.

> Interactions

This ECM will reduce the cooling load at the campus by lowering the heat gains in the conditioned spaces from the light fixtures. It will also increase the heating load during the heating season due to the loss of that heat gain. This resulted in a net savings in natural gas due to interactions with the use of steam to provide chilled water from the central plant. Ameresco used the eQUEST modeling program to determine the heating penalty and cooling savings by using the watts per square-foot of the existing and proposed systems. Refer to the model output data in the appendices for further information.

References

- Utility Data
- Field notes, survey data, logger data
- Lighting Manufacturer Catalogs
- Kaufman, John E., PE, FIES, and Christensen, Jack F. IES Ready Reference. Illuminating Engineering Society of North America, 1989
- U.S. Department of Energy (DOE). Advanced Lighting Guidelines. Report Number: DOE/EE-0008, 1993
- Illuminating Engineering Society of North America (IES). IES Lighting Handbook. New York, New York, 1999

Assumptions

Assumptions made in the development of this proposal include:

- The savings for the measure are based on several run-hour schedules.
- All work surfaces are free of asbestos and other hazardous materials. NMSU is responsible for any hazardous material abatement.
- The cost of the project does not include any repair or upgrades of existing electrical distribution systems that are not up to current codes.

Utility Interruptions

Electricity interruption will be isolated to the area of work and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on building occupants.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Lighting Fixtures – 20 years
- Electronic Fluorescent Ballasts – 100,000 run hours
- Fluorescent Lamps – 2- and 4-foot lamps have a service life of 30,000 hours
- HID Lamps – 30,000 run hours
- Electronic HID Ballast – 100,000 run hours
- LEDs – 50,000 to 100,000 run hours
- Lighting Controls – 15 Years

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit. The manufacturer provides a 60-month limited warranty on the electronic ballasts, and a 30-month limited warranty on the fluorescent lamps.

> Interface with Existing Equipment

The retrofit of the existing fixtures will have a minimal impact on the aesthetics of the facility. Retrofitting the lighting will reduce the electrical consumption at the facility, lower the cooling load, and raise the heating load.

ECM 2: Exterior Lighting

General Description

> ECM Summary

The intent of this retrofit is to replace the existing building exterior lighting as shown in the recommended modifications below. The exterior lighting scope includes wall packs, floods, cylinders and surface mount box fixtures for buildings identified in the ECM Matrix. Where feasible, LED technology will be proposed. By going from HID, CFL, or incandescent technology to LED, the rated life of the lamps will increase from 20,000 (HID), 10,000 (CFL) or 1,000 (Incandescent) to 25,000, 50,000 or 100,000 for the LED depending on manufacturer and fixture type. This will alleviate many maintenance concerns as well as provide the latest, most efficient technology. NMSU has already begun the switch to

LED fixtures by replacing some of the wall pack type fixtures throughout campus. The following factors will be taken into consideration for the exterior building lighting:

- Dark Sky Compliant
- Age and Condition of Existing Fixtures
- Existing Lighting Technology Type
- Photocell or Timer Controlled
- Color of Existing Fixtures

> Existing Conditions

Exterior building lighting consists of various types of lighting technologies and fixtures throughout the campus. Lighting technologies include HID sources (Metal Halide and High Pressure Sodium), CFL, incandescent, and linear fluorescent. Fixture types found are recessed cans, surface mount box style, wall-packs, floods, and post top.

Recommended Modifications

Ameresco proposes replacing the existing exterior lighting with the following:

- Replace all exterior HID (Mercury Vapor, Metal Halide or High Pressure Sodium) fixtures with new LED fixtures. Fixture types are wall packs, floods, cylinders and surface mount box fixtures. This upgrade will result in significant energy savings along with longer life products with instant on lighting.
- Retrofit all incandescent lamps with screw in LED lamps or CFL lamps (dimming fixtures will be retrofitted with Screw in or Plug in LED lamps). Residence Halls will be retrofit with CFL lamps; all other areas will be LED.
- Retrofit or Replace all 34W/40W T12 Magnetic Ballast fixtures with Premium 28W T8 800 Series Lamps and High Efficiency Multi-Volt Instant Start Electronic Ballasts. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Retrofit or Replace all 32W T8 / Electronic Ballast fixtures with Premium 28W T8 800 Series Lamps and High Efficiency Multi-Volt Instant Start Electronic Ballasts. Ballast output will be tailored to each specific location to obtain recommended light levels.
- Re Lamp all Compact Fluorescent fixtures with 4 Pin Plug In lamps with energy saving 4 Pin Plug In lamps.
- Existing screw in CFL lamps and CFL 2 pin plug in lamps are EXCLUDED from the scope of work

Detailed Project Scope

This measure will include the installation of the fixtures, lamps, ballasts, wiring, and kits needed for a complete project. A complete list of the exterior lighting project fixtures is provided in the technical appendices.

The project scope of work includes:

- Surveying the existing lighting fixtures for pre-existing damage to the fixture housing or wiring.
- Reporting any damage to NMSU for correction.
- Replacing or retrofit the light fixtures with the appropriate kits or fixtures.
- Cleaning all inside surfaces of the light fixtures.
- Cleaning up work area and disposing of any construction debris in Ameresco-supplied waste bins and remove from site.
- Complying with applicable local, state, and/or federal codes.

Exclusions to the scope of work include:

- Sampling, testing or removing asbestos or lead
- Repairing existing damaged or faulty electrical equipment and wiring
- Upgrading electrical distribution system required to meet current electrical codes
- Replacing any lenses
- Replacing broken or damaged light poles or supports
- Stamping and signing engineering plans and specifications

Ameresco has included lamp and ballast recycling and disposal in the project scope of work. Recycling certificates will be provided to NMSU for all recycled material. PCB ballasts will be disposed of using the appropriate containers and hazardous material handling procedures.

Energy Savings Proposed

Ameresco performed detailed lighting calculations to determine the energy savings associated with the project. The energy savings will result from the operation of more efficient fixtures. Direct electric savings are associated with the reduced lamp wattages. Table R-3 summarizes the energy savings associated with this project.

Table. R-3. Energy Savings Associated with ECM 2

Annual Savings	Units
203,244	kWh
4.7	kW
$10,143	Utility Cost Savings

> Energy

Detailed calculations for energy and cost savings for ECM-2 are provided in the appendices. Energy savings for the retrofits are determined by comparing the baseline existing kW and kWh with the proposed kW and kWh. Total cost savings from lighting retrofit is then calculated from the energy savings and the baseline energy cost.

kW Savings = existing kW – proposed kW

kWh Savings = existing kWh – proposed kWh

kW $ Savings = kW savings x Demand Cost

kWh $ Savings = kWh savings x Energy Cost

Existing energy usage for lighting is calculated from the number of existing light fixtures and their rated wattages. Existing operating hours of the fixtures are based on exterior photocell operation, which is equal to 4,368 hours per year.

Existing kW = existing quantity x existing wattage

Existing kWh = existing operating hours x existing kW

Proposed energy usage after retrofit is calculated based on the proposed number of fixtures and rated wattage. The post-retrofit run hours used in the calculation are the same as the existing run hours.

Proposed kW = proposed quantity x proposed wattage

Proposed kWh = proposed operating hours x proposed kW

> Maintenance

Maintenance savings are based on material costs only. Ameresco is proposing using long life LED lamps, which will increase the time between burnouts. The maintenance savings for ECM-2 are $4,123 per year. Replacing the old equipment will reduce internal labor associated with maintaining and operating the equipment. These savings are not included in the calculation.

> Interactions

There are no savings interactions for this measure since the light fixtures are in unconditioned exterior spaces.

References

- Utility data
- Field notes, survey data, logger data
- Lighting Manufacturer Catalogs
- Kaufman, John E., PE, FIES, and Christensen, Jack F. IES Ready Reference. Illuminating Engineering Society of North America, 1989
- DOE. Advanced Lighting Guidelines. Report Number: DOE/EE-0008, 1993
- IES. IES Lighting Handbook. New York, New York, 1999

Assumptions

Assumptions made in the development of this proposal include:

- The savings for the measure are based on run hours shown in the room-by-room table in the technical appendix.
- All work surfaces are free of asbestos and other hazardous materials. NMSU is responsible for any hazardous material abatement.
- The cost of the project does not include any repair or upgrades of existing electrical distribution systems that are not up to current codes.

Utility Interruptions

Electricity interruption will be isolated to the area of work and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on students, faculty, and staff.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Lighting Fixtures – 20 years
- LEDs – 50,000 to 100,000 run hours

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit.

> Interface with Existing Equipment

The retrofit of the existing fixtures will improve the aesthetics of the campus. The new LED fixtures will look similar those already installed by the facility staff and the retrofit kits will re-use the existing fixture housing. Retrofitting the exterior site lighting will also reduce the electrical demand and consumption at the campus.

ECM 3: Exterior Pole Mounted Lighting

General Description

> ECM Summary

The intent of this retrofit is to replace selected exterior pole lighting on campus. These include parking lots, roadway and street lighting. New LED fixtures for all exterior pole lighting will be provided. In addition to replacing the fixtures, the existing thin walled poles identified in the technical appendix would be replaced with new pre-stressed, spun-cast concrete lighting poles.

> Existing Conditions

NMSU has already begun the switch to LED fixtures on poles, as several parking lot areas have been identified as existing LED fixtures. In addition to replacing fixtures, NMSU has indicated that many existing poles around campus need to be replaced; these are referred to as Thin Walled Poles. These Thin Walled Poles were identified in the audit. There are approximately 25 existing Thin Walled Poles located in parking lots and 246 existing Thin Walled Poles located on streets and other locations.

Recommended Modifications

Ameresco proposes replacing the existing exterior pole mounted lighting with the following:

- Replace specific exterior HID (Metal Halide and High Pressure Sodium) fixtures with new LED fixtures of like type. Fixture types are Cobra Heads, Shoeboxes, Post Tops and Floods. This upgrade will result in significant energy savings along with longer life products with instant on lighting.

- Replace specified thin walled poles with new 30' Ameron decorative poles and supporting sweep arms. Poles located in parking lots will be installed with a concrete base and non-parking areas to be direct burial. This upgrade includes new LED fixtures. Concrete base installation will include excavation, concrete form, reinforcement, backfill and compaction. Direct burial installation will include excavation, backfill and compaction. A direct burial junction box at each pole base is included to allow for existing branch circuits to be spliced and tapped.

Detailed Project Scope

Ameresco is proposing to begin the new pole installation at the NW corner of the Las Cruces Main Campus and working Eastbound but staying North of Stewart St. Please see the maps provided in the technical appendix for locations of poles (lettered and numbered in RED).

Included are the following:

(28) Roadway Poles
(52) Site Lighting Poles
(10) Parking Lot Poles

This measure will include the installation of the fixtures, lamps, ballasts, wiring, and kits needed for a complete project. A complete list of the exterior pole mounted lighting project fixtures is provided in the technical appendices.

The project scope of work includes:

- Replacing specified thin walled poles with new 30' Ameron decorative poles and supporting sweep arms. Replacing the existing poles and light fixtures as specified.

- Poles located in parking lots will be installed with a concrete base and non-parking areas to be direct burial.

- Concrete base installation will include excavation, concrete form, reinforcement, backfill and compaction.
- Direct burial installation will include excavation, backfill and compaction.
- Cleaning up work area and disposing of any construction debris in Ameresco-supplied waste bins and remove from site.
- Complying with applicable local, state, and/or federal codes.

Exclusions to the scope of work include:

- Sampling, testing or removing asbestos or lead
- Repairing existing damaged or faulty electrical equipment and wiring
- Upgrading electrical distribution system required to meet current electrical codes
- Stamping and signing engineering plans and specifications

Ameresco has included lamp and ballast recycling and disposal in the project scope of work. Recycling certificates will be provided to NMSU for all recycled material. PCB ballasts will be disposed of using the appropriate containers and hazardous material handling procedures.

Energy Savings Proposed

Ameresco performed detailed lighting calculations to determine the energy savings associated with the project. The energy savings will result from the operation of more efficient fixtures. Direct electric savings are associated with the reduced lamp wattages. Table R-4 summarizes the energy savings associated with this project.

Table. R-4. Energy Savings Associated with ECM 3

Annual Savings	Units
96,706	kWh
2.2	kW
$4,795	Utility Cost Savings

> Energy

Detailed calculations for energy and cost savings for ECM-2 are provided in the appendices. Energy savings for the retrofits are determined by comparing the baseline existing kW and kWh with the proposed kW and kWh. Total cost savings from lighting retrofit is then calculated from the energy savings and the baseline energy cost.

kW Savings = existing kW – proposed kW

kWh Savings = existing kWh – proposed kWh

kW $ Savings = kW savings x Demand Cost

kWh $ Savings = kWh savings x Energy Cost

Existing energy usage for lighting is calculated from the number of existing light fixtures and their rated wattages. Existing operating hours of the fixtures are based on exterior photocell operation, which is equal to 4,368 hours per year.

Existing kW = existing quantity x existing wattage

Existing kWh = existing operating hours x existing kW

Proposed energy usage after retrofit is calculated based on the proposed number of fixtures and rated wattage. The post-retrofit run hours used in the calculation are the same as the existing run hours.

Proposed kW = proposed quantity x proposed wattage

Proposed kWh = proposed operating hours x proposed kW

> Maintenance

Maintenance savings are based on material costs only. Ameresco is proposing using long life LED lamps, which will increase the time between burnouts. The maintenance savings for ECM-3 are $888 per year. Replacing the old equipment will reduce internal labor associated with maintaining and operating the equipment. These savings are not included in the calculation.

> Interactions

There are no savings interactions for this measure since the light fixtures are in unconditioned exterior spaces.

References

- Utility data
- Field notes, survey data, logger data
- Lighting Manufacturer Catalogs
- IES. IES Lighting Handbook. New York, New York, 1999

Assumptions

Assumptions made in the development of this proposal include:

- The savings for the measure are based on run hours shown in the room-by-room table in the technical appendix.
- All work surfaces are free of hazardous materials. NMSU is responsible for any hazardous material abatement.
- The cost of the project does not include any repair or upgrades of existing electrical distribution systems that are not up to current codes.

Utility Interruptions

Electricity interruption will be isolated to the area of work and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on students, faculty, and staff.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Lighting Fixtures – 20 years
- LEDs –100,000 run hours

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit.

> Interface with Existing Equipment

The retrofit of the existing poles and pole mounted fixtures will improve the aesthetics of the campus. The new LED fixtures will look similar those already installed by the facility staff. Retrofitting the exterior pole mounted lighting will also reduce the electrical demand and consumption at the campus.

ECM 6: Retro-Commissioning

General Description

> ECM Summary

Retrocommissioning (RCx) is a systematic process to identify the effectiveness of the facilities Direct Digital Control (DDC) system. It is primarily focused on building HVAC systems and central utility plant mechanical systems with an emphasis on identifying operational or energy related issues. It provides a way to inspect, test and verify that each system is working as per its design intent to deliver proper operation and energy efficiency.

> Existing Conditions

NMSU has a well-developed campus wide DDC system. Individual buildings have a variety of controls ranging from stand-alone and pneumatic controls to fully operable DDC systems extending to the zone level. Building level controls are primarily TAC Xenta controls communicating to the campus Niagara front end over the network via each building's JACE controllers. Generally, the DDC system is very well developed and maintained, however Ameresco noted opportunities to improve the overall system performance through the retrocommissioning process. While the DDC components themselves may be in good working condition, the field devices and mechanical components they control may be in need of adjustment, repair or replacement. Specific examples would include leaking control valves, worn dampers or other issues that could prevent systems from meeting their peak operational effectiveness.

Often these issues are simply related to the normal wear and tear associated with typical operation. In some cases for example, the sequences of operation may also be optimized through pressure or temperature reset strategies.

Recommended Modifications

For each building identified in the ECM Matrix, the following inspections and tests would be performed.

Equipment Inspections – On a per building and per system basis detailed inspections of all control devices would be performed. This would document the physical condition of all control elements in terms of their condition and service suitability. The completed Equipment Inspections Forms would be provided by Ameresco's RCx agent to NMSU's representative for review. Any control elements needing repair will be listed on the Issues Log by the agent for subsequent repair authorization to the controls subcontractor.

Point to Point Verifications – The Ameresco commissioning agent would provide the controls subcontractor with Point to Point Verification forms and procedures. The controls subcontractor would physically conduct the point to point verifications with close coordination with the agent and NMSU's representative. The point to point verifications validate each control point's existence, condition, settings, and operational status. During the point to point verification the controls subcontractor would physically verify each control element's zero and span, state change, calibration, etc. Any control elements failing the verification test would be listed on the Issues Log by the agent for subsequent repair authorization to the controls subcontractor.

Functional Performance Tests – Upon resolution of the issues identified in the Equipment Inspections and Point to Point Verifications, the controls subcontractor with direction from the commissioning agent and NMSU's Energy Manager, would perform Functional Performance Tests (FPT's). The test plan and procedure will be developed by the agent and is designed to systematically test and verify the sequence of operations for each system type identified in the Air and Water Systems to be Tested section of the Detailed Project Scope. Any sequences failing the FPT's would be listed on the Issues Log by the agent for subsequent sequence corrections and programming. Follow up testing shall be done on any systems requiring sequence modifications.

The controls subcontractor's activities during each of the above inspections and tests would be coordinated with and may be witnessed by the RCx agent and NMSU's representative.

Detailed Project Scope

The following is a list of potential HVAC systems that shall be included within the scope of work. The type and quantities of systems shall be identified by the Ameresco commissioning agent.

<u>Air Side Systems:</u>

- Constant Volume – Dual Duct Air Handler: Typical units are equipped with supply fan(s), return or relief fan(s), cooling coil(s), heating coil(s) and mixed air economizer. The units may or may

not be equipped with VFDs. Units may have a combination of pneumatic and/or DDC control elements.

- Constant Volume – Dual Duct Terminal Box: Typical units are equipped with a cooling damper, heating damper, heating, cooling and or total airflow, discharge air temperature and one or two pneumatic or DDC control actuator(s).
- Variable Volume – Dual Duct Air Handler: Typical units are equipped with supply fan(s), return or relief fan(s), cooling coil(s), heating coil(s) and mixed air economizer. The units are equipped with VFDs and static pressure control and building static pressure control. Units may have a combination of pneumatic and/or DDC control elements.
- Variable Volume – Dual Duct Terminal Box: Typical units are equipped with a cooling damper, heating damper, heating, cooling and or total airflow, discharge air temperature and two pneumatic or DDC control actuator(s).
- Constant Volume – Single Duct Air Handler: Typical units are equipped with supply fan(s), return or relief fan(s), cooling coil(s), heating coil(s) and mixed air economizer. The units may or may not be equipped with VFDs. Units may have a combination of pneumatic and/or DDC control elements.
- Variable Volume – Single Duct Air Handler: Typical units are equipped with supply fan(s), return or relief fan(s), cooling coil(s), heating coil(s) and mixed air economizer. The units are equipped with VFDs, duct static pressure control and building static pressure control. Units may have a combination of pneumatic and/or DDC control elements.
- Variable Volume – Single Terminal Box (No reheat): Typical units are equipped with a volume damper and airflow, and pneumatic or DDC control actuators.
- Variable Volume – Single Terminal Box (With reheat): Typical units are equipped with a volume damper, airflow, reheat valve, discharge air temperature and pneumatic or DDC control actuator.
- Constant Volume Multizone Unit – Units consist of hot deck, cold deck, neutral deck, supply fan(s), return fan(s) and mixed air economizer with up to 12 zones per unit. Units may have a combination pneumatic and DDC controls.
- Packaged Single Zone Unit – Units consist of a package single zone system with one or more DX cooling stages, in gas, electric, or heat pump configurations with or without economizer.
- Split System – A single zone DX system with split condenser and cooling or heating coil. This may include heat pumps.
- Fan Coil Unit (2-Pipe) – Units consist of one coil and multispeed fan motor for cooling or heating mode. May or may not have control valve(s).
- Fan Coil Unit (4-Pipe) – Units consist of one cooling coil, one heating coil and multispeed fan motor with cooling or heating mode. May or may not have control valve(s).
- Water Source Heat Pump – A single zone packaged heat pump with compressor, fan, reversing valve and isolation valve.

Water Side Systems:

- Constant Volume Tertiary Chilled Water Pump(s) - One or two chilled water pumps in a lead/standby configuration. Pumps may or may not have VFDs.
- Variable Volume Tertiary Chilled Water Pump(s) - One or two chilled water pumps in a lead/standby configuration. Pumps have VFDs and static pressure sensors. Pumps may or may not have dedicated VFD, early installations included one (1) VFD switched to lead pump.
- Hot Water Converter – Building heating steam to hot water converter. May be equipped with 1/3 and 2/3 steam control valves. Control valves may be stand-alone, pneumatic or DDC controlled.
- Constant Volume Hot Water Pump(s) - One or two heating water pumps in a lead/standby configuration. Pumps may or may not have VFDs. Pumps may or may not have dedicated VFD, some installations include one (1) VFD switched to lead pump.
- Heat Recovery Loop – Hydronic coils and pumped between exhaust and outside air ducts.
- Heat Recovery Unit- 100% outdoor air with exhaust air going thru one half of heat wheel.

Due to the nature of retrocommissioning, the number and type of issues and their repair costs can't be fully determined until after the inspections and tests are performed and the results obtained. Therefore, the material costs associated with this measure are budgetary not-to-exceed costs and provide a fund from which to perform the needed repairs. It is Ameresco's intent to work with NMSU to prioritize and rank items on the Issues Log so that issues with the highest priority are corrected within the material cost budget. Issues related to component replacements are generally awarded to the controls subcontractor for correction. However, in some cases the repairs may be referred to NMSU's facilities services for correction or repair.

Exclusions to the scope of work include:

Sampling, testing, or removing asbestos or lead

RCx of Fume Hoods

Repair costs that exceed the material cost budget

Code related upgrades

Repairs unrelated to HVAC mechanical, electrical or control systems

Stamping and signing engineering plans and specifications

Energy Savings Proposed

Ameresco developed detailed eQUEST models to determine the energy savings associated with the project. The energy savings will result from the improved operation and efficiency of the HVAC systems. Table R-5 summarizes the energy savings associated with this project.

Table. R-5. Energy Savings Associated with ECM 6

Annual Savings	Units

1,025,302	kWh
125.6	kW
11,453	DTh, Natural Gas
$141,230	Utility Cost Savings

> Energy

Ameresco calculated the energy savings for this measure using calibrated building simulation models. Ameresco developed calibrated baseline energy simulation models for a statistically relevant number of campus buildings to represent the population of measures to be installed. The inputs for the individual building models were developed to match the existing building conditions, including as-built construction specifications and the operation of the buildings concurrent with the time period associated with the utility baseline (September 2011 – August 2012). These inputs include project and site conditions, building shells with architectural details and constructions, internal loads such as lighting density and schedules, water-side loads and schedule and air-side loads and schedules. The baseline models' energy consumption was calibrated using NMSU provided building sub-meter data for electricity, natural gas, chilled water, and steam utilities. Calibrations were made to the utility data according to IPMVP guidelines.

Parametric analysis was then performed on each individual building model for each measure in a manner that captured the interactive effects of each of the proposed ECMs. Results from the modeled building measures were then extrapolated to the remaining population of building measures. The combined modeled and extrapolated results were then applied to a whole calibrated whole campus model, including the central utility plant. Parametric analysis of this calibrated whole campus model captured the interactive effects of proposed ECMs on central plant chilled water production, steam production, and electric and natural gas utility consumption. The resulting central plant energy consumption savings as indicated by the whole campus model were then credited to the individual building measures on a pro-rated basis to capture the plant level impacts of the measures on a per building basis.

Detailed models and results are available electronically for review or on-going M&V purposes.

> Maintenance

No maintenance savings are claimed for this measure. Typically, maintenance costs are reduced as the retrocommissioning work prevents current and future work orders to repair failed components.

> Interactions

This ECM would reduce the cooling and heating loads at the facility by ensuring that HVAC systems are operating to meet their design intent and through optimized sequences of operation. Refer to the model output data in the appendices for further information.

References

Field notes, survey data, logger data

Niagara system graphics and trend logs

Assumptions

The NMSU Niagara system, together with field observations was used to identify RCx opportunities in modeled buildings. It is assumed that the sample of modeled building is representative of the population of buildings for the proposed measure.

Utility Interruptions

Electricity interruption will be isolated to the area of work and its duration minimized through carefully planned testing and installation phasing. Testing and repair schedules will be coordinated with site personnel to minimize the impact on building occupants.

Other

> Equipment Service Life

The equipment service life for the major components includes:

DDC field devices – 15 years

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit.

> Interface with Existing Equipment

The interface to existing equipment is considered to be negligible as each DDC component identified for repair would replace an existing component. Therefore, the impact to existing equipment would be considered a like-kind replacement.

ECM 7: VAV Retrofit

General Description

> ECM Summary

For each of the buildings identified in the ECM Matrix, Ameresco proposes to convert specific air handling systems from constant volume to variable air volume, (VAV) systems. This measure would retrofit the existing mixing boxes and the air handling systems supplying these facilities. The optimization of the air distribution systems and the control strategy will result in lower thermal and fan electric energy consumption / power demand. Minimization of mixing cold and warm airstreams and supplying only the needed quantity of air (CFM) to the spaces served achieves occupant comfort during off peak load periods of time. Coincident modifications will be necessary at the main air systems (air handling units / AHU's) to throttle the air supply as the modified boxes respond to load changes. Strategically developed mixing box internal retrofit "kits" will be utilized to avoid taking the existing boxes down out of the ceiling and/or the necessity to modify ductwork.

> Existing Conditions

Several different cases exist for the current VAV systems and associated sequences of operation. These systems were designed to have heating and cooling available to all zones / boxes at all times. For example, for dual duct systems, the box sequence would mix varying quantities of hot air with inversely varied quantities of cold air to achieve space temperature setpoint. The air handling units serving these (existing) boxes, or terminal units, typically had fixed setpoints for the heating and cooling coils. Hot duct temperature setpoints were sometimes reset with outdoor air temperature for better controllability during mild low heating load) weather. Cold duct temperature setpoints were typically set at a fixed setpoint of 55^{o}F. In most cases, the main supply fan was used for both the cooling duct and the heating duct, but in limited cases, the heating supply fan and the cooling supply fan are separate fans. In the one case of single duct boxes at Young hall, the main air handler has both a cooling coil and a heating coil in series to provide supply air for the boxes.

The existing Box type / configuration are as follows:

- Young hall has single duct boxes with a Mitco actuator on the supply air to the box. A heating coil with 3 way hot water control valve has been installed on the leaving side of the box. The pneumatic room thermostats modulate the supply air actuator in sequence with the hot water control valve to control space temperature setpoint.
- Astronomy and Milton have true double duct boxes with separate pneumatic actuators on the hot duct and the cold ducts serving the box. Room pneumatic thermostats modulate the cooling damper actuator and heating damper actuator, mixing the two airstreams and maintaining space temperature setpoint.
- Branson Hall, Guthrie and Breland have true double duct boxes with a single pneumatic actuator. A space / room thermostat modulates the cold and hot duct airstreams via the one (1) pneumatic actuator. The cold duct damper and hot duct damper (internal to the Box) are

mechanically / physically linked in an inverse arrangement. The box can go from 100% cold /0% Hot to 50% cold/50% hot; to 0 % cold / 100% hot CFM and is thus a constant volume box.

- The Business Complex and the Music Building have , in certain parts of the facilities, true double duct boxes with separate (and sometimes multiple) Mitco dampers (throttling devices), on both the cold duct and the hot duct. The larger boxes, for larger spaces served required the splitting of the cooling and/or the heating CFM into multiple Mitco throttling devices (dampers). Ceiling space also drove the requirement for multiple Mitco's. Space mounted pneumatic room thermostats modulate the hot and cold duct dampers, in a constant (total) volume fashion, to maintain space temperature setpoint.
- Clara Belle English and Speech are equipped with boxes that contain three actuators. Upstream, the boxes have separate pneumatic actuators for the hot and cold duct airstreams and a third for total box volume. Mechanical devices within the box (and factory set and shipped) and the third actuator control total volume CFM for each Box.
- Science Hall's main Penthouse AHU is a dual duct VAV system. The air handler has been retrofitted with DDC. All of the zone damper actuators remain pneumatic. The scope of work for this air handler is to retrofit all existing zone terminal boxes from pneumatic to DDC control. There are 179 each Trox DD VAV terminal boxes, 3 each single duct VAV boxes and 10 each constant volume DD boxes.
- John Whitlock Hernandez Hall's eight-zone multizone air handler is equipped with a hot deck, cold deck and neutral deck. There is a 25 HP supply fan and a 5 HP return fan. The scope of work for this unit is to convert it from multizone to VAV with VFDs.
- Foster Hall's AUH-4 is a constant volume dual duct air handler. It has been retrofitted with TAC DDC controls. It has been partially converted to VAV with the addition of VFD's on the supply and relief fans. There are no duct static pressure sensors and the pneumatic dual duct mixing boxes are constant volume. The scope of this retrofit is to install new duct static and building static pressure sensors and to convert the mixing boxes from pneumatic constant volume to pressure independent VAV boxes. There are 23 each, Tuttle and Bailey type constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications as noted below. There are 3 each, dual duct mixing boxes with dual actuators. These boxes require control modifications only.

Recommended Modifications

Ameresco proposes the installation of internal retrofit kits and Belimo linear and rotary damper actuators on and in the terminal units in the selected buildings, the necessary static pressure sensing and control devices on the air systems serving the boxes. Double Duct air systems without existing variable speed drives to be equipped with VFD's on both supply and return fan(s). Discharge / Supply air temperature setpoint reset to be integrated in to the box sequences. Multizone (true) supply air systems are to be de-coupled and separate zone damper actuators installed on the hot and cold side of the zone. The single duct system at Young hall to have new Belimo linear actuators installed on the existing Mitco throttling devices and they will be converted to two position. Internal retrofit kits to be installed in

existing boxes and supply air system discharge temperature setpoint control to be integrated in to the box sequence.

The recommended modification of the sequence of operation of the existing terminal units / boxes is to include adjustable deadband around adjustable room temperature setpoint. Minimum total box CFM to be equal to or greater than box / zone ventilation / exhaust CFM at all points in the sequence. On the heating side, and on the low side of the deadband, the box CFM shall increase up to maximum heating CFM for each box. On the cooling side, and on the high end of the deadband, the box CFM shall increase up to maximum cooling CFM for each box. In both cases, the existing hot and cold duct dampers to operate in two position fashion and the new box total volume damper (kit) to be modulated by new internal Belimo linear actuator. Local controller to be connected to flow ring and pressure independent control employed.

At deadband with no call for heating or cooling in the spaces served, the default air stream shall be selectable by the operator and during cooling mode shall be the hot duct. During heating mode, the default shall be the cold duct. The box minimum CFM must be satisfied from one or the other of the cold and hot ducts. Since likelihood of heating plant being shut down during cooling mode, and vice versa, this meets minimum CFM requirement with airstream that is close to space temperature and avoid short cycling of boxes at deadband.

Detailed Project Scope

The VAV Retrofit ECM modifies the existing VAV boxes and their sequence of operation to result in thermal savings in conditioning the spaces and electric fan energy expended at the primary air source / supply fan. Both the double duct and single duct VAV box sequences will be modified. To mitigate construction costs of taking boxes down from their existing locations and/or modifying ductwork, strategic control components will be replaced and added to result in an optimized sequence of operation. Minimum supply CFM from any given VAV box must be of a quantity which is at least equal to the ventilation CFM of that same VAV zone. Minimum heating CFM and minimum CFM are, in most cases equal, but if minimums are different, that will be incorporated into the sequence.

The future sequence of operation will drive the volume of the box up to maximum CFM as the space temperature tries to vary from space temperature setpoint. At space temperature setpoint, the total box supply CFM to the space will be equal to the box zone minimum ventilation CFM. An adjustable deadband will exist, allowing the operator to further optimize the energy usage by widening the deadband, or conversely, making it more narrow. This addresses the breakeven load level when the heat gain in the box space approximately equals the heat loss to the outdoor air. Deadband also allows a band of space temperature within which the occupants are comfortable. The midpoint of their space setpoint might be 75 degrees, but if their deadband is +/- 1.5 degrees, the temperature in that space would be allowed to vary from 73.5 to 76.5 without any further expenditure of thermal or fan energy.

The cooling and heating maximum CFM's are typically such that the heating maximum CFM is about half the maximum cooling CFM. The new controls shall, on an increase in cooling load in the box space/zone, increase the cooling CFM proportionally to the increase of cooling load up to maximum box cooling CFM. Simultaneously, the hot duct CFM shall be minimum or, most likely, 0 CFM. This avoids the

simultaneous heating and cooling of the air and the mixing of same. As the cooling load in the space decreases, the box supply CFM will be at minimum total supply CFM and be back in the deadband. Upon an increase in heating load, the new controls will increase the heating CFM proportionally to the heating maximum CFM.

Single duct VAV boxes will be retrofitted with total box CFM modulation and supply air reset at the AHU serving the boxes. The supply air temperature will be reset upward until the box with the highest demand for cooling will be at 100% CFM box volume. All other boxes will have to reheat the supply air as their space zones demand more heating. A deadband around setpoint can still exist for each box above which the cooling CFM is increased to the maximum cooling CFM for that box and conversely, will throttle down to minimum box CFM and heat the least CFM possible. The AHU, if it is equipped with a heating coil will preheat the supply air to a temperature which can still be used for interior zones requiring less heating / more cooling.

Table R-6 provides a summary of the air handlers covered under the proposed measure.

Table R-6. Proposed VAV Retrofit AHU's

Building	Unit	HP	SA CFM
032 Young Hall	Main AHU	15	15,500
034 Foster Hall	AHU-4	25 (2)	51,800
083 Milton Hall	Rm 115 DD AHU	15	16,000
184 Breland Hall	N DD AHU	30	32,800
184 Breland Hall	S MZ AHU	7.5	9,700
225 Astronomy Building	Main AHU	20	18,000
278 Branson Library	West DD AHU	75	86,400
278 Branson Library	North DD AHU	50	53,200
288 Guthrie Hall	AHU East	30	26,000
288 Guthrie Hall	AHU West	40	39,000
364 English Building	Main DD AHU	40	32,500
365 Speech Building	Main DD AHU	25	22,000
386 Business Complex	Main Cooling AHU	60	40,600
386 Business Complex	Main Heating AHU	30	33,400
389 Music Building	1st Floor AHU	15	12,150
389 Music Building	2nd Floor AHU	20	18,600
391 Science Hall	PH AHU	60 (2)	130,000
397 Hernandez Hall	AHU-1	15	15,500

Note: To facilitate this ECM, NMSU shall be responsible for the upgrade or furnishing and installation of any new JACE's that may be required. Ameresco's controls subcontractor shall furnish and install all necessary controls where the new controls shall be capable of operating locally on a stand-alone basis specific to their protocol and NMSU shall be responsible for all JACE configurations. It is the intent that the controls subcontractor is not dependent on the JACE for operation of their controls. NMSU shall provide for all programming and configurations within Niagara including the revised sequences of operation, system graphics, trends, schedules and alarms. NMSU shall also provide support for commissioning through Niagara to the individual field devices. NMSU will be responsible for providing all programming of the Niagara system within the timeframe agreed to in the construction schedule. This schedule will be updated weekly and reviewed during the construction progress meetings.

> Building Detailed Scopes of Work

The scopes of work vary by building and by system but include mechanical and control system retrofits.

Mechanical system retrofits include the modification of constant volume dual duct terminal boxes and installation of premium efficiency motors and VFDs. There are primarily three types of terminal box retrofits required. A number of buildings utilize constant volume Tuttle and Baily or Anemostat type mixing boxes. These boxes require the installation of a new Titus (or equal) modulating damper and conversion of the existing mixing damper a two-position heating or cooling mode damper. Mitco terminal units require a similar retrofit. Other dual duct mixing boxes utilize one pneumatic actuator controlling the hot and cold deck dampers through a reverse acting hot and cold deck linkage. These boxes will require mechanical separation of hot and cold dampers. New premium efficiency, inverter rated motors are required where the existing motors are not inverter rated and the new motors would be retrofitted with new belts and sheaves. New VFD's would be installed on supply ad return fans where they are not yet installed.

The controls system scope includes the removal of all pneumatic controls and replacement with new DDC devices for each of the affected air handlers. The retrofit would reuse existing DDC systems to the extent practical. The controls retrofit includes the installation of all new control elements as needed to control all terminal boxes and air handlers together with the modifications to the sequence of operation for static pressure reset with direct coordination and supervision by NMSU 's Manager or Energy Management Services and Ameresco. Control sequence modifications shall be initially developed by Ameresco and NMSU for subcontractor's implementation.

Individual Building Detailed Scope of Work

032 Young Hall - Roof mounted PRTU: This unit shall be converted from constant volume single duct single MITCO external actuator to single duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are variable volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic air handler and zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 21 each, Singer brand variable volume single duct VAV boxes with one external MITCO and pneumatic actuators and a pneumatic 3-way hat water control valve. These boxes will require mechanical and control modifications.

034 Foster Hall - AUH-4 is a constant volume dual duct air handler. It has been retrofitted with TAC DDC controls. It has been partially converted to VAV with the addition of VFD's on the supply and relief fans. There are no duct static pressure sensors and the pneumatic dual duct mixing boxes are constant volume. The scope of this retrofit is to install new duct static and building static pressure sensors and to convert the mixing boxes from pneumatic constant volume to pressure independent VAV boxes. There are 20 each, Tuttle and Bailey type constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications. There are 3 each, dual duct mixing boxes with dual actuators. These boxes require control modifications only.

075 Business Complex - Cabinet Fans 1 & 2: These units shall be converted from variable air volume double duct multiple MITCO throttling devices and external pneumatic actuators to double duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are variable volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic air handler and zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 75 each boxes equipped with multiple MITCO brand throttling devices and multiple pneumatic actuators. These boxes will require mechanical and control modifications as noted below.

083 Milton Hall - 1st Floor Mech Rm 155A: This unit shall be converted from variable volume dual duct two external pneumatic actuators to dual duct VAV with DDC controls on the air handler and the boxes. All existing air handler and zone devices are constant volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic zone controls including valve bodies and valve actuators and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 21 each, Krueger LMHDPE-9 brand variable volume dual duct mixing boxes with two external pneumatic actuators. These boxes will require mechanical and control modifications as noted below.

Room 015 Milton Multizone AHU: The 7 zone multizone air handler is equipped with a hot deck and cold deck. There is a supply fan and no return fan. The controls are entirely DDC including zone damper actuation. The scope of work for this unit is to convert it from multizone to VAV with VFDs. The unit already has a supply fan VSD.

184 Breland Hall - Supply Fan # 1 is contained in N. Rooftop Penthouse as a part of the built up unit. These units shall be converted from variable volume dual duct external MITCO Throttling devices and pneumatic actuators to dual duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are variable volume pneumatic. The scope of work for these air supply and return systems is to remove all existing pneumatic zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 24 each Tuttle & Bailey brand constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications as noted below.

The multizone air handling unit is contained in S. Rooftop Penthouse as a part of the constant volume system serving the office area. This unit shall be converted from true multizone to variable volume reusing the zone distribution ductwork. VSD's will be added to supply and return fans. The chilled water control valve will be replaced under the chilled water pump bypass ECM.

Multizone AHU: The 10 zone true multizone air handler is equipped with a hot deck, cold deck. There is a 7.5 HP supply fan and a 3 HP return fan. The controls are mostly pneumatic with hot deck and cold deck temperature controlled by local DDC. The hot water valve is 3-Way DDC and the cold deck is pneumatic 3-Way with bypass leg removed. The scope of work for this unit is to convert it from multizone to VAV with VFDs.

225 Astronomy Building - Basement AHU-1: This unit shall be converted from constant volume dual duct two external actuators to dual duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are constant volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 31 each, Price RNP type constant volume dual duct mixing boxes with two external pneumatic actuators. These boxes will require mechanical and control modifications as noted below. The Supply Fan motor is already inverter rated.

278 Branson Library - N and S Penthouse Supply Fans 1 & 2 and Return Fans 1 & 2 1,2 & 3: These units shall be converted from constant volume dual duct single actuator to dual duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are constant volume pneumatic. The scope of work for these air supply and return systems is to remove all existing pneumatic zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 63139 each, Tuttle and Bailey type constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications as noted below. All four of the Supply and Return fans Motors are already inverter rated.

W Penthouse Supply Fan 1 and Exhaust Fans 1 – 4: This unit shall be converted from constant volume dual duct single actuator to dual duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are constant volume pneumatic. The scope of work for these air supply and return systems is to remove all existing pneumatic zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 76 each, Tuttle and Bailey type constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications as noted below. The Supply Fan already has a VSD on it.

288 Guthrie Hall - Basement supply fans SF-1 and SF-2 are contained in the built up unit: These units shall be converted from constant volume dual duct single actuator to dual duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are constant volume pneumatic. The scope of work for these air supply and return systems is to remove all existing pneumatic zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total

box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 37 each Anemostat HVE-10 MBV L-J type constant volume dual duct mixing boxes with a single pneumatic actuator. These boxes will require mechanical and control modifications as noted below.

364/365 English/Speech Buildings - English Rm 123 and Speech S Penthouse Built-Up Units: These units shall be converted from variable volume dual duct three internal pneumatic actuators in box to dual duct VAV with DDC controls on the air handler and the boxes. All existing air handler and zone devices are variable volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic zone controls including valve bodies and valve actuators and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 55 each, Krueger LMHD 1-10 brand variable volume dual duct mixing boxes with three (3) internal pneumatic actuators. These boxes will require mechanical and control modifications as noted below.

389 Music Building - AHU-3A and AHU-4A (North side Mech Rms.): These units shall be converted from variable air volume double duct multiple MITCO throttling devices and external pneumatic actuators to double duct VAV with DDC controls on the air handler and the boxes. All existing zone devices are variable volume pneumatic. The scope of work for this air handler is to remove all existing pneumatic air handler and zone controls and replace them with new, pressure independent DDC components so as to provide for accomplishing total box CFM output supply to vary from the heating maximum CFM down to a box minimum CFM (for box zone ventilation), across an adjustable deadband around space setpoint and then up to cooling maximum CFM. There are approximately 37 each boxes equipped with multiple MITCO brand throttling devices and multiple pneumatic actuators. These boxes will require mechanical and control modifications as noted below.

391 Science Hall – The main Penthouse AHU at Science Hall is a dual duct VAV system. The air handler has been retrofitted with DDC. All of the zone damper actuators remain pneumatic. The scope of work for this air handler is to retrofit all existing zone terminal boxes from pneumatic to DDC control. There are 179 each Trox DD VAV terminal boxes, 3 each single duct VAV boxes and 10 each constant volume DD boxes.

397 John Whitlock Hernandez Hall – The 8 zone multizone air handler is equipped with a hot deck, cold deck and neutral deck. There is a 25 HP supply fan and a 5 HP return fan. The controls are entirely pneumatic. The scope of work for this unit is to convert it from multizone to VAV with VFDs.

Energy Savings Proposed

The savings for this measure are a result of the reduction in the amount of thermal and electrical fan energy to maintain the space temperatures at setpoint. Savings are also achieved by elimination or minimizing of the amount of mixing (simultaneous heating and cooling) of the heating and cooling

airstreams. Savings are also achieved by reducing the supply air quantity to the space in off peak periods and by the implementation of a deadband control range to space temperatures.

Ameresco developed detailed eQUEST models to determine the energy savings associated with the project. The energy savings will result from the improved operation and efficiency of the HVAC systems. Table R-7 summarizes the energy savings associated with this project.

Table. R-7. Energy Savings Associated with ECM 7

Annual Savings	Units
2,712,476	kWh
378.7	kW
-2,398	DTh, Natural Gas
$172,553	Utility Cost Savings

> Energy

Ameresco calculated the energy savings for this measure using calibrated building simulation models. Ameresco developed calibrated baseline energy simulation models for a statistically relevant number of campus buildings to represent the population of measures to be installed. The inputs for the individual building models were developed to match the existing building conditions, including as-built construction specifications and the operation of the buildings concurrent with the time period associated with the utility baseline (September 2011 – August 2012). These inputs include project and site conditions, building shells with architectural details and constructions, internal loads such as lighting density and schedules, water-side loads and schedule and air-side loads and schedules. The baseline models' energy consumption was calibrated using NMSU provided building sub-meter data for electricity, natural gas, chilled water, and steam utilities. Calibrations were made to the utility data according to IPMVP guidelines.

Parametric analysis was then performed on each individual building model for each measure in a manner that captured the interactive effects of each of the proposed ECMs. Results from the modeled building measures were then extrapolated to the remaining population of building measures. The combined modeled and extrapolated results were then applied to a whole calibrated whole campus model, including the central utility plant. Parametric analysis of this calibrated whole campus model captured the interactive effects of proposed ECMs on central plant chilled water production, steam production, and electric and natural gas utility consumption. The resulting central plant energy consumption savings as indicated by the whole campus model were then credited to the individual building measures on a pro-rated basis to capture the plant level impacts of the measures on a per building basis.

Detailed models and results are available electronically for review or on-going M&V purposes.

> Maintenance

No maintenance savings are claimed for this ECM. However, the reduced loads on the equipment may extend the useful life and is expected to reduce the maintenance and repair costs associated with equipment run hours. Reducing the load will free up cooling capacity, allowing existing equipment to

meet expanded internal loads that may have been installed since design (e.g. computer loads, A/V equipment, etc.). The reduction in total airflow will reduce the load on the filtration systems serving the air handling equipment and may extend filter life.

> Interactions

Supply fan turndown will reduce thermal and electric fan energy at the air handler. VAV Retrofit will interact with night setback/setup, optimum start/stop, and morning cool-down/warm-up. The morning cool-down/warm-up period load is reduced due to the reduced ventilation rates during the low-occupancy or unoccupied periods. The cool-down/warm-up period length is directly proportional to the load. The optimum start sequence will reduce the warm-up/cool-down period length as the time to meet setpoint is reduced. The hardware modifications make it possible to use the outdoor air dampers and exhaust fan control to purge the mass heat accumulated during the previous afternoon via the exhaust fans/outdoor air dampers instead of mechanical cooling when outdoor air conditions permit.

References

Data obtained from facility:

- NMSU Niagara Building Automation System
- Architectural, structural, mechanical, and electrical drawings
- Electricity bills
- Natural gas bills

General Data:

- Field notes
- HVAC Manufacturer Catalogs

Assumptions

The following assumptions were made in the development of this proposal:

- VAV Retrofit ECM assumes return / exhaust fans are functional and are being run.
- Supply CFM estimates from Mechanical Drawings Schedules.
- The savings for the measure are based on NMSU supplied run hour schedules.
- Heating and cooling capacities of the units are based on nameplate data and building's mechanical drawings.
- All work surfaces are free of asbestos and other hazardous materials. NMSU is responsible for any hazardous material abatement.

Utility Interruptions

Electric interruption will be isolated and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on building occupants.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Variable Speed Drives – 15 years
- Control systems – 15 years
- Electric Motors – 15 years

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit.

> Interface with Existing Equipment

The VAV retrofit equipment and devices interface with existing CV and VAV boxes currently installed at listed facilities. Provisions for varying air quantities to boxes that were previously constant volume are included in this ECM including static pressure sensors and variable speed drives. Replacement of existing pneumatic room thermostats is included in this ECM. Existing pneumatic actuators at and inside existing terminal units, CV boxes and/or existing VAV boxes is included in this ECM.

ECM 10: Economizer Upgrade or Repair

General Description

> ECM Summary

For buildings identified in the ECM Matrix, Ameresco proposes to refurbish, repair, upgrade, or replace the economizer dampers and the controls that operate them. A high number of hours of occurrence at which free cooling is available make significant mechanical electric cooling energy savings possible for NMSU. Most air handling (AHU's) systems have 100% outdoor air capability and are equipped with return fans to make utilization of (untreated) outdoor air for cooling needs possible. The outdoor air, return air, and relief airstreams are typically equipped with control dampers and associated controls to throttle and mix these airstreams to provide this cooling to the spaces served. Unlike manual (operated) dampers, these control dampers are designed to control the airstream quantities (CFM's) in a fairly precise manner. They typically have somewhat linear characteristics so as to control the airflow accurately. These dampers include shafts riding in bushings or bearings and modulate open and closed numerous times over their useful life as the cooling load and outdoor air condition change. This ECM includes restoring these dampers (and the controls associated with them) to industry standards. Most of the damper actuators were originally the pneumatic type. Many have already been converted to electronic / DDC (Direct Digital Control)

> Existing Conditions

During the energy audit, Ameresco found several economizer configurations. Most air systems are double duct with 100% outdoor air capability and are equipped with a return fan. Young Hall, HSS, Milton KRWC Studio, and the Music Building's single zone units are configured like the double duct units except it has only one supply duct with a heating and cooling coil in series. Branson West has four exhaust fans that act as a relief fan, and Business and Zuhl have separate heating and cooling supply fans. Some of the smaller single zone units serving Milton have outdoor intake but no integral relief or return damper.

A large number of economizer air systems have pneumatic damper actuators others have been retrofitted with high torque electronic (DDC) actuators.

The economizer dampers per se are typically opposed blade control dampers and are of a fairly wide range of age and condition. Some are installed in exterior walls and some are integral to the air handling equipment. Some of the dampers are in need of repairs, including linkages etc.

Detailed Project Scope

Table R-8 provides a list of the air handlers identified in the scope of work for this measure.

Table R-8. Economizer AHU's

Building	Unit	Type	CFM
032 Young Hall	PRTU	SD VAV	15,501
034 Foster Hall	AHU-2	SD VAV	30,000
034 Foster Hall	AHU-3	SD VAV	36,000
034 Foster Hall	AHU-4	DD	51,800
083 Milton Hall	AHU-1	DD	16,000
083 Milton Hall	AHU-2	SZ	11,810
184 Breland Hall	AHU-1	DD	32,800
184 Breland Hall	AHU-2	MZ	9,700
187 Chemistry Building	AHU-8A	DD VAV	-
187 Chemistry Building	AHU-8B	DD VAV	-
225 Astronomy Building	AHU-1	DD	18,000
244 Gerald Thomas Hall	AHU BASEMENT	DD	-
244 Gerald Thomas Hall	AHU EAST	DD	19,500
244 Gerald Thomas Hall	AHU WEST	DD	-
278 Branson Library	DD WEST	DD	86,400
278 Branson Library	DD SF NORTH	DD	26,605
278 Branson Library	DD SF NORTH	DD	26,605
288 Guthrie Hall	SF-1	DD	26,000
288 Guthrie Hall	SF-2	DD	39,000
363 Engineering Complex 1	F-2	DD VAV	30,000
363 Engineering Complex 1	LF-1	SD	15,000
363 Engineering Complex 1	LF-2	SD	15,000
363 Engineering Complex 1	LF-3	SD	15,000
364 English Building	RTDD	DD	32,500
365 Speech Building	PHDD	DD	22,000
386 Business Complex	CF-1	DD CLG	40,610
389 Music Building	1A	SZ	12,500
389 Music Building	2A	SZ	3,460
389 Music Building	3A	DD	12,150
389 Music Building	4A	DD	18,600
389 Music Building	5A	SZ	4,000
389 Music Building	6A	SZ	9,000
391 Science Hall	PH AHU	DD VAV	130,000
397 Hernandez Hall	AHU-2	DD VAV	25,450
397 Hernandez Hall	AHU-1	MZ	15,500
461 Zuhl Library	AHU-1	DD	56,000
461 Zuhl Library	AHU-2	DD	56,000
541 Foreman Engineering Complex	AHU-1	SD VAV	14,800
541 Foreman Engineering Complex	AHU-2	SD VAV	26,500
541 Foreman Engineering Complex	AHU-3	SD VAV	7,300
541 Foreman Engineering Complex	AHU-4	SD VAV	28,700
541 Foreman Engineering Complex	AHU-5	SD VAV	-
541 Foreman Engineering Complex	AHU-6	SD VAV	13,150
590 Health and Social Services	AHU-1	DD	35,000
590 Health and Social Services	AHU-2	DD	35,000

The scope of work includes refurbishment, repair, and replacement of all economizer control dampers serving the listed air systems. The Work is divided into Mechanical and Control Scopes to accommodate the appropriate trades.

The intent of this retrofit is to reduce the electric energy consumption of the mechanical cooling equipment serving the buildings. This is achieved through by the upgrade or refurbishment of the mixed air economizers. This work includes replacement of pneumatic devices with DDC devices and installation of new DDC points.

The mechanical scope includes the repair or refurbishment of the mixed air economizer dampers as needed as needed to facilitate proper mechanical economizer operation. This scope includes on an as needed basis the following work.

- Refurbish all existing outdoor air, return air, relief air, and /or exhaust air dampers whether located in wall, ceiling, floor, partition or is integral to the air handling equipment.
- Replace blade edge seals, blade shaft bushings or bearings, couplings, linkage brackets, mounting plates etc.
- Re-align any components to allow smooth operation of damper section without undue force or torque.
- Re-attach any disconnected component and repair damage from manual blocking off or other manipulation of the dampers.
- Replace in kind, any dampers that are deemed by Ameresco to be no longer serviceable. Ruskin CD-35 or better.

The controls scope includes testing and repair or furnishing and replacement of the mixed air economizer damper actuators, sensors and controls as needed as needed to facilitate proper dry-bulb temperature comparative economizer control and operation. This scope includes on an as needed basis the following work as determined by Ameresco.

- Replace pneumatic damper actuators with DDC actuators Belimo or approved equal. Provide high torque models and submit selections to Ameresco and NMSU before installing.
- Remove copper tubing associated with pneumatic damper actuators at the point of connection and permanently cap and seal all related pneumatic tubing.
- Remove poly pneumatic tubing back to wall or source and permanently cap and seal. Remove pneumatic actuator mounting plate, bracket, linkage, couplings, kits etc.
- Integrate the new DDC damper actuators into the DDC control system utilizing the existing controller outputs.
- Furnish and install any new DDC sensors and controls as needed for mixed air damper and economizer control.
- Perform a point to point test of all points associated with the operation and control of each outside air, return air, exhaust air, or relief air damper together with their related sensors and controls.

- Perform functional performance testing of the mixed air economizer in each mode of operation including, occupied and unoccupied mode, morning start-up/cool down, economizer mode, night cycle, mixed air temperature reset and control, cooling mode and heating mode.
- Any systems employing CO2 control shall override use of return air to maintain return air CO2 setpoint.
- Set up all Trends, build all Graphics, and create any user inputs for fine tuning each individual system.
- The controls subcontractor shall be responsible for modifying the sequence of operation as needed for each air handler's economizer operation with direct coordination and supervision by NMSU 's Manager or Energy Management Services and Ameresco. Control sequence modifications shall be initially developed by Ameresco and NMSU for subcontractor's implementation.

Note: To facilitate this ECM, NMSU shall be responsible for the upgrade or furnishing and installation of any new JACE's that may be required. Ameresco's controls subcontractor shall furnish and install all necessary controls where the new controls shall be capable of operating locally on a stand-alone basis specific to their protocol and NMSU shall be responsible for all JACE configurations. It is the intent that the controls subcontractor is not dependent on the JACE for operation of their controls. NMSU shall provide for all programming and configurations within Niagara including the revised sequences of operation, system graphics, trends, schedules and alarms. NMSU shall also provide support for commissioning through Niagara to the individual field devices. NMSU will be responsible for providing all programming of the Niagara system within the timeframe agreed to in the construction schedule. This schedule will be updated weekly and reviewed during the construction progress meetings.

Energy Savings Proposed

Ameresco developed detailed eQUEST models to determine the energy savings associated with the project. The energy savings will result from the improved operation and efficiency of the HVAC systems. Table R-9 summarizes the energy savings associated with this project.

Table. R-9 Energy Savings Associated with ECM 10

Annual Savings	Units
1,470,702	kWh
89.8	kW
-46	DTh, Natural Gas
$96,358	Utility Cost Savings

> Energy

Ameresco calculated the energy savings for this measure using calibrated building simulation models. Ameresco developed calibrated baseline energy simulation models for a statistically relevant number of campus buildings to represent the population of measures to be installed. The inputs for the individual building models were developed to match the existing building conditions, including as-built construction specifications and the operation of the buildings concurrent with the time period associated with the utility baseline (September 2011 – August 2012). These inputs include project and

site conditions, building shells with architectural details and constructions, internal loads such as lighting density and schedules, water-side loads and schedule and air-side loads and schedules. The baseline models' energy consumption was calibrated using NMSU provided building sub-meter data for electricity, natural gas, chilled water, and steam utilities. Calibrations were made to the utility data according to IPMVP guidelines.

Parametric analysis was then performed on each individual building model for each measure in a manner that captured the interactive effects of each of the proposed ECMs. Results from the modeled building measures were then extrapolated to the remaining population of building measures. The combined modeled and extrapolated results were then applied to a whole calibrated whole campus model, including the central utility plant. Parametric analysis of this calibrated whole campus model captured the interactive effects of proposed ECMs on central plant chilled water production, steam production, and electric and natural gas utility consumption. The resulting central plant energy consumption savings as indicated by the whole campus model were then credited to the individual building measures on a pro-rated basis to capture the plant level impacts of the measures on a per building basis.

Detailed models and results are available electronically for review or on-going M&V purposes.

> Maintenance

No maintenance savings are claimed for this ECM. Refurbishment of economizer dampers may reduce maintenance and repair resources expended by NMSU by reducing unscheduled repair work associated with age and condition of existing dampers and the actuators, linkage, etc.

> Interactions

This ECM will reduce the mechanical electrical cooling load on the central plant. For air systems currently equipped with CO2 sensors and controls a definite and important interaction exists. The governing factor is the space CO2 level. The CO2 level will override the economizer free cooling mode and increase outdoor air quantity to lower the CO2 regardless of free cooling availability. Any cold deck (setpoint) reset strategies will remain intact and reset the mixed air temperature setpoint in like manner. Minimum outdoor air CFM will be maintained for ventilation requirements and if that drives supply air above required setpoint, the system will switch to mechanical cooling. Warm-up and/or cool down before occupancy strategies will take advantage of outdoor air condition in real time and introduce outdoor air to the advantage of NMSU.

References

- Electric bills and NMSU usage logs and records
- Field notes, survey data, logger data, and trend logs.
- Mechanical Drawings and Mechanical Equipment Schedules.
- Nametag data and manufacturer's published data.

Assumptions

Assumptions made in the development of this proposal include:

- The savings for the measure are based on NMSU's supplied run-hour schedules.
- All work surfaces are free of asbestos and other hazardous materials. NMSU is responsible for any hazardous material abatement.

Utility Interruptions

Electricity interruption will be isolated to the area of work and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on building occupants.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Control Dampers – 20 years
- DDC Belimo Damper Actuators – 15 years
- Control Devices – 15 years

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit.

> Interface with Existing Equipment

The retrofit of the existing economizer dampers will have a minimal impact on the air side systems serving the facility. Retrofitting the dampers will reduce the mechanical electrical energy consumption at the central plant facility and lower the cooling load demand.

ECM 12: Chilled Water Pump Bypass

General Description

> ECM Summary

For each building identified in the ECM Matrix, Ameresco proposes to install chilled water bypass valves on all tertiary (Building) chilled water pumps served by the central plant. These systems will include all requisite isolation valves, strainers, and other hydronic specialty equipment and devices. Any existing chilled water coils currently equipped with 3-Way control valves (or wild coils) will be converted to 2-Way DDC actuated control valves (wherever possible). The existing chilled water pumps shall remain in place and operational (remotely) so that upon failure of central plant flow, the existing chilled water pumps will automatically energize and provide chilled water flow to the building. The recently enhanced flow configuration of the central plants makes variable flow primary strategy possible out at the chilled

water coils served by the plant. (Static) water pressure sensors located at major chilled water coils and fan coil circuits will make reset strategies possible for the central plant. Electrical pump energy is reduced both at the building level and at the plant level.

Several building chilled water distribution configurations exist at the various buildings included in this ECM and, in some of the buildings, multiple and remote chilled water pumps serve various phases of the individual buildings as it has evolved since original construction. Branson Library, for example, has recent construction for the East systems that, although updated on the airside equipment, is still served by a chilled water pump at the bottom of the East chase. Most buildings have typical dual chilled water pumps piped in parallel that distribute chilled water to their particular array of AHU and FCU chilled water coils. Some (static) water pressure sensors have already been installed for local CHWP VSD control and extensive replacement of 3-W chilled water control valves with DDC 2-W chilled water control valves.

> Existing Conditions

Existing chilled water "circulating" circulating systems have, as the buildings evolved from original construction been used during the "shoulder months" (Fall & Spring) to throttle the central plant return water back so as to maintain a target plant chilled water return temperature. These systems raise the chilled water supply temperature to the chilled water coils. To prevent runaway flow conditions which drive the central plant delta T (differential temperature) down and force the central plant to run more chillers than thermally necessary. These recirculating configurations are to be discontinued in this ECM and because they will no longer be needed. The valves will be closed and locked.

Some of the "Tunnel Valves" and flow meters pose unnecessary pressure drops in water pressure due to being sized for previous system configurations and flow rates. New, properly sized flow meters are not included in this ECM (Future by NMSU), but replacement of the "Tunnel Valves" that are currently undersized is included in this ECM.

Recommended Modifications

Ameresco recommends modifications of existing tertiary (Building) chilled water distribution systems. With recent central plant configuration and pumping capabilities, it has become possible to reduce electrical pumping energy being expended to distribute the chilled water to the chilled water cooling coils served by the plant. The provision of keeping the existing pumps operational is also recommended in the event of plant situations during which they are needed. Strainers and shut-off valves are included in Ameresco's recommendation as is converting all existing 3-W chilled water control valves to 2-W in order to take full advantage of the bypass system. Strategically placed (static) water pressure sensors are included so that the plant can reset pressures and vary pumping resources to optimize the central plant. Any "wild" coils will be equipped with new 2-way control valves and appropriate DDC controls.

Detailed Project Scope

Note: To facilitate this ECM, NMSU shall be responsible for the upgrade or furnishing and installation of any new JACE's that may be required. Ameresco's controls subcontractor shall furnish and install all necessary controls where the new controls shall be capable of operating locally on a stand-alone basis

specific to their protocol and NMSU shall be responsible for all JACE configurations. It is the intent that the controls subcontractor is not dependent on the JACE for operation of their controls. NMSU shall provide for all programming and configurations within Niagara including the revised sequences of operation, system graphics, trends, schedules and alarms. NMSU shall also provide support for commissioning and testing through Niagara to the individual field devices. NMSU will be responsible for providing all programming of the Niagara system within the timeframe agreed to in the construction schedule. This schedule will be updated weekly and reviewed during the construction progress meetings.

The intent of this retrofit is to reduce the electric energy consumption of the selected chilled water pumps at NMSU facilities. This is achieved through installation of the chilled water bypass piping and controls, shutting down the tertiary pumps and implementing a primary pump chilled water static pressure reset control sequence.

The mechanical scope is summarized below:

- Demolish and remove pipe insulation and piping as needed to facilitate installation of the new bypass piping assemblies.
- Relocate any existing drains, test ports, valves, strainers or other appurtenances as needed to facilitate the installation.
- Fabricate and install the chilled water bypass pipe assembly including all necessary valves, strainers and fittings.
- Pipe materials shall match the existing material in each location.
- Pipe diameters shall match the existing diameters at each point of connection.
- Pipe fitting methods shall match existing in each location (flanged, welded, soldered, etc.)
- Valve and fitting pressure ratings shall match existing in each location.
- Insulation material, thickness and jacketing shall be furnished and installed to match the existing material, thickness and jacketing materials.
- Each bypass assembly over 2.5” shall include two wafer type full port butterfly isolation valves with bare stem and lever lock (200 PSI and 180F) and one, two position butterfly control valve.
- The installation of new strainers or the relocation of existing strainers will be identified on a case by case basis as per the scope of work documents. All newly furnished strainers shall be equipped with a drain valve and hose fitting.
- Furnish and install any necessary piping supports or hangers as needed.
- For in-line pumps, the bypass piping shall be located in a manner that allows access to the pump for maintenance purposes. For locations with end suction pumps, the bypass piping shall be located overhead at or near the same level of the existing supply and return piping.
- Recharge and air bleed the chilled water piping as needed.
- Leak testing shall be done by “in-service” testing at the system operating pressure.

- Cooling coil control valves shall be furnished by the controls subcontractor and installed by the mechanical subcontractor. The mechanical subcontractor shall permanently cap and seal 3-way valve recirculation pipes where replacing valves with 2-way valves.
- Chilled water static pressure and differential pressure sensors shall be furnished by the controls subcontractor and installed by the mechanical subcontractor.

The majority of buildings listed in are currently equipped with Schneider TAC Xenta DDC systems and/or a combination of pneumatic and DDC. All new controllers shall be Schneider Xenta or approved equal. Each building is equipped with a JACE communicating to a Niagara front end over the campus network.

The following buildings are currently equipped with Xenta controllers. Spare DDC points are available for each bypass valve and can be utilized for this work. New controllers or expansion devices shall be furnished at any location as needed to accommodate the new points.

- 34 Foster Hall
- 187 Chemistry Building
- 244 Gerald Thomas Hall
- 363 Engineering Complex I, (EC I)
- 368 Knox Hall
- 391 Science Hall
- 397 John Whitlock Hernandez Hall, (EC-II)
- 551 Skeen Hall
- 032 Young Hall
- 033 Kent Hall
- 035 William B. Conroy Honors
- 060 Dan W. Williams Hall
- 172 Hadley Hall
- 389 Music Building
- 083 Milton Hall
- 225 Astronomy Building
- 365 Speech Building
- 461 Zuhl Library
- 590 Health and Social Services Building

The following buildings either do not currently have DDC or have BACnet controls. These buildings shall be retrofitted with new BACnet controls with provisions as noted above for additional points.

- 184 Breland
- 248 Regents Row
- 278 Branson

Division 25 of the NMSU specifications requires BACnet however; retrofit work on existing chilled water pump systems is Lonworks or BACnet as indicated above

The control scope of work includes all electrical power wiring, conduit, circuit breakers, control transformers. Where necessary, Ameresco demolish and remove existing pneumatic field devices to facilitate the installation of the new control elements. All pneumatic terminations shall be permanently closed and properly sealed. The related pneumatic tubing shall be removed to the point of wall or ceiling penetrations.

Ameresco shall furnish and install all control elements necessary for a complete functioning system. This includes all sensors, controllers, control transformers, wiring, conduit, enclosures, and any other devices needed for a complete installation.

Bypass Valves – Ameresco shall furnish bypass valves. All bypass valves shall be two position butterfly valves with fail-safe, spring return, closed position. All valves shall utilize full lug butterfly-type control valves rated for the same operating pressure as the piping system in which such valves are installed. Valves shall have bubble tight shut-off against either side of the valve. Valves shall have positive positioners or oversized operators if required for proper sequence control

Globe Valves - Provide straight through pattern-type, 2-way, union globe valves. Valves 1/2" to 2" in size shall have bronze, brass, stainless steel or approved corrosion resistant bodies and screwed ends. Valves 2-1/2" and larger shall have high-tensile cast iron or cast steel bodies, bronze stainless steel or approved corrosion resistant seats and trim and flanged ends. All valve stems shall be 316 or 416 stainless steel. Valves shall be designed to provide equal percentage flow characteristics at constant pressures with a rangeability of 300 to one. Low-pressure valves shall be provided with a renewable composition disc compound that will ensure tight seating.

Water differential pressure sensors shall have a minimum range of 0 to 50 PSID with overpressure protection as required by the application. Install sensor with a 3 valve manifold. Provide siphons and pressure snubbers as required.

Energy Savings Proposed

Ameresco developed detailed eQUEST models to determine the energy savings associated with the project. The energy savings will result from the improved operation and efficiency of the HVAC systems. Table R-10 summarizes the energy savings associated with this project.

Table. R-10. Energy Savings Associated with ECM 12

Annual Savings	Units
1,066,203	kWh
72.8	kW
-155	DTh, Natural Gas
$79,035	Utility Cost Savings

> Energy

Ameresco calculated the energy savings for this measure using calibrated building simulation models. Ameresco developed calibrated baseline energy simulation models for a statistically relevant number of campus buildings to represent the population of measures to be installed. The inputs for the individual building models were developed to match the existing building conditions, including as-built construction specifications and the operation of the buildings concurrent with the time period associated with the utility baseline (September 2011 – August 2012). These inputs include project and site conditions, building shells with architectural details and constructions, internal loads such as lighting density and schedules, water-side loads and schedule and air-side loads and schedules. The baseline models' energy consumption was calibrated using NMSU provided building sub-meter data for electricity, natural gas, chilled water, and steam utilities. Calibrations were made to the utility data according to IPMVP guidelines.

Parametric analysis was then performed on each individual building model for each measure in a manner that captured the interactive effects of each of the proposed ECMs. Results from the modeled building measures were then extrapolated to the remaining population of building measures. The combined modeled and extrapolated results were then applied to a whole calibrated whole campus model, including the central utility plant. Parametric analysis of this calibrated whole campus model captured the interactive effects of proposed ECMs on central plant chilled water production, steam production, and electric and natural gas utility consumption. The resulting central plant energy consumption savings as indicated by the whole campus model were then credited to the individual building measures on a pro-rated basis to capture the plant level impacts of the measures on a per building basis.

Detailed models and results are available electronically for review or on-going M&V purposes.

> Maintenance

Maintenance savings are not claimed for this ECM. At the same time, nearly all maintenance and repair of tertiary (building) pumps will become unnecessary as these pumps will typically not be in use. Annual inspections, testing, and "exercising" these pumps is recommended.

> Interactions

This ECM will interact with any other system or action that involves chilled water flow in the buildings. Interactions with the central plant will occur as the cooling load on each building changes. The reset strategies employed by the plant will be augmented by selected (static) water pressure at various strategically located in each buildings chilled water distribution systems (pipes). Utilizing integrated control system, the plant can automatically identify the worst case point in the system and reset pump speeds accordingly. This optimizes the plant and allows the plant to pump according to actual thermal load. Avoiding over pumping and low delta T across the plants, unnecessary chillers will not have to be brought on line.

References

- Utility data
- Field notes, survey data, logger data and trend logs.
- Record drawings and submittal records.
- Niagara trend and graphic data

Assumptions

Assumptions made in the development of this proposal include:

- The savings for the measure are based on observed schedules.
- All work surfaces are free of asbestos and other hazardous materials. NMSU is responsible for any hazardous material abatement.

Utility Interruptions

Chilled water availability for individual buildings during pipe modification work will be isolated to the area of work and its duration minimized through carefully planned installation phasing. Installation schedules will be coordinated with site personnel to minimize the impact on building occupants.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Bypass control valves – 20 years
- Controls and sensors – 15 years
- Hydronic equipment and devices – 15 years

> Warranty

Ameresco provides a 1-year warranty for materials and labor for the retrofit. Interface with Existing Equipment

ECM 26: Satellite Plant Energy Savings

General Description

> ECM Summary

NMSU recently added the new Satellite Utility Plant (SUP) to meet existing and future chilled water capacity for the Las Cruces Campus. The plant includes a new 2,500 ton duplex chiller and a new glycol ice production chiller rated at 877 tons. The new plant also has a new 250 HP variable primary chilled water distribution pumps together with 100 HP condenser water and glycol pumps. The ice storage system includes 72 each Calmac 1500 ice storage tanks coupled with a plate and frame heat exchanger. The condenser water loop has a three cell counter flow cooling tower with three 50 HP variable speed fans.

The new satellite plant displaces existing CUP chillers with the new duplex chiller during off-peak periods and increases the chilled water thermal storage capacity for use during summer on-peak periods. Modifications to the primary chilled water piping allow for the bypass of the existing tertiary pumps (ECM-12).

> Existing Conditions

Basic operation and commissioning of the SUP began during the Ameresco energy audit. During the course of the audit, Ameresco determined that the SUP would provide significant energy savings due to the following operating conditions:

- Displacement of central utility plant secondary pumping by reduced demand SUP variable speed primary pumps
- Displacement of central utility plant electric chiller operation by high efficiency SUP variable speed duplex chiller
- Reduced electric chiller energy consumption during on peak periods due to the addition of SUP ice storage capacity

Ameresco also observed an increase in monthly peak demand associated with the additional charging requirements of the ice storage system. The charging of this system, using the glycol chiller, increases overall campus peak demand, which typical occurs during the off peak period. During the audit, the initiation and duration of ice and thermal storage charging was performed manually by facility staff. The staging is not yet optimized for overall campus peak electric load reduction.

Finally, Ameresco noted chilled water supply temperatures as low as 41 deg F entering the campus secondary loop from both the SUP and CUP. Chilled water supply temperatures as low as 43 deg F were observed entering air handling unit chilled water coils. These temperatures are well below the typical design entering water temperatures for cooling coils, and incur a significant efficiency penalty on primary cooling equipment. In addition, condenser water temperatures were observed to be 15 to 20 degrees above the ambient wet-bulb temperature, which also decreases chiller efficiency.

Recommended Modifications

Ameresco proposes the following modifications to current SUP and CUP operations. The proposed changes will maximize the energy savings associated with the commissioning of the SUP addition project:

Automatic staging of thermal and ice storage charging and discharging: Manual staging of thermal and ice storage charging and discharge should be avoided. In particular, manual staging of charging generally causes increased demand coincident with increasing building electrical loads (lights, fans, etc.). Charging should be automatically timed, with limited override capability, such that all storage is fully charged by no later than 7 am.

In addition, discharge of thermal and ice storage should be strictly limited to the period associated with the higher on-peak kWh charge. Conserving discharge reduces the time required to charge overnight and reduces to extension of the increased charging demand coincidence with increasing building loads.

Optimize secondary chilled water loop pumping via differential pressure reset: The SUP variable speed primary pumps were specified with sufficient pressure capacity to serve the entire campus secondary loop. The CUP chilled water piping manifold modifications also reduced the head required to provide loop flow from the CUP. Significant energy savings are available via dynamic reset of the loop head pressure set point based on flow demand as indicated by chilled water coil valves. In is recommended that loop pressure setpoints are reset such that the chilled water coil valves in buildings with the high cooling loads are fully open. Building loop pressure setpoints would also be similarly reset. The SUP primary pumps and the CUP secondary pumps would modulate to maintain the loop pressure setpoints.

Chilled water and condenser water temperature reset: As discussed above, chilled water supply temperatures are generally lower than design, and condenser water temperatures are well above the design approach for the cooling towers. Significant energy savings are available from resetting both the chilled water and condenser water supply temperatures based on load and ambient conditions.

Chilled water reset would increase the chilled water supply temperature base either on outdoor air temperature, to maintain a chilled water return temperature setpoint, or a secondary loop temperature

difference. Condenser water reset would decrease the condenser water supply temperature to maintain either a fixed approach to the ambient wet-bulb temperature, or a fixed temperature across the condenser of the operational chiller(s). In both cases, limits on the reset ranges would be applied according to the chiller manufacturer's recommendations, and in both cases the results would be increases in chiller efficiency at both full and part-loads.

Detailed Project Scope

The scope for this measure is to optimize the plant sequences of operation as noted above. These sequence modifications would be developed with coordination with NMSU, GLHN and Ameresco's engineers.

Implementation of the revised sequences would be done by the controls sub-contractor and NMSU's facilities personnel in coordination with Ameresco's engineers.

Functional performance tests of the optimized sequences would be designed by Ameresco for implementation by the controls sub-contractor with direction from Ameresco and NMSU facilities engineers.

Trend logs would be developed to monitor system performance on an on-going basis.

Energy Savings Proposed

Table R-11 summarizes the energy savings associated with this project.

Table. R-11 Energy Savings Associated with ECM 26

Annual Savings	Units
2,126,102	kWh
-449.6	kW
160	DTh, Natural Gas
$368,553	Utility Cost Savings

> Energy

Ameresco calculated the energy savings for this measure using calibrated building models, a calibrated whole campus model, and a modified whole campus model incorporating the satellite utility plant (SUP) addition. The inputs for the building and whole campus models were developed to match the existing building conditions, specifications and operating parameters of the buildings and central utility plant concurrent with the time period associated with the utility baseline (September 2011 – August 2012). The baseline models' energy consumption was calibrated using NMSU-provided building sub-meter and whole campus utility meter data for electricity, natural gas, chilled water, and steam utilities. Calibrations were made to the utility data according to IPMVP guidelines.

Parametric analysis was then performed on the models to capture the interactive effects of the proposed ECMs. The whole campus model was additionally modified to reflect the addition of the SUP and its incorporation into the chilled water system staging. Parametric analysis of this modified campus model captured the interactive effects of proposed ECMs on satellite and central utility plant chilled

water production, steam production, and electric and natural gas utility consumption. The relative energy consumption of the modified campus model and the calibrated campus model, both with the proposed ECMs applied, represents the energy savings associated with this measure.

Detailed models and results are available electronically for review or on-going M&V purposes.

> Maintenance

Maintenance procedures for the satellite plant would be those procedures included in the plant O&M manuals or the manufacturers' recommend procedures for all major equipment. NMSU's facilities staff would maintain a set of plant operation and maintenance logs for the purpose of monitoring and reporting of equipment utilization.

> Interactions

There are multiple interactions between the satellite plant, CUP, chilled water distribution pumping systems and campus buildings. These interactions are captured in the plant model and include their interactive effects.

References

- GLHN Chilled Water System Improvements – Satellite Plant Building Package
- GLHN Chilled Water System Improvements – Site Utility Distribution Package
- Niagara system trend logs and system graphics
- Plant and campus utility data

Assumptions

Assumptions made in the development of this proposal include:

- The commissioning and turnover of the satellite utility plant will be completed per the terms of the contract between the engineering firm of record, the general contractor, and NMSU. Responsibility of the completion and acceptance of any "punch-list" issues remain with the general contractor and NMSU.
- The energy savings associated with this measure assumes that the plant is maintained in working order per the terms of any operations and maintenance documentation provided by the general contractor or warranty provided by the equipment manufacturers. Ameresco does not accept any responsibility for any warranty issues.
- An additional project, which includes the replacement of the absorption chillers in operation during the baseline period, is not included in this measure. See Schedule B for a proposed correction to the baseline for this project

Utility Interruptions

There are no utility interruptions associated with this measure.

Other

> Equipment Service Life

The equipment service life for the major components includes:

- Chillers – 20 years
- Controls and sensors – 15 years
- Hydronic equipment and devices – 15 years

> Warranty

This measure does not affect the warranty of any plant equipment.

> Interface with Existing Equipment

The addition of the satellite utility plant provides additional chilled water cooling capacity to the campus loop via a campus loop extension. This loop extension is part of a separate capital project, completed outside of this measure. The primary chilled water pumps included in the SUP are sized to provide the head and flow required to serve the existing campus chilled water loop. This will significantly reduce the run-hours of the central utility plant primary and secondary pumps.

The staging of the existing central utility plant chillers is modified because of the SUP addition. The SUP duplex chiller now represents the first stage of electric chiller capacity, displacing the CUP electric chillers during periods when the total campus load is less than 4,000 tons during off peak periods. This will significantly reduce the run-hours of the CUP electric chillers and associated auxiliaries.

ECMs 28, 29, & 30: MyEnergyPro™ Information System

General Description

> ECM Summary

In response to NMSU's desire for a real-time energy information system, Ameresco proposes using the existing Tridium Building Automation System (BAS) and installing MyEnergyPro™ (MEP) to develop and customize a web application that will meet the unique requirements of the University. The three different websites that will be customized as part of this project are OpsPRO, UtilityPRO, and Optimization Model (OM).

> OpsPRO (ECM 28)

MyEnergyPro™ OpsPRO is a secure, login essential, website that provides real-time energy usage for campus buildings, building equipment and central utility plant equipment. This application is used mainly by energy managers, facility managers, billing and accounting groups and administration. The main components and features of this site include:

Campus Map – with buildings' current usage values, color coded to indicate difference from forecast; each user can custom define color range

Current/Historical Graph – chart and tabular view of all building and equipment data points

Multi-Building/Multi-Year Graph – up to five different data points for up to five different time periods graphed in one comparison chart; compare to baseline year data

Building Administration – add/modify buildings and meters

User/Role Administration – add/modify users and roles

Export to Excel - for all charts and reports

Alarm Module – email or text based on the difference between current and historical value. User can define the threshold, as well as, type of media (email or text)

Reports– customized set of reports and charts

Building Invoice – customized building monthly utility invoice calculation

Role Based Access – program access defined by user role and responsibilities

Monthly Invoice Input Sheet – monthly recharge related values for building invoice module that require manual input

> UtilityPRO (ECM 29)

MyEnergyPro™ UtilityPRO is a monthly utility bill management tool accessed through a secure login required website. Clients can view their monthly utility bills, including but not limited to electric, gas, water and renewables, all in one simple chart. The monthly usage is compared with baseline usage, which can have weather normalization, facility changes and set point adjustments. The key utility data can be displayed in a table report format, and exported to Excel or image file. With proper permissions, a client can also view the Measurement and Verification (M&V) Report, which shows the monthly savings, as well as, the guaranteed amount. The savings are displayed in both usage and dollars, and converted to pounds of CO_2 for greenhouse gas impact. The Variance Report compares monthly usage, rate, and demand from year to year, and color coded based on the difference. This gives the client the ability to easily identify potential errors in their bills.

A second (optional) component of UtilityPRO is the Controls Module, where close to real-time room by room set point, room and exterior temperatures can be viewed. This provides a diagnostic tool to assist the client in the persistency of energy efficiency related to HVAC projects. Included in this module is a what-if analysis function, where the client can use a slider on the screen to change the room set point, and see the potential impact on the monthly bill instantaneously.

Additionally, UtilityPRO has built in export modules customized for individual clients. Clients can download their billing data to financial software packages, in a format that can be automatically

imported into those programs. UtilityPRO also has an Energy Star engine that is integrated with the Automated Benchmarking System to both send utility data and receive Energy Star ratings. Energy Star ratings are then imported and displayed in the monthly charts.

UtilityPRO also links to a client's other Energy Information sites, such as OpsPRO and DashPRO, if such sites exist. Clients can use UtilityPRO as a portal and one-stop shopping for all their Energy Information needs. Please reference the following pages for screenshots of our UtilityPRO product. The following components are included in the UtilityPRO package:

Monthly Utility Bill Graph – graph monthly electricity bills compared to a pre-determine baseline and historical usage

Monthly Utility Bill Report – create report for monthly electricity bills compared to historical usage

Bill Export – export bills to pre-defined formats that can be imported to PeopleSoft or other accounting systems

Benchmarking – upload to Energy Star through Automated Benchmarking System

Customer Support – online customer support including support ticket management and document archive

Controls Module – room by room setpoint monitoring and what-if scenario analysis

> Optimization Model (ECM 30)

The Optimization Model (OM) is an economic dispatch model where facility managers can find the most cost effective operation of a central plant or multi-interconnected central plants. This analytical tool takes in detailed, minute by minute consumption and production values for all major plant equipment and calculates the four most cost effective operating scenarios taking into account actual utility rates and identifies the production and cost of each piece of equipment on an hour by hour basis. Additionally, built in the OM is a modeling tool where users can change up to 30 variables and do what-if scenarios on the fly and save those scenarios for future reference. Please reference the following pages for Optimization Model screenshots. The main features of the optimization model are as follows:

Economic Dispatch of Central Plant Equipment

Real-Time Decision Making

Real-Time Consumption, Production & Rate Info

Large or Multiple Interconnected Central Plants

Real-Time Efficiency Equipment Calculation

Real-Time Costs of Consumption and Production Calculation

Development of Four Most Economical Operating Scenarios

What-if Scenario Analysis

Comparison with Previously Saved Historical 'Typical Usage Day' Energy Consumption

> Data Acquisition – OpsPRO and OM

Ameresco will use existing Tridium system to monitor thermal, gas, water, and electric energy usage in the facilities and parking lots. No additional meters are proposed for this measure. Where applicable, Tridium data will include:

Electrical by kilowatt, kWh, power quality, and British thermal unit (Btu)

Chilled water by temperatures, flows, tons, ton per hour, and Btu

Hot water by temperature, flow, and Btu

Steam by flow, pressure, temperature, and Btu

Natural gas meters to monitor the gas flow rate and volume by standard cubic feet per hour and total Btu

Domestic water by flow and gallons

The central database will be a Microsoft SQL Server. The data from the SQL server will be made available to front-end (web application) using web service functions developed with ASP.NET. Ameresco will develop the main websites with Flex 4 architecture and deliver over the Internet via the Flash Player 10+ browser plug-in technology. Flash provides a rich user experience, similar to a desktop application profile. To simplify site maintenance, xml configuration files will be incorporated in the design wherever possible. For example, language for the informational page can be replaced without recompiling the site.

> Backend

1. Data Integration

A critical part of the project is to create a reliable data import job. We will design an automated job to import real time energy data to the designated SQL Server database.

Data to be imported will include:

Buildings

- kW demand
- Power quality
- Chilled water
- Hot water
- Steam
- MMBtu (where available)
- Natural Gas (where available)
- Domestic water (where available)
- Others to be defined

2. SQL Server Database

Ameresco will design a SQL Server database to house real-time and historical data. The objects in the database will include:

Tables

Stored procedures

Functions

We intend to store minute data only for a short period of time (e.g., 2 hours). Historical data will be stored in 15-minute intervals for an amount of time determined by NMSU.

3. Web Service Module

Web Service is used to pass data between the SQL server database and the frontend Flex program. It includes functions that the Flex program calls to query the database. It is a separate module from the main website in terms of development and release and we will create Web service:

Site to host web service functions in ASP.NET

Functions to expose SQL stored procedures

Assumptions and Server Requirements

Data for the websites will reside in a SQL Server database, and collected through Tridium framework

SQL Server database will be located at NMSU

- NMSU is to provide a standalone or shared server for MEP data
- The server should have Microsoft SQL Server 2008 full version installed

Website will be hosted by NMSU

- NMSU is to provide a standalone designated webserver for MEP websites
- The server should have IIS 7 installed

NMSU will provide unfettered access for the Ameresco team to both the SQL and web servers

Note: the above is based on preliminary discussions, subject to change after further evaluation of the system.

> Sample Server Specification

The following provides a sample specification sheet for the standalone web server, using Dell server hardware. This system can be designated for NMSU MEP websites:

PowerEdge R210II
SYSTEM COMPONENTS
PowerEdge R210II
PowerEdge R210II Chassis with Cabled 2x3.5 HDs and
Quad-Pack LED Diagnostics, No Operating System
Catalog Number: 8 RCRC1004559-3072699

Module	Description
PowerEdge R210 II	PowerEdge R210II Chassis with Cabled 2x3.5 HDs and Quad-Pack LED Diagnostics
Operating System	No Operating System
Ship Group	Shipping Material, PowerEdge R210II
Memory	8GB Memory (4x2GB), 1333MHz Single Ranked UDIMM
Processor	Intel® Xeon® E3-1270 3.40 GHz, 8M Cache, Turbo, Quad Core/8T (80W)
Primary Hard Drive	HD Multi-Select
Internal Controller	PERC H200 Adapter Internal RAID Controller for 3.5 HDDs
Network Adapter	On-Board Dual Gigabit Network Adapter
Embedded Management	iDRAC6 Enterprise
Internal Optical Drive	DVD-RW Drive, SATA
Bezel	Bezel
System Doc	Electronic System Documentation and Open Manage DVD Kit
Hard Drive Configuration	Add-in H200 (SAS/ SATA Controller), 2 Hard Drives - RAID 1
Rails	2-Post/4-Post 1U Static Rails, Short

Hardware Support Services	3 Year ProSupport and NBD On-site Service
Installation Services	No Installation
Proactive Maintenance	Maintenance Declined
Power Cords	NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord
Hard Drives (Multi-Select) (2)	1TB 7.2K RPM SATA 3.5in Cabled Hard Drive

References

Data obtained from facility:

- Tridium data definition
- Utility bills

General Data:

- Field notes, controls points

Training, Warranty, License, and Support

After the initial installation of OpsPRO, the product will be under warranty for one year. During the warranty period, Ameresco will provide full support of the MEP program. Ameresco will also train NMSU employees/students on data validation functions and basic support items. After the initial first year, an annual license fee will apply.

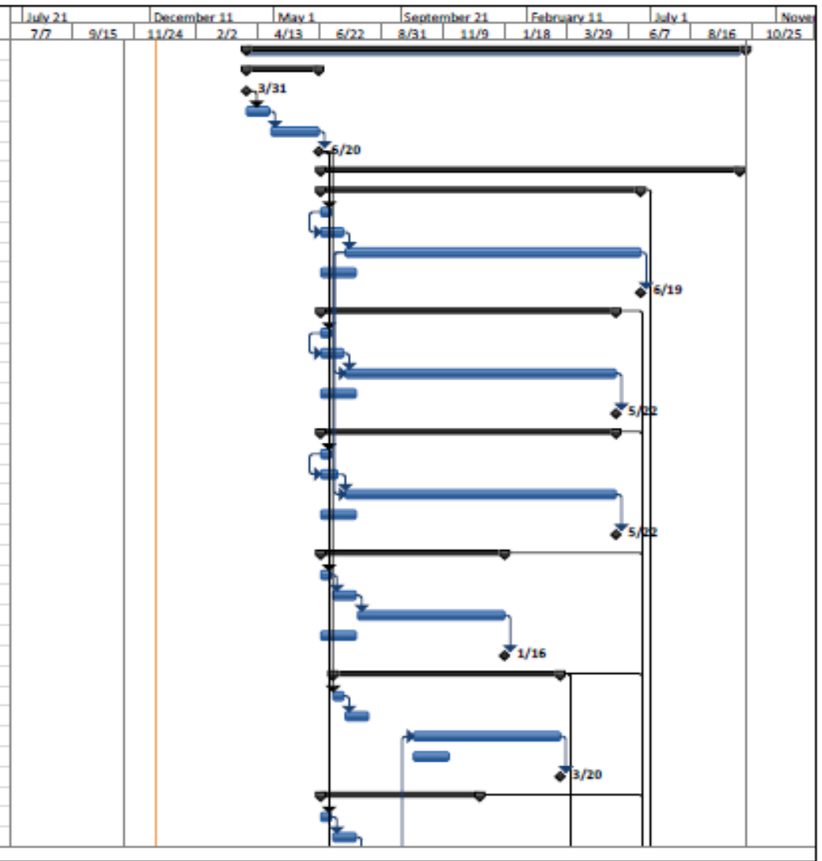
The license fee is shown in the cash flow and covers:

- Upgrades
- Email and phone support
- Remote support and maintenance of website
- Remote support and maintenance of SQL server
- Daily data quality report

Ameresco will include 48 hours of software development per year. This can be used toward adding new features or refining existing features, to make the OpsPRO ultimately more customized to the needs of NMSU.

SCHEDULE S. CONSTRUCTION AND INSTALLATION SCHEDULE

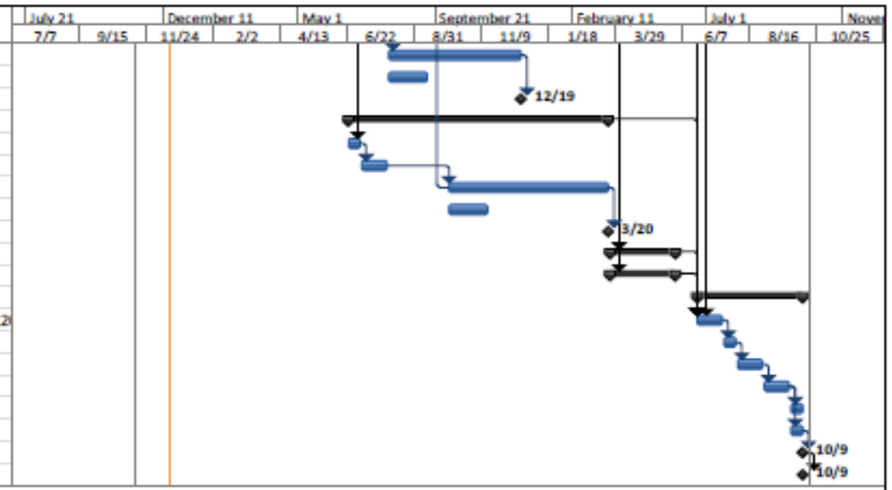
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**New Mexico State University**	**405 days**	**Mon 3/31/14**	**Fri 10/16/15**	
2		**Pre-construction**	**60 days**	**Mon 3/31/14**	**Fri 6/20/14**	
3		Project kick-off	0 days	Mon 3/31/14	Mon 3/31/14	
4		Subcontracts	20 days	Mon 3/31/14	Fri 4/25/14	3
5		Early procurement documents	40 days	Mon 4/28/14	Fri 6/20/14	4
6		**Notice to Proceed**	0 days	Fri 6/20/14	Fri 6/20/14	5
7		**Construction**	**340 days**	**Mon 6/23/14**	**Fri 10/9/15**	
8		**Interior Lighting**	**260 days**	**Mon 6/23/14**	**Fri 6/19/15**	
9		Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
10		Material procurement	20 days	Mon 6/23/14	Fri 7/18/14	9SS
11		Installation	240 days	Mon 7/21/14	Fri 6/19/15	10
12		Engineering & Design	30 days	Mon 6/23/14	Fri 8/1/14	
13		Substantial completion	0 days	Fri 6/19/15	Fri 6/19/15	11
14		**Exterior Lighting**	**240 days**	**Mon 6/23/14**	**Fri 5/22/15**	
15		Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
16		Material procurement	20 days	Mon 6/23/14	Fri 7/18/14	15SS
17		Installation	220 days	Mon 7/21/14	Fri 5/22/15	16,11SS
18		Engineering & Design	30 days	Mon 6/23/14	Fri 8/1/14	
19		Substantial completion	0 days	Fri 5/22/15	Fri 5/22/15	17
20		**Exterior Pole Mounted Lighting**	**240 days**	**Mon 6/23/14**	**Fri 5/22/15**	
21		Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
22		Material procurement	3 wks	Mon 6/23/14	Fri 7/11/14	21SS
23		Installation	220 days	Mon 7/21/14	Fri 5/22/15	22,11SS
24		Engineering & Design	30 days	Mon 6/23/14	Fri 8/1/14	
25		Substantial completion	0 days	Fri 5/22/15	Fri 5/22/15	23
26		**Retro-Commissioning**	**150 days**	**Mon 6/23/14**	**Fri 1/16/15**	
27		Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
28		Material procurement	20 days	Mon 7/7/14	Fri 8/1/14	27
29		Installation	5 mons	Mon 8/4/14	Fri 1/16/15	28
30		Engineering & Design	30 days	Mon 6/23/14	Fri 8/1/14	
31		Substantial completion	0 days	Fri 1/16/15	Fri 1/16/15	29
32		**Variable Air Volume Retrofit**	**185 days**	**Mon 7/7/14**	**Fri 3/20/15**	
33		Pre-construction M&V	10 days	Mon 7/7/14	Fri 7/18/14	6FS+2 wks
34		Material procurement	20 days	Mon 7/21/14	Fri 8/15/14	33
35		Installation	5 mons	Mon 10/6/14	Fri 3/20/15	47SS
36		Engineering & Design	30 days	Mon 10/6/14	Fri 11/14/14	
37		Substantial completion	0 days	Fri 3/20/15	Fri 3/20/15	35
38		**Economizer Upgrade or Repair**	**130 days**	**Mon 6/23/14**	**Fri 12/19/14**	
39		Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
40		Material procurement	20 days	Mon 7/7/14	Fri 8/1/14	39



Project: NMSU - Preliminary Cons
Date: Wed 12/18/13

Task | Project Summary | Inactive Milestone | Manual Summary Rollup | Deadline
Split | External Tasks | Inactive Summary | Manual Summary | Progress
Milestone | External Milestone | Manual Task | Start-only
Summary | Inactive Task | Duration-only | Finish-only

ID		Task Mode	Task Name	Duration	Start	Finish	Predecessors
41			Installation	100 days	Mon 8/4/14	Fri 12/19/14	40
42			Engineering & Design	30 days	Mon 8/4/14	Fri 9/12/14	
43			Substantial completion	0 days	Fri 12/19/14	Fri 12/19/14	41
44			**Chilled Water Bypass**	**195 days**	**Mon 6/23/14**	**Fri 3/20/15**	
45			Pre-construction M&V	10 days	Mon 6/23/14	Fri 7/4/14	6
46			Material procurement	20 days	Mon 7/7/14	Fri 8/1/14	45
47			Installation	6 mons	Mon 10/6/14	Fri 3/20/15	46
48			Engineering & Design	30 days	Mon 10/6/14	Fri 11/14/14	
49			Substantial completion	0 days	Fri 3/20/15	Fri 3/20/15	47
50			**MyEnergyPro™ - OpsPRO**	**50 days**	**Mon 3/23/15**	**Fri 5/29/15**	**32**
56			**MyEnergyPro™ - Optimization Model**	**50 days**	**Mon 3/23/15**	**Fri 5/29/15**	**32**
62			**Project Closeout and Completion**	**80 days**	**Mon 6/22/15**	**Fri 10/9/15**	
63			Punchlist completion	20 days	Mon 6/22/15	Fri 7/17/15	56,50,44,8,14,2
64			Documentation	10 days	Mon 7/20/15	Fri 7/31/15	63
65			Final Commissioning	20 days	Mon 8/3/15	Fri 8/28/15	64
66			Post-construction M&V	20 days	Mon 8/31/15	Fri 9/25/15	65
67			Final Inspection and Acceptance	10 days	Mon 9/28/15	Fri 10/9/15	66
68			Training	10 days	Mon 9/28/15	Fri 10/9/15	66
69			Final Completion	0 days	Fri 10/9/15	Fri 10/9/15	68
70			Performance Period Begins	0 days	Fri 10/9/15	Fri 10/9/15	69



Project: NMSU - Preliminary Cons
Date: Wed 12/18/13

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only			
Summary		Inactive Task		Duration-only		Finish-only			

SCHEDULE T. SYSTEMS START-UP AND COMMISSIONING OF EQUIPMENT; OPERATING PARAMETERS OF INSTALLED EQUIPMENT

T. Commissioning

T.1 Systems Start-Up and Commissioning

The performance testing and commissioning matrix for the project is provided in Table T.1. Pre-functional and functional inspection and testing forms and procedures will be developed during the design and construction phases, based on actual system design and installation. Results of pre-functional and functional testing will be included in the O&M manuals.

The commissioning process consists of two main steps: pre-functional check and functional testing. Pre-functional check is the verification process before, during, and after construction to ensure the system is installed according to design. This process includes verification of installed equipment according to engineering specifications and submittals, verification of installation work according to manufacturer's specifications, inspections for equipment or installation flaws or inconsistency, and other related inspection works. Pre-functional checks must be performed before a full functional testing can be performed. Each subcontractor will be responsible for their own individual checks prior to start-up and functional testing of the equipment. Ameresco will be responsible for the project-wide pre-functional checks during and after constructions to ensure the system installed is as designed.

The second step in the commissioning process, the functional test, is the process of testing the installed systems to ensure that they operate as designed, and that they can achieve the performance as intended. In the functional test, operation of each piece of equipment and its operation as part of a system is verified, such as motor speed, water flow and pressure, etc. The functional test also includes testing the system performance under various simulated conditions (e.g., to simulate peak heating load if the test is conducted in the summer). Results of the tests will be recorded and any discrepancies with design values will be noted. Necessary modifications will be performed to rectify a performance level that does not conform to design. Generally, Ameresco will be responsible for conducting and supervising the functional test along with approved representatives from vendors and subcontractors. NMSU's facilities personnel are also encouraged to be involved in the process as it will help in transitioning the operation and maintenance responsibilities.

Table T.1. Performance Testing and Commissioning Matrix

ECM	Equipment/ Systems to be Performance Tested	Observations, Tests, and Inspections during Construction (Pre-functional)	Pre-functional Responsibility	Observations, Tests, and Inspections prior to Acceptance (Functional)	Functional Responsibility	Testing Documentation
ECM 1: Lighting Retrofits and Controls	Lighting fixtures	Visually verify proper installation of all fixtures as completed.	Lighting contractor	Measure power input at the switch or fixture for a statistically significant number of fixtures in locations mutually agreed by NMSU and Ameresco.	Sub-contractor, Ameresco, NMSU	Lighting commissioning data sheets will be completed for all new fixtures.
ECM 2: Exterior Site Lighting	Lighting fixtures	Visually verify proper installation of all fixtures as completed.	Lighting contractor	Measure power input at the circuit or fixture for a statistically significant number of fixtures in locations mutually agreed by NMSU and Ameresco.	Sub-contractor, Ameresco, NMSU	Lighting commissioning data sheets will be completed for all new fixtures.
ECM 3: Exterior Pole Mounted Lighting	Lighting fixtures	Visually verify proper installation of all fixtures as completed.	Lighting contractor	Measure power input at the circuit or fixture for a statistically significant number of fixtures in locations mutually agreed by NMSU and Ameresco.	Sub-contractor, Ameresco, NMSU	Lighting commissioning data sheets will be completed for all new fixtures.
ECM 6: Retro-commissioning	HVAC Systems including air handlers, terminal devices, pumps, fans and controls	Visual inspection and verification with in situ-inspections and point to point verifications	Controls sub-contractor	Test functionality in each system through the central EMCS using functional performance test procedures. Verify proper operation on a point by point basis.	Sub-contractor, Ameresco, NMSU	One line drawings, commissioning document provided with O&M manual.
ECM 7: Variable Air Volume Retrofit	HVAC Systems including air handlers, terminal devices, fans and controls	Visual inspection and verification with pre-functional inspections and point to point verifications	Controls sub-contractor	Test VAV functionality in each AHU through the central EMCS using functional performance test procedures. Verify proper operation on a point by point basis.	Sub-contractor, Ameresco, NMSU	Documented results will be provided that include start-up and functional performance test reports.

Table T.1. Performance Testing and Commissioning Matrix

ECM	Equipment/ Systems to be Performance Tested	Observations, Tests, and Inspections during Construction (Pre-functional)	Pre-functional Responsibility	Observations, Tests, and Inspections prior to Acceptance (Functional)	Functional Responsibility	Testing Documentation
ECM 10: Economizer Upgrade or Repair	Air handling units	Visual inspection and verification with in situ-inspections and point to point verifications	Controls sub-contractor	Test economizer functionality in each AHU through the central EMCS using functional performance test procedures. Verify proper operation on a point by point basis.	Sub-contractor, Ameresco, NMSU	Documented results will be provided that include start-up and functional performance test reports.
ECM 12: Chilled Water Pump Bypass	Chilled water tertiary pumps	Visual inspection and verification with pre-functional inspections and point to point verifications	Controls sub-contractor and Mechanical sub-contractor	Test the bypass functionality in each system through the central EMCS using functional performance test procedures. Verify proper operation on a point by point basis.	Sub-contractor, Ameresco, NMSU	Documented results will be provided that include start-up and functional performance test reports.
ECM 26: Satellite Plant Energy Savings	Chillers, CHW pumps, CW pumps, glycol pumps, cooling towers, ice storage systems and controls	Visual inspection and verification with in situ-inspections and point to point verifications	Controls sub-contractor and Ameresco	Test the plant functionality in each system through the central EMCS using functional performance test procedures. Verify proper operation on a system level basis.	Sub-contractor, Ameresco, NMSU	Documented results will be provided that include the functional performance test reports.

T.2 Preliminary Commissioning Plan

Purpose of the Commissioning Plan

The purpose of the commissioning plan is to provide direction for the commissioning process during construction, providing resolution for issues such as scheduling, roles and responsibilities, lines of communication and reporting, approvals, and coordination.

Commissioning Goals and Objectives

Commissioning is a systematic process of ensuring that the building systems perform according to the design intent and the owner's operational requirements. All equipment and systems should be installed according to manufacturer's recommendations and the best practices and standards of the industry.

Commissioning will include documenting the design intent, followed by activities in the construction, acceptance, and warranty phases of the project. The participation of the contractors in commissioning activities will follow the requirements defined in the specifications. The three main goals of the commissioning process are:

1. Facilitate the final acceptance of the project at the earliest possible date.
2. Facilitate the transfer of the project to the owner's maintenance staff.
3. Ensure that the comfort systems meet the requirements of the occupants. Commissioning is also intended to achieve the following specific objectives:
    - Document that equipment is installed and started per manufacturer's recommendations.
    - Document that equipment and systems receive complete operational checkout by installing contractors.
    - Document system performance with thorough functional performance testing and monitoring.
    - Verify the completeness of operations and maintenance materials.
    - Ensure that the owner's operating personnel are adequately trained on the operation and maintenance of building equipment.

Commissioning Team Information

The commissioning team will consist of representatives from Ameresco, the mechanical and control sub-contractors and NMSU's facilities staff. Individual team members will be identified together with their qualifications at a future date.

Abbreviations and Definitions

The following are common abbreviations used in this document.

A/E	Architect and design engineers	FPT	Functional performance test
CP	Commissioning provider	GC	General contractor
CC	Controls contractor	MC	Mechanical contractor
CX	Commissioning	PF	Pre-functional checklist
EM	Energy Manager	PM	Project Manager
CX Plan	Commissioning Plan document	Subs	Subcontractors to General
EC	Electrical contractor	TAB	Test and balance contractor
MM	Maintenance Manager	Staff	Maintenance Staff

Roles and Responsibilities

General Management Plan

In general, the CP coordinates the commissioning activities and reports to the Ameresco project manager. The CP's responsibilities, along with all other contractors' commissioning responsibilities are detailed in the specifications. The Specifications will take precedence over this Commissioning Plan. All members work together to fulfill contracted responsibilities and meet the objectives of the Contract Documents.

General Descriptions of Roles

General descriptions of the commissioning roles are as follows:

CP: Coordinates the CX process, writes and/or reviews testing plans, directs and documents performance testing.
PM: Facilitates and supports the CX process and gives final approval of the CX work. MM: Coordinates maintenance staff participation in commissioning activities.
GC: Facilitates the CX process, ensures that Subs perform their responsibilities and integrates CX into the construction process and schedule.
Subs: Demonstrate correct system performance.
Staff: Participate in commissioning tasks and performance testing, review O&M documentation, attend training.
A/E: Perform construction observation, approve O&M manuals and assist in resolving problems.
Mfr.: Equipment manufacturers and vendors provide documentation to facilitate the commissioning work and perform contracted startup.

Specifications and Commissioning

Commissioning language in the specifications details the scope of commissioning for this project. The following table lists the sections of the specifications that include commissioning related language with a brief description.

Commissioning specifications will be developed at a future date

General Management Plan and Protocols

The following protocols will be used on this project.

Issue	**Protocol**
For requests for information (RFI) or formal documentation requests:	The CP goes first through the PM.
For minor or verbal information and clarifications:	The CP goes direct to the informed party.
For notifying contractors of deficiencies:	The CP documents deficiencies through the PM, but may discuss deficiency issues with contractors prior to notifying the PM.
For scheduling functional tests or training:	The CP provides input and coordination of testing and training. Scheduling is done through the PM.
For scheduling commissioning meetings:	The CP selects the date and schedules through the PM.
For making a request for significant changes:	The CP has no authority to issue change orders.
For making minor changes in specified sequences of operations:	Any required changes in sequences of operations required to correct operational deficiencies must be approved and documented by the PM and A/E team. The CP may recommend to the PM changes in sequences of operation to improve efficiency or control.
Subcontractors disagreeing with requests or interpretations by the CP shall:	Resolve issues at the lowest level possible. First with the CP, then with the GC and PM. Some issues may require input from the A/E team.

Commissioning Process

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

Commissioning Scoping Meeting

The scoping meeting brings together all members of the design, construction, and operations team that will be involved in the commissioning process. Each building system to be commissioned is addressed, including commissioning requirements, and completion and start-up schedules. During the scoping meeting, all parties agree on the scope of work, tasks, schedules, deliverables, and responsibilities for implementation of the Commissioning Plan.

Final Commissioning Plan

The commissioning agent finalizes the draft Commissioning Plan using the information gathered from the scoping meeting. The initial commissioning schedule is also developed along with a detailed timeline. The timeline is fine-tuned as construction progresses.

Design Intent Documentation

The design requirements, relative to the building systems selected for commissioning, must be explicitly documented in order to establish a baseline of performance expectations to which the actual installed performance is compared. The commissioning provider, with the assistance of the building owner and design team, prepares a Design Intent Summary that documents the design intent for those building systems selected for commissioning. The Design Intent Summary reflects the underlying assumptions and requirements that become represented in the construction documents.

Submittals

The general contractor will provide the commissioning agent with a set of equipment and system submittals. This equipment data includes installation and start-up procedures, O&M data, performance data and temperature control drawings. The subcontractors, general contractor or A/E notify the commissioning agent of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems.

Site Observation

The commissioning agent makes periodic site visits to witness equipment and system installations. Each site visit will have a specific agenda and will be coordinated with the general contractor site supervisor. The commissioning agent attends selected planning and job-site meetings in order to remain informed on construction progress and to update parties involved in commissioning. The general contractor provides the commissioning agent with information regarding substitutions or change orders that may affect commissioned equipment or the commissioning schedule.

Pre-functional Checklists and Startup Procedures

A Pre-Functional Inspection Checklist are developed and completed for all mechanical equipment being commissioned. The checklist captures equipment nameplate and characteristics data, and confirms the as-built status of the equipment or system. The checklists ensure that the systems are complete and operational and document the installation of components and completion of systems.
The checklists are prepared by the commissioning agent from manufacturer's data, drawings and specifications to include the required installation, checkout, and start up procedures. The installing subcontractors date and initial the checklists as the construction and start-up is completed. The commissioning agent reviews and verifies the completed checklists before scheduling the functional performance testing.

Development of Functional Test and Verification Procedures

Functional performance testing verifies the intended operation of individual components and system interactions under various conditions and modes of operation. The systems are run through all of the sequences of operation and the response of components is verified. Testing proceeds from components to subsystems to systems, and finally to interlocks and connections between systems.

The commissioning agent prepares functional performance test plans so that the complete sequence of operations is included. The commissioning agent obtains all documentation, including an updated points list, control sequences, and setpoints. If necessary, the commissioning agent may request clarifications from contractors and the design team regarding sequences and operation. Prior to execution, the commissioning agent provides a copy of the primary equipment tests to the installing subcontractor and general contractor who can review the tests for feasibility, safety, warranty and equipment protection.

Execution of Functional Testing Procedures

The commissioning agent schedules functional tests through the general contractor and subcontractors. Under the supervision of the commissioning agent, the installing subcontractor performs the hardware and/or software manipulations required for the testing. Owner maintenance staff may also be present in order to assist in system observations. The commissioning agent witnesses and records the results of functional performance testing. Any deficiencies found from functional performance testing will be documented in a Deficiency Report. The report will include all details of the components or systems found to be non-compliant with the parameters of the functional performance test plans and design documents. The deficiency report will become part of the punch list. The report will detail the adjustments or alterations required to correct the system operation, and identify the responsible party. The deficiency report will be continuously updated. The commissioning agent schedules any required retesting through the general contractor. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between commissioning agent, sub-contractor and general contractor.

Short-Term Diagnostic Monitoring

Short-term diagnostic testing, using data acquisition equipment or building automation system trends to record system operation over a suitable period, may be used to investigate the dynamic interactions between components in the building system. The monitoring occurs after occupancy to evaluate the building systems' performance under natural occupancy and ambient load conditions. The objectives of the monitoring are to evaluate scheduling, the interaction between heating and cooling, and the effectiveness of the systems in meeting the comfort requirements of the occupants.

Operations and Maintenance Manuals

The operation and maintenance manuals prepared by the contractors for the owner's maintenance personnel are reviewed for completeness. The contractors are encouraged to submit O&M manuals at the earliest possible date. Materials may be added, or requested from the contractors, to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. A database of preventative maintenance information may also be created from the materials in the O&M manuals.

Training and Orientation of Owner Personnel and Occupants

Effective maintenance personnel training is critical to the long term performance of the new building. The commissioning agent will assist the owner and general contractor in organizing the training sessions by identifying the appropriate staff for each session and creating an overall training plan.

For each training session, the contractors provide a detailed agenda for each piece of equipment or system for which training is required. The agenda describes the training scope, duration, and methods, along with the name and qualifications of the trainers. The commissioning agent develops a plan for including in the training session contractors / trainers from different disciplines, when appropriate. The trainer documents each training session (duration, general subjects covered, and attendees). The commissioning agent may witness any of the training sessions.

Warranty Period

Seasonal variation in operations or control strategies may require additional testing during peak cooling and heating seasons to verify system performance. During the warranty period, seasonal testing and other deferred testing is completed as required to fully test all sequences of operation. The commissioning agent coordinates this activity. Tests are executed and deficiencies corrected by the appropriate subcontractors, witnessed by facilities staff and the commissioning agent. Any final adjustments to the O&M manuals and as-builts due to the testing are made. The commissioning agent will request input from the owner's operations staff and occupants about the performance of the building systems. The commissioning agent also supports the general contractor's troubleshooting process during the warranty period. The general contractor's warranty team will first try and resolve the issues before requesting assistance from the commissioning agent.

Commissioning Report

A final Commissioning Report will be compiled which summarizes all of the tasks, findings, and documentation of the commissioning process. The report will address the actual performance of the building systems in reference to the design documents. All test reports by various sub-contractors, manufacturers and controlling authorities will be incorporated into the final report.

The commissioning report includes:

- An evaluation of the operating condition of the systems at the time of functional test completion,
- Deficiencies that were discovered and the measures taken to correct them,
- Functional test procedures and results,
- Reports that document all commissioning field activities as they progressed, and
- A description and estimated schedule of required deferred testing.

General Issues

The following sequential priorities are followed:

1. Equipment is not “temporarily” started (for heating or cooling), until pre-start checklist items and all manufacturers’ pre-start procedures are completed and moisture, dust and other environmental and building integrity issues have been addressed.
2. Functional performance testing does not begin until pre-functional, start-up and TAB is completed for a given system.
3. The controls system and equipment it controls are not functionally tested until all points have been calibrated and pre-functional checklists are completed.

Sample Project Schedule

Preliminary Commissioning Schedule

Commissioning Activity	Duration	Estimated Start Date	Estimated Completion Date
Document design intent and basis of design			
Commissioning Plan			
Preliminary Commissioning Plan			
Scoping Meeting			
Final Commissioning Plan			
Submittals and test writing			
Review Mechanical submittals			
Write Startup and PF checklists			
DDC program review meeting			
Write FPT Tests			
Construction Observation			
Site observations			
HVAC PF checklist completion			
Equipment startup			
Startup documentation			
Controls system checkout			
Test and Balance			
TAB air side			
TAB water side			
HVAC Functional performance testing			
Substantial Completion			
Post Acceptance Phase			
Owner move-in			
Short-term diagnostic monitoring			
O&M, training, reporting, warranty			
O&M Manuals submitted			
Review O&M manuals			
Review as-built documentation			
Seasonal testing			
Final commissioning report			

T.3 Sample Prefunctional Checklist

Prefunctional Checklist

Project _____

PC-_____ VARIABLE FREQUENCY DRIVE on _____

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event, as marked below, respective to each responsible contractor. This prefunctional checklist is submitted for approval, subject to an attached list of outstanding items yet to be completed. A Statement of Correction will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed. ___List attached.

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

Prefunctional checklist items are to be completed as part of startup & initial checkout, preparatory to functional testing.

- This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.
- Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).
- If this form is not used for documenting, one of similar rigor shall be used.
- Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.
- "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CA = commissioning agent, CC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor, _____ = _____.

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

Commissioning Agent	Date	Owner's Representative	Date

2. Requested documentation submitted

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

Check Equip Tag->						Contr.
Manufacturer's cut sheets						
Performance data (fan curves, coil data, etc.)						
Installation and startup manual and plan						
Sequences and control strategies						
O&M manuals						

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

3. Model verification [Contr = _____]

1 = as specified, 2 = as submitted, 3 = as installed. Check if Okay. Enter note number if deficient.

Equip Tag--->						
Manuf.	1					
	2					
	3					
Model	1					
	2					
	3					
Serial #	3					
Capacity	1					
	2					
	3					

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

4. Installation Checks

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

Check Equip Tag->						Contr.
General Installation						
Permanent label affixed						
Securely mounted						
Drive location not subject to excessive temperatures						
Drive location not subject to excessive moisture or dirt						
Drive size matches motor size						
Pilot lights functioning						
VFD wired to controlled equipment						
Programming and Controls						
Internal setting designating the model is correct						

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

Check Equip Tag->						Contr.
Input of motor FLA represents 100% to 105% of motor FLA rating						
Appropriate Volts vs Hz curve is being used						
Accel and decel times are around 10-50 seconds, except for special applications. Record actual for each unit.						
Lower frequency limit at 0 for VAV fans and around 10-30% for chilled water pumps. Record actual for each unit.						
Upper frequency limit set at 100%, unless explained otherwise						
VFD interlocked to control system						
Static or differential pressure sensor or other controlling sensor properly located and per drawings						
Controlling sensor calibrated						
Unit is programmed with full written programming record submitted						
RPM readout in BAS verified with VFD readout						
All control devices, pneumatic tubing and wiring complete						
Specified sequences of operation and operating schedules have been implemented with all variations documented						
Specified point-to-point checks have been completed and documentation record submitted for this system						
Final						
Startup report completed with this checklist attached						
Safeties installed and safe operating ranges for this equipment provided to the commissioning agent						

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

T.4 Sample Functional Performance Test Procedure

Functional Performance Test

Variable Frequency Drive (VFD)
VAV Fan Application

Constant Static Pressure Application

Project: _____ Date: _____
Address: _____

Commissioning Participants:
Commissioning agent: _____ of _____
EMS operator: _____ of _____
VFD technician: _____ of _____
HVAC technician: _____ of _____
Owner's rep.: _____ of _____

Air handler ID:_____. ___ Supply fan (SF) Hp: ___ CFM: _____ RPM _____ SP_____
___ Return fan (RF) Hp: ___ CFM: _____ RPM _____ SP_____
VFD brand and model: _____

The following functional performance test is for a VFD controlling a VAV air handler to a **constant** duct static pressure (SP). ***A check-mark denotes acceptance or compliance.***

I. Design Intent and Documentation Verification

___ Review the design documents and the specifications.
___ Verify that the VFD ___description, ___specifications, ___technical and troubleshooting guide and the installation, ___programming record and ___balance report are on-site.
From the design documents determine: Location of static pressure sensor:
_____
Nearest duct fitting upstream (fitting and distance):_____
Nearest duct fitting downstream:_____
Control strategy for the return fan:_____
_____

II. VFD Installation

Static Pressure Sensor

Linear Position

Location of sensor in % of the distance from fan to terminal box: _____
Normally, the sensor should be located 2/3 to 3/4 the distance from the fan to the terminal box of the most restrictive branch.

____Complies?

Pressure Reading Reliability

Nearest duct fitting upstream (fitting and distance):_____
Nearest duct fitting downstream:_____
The SP sensor controlling the VFD must be located so as to properly sense the static pressure in the duct without being adversely affected by changes in flow from duct fittings. This ideally requires the sensor to be at least 10 duct diameters downstream and 5 duct diameters upstream from any duct takeoff or elbow fittings.

___Complies?

Pressure Offset (Po)

Duct static pressure fan is being controlled to: _____in. H_20 [A].

Pressure rise across supply fan at design conditions (from balance report summary): _____in. H_20 [B]. Pressure offset, Po, [A] / [B]: _____.

Optimally, Po should be 0.3 or less in order for the VFD and fan to be able to respond to small pressure changes and realize adequate energy savings. If Po is greater than 0.4, the duct SP sensor is probably located too close to the fan.

___Complies?

Balancing to Lowest Pressure

Review the HVAC balance report and verify that according to the report, the system was balanced so the VFD controls to the lowest possible duct static pressure (that is, a capacity test was performed). The controlling duct static pressure from balance reports is _____in. H_20.

The corresponding VFD frequency or fan RPM from the balance report is: supply fan (SF):_____, return fan (RF):_____. Refer to the end of this test for details of the capacity test.

___Balanced to lowest static? (this is further verified by #2 under Section IV)

Turn-Down Ratio

What is the minimum Hz the VFD will take the fan to? _____ What is the reason for any limitations?_____

General Issues

___ Verify that any power quality mitigation measures required from the specifications have been completed.

___ Verify that any inlet vanes or outlet dampers on the fan have been removed or permanently held full open.

___ Verify verbally that the acceleration and deceleration ramp time of the VFD is between one and four minutes.
Actual ramp time: up _____min. down _____min. (too short of ramp times will result in "hunting" and excess modulation by the VFD, typical ramp times are 1 to 4 minutes)

___ Verify that the lower frequency limit is 0, unless explained.

___ Verify that the VFD has been integrated into the EMS as per specification.

___ Verify that the EMS monitors the duct static pressure or that an in-line "T" in the static pressure hose is extended to near the VFD, from which a magnehelic static pressure reading can be made during testing.

III. Functional Performance Test

This test is not intended to verify that the VAV system is functioning properly, but rather that the VFD is functioning properly.

1. **Boxes Partially Open (intermediate CFM).** If current conditions are such that the system is not expected to be in full cooling, nor be at the minimum flow condition:
   a. Read the frequency output of the VFDs and record in Table 1 in the "Boxes Partially Open" column for both the supply fan (SF) and return fan (RF) if applicable.
   b. Read the duct static pressure and record in the same column.

   If the conditions are not in an "intermediate" position, change all space temperature set points to 4 degrees below the actual temperature in the space, to simulate an approaching of thermostat satisfaction and take readings.

2. **Boxes to Maximum Open (Full Cooling).** Using the (EMS) or other means, change all the space temperature setpoints to at least 10 degrees below the current space temperature so that the entire HVAC system supplied from this fan is in full cooling in all zones and *all* terminal boxes are open to their maximum "stops."

   a. Measure or read the duct static pressure controlling the VFD and record in the "Open to Max. Stop" column in Table 1.
   b. Read the frequency output of the VFDs and record in Table 1.

3. **Boxes to Minimum Positions.** Change all space temperature set points to be equal to the actual space temperatures to simulate a satisfied condition, driving the boxes to their minimum.
   a. Take the frequency and static pressure readings and record in Column D.

IV. Analysis

Table 1.

A Design static pressure_____ Design freq. (Hz): SF _____ RF _____ Design RPM: SF_____ RF _____ SP being controlled to now _____	**B** **Terminal Boxes Open to Max. Stop** **SF | RF**	**C** **Boxes Partially Open** **SF | RF**	**D** **Boxes Closed to Min. Stop** **SF | RF**
VFD frequency. or RPM	**|**	**|**	**|**
Static pressure during VFD test			
Static pressure during capacity test		(from TAB report data form)	

1. Fractional variance of SF design frequency or RPM to full open, 1-(B / A): _____. If the full open SF frequency or RPM is more than 5% less than the design value (assuming the design and actual static are equal), all boxes may not be driven full open. Investigate as appropriate.

___Less than 5% variance?

2. The SP with full open boxes (B) should be significantly less than the SP during the partially loaded conditions and should be within 0.15 inches SP of the SP from the capacity test. If the VFD SP is greater than the capacity test SP, all boxes may not be fully open. If the SP's are not close to each other, the TAB data may be inaccurate. Compliance basically verifies that a capacity test was completed.

___Complies?

3.**___Is the SP in (C) and (D) within 10% of controlled variable in (A)?**

4.**___The min. turn down ratio (from Section II) should be close to (freq. D/B) Y/N?**

5.**___Return fan RPMs or frequencies track well with changes in SF RPM, accounting for changes in OSA quantities and relief strategy?**

6. Static pressure (SP) readings at the last two conditions should remain within 5% of each other. If the there is more than a 5% variance, the sensor may be unstable, possibly from being too close to duct fittings.

___Less than 5% variance?

___Collaborative Trending: If the variance is greater than 5% and if the Pressure Reading Reliability location doesn't comply, from Section III, trending (monitoring) the SP against terminal unit damper position or SF flow is recommended to confidently verify stability. The SP should remain constant (+/- 5%) regardless of damper position or flow.. SP trended? _____

___Complies? (sensor is stable)

7.**___For the frequency or RPM readings in Table 1, are the values in Col. B > C > D?**

V. Training

___The training specified in the design incentive agreement has been completed.

Required Capacity Test

To insure that energy use is minimized, the HVAC system must be balanced at design conditions at the lowest possible static pressure possible. This requires that the lowest possible static pressure (SP) be found at the sensor that will allow full design flow at the TU most difficult to satisfy. This system minimum SP found is what the VFD should control to. This is accomplished by changing the temperature setpoint for all zones to 55F, causing all terminal units (TU) to be calling for full cooling. Each TU's airflow is then measured against the design flow. The TU that is receiving the lowest fraction of design is identified. The current SP at the controlling sensor is noted. A calculation is made, giving the SP required at the sensor to allow the identified most critical TU box to meet its design flow. The equation is $SP_2 = SP_1 \times Q_2^2 / Q_1^2$. Where Q_1 = actual or fraction of design flow during capacity test. Q_2 = design flow or 1.0 if using fractions. SP_1 = SP at sensor. SP_2 = SP to control to. It is noted that if all boxes were calling for full cooling simultaneously, the fan could not maintain the new SP_2 value, due to diversity fan size reduction having been made by the design engineer.

Parties required for VFD site commissioning work

Commissioning agent To witness and record the tests.

EMS operator To drive boxes open and shut by changing the set points, etc.

VFD technician To use the keypad to verify the ramp time. (unless verified at start-up, which is recommended). Sequencing the keypad to display ramp time could be done by the commissioning agent, alone after reviewing the VFD technical manual.

HVAC technician To apply magnehelic gages to the pressure tap to measure duct static, if not monitored by EMS.

T.4 Sample Manufacturer's Installation Checklist and Start-Up

Each piece of equipment will be started and tested following the manufacturer's written start up procedures. These procedures will be included as part of the Operation and Maintenance manuals provided at the conclusion of the project.

SCHEDULE U. STANDARDS OF COMFORT

Note: The Standards of Comfort provide results for buildings included with HVAC measures installed. This list will be expanded to the population of buildings included within the project.

U. Standards of Comfort

The guaranteed energy savings included in the EPC are based on pre-retrofit equipment operating schedules and space temperatures. These values were established based on space temperature monitoring during the course of the IGA and fan schedule trend logging via the campus energy management system. The energy saving calculations generally assume that these fan schedules and space temperature are maintained as a part of the energy conservation measure implementation within ±2 degrees. In some modeled building cases, the variance is outside of this range due to baseline model calibration requirements.

			Existing						Proposed					
			Occupied		Unoccupied		Fan Schedule		Occupied		Unoccupied		Fan Schedule	
	Modeled Buildings	Mechanical Systems/Zones	Cooling (F)	Heating (F)	Cooling (F)	Heating (F)	Schedule	Annual Hours	Cooling (F)	Heating (F)	Cooling (F)	Heating (F)	Schedule	Annual Hours
244	Gerald Thomas Hall	Basement AHU	71	71	71	71	24/7	8760	76	73	76	73	24/7	8760
244	Gerald Thomas Hall	East RTU	69	71	69	71	24/7	8760	73	73	73	73	M-F: 7:00 AM to 7:00 PM	8760
244	Gerald Thomas Hall	West RTU	69	71	69	71	24/7	8760	73	73	73	73	24/7	8760
301	Thomas and Brown Hall	AHU-1	74	74	OFF	OFF	M: 4:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: 9:00 AM to 5:00 PM	5096	75	73	OFF	OFF	M: 4:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: 9:00 AM to 5:00 PM	5096
34	Foster Hall	AHU-2	72	71	72	71	24/7	8760	73	71	72	71	24/7	8760
34	Foster Hall	AHU-3	71	71	71	71	24/7	8760	72	71	71	71	24/7	8760
34	Foster Hall	AHU-4	71	71	71	71	24/7	8760	72	71	71	71	24/7	8760
34	Foster Hall	AHU-1	75	75	75	75	24/7	8760	73	73	75	75	24/7	8760
34	Foster Hall	MAU-1	61	70	61	70	24/7	8760	64	74	61	70	24/7	8760
34	Foster Hall	Fan Coil Zones	74	74	74	74	24/7	8760	74	74	74	74	24/7	8760
288	Guthrie Hall	West Fan Zones	75	75	OFF	OFF	M: 3:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: OFF	4316	75	74	OFF	OFF	M: 3:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: OFF	4316
288	Guthrie Hall	East Fan Zones	74	74	OFF	OFF	M: 3:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: OFF	4316	75	74	OFF	OFF	M: 3:00 AM to 10:00 PM, T-F: 6:00 AM to 10:00 PM, SS: OFF	4316
285	Corbett Center		75	74	75	74	24/7	8760	76	74	76	74	24/7	8760
285	Corbett Center		76	74	76	74	24/7	8760	75	73	75	73	24/7	8760
285	Corbett Center		75	74	75	74	24/7	8760	75	74	75	74	24/7	8760
285	Corbett Center		75	73	75	73	24/7	8760	75	73	75	73	24/7	8760
285	Corbett Center		75	74	75	74	24/7	8760	77	76	77	76	24/7	8760
285	Corbett Center		73	72	73	72	24/7	8760	76	74	76	74	24/7	8760
321	James B. Delamater Activity Center	AHU-1	73	74	73	74	24/7	8760	75	71	75	71	24/7	8760
321	James B. Delamater Activity Center	AHU-2	75	75	75	75	24/7	8760	75	72	75	72	24/7	8760
321	James B. Delamater Activity Center	AHU-3	73	74	73	74	24/7	8760	75	73	75	73	24/7	8760
321	James B. Delamater Activity Center	AHU-4	73	74	73	74	24/7	8760	75	73	75	73	24/7	8760
321	James B. Delamater Activity Center	AHU-5	72	72	72	72	24/7	8760	75	72	75	72	24/7	8760
321	James B. Delamater Activity Center	AHU-6	75	71	75	71	24/7	8760	76	70	76	70	24/7	8760
321	James B. Delamater Activity Center	New AHU-1	71	71	71	71	24/7	8760	75	71	75	71	24/7	8760
321	James B. Delamater Activity Center	New AHU-2,3	76	70	76	70	24/7	8760	76	70	76	70	24/7	8760
	Modeled Building System/Zone Average		**73**	**73**	**73**	**72**		**8277**	**74**	**73**	**74**	**72**		**8277**

Non-Modeled Buildings		Mechanical Systems/Zones	Existing						Proposed					
			Occupied		Unoccupied		Fan Schedule		Occupied		Unoccupied		Fan Schedule	
			Cooling (F)	Heating (F)	Cooling (F)	Heating (F)	Schedule	Annual Hours	Cooling (F)	Heating (F)	Cooling (F)	Heating (F)	Schedule	Annual Hours
10	GODDARD HALL	All Modified Fan Systems and Zones	73	73	73	72		8277	74	73	74	72		8277
32	YOUNG HALL		73	73	73	72		8277	74	73	74	72		8277
83	MILTON HALL100% I&G ELIGIBLE		73	73	73	72		8277	74	73	74	72		8277
184	BRELAND HALL		73	73	73	72		8277	74	73	74	72		8277
225	ASTRONOMY BUILDING		73	73	73	72		8277	74	73	74	72		8277
278	BRANSON LIBRARY		73	73	73	72		8277	74	73	74	72		8277
364	CLARA BELLE WILLIAMS HALL		73	73	73	72		8277	74	73	74	72		8277
365	SPEECH BUILDING		73	73	73	72		8277	74	73	74	72		8277
386	BUSINESS COMPLEX BUILDING		73	73	73	72		8277	74	73	74	72		8277
389	MUSIC BUILDING		73	73	73	72		8277	74	73	74	72		8277
461	ZUHL LIBRARY		73	73	73	72		8277	74	73	74	72		8277
590	HEALTH AND SOCIAL SERVICES BUILDING		73	73	73	72		8277	74	73	74	72		8277
585	WOOTON HALL		73	73	73	72		8277	74	73	74	72		8277
187	CHEMISTRY BUILDING		73	73	73	72		8277	74	73	74	72		8277
188	GARDINER HALL		73	73	73	72		8277	74	73	74	72		8277
189	JETT HALL		73	73	73	72		8277	74	73	74	72		8277
363	ENGINEERING COMPLEX I		73	73	73	72		8277	74	73	74	72		8277
391	SCIENCE HALL		73	73	73	72		8277	74	73	74	72		8277
397	JOHN WHITLOCK HERNANDEZ HALL		73	73	73	72		8277	74	73	74	72		8277
541	ED AND HAROLD FOREMAN ENGINEERING COMPLEX		73	73	73	72		8277	74	73	74	72		8277

SCHEDULE V. ESCO'S TRAINING RESPONSIBILITIES

V. Training Plan

Training and orientation on the systems installed will vary depending on the complexity of the specific equipment installed for each ECM. Training will be provided in the following levels:

- Level 1: For systems and/or equipment that are essentially direct replacements of existing equipment, and where no additional specific skills will be required to perform operations and maintenance functions, training will be limited to a general overview of the equipment installed and a review of the O&M manuals. Training will be directed to NMSU facilities operation and maintenance personnel. The review of the O&M manuals will provide staff with familiarity with the equipment that is installed, manufacturer's recommended maintenance procedures, and warranty information. Training should be provided at the completion of construction of each of the ECMs.

- Level 2: For systems/equipment that are new to the site and require some general understanding as to their function and operation, training will include a minimal amount of classroom time that will provide an overview of the technology and any specific maintenance or operation requirements. Following the classroom training, a site tour will be conducted to view the installation and operation of the equipment. Training should occur at both the onset and completion of construction. Equipment cut sheets will be provided at the beginning of construction and that will provide a general description of the equipment, function, and operation. At the conclusion of construction, the O&M manuals will provide parts lists and warranty information.

- Level 3: For systems and/or equipment that are new to the site and more complex in nature, training will be directed to both the facilities engineering and the O&M personnel. In general, training will consist of classroom training followed by hands-on instruction in the field. Training will be provided through a complement of Ameresco personnel, design engineers, installation contractors, and manufacturer's representatives, as necessary, and will be dictated by the complexity of the installation, participant's prior experience with the equipment that is installed, and contractual obligations.

- Specifics on the training program, including schedule and training materials, will be further refined during the design process, but the training, in general, will consist of the following:

    - Explanation of the design concept

        - Design intent

        - Energy efficiency considerations

        - Seasonal modes of operation

  - Emergency conditions and operation
  - Comfort conditions and indoor air quality
- Systems operation
  - Operation of individual components, instruction from authorized factory technicians, if required
  - Physical location of critical shut-off valves, fire, smoke, and balancing dampers, relief valves, safeties, and control panels
  - System operational procedures for all modes in manual and automatic modes
- Operation of the control systems
  - Sequences of operation
  - Use of graphical user interfaces
  - Alarms and problem indicators
  - Diagnostics and corrective actions
- Service and maintenance
  - Use of the O&M manuals
  - Instruction and logging procedures for lubrication
  - Instruction from authorized factory technicians, where applicable
  - Troubleshooting and investigation of malfunctions
  - Recommended procedures for collecting, interpreting, and storing specific performance data

The types of training planned for this project is listed in Table V-1. Training will be provided during construction, commissioning, and acceptance phases as dictated by the complexity of the ECM.

Table V-1. Training Plan

Energy Conservation Measure	Training Level	Training (Hours)	
		Classroom	Field
ECM 1: Interior Lighting	1	N/A	1
ECM 2: Exterior Lighting	1	N/A	1
ECM 3: Exterior Pole Mounted Lighting	1	N/A	1
ECM 6: Retrocommissioning	2	2	4
ECM 7: VAV Retrofit	2	2	4
ECM 10: Economizer Upgrade or Repair	1	N/A	2
ECM 12: Chilled Water Pump Bypass	2	2	3
ECM 26: Satellite Plant Savings	3	4	4
ECM 27-29: MyEnergyPro™	3	8	N/A

SCHEDULE BB. ESCO'S MAINTENANCE RESPONSIBILITIES

None. Ameresco is not responsible for maintenance of NMSU components or systems.

SCHEDULE CC. INSTITUTION'S MAINTENANCE RESPONSIBILITIES

CC. Operations and Maintenance Plan

A well-designed and properly executed maintenance program is a crucial element to long-term ECM performance and savings. In order to maximize the energy savings and equipment performance, the ECMs should be maintained under an ongoing, structured service program for the life of the contract, and ideally beyond. Ameresco has a vested interest in the equipment performance and maintenance required to realize all possible energy savings, which form the basis of our guarantee. Typically, the equipment and systems Ameresco proposes can generally be maintained and serviced by a variety of service entities including maintenance personnel currently employed by NMSU and/or a combination of service providers.

CC.1 Scheduled Preventative Maintenance

Table CC.1 shows a summary of the O&M plans for this project. Detailed descriptions of the included scope for each ECM are presented following Table CC.1.

Table CC.1. Operations and Maintenance Matrix

ECM	Operations Responsibilities		Maintenance Responsibilities		Warranty
	Ameresco	NMSU	Ameresco	NMSU	
ECM 1: Interior Lighting	None	None	None	Fixture cleaning Corrective maintenance at lamps and ballasts after warranty period	The lamps and ballasts are covered by manufacturer's warranties. All warranties will be administered by each individual manufacturer. Ameresco will furnish, upon completion of work, contact information for all manufacturers. For warranty purposes, manufacturers may request the defective product be returned for analysis. NMSU must retain all lamps and ballasts which fail prematurely and provide to the manufacturer upon request.
ECM 2: Exterior Lighting	None	None	None	Fixture cleaning Corrective maintenance at lamps and ballasts after warranty period	The lamps and ballasts are covered by manufacturer's warranties. All warranties will be administered by each individual manufacturer. Ameresco will furnish, upon completion of work, contact information for all manufacturers. For warranty purposes, manufacturers may request the defective product be returned for analysis. NMSU must retain all lamps and ballasts which fail prematurely and provide to the manufacturer upon request.

Table CC.1. Operations and Maintenance Matrix

ECM	Operations Responsibilities		Maintenance Responsibilities		Warranty
	Ameresco	NMSU	Ameresco	NMSU	
ECM 3: Exterior Pole Mounted Lighting	None	None	None	Corrective maintenance at lamps and ballasts after warranty period	The lamps and ballasts are covered by manufacturer's warranties. All warranties will be administered by each individual manufacturer. Ameresco will furnish, upon completion of work, contact information for all manufacturers. For warranty purposes, manufacturers may request the defective product be returned for analysis. NMSU must retain all lamps and ballasts which fail prematurely and provide to the manufacturer upon request.
ECM 6: Retro-Commissioning	None	Periodic inspections to verify proper operation.	None	Preventive maintenance per manufacturer's recommendations including sensor calibration at recommended intervals Corrective maintenance at sensors, equipment, and sequences as necessary	Ameresco provides a 1-year warranty and transfers manufacturer's warranty on equipment and material
ECM 7: VAV Retrofit	None	Periodic inspections to verify proper operation.	None	Preventive maintenance per manufacturer's recommendations including sensor calibration at recommended intervals Corrective maintenance at sensors, equipment, and sequences as necessary	Ameresco provides a 1-year warranty and transfers manufacturer's warranty on equipment and material

Table CC.1. Operations and Maintenance Matrix

ECM	Operations Responsibilities		Maintenance Responsibilities		Warranty
	Ameresco	NMSU	Ameresco	NMSU	
ECM 10: Economizer Upgrade or Repair	None		None	Preventive maintenance per manufacturer's recommendations including sensor calibration at recommended intervals Corrective maintenance at sensors, equipment, and sequences as necessary	Ameresco provides a 1-year warranty and transfers manufacturer's warranty on equipment and material
ECM 12: CHW Pump Bypass	None		None	Preventive maintenance per manufacturer's recommendations including sensor calibration at recommended intervals Corrective maintenance at sensors, equipment, and sequences as necessary	Ameresco provides a 1-year warranty and transfers manufacturer's warranty on equipment and material
ECM 26: Satellite Plant Savings	None	Operate plant systems based upon the manufacturer's recommendations and sequences of operation.	None	Preventive maintenance per manufacturer's recommendations including sensor calibration at recommended intervals Corrective maintenance at sensors, equipment, and sequences as necessary	Not applicable
ECM 28-30: MyEnergyPro™	None	Periodic inspection to ensure meter calibration	None	Preventive maintenance per manufacturer's recommendations including meter calibration at recommended intervals	Ameresco provides a 1-year warranty on programming and transfers manufacturer's warranty on equipment and material

CC.2 Service Descriptions

System Operation: Ongoing, normal equipment adjustments necessary to satisfy the building occupants and assure the continued effective and efficient operation of equipment or systems.

Preventative Maintenance: Periodic inspections, tests, calibrations, and adjustments needed for sustaining or restoring energy systems to required performance.

Corrective Maintenance: Services needed to replace, rebuild, or restore to specified performance, the systems and equipment that are in danger of failing or are inadequate.

Local Maintenance and Support: The primary point of contact for service support.

CC.3 Service Coordination

Ameresco's service contact will be determined at a future date prior to turn over to NMSU.

The scope of services for any and all of the ECMs included with this performance contract, or the programs as a whole, can be modified or fine-tuned at any time during the contract term. For example, where full coverage is not included, additional services can be provided on a time and materials basis, based on pre-negotiated rates. Services can also be provided for equipment not replaced or modified as part of this performance contract.

CC.4 Operation and Maintenance Scope

The following work is a description of Ameresco's maintenance and operation obligations under this contract. Any additional work requested beyond the scope identified below can be performed on a time and materials basis as directed by NMSU, subject to mark-ups identified in the contract.

ECM 1: Interior Lighting

System Operation

NMSU is responsible for the operations of the system.

Preventative Maintenance

Not applicable for this measure.

Corrective Maintenance

Ameresco will provide NMSU with additional bench stock at the end of construction to allow NMSU staff to replace any lamp or ballast that fails prematurely. NMSU will be responsible for providing replacement lamps and ballasts after the warranty period expires.

Local Maintenance and Repair Support

To be determined.

ECM 2: Exterior Lighting

System Operation

NMSU is responsible for the operations of the system.

Preventative Maintenance

Not applicable for this measure.

Corrective Maintenance

Ameresco will provide NMSU with additional bench stock at the end of construction to allow NMSU staff to replace any lamp or ballast that fails prematurely. NMSU will be responsible for providing replacement lamps and ballasts after the warranty period expires.

Local Maintenance and Repair Support

To be determined.

ECM 3: Exterior Pole Mounted Lighting

System Operation

NMSU is responsible for the operations of the system.

Preventative Maintenance

Not applicable for this measure.

Corrective Maintenance

Ameresco will provide NMSU with additional bench stock at the end of construction to allow NMSU staff to replace any lamp or ballast that fails prematurely. NMSU will be responsible for providing replacement lamps and ballasts after the warranty period expires.

Local Maintenance and Repair Support

To be determined.

ECM 6: Retro-Commissioning

System Operation

NMSU is responsible for the operations of the system. Utilize approved control sequences of operation on an ongoing basis.

Preventative Maintenance

Periodically inspect field devices, verify system of operations, inspect and check AHU components including dampers, coils, valves, motors, belts and sheaves and other active devices as needed.

Corrective Maintenance

Perform corrective maintenance as needed.

Local Maintenance and Repair Support

To be determined.

ECM 7: Variable Air Volume Retrofit

System Operation

NMSU is responsible for the operations of the system. Utilize approved control sequences of operation on an ongoing basis.

Preventative Maintenance

Periodically inspect field devices, verify system of operations, inspect and check AHU components including dampers, coils, valves, motors, belts and sheaves and other active devices as needed.

Corrective Maintenance

Perform corrective maintenance as needed.

Local Maintenance and Repair Support

To be determined.

ECM 10: Economizer Upgrade or Repair

System Operation

NMSU is responsible for the operations of the system. Utilize approved control sequences of operation on an ongoing basis.

Preventative Maintenance

Periodically inspect field devices, verify system of operations, inspect and check AHU components including dampers, coils, valves, motors, belts and sheaves and other active devices as needed.

Corrective Maintenance

Perform corrective maintenance as needed.

Local Maintenance and Repair Support

To be determined.

ECM 12: Chilled Water Pump Bypass

System Operation

NMSU is responsible for the operations of the system. Utilize approved control sequences of operation on an ongoing basis.

Preventative Maintenance

Periodically operate and cycle pumps to ensure reliable operation.

Corrective Maintenance

Perform corrective maintenance as needed.

Local Maintenance and Repair Support

To be determined.

ECM 26: Satellite Plant Savings

System Operation

NMSU is responsible for the operations of the system. Utilize approved control sequences of operation on an ongoing basis.

Preventative Maintenance

Follow manufacturer's operations and maintenance procedures for all mechanical and controls systems. Perform daily inspections and maintain operations and maintenance logs for all major equipment.

Corrective Maintenance

Perform corrective maintenance as needed.

Local Maintenance and Repair Support

To be determined.

ECM 28-30: MyEnergyPro™

System Operation

NMSU is responsible for the operations of the system.

Preventative Maintenance

NMSU will be responsible for providing all project management on meters, communication devices, and servers.

Corrective Maintenance

For any Web-based programming problems or issues Ameresco's MyEnergyPro™ warranty will take effect and problems will be resolved by Ameresco.

Local Maintenance and Repair Support

The primary point of contact for service support for this measure is Dr. Judy Fisher.

SCHEDULE DD. FACILITY MAINTENANCE CHECKLIST

DD.0 Facilities Maintenance Checklists

Maintenance checklists would utilize the manufacturer's recommended maintenance O&M manuals. Checklists would utilize each manufacturer's available lists and may vary. Alternatively, NMSU's existing maintenance checklists may be used or modified for each measure.

DD.1 Maintenance Checklists

ECM 1: Interior Lighting

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 2: Exterior Lighting

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 3: Exterior Pole Mounted Lighting

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 6: Retro-Commissioning

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 7: Variable Air Volume Retrofit

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 10: Economizer Upgrade or Repair

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 12: Chilled Water Pump Bypass

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 26: Satellite Plant Savings

Maintenance Checklists

Utilize NMSU's existing maintenance logs or the manufacturer's inspection checklists.

ECM 28-30: MyEnergyPro™

Maintenance Checklists

None

SCHEDULE JJ – ALTERNATIVE DISPUTE RESOLUTION

JJ. Dispute Resolution -- If a dispute arises between the Parties regarding a matter provided for in this Agreement, or a Party's performance of its obligations as stated in the Agreement, the Parties agree that such dispute will be resolved in the manner prescribed in this Section X.

JJ.1 Initiation and Response: If a dispute arises concerning this Agreement, a representative(s) from management of both Parties shall meet in person or by phone within ten business days after either Party gives the other Party written notice of the dispute (the "***Dispute Notice***"). The Dispute Notice shall set forth in reasonable detail the aggrieved party's position and its proposal for resolution of the dispute. The Parties will attempt in good faith to expeditiously negotiate a resolution to the dispute

JJ.2 Mediation: If the dispute is not resolved within 30 calendar days after the first meeting of the Parties, then the Parties shall endeavor to resolve their Claims by non-binding mediation. A request for mediation shall be made in writing, delivered to the other Party and filed with the person or entity administering the mediation. The mediator shall be selected jointly by the Parties and shall be an individual with expertise in the area of construction claims. The Parties shall equally share the fees of the mediator and each shall be liable for their own respective costs and expenses. The mediation shall be held in Dona Ana County, New Mexico.

JJ.3 Confidentiality: Negotiations undertaken pursuant to this Section X will be deemed confidential as settlement discussions. Nothing said by a Party, nor any position taken during the course of the negotiations will be introduced as evidence by the opposing Party in any subsequent litigation concerning the same or related transactions.

JJ.4 Condition Precedent: The exhaustion of the dispute resolution procedure provided for in this Section X shall be a condition precedent to the filing of any legal action in a court of law. A party's failure to comply with this Section X shall entitle the other Party to recover its costs and reasonable attorney's fees in any judicial proceedings that circumvent this dispute resolution provisions.

SCHEDULE KK - Current and Known Capital Projects at Facility

An energy performance contract generally requires a defined energy consumption baseline. The guaranteed energy savings are defined relative to this baseline. For the purposes of this EPC the baseline is the energy consumption during a particular time period, specifically September 2011 through August 2012. This time period was selected for a number reasons including availability and continuity of utility and building sub-meter data, weather similarity with the Typical Meteorological Year 3 weather data used in the energy modeling calculations, and the relatively nominal facility operations during this period.

The facility operations during the baseline period are considered nominal relative to the current period going back to September 2012. Since the end of the baseline period a number of ongoing major facility additions and modification projects have been implemented which significantly affect energy consumption of individual buildings and the campus overall. These projects introduced significant, non-standard variations into the campus energy consumption. These variations rendered the concurrent utility and sub-meter data unsuitable for use in developing a calibrated energy model for the campus.

The projects include, but are not limited to, the following:

- Continuous migration of pneumatic AHU controls to direct digital control including
    - Partial introduction of discharge air temperature reset controls
    - Partial introduction of chilled water and hot water lockouts
- Selective installation of variable frequency drives for AHU fan motors
- Limited air handling unit damper actuator repairs
- Migration of Barnes and Noble bookstore AHU to campus chilled water loop
- Activation of additional well pumps
- Comprehensive replacement of AHU in Jett Hall
- Renovation of Branson Hall
- Limited implementation of tertiary chilled water pumping bypass
- Construction and commissioning of new satellite chilled water plant including
    - 10,000 sq ft chilled water plant facility
    - New 2500 ton water-cooled variable speed centrifugal chiller

    - New 1500 ton water-cooled glycol chiller
    - 1200 ton-hrs ice storage capacity
    - Cooling tower with three cells & variable speed fans
    - Associated condenser water and chilled water pumping
- Major primary and secondary loop piping modifications at chilled water plant and throughout campus
- Ongoing installation of steam driven centrifugal chiller including
    - Decommissioning of absorption chillers and associated cooling towers
    - Installation of new 2500 ton steam driven chiller and new cooling tower
- Vacation of Monagle Residence Hall
- Completion and occupation of Chamisa Village II residential complex
- Completion and occupation of Center for the Performing Arts