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FINAL SUBMITTAL

ENERGY SURVEYS OF
ARMY INDUSTRIAL FACILITIES
ENERGY ENGINEERING ANALYSIS PROGRAM
LETTERKENNY ARMY DEPOT
CHAMBERSBURG, PENNSYLVANIA

VOLUME II

APPENDICES

CONTRACT NO. DACA65-91-C-0071

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS
NORFOLK, VIRGINIA

PREPARED BY:

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RS&H PROJECT NO. 2900379001

JANUARY 1992

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Marie Wakefield,
Librarian Engineering

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PRENEGOTIATION MINUTES
AND
SCOPE OF WORK

PRENEGOTIATION MINUTES

Attendees: Dick Faith, LEAD
Jeff Hager, LEAD
Tom Hagie, LEAD
Paul Hutchins, RS&H
Bryant Williams, COE, Norfolk

Location: Letterkenny Army Depot, Bldg. 663

Date: December 5, 1990

The general scope of work was discussed and LEAD personnel were invited to list specific areas of interest.

- Several studies should be reviewed:
  - Larson Report on Boilers
  - EMCS Report--BKA
  - People's Gas Report--Natural Gas Conversion
  - Paint Booth--BKA
- Major energy users:
  - Dip tanks--37, 57, 350 and 370
  - Paint booths--37, 57, 320, 350 and 370
  - Steam cleaning--37, 57 and 351
- Heat recovery wheel in 370 has been a problem--plugged filters
- Would like a boiler monitoring system--system in Fire Department may be expandable
- Building 370--Air conditioning is being changed--biggest electricity user
- Buildings 3 and 10 use air conditioning year round
- EMCS is old--1975 Delta 1000
- Be certain to show assumptions

SCOPE OF WORK

CEHND-ED-ME

January 1991

GENERAL SCOPE OF WORK

FOR AN

ENERGY SURVEY OF ARMY INDUSTRIAL FACILITIES

LETTERKENNY ARMY DEPOT

Performed as part of the

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK
FOR AN
ENERGY SURVEY OF ARMY INDUSTRIAL FACILITIES

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1. <u>BRIEF DESCRIPTION OF WORK:</u> The Architect-Engineer (AE) shall:

1.1 Perform a complete energy audit and analysis of the industrial facility.

1.2 Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.

1.3 Prepare programming and implementation documentation for all justifiable energy conservation opportunities.

1.4 List and prioritize all recommended energy conservation opportunities.

1.5 Prepare a comprehensive report which will document the work accomplished, the results and the recommendations.

2. <u>GENERAL</u>

2.1 A coordinated energy study, including a detailed energy survey, shall be accomplished for the industrial facility. The study shall integrate the results of and any available data from prior or ongoing energy conservation studies, projects, designs, or plans. This Scope of Work is not intended to prescribe the methods in which the study is to be conducted or limit the AE in the exercise of his professional engineering expertise, good judgment or investigative ingenuity. However, the information and analyses outlined herein are considered to be minimum essentials for adequate performance of this study. The study shall include a comprehensive energy report documenting study methods and results.

2.2 All ECOs recommended shall comply with all current criteria (e.g., environmental, safety) for the industrial facility. These criteria may have changed since the facility was constructed. Replacement of people with automation systems may allow reductions in outside air quantities, ventilation rates, and similar items resulting in significant energy savings. Stated requirements for special environments (temperature/humidity control) for industrial equipment and processes shall be researched as needed by the AE to verify (a) the requirement and (b) the degree of control essential for the industrial mission.

2.3 All recommended ECOs, including maintenance, operational and low cost/no cost opportunities as well as Energy Conservation Investment Program (ECIP) and Energy Conservation and Management Program (ECAM) projects shall be ranked in order of highest to lowest Savings to Investment Ratio (SIR).

2.4 Other studies performed under the Energy Engineering Analysis Program (EEAP) have been accomplished for the installation. Applicable portions of the studies if any, shall be updated as needed and incorporated into the report. The report shall list the recommended ECOs from the previous studies that pertain or should pertain to industrial facilities processes. This list shall summarize the ECOs (cost, short description, and anticipated energy savings) and identify the fiscal year for which the project was or is programmed. Any industrial facility related ECO identified in the previous studies but not recommended shall be reevaluated under this contract. Any industrial facility related ECO recommended from the previous studies but not implemented nor programmed for implementation shall be updated and in accordance with the latest ECIP criteria.

2.5 The terms "industrial", "production", and "process" are used interchangeably in this Scope of Work and should be interpreted broadly to include research, test and development, end item maintenance and repair, supply and distribution, as well as the typical "production centers" in Army industrial facilities. The term "facility" means one or more buildings or enclosures together with the equipment installed therein. It implies an integrated production system which requires a coordinated approach to achieve the best overall results.

2.6 The "Energy Conservation Investment Program (ECIP) Guidance," described in letter from CEHSC-FU, dated 25 April 1988 and revised by letter from CEHSC-FU-P, dated 15 June 1989, establishes criteria for ECIP/ECAM Projects and shall be used for performing the economic analyses of all ECOs and projects. Construction cost escalation for DD Form 1391 submission shall be calculated using the guidelines contained in AR 415-17 and the latest Tri-Service MCP index. The Tri-Service MCP Index, when updated, is contained in the latest applicable edition of the Engineer Improvement Recommendation System (EIRS) bulletin.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP/ECAM or MCA funding, and determining, in coordination with installation personnel, the appropriate packaging and implementation approach for all feasible ECOs.

2.8 Projects which qualify for ECIP/ECAM funding shall be identified, separately listed, and prioritized by Savings to Investment Ratio.

2.9 All energy conservation opportunities shall be listed and prioritized by SIR.

3. <u>WORK TO BE ACCOMPLISHED</u>

3.1 Audit. The audit consists of gathering data and inspecting industrial facilities in the field, including those which are government-owned, contractor operated (GOCO). These activities shall be closely coordinated with the contractor operator at GOCOs, facilities or plant engineer representatives, production engineers, the installation commander or his representative, and the Government's representative. The AE shall become thoroughly familiar with the facility and its industrial mission and undertake all necessary field trips to obtain required data. The AE shall consolidate or summarize the survey data to make it concise, and shall submit the summarized data as part of the report. Data sources shall be identified and assumptions clearly stated and justified. All test and/or measurement equipment shall be properly calibrated prior to its use.

3.1.1 Boiler plants, chilled water plants, incinerators, and similar facilities listed in Annex D that are associated with the industrial facility shall be included in the study. The intent is to determine the condition of existing equipment, efficiency of boiler plant equipment, operational procedures, adequacy of plant capacity, and heat recovery possibilities in addition to the general items listed.

3.1.2 During the audit process promising applications of solar energy for industrial processes shall be identified. Tremendous amounts of steam and hot water are used in industrial facilities dictating active consideration and analysis of potential solar applications.

3.1.3 The audit shall be conducted with the view that the term "industrial facility" means an integrated production infrastructure including the building envelope, industrial equipment, process standards, materials, utilities and other components of the industrial operation which have an energy value. Envelope energy and process energy are interrelated. Inputs and outputs, particularly of thermal energy, should be balanced in order to optimize overall energy efficiency of industrial facilities. ECOs should therefore reflect the "systems" approach for a totally integrated facility, and assure that any energy tradeoffs between buildings and processes are analyzed.

3.1.4 Data collected during the audit shall, as a minimum, include:

3.1.4.1 Building data.

a. Building number, building age, number of floors, and gross square feet.

b. Floor area, HVAC zones, nonair-conditioned spaces, and usage of space ("industrial" or "other").

c. Glass areas.

d. Wall and roof surface areas and condition, type of construction, and "U" factors.

e. Drawings, equipment schedules, shop layouts, utilities distribution diagrams, etc.

f. Nameplate data of energy related building equipment.

g. Any major expansions, alterations, or modernization projects.

3.1.4.2 Weather information.

3.1.4.3 Operating methods.

a. Facilities operating hours (peacetime).

b. Personnel strength (direct labor).

c. Facilities system and equipment operating and maintenance schedules.

d. Control set points, chilled water temperatures, and freeze protection temperatures.

e. Rooms, areas, or zones with special or critical requirements.

3.1.4.4 Past performance records.

a. Energy peak demands.

b. Latest annual energy consumption (Gross BTU/yr, BTU/SF/yr, BTU/end product/yr) for total installation and facility(ies) being studied.

c. Utility rate schedules.

d. Energy conservation projects (ECIP/ECAM/other) in facilities being studied.

3.1.4.5 Energy sources.

3.1.4.6 Production data.

a. Production areas by type utilization (e.g., fabrication, finishing, assembly, test, storage, etc.).

b. Production equipment schedules, age, utilization, and energy requirements.
c. Production equipment replacement or modernization plans.
d. Process flow layouts.
e. Production rates/quantities.
f. Material handling systems.
g. Expected changes (equipment, process, facilities, workload, etc.).

3.2 Analysis. The energy analysis is a comprehensive study of the industrial facilities energy usage. It includes a detailed investigation of the operation, environment and equipment. The AE shall use generally accepted energy calculations techniques, which are fully documented. For complex buildings, computer modeling shall be used to incorporate field survey data, weather data, production data, occupancy schedules, building construction data, energy distribution systems and equipment data into a model of the total facility. The computer program shall, for varying production rates (peacetime levels and full mobilization), develop load profiles, calculate energy savings, and evaluate the energy requirements of the industrial facility. The computer results should be verified by comparing them to any available past utility bills or records. Acceptable computer programs are listed in Annex D. If a different program is to be used, the AE shall submit a sample computer run with an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities for approval by the Contracting Officer prior to use of the program for analysis.

A regression analysis will be performed on the installation historical energy data. The purpose will be to determine what variables affect the energy use at the installation and to what degree. Typical variables to be studied are heating degree-days, cooling degree-days and population. Others will also be sought with the intent to find the best correlation.

3.2.1 The energy analysis shall provide the following types of information:

a. A baseline of energy usage of the existing facility (at current production capacity prior to implementing ECOs generated by this study).
b. Comparison of equipment capacities with current workloads.
c. Energy usage by systems (lighting, heating, cooling, process, etc.).
d. Basis for evaluating ECOs.
e. A baseline of energy usage of the facility after incorporation of all recommended ECOs (assuming no change in production level).

3.2.2 The AE shall develop graphic presentations, i.e. graphs and charts which depict a complete energy consumption picture for the industrial facility both presently and after implementation of energy conservation opportunitiesand include these in the report.

3.2.3 The AE shall develop a listing of each shop, zone, or area of the facility as appropriate. The list shall include the air handling system and humidity setpoints, lighting levels, number and types of light fixtures, differential pressure readings and similar data required for the analysis. The valid criteria requirements for supply, return and exhaust air quantities, temperature and humidity setpoints, lighting levels, etc., shall also be shown. The listing shall be in sufficient detail so that areas with potential energy savings can be identified. The AE shall be familiar with the latest Army environmental and safety criteria and shall evaluate installed systems for possible energy saving revisions which may be permitted by current criteria.

3.2.4 If data is available, the AE shall develop an historical load profile by year for the past three fiscal years for each energy source utilized.

3.2.5 The AE shall project energy costs for three fiscal years from the date of contract award. Department of Energy (DOE) projections are acceptable.

3.3 Identify ECOs. All methods of energy conservation which are reason able and practical shall be considered, including improvements of operational methods and procedures and maintenance practices as well as the physical facilities. A list of energy conservation opportunities is included as Annex A to this scope. This list is not intended to limit or guide the AE but only to assure that at least these opportunities are considered, discussed and documented in the report. Those items on the list which are not practical, have been previously accomplished, are inappropriate or can be eliminated from detailed analysis based on preliminary analysis shall be listed in the report along with the reason for elimination from further analysis. All potential ECOs which are not eliminated by preliminary considerations shall be thoroughly documented and evaluated as to technical and economic feasibility. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings, and sketches shall also be included). A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

3.4 Energy Monitoring and Control Systems (EMCS)/Process Control System (PCS).

3.4.1 The AE shall determine the feasibility of single building EMCS/PCS for those buildings listed in Annex B. The intent of this study is to determine on a building-by-building basis, the feasibility of implementing an EMCS/PCS where existing HVAC and process controls are of sound condition and quality to warrant the additional expense. The documentation shall be of sufficient accuracy to insure that future project design calculations that will be done after completion of this study will not deviate more than 20 percent from the results of this study.

3.4.2 The AE shall perform feasibility evaluations in accordance with guidance in HNDSP-84-076-ED-ME. The use of existing survey data is acceptable only if it is in sufficient detail and can be easily revalidated by building walk through inspections. The standard evaluation forms contained in HNDSP84-076-ED-ME shall be a part of the submittal. EMCS/PCS analyses and evaluations shall be developed using TM 5-815-2. EMCS costs shall be developed using the Cost Estimating Guides--HNDSP88-207-ED-ME, HNDSP88-208- ED-ME, HNDSP88-209-ED-ME or HNDSP88-210-ED-ME--depending on size. Energy savings calculations shall be in accordance with NCEL CR 82.030. EMCS/PCS evaluations shall consider but not be limited to the following features:

a. Start/Stop Programs

Load shedding for electrical demand limiting
Lighting control
Start/Stop Optimization

b. Ventilation and Recirculation Programs

Dry bulb economizer
Outside air reduction
Industrial process economizer
Exhaust air reduction/optimization (based on production activity)

c. Temperature Reset Programs

Space temperature night setback
Process temperature night setback

d. Labor Savings/Monitoring (Example: Boiler plant monitoring (EMCS/PCS logging of points which are present are manually logged.)

e. Machine run time, production profiles and maintenance management

3.4.3 The AE's recommendations for an EMCS/PCS shall be in sufficient detail to define the system configuration, the approximate quantity and types of control instruments and sensors, and the data transmission system. The selection of points to be monitored and controlled shall be given priority based upon ECIP criteria. The control system functions, expected energy reduction, and monetary savings (including the manner in which these savings are to be achieved) shall be explained.

3.4.4 The AE shall prepare and provide recommendations in narrative form. Input/output (I/O) summary tables shall be prepared and provided for each system selected in accordance with HNDSP-84-076-ED-ME. Cost estimates shall be prepared and provided in accordance with the Cost Estimating Guides for the mechanical and electrical modifications required to implement the EMCS/PCS.

3.4.5 Inoperative controls shall be surveyed in accordance with TM 5-815-2. Cost estimates to repair and replace inoperative controls shall be as described in the Cost Estimating Guides.

3.4.6 Labor savings/monitoring shall be included, provided the SIR is not affected to the extent of jeopardizing the ECIP requirements.

3.5 <u>Project Documentation</u>. All energy conservation opportunities the AE has considered shall be included in one of the following categories and presented as such in the report:

3.5.1 ECIP/ECAM Projects. To qualify as an ECIP/ECAM project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $200,000 and Savings to Investment Ratio greater than one and a simple payback period of less than eight years. For ECAM projects, the $200,000 limitation

Savings to Investment Ratio greater than one and a simple payback period of less than eight years. For ECAM projects, the $200,000 limitation may not apply. The AE shall check with the installation for guidance. The overall project, and each discrete part of the project, shall have a SIR greater than one. For all projects meeting the above criteria, complete programming documentation will be required. Programming documentation shall consist of a DD Form 1391, life cycle cost analysis summary sheet(s) (with necessary backup data to verify the numbers presented), and a project development brochure (PDB). These forms shall be separate from the report. They shall be bound similarly to the final report in a manner which will facilitate repeated disassembly and reassembly. A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO is combined. For projects and ECOs updated or developed from the previous studies, the backup data shall consist of copies of the original calculations and analysis, with new pages updating and revising the original calculations and analysis. In addition, the backup data shall include as much of the following as is available: the increment of work the project or ECO was developed under in the previous study, title(s) of the project(s), the energy to cost (E/C) ratio, the benefit to cost (B/C) ratio, the current working estimate (CWE), and the payback period. This information shall be included as part of the backup data. The purpose of this information is to provide a means to prevent duplication of projects in any future reports. For projects or ECOs the installation wants submitted as ECIP/ECAM projects, complete programming documentation shall be prepared.

3.5.1.1 Military Construction Project Data (DD Form 1391). These documents shall be prepared in accordance with AR 415-15 and the supplemental requirements in Annex B. A complete DD Form 1391 shall be prepared for each project. The form shall include a statement that the project results from an EEAP study. Documents shall be complete as required for submission to higher DA headquarters. These programming documents will require review and signatures by the proper installation officials. All documents shall be complete except for the required signatures.

3.5.1.2 Project Development Brochures (PDBs). Preparation of PDBs requires the AE to delineate the functional requirements of the project as related to the specific site. The AE shall prepare PDBs in accordance with AR 415-20 and TM 5-800-3. Most projects will not require all the forms and checklists included in the Technical Manual (TM). Only that information needed for the project shall be included. The PDB-I format described in the TM shall be used for whatever information is needed.

3.5.2 Non-ECIP/ECAM Projects. Projects which normally do not meet ECIP/ECAM criteria, but which have an overall SIR greater than one shall be individually packaged and fully documented and included as a separate section in the volume containing the programming documentation. The life cycle cost analysis summary sheet shall be completed through and including line 6 for all projects or ECOs. Each shall be analyzed to determine if they are feasible even if they do not meet ECIP/ECAM criteria. These ECOs or projects may not meet the nonenergy qualification test. For projects or ECOs which meet this criteria, the life cycle cost analysis summary sheet, completely filled out, with all the necessary backup data to verify the numbers presented, a complete description of the project and the simple payback period shall be included in the report. Additionally, these projects shall have the necessary documentation prepared, in accordance with the requirements of the Government's representative, for one of the following categories:

a. Quick Return on Investment Program (QRIP). This program is for projects which have a total cost not over $100,000 and a simple payback period of two years or less.

b. OSD Productivity Investment Funding (OSD PIF). This program is for projects which have a total cost of more than $100,000 and a simple payback period of four years or less.

c. Productivity Enhancing Capital Investment Program (PECIP). This program is for projects which have a total cost of more than $100,000 and a simple payback period of four years or less.

The above programs are described and documentation shall be prepared in accordance with AR 5-4, Change No. 1. A sample implementation document, consisting of a DA Form 5108-R, sketches and manufacturers data and a life cycle cost analysis summary sheet, shall be submitted for review and approval with the interim submittal. This sample shall be submitted and approved prior to the preparation of any other implementation documentation. To the degree possible, the project selected for the sample submission shall be typical of the majority of subsequent projects to be submitted. The sample shall consist of complete implementation documentation with primary emphasis on format and manner of presentation rather than precise accuracy of cost estimates and energy saving data.

d. Regular Military Construction Army (MCA) Program. This program is for projects which have a total cost greater than $200,000 and a simple payback period of eight to twenty-five years. Projects or ECOs which qualify for this program shall be economically analyzed in accordance with the requirements for Special Directed Studies in Engineering Technical Letter (ETL) 1110-3-332. Documentation shall be in accordance with paragraph 3.5.1 except that the economic analysis required by ETL 1110-3-332 shall be included in lieu of the ECIP life cycle cost analysis.

e. Low Cost/No Cost Projects. These are projects that the installation can perform using their resources. For these projects the following information shall be provided:

(1) Brief description of the project.

(2) Brief description of the reasons for the modification.

(3) Specific instructions for performing the modification.

(4) Estimated dollar and energy savings per year.

(5) Estimated manhours and labor and materials costs. Costs shall be calculated for the current calendar year and so marked. Manhours shall be listed by trade. For projects that would repair an existing system so that it will function properly, also include the estimated manhours by trade and labor and material costs necessary to maintain the system in that condition. Some of the simple practical modifications may be developed on a per unit basis. An example of this type of modification would be the repair or replacement of steam traps on an as needed basis. As a rule, however, the AE should develop complete projects, if at all possible, rather than per unit modifications.

Separate sheets for each project showing the above information shall be prepared and included in the report.

3.5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

4. DETAILED SCOPE OF WORK: The general Scope of Work is intended to apply to contract efforts for all Army industrial facilities except as modified by the detailed Scope of Work for each specific installation. The detailed Scope of Work is contained in Annex D.

5. PROJECT MANAGEMENT

5.1 Project managers. The AE shall designate a project manager to serve as a point of contact and liaison for all work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager must be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

5.2 Installation assistance. The Commanding Officer or contractor operator at each installation will designate an individual who will serve as the point of contact for obtaining information and assisting in establishing contacts with the proper individuals and organizations as necessary to accomplish the work required under this contract.

5.3 Public disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed under this contract, except as authorized by the Contracting Officer.

5.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE and/or the designated representative(s) shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, are in addition to the presentation and review conferences.

5.5 Site visits, inspections, and investigations. The AE, consultants, if applicable, and/or designated representative(s) thereof shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

5.6 Records

5.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representatives(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten (10) calendar days, a reproducible copy of the records.

5.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of work under this contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record or request or receipt of material.

6. SUBMITTALS, PRESENTATIONS AND REVIEWS

6.1 General. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and be indexed. Tabs and dividers shall clearly and distinctly divide sections, subsections, and appendices. All pages shall be numbered. The AE shall give a formal presentation of all but the final submittal to installation, command, and other Government personnel. The AE shall prepare slides or view graphs showing the results of the study to date for his presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. The AE shall provide the comments from all reviewers and written notification of the action taken on each comment to all reviewing agencies within three weeks after the review meeting. It is anticipated that each presentation and review conference will require approximately one working day. The presentation and review conferences will be at the installation on the date(s) agreeable to the industrial facilities personnel, the Director of Engineering and Housing, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

6.2 Interim Submittal. An interim report shall be submitted for review after completion of the field survey and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings and SIRs of all the ECOs shall be included. The simple payback period of all ECOs shall be calculated and shown in the report. The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. During the review period, the Government's representative shall coordinate with the industrial facilities personnel, and the Director of Engineering and Housing and provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. A sample implementation document (DA Form 5108-R, sketches and manufacturers data, life cycle cost analysis summary sheet and supporting data) for one project shall be submitted with this submittal for review and approval. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

6.3 Prefinal Submittal. The AE shall prepare and submit the prefinal report when all work under this contract is complete. The AE shall submit the Scope of Work for the installation studied and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The report shall include an order of priority by SIR in which the recommended ECOs should be accomplished. The synergistic effects of all of the ECOs on one another shall have been determined and the results of the original calculations adjusted accordingly. Completed programming and implementation documents for all recommended projects shall be included. The programming and implementation documents shall be ready for review and signature by the installation commander. The prefinal report, separately bound Executive Summary and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The prefinal submittal shall be arranged to include (a) a separately bound Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex C for minimum requirements), (b) the narrative report containing a copy of the Executive Summary at the beginning of the volume and describing in detail what was accomplished and the results of this study, (c) appendices to include the detailed calculations and all backup material and (d) the programming and implementation documentation. A list of all projects and ECOs developed during this study shall be included in the Executive Summary and shall include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

6.4 Final Submittal. Any revisions or corrections resulting from comments made during the review of the prefinal report or during the presentation and review conference shall be incorporated into the final report. These revisions or corrections may be in the form of replacement pages, which may be inserted in the prefinal report, or complete new volumes. Pen and ink changes or errata sheets will not be acceptable. If replacement pages are to be issued, it shall be clearly stated with the prefinal submittal that the submitted documents will be changed only to comply with the comments made during the prefinal conference and that the volumes issued at the time of the prefinal submittal should be retained. Failure to do so will require resubmission of complete volumes. If new volumes are submitted, they shall be in standard three-ring binders and shall contain all the information presented in the prefinal report with any necessary changes made. Detailed instructions of what to do with the replacement pages should be securely attached to the replacement pages.

7. OPERATION AND MAINTENANCE INSTRUCTION. The AE shall prepare a one-day instructional course for the mechanical and electrical operation and maintenance personnel and affected production supervisors to explain possible energy saving potentials due to modified equipment and systems operation. The course will identify operational items noted during the audit, in both facilities and process areas, which will effect energy conservation, and will explain and savings possible. This course will be held near the end of the study period at a time agreeable to the AE and the Government representative. This course is in addition to the formal review and presentations required. An outline of the topics that will be covered shall be submitted with the prefinal report.

8. ENTRY AND EXIT INTERVIEWS. The AE and the Government's representative shall conduct entry and exit interviews with the Facilities or Plant Engineer and other interested managers before starting work at the facility and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

8.1 The entry interview shall thoroughly describe the intended procedures for the survey. As a minimum, the interviews shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the facilities or plant engineer.

e. Limitations imposed by production operations.

f. Plant security and safety procedures.

8.2 The exit interview shall include a thorough briefing describing the work accomplished, problems encountered, probable areas of energy conservation, and any follow-on efforts which may be required.

9. SERVICES AND MATERIALS. All services, supplies, materials (except those specifically enumerated to be furnished by the Government), plant, labor, superintendence and travel necessary to perform the work and render the data required under this contract shall be included in the lump sum price of the contract.

ANNEX A

ENERGY CONSERVATION OPPORTUNITIES (ECOs)

ECOs shall not be recommended if their implementation would be detrimental to the facility's mission during peacetime. ECOs which may pose a constraint on mobilization production requirements shall include an analysis thereof, along with recommended contingency actions. Industrial process ECOs shall include, but not be limited to, the following:

- Production equipment replacements, modifications, disposals.
- Energy efficient motors and variable frequency drives.
- Scheduling/loading of production equipment.
- Waste heat recovery from industrial processes.
- Automated control of production equipment, integrated with existing or proposed EMCS equipment, if appropriate.
- Improve facility layout and space utilization.
- Solar applications.
- Consolidate processes and equipment requiring special environments.
- Building ventilation, exhaust systems.
- Production equipment maintenance.
- Improved methods/controls to reduce scrap, rework, and "goldplating", which consume energy without contributing to production mission.
- Steam distribution and condensate return systems.
- Compressed air distribution systems.
- Lighting control (zones, levels, etc.).
- Electrical Distribution.
- Radiant heating.
- Loading dock seals.
- Thermal storage.

- Reflectors for fluorescent fixtures.
- Water Spray roof cooling.
- Occupancy sensors to control lighting or HVAC.
- Photocells to control lighting.
- Timers to control lighting.
- Separate switches to control lighting arrangements.
- Efficient lighting

ANNEX B

REQUIRED DD FORM 1391 DATA

To facilitate ECIP/ECAM project approval, the following supplemental data shall be provided:

a. In title block, clearly identify project as "ECIP" or"ECAM."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of building zones, or areas including building numbers, square foot floor area and usage (administration, production, etc.).

d. Complete list of production equipment, process controls and ancillary equipment to be installed or retrofitted.

e. List references, assumptions and provide calculations to support life cycle dollar and energy savings and indicate any added costs.

(1) If a specific building, zone or area is used for sample calculations, identify the building, zone or area, category, age, square footage floor area, window and wall area for such. For a specific piece of production equipment or system, provide complete description, environmental requirement, manner of operation, age, etc.

(2) Identify weather data source, if applicable.

(3) Compare process-building systems interface before and after improvements.

(4) Provide and justify process criteria and temperature profiles before and after retrofit of buildings or modification of process. Include source of expertise and demonstrate savings claimed by process energy contributions, exhaust or outside air quantities, temperatures, humidity, production flow, etc.

f. Recommended process/equipment efficiency improvements must identify data to support present properly adjusted operation and future expected efficiency. If full replacement of equipment is indicated, explain rejection of alternatives such as repair, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit/replacement.

g. An ECIP/ECAM life cycle cost analysis summary sheet as shown in the ECIP guidance will be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple payback period and a statement attesting that all buildings and production equipment will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable, and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in the ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance, dated 25 April 1988 and revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

m. The five digit category code number for all ECIP/ECAM projects developed under this scope of work is 80000.

ANNEX C

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data.

3. Present Energy Consumption.

   o Total Annual Energy Used.

   o Source Energy Consumption.

   Electricity - KWH, Dollars, BTU
   Fuel Oil - GALS, Dollars, BTU
   Natural Gas - THERMS, Dollars, BTU
   Propane - GALS, Dollars, BTU
   Other - QTY, Dollars, BTU

   o Energy Consumption by Systems.

4. Historical Energy Consumption.

5. Production Profile and Trends.

6. Energy Conservation Analysis.

   o ECOs Investigated.

   o ECOs Recommended.

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP/ECAM Projects Developed. (Provide list)*

   o Non-ECIP/ECAM Projects Developed. (Provide list)*

   o Operational or Policy Change Recommendations.

* Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date. For all programmed projects also include the year in which it is programmed and the programmed year cost.

7. Energy and Cost Savings.

- o Total Potential Energy and Cost Savings.
- o Percentage of Energy Conserved.
- o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented based on Projected Workloads.

8. Energy Plan.

- o Project Breakouts with Total Cost and SIR.
- o Schedule of Energy Conservation Project Implementation

ANNEX D

DETAIL SCOPE OF WORK
ENERGY SURVEYS OF ARMY INDUSTRIAL FACILITIES
ENERGY ENGINEERING ANALYSIS PROGRAM

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Special Requirements and Information	D-10,11

AREAS/BUILDINGS TO BE AUDITED

Shops and Maintenance:	12, 13, 14, 19, 33, 37, 42, 57, 320, 370, 350, 422, 424, 426, 431, 433, 436
Warehouses:	
Conveyor System:	2, 4, 5, 6, 7, 8, 9
Dehumidified, Unheated:	31, 32, 34, 41, 44, 47, 52, 53, 55, 56
Dehumidified, Heated:	33, 42, 43
Central Heating Plants:	2, 3, 8, 12, 225, 349, 423, 683

SPECIFIC ECOS

1. Reduce energy loss due to compressed air leaks (Building 350).

2. Reduce energy loss at steam clean racks (Buildings 37 and 351)

3. Reduce heat loss from dip tanks (Buildings 37, 57, 350 and 370).

4. Heat recovery at paint spray booths (Buildings 37, 57, 320, 350 and 370).

5. Individual building EMCS (370 and other energy intensive process buildings).

6. Reduce make-up at boiler (Building 349)

7. Reduce boiler auxiliaries energy use (Building 349)

ECOS TO BE UPDATED

Project Number	Description
G-N	Warehouse Door Seals, Building Numbers 2 and 4
D	Combination Project: Exhaust Heat Recovery, Buildings 37 and 350; Engine Test Cell Heat Recovery, Building 37
E	Vapor Barrier for Dehum. Warehouses 11, 18, 31, 32, 34, 41, 44, 47, 52, 53, 55, 56
G	Exhaust Heat Recovery Building, 350 North End Dip Tanks, All Dip Tank
H	Baghouse 350 Insulation and Air Return
I	Supply/Exhaust Air Heat, Building 350 Paint Booths Numbers 59 and 60
G-E	Exhaust Heat Recovery, Building Number 1, Paint Booth, North End of Building
G-F	Exhaust Heat Recovery, Building Number 14, Paint Booth, East Side of Building
G-G	Exhaust Heat Recovery, Building Number 37, Mid-Building Paint Booth-LEAD 468
G-P	Warehouse Plastic-Strip Doors (Curtain Type), Building Numbers 2 and 4, Fast Moving Doors Air Curtains
G-U	Storm Windows, Building Number 3
G-V	Warehouse Dock Seals, Building Number 2
J	Exhaust Heat Recovery, Building 350 South End-Medium Sized Paint Booths
N	Window and Wall Insulation, 400 Series Buildings
R	Replacement of Existing Buildings 31, 32, 33, 34, 41, 42, 43 and 44 Fluorescent and Mercury Vapor General Area Lighting with High Pressure Sodium Vapor Lighting

ECOS TO BE UPDATED
(Continued)

Project Number	Description
G-I	Exhaust Heat Recovery, Building Number 350, South End-Dip Tank
G-J	Steam Supply, Building Number 320

SCHEDULE OF ACTIVITIES

Activity	Calendar Days (NTP Plus)
NTP	0
Interim Submittal	235
Interim Review Conference	285
Prefinal Submittal	325
Prefinal Review Conference	365
Prefinal (Corrected)/Final Submittal	395

SUBMITTAL DISTRIBUTION LIST

Address	Interim 60%	Prefinal 90%	Final 100%
Commander U.S. Army Engineer Division, North Atlantic ATTN: CENAD-EN-MM 90 Church Street New York, NY 10007	2 cys	2 cys	1 cy
Commander Office of Chief of Engineers ATTN: CEEC-EE (McCarty) Pulaski Building Washington, DC 20314	Executive Summary Only	1 cy	1 cy
Commander U.S. Army Engineer District, Norfolk ATTN: CENAO-EN-MP (Wilkins) 803 Front Street Norfolk, VA 23510	3 cys	3 cys	2 cys
Army Energy Office ATTN: DALO-LEP (Keath) New Cumberland Army Depot New Cumberland, PA 17070	Executive Summary Only	1 cy	1 cy
Commander Letterkenny Army Depot ATTN: SDSLE-EM (D. Faith) Building 663 Chambersburg, PA 17201-4150	2 cys	2 cys	1 cy
	7 cys	9 cys	6 cys

GOVERNMENT FURNISHED CRITERIA

1. Building information schedule (manual).

2. Production equipment schedule.

3. Utility procurement records (including reimburseable).

4. Facilities engineering technical data support.

5. Equipment modernization/acquisition plan.

6. Basic utility systems information maps.

7. Equipment layout and utilization records.

8. Final reports of previously completed studies performed under the Energy Engineering Analysis Program (EEAP). Only portions pertaining to the industrial facilities, if any, need to be made available.

9. Latest copies of any other energy studies performed since the previous EEAP study. Only portions pertaining to the industrial facilities, if any, need to be made available.

10. Energy Resources Management Plan.

11. ETLs 1110-3-282, Energy Conservation; 1110-3-318, Procedures for Programming Energy Monitoring and Control Systems (EMCS) Funded Through the MCA Program; 1110-3-332, Economic Studies; and 1110-3-354, Direct Digital Control of Heating, Ventilation and Air Conditioning (HVAC) Systems.

12. Architectural and engineering instructions.

13. Energy Conservation Investment Program (ECIP) Guidance, dated 25 April 1988 and revision dated 15 June 1989.

14. Information on Existing EMCS Studies, Designs, Construction Contracts, or Operating Systems.

15. TM 5-785, Engineering Weather Data; TM 5-800-2, General Criteria Preparation of Cost Estimation; TM 5-800-3, Project Development Brochure; and TM 5-815-2, Energy Monitoring and Control Systems (EMCS).

16. AR 415-15, Military Construction Army (MCA) Program Development; AR 415-17, Cost Estimating for Military Programming; AR 415-20, Construction, Project Development and Design Approval; AR 415-28, Department of the Army Facility Classes and Construction Categories; AR 415-35, Construction, Minor

Construction; AR 420-10, General Provisions, Organization, Functions and Personnel; AR 11-27, Army Energy Program; and AR 5-4, Change Number 1, Department of the Army Productivity Improvement Program.

17. HNDSP-84-076-ED-ME, Preliminary Survey and Feasibility Study for Energy Monitoring and Control Systems.

18. NCEL CR 82.030, Standardized EMCS Energy Savings Calculations. (Only if needed for this study.)

19. HNDSP88-207-ED-ME, HNDSP88-208-ED-ME, HNDSP88-209-ED-ME and HNDSP88-210-ED-ME, EMCS Cost Estimating Guides.

20. The latest applicable Engineer Improvement Recommendation System (EIRS) bulletin.

21. An example of a correctly completed programming document for an ECIP/ECAM project.

22. Production data.

23. EEAP, RS&H.

24. Boiler Study, Larson.

25. EMCS Study, BKA.

26. Natural Gas Conversion Study, People's Gas.

27. Paint Booth Heat Recovery, BKA.

SPECIAL REQUIREMENTS AND INFORMATION

1. Point of contact at Letterkenny Army Depot and liaison for all work required under this contract is:

Jeff Hager
Letterkenny Army Depot
ATTN: SDSLE-EME
Building 663
Chambersburg, PA
Phone: (717) 267-8005

2. The fiscal year to which all ECIP projects should be estimated to and programming or implementation documents prepared for is FY 93. Depending on project packaging, the Installation Commander may determine different program years for the final report. Remaining projects shall be escalated to a FY TBD.

3. A computer program titled Life Cycle Costing in Design (LCCID) is available from the BLAST Support Office in Urbana, Illinois for a nominal fee. The computer program can be used for performing the economic calculations for ECIP and non-ECIP ECOs. The AE is encouraged to obtain this computer program. The BLAST Support Office can be contacted at 144 Mechanical Engineering Building, 1206 West Green Street, Urbana, Illinois 61801. The telephone number is (217) 333-3977. AE shall indicate in writing what program will be used.

4. Consolidated review comments will be provided to AE by Project Manager about 14 days prior to review conferences. AE will review each comment and provide consolidated proposed responses to Project Manager 48 hours prior to conference.

5. AE will provide cover letter with all submittals noting a review is required and that a Review Conference is scheduled approximately 45 days hence. Letter will also inform recipients of letter to follow from Norfolk District COE setting exact conference date.

6. Acceptable programs for computer modeling of building energy systems are:

a. BLAST*

b. DOE 2.1B*

c. Carrier E20 or HAP**

d. TRACE**

*Very accurate, but requires a lot of time for input; therefore, rather expensive for straightforward projects.

**Adequate for load determination, equipment selection, and energy performance for most projects.

APPENDIX B

BACKUP DATA AND CALCULATIONS

APPENDIX B

BACKUP DATA, CALCULATIONS AND COST ESTIMATES

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ENERGY PRICES, BASIC ASSUMPTIONS AND ECONOMIC PARAMETERS

ENERGY PRICES, BASIC ASSUMPTIONS AND ECONOMIC PARAMETERS

Energy Prices (FY 91):

Purchased Electricity:	3,413 Btu/kwh, $10.94/MBtu, $0.0373/kwh (avg.)
Energy charge:	$6.53/MBtu, $0.0222/kwh
Demand charge:	$6.59/kw/Mo
Source:	1/91 Electric bill
*Fuel Oil No. 2:	138,690 Btu/gallon, $7.43/MBtu, $1.03/gallon
*Fuel Oil Nos 5 & 6:	149,690 Btu/gal, $6.61/MBtu, $0.99/gallon
Source:	LEAD memo, 15 Oct. 1990

Boiler Data: (Source: LEAD Mechanical Engineering Department)

Boiler efficiency	86%
Make-up flow	30% (avg.)
temp	60°F (avg.)
Condensate flow	70% (avg.)
temp	110°F (avg.)
Boiler system Efficiency	80%

Building Temperature Setpoints:

Winter	68°F
Summer	78°F

Basis for Cost Estimates:

Adjustment	Labor	Material	Comments
Sales Tax	NA	6.5	Includes state and local
FICA/Insurance	20.0%	NA	--
Overhead	15.0%		--
Profit	10.0%		--
Performance Bond	1.0%		--
Contingency	5.0%		New construction
	7.5%		Modernization
	10.0%		Renovation work
SIOH	5.5%		Automatically included in LCCID
Design Fees	6.0%		Automatically included in LCCID

All costs are adjusted to January 1991.

---

*On October 1, 1991, the price LEAD pays for fuel oil decreased per their annual contract. All ECOs were recalculated except those that were non-qualifying for any funding (SIR < 1.0 or payback greater than 25 years) using the FY 91 rates.

FY 92 Prices:
Fuel Oil No. 2: $4.98/MBtu, $0.69/gallon
Fuel Oil Nos. 5 and 6: $4.41/MBtu, $0.66/gallon

7172679659

Jeff Hogan

ROUTINE

* U N C L A S S I F I E D *

TOR=261 2059 TOD=261 205938 MSG NBR-0AA8-00F308

1D

CF: Tom

ACTION: SDSLE TL ASQNC-DL

INFO: SDSLE

RTTUZYUW RUEMANI6442 2612055-UUUU--RUEPABA.
ZNR UUUUU
R 181500Z SEP 91
FM CDR USAGMPA NEW CUMBERLAND PA //STRGP-FT//
TO AIG 8823
AIG 8829
AIG 7305
INFO RUEADWD/HQDA WASHDC //DALO-TSE//
RUKGNLA/CDR DFSC CAMERON STA VA //DFSC-R//
RUCIFRA/CDR TROSCOM STL MO //AMCPM-PWL//
ZEN/CDR LEA NCAD PA //LOEA-PL//
BT
UNCLAS
SUBJECT: BULK PETROLEUM STANDARD PRICES
A. DFSC MSG 111700Z SEP 91 (U) (NOTAL).
1. THE FOLLOWING STANDARD PRICES ARE PROVIDED BY PRODUCT CODE FOR DFSC MAJOR PETROLEUM PRODUCTS AND ARE EFFECTIVE 01 OCT 91.

PRODUCT CODE	UNIT OF ISSUE		STANDARD PRICE
* MUR Gasoline	GALLON	9130001487103	.82
MUP	GALLON		.84
DF1	GALLON		.69
* DF2 #2 Diesel Fuel	GALLON	9140002865294	.69

PAGE 02 RUEMANI6442 UNCLAS

KSN	GALLON		.69
FS1	GALLON		.69
* FS2 #2 Burner	GALLON	9140002474365	.69
FS4	GALLON		.66
* FS5 #5 Burner	GALLON	9140010584431	.66
* FS6 #6 Burner	GALLON	9140002474354	.66
JP4	GALLON		.70
JP5	GALLON		.71
JP8	GALLON		.70
130	GALLON		1.31

2. DFSC PRICE BULLETIN WILL BE PROVIDED AT A LATER DATE.
3. PER REF A THE OFFICE OF SECRETARY OF DEFENSE HAS INDICATED THAT A SEPARATE STANDARD PRICE FOR INTO-PLANE DELIVERIES MAY BE ESTABLISHED

ROUTINE

* U N C L A S S I F I E D *

SDSLE-EME

15 Oct 90

MEMORANDUM FOR See Distribution

SUBJECT: Fuel Prices

	FY88	FY89	FY90	FY91	
#FS2	.82	.65	.65	1.03	Contracted Per year Thru Cameron Station
#5	.70	.55	.55	.99	
#6	.70	.55	.55	.99	
MVS (mogas)	.84	.69	.69	1.23	
JP4	.75	.61	.61	1.05	
DF2	.75	.65	.65	1.03	
DF1				1.03	
Propane	~~1.129~~	~~1.129~~	~~.749~~	~~.749~~ 1.109	market Driven Per Gal
Electric					
Base	.02219	.02145	.02145	.02200	
Demand	6.355	6.0300	6.0300	$ 6.0120	Per KVA
Average	.0424	.0424	.0424	.0424	

Per Denny Prenize .0357 KWH
717-267-5406

Jeffrey L. Hager
JEFFREY L. HAGER
Energy Program Technician

CF:
SDSLE-RPA
SDSLE-ER
SDSLE-ERW
SDSLE-EPE
SDSLE-EME

Boiler System Efficiency Calculations

Boiler System Efficiency Calculations

Assumptions:

Boiler Eff. = 0.86
Make-up = 10%
Condensate temp. = 130°F

I-2a

GUARANTEED FUEL-TO-STEAM EFFICIENCIES*
MODEL CB FIRETUBE BOILERS
OPERATING PRESSURE = <u>10 PSIG</u>

BOILER SIZE (BHp)	FUEL = NATURAL GAS**				FUEL = NO. 2 OIL***			
	25%	50%	75%	100%	25%	50%	75%	100%
100	82.5	83.5	83.5	83.5	85.5	86.5	86.5	86.5
125	81.0	82.0	82.0	82.0	84.0	85.0	85.5	85.5
150	82.0	83.0	83.0	83.0	85.0	86.0	86.5	86.5
200	82.5	83.5	83.5	83.5	86.0	87.0	87.0	87.0
250	81.5	82.0	82.0	82.0	85.0	85.5	85.5	85.5
300	82.0	82.5	82.5	82.5	85.5	86.0	86.0	86.0
350	82.5	83.0	83.0	83.0	85.5	86.5	86.5	86.5
400	82.0	83.0	83.0	83.0	85.0	86.0	86.5	86.5
500	82.5	84.0	84.0	84.0	86.0	87.0	87.5	87.5
600	83.0	84.0	84.5	84.5	86.0	87.5	87.5	87.5
700	83.0	84.5	84.5	84.5	86.5	87.5	88.0	88.0
800	83.5	84.5	84.5	84.5	87.0	88.0	88.0	88.0

BOILER SIZE (BHp)	FUEL = NO. 6 OIL****			
	25%	50%	75%	100%
100	86.0	87.0	87.0	87.0
125	84.5	85.5	86.0	86.0
150	85.5	86.5	87.0	87.0
200	86.5	87.5	87.5	87.5
250	85.5	86.0	86.0	86.0
300	86.0	86.5	86.5	86.5
350	86.0	87.0	87.0	87.0
400	85.5	86.5	87.0	87.0
500	86.5	87.5	88.0	88.0
600	86.5	88.0	88.0	88.0
700	87.0	88.0	88.5	88.5
800	87.5	88.5	88.5	88.5

*Include radiation and convection boiler heat losses to the boiler room.

**1000 BTU/Cu. ft; Max. smoke density = Bacharach "0"

***140,000 BTU/Gal.; Max. smoke density = Bacharach "1"

****150,000 BTU/Gal.; Max. smoke density = Bacharach "2-3"

<u>NOTE:</u> These efficiencies are attainable and provable – <u>in your boiler room!</u>

Ref: Cleaver Brooks Catalogue

GUARANTEED FUEL-TO-STEAM EFFICIENCIES*
MODEL CB FIRETUBE BOILERS
OPERATING PRESSURE = <u>125 PSIG</u>

BOILER SIZE (BHp)	FUEL = NATURAL GAS**				FUEL = NO. 2 OIL***			
	25%	50%	75%	100%	25%	50%	75%	100%
100	78.5	80.5	81.0	81.0	81.5	83.5	84.0	84.0
125	77.0	79.0	79.5	79.5	80.0	82.0	82.5	83.0
150	78.0	80.0	80.5	80.5	81.0	83.0	83.5	84.0
200	79.0	80.5	81.0	81.5	82.0	84.0	84.5	84.5
250	78.0	79.5	80.0	80.0	81.5	83.0	83.0	83.0
300	78.5	80.0	80.5	80.5	81.5	83.5	83.5	83.5
350	78.5	80.5	81.0	81.0	82.0	84.0	84.5	84.5
400	78.0	80.0	80.5	80.5	81.5	83.5	84.0	84.0
500	79.0	81.0	81.5	81.5	82.0	84.0	85.0	85.0
600	79.5	81.0	82.0	82.0	82.5	84.5	85.0	85.5
700	79.5	81.5	82.0	82.0	82.5	84.5	85.5	85.5
800	80.0	81.5	82.0	82.0	83.0	85.0	85.5	85.5

BOILER SIZE (BHp)	FUEL = NO. 6 OIL****			
	25%	50%	75%	100%
100	82.0	84.0	84.5	84.5
125	80.5	82.5	83.0	83.5
150	81.5	83.5	84.0	84.5
200	82.5	84.5	85.0	85.0
250	82.0	83.5	83.5	83.5
300	82.0	84.0	84.0	84.0
350	82.5	84.5	85.0	85.0
400	82.0	84.0	84.5	84.5
500	82.5	84.5	85.5	85.5
600	83.0	85.0	85.5	86.0
700	83.0	85.0	86.0	86.0
800	83.5	85.5	86.0	86.0

*Include radiation and convection boiler heat losses to the boiler room.

**1000 BTU/Cu. ft.; Max. smoke density = Bacharach "0"

***140,000 BTU/Gal.; Max. smoke density = Bacharach "1"

****150,000 BTU/Gal.; Max. smoke density = Bacharach "2-3"

<u>NOTE:</u> These efficiencies are attainable and provable – <u>in your boiler room!</u>

RS&H

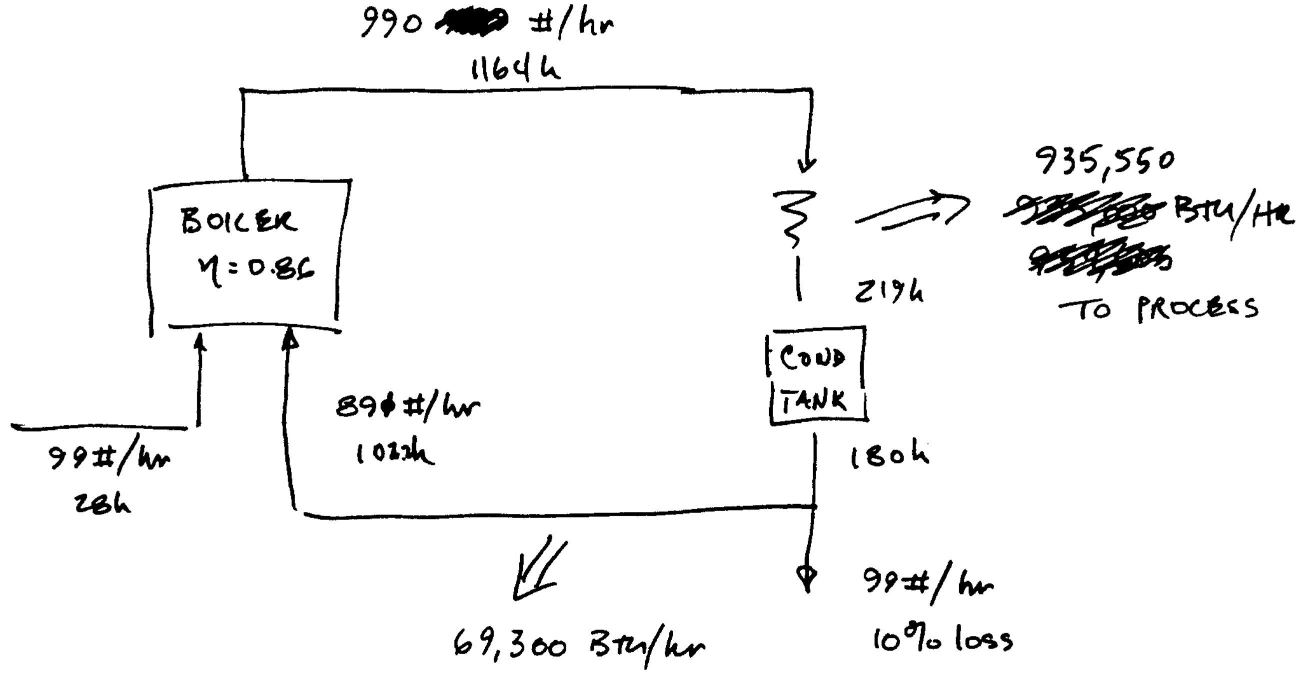
SUBJECT ____________ AEP NO ____________

SHEET ______ OF ______

DESIGNER PFA DATE ____________

CHECKER ____________ DATE ____________

FOR A 10 #/hr change in steam flow assuming all losses after cond. tank are constant



COND. RTN ENTHALPY : $890\,(180 - h) = 69{,}300$

$h = 102.2$

$$\text{FUEL REQ'D} = \frac{990\,(1164) - 890\,(102.2) - 99\,(28)}{0.86}$$

$= 1{,}230{,}965$ Btu/HR

$$\frac{\Delta\ \text{PROC}}{\Delta\ \text{FUEL}} = \frac{945{,}000 - 935{,}550}{1{,}242{,}442 - 1{,}230{,}965} = 0.82$$

This calculation assumes all losses after condensate tank are independ of flow. The actual value lies somewhere between 0.82 and 0.76. say 0.80 Therefore, a 1 MBtu savings in process energy will save 1.25 MBtu's of fuel.

RS&H®

SUBJECT: LEAD BOILER/STEAM SYSTEM EFFICIENCY

DESIGNER: RFH

CHECKER:

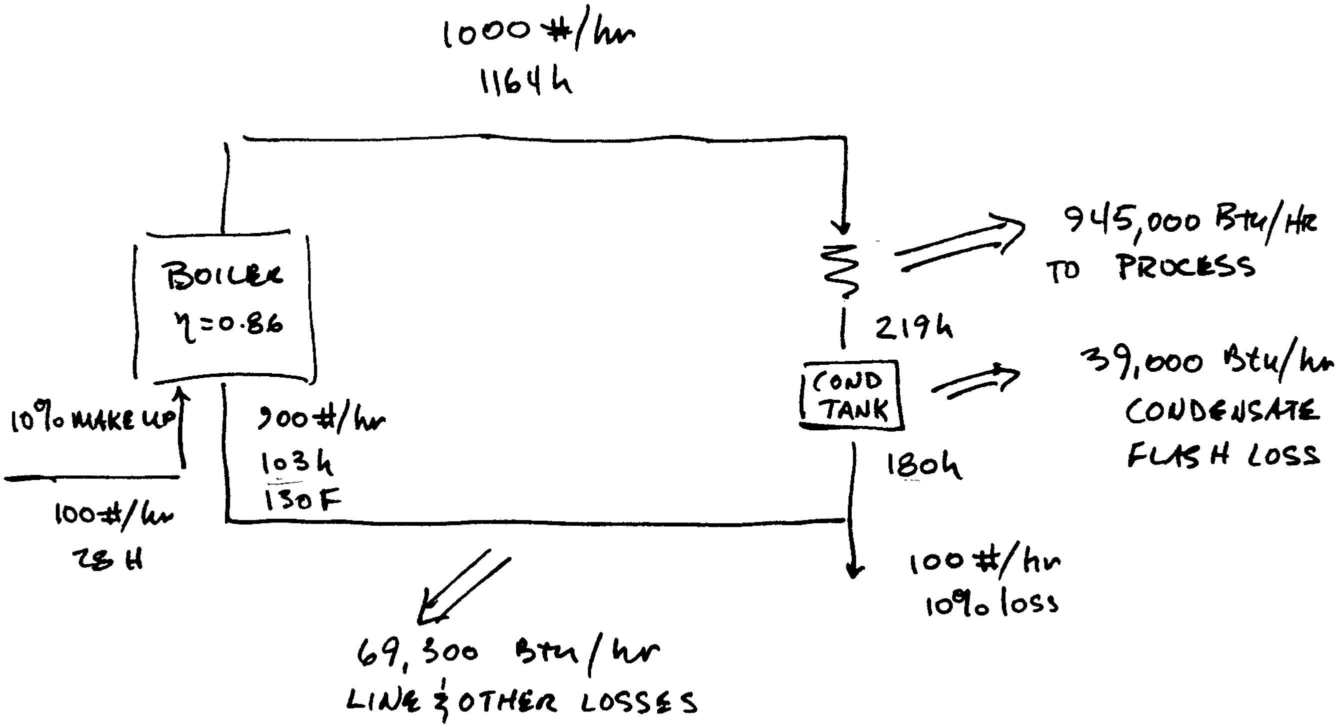
AEP NO: [redacted]

SHEET: 1 OF

DATE: 3/15/91

DATE:

Calculate the fuel requirements for changes in steam flow due to energy savings projects.



$$\text{FUEL REQ'D} = \frac{1000(1164) - 900(103) - 100(28)}{0.86}$$

$$= 1{,}242{,}442 \text{ BTU/HR}$$

$$\frac{\text{PROC}}{\text{FUEL}} = \frac{945{,}000}{1{,}242{,}442} = 0.76$$

Heating Energy Use Per CFM of Exhausted Air

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	1
	9 AM - 5 PM	1
	5 PM - 1 AM	1
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Total Operation Hours While Heating (and corrected for working days/week)	4776	118,470
Avg outdoor temp while heating (F)	45.0	

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.375
	9 AM - 5 PM	1
	5 PM - 1 AM	0.625
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	518	-4	1.08	1	0	0
65	69	296	217	278	502	1	1.08	1	1	542
60	64	269	196	236	444	6	1.08	1	6	2,880
55	59	249	191	209	415	11	1.08	1	12	4,930
50	54	221	193	202	402	16	1.08	1	17	6,949
45	49	218	193	206	404	21	1.08	1	23	9,151
40	44	237	236	239	474	26	1.08	1	28	13,317
35	39	289	246	286	533	31	1.08	1	33	17,849
30	34	304	194	258	469	36	1.08	1	39	18,244
25	29	184	106	152	270	41	1.08	1	44	11,956
20	24	124	65	90	168	46	1.08	1	50	8,334
15	19	75	32	57	96	51	1.08	1	55	5,274
10	14	54	13	26	50	56	1.08	1	60	2,994
5	9	18	3	9	15	61	1.08	1	66	1,013
0	4	9	0	2	5	66	1.08	1	71	330
-5	-1	3	0	1	2	71	1.08	1	77	134
-10	-6	1	0	0	0	76	1.08	1	82	31
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	4766					103,927
Total Operation Hours While Heating (and corrected for working days/week)					3035					74,233
Avg outdoor temp while heating (F)					45.0					

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter		65
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.25
	9 AM - 5 PM	1
	5 PM - 1 AM	0.75
Operation Days Per Week		6

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	525	-7	1.08	1	0	0
65	69	296	217	278	500	-2	1.08	1	0	0
60	64	269	196	236	440	3	1.08	1	3	1,426
55	59	249	191	209	410	8	1.08	1	9	3,542
50	54	221	193	202	400	13	1.08	1	14	5,612
45	49	218	193	206	402	18	1.08	1	19	7,815
40	44	237	236	239	475	23	1.08	1	25	11,787
35	39	289	246	286	533	28	1.08	1	30	16,110
30	34	304	194	258	464	33	1.08	1	36	16,519
25	29	184	106	152	266	38	1.08	1	41	10,917
20	24	124	65	90	164	43	1.08	1	46	7,593
15	19	75	32	57	94	48	1.08	1	52	4,847
10	14	54	13	26	46	53	1.08	1	57	2,633
5	9	18	3	9	14	58	1.08	1	63	893
0	4	9	0	2	4	63	1.08	1	68	255
-5	-1	3	0	1	2	68	1.08	1	73	110
-10	-6	1	0	0	0	73	1.08	1	79	20
-15	-11	0	0	0	0	78	1.08	1	84	0
Totals					4735.5					90,080
Total Operation Hours While Heating (and corrected for working days/week)					3181					77,211
Avg outdoor temp while heating (F)					42.5					

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter	68
Air Quantity (cfm)	1
Hour Fractions 1 AM - 9 AM	0.25
9 AM - 5 PM	0.75
5 PM - 1 AM	0
Operation Days Per Week	5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating (and corrected for working days/week)	1465	35,618
Avg outdoor temp while heating (F)	45.0	

Cost Estimates Backup

RS&H

SUBJECT BKA MARK UPs

DESIGNER P. Hutchins

CHECKER

AEP NO

SHEET OF

DATE 5/16/91

DATE

Since price estimates from the "Study of Heat Recovery Applications for Paint and Drying Booths" by Brinjac, Kambic and Assoc. (BKA), 8/89 provided detailed and more recent cost estimates than the LEAD EEAP, by RS&H, so, the BKA estimates were used. However, the cost mark ups used by BKA had to be modified to be consistent with the Army's current requirements.

	BKA (8/87)		Current Requirements	
Sales tax	6 %		6.5%	
Labor Mark up	21 %		20%	
Overhead	10 %	1.62	15%	1.56
Profit	10 %		10 %	
Design Contingency	10 %		10%	
Construction Contingency	5 %			
SIOH	5.5 %		5.5 %	
Engineering Design	10 %		6 %	

Ref. BKA Report, Vol. I., p171-186

Since the mark-ups are so close corrections were made only for those projects qualifying for funding, ie. SIR >1.0 and payback < 10 years.

RS&H®

SUBJECT LEAD LABOR RATES | AEP NO
SHEET / OF
DESIGNER P. Hutchins | DATE 5/29/91
CHECKER | DATE

LETTERKENNY LABOR RATES

STEAM/PLUMBING - #16.17/hr

A/C / ELECTRICAL - #16.76/hr

Building Cost Index history, 1913-1990

How ENR builds the index: 68.38 hours of skilled labor at the 20-city average of bricklayers', carpenters' and structural ironworkers' rates, plus **25 cwt of standard structural steel shapes** at the mill price, plus **22.56 cwt (1.128 tons) of portland cement** at the 20-city price, plus **1,088 board-ft of 2 x 4 lumber** at the 20-city price

Annual average

Year	Index	Year	Index	Year	Index
1913	100	1933	148	1953	431
1914	92	1934	167	1954	446
1915	95	1935	166	1955	469
1916	131	1936	172	1956	491
1917	167	1937	196	1957	509
1918	159	1938	197	1958	525
1919	159	1939	197	1959	548
1920	207	1940	203	1960	559
1921	166	1941	211	1961	568
1922	155	1942	222	1962	580
1923	186	1943	229	1963	594
1924	186	1944	235	1964	612
1925	183	1945	239	1965	627
1926	185	1946	262	1966	650
1927	186	1947	313	1967	676
1928	188	1948	345	1968	721
1929	191	1949	352	1969	790
1930	185	1950	375	1970	836
1931	168	1951	401		
1932	131	1952	416		

Base: 1913=100

Monthly index

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual avg.
1971	875	877	905	913	933	946	959	970	986	997	1001	1005	948
1972	1011	1016	1022	1027	1039	1047	1053	1057	1067	1070	1082	1090	1048
1973	1102	1114	1123	1135	1140	1138	1137	1144	1150	1156	1155	1158	1138
1974	1156	1154	1155	1177	1177	1199	1233	1240	1236	1246	1239	1240	1205
1975	1242	1265	1265	1269	1287	1307	1317	[illegible]	[illegible]	1351	1349	1354	1306
1976	1362	1370	1378	1391	1398	1416	1425	1455	1467	1476	1479	1484	1425
1977	1489	1499	1504	1506	1507	1521	1539	[illegible]	[illegible]	1618	1604	1607	1545
1978	1609	1617	1620	1621	1652	1663	1696	1705	1720	1721	1732	1734	1674
1979	1740	1740	1750	1749	1753	1809	1829	[illegible]	[illegible]	[illegible]	1901	1909	1819
1980	1895	1894	1915	1899	1888	1916	[illegible]	1971	1976	1976	2000	2017	1941
1981	2015	2016	2014	2064	2076	2080	2106	2131	2154	2151	2181	2178	2097
1982	2184	2198	2192	2197	2199	2225	2258	2259	2163	2262	2268	2297	2225
1983	2311	2348	2352	2347	2351	2388	2414	2428	2430	2416	2419	2406	2384
1984	2402	2407	2412	2422	2419	2417	2418	2428	2430	2424	2421	2408	2417
1985	2410	2414	2406	2405	2411	2429	2448	2442	2441	2441	2446	2439	2428
1986	2440	2446	2447	2458	2479	2493	2499	2498	2504	2511	2511	2511	2483
1987	2515	2510	2518	2523	2524	2525	2538	2557	2564	2569	2564	2589	2541
1988	2574	2576	2586	2591	2592	2595	2598	2611	2612	2612	2616	2617	2598
1989	2619	2613	2616	2619	2621	2626	2631	2639	2668	2672	2674	2679	2640
1990	2673	2675	2685	2684	2697	2725	2725	2721	2729	2729	2730		

FEB. 91 [redacted]

$$\frac{1/91}{7/80} \Rightarrow \frac{2716}{1950} = 1.39$$

Construction Cost Index history, 1906-1990

How ENR builds the index: 200 hours of common labor at the 20-city average of common labor rates, plus **25 cwt of standard structural steel shapes** at the mill price, plus **22.56 cwt (1.128 tons) of portland cement** at the 20-city price, plus **1,088 board-ft of 2 x 4 lumber** at the 20-city price

Annual average

Year	Index	Year	Index	Year	Index
1906	95	1928	207	1950	510
1907	101	1929	207	1951	543
1908	97	1930	203	1952	569
1909	91	1931	181	1953	600
1910	96	1932	157	1954	628
1911	93	1933	170	1955	660
1912	91	1934	198	1956	692
1913	100	1935	196	1957	724
1914	89	1936	206	1958	759
1915	93	1937	235	1959	797
1916	130	1938	236	1960	824
1917	181	1939	236	1961	847
1918	189	1940	242	1962	872
1919	198	1941	258	1963	901
1920	251	1942	276	1964	936
1921	202	1943	290	1965	971
1922	174	1944	299	1966	1019
1923	214	1945	308	1967	1074
1924	215	1946	346	1968	1155
1925	207	1947	413	1969	1269
1926	208	1948	461	1970	1381
1927	206	1949	477		

Base: 1913=100

Monthly index

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual avg.
1971	1465	1467	1496	1513	1551	1589	1618	1629	1654	1657	1665	1672	1581
1972	1686	1691	1697	1707	1735	1761	1772	1777	1786	1794	1808	1816	[illegible]
1973	1838	1850	1859	1874	1880	1896	1901	1902	1929	1933	1935	1939	1895
1974	1940	1940	1940	1961	1961	1993	2040	2076	2089	2100	2094	2101	2020
1975	2103	2128	2128	2135	2164	2205	2248	2274	2275	2293	2292	2297	2212
1976	2305	2314	2322	2327	2357	2410	2414	2445	2465	2478	2486	2490	2401
1977	2494	2505	2513	2514	2515	2541	2579	2611	2644	2675	2659	2660	2576
1978	2672	2681	2693	2698	2733	2753	2821	2829	2851	2851	2861	2869	2776
1979	2872	2877	2886	2886	2889	2984	3052	3071	3120	3122	3131	3140	3003
1980	3132	3134	3159	3143	3139	3198	3260	3304	3319	3327	3355	3376	3237
1981	3372	3373	3384	3450	3471	3496	3548	3616	3657	3660	3697	3695	3535
1982	3704	3728	3721	3731	3734	3815	3899	3899	3902	3901	3917	3950	3825
1983	3960	4001	4006	4001	4003	4073	4108	4132	4142	4127	4133	4110	4066
1984	4109	4113	4118	4132	4142	4161	4166	4169	4176	4161	4158	4144	4146
1985	4145	4153	4151	4150	4171	4201	4220	4230	4229	4228	4231	4228	4195
1986	4218	4230	4231	4242	4275	4303	4332	4334	4335	4344	4342	4351	4295
1987	4354	4352	4359	4363	4369	4387	4404	4443	4456	4459	4453	4478	4406
1988	4470	4473	4484	4489	4493	4525	4532	4542	4535	4555	4567	4568	4519
1989	4574	4567	4568	4571	4572	4593	4598	4606	4647	4646	4655	4679	[illegible]
1990	4673	4674	4701	4703	4697	4735	4735	4752	4755	4755	4780		

FEB 91 4773

ENERGY PRODUCTION DATA, DATA AND ANALYSIS

LETTERKENNY ARMY DEPOT
FUEL CONSUMPTION REPORT
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 1					SERVES BUILDINGS: 1, 2									FUEL TYPE: 5
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
** BOILER LOCATION: BUILDING 2					SERVES BUILDINGS: 4, 7									FUEL TYPE: 2
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
** BOILER LOCATION: BUILDING 3					SERVES BUILDINGS: 3, 5									FUEL TYPE: 5
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
** BOILER LOCATION: BUILDING 8					SERVES BUILDINGS: 6, 8, 9									FUEL TYPE: 2
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
** BOILER LOCATION: BUILDING 10					SERVES BUILDINGS: 10									FUEL TYPE: 2
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
** BOILER LOCATION: BUILDING 12					SERVES BUILDINGS: 12, 13, 14									FUEL TYPE: 5
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
** BOILER LOCATION: BUILDING 37HP					SERVES BUILDINGS: 37									FUEL TYPE: 2
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
** BOILER LOCATION: BUILDING 37N					SERVES BUILDINGS: 37									FUEL TYPE: 5
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

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** BOILER LOCATION: BUILDING 37W SERVES BUILDINGS: 37 FUEL TYPE: 5

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
37W	FY87	809	4259	4881	5170	6669	3235	4434	587	0	0	21	314	30379
37W	FY88	2263	5063	7661	7255	7621	11432	50	20	0	0	0	952	42317
37W	FY89	3246	1966	9258	5384	5473	11458	1340	417	0	0	0	0	38542
37W	FY90	3002	5780	11973	5877	6659	498	85	92	0	0	0	0	33966

** BOILER LOCATION: BUILDING 57 SERVES BUILDINGS: 57 FUEL TYPE: 2

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
57	FY87	157	3620	1797	149	1696	1005	3843	4179	3144	5374	873	1612	27449
57	FY88	62	340	1081	301	10509	102	113	120	120	120	240	320	13428
57	FY89	4121	2677	3946	2854	4992	713	779	984	155	265	0	99	21585
57	FY90	2388	4519	1715	830	2377	4442	-1	-1	0	0	0	0	16269

** BOILER LOCATION: BUILDING 57 SERVES BUILDINGS: 57 FUEL TYPE: 5

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
57	FY87	5215	2210	14650	9417	3805	7076	3543	2089	0	0	137	0	48142
57	FY88	279	1192	3890	11168	4239	1077	8406	6077	12160	2522	5044	6322	62376
57	FY89	6821	2588	3172	2675	0	298	8856	7436	0	0	0	0	31846

** BOILER LOCATION: BUILDING 57 UG SERVES BUILDINGS: 57 FUEL TYPE: 5

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
57 UG	FY90	4326	7258	5198	5689	8636	5797	4962	129	0	0	0	0	41995

BOILER LOCATION: BUILDING 320 SERVES BUILDINGS: 320 FUEL TYPE: 2

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
320	FY87	7628	13057	17319	13964	17411	9351	13923	4526	63	0	0	0	97242
320	FY88	7610	13190	17159	11396	20536	2500	9700	7474	0	19478	1122	2244	112409
320	FY89	16388	3739	6956	14056	13696	11761	5482	4600	0	0	0	317	76995
320	FY90	6844	8494	3607	21073	6236	10041	2415	4585	0	0	0	0	63295

** BOILER LOCATION: BUILDING 349 SERVES BUILDINGS: 349, 350, 351, 370 FUEL TYPE: 6

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
349	FY87	18477	11407	109053	93915	87451	193015	163756	33396	8355	10026	107039	94669	930559
349	FY88	78372	99354	119664	90881	115473	194266	76869	24404	62407	8469	54091	48076	972326
349	FY89	38176	107521	93424	127421	100793	3602	115759	46672	111864	43945	28152	26128	843457
349	FY90	50101	63613	92937	131077	115055	141479	33392	432180	33138	28350	8274	21252	1150848

** BOILER LOCATION: BUILDING 349 SERVES BUILDINGS: 349, 350, 351, 370 FUEL TYPE: FOR

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
349	FY90	0	0	0	0	0	0	0	0	0	0	24654	0	24654

** BOILER LOCATION: BUILDING 423 SERVES BUILDINGS: 421, 422, 423, 424, 426, 428, 431, 436, 437, 438 FUEL TYPE: 5

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
423	FY87	2359	11372	18484	20266	19124	14146	3046	1040	0	0	207	0	90044
423	FY88	7292	10570	31056	22230	20582	9972	19597	731	0	0	0	0	122030
423	FY89	7536	1242	29500	1570	14036	20925	6723	3274	0	0	0	0	84806
423	FY90	4708	13192	25420	22624	7019	21319	8332	996	0	0	0	0	103610

** BOILER LOCATION: BUILDING 1466 SERVES BUILDINGS: FUEL TYPE: 2

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
1466	FY87	0	251	1457	1539	2421	1381	441	136	0	0	0	0	7626
1466	FY88	195	1056	1428	3740	3351	1431	0	658	0	0	0	0	11859
1466	FY89	522	1390	2309	1754	2253	1355	984	0	0	0	0	425	10992
1466	FY90	1097	0	3836	2064	1313	750	278	0	0	0	0	0	9338

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BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 2360					SERVES BUILDINGS: 2354, 2357, 2383, 2364, 2360									FUEL TYPE: 2
2360	FY87	3196	3183	1423	2097	5453	656	329	924	0	0	1088	901	19250
2360	FY88	0	0	676	1168	2945	2080	850	0	0	0	0	1961	9680
2360	FY89	2215	3212	2423	1310	738	484	0	637	0	1961	298	911	14189
2360	FY90	298	2330	689	1352	2623	4754	78	510	0	0	0	0	12634
** BOILER LOCATION: BUILDING 2360					SERVES BUILDINGS: 2354, 2357, 2383, 2364, 2360									FUEL TYPE: 5
2360	FY87	5626	9701	11783	767	3516	2770	2616	293	0	0	0	392	37464
2360	FY88	1511	278	18255	15537	6497	11601	6980	6739	0	0	0	0	67398
2360	FY89	2243	393	11625	7361	12619	21720	8934	3709	2641	0	300	298	71843
2360	FY90	911	4626	15765	10602	11223	6420	1930	0	0	0	0	0	51477
** BOILER LOCATION: BUILDING 2384					SERVES BUILDINGS:									FUEL TYPE: 2
2384	FY87	0	234	237	20	210	285	209	0	0	101	0	0	1296
2384	FY88	0	290	192	241	206	68	0	262	0	0	0	0	1259
2384	FY89	0	237	144	248	102	243	0	254	0	0	0	0	1228
2384	FY90	0	0	0	0	0	0	0	0	0	0	0	0	0
** BOILER LOCATION: BUILDING 2702					SERVES BUILDINGS:									FUEL TYPE: 2
[illegible]02	FY87	113	280	115	323	327	124	203	0	0	0	0	0	1485
[illegible]2	FY88	0	290	216	236	464	0	0	0	0	246	0	0	1452
2702	FY89	0	267	290	247	277	397	100	0	0	0	0	320	1898
2702	FY90	0	276	261	440	359	0	265	0	0	0	0	0	1601
** BOILER LOCATION: BUILDING 2755					SERVES BUILDINGS:									FUEL TYPE: 2
2755	FY87	0	333	0	0	687	2148	616	0	0	0	0	0	3784
2755	FY88	0	228	1170	2248	1342	0	1640	298	0	0	0	0	6926
2755	FY89	0	1572	1335	1713	1285	1060	1174	247	0	0	0	0	8386
2755	FY90	0	451	1407	850	1190	395	0	0	0	0	0	0	4293
** BOILER LOCATION: BUILDING 3170					SERVES BUILDINGS:									FUEL TYPE: 2
3170	FY87	0	112	30	180	115	25	0	0	0	0	36	0	498
3170	FY88	0	32	17	55	0	20	0	0	33	0	0	0	157
3170	FY89	0	59	48	39	18	0	0	0	0	0	0	66	230
3170	FY90	0	0	31	59	47	0	0	0	0	0	0	0	137
** BOILER LOCATION: BUILDING 3311					SERVES BUILDINGS:									FUEL TYPE: 2
3311	FY87	0	203	295	434	666	457	104	0	0	0	0	0	2159
3311	FY88	153	392	282	1157	512	754	0	287	0	0	0	0	3537
3311	FY89	0	535	552	640	642	329	208	206	0	0	0	0	3112
3311	FY90	0	284	542	520	289	344	0	0	0	0	0	0	1979
** BOILER LOCATION: BUILDING 3321					SERVES BUILDINGS:									FUEL TYPE: 2
3321	FY87	0	94	395	0	448	438	305	0	0	0	74	0	1754
3321	FY88	244	464	201	662	357	700	0	511	0	0	0	0	3139
[illegible]1	FY89	0	654	413	695	655	379	335	495	0	0	0	0	3626
[illegible]1	FY90	0	0	400	104	281	0	400	0	0	0	0	0	1185

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BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION:	BUILDING 3387				SERVES BUILDINGS:									FUEL TYPE: 2
3387	FY87	0	200	0	459	142	174	157	0	0	0	0	0	1132
3387	FY88	0	204	164	161	300	235	0	114	0	0	0	0	1178
3387	FY89	0	0	177	258	195	212	0	234	0	0	0	0	1076
3387	FY90	0	142	264	241	0	262	0	0	0	0	0	0	909
** BOILER LOCATION:	BUILDING 3626				SERVES BUILDINGS:									FUEL TYPE: 2
3626	FY87	0	444	1232	839	648	2336	536	301	0	0	0	0	6336
3626	FY88	0	1255	769	1554	1588	899	0	943	0	0	0	0	7008
3626	FY89	0	1310	981	1267	1488	852	1086	0	0	0	0	0	6984
3626	FY90	0	1153	1340	0	1333	0	1952	0	0	0	0	0	5778
** BOILER LOCATION:	BUILDING 3700				SERVES BUILDINGS:									FUEL TYPE: 2
3700	FY87	0	1150	300	1052	760	1517	325	0	0	0	0	0	5104
3700	FY88	197	1125	501	1096	860	0	1118	0	0	183	0	0	5080
3700	FY89	0	77	0	2290	1369	703	814	608	0	0	0	0	5861
3700	FY90	0	670	1514	951	520	1454	0	0	0	0	0	0	5109
** BOILER LOCATION:	BUILDING 3751				SERVES BUILDINGS:									FUEL TYPE: 2
3751	FY87	178	935	352	2136	1283	1370	592	0	382	0	0	0	7228
3751	FY88	0	205	0	0	0	0	0	0	0	0	0	0	205
3751	FY89	0	0	627	253	940	1047	525	590	0	0	0	1725	5707
3751	FY90	0	3469	2763	1691	1025	2171	0	0	0	0	0	0	11119
** BOILER LOCATION:	BUILDING 3810				SERVES BUILDINGS:									FUEL TYPE: 2
3810	FY87	0	1687	2205	0	7163	3453	1051	0	0	0	0	0	15559
3810	FY88	907	1017	1910	4405	11657	2531	1786	1538	0	0	0	0	25751
3810	FY89	0	1598	2290	1328	2233	2427	2398	0	0	0	0	0	12274
3810	FY90	2276	0	4636	4611	1504	0	0	0	0	0	0	0	13027
** BOILER LOCATION:	BUILDING 3812				SERVES BUILDINGS:									FUEL TYPE: 2
3812	FY87	0	441	147	855	682	300	412	0	0	0	0	0	2837
3812	FY88	157	127	160	642	513	319	354	171	0	0	0	0	2443
3812	FY89	0	316	287	408	336	343	619	0	0	0	0	0	2309
3812	FY90	532	0	512	652	420	0	0	0	0	0	0	0	2116
** BOILER LOCATION:	BUILDING 4341				SERVES BUILDINGS:									FUEL TYPE: 2
4341	FY87	0	203	221	626	253	471	125	0	125	0	0	0	2024
4341	FY88	0	385	269	615	353	198	0	331	0	0	0	46	2197
4341	FY89	0	192	307	630	241	347	146	241	0	0	0	0	2104
4341	FY90	0	277	462	0	701	0	100	0	0	0	0	0	1540
** BOILER LOCATION:	BUILDING 4756				SERVES BUILDINGS:									FUEL TYPE: 2
4756	FY87	0	608	1202	0	4583	1715	1126	0	0	0	0	0	9234
4756	FY88	407	1422	1903	2241	3665	2668	0	1872	0	0	0	0	14178
4756	FY89	0	2051	2016	1270	2525	2005	890	875	0	0	0	0	11632
4756	FY90	0	1104	2019	2946	1507	2000	0	0	0	0	0	0	9576

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BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION:	BUILDING 5249				SERVES BUILDINGS:									FUEL TYPE: 2
5249	FY87	0	887	112	2986	0	0	0	0	0	0	0	0	3985
5249	FY88	0	816	1798	2691	1929	1706	0	1727	0	0	0	0	10667
5249	FY89	0	1168	1337	2316	956	1601	536	1799	0	0	0	0	9713
5249	FY90	0	1772	1070	2102	1606	0	0	0	0	0	0	0	6550
** BOILER LOCATION:	BUILDING 5250				SERVES BUILDINGS:									FUEL TYPE: 2
5250	FY87	0	1270	738	1364	978	940	447	284	0	0	0	127	6148
5250	FY88	451	1149	995	1362	836	1255	542	419	0	0	0	0	7009
5250	FY89	0	0	0	0	0	0	0	0	0	0	0	0	0
5250	FY90	0	0	519	625	600	300	600	0	0	0	0	0	2644
** BOILER LOCATION:	BUILDING 5313				SERVES BUILDINGS:									FUEL TYPE: 2
5313	FY87	0	343	175	716	891	530	274	0	0	0	0	0	2929
5313	FY88	77	465	813	1214	927	834	112	148	0	0	0	0	4590
5313	FY89	0	407	938	745	526	365	171	124	0	0	0	0	3276
5313	FY90	0	299	755	326	605	275	250	0	0	0	0	0	2510
** BOILER LOCATION:	BUILDING 5316				SERVES BUILDINGS:									FUEL TYPE: 5
5316	FY87	0	0	3250	5750	4000	5500	0	0	0	0	0	0	18500
5316	FY88	0	4200	4500	0	5846	5909	0	0	0	0	0	0	20455
5316	FY89	1935	4000	3000	4500	0	5150	0	3108	0	0	0	0	21693
5316	FY90	0	0	4100	4000	0	4000	0	0	0	0	0	0	12100
** BOILER LOCATION:	BUILDING 5647				SERVES BUILDINGS:									FUEL TYPE: 2
5647	FY87	0	548	1394	1786	994	256	215	135	8	0	0	0	5336
5647	FY88	610	660	450	1314	2677	1213	1282	1550	5240	0	0	0	14996
5647	FY89	723	598	1264	2339	1230	989	345	302	45	0	0	0	7835
5647	FY90	0	435	1332	770	757	581	497	0	0	0	0	0	4372
** BOILER LOCATION:	BUILDING AMMO				SERVES BUILDINGS: ALL AMMO EXCEPT 2360 AREA									FUEL TYPE: 2
AMMO	FY87	291	11767	14697	24281	28202	27764	7288	856	515	452	185	127	116425
AMMO	FY88	4493	16056	17945	26163	37599	20959	5226	11054	5273	429	0	46	145243
AMMO	FY89	3180	16431	18766	22940	17271	19704	10331	9434	45	0	0	2536	120638
AMMO	FY90	2808	11428	27763	23380	14057	13332	4342	0	0	0	0	0	97110

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YR	ELECT	FSD	FSR	OTHER	TOTAL
USE(MBTU)					
FY87	163,813	89,803	213,230	3,316	470,162
FY88	165,759	112,242	232,519	989	511,509
FY89	170,053	101,576	219,479	661	491,769
FY90	169,931	107,320	188,578	6,664	472,493
COST($)					
FY87	1,943,000	486,000	997,000	24,000	3,450,000
FY88	2,152,000	526,000	854,000	12,000	3,544,000
FY89	1,712,000	476,000	806,000	7,000	3,001,000
FY90	1,774,000	433,000	668,000	20,000	2,895,000
UNIT COST($/MBTU)					
FY87	11.86	5.41	4.68	7.24	7.34
FY88	12.98	4.69	3.67	12.13	6.93
FY89	10.07	4.69	3.67	10.59	6.10
FY90	10.44	4.04	3.54	3.00	6.13

LETTERKENNY ENERGY DATA FILE
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FY	MONTH	ELECT	HTG FUELS	TOTAL ENERGY	HDD	CDD	FSD	FSR	FSX/FOR	PPG	LABOR FORCE	SUPPLY MH/10	ELECT COST($)	HTG COST($)
88	Oct-87	14116	26456	40572	517	0	6390	19942	21	103			183226	106513
	Nov-87	13932	29815	43747	632	0	9337	20433	11	34	5181		180837	120036
	Dec-87	12283	51392	63675	905	0	14952	36301	11	128	5172		159433	206906
	Jan-88	12826	56585	69411	1264	0	19746	36704	16	119	5147		166481	227813
	Feb-88	13308	58472	71780	960	0	19910	38407	26	129	5019		172738	235410
	Mar-88	12314	44897	57211	715	0	16245	28593	21	38	4961		159836	180757
	Apr-88	13960	31960	45920	456	2	10241	21659	16	44	4933		181201	128672
	May-88	13393	14758	28151	153	38	4590	10122	11	35	4920		173841	59416
	Jun-88	14082	6337	20419	59	188	1205	5099	5	28	4901		182784	25513
	Jul-88	14611	4652	19263	8.5	386	1724	2886	5	37	4889		189651	18729
	Aug-88	16228	12013	28241	10	320	4928	7004	5	76	4880		210639	48365
	Sep-88	14707	8410	23117	121	30	2971	5369	5	65	4865		190897	33859
89	Oct-88	13123	22218	35341	519	2	7310	14850	16	42	4824		132149	89020
	Nov-88	13526	32948	46474	655	1	11790	21093	16	49	4874		136207	132011
	Dec-88	12915	48529	61444	1042	0	16677	31768	26	58	4919		130054	194438
	Jan-89	14127	43529	57656	983	0	13252	30108	11	158	4962		142259	174405
	Feb-89	12621	44749	57370	987	0	15361	29304	5	79	4950		127093	179293
	Mar-89	13959	51944	65903	888	0	16327	35534	11	72	4961		140567	208121
	Apr-89	13959	23618	37577	511	0	6338	17245	11	24	4963		140567	94629
	May-89	15434	18721	34155	363	18	4887	13813	5	16	4992		155420	75008
	Jun-89	14970	4728	19698	18	132	2266	2439	5	18	5034		150748	18943
	Jul-89	16690	4837	21527	14	192	1281	3533	5	18	5048		168068	19380
	Aug-89	16089	16207	32296	26	168	2534	13662	11	0	5076		162016	64936
	Sep-89	12642	9688	22330	132	60	3553	6130	5	0	5094		127305	38816
90	Oct-89	14406	16932	31338	376	16	6699	10210	11	12	5127	9970	150399	62733
	Nov-89	13846	36079	49925	704	0	13170	22878	11	20	5135	9200	144552	133674
	Dec-89	13262	66339	79601	1348	0	26125	40136	32	46	5130	8610	138455	245788
	Jan-90	13703	50795	64498	825	0	17102	33654	11	28	5100	10060	143059	188197
	Feb-90	13829	44665	58494	738	0	13485	31146	21	13	5083	9250	144375	165485
	Mar-90	12672	27977	40649	632	20	11382	16535	21	39	5071	10540	132296	103656
	Apr-90	14382	22812	37194	398	34	6099	16667	32	14	5046	9540	150148	84519
	May-90	14051	10415	24466	168	15	2936	7463	11	5	4964	11190	146692	38588
	Jun-90	13645	8478	22123	15	183	3093	5369	16	0	4927	10020	142454	31411
	Jul-90	14539	4467	19006	6	238	1043	44	3375	5	4876	8980	151787	16550
	Aug-90	15628	5745	21373	6	211	1514	1295	2935	1	4843	11910	163156	21285
	Sep-90	15966	7858	23824	102	82	4672	3181	5	0	4656	11170	166685	29114

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DATE: 05-Jun-91

LABOR HOURS

FY	MONTH	BLDG 1	BLDG 12,13	BLDG14	BLDG 47N	BLDG 37	BLDG 57	BLDG 350	BLDG 351	BLDG 370	TOTAL
90	Oct-89	2357	4333	7245	2704	25450	7244	106157	6783	92995	255268
	Nov-89	1957	3706	5936	2649	25244	5866	92315	4892	81301	223866
	Dec-89	1786	4090	5570	2165	19581	5655	89961	5557	78111	212476
	Jan-90	2210	4865	6989	2399	22088	7363	105293	6178	96931	254316
	Feb-90	2105	4517	6467	2215	21191	6368	92361	5399	92052	232675
	Mar-90	2492	5502	7442	2474	24310	6642	103133	5981	107934	265910
	Apr-90	2436	4650	7051	2337	21866	6068	92862	5748	94803	237821
	May-90	2442	5018	8534	2405	20940	7177	96135	5507	88738	236896
	Jun-90	2930	4954	8767	2112	18525	6448	86059	4930	84669	219394
	Jul-90	2379	5394	8191	2043	17442	8100	80749	4624	82031	210953
	Aug-90	2729	5458	9038	2433	20359	8950	92756	4464	96851	243038
	Sep-90	2454	5684	7853	2138	18057	6994	77999	3897	86030	211106

PRELIMINARY EVALUATION OF ECOS

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 2

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low/No Cost Project
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Update Previous EEAP
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	ECO Analysis Performed

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 4

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low/No Cost Project
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Update Previous EEAP

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 5

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Low Potential Savings
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L.	Steam distribution and condensate return systems	Low/No Cost Project
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Oper. & Maint. Item
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Low Potential Savings
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	ECO Analysis Performed
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Low Potential Savings
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Oper. & Maint. Item

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 6

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	ECO Analysis Performed
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L.	Steam distribution and condensate return systems	Low Potential Savings
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low/No Cost Project
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Low Potential Savings
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Low Potential Savings
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Low Potential Savings
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Oper. & Maint. Item

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 7

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Oper. & Maint. Item
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Oper. & Maint. Item
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Not Applicable
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Oper. & Maint. Item

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 8

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	ECO Analysis Performed
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L.	Steam distribution and condensate return systems	Low Potential Savings
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Not Applicable
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Low Potential Savings
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Not Applicable
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Low Potential Savings
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	ECO Analysis Performed

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Conveyor Warehouse NUMBER: 9

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	ECO Analysis Performed
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low/No Cost Project
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Not Applicable
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Not Applicable
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Not Applicable

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Recoil Maintenence NUMBER: 12

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Not Applicable
G. Solar applications	Not Applicable
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Low Potential Savings
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Low Potential Savings
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Recoil Maintenence NUMBER: 13

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Not Applicable
G. Solar applications	Not Applicable
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Low Potential Savings
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Low Potential Savings
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Optical Systems Maintenance NUMBER: 14

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Low Potential Savings
I. Building ventilation and exhaust systems	Low Potential Savings
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Not Applicable
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Low Potential Savings
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Flamable Material Warehouse NUMBER: 19

	ECO Description	Project Status
A.	Production equipment changes	Not Applicable
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Low Potential Savings
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Low Potential Savings
J.	Production equipment maintenance	Not Applicable
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L.	Steam distribution and condensate return systems	Low Potential Savings
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low/No Cost Project
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Not Applicable
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Low Potential Savings
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Low Potential Savings
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Oper. & Maint. Item

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Dehumidified Unheated Warehouse NUMBER: 31

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Not Applicable
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Not Applicable
G.	Solar applications	Not Applicable
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Not Applicable
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L.	Steam distribution and condensate return systems	Not Applicable
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low Potential Savings
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Not Applicable
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Not Applicable
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Not Applicable
W.	Timers to control lighting	Not Applicable
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Dehumidified Heated Warehouse NUMBER: 33

ECO Description	Project Status
A. Production equipment changes	Not Applicable
B. Efficient motors and variable frequency drives	Not Applicable
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Not Applicable
F. Improve facility layout and space utilization	Not Applicable
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Not Applicable
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Engine/Transmission Maintenance **NUMBER:** 37

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	ECO Analysis Performed
E. Automated production controls	ECO Analysis Performed
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Low Potential Savings
I. Building ventilation and exhaust systems	ECO Analysis Performed
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Not Applicable
M. Compressed air systems	Low Potential Savings
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Not Applicable
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Not Applicable
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Not Applicable
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Dehumidified Heated Warehouse NUMBER: 43

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Low Potential Savings
I. Building ventilation and exhaust systems	Low Potential Savings
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Not Applicable
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Chemical Equipment Maintenance NUMBER: 57-NC

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Low Potential Savings
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Not Applicable
M. Compressed air systems	Low/No Cost Project
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Not Applicable
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Not Applicable
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Battery Charging Shop NUMBER: 57-NW

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Not Applicable
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Not Applicable
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Depot Vehicle Maintenance NUMBER: 57-S

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Not Applicable
H. Consolidate processes and equipment requiring special environments	Low Potential Savings
I. Building ventilation and exhaust systems	Low Potential Savings
J. Production equipment maintenance	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Not Applicable
M. Compressed air systems	Low Potential Savings
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Not Applicable
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: New Vehicle Care NUMBER: 320

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Oper. & Maint. Item
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	ECO Analysis Performed
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Update Previous EEAP
M. Compressed air systems	Low/No Cost Project
N. Lighting control (zones & levels)	Low/No Cost Project
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	ECO Analysis Performed

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Vehicle Maintenance NUMBER: 350

ECO Description	Project Status
A. Production equipment changes	ECO Analysis Performed
B. Efficient motors and variable frequency drives	Oper. & Maint. Item
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Update Previous EEAP
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	ECO Analysis Performed
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	ECO Analysis Performed
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Update Previous EEAP

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Indust./Ground Water Treatment NUMBER: 360

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Not Applicable
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Not Applicable
G.	Solar applications	Not Applicable
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Not Applicable
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L.	Steam distribution and condensate return systems	Not Applicable
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low Potential Savings
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Low Potential Savings
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Not Applicable
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Not Applicable
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Electronic Systems Maint. NUMBER: 370

ECO Description	Project Status
A. Production equipment changes	ECO Analysis Performed
B. Efficient motors and variable frequency drives	Oper. & Maint. Item
C. Production equipment scheduling	Low Potential Savings
D. Waste heat recovery	Low Potential Savings
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Low Potential Savings
G. Solar applications	Low Potential Savings
H. Consolidate processes and equipment requiring special environments	Low Potential Savings
I. Building ventilation and exhaust systems	Low Potential Savings
J. Production equipment maintenance	Low Potential Savings
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Low Potential Savings
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Low/No Cost Project
N. Lighting control (zones & levels)	Low/No Cost Project
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Low Potential Savings
S. Reflectors for fluorescent fixtures	ECO Analysis Performed
T. Water spray roof cooling	Low Potential Savings
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Low Potential Savings
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	ECO Analysis Performed

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Production Equipment Maint. NUMBER: 422

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Not Applicable
C.	Production equipment scheduling	Low Potential Savings
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Low Potential Savings
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Low Potential Savings
I.	Building ventilation and exhaust systems	Low Potential Savings
J.	Production equipment maintenance	Not Applicable
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L.	Steam distribution and condensate return systems	Low/No Cost Project
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low Potential Savings
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Not Applicable
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Low Potential Savings
T.	Water spray roof cooling	Not Applicable
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Not Applicable
W.	Timers to control lighting	Not Applicable
X.	Separate switches to control lighting arrangements	Not Applicable
Y.	Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Upholstery, Wood & Optics Maint NUMBER: 424

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Not Applicable
D.	Waste heat recovery	Low Potential Savings
E.	Automated production controls	Not Applicable
F.	Improve facility layout and space utilization	Low Potential Savings
G.	Solar applications	Low Potential Savings
H.	Consolidate processes and equipment requiring special environments	Not Applicable
I.	Building ventilation and exhaust systems	Low Potential Savings
J.	Production equipment maintenance	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L.	Steam distribution and condensate return systems	Low/No Cost Project
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low/No Cost Project
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Not Applicable
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Low Potential Savings
T.	Water spray roof cooling	Low Potential Savings
U.	Occupancy sensors to control lighting or HVAC systems	Low/No Cost Project
V.	Photocells to control lighting	Not Applicable
W.	Timers to control lighting	Not Applicable
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Water Treatment Plant NUMBER: 554

ECO Description	Project Status
A. Production equipment changes	Low Potential Savings
B. Efficient motors and variable frequency drives	Low Potential Savings
C. Production equipment scheduling	Not Applicable
D. Waste heat recovery	Not Applicable
E. Automated production controls	Low Potential Savings
F. Improve facility layout and space utilization	Not Applicable
G. Solar applications	Not Applicable
H. Consolidate processes and equipment requiring special environments	Not Applicable
I. Building ventilation and exhaust systems	Not Applicable
J. Production equipment maintenance	Not Applicable
K. Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L. Steam distribution and condensate return systems	Low Potential Savings
M. Compressed air systems	Not Applicable
N. Lighting control (zones & levels)	Low Potential Savings
O. Electrical distribution	Low Potential Savings
P. Radiant heating	Low Potential Savings
Q. Loading dock seals	Not Applicable
R. Thermal energy storage	Not Applicable
S. Reflectors for fluorescent fixtures	Low Potential Savings
T. Water spray roof cooling	Not Applicable
U. Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V. Photocells to control lighting	Not Applicable
W. Timers to control lighting	Low Potential Savings
X. Separate switches to control lighting arrangements	Low Potential Savings
Y. Other applicable ECO's	Low Potential Savings

LETTERKENNY ARMY DEPOT

PRELIMINARY EVALUATION OF ECO'S

BUILDING NAME: Sewage Treatment Plant NUMBER: 2326

	ECO Description	Project Status
A.	Production equipment changes	Low Potential Savings
B.	Efficient motors and variable frequency drives	Low Potential Savings
C.	Production equipment scheduling	Low Potential Savings
D.	Waste heat recovery	Not Applicable
E.	Automated production controls	Low Potential Savings
F.	Improve facility layout and space utilization	Not Applicable
G.	Solar applications	Not Applicable
H.	Consolidate processes and equipment requiring special environments	Low Potential Savings
I.	Building ventilation and exhaust systems	Not Applicable
J.	Production equipment maintenance	Low Potential Savings
K.	Improved methods/controls to reduce scrap, rework and "goldplating"	Not Applicable
L.	Steam distribution and condensate return systems	Not Applicable
M.	Compressed air systems	Not Applicable
N.	Lighting control (zones & levels)	Low Potential Savings
O.	Electrical distribution	Low Potential Savings
P.	Radiant heating	Low Potential Savings
Q.	Loading dock seals	Not Applicable
R.	Thermal energy storage	Not Applicable
S.	Reflectors for fluorescent fixtures	Low Potential Savings
T.	Water spray roof cooling	Low Potential Savings
U.	Occupancy sensors to control lighting or HVAC systems	Low Potential Savings
V.	Photocells to control lighting	Not Applicable
W.	Timers to control lighting	Low Potential Savings
X.	Separate switches to control lighting arrangements	Low Potential Savings
Y.	Other applicable ECO's	Low Potential Savings

ECO CALCULATIONS AND COST ESTIMATES

SECTION IV

ECO CALCULATIONS AND COST ESTIMATES

ECO #	Description	Page
1	Compressed air valve replacement in Building 350	1-1
2	"Steam" cleaning heat method modification	2-1
3	Dip tank covers	3-1
4	Heat recovery from paint booth exhaust air	4-1
5	EMCS in Building 370	5-1
6	Heat recovery from condensate in Building 349	6-1
7	No. 6 fuel oil recirculation control in Building 349	7-1
8	Reflectors for fluorescent fixtures in Building 370	8-1
9	Paint booth fan controls	9-1
10	Paint booth air flow control	10-1
11	Blast booth fan cut off	11-1
12	Boiler conversion to #5 fuel oil	12-1
13	Energy efficient fluorescent lamps in Building 370	13-1
14	Energy efficient frequency converters in Building 370	14-1
15	Modular offices in Buildings 6-South, 8 & 9	15-1
16	Boiler conversion to natural gas	16-1
D-UP	Heat recovery from paint booths and engine test cells	D-UP-1
E-UP	Vapor barrier for dehumidified warehouses	E-UP-1
G-UP	Dip tank exhaust heat recovery in Building 350-North	G-UP-1
H-UP	Baghouse insulation and exhaust air return	H-UP-1
I-UP	Large paint booth exhaust heat recovery in Building 350	I-UP-1
J-UP	Medium paint booth exhaust heat recovery in Building 350	J-UP-1
N-UP	Window and wall insulation in 400-series buildings	N-UP-1
R-UP	High pressure sodium lighting in warehouses	R-UP-1
G-E-UP	Paint booth exhaust heat recovery in Building 1	G-E-UP-1
G-F-UP	Paint booth exhaust heat recovery in Building 14	G-F-UP-1
G-G-UP	Paint booth exhaust heat recovery in Building 37	G-G-UP-1
G-I-UP	Dip tank exhaust heat recovery in Building 350-South	G-I-UP-1

ECO #1 Compressed Air Valve Replacement in Bldg 350

EACH COLUMN CONTAINS AT LEAST ONE COMPRESSED AIR ROOT VALVE. DRAWINGS SHOW 4 ROWS OF 57 COLUMNS EACH, TOTAL 228 COLUMNS => 228 ± AIR STATIONS. 40 COL'S HAD LEAKS.

COLUMNS SURVEYED

B19 THRU B57 AND C11 THRU C57 => 84 COL'S

PERCENT W/LEAKS

$$\frac{40}{84} \times 100 = 47.62\%$$

ESTIMATED COL'S W/LEAKS

228 COL'S × .4762 = 109 COL'S.

TOTAL ESTIMATED LEAKAGE

Σ LEAKS = 31 CFM

$$\frac{31\text{ CFM}}{40\text{ COL'S}} \times 109\text{ COL'S} = 84.5\text{ CFM}.$$

TOTAL VALUE OF LEAKS

$$\frac{84.5\text{ CFM}}{} \times \frac{60\text{ M}}{\text{H}} \times \frac{8760\text{ H}}{\text{YR}} \times \frac{0.009\text{ MBTU}}{1000\text{ cf}} \times \frac{\$10.94}{\text{MBTU}} \approx \$4000/\text{YR}$$

TOTAL ENERGY SAVED

$$\frac{\$4000}{\text{YR}} \times \frac{\text{MBTU}}{\$10.94} = 366\text{ MBTU/YR}.$$

RSH

Telephone Call Confirmation

(704) 529-2104

Project No. 290-0379-001

Local ______ L.D. ✓ Placed ✓ Rec'd. ______ Date ______

G. Fallon Conversed With Tom Knowland

Of Ingersol-Rand Regarding Compressor Energy Use

TK gave the following energy use values:

CFM	Bhp	PSIG	Btu/CFM	kwh/kcf	MBTU/kcf
1595	319	110	509	2.70	0.0092
1560	330	125	538	2.86	0.0098
1603	306	100	485	2.57	0.0088

CALC ENERGY USE PER CFM OF AIR

MOTOR EFF = 0.92

Distribution:

3/89

RS&H

SUBJECT: LEAD ECO #1
AEP NO:
SHEET 2 OF
DESIGNER: G. Fallon
DATE:
CHECKER: P. Hutchins
DATE:

COST of BALL VALVE

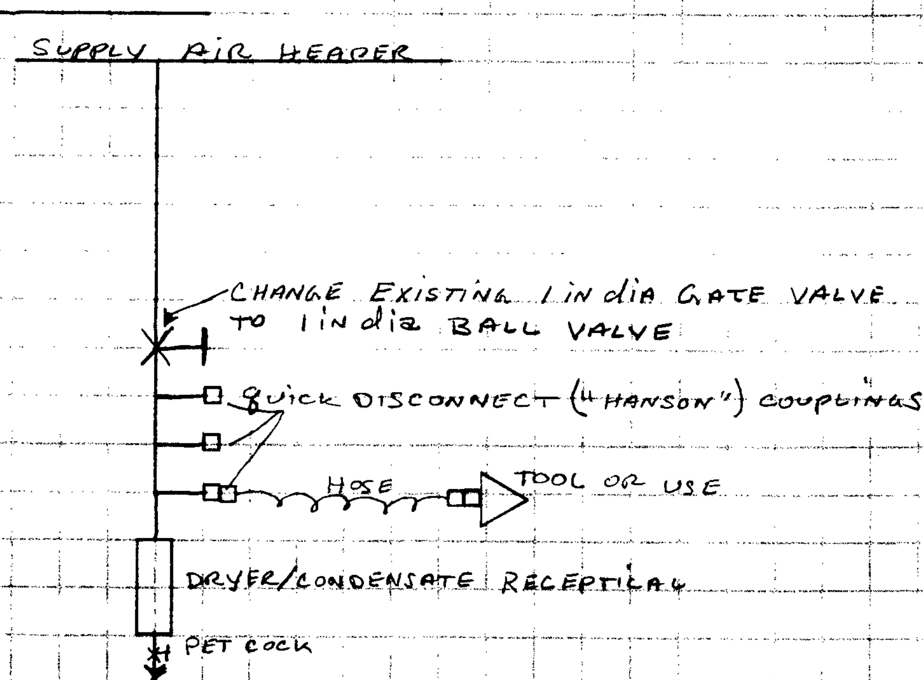
FROM MEANS, ITEM 151-955-1470
AND FROM CONSTRUCTION COST CALCULATION (ATTACHED)

228 VALVES = $8131

PAYBACK

$$\frac{\$8131}{\$4000/\text{YR}} = 2.0 \text{ years}$$

SKETCH



NOTE: EXISTING GATE VALVE OFTEN HAS LEAKY VALVE STEM AND ARE RARELY CLOSED. THIS ALLOWS DOWNSTREAM LEAKS TO CONTINUE. VALVE IS "DIFFICULT" TO SHUT OFF. BALL VALVE IS quick shut off TYPE. Therefor MORE LIKELY TO BE SHUT OFF By Workers WHEN ASKED to DO SO.

05/09/91

ECO Construction Cost Estimate
Calculations

ECO Name: Air Valves Replacement in Building 350

ECO #: 1

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$2,109
Labor		$2,440
	Subtotal bare costs	$4,549
FICA Insurance (20% of Labor)		$488
Sales Tax (6.5% of Material)		$137
	Subtotal	$5,174
Overhead (15%)		$776
	Subtotal	$5,950
Profit (10%)		$595
	Subtotal	$6,545
Bond (1%)		$65
	Subtotal	$6,610
Contingency (10%)		$661
Subtotal (Construction Cost Input For LCCID *)		$7,271
SIOH (5.5% of Construction Cost)		$400
	Subtotal	$7,671
Design (6% of Construction Cost)		$436
Total Project Cost		$8,107

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR: G. Fallon

CHECKED BY

ECO #1 SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
1 IN Ø BALL VALVE	228	EA	10.70	2440	9.25	2109	4549

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—516146

ECO#1

LETTERKENNY ARMY DEPOT
COMPRESSED AIR SURVEY
BUILDING 350

COLUMN/ LOCATION ID	LEAK* DETECTION TECHNIQUE	FLOW** (CFM)	COMMENT
B26	A	0.659	VALVE PACKING (MEASURED)
B54	A	1	VALVE PACKING
C24	A	1.5	1 HOSE COUPLING
C28	A	1.5	DRYER DRAIN
C32	A	1.5	VALVE PACKING
C47	A	1	VALVE PACKING
PB60	A	4.1	DRYER DRAIN PAINT BOOTH 60 (MEASURED
B19	D	<0.5	VALVE PACKING (MEASURED)
B23	D	<0.5	VALVE PACKING
B27	D	<0.5	HOSE COUPLING
B30	D	<0.5	HOSE COUPLING
B31	D	<0.5	HOSE COUPLING
B35	D	<1.5	3 HOSE COUPLING
B36	D	<0.5	1 HOSE COUPLING
B37	D	<0.5	1 HOSE COUPLING (BREATHABLE AIR)
B38	D	>0.5	1 HOSE COUPLING
B50	D	<0.5	VALVE PACKING
C21	D	<0.5	1 HOSE COUPLING
C36	D	<0.5	1 HOSE COUPLING
C38	D	<0.5	VALVE PACKING (BREATHABLE AIR)
C39	D	<0.5	VALVE PACKING (BREATHABLE AIR)
C42	D	<0.5	VALVE PACKING
C46	D	<0.5	1 HOSE COUPLING
C51	D	<0.5	1 HOSE COUPLING
C52	D	<0.5	1 HOSE COUPLING
C54	D	<0.5	1 HOSE COUPLING
C55	D	<0.5	DRAIN COCK
B39	F	1	1 HOSE COUPLING
B46	F	1	VALVE PACKING (MEASURED)
B48	F	1	VALVE PACKING
B51	F	1	VALVE PACKING
B55	F	1	DRAIN COCK
C11	F	<1	1 HOSE COUPLING
C13	F	<1	1 HOSE COUPLING
C14	F	1	DRYER DRAIN
C17	F	<1	1 HOSE COUPLING
C18	F	<1	1 HOSE COUPLING
C23	F	1	1 HOSE COUPLING
C25	F	1	1 HOSE COUPLING
C31	F	1	1 HOSE COUPLING
C45	F	1	VALVE PACKING
		31	

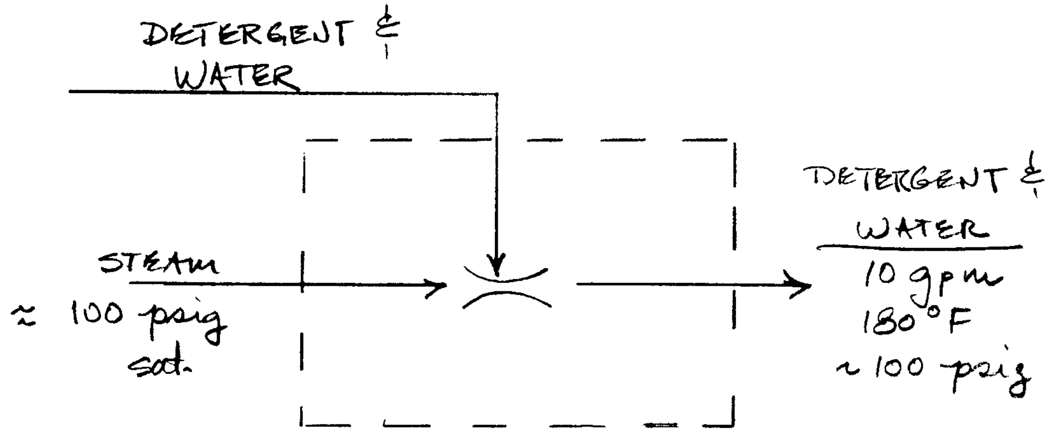
* A = AUDIBLE TO HUMAN EAR WITH "AT WORK" BACKGROUND NOISE
D = DETECTOR ONLY. LEAK COULD NOT BE HEARD OR FELT
F = CAN BE FELT WITH HAND

** FLOW WAS MEASURED IN EACH OF THE MAJOR CATAGORIES (A,D,F).
FLOW WAS ESTIMATED BASED ON CATAGORY OF DETECTION SENSITIVITY

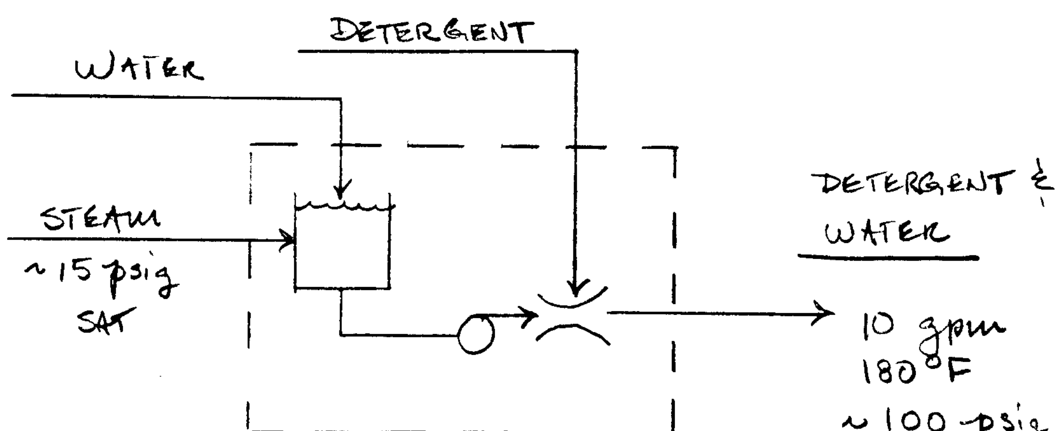
RS&H®

SUBJECT LEAD ECO #2
AEP NO 290.0379-001
SHEET ____ OF ____
DESIGNER G. Fallon
DATE ____
CHECKER P. Hutchins
DATE 9/25/91

ECO #2 - Modify "Steam" Cleaning Method



EXISTING METHOD



PROPOSED METHOD

There is no change in energy consumption between the two methods. However energy and manpower savings can result in the boiler plant, Bldg. 349.

RS&H®

SUBJECT: ECO #2

DESIGNER: G. Fallen

CHECKER:

AEP NO:

SHEET ___ OF ___

DATE:

DATE:

Manpower savings result from reduced safety requirements and thermal stresses for a low pressure boiler. This would allow a reduction in manpower for operation and allow shut down on weekends.

However, Keeler representatives would not recommend lower the boiler pressure below 50 psig. Also LEAD personnel have begun shutting the boiler plant down on weekends (summer, 1991).

Energy savings could be realized by installing a pressure reducing valve at the boiler house. Savings would be due to reduced steam flow through existing steam leaks and reducted conduction losses through steam lines.

In this case losses through underground, insulated steam lines is small. Steam leaks should be fixed regardless of the pressure.

RS&H

SUBJECT: ECO #2
AEP NO:
SHEET ___ OF ___
DESIGNER: G. Fallon
DATE:
CHECKER:
DATE:

The result is there are no manpower to be realized. Energy savings are minimal and difficult to quantify.

05/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Steam clean modification

ECO #: 2

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$5,476
Labor		$4,124
	Subtotal bare costs	$9,600
FICA Insurance (20% of Labor)		$825
Sales Tax (6.5% of Material)		$356
	Subtotal	$10,781
Overhead (15%)		$1,617
	Subtotal	$12,398
Profit (10%)		$1,240
	Subtotal	$13,638
Bond (1%)		$136
	Subtotal	$13,774
Contingency (10%)		$1,377
Subtotal (Construction Cost Input For LCCID *)		$15,151
SIOH (5.5% of Construction Cost)		$833
	Subtotal	$15,984
Design (6% of Construction Cost)		$909
Total Project Cost		$16,893

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

REYNOLDS, SMITH & HILLS
ARCHITECTS ENGINEERS PLANNERS

PROJECT: ECO #2 "Steam" Clean Modification

SHEET ___ OF ___

LOCATION: LETTERKENNY ARMY DEPOT

A E FILE NO.

CONSTRUCTION COST ESTIMATE

DATE

BASIS FOR ESTIMATE: ☐ PRE-DESIGN STUDY ☑ SCHEMATIC DESIGN ☐ DESIGN DEVELOPMENT ☐ FINAL DESIGN

ESTIMATOR: G. FALLON

CHECKER: P. Hutch

ITEM NO.	DESCRIPTION	QUANTITY		LABOR		MATERIAL		TOTAL COST
		NO. OF UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
1	50 gpm Hi. PRES. WASH PUMP.	1	EA	335	335	2570	2570	2905
2	500 gal HOT WATER TANK	1	EA	160	160	1325	1325	1325
3	2" ϕ SCH 40 pipe	500	ft	5.75	2875	2.91	1455	4330
4	2" ϕ " ELS	8	EA	20	160	3.69	30	190
5	2" ϕ " T's	18	EA	33	594	5.35	96	690
	TOTAL				4124		5476	9600

RSH 52D (Sept 1979)

RS&H

SUBJECT: LEAD ECO #2

AEP NO:

SHEET: OF:

DESIGNER: G. Fallon

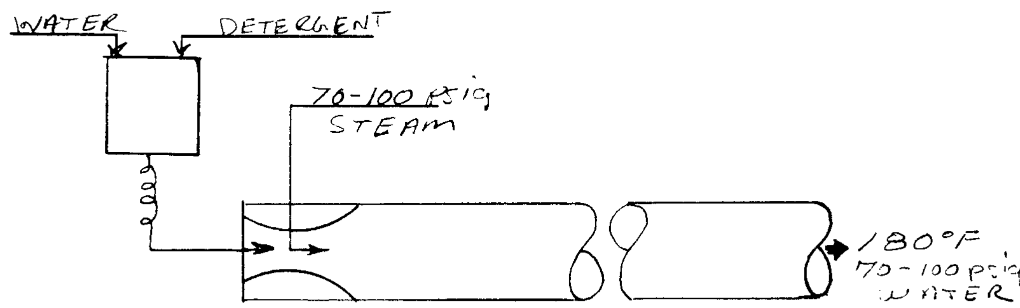
DATE:

CHECKER:

DATE:

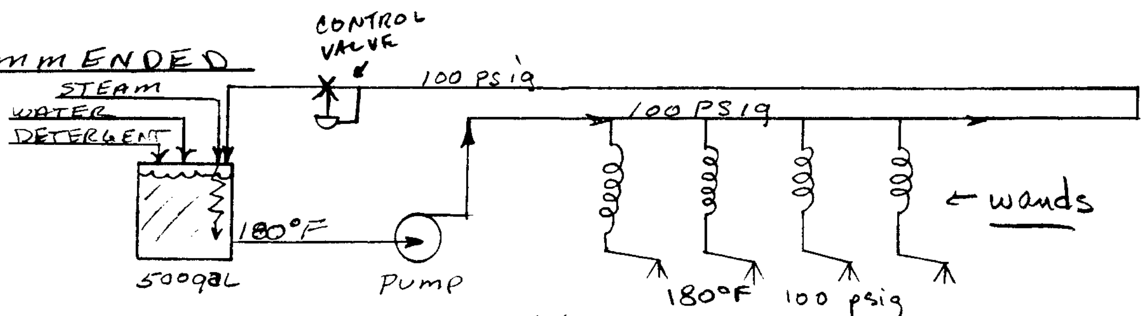
SCHEMATIC FLOW DIAGRAM

CURRENT



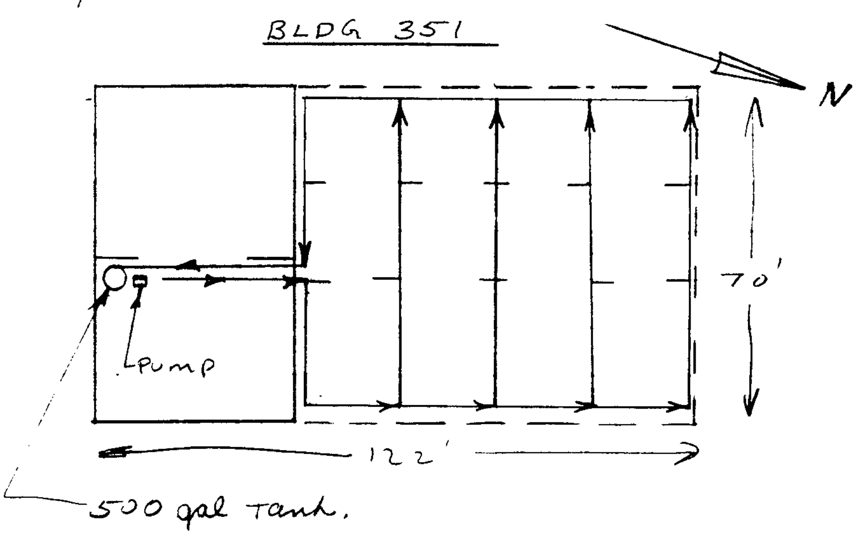
CLEANING WAND

RECOMMENDED



PHYSICAL LOCATION

BLDG 351



PIPE (70 x 5) + (40 x 2) + (0 x 2)
= 450' ≈ 500'

RS&H

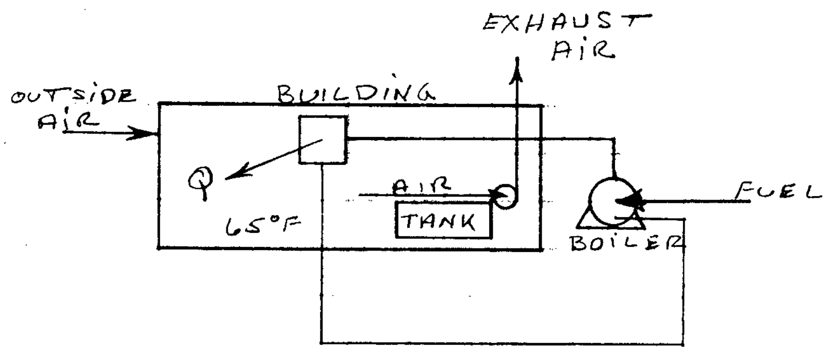
SUBJECT LETTERKENNY EEAP
ECO #3
DESIGNER G. F.
CHECKER [signature]

AEP NO 290-0379-001
SHEET 1 OF 4
DATE 3-21-91
DATE

ECO # 3 Dip Tank Covers with Exhaust Fan Controls

ASSUMPTIONS:

1. ROOM TEMPERATURE = 68°F
2. HEAT LOAD FACTOR (HLF)
   $HLF_1 = 0.166$ MBTU/yr·CFM (24 h/d, 7 d/w)
   $HLF_2 = 0.0742$ MBTU/yr·CFM (16 h/d, 5 d/w)
3. FAN EFFICIENCY = 0.5
4. STEAM GENERATION EFFICIENCY = 0.8
5. FAN ΔP = 3 IN. W.C.
6. LEAKAGE FLOW WITH COVER IN PLACE = 1% DESIGN FLOW



CURRENT ENERGY USE (TANK 431B, BLDG 37)

$$Q = \frac{\text{CFM} \times \text{HEAT LOSS FACTOR (MBTU/CFM·YR)}}{\text{STEAM GEN. EFF}}$$

$$= \frac{5200 \times 0.166}{0.8} = 1079 \text{ MBTU/yr \#2 F.O.}$$

CURRENT FAN ENERGY USE

$$\text{FAN HP} \times \text{BTU/HP HR} \times 8760 \text{ HR/YR} \times \frac{\text{MBTU}}{10^6 \text{ BTU}} =$$

$$\frac{5200 \times 3}{6356 \times .5} \text{ HP} \times 2545 \text{ BTU/HP HR} \times 8760 \text{ HR/YR} \times \frac{1}{10^6} = 109 \text{ MBTU/YR}$$

ELECTRIC

RS&H®

SUBJECT LETTERKENNY EEAP

AEP NO

SHEET 2 OF 4

DESIGNER G. F. DATE 3-21-91

CHECKER DATE

ENERGY CONSUMPTION @ COVER

(16 h/d, 5d/w) (8 h/d 5d/w + weekends)

Q = HEAT LOSS IN OPERATION + HEAT LOSS COVERED

$$= \frac{CFM \times HLF}{\eta} + \frac{(LEAKAGE\ CFM \times (HLF_1 - HLF_2))}{\eta}$$

$$= \frac{5200 \times 0.0742}{0.8} + \frac{52 \times (0.166 - 0.0742)}{0.8} = 488\ MBTU/YR$$

FAN ENERGY CONSUMPTION @ COVER

NOTE: FAN ΔP CONTROLS WILL REDUCE FAN SPEED VIA A VARIABLE FREQUENCY DRIVE TO MAINTAIN SET ΔP WHEN COVER IS IN PLACE.

CONSUMPTION = ENERGY USE WHILE COVERED & UNCOVERED.

UNCOVERED CONSUMPTION

$$= CURRENT\ FAN\ USE \times \frac{UNCOVERED\ TIME}{TOTAL\ TIME}$$

$$= 109 \times \frac{4160}{8760} = 51.76\ MBTU\ ELEC/YR$$

COVERED CONSUMPTION

$$\frac{52 \times 3}{6356 \times .5}(HP) \times 2545\frac{BTU}{HP\ HR} \times (8760 - 3035)\ HRS/YR \times \frac{MBTU}{10^6\ BTU} = 0.715\ \frac{MBTU\ el}{YR}$$

TOTAL CONSUMPTION

TOTAL = COVERED + UNCOVERED

$$= 0.715 + 51.76 = 52.47\ \frac{MBTU\ elec}{YR}$$

RS&H®

SUBJECT LETTERKENNY EEAP | AEP NO
SHEET 3 OF 4
DESIGNER G. F. | DATE 3/21/91
CHECKER | DATE

SAVINGS

FUEL OIL

SAVINGS = (CURRENT) − (W COVER)
= 1079 MBTU/YR − 488 MBTU/YR
= 591 MBTU/YR #2 FUEL OIL

ELECTRICITY

SAVINGS = (CURRENT) − (W COVER)
= 109 − 52.47
= 56.53 MBTU ELEC/YR

TOTAL DEPOT

ASSUMPTIONS:
1) ALL TANK FANS OPERATE CONTINUOUSLY AT DESIGN FLOW (PER OSHA REQUIREMENTS)
2) TANKS ARE "USED" 2 SHIFTS/day, 5 d/w, 52 w/yr

APPROACH: 1) CALCULATE UNIT HEAT SAVING FACTOR FROM SINGLE TANK PROCEEDURE ABOVE
2) APPLY FACTORS TO ALL OTHER TANKS
3) SUM RESULTS FOR TOTAL FACILITY.

UNIT HEAT SAVING FACTOR = $\frac{\text{HEAT SAVED}}{\text{CFM}}$

UHSF = $\frac{591 \text{ MBTU/yr}}{5200 \text{ cfm}} = 0.1137 \frac{\text{MBTU}}{\text{CFM YR}}$

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SUBJECT LETTERKENNY EEAP

AEP NO

SHEET 4 OF 4

DESIGNER G. F.

DATE 3-21-91

CHECKER

DATE

UNIT ELECTRICITY SAVING FACTOR = $\frac{\text{ELECTRIC ENERGY SAVED}}{\text{CFM}}$

$$UESF = \frac{56.53 \ \frac{\text{MBTU ELEC}}{\text{YR}}}{5200 \text{ CFM}} = 0.0109 \ \frac{\text{MBTU ELEC}}{\text{CFM YR.}}$$

APPLYING THESE FACTORS TO EACH VENTED TANK (SEE ENCLOSED SPREADSHEET CALCULATION) YIELDS:

TOTAL FACILITY HEAT SAVED = Σ INDIVIDUAL TANKS

= 26,034 MBTU FUEL/YR

TOTAL FACILITY ELEC ENERGY SAVED = Σ INDIVIDUAL TANKS

= 2,496 $\frac{\text{MBTU ELEC}}{\text{YR.}}$

LETTERKENNY ARMY DEPOT
DIP TANK COVER
SUMMARY

Building Number	Tank ID	Design Ventil. (cfm)	Common or Dedicated Fan (D)-(C)	Annual FUEL(5& 6)Saved (Mbtu)	Value of Saved Energy ($/yr)	Annual Electric Saved (Mbtu)	Value of Saved Ele Energy ($/yr)	Total Cost Savings ($/yr)	Const. Cost* ($)	Payback (Yrs)
1N	2861-1	10,000	D	1,137	$5,014	109	$1,192	$6,207	$9,148	1.5
	2861-2	3,750	C	426	$1,880	41	$447	$2,327	$1,438	0.6
	2861-3	7,500	C	853	$3,761	82	$894	$4,655	$1,438	0.3
	2861-4	7,500	C	853	$3,761	82	$894	$4,655	$1,438	0.3
	2861-5	7,500	C	853	$3,761	82	$894	$4,655	$1,438	0.3
	2861-6	7,500	D	853	$3,761	82	$894	$4,655	$9,148	2.0
	2861-7	7,500	C	853	$3,761	82	$894	$4,655	$1,438	0.3
	2861-8	7,500	C	853	$3,761	82	$894	$4,655	$1,438	0.3
	400	3,060	C	348	$1,534	33	$365	$1,899	$1,438	0.8
	402	4,500	D	512	$2,256	49	$537	$2,793	$9,148	3.3
	378	4,500	C	512	$2,256	49	$537	$2,793	$1,438	0.5
	377	4,500	C	512	$2,256	49	$537	$2,793	$1,438	0.5
	4577	1,560	C	177	$782	17	$186	$968	$1,438	1.5
	4741	4,050	C	460	$2,031	44	$483	$2,514	$1,438	0.6
Subtotal 1N	14	80,920	3	9,201	$40,575	882	$9,649	$50,224	$43,262	0.9
37	2568	6,800	D	773	$3,410	74	$811	$4,221	$9,148	2.2
	4318	5,200	D	591	$2,607	57	$620	$3,227	$9,148	2.8
	4319	9,600	D	1,092	$4,814	105	$1,145	$5,958	$9,148	1.5
	4193	6,000	D	682	$3,009	65	$715	$3,724	$9,148	2.5
Subtotal 37	4	27,600	4	3,138	$13,839	301	$3,291	$17,130	$36,592	2.1
350N	2514	9,360	D	1,064	$4,693	102	$1,116	$5,809	$9,148	1.6
	2516	6,480	D	737	$3,249	71	$773	$4,022	$9,148	2.3
	2518	9,360	D	1,064	$4,693	102	$1,116	$5,809	$9,148	1.6
	2520	12,600	D	1,433	$6,318	137	$1,502	$7,820	$9,148	1.2
	2744	5,500	D	625	$2,758	60	$656	$3,414	$9,148	2.7
	1479	3,600	D	409	$1,805	39	$429	$2,234	$9,148	4.1
	1480	6,860	D	780	$3,440	75	$818	$4,258	$9,148	2.1
	2606	993	D	113	$498	11	$118	$616	$9,148	14.8
350S	2531	12,000	D	1,364	$6,017	131	$1,431	$7,448	$9,148	1.2
	2536	11,000	D	1,251	$5,516	120	$1,312	$6,827	$9,148	1.3
	2539	2,500	D	284	$1,254	27	$298	$1,552	$9,148	5.9
Subtotal 350	11	80,253	11	9,125	$40,240	875	$9,570	$49,810	$100,628	2.0

LETTERKENNY ARMY DEPOT
DIP TANK COVER
SUMMARY

	Building Number	Tank ID	Design Ventil. (cfm)	Common or Dedicated Fan (D)-(C)	Annual FUEL(5& 6)Saved (Mbtu)	Value of Saved Energy ($/yr)	Annual Electric Saved (Mbtu)	Value of Saved Ele Energy ($/yr)	Total Cost Savings ($/yr)	Const. Cost* ($)	Payback (Yrs)
	370	T-1	3,800	C	432	$1,905	41	$453	$2,359	$1,438	0.6
		T-2	2,700	C	307	$1,354	29	$322	$1,676	$1,438	0.9
		T-3	5,700	D	648	$2,858	62	$680	$3,538	$9,148	2.6
		T-4	5,700	C	648	$2,858	62	$680	$3,538	$1,438	0.4
		T-5	3,600	C	409	$1,805	39	$429	$2,234	$1,438	0.6
		T-6	2,700	C	307	$1,354	29	$322	$1,676	$1,438	0.9
		T-7	5,700	D	648	$2,858	62	$680	$3,538	$9,148	2.6
		T-8	3,800	C	432	$1,905	41	$453	$2,359	$1,438	0.6
		T-9	2,700	C	307	$1,354	29	$322	$1,676	$1,438	0.9
		T-10	3,800	C	432	$1,905	41	$453	$2,359	$1,438	0.6
Subtotal	370	10	40,200	2	4,571	$20,157	438	$4,794	$24,951	$29,800	1.2
Total	4	39	228,973	20	26,034	$114,811	2,496	$27,304	$142,115	$210,282	1.5

* Costs for differential pressure controls and VF drives are not distributed over tanks sharing a common fan.

QRIP Calc using FY92 Fuel Oil Prices

Current energy use:

$$\text{Elec} = \text{Fan Hp} * \text{Btu/Hp} * 8760\ \text{Hr/yr} * \frac{1\ \text{MBtu}}{10^6\ \text{MBtu}} * 10.94\ \$/\text{MBtu}$$

$$\text{Fan Hp} = \frac{\text{cfm}\ \Delta P}{6356\ \eta_{fan}}$$

$$= \frac{(228{,}973)(3)}{(6356)(0.5)} * 2545\ \frac{\text{Btu}}{\text{Hp Hr}} * \frac{8760}{10^6} * 10.94\ \$/\text{MBtu} = \$52{,}700/\text{yr.}$$

$$\text{Fuel Oil} = \text{cfm} * \text{HLF} \div \eta_{blr} = 228{,}973 * 0.166 \div 0.8 = 47{,}512\ \text{MBtu/yr}$$

$$47{,}512 * 4.41\ \$/\text{MBtu} = \$209{,}500/\text{yr}$$

TOTAL COSTS = $262,200/yr

05/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Cover

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$4,400
Labor	$960
Subtotal bare costs	$5,360
FICA Insurance (20% of Labor)	$192
Sales Tax (6.5% of Material)	$286
Subtotal	$5,838
Overhead (15%)	$876
Subtotal	$6,714
Profit (10%)	$671
Subtotal	$7,385
Bond (1%)	$74
Subtotal	$7,459
Contingency (10%)	$746
Subtotal (Construction Cost Input For LCCID *)	$8,205
SIOH (5.5% of Construction Cost)	$451
Subtotal	$8,656
Design (6% of Construction Cost)	$492
Total Project Cost	$9,148

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

05/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Covers w/o Controls

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$500
Labor	$320
Subtotal bare costs	$820
FICA Insurance (20% of Labor)	$64
Sales Tax (6.5% of Material)	$33
Subtotal	$917
Overhead (15%)	$138
Subtotal	$1,055
Profit (10%)	$106
Subtotal	$1,161
Bond (1%)	$12
Subtotal	$1,173
Contingency (10%)	$117
Subtotal (Construction Cost Input For LCCID *)	$1,290
SIOH (5.5% of Construction Cost)	$71
Subtotal	$1,361
Design (6% of Construction Cost)	$77
Total Project Cost	$1,438

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

09/26/91

ECO Construction Cost Estimate Calculations

ECO Name: Dip Tank Covers

ECO #: 3

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$97,500
Labor		$25,280
	Subtotal bare costs	$122,780
FICA Insurance (20% of Labor)		$5,056
Sales Tax (6.5% of Material)		$6,338
	Subtotal	$134,174
Overhead (15%)		$20,126
	Subtotal	$154,300
Profit (10%)		$15,430
	Subtotal	$169,730
Bond (1%)		$1,697
	Subtotal	$171,427
Contingency (10%)		$17,143
Subtotal (Construction Cost Input For LCCID *)		$188,570
SIOH (5.5% of Construction Cost)		$10,371
	Subtotal	$198,941
Design (6% of Construction Cost)		$11,314
Total Project Cost		$210,255

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

For QRIP - Tank cover costs

(p. 3-9)

Covers represent 26% of project cost => 31980 / 122,780 = 0.26

Therefore 210,257 * 0.26 = $54,765

RS&H®	SUBJECT ECO #3	AEP NO Z90-0379-001	
		SHEET	OF
	DESIGNER P. Hutchins	DATE	
	CHECKER	DATE	

Additional maintenance costs

Covers will last about 5 years

Therefore, covers will be replaced 3 times over the 15 year project life

For LCCID 1/5 of 39 covers will be replaced annually

$1/5 * \$600 * 39 = \$4700$

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: LEAD

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.

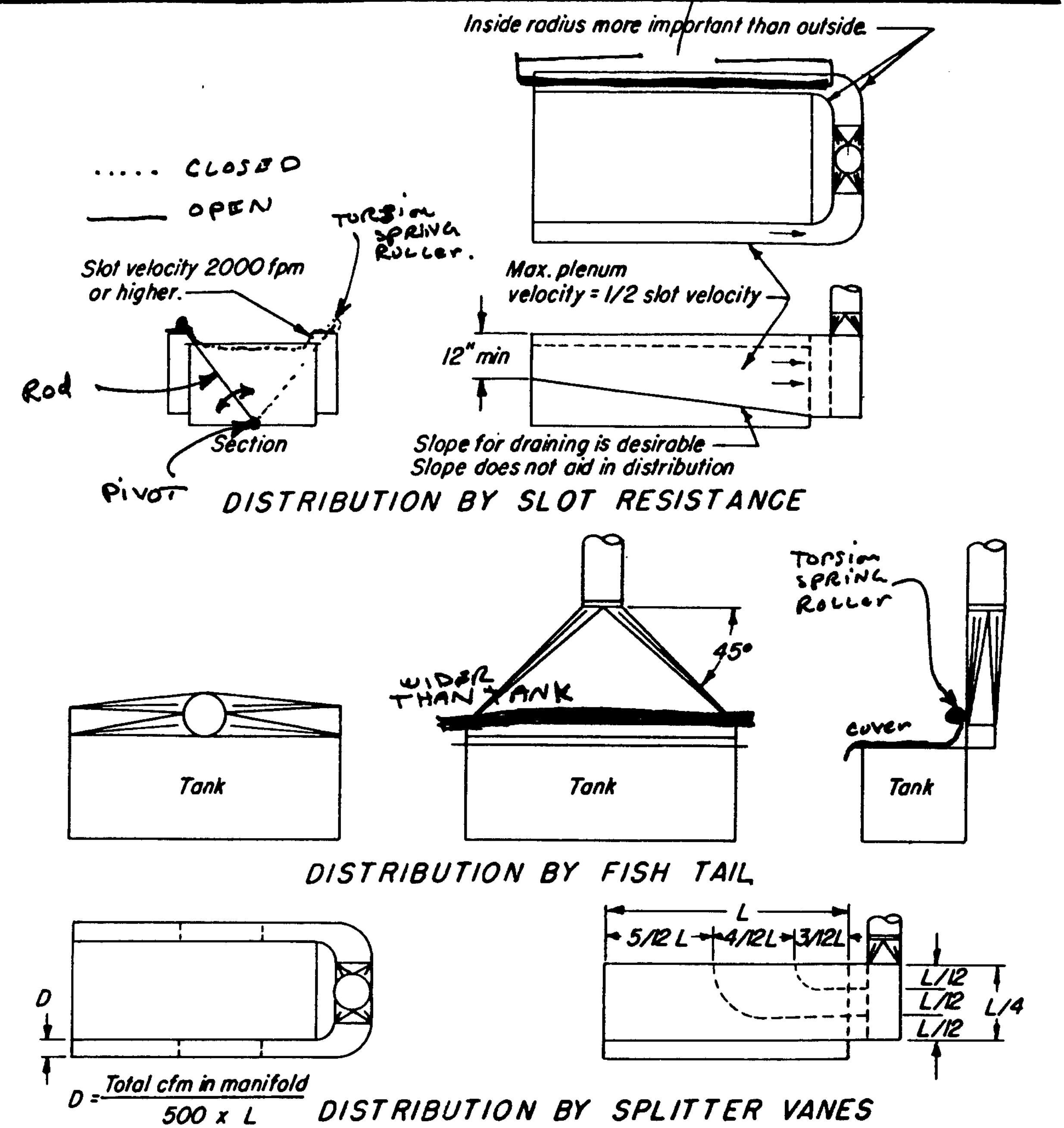
ESTIMATOR: G. FALLON

CHECKED BY: P. Hutchinson

TANK COVER & FAN CONTROLLER SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
DIP TANK COVER	39	EA	320	12,480	500	19,500	31,980
@ MOVEABLE MOUNT.							
FAN PRESSURE							
XMITTER	20	EA	160	3,200	550	11,000	14,200
CONTROLLER	20	EA	160	3200	550	11,000	14,200
FAN MOTOR VARI.							
FREQ. DRIVE	20	EA	320	6400	2800	56,000	62,400
				25280		97,500	122780
For DRIP Covers represent				31930 / 122,780	=	26% of	project costs

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE



With low plenum velocities and high slot velocities, good distribution is obtained. If this design is not possible, splitter vanes should be used. Slots over 10 feet to 12 feet in length usually need multiple take-offs.

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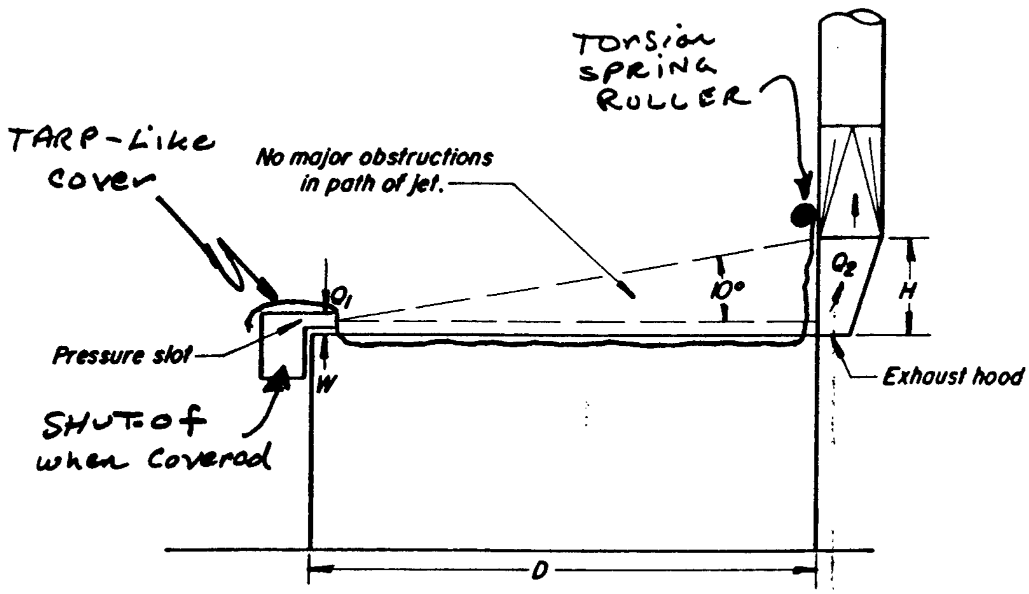
PRINCIPLES OF MANIFOLD DESIGN

DATE *1-70* | *Fig. 4-12*



PUSH PULL HOODS

Exhaust Hood

Quantity of air exhausted,

Q_2 = 100 to 150 cfm /sq. ft. of tank area, depending on temperature of liquid, cross drafts, agitation, etc.

Hood height should be,

$H = D \times \tan 10°$.

$= 0.18D$

Pressure Slot

Quantity of air supplied,

$$Q_1 = \frac{1}{D \times E} \times Q_2$$

where; D = length of throw, feet

E = entrainment factor.

Throw length, D, feet	Entrainment factor, E
0 - 8	2.0
8 - 16	1.4
16 - 24	1.0
over 24	0.7

Slot width W should be designed for a velocity of 1000 to 2000 fpm.

Design such systems so they can be easily modified or adjusted to obtain desired results.

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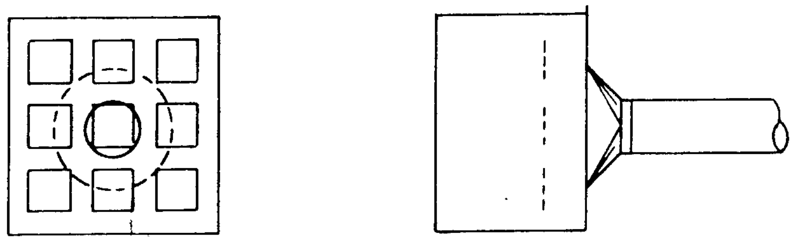
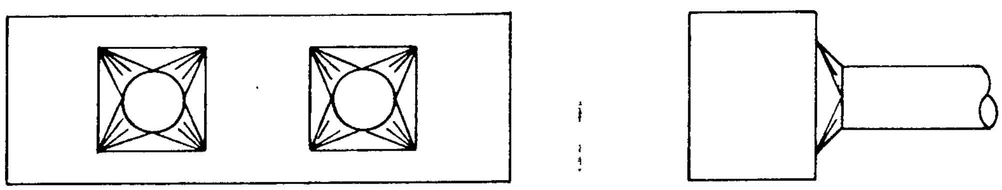
HOOD DESIGN DATA

DATE 1-64	Fig. 4-17

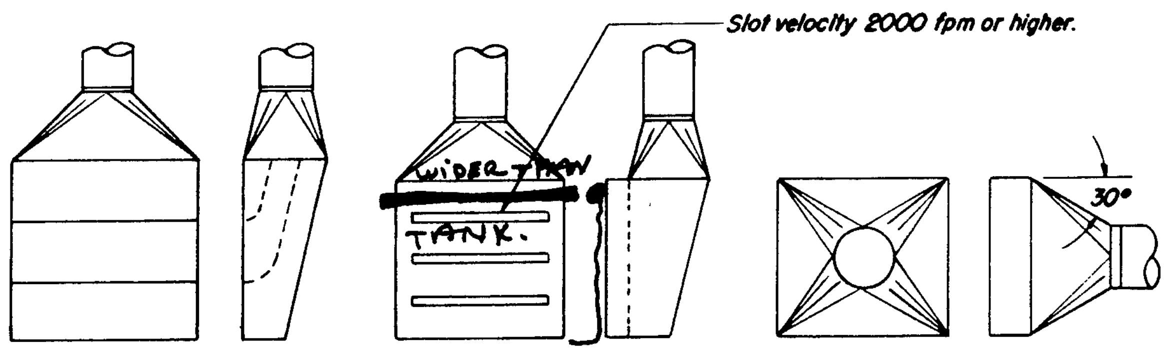


DISTRIBUTION BY BAFFLES
See Fig. 4-16



LONG BOOTHS - DISTRIBUTION BY MULTIPLE TAKE-OFFS and TAPERS

BOOTH-TYPE HOODS
(Same principle apply to canopy type)



DISTRIBUTION BY SPLITTER VANES

DISTRIBUTION BY SLOT (or baffles)

DISTRIBUTION BY TAPER

SIDE-DRAFT & SUSPENDED HOODS

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GOVERNMENTAL INDUSTRIAL HYGIENISTS

PRINCIPLES OF MANIFOLD DESIGN

DATE 1-64	Fig. 4-13

THE KING OF
TARPAULINS
GOSPORT MANUFACTURING COMPANY, INC.

DUNS: 04-598-0844
TELEPHONE: 812/879-4224
OUT OF STATE: 800/457-4406
FAX: 812/879-4227
11 LOUSISA STREET, P.O. BOX #26, GOSPORT, INDIANA 47433

March 15, 1991

REYNOLDS, SMITH & HILLS
4651 SALISBURY ROAD
JACKSONVILLE, FL 32256
ATTN: GEORGE FALLEN

Dear George:

Please find the information that I have enclosed for you per our recent phone conversation.

You can be assured that Gosport Manufacturing Company will provide you with the best in quality and excellent service in meeting your tarpaulin needs. Not only do we offer quality, 100% American made products, we stand behind everything we make.

If I can be of any service, or if you have any questions, please do not hesitate to call me at **800-457-4406.** Thank you for your consideration!

Looking forward to doing business with you!

Sincerely,

David S. Daubenheyer

David S. Daubenheyer
Account Executive

DSD/mg

Enclosures

TARPAULINS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
CANVAS TARPS*						
Noble	4	TCN08	8 oz.	1½" hem	Drab, Brown	24¢
Noble	4	TCN10	10 oz.	1½" hem	Drab, Brown	25¢
Noble	4	TCN12	12 oz.	1½" hem	Drab, Brown	27¢
Noble	4	TCN15	14.9 oz.	1½" hem	Drab, Brown	32¢
Royal	3	TCR08	8 oz.	Reinforced patches, brass grommets	Drab, Brown	25¢
Royal	3	TCR10	10 oz.	Reinforced patches, brass grommets	Drab, Brown	26¢
Royal	3	TCR12	12 oz.	Reinforced patches, brass grommets	Drab, Brown	28¢
Royal	3	TCR15	14.9 oz.	Reinforced patches, brass grommets	Drab, Brown	33¢
Majestic	4	TCM08	8 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	25¢
Majestic	4	TCM10	10 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	26¢
Majestic	4	TCM12	12 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	28¢
Majestic	4	TCM15	14.9 oz.	Rope-in-hem, two rows of stitching	Drab, Brown	33¢
Regal	3	TCG08	8 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	26¢
Regal	3	TCG10	10 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	27¢
Regal	3	TCG12	12 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	29¢
Regal	3	TCG15	14.9 oz.	D-rings, reinforced patches, rope-in-hem	Drab, Brown	34¢
VINYL TARPS						
Neoprene	5	TVN16	16 oz.	Extra durable material	Black	57¢
~~Laminated~~	5	~~TVL10~~	~~10 oz.~~	~~Flame resistant treated~~	~~Grn, Red, Blu~~	34¢
Laminated	5	TVL14	14 oz.	Flame resistant treated	Grn, Red, Blu	40¢
Coated	5	TVC18	18 oz.	Tear and puncture resistant	Large variety	47¢
Coated	5	TVC22	22 oz.	Tear and puncture resistant	Large variety	52¢
POLYETHYLENE TARPS						
Ultrastrong	8	TPU		D-rings, reinforced patches, rope-in-hem	Blue	19¢
All-American	8	TPA		Rope-in-hem, two rows of stitching (Orders less than $100, 9.5¢ per sq. ft.)	Blue	8.5¢
Poly Tarp	10	TP89FR		8 x 9, flame resistant	Opaque	14¢
Poly Tarp	10	TP10D4		10 x D4	White/White	9¢
Poly Tarp	10	TP1212		12 x 12	Black/White	19¢
Poly Tarp	10	TP89UV		8 x 9, UV resistant	White/White	13¢
Poly Tarp	10	TPS1010		10 x 10	Silver	13¢
Poly-Star Tarps in Poly-Star Section						
INFLATION FIGHTER TARPS						
	9	TIF10	10 oz.	Made from piece goods, fabric varies	Varies	22¢
	9	TIF12	12 oz.	Made from piece goods, fabric varies	Varies	23.5¢
DRY FINISH TARPS						
	9	TDF10	10 oz.	No rub off or discoloration damage	Pearl B	26¢
	9	TDF103	10.3 oz.	Army Duck, no rub off damage	Pearl B	37¢

COVERS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
SWIMMING POOL COVERS						
Royal	9	CVPR10	10 oz.	Vinyl laminated, reinforced patches & webbing	Grn, Red, Blu	37¢
Royal	9	CVPR14	14 oz.	Vinyl laminated, reinforced patches & webbing	Grn, Red, Blu	44¢
American	9	CPPAL		Light weight poly, reinforced patches & webbing	Blue	13¢
American	9	CPPAH		Heavy weight poly, reinforced patches & webbing	Blue	23¢
Net	9	CNP		Reinforced patches & webbing	Multi-color	26¢

*Commercial Canvas Flame Resistant, add 5¢ per square foot.

3-14

COVERS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESCRIPTION	COLOR	PRICE (per sq. ft.)
CAR COVERS						
A	11	CDC-A		Poly-cotton blend, elastic & tie downs	Pearl Green	$54.99 net
B	11	CDC-B		Poly-cotton blend, elastic & tie downs	Pearl Green	$61.99 net
C	11	CDC-C		Poly-cotton blend, elastic & tie downs	Pearl Green	$67.99 net
D	11	CDC-D		Poly-cotton blend, elastic & tie downs	Pearl Green	$72.99 net
E	11	CDC-E		Poly-cotton blend, elastic & tie downs	Pearl Green	$77.99 net
F	11	CDC-F		Poly-cotton blend, elastic & tie downs	Pearl Green	$84.99 net
Bag	11	MCSB		Car cover storage bag		$3.95 net
TRUCK COVERS						
Net	6	CNTT		Top grade PVC coated poly net, 2" hems	Grn, Blu, Blk Multi-color	24¢
Net	6	CNTE		Economy grade, 1½" hem	Varies	20¢
Steel Hauler	6	CCH12	12 oz.	Cotton Duck, D-rings set into eave bands	Drab, Brown	38¢
Steel Hauler	6	CCH15	14.9 oz.	Cotton Duck, D-rings set into eave bands	Drab, Brown	44¢
Steel Hauler	6	CVH18	18 oz.	Vinyl coated nylon, D-rings set into eave bands	Large variety	62¢
GYM COVERS						
Canvas	13	CCG10	10 oz.	Flame resistant, meets state school fire codes	Tan	Quote
Vinyl	13	CVG10	10 oz.	Completely waterproof & flame resistant Meets state school fire codes	Large variety	Quote
FIELD COVERS						
Polyethylene	13	CPF		Completely waterproof, high UV treated	Blue	Quote
Vinyl	13	CVF10	10 oz.	Durable cover, completely waterproof	Large variety	Quote
Vinyl	13	CVF14	14 oz.	Durable cover, completely waterproof	Large variety	Quote
SALVAGE COVERS						
Canvas	10	CCS12	12 oz.	Triple-thick hem		35¢
Canvas Duck	10	CCSD	#12	Triple-thick hem		44¢
Dry Finish	10	CDS10	10.38 oz.	Triple-thick hem, no rub off damage	Pearl B	45¢
Dry Finish	10	CDS13	13 oz.	Triple-thick hem, no rub off damage	Pearl B	49¢
Vinyl	10	CVS10	10 oz.	Vinyl laminated nylon, triple-thick hem	Red, Green	40¢
Vinyl	10	CVS14	14 oz.	Vinyl laminated nylon, triple-thick hem	Red, Green	45¢

BOAT COVERS

NAME	CATALOG PAGE	ORDER NUMBER	WEIGHT	DESIGNED FOR	BOAT LENGTH (Feet)	BEAM WIDTH (Inches)	STOCK NUMBER	OUTBOARD STOCK NUMBER	NET PRICE
Standard	12	CDBS14	8 oz.	V-Hull	14	68	RF-14		$55.95
Standard	12	CDBS15	8 oz.	V-Hull	15	76	RF-15		$59.95
Standard	12	CDBS16	8 oz.	V-Hull	16	76	RF-16		$66.95
Standard	12	CDBS17	8 oz.	V-Hull	17	80	RF-17		$69.95
Standard	12	CDBS18	8 oz.	V-Hull	18	86	RF-18		$73.95
Deluxe	12	CDBD14	10.5 oz.	V-Hull	14	68	DRF-14		$63.95
Deluxe	12	CDBD15	10.5 oz.	V-Hull	15	76	DRF-15		$67.95
Deluxe	12	CDBD16	10.5 oz.	V-Hull	16	76	DRF-16		$72.95
Deluxe	12	CDBD17	10.5 oz.	V-Hull	17	80	DRF-17		[illegible]
Deluxe	12	CDBD18	10.5 oz.	V-Hull	18	86	DRF-18		[illegible]
Tri-Hull	12	CDBT15	10.5 oz.	Cathedral Hulls	15	75	RI/O-15	RO-15	[illegible]
Tri-Hull	12	CDBT16	10.5 oz.	Cathedral Hulls	16	80	RI/O-16	RO-16	[illegible]
Tri-Hull	12	CDBT17	10.5 oz.	Cathedral Hulls	17	82	RI/O-17	RO-17	[illegible]
Tri-Hull	12	CDBT18	10.5 oz.	Cathedral Hulls	18	86	RI/O-18	RO-18	[illegible]

Project No. ____________

Telephone Call Confirmation

reynolds, smith and hills

Local ______ L.D. X Placed ______ Rec'd X Date 3-21-91

G. FALLON G.W.F. Conversed with BOB FINK (717) 782-3902

Of OSHA HARRISBURG, PA. Regarding DIP TANK COVERS.

G.F. EXPLAINED FLEXIBLE DIP TANK COVERS WITH FAN ΔP CONTROLS.

B.F. ADVISED THAT OSHA HAS VERY SPECIFIC REGULATIONS RE: MINIMUM DIP TANK AIR FLOW REQUIREMENTS AIMED AT PROTECTING WORKERS FROM ON THE JOB HAZARDS.

ALTHOUGH REDUCING THE AIR FLOW WOULD BE A "TECHNICAL" VIOLATION, NO CITATION WOULD BE ISSUED AS LONG AS THERE WAS NO HAZARD TO THE WORKER.

HE FELT THAT AS LONG AS THE FANS WERE DRAWING AIR FROM THE CAVITY BETWEEN THE COVER AND THE FLUID THAT ANY EVOLVED FUMES WOULD STILL BE EXHAUSTED.

NOTE: MR FINK ADVISED THAT DIP TANK VENT FANS SHOULD BE OPERATED AT ALL TIMES (24 HRS/DAY) AS A GENERAL RULE. THIS WAS ECHOED BY LEAD HYGIENISTS.

Distribution:

ECO # 5

EMCS for Building 370

Assumptions:

1. This ECO will use the calculations and cost estimates of the Brinjac, Kambic and Associates 1-16-89 report; Energy Monitoring and Control System Study, Phase II Submission.

2. The energy costs will be updated to reflect the current values.

3. The capital cost estimates will be esclated based on ENR Construction Cost Index history.

BK & A Data:

Electricity Cost = \$0.06/kwh = \$17.58/MBtu

Fuel Oil #6 Cost = $\$0.70/\text{gal} \times \frac{1\ \text{gal}}{0.150\ \text{MBtu}} = \$4.67/\text{MBtu}$

Current Data:

Electricity Cost = \$0.0373/Kwh = \$10.94/MBtu

Fuel Oil #6 Cost = $\$0.99/\text{gal} \times \frac{1\ \text{gal}}{0.14969\ \text{MBtu}} = \$6.61/\text{MBtu}$

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SUBJECT Bldg. 370 EMCS
LEAD
DESIGNER WTT
CHECKER

AEP NO
SHEET 2 OF
DATE
DATE

Only the total energy cost savings are shown on the EMCS Programs Summary sheets. The programs with acceptable paybacks are:

(1) Scheduled Start/stop (SSS)
(4) Day/Night Temperature Setback (DNS)
(6) LEAD Modified Economizer (LME)
(9) Reheat Coil Reset (RR)

The start/stop, day/night setback and reheat reset programs save both heating (fuel oil #5) energy and cooling (Electricity) energy. The LEAD modified economizer saves cooling energy (electricity)

Since only the total energy savings are given, the following calculations will split out the two types of energy saved so the current values can be applied.

From the BK&A Input Data:

Winter set point = 68°F

Summer set point = 75°F

Winter avg. temp. = 42.7 °F

Summer avg. temp. = 80 °F

Weeks of winter = 26.9

Weeks of summer = 25.1

Since the weeks of winter is approximately equal to the weeks of summer, is is assumed that the temperature differences will be the driving force for the energy savings.

Winter ΔT = 68 °F − 42.7 °F = 25.3 °F

Summer ΔT = 80 °F − 75 °F = 5 °F

assume a sensible heat ratio of 0.75 so the "effective" summer ΔT = 5 ÷ 0.75 = 6.7 °F

The total energy saved (summer & winter) is represented by:

Total ΔT = 25.3 + 6.7 = 32

Fuel Oil (Winter)

$\frac{25.3}{32} = 0.79 \Rightarrow$ 79 % of the annual energy savings is fuel oil

Electricity (Summer)

$\frac{6.7}{32} = 0.21 \Rightarrow$ 21 % of the annual energy savings is electricity

The relative portions of the given annual cost savings are:

0.79 × Total MBtu × $4.67/MBtu = Fuel oil cost savings

0.21 × Total MBtu × $17.58/MBtu = Electric cost savings

Total cost savings = Fuel oil savings + Electric savings

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AEP NO
SHEET 4 OF
DATE
DATE

For one MBtu saved:

Total cost savings = $0.79 \times 1\ \text{MBtu} \times 4.67\ \frac{\$}{\text{MBtu}} + 0.21 \times 1\ \text{MBtu} \times 17.58\ \frac{\$}{\text{MBtu}}$

Total Cost Savings = \$3.69 (Fuel oil) + \$3.69 (Elec)

This means the total cost savings is made up of 50% fuel oil cost savings and 50% electrical cost savings.

To update the energy cost savings:

Electricity: \$10.94/MBtu ÷ \$17.58/MBtu = $0.62\ \frac{\text{Current \$/MBtu}}{\text{BKA \$/MBtu}}$

Fuel Oil #6: \$6.61/MBtu ÷ \$4.67/MBtu = $1.45\ \frac{\text{Current \$/MBtu}}{\text{BKA \$/MBtu}}$

The original energy cost savings from the BK&A report are shown on the spreadsheet titled "Building 370 EMCS - From BK&A Report."

The new updated energy cost savings are shown on the spreadsheet titled "Building 370 EMCS - Update."

Total energy cost savings = \$72,087/year

Total capital cost = \$182,447 (See cost estimate sheets for details)

Simple Payback = Cost ÷ Savings = \$182,447/\$72,087/yr

Payback = 2.5 years

ECO #5

Letterkenny Army Depot Apr-91
Building 370 EMCS - From BK&A Report

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	4642		991	1353	6986
3	AHU	No	100%	1	3554		2138	2920	8612
4	AHU	No	100%	1	549		2138		2687
8	AHU	Yes	Min	2		407			407
9	AHU	No	Min	1	403				403
19	AHU	No	Min	1	403				403
27	AHU	No	100%	1	4670		2138	2920	9728
28	AHU	No	100%	1	2544		991	1353	4888
29	AHU	No	100%	1	1195				1195
30	AHU	No	100%	1	4830				4830
31	AHU	No	100%	1	4444		1739	2375	8558
32	AHU	No	100%	1	4257		2138	2920	9315
370a	AHU	No	100%	1	4079		2138	2920	9137
370b	AHU	No	100%	1	4079		2138	2920	9137
Total Annual Energy Cost Savings					39649	407	16549	19681	76286
Capital Cost Per Controlled System					1653	1653	4233	4249	
Total Capital Cost					21489	1653	38097	33992	95231
Simple Payback - Years					0.54	4.06	2.30	1.73	1.25

AHU - Air handling unit
SSS - Scheduled start/stop
DNS - Day/night temperature setback
LME - LEAD modified dry bulb economizer
RR - Reheat coil reset

Eco #5

Letterkenny Army Depot
Building 370 EMCS - Update Summary

Apr-91

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	4801		617	1399	6818
3	AHU	No	100%	1	3676		1330	3020	8027
4	AHU	No	100%	1	568		1330		1898
8	AHU	Yes	Min	2		421			421
9	AHU	No	Min	1	417				417
19	AHU	No	Min	1	417				417
27	AHU	No	100%	1	4830		1330	3020	9181
28	AHU	No	100%	1	2631		617	1399	4648
29	AHU	No	100%	1	1236				1236
30	AHU	No	100%	1	4996				4996
31	AHU	No	100%	1	4597		1082	2457	8135
32	AHU	No	100%	1	4403		1330	3020	8754
370a	AHU	No	100%	1	4219		1330	3020	8570
370b	AHU	No	100%	1	4219		1330	3020	8570
Total Annual Energy Cost Savings					41011	421	10298	20357	72087
Capital Cost Per Controlled System					1703	1703	4360	4376	

AHU - Air handling unit
SSS - Scheduled start/stop
DNS - Day/night temperature setback
LME - LEAD modified dry bulb economizer
RR - Reheat coil reset

Calculations:

Equipment Capital Cost = BK&A Capital Cost x 2716 / 2639
= BK&A Capital Cost x 1.03

For LME Program:

Electric Cost Savings = BK&A Total Savings x 10.94 / 17.58
= BK&A Total Savings x 0.62

For SSS, DNS and RR Programs:

Electric Cost Savings = BK&A Total Savings x 0.5 x 10.94 / 17.58
= BK&A Total Savings x 0.31

Fuel Oil Cost Savings = BK&A Total Savings x 0.5 x 6.61 / 4.67
= BK&A Total Savings x 0.72

Total Cost Savings = Electric Cost Savings + Fuel Oil Cost Savings

ECO#5

Letterkenny Army Depot
Building 370 EMCS - Update

Apr-91

Electricity Cost Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	1444		617	421	2482
3	AHU	No	100%	1	1106		1330	909	3345
4	AHU	No	100%	1	171		1330		1501
8	AHU	Yes	Min	2		127			127
9	AHU	No	Min	1	125				125
19	AHU	No	Min	1	125				125
27	AHU	No	100%	1	1453		1330	909	3692
28	AHU	No	100%	1	792		617	421	1829
29	AHU	No	100%	1	372				372
30	AHU	No	100%	1	1503				1503
31	AHU	No	100%	1	1383		1082	739	3204
32	AHU	No	100%	1	1325		1330	909	3564
370a	AHU	No	100%	1	1269		1330	909	3508
370b	AHU	No	100%	1	1269		1330	909	3508
Total Annual Electric Cost Savings					12337	127	10298	6124	28886

Fuel Oil #5 Cost Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	3357		0	978	4336
3	AHU	No	100%	1	2570		0	2112	4682
4	AHU	No	100%	1	397		0		397
8	AHU	Yes	Min	2		294			294
9	AHU	No	Min	1	291				291
19	AHU	No	Min	1	291				291
27	AHU	No	100%	1	3377		0	2112	5489
28	AHU	No	100%	1	1840		0	978	2818
29	AHU	No	100%	1	864				864
30	AHU	No	100%	1	3493				3493
31	AHU	No	100%	1	3214		0	1718	4931
32	AHU	No	100%	1	3079		0	2112	5190
370a	AHU	No	100%	1	2950		0	2112	5062
370b	AHU	No	100%	1	2950		0	2112	5062
Total Annual Fuel Oil Cost Savings					28674	294	0	14233	43201

Electric Cost Savings:

For LME Program = BK&A Total Savings x 10.94 / 17.58
= BK&A Total Savings x 0.62

For SSS, DNS & RR = BK&A Total Savings x 0.5 x 10.94 / 17.58
= BK&A Total Savings x 0.31

Fuel Oil Cost Savings = BK&A Total Savings x 0.5 x 6.61 / 4.67
= BK&A Total Savings x 0.72

ECO #5

Letterkenny Army Depot
Building 370 EMCS - Update

Apr-91

Electric Energy Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	132		56	38	227
3	AHU	No	100%	1	101		122	83	306
4	AHU	No	100%	1	16		122		137
8	AHU	Yes	Min	2		12			12
9	AHU	No	Min	1	11				11
19	AHU	No	Min	1	11				11
27	AHU	No	100%	1	133		122	83	337
28	AHU	No	100%	1	72		56	38	167
29	AHU	No	100%	1	34				34
30	AHU	No	100%	1	137				137
31	AHU	No	100%	1	126		99	68	293
32	AHU	No	100%	1	121		122	83	326
370a	AHU	No	100%	1	116		122	83	321
370b	AHU	No	100%	1	116		122	83	321
Annual Electricity Savings, MBtu/Yr					1128	12	941	560	2640

Fuel Oil #5 Energy Savings

System	Equip.	Critical Area	O.A. Cap.	Shifts	SSS 1	DNS 4	LME 6	RR 9	Totals
2	AHU	No	100%	1	508		0	148	656
3	AHU	No	100%	1	389		0	319	708
4	AHU	No	100%	1	60		0		60
8	AHU	Yes	Min	2		45			45
9	AHU	No	Min	1	44				44
19	AHU	No	Min	1	44				44
27	AHU	No	100%	1	511		0	319	830
28	AHU	No	100%	1	278		0	148	426
29	AHU	No	100%	1	131				131
30	AHU	No	100%	1	528				528
31	AHU	No	100%	1	486		0	260	746
32	AHU	No	100%	1	466		0	319	785
370a	AHU	No	100%	1	446		0	319	766
370b	AHU	No	100%	1	446		0	319	766
Annual Fuel Oil Savings, MBtu/Yr					4338	45	0	2153	6536

Electric Energy Savings = Electric cost savings / $10.94/MBtu

Fuel Oil Energy Savings = Fuel Oil Cost Savings / $6.61/MBtu

ECO#5

BK&A EMCS Study

Input Data

REQUIRED INPUTS/CALCULATIONS FOR EMCS CALCULATIONS

	LEAD	B-370
ELECTRIC ($/KWH):	0.06	0.06
BTU/KWH:	3413	3413
FUEL OIL ($/GAL):	0.60	0.70
BTU/GAL (HV):	137,000	150,000
KW/TON (CPT):	1.25	1.25
HEATING EFF(HEFF):	60 %	50 %

WINTER DESIGN O/A : 8 °F
SUMMER DESIGN O/A : 90 °F
WINTER SET POINT (WSP) : 68 °F
SUMMER SET POINT (SSP) : 75 °F
LOW TEMP LIMIT (LTL) : 50 °F

PERCENT O/A (POA): 0.1

THERMOSTAT SET-UP (SU): 15 °F
THERMOSTAT SET-DOWN (SD): 15 °F

LOAD FACTOR (L): 80 %

PRESENT WARM-UP TIME (WH): 2 HR(S)
PRESENT COOL-DOWN TIME(CH): 2 HR(S)

HEATING DEGREE DAYS(HDD): 5519 (FOR LEAD)

REHEAT SYSTEM RESET (RHR) : 3 °F

COOLING FULL LOAD HOURS (CFLH) : 1100 HRS (PITT, PA)

PRESENT CONDENSER WATER TEMP: 85 °F

HOURS OPERATION / WEEK (OP SCH #2): 168 HR/WK

HOURS OPERATION / WEEK (OP SCH #1): 78 HR/WK

LIGHTING LEVEL (WATTS/FT2): 3 (W/FT2)

AVERAGE O/A WET BULB: 68.3 °F
AVERAGE O/A ENTHALPY (OAH): 32.6 BTU/LB
R/A ENTHALPY (RAH): 29.9 BTU/LB

TOTAL WEEKS OF WINTER (WKW): 26.9 WEEKS
TOTAL WEEKS OF SUMMER (WKS): 25.1 WEEKS

AVERAGE WINTER TEMPERATURE (AWT): 42.7 °F
AVERAGE SUMMER TEMPERATURE (AST): 80.0 °F

DAYS REQ'D WARM-UP (AWD) : 250.6 DAYS/YEAR

EQUIPMENT RUN TIME (ERT): 280 HOURS/YEAR
7

ECONOMIZER HOURS :
CRITICAL BLDGS(50°-55°)0800-1700: 200 HOURS/YR
NON-CRITICAL BLDGS(50°-55°)0800-1700: 200 HOURS/YR

AVERAGE CONDENSER WATER TEMP (ACWT): 73.9 F
REDUCTION OF CONDENSER TEMP (RCWT): 11.1 °F

HEATING FULL LOAD HOURS (HFLH): 36,167 DEG-HRS

LEAD MODIFIED ECONOMIZER HOURS:
CRITICAL BLDGS(50-60 DEG)0800-1700HRS 397
NON-CRITICAL BLDGS(50-60 DEG)0800-1700HR 397

ECO #5

LETTERKENNY ARMY DEPOT
ENERGY MONITORING AND CONTROL SYSTEM STUDY
FY88, OMA, PN262

BUILDING NO. 370

OPERATING SCHEDULE

0600-1700 : 1
0100-2400 : 2

SYSTEM	SYSTEM TYPE	GIVEN INFO	OPERATING SCHEDULE	CAPACITY (BTU/HR) HEATING	CAPACITY (BTU/HR) COOLING	FAN CFM	FAN HP	(1) SCHEDULED S/S	(1) PAYBACK PERIOD	(2) OPTIMUM S/S	(2) PAYBACK PERIOD	(3) DUTY CYCLING	(3) PAYBACK PERIOD	(4) DAY/NIGHT SETBACK	(4) PAYBACK PERIOD	(5) DRY BULB ECONO.	(5) PAYBACK PERIOD
001	2	2	2	0	1956000	0		$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR
002	5	7	1	223100	470770	14600	23	$4,642	0.36	$257	3.90	$471	3.51	$0	ERR	$499	7.53
003	5	7	1	350520	542745	31500	15	$3,554	0.47	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49
004	5	6	1	0	219660	31500	15	$549	3.01	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49
005	5	7	1	112450	86625	1680	1.5	$0	ERR	$17	59.82	$31	53.80	$0	ERR	$0	ERR
008	4	2	2	0	36000	1449	0.5	$0	ERR	$6	179.46	$26	63.41	$407	4.06	$0	ERR
009	6	2	1	187826	60000	2415	1	$403	4.10	$11	89.73	$20	80.70	$0	ERR	$0	ERR
019	6	2	1	187826	60000	2415	1	$403	4.10	$11	89.73	$20	80.70	$0	ERR	$0	ERR
021	6	2	1	187826	60000	2415	1	$0	ERR	$11	89.73	$20	80.70	$0	ERR	$0	ERR
026	2	2	2	0	3000000	0		$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR
027	5	7	1	118460	295850	31500	15	$4,670	0.35	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49
028	5	7	1	188100	279270	14600	23	$2,544	0.65	$257	3.90	$471	3.51	$0	ERR	$499	7.53
029	5	7	1	205630	658940	2840	2	$1,195	1.38	$22	44.87	$41	40.35	$0	ERR	$0	ERR
030	5	7	1	100730	281970	1680	1.5	$4,830	0.34	$17	59.82	$31	53.80	$0	ERR	$0	ERR
031	5	7	1	204330	633600	25620	15	$4,444	0.37	$168	5.98	$307	5.38	$0	ERR	$876	4.29
032	5	7	1	470910	480870	31500	15	$4,257	0.39	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49
370-A	5	7	1	155000	429750	31500	15	$4,079	0.41	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49
370-B	5	7	1	182970	375300	31500	15	$4,079	0.41	$168	5.98	$307	5.38	$0	ERR	$1,077	3.49

ECO #5

LETTERKENNY ARMY DEPOT
ENERGY MONITORING AND CONTROL SYSTEM STUDY
FY88, OMA, PN262

BUILDING NO. 370

POTENTIAL EMCS PROGRAMS

(6) LEAD MOD./ECONO.	PAYBACK PERIOD	(7) VENT. & RECIRC.	PAYBACK PERIOD	(8) H/C DECK TEMP RESET	PAYBACK PERIOD	(9) REHEAT RESET	PAYBACK PERIOD	(10) H.W. O/A RESET	PAYBACK PERIOD	(11) CHW RESET	PAYBACK PERIOD	(12) COND WTR RESET	PAYBACK PERIOD	(13) BOILER MONTRING	PAYBACK PERIOD	SYSTEM
$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$323	22.73	$295	14.07	$0	ERR	001
$991	4.27	$0	ERR	$452	ERR	$1,353	3.14	$0	ERR	$0	ERR	$0	ERR	$0	ERR	002
$2,138	1.98	$4	660.20	$976	ERR	$2,920	1.46	$0	ERR	$0	ERR	$0	ERR	$0	ERR	003
$2,138	1.98	$0	12378.76	$976	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	004
$0	ERR	$0	14349.46	$52	ERR	$156	27.29	$0	ERR	$0	ERR	$0	ERR	$0	ERR	005
$0	ERR	$0	8609.68	$45	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	008
$0	ERR	$0	8609.68	$75	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	009
$0	ERR	$0	8609.68	$75	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	019
$0	ERR	$0	ERR	$75	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	$0	ERR	021
$0	ERR	$4	660.20	$0	ERR	$0	ERR	$0	ERR	$495	14.82	$453	9.18	$0	ERR	026
$2,138	1.98	$2	1424.41	$976	ERR	$2,920	1.46	$0	ERR	$0	ERR	$0	ERR	$0	ERR	027
$991	4.27	$0	7322.65	$452	ERR	$1,353	3.14	$0	ERR	$0	ERR	$0	ERR	$0	ERR	028
$0	ERR	$0	12378.76	$88	ERR	$263	16.14	$0	ERR	$0	ERR	$0	ERR	$0	ERR	029
$0	ERR	$3	811.72	$52	ERR	$156	27.29	$0	ERR	$0	ERR	$0	ERR	$0	ERR	030
$1,739	2.43	$4	660.20	$794	ERR	$2,375	1.79	$0	ERR	$0	ERR	$0	ERR	$0	ERR	031
$2,138	1.98	$4	660.20	$976	ERR	$2,920	1.46	$0	ERR	$0	ERR	$0	ERR	$0	ERR	032
$2,138	1.98	$4	660.20	$976	ERR	$2,920	1.46	$0	ERR	$0	ERR	$0	ERR	$0	ERR	370-A
$2,138	1.98	$0	ERR	$976	ERR	$2,920	1.46	$0	ERR	$0	ERR	$0	ERR	$0	ERR	370-B

Eco #5

LETTERKENNY ARMY DEPOT
ENERGY MONITORING AND CONTROL SYSTEM STUDY
FY88, OMA, PN262

Building No. 370 EMCS Program Listing (< 3 year Payback).

Program	System	Annual Savings	Payback
Schedule S/S	002	$4,642.00	.36
	003	3,554.00	.47
	027	4,670.00	.35
	028	2,544.00	.65
	029	1,195.00	1.38
	030	4,830.00	.34
	031	4,440.00	.37
	370-A	4,079.00	.41
LEAD Mod. Economizer	003	$2,138.00	1.98
	004	2,138.00	1.98
	027	2,138.00	1.98
	031	1,739.00	2.43
	032	2,138.00	1.98
	370-A	2,138.00	1.98
	370-B	2,138.00	1.98
Reheat Reset	003	$2,920.00	1.46
	027	2,920.00	1.46
	031	2,375.00	1.79
	032	2,920.00	1.46
	370-A	2,920.00	1.46
	370-B	2,920.00	1.46

Total Building No. 370 Annual Potential Savings: $65,757.00

(EMCS Programs < 3 year Payback)

87079

05/14/91

ECO Construction Cost Estimate Calculations

ECO Name: EMCS For Building 370

ECO #: 5

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$62,256
Labor	$41,771
Subtotal bare costs	$104,027
FICA Insurance (20% of Labor)	$8,354
Sales Tax (6.5% of Material)	$4,047
Subtotal	$116,428
Overhead (15%)	$17,464
Subtotal	$133,892
Profit (10%)	$13,389
Subtotal	$147,281
Bond (1%)	$1,473
Subtotal	$148,754
Contingency (10%)	$14,875
Subtotal (Construction Cost Input For LCCID *)	$163,629
SIOH (5.5% of Construction Cost)	$9,000
Subtotal	$172,629
Design (6% of Construction Cost)	$9,818
Total Project Cost	$182,447

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED April 12, 1991	SHEET 1 OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☑ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. N/A | ESTIMATOR W. T. Todd | CHECKED BY P. Hutchins

EMCS #370 SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Scheduled Start/Stop	13	Ea.	736	9,568	917	11,921	
Day/Night Setback	1	Ea.	736	736	917	917	
Modified Economizer	9	Ea.	1631	14,679	2602	23,418	
Reheat Coil Reset	8	Ea.	1586	12,688	2663	21,304	
FID Installation	—	—	2883	2,883	2883	2,883	
Subtotal 1989 $				40,554		60,443	100,997
Escalate (x 1.03)							
Subtotal 1991 $				41,771		62,256	$104,027

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—510148

COST ESTIMATE BACK-UP

Eco #5

LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: SCHEDULED START/STOP

I/O Requirements

Digital Inputs - Equipment status
Analog Inputs - Space dry bulb temperature
Digital Outputs - on/off control relay

Cost Estimate:

	Material Cost	Labor MH	Labor Costs	Total Costs
DIGITAL INPUT FUNCTIONS:				
1. Differential Pressure (Air) (e.g., fan status):				
Air DP Switch	70	1.9 (SM)	44	114
DI Common Costs	139	8.4 (E)	193	332
Totals	209	8.4(E)+1.9(SM)	237	446
ANALOG INPUT FUNCTIONS:				
1. Space Temperature	125	1.4 (E)	32	157
RTD and Transmitter	210	9.4 (E)	216	426
AI Common Costs	335	10.8 (E)	248	583
DIGITAL OUTPUT FUNCTIONS:				
1. Controller Override (e.g., Economizer Switchover)				
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.5 (P)	12	37
DO Common Costs	139	8.4 (E)	193	332
Totals	373	1.5(P)+9.4(E)	251	624

SCHEDULED START/STOP Total Estimated Cost $1,653.00

Totals	$917		$736	$1653

REV 25 JUL 80

5-15

ECO #5

LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: DAY/NIGHT SETBACK

I/O Requirements

Digital Inputs - Equipment status

Analog Inputs - Space dry bulb temperature

Digital Outputs - on/off control relay

Cost Estimate:

	Material Cost	Labor MH	Labor Costs	Total Costs
ANALOG INPUT FUNCTIONS:				
1. Space Temperature:				
RTD and Transmitter	125	1.4 (E)	32	157
AI Common Costs	210	9.4 (E)	216	426
Totals	335	10.8 (E)	248	583
DIGITAL INPUT FUNCTIONS:				
1. Differential Pressure (Air) (e.g., fan status):				
Air DP Switch	70	1.9 (SM)	44	114
DI Common Costs	139	8.4 (E)	193	332
Totals	209	8.4(E)+1.9(SM)	237	446
DIGITAL OUTPUT FUNCTIONS:				
1. Controller Override				
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.5 (P)	12	37
DO Common Costs	139	8.4 (E)	193	332
Totals	373	1.5(P)+9.4(E)	251	624

DAY/NIGHT SETBACK Total Estimated Cost $1,653.00

Totals $917 $736 $1653

87079

LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: LEAD MODIFIED ECONOMIZER

I/O Requirements

Digital Inputs - Humidity high limit

Analog Inputs - O/A damper position
O/A dry bulb temperature
Mixed Air Temperature.

Analog Outputs - Auto/minimum open
O/A damper control

Cost Estimate:

	Material Cost	Labor MH	Labor Costs	Total Costs
DIGITAL INPUT FUNCTIONS:				
1. O/A Humidity:				
Humidity Switch	105	1.5 (E)	35	140
DI Common Costs	139	8.4 (E)	193	332
Totals	244	9.9 (E)	228	472
ANALOG INPUT FUNCTIONS:				
1. Damper (Valve) Continuous Position				
Potentiometer	135	2.0 (E)	46	181
Potentiometer-Current Transducer	75	0.9 (E)	21	96
AI Common Costs	210	9.4 (E)	216	426
Totals	~~250~~ 420	12.3 (E)	283	703
2. Outside Air Temperature:				
RTD and Transmitter	130	2.2 (E)	51	181
Instrument Shelter	350	2.0 (E)	46	396
AI Common Costs	210	9.4 (E)	216	426
Totals	690	13.6 (E)	313	1,003
3. Duct (Point) Temperature:				
RTD and Transmitter	130	2.3 (E)	51	181
AI Common Costs	210	9.4 (E)	216	426
Totals	340	11.6 (E)	267	607

EMCS Program: LEAD MODIFIED ECONOMIZER (Continued)

ANALOG OUTPUT FUNCTIONS:

	Material Cost	Labor MH	Labor Costs	Total Costs
1. Control Point Adjustment Fail Low, High, or Local Loop				
CPA Controller, Pneumatic	130	1.8 (P)	41	171
I/P Converter	205	1.0 (P)	23	228
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.9 (P)	21	46
AO Common Costs	200	9.4 (E)	216	416
DO Common Costs	139	8.4 (E)	193	332
Total	908	18.8(E)+4.7(P)	540	1,448

"LEAD MODIFIED" ECONOMIZER Total Estimated Cost $4,233.00

	Material	Labor	Total
Totals	$2602	$1631	$4233

ECO#5

LEAD EMCS PROGRAM COST ESTIMATES

EMCS Program: REHEAT COIL RESET

<u>I/O Requirements</u>

Analog Inputs - Cold deck temperature
Reheat coil valve position
Space dry bulb temperature
Space relative humidity

Analog Outputs - Cold deck temperature CPA

<u>Cost Estimate:</u>

	Material Cost	Labor MH	Labor Costs	Total Costs
ANALOG INPUT FUNCTIONS:				
1. Duct (Point) Temperature:				
RTD and Transmitter	130	2.2 (E)	51	181
AI Common Costs	210	9.4 (E)	216	426
Totals	340	11.6 (E)	267	607
2. Valve Continuous				
Potentiometer	135	2.0 (E)	46	181
Potentiometer-Current Transducer	75	0.9 (E)	21	96
AI Common Costs	210	9.4 (E)	216	426
Totals	~~250~~ 420	12.3 (E)	283	703
3. Space Temperature:				
RTD and Transmitter	125	1.4 (E)	32	157
AI Common Costs	210	9.4 (E)	216	426
Totals	335	10.8 (E)	248	583
4. Space Relative Humidity:				
RH Sensor and Transmitter	450	1.4 (E)	32	482
AI Common Costs	210	9.4 (E)	216	426
Totals	660	10.8 (E)	248	908
ANALOG OUTPUT FUNCTIONS:				
1. Control Point Adjustment, Fail Low, High, or Local Loop				
CPA Controller, Pneumatic	130	1.8 (P)	41	171
I/P Converter	205	1.0 (P)	23	228
Control Relay	19	1.0 (E)	23	42
EP Valve	190	1.0 (P)	23	213
Pressure Regulator	25	0.9 (P)	21	46
AO Common Costs	200	9.4 (E)	216	416
DO Common Costs	139	8.4 (E)	193	332
Total	908	18.8(E)+4.7(P)	540	1,448

REHEAT COIL RESET Total Estimated Cost $4,249.00.

Totals #2663 5-19 #1586 #4249

ECO#5

LETTERKENNY ARMY DEPOT
ENERGY MONITORING AND CONTROL SYSTEM STUDY
FY88, OMA, PN262
BUILDING NO. 370

INDIVIDUAL BUILDINGS EMCS SAVINGS, COST AND PAYBACK PERIOD

A. Total (< 3 year payback) program savings — $65,757.00

B. Total (< 3 year payback) program costs:

Schedule Start/Stop (9 Systems)	$ 1,653.00 each
LEAD Modified Economizer (7 Systems)	$ 4,233.00 each
Reheat Coil Reset (6 Systems)	$ 4,249.00 each

C. Building FID Installation Cost (Include Power Conditioner plus 120 Vac) — $ 5,766.00

D. Building No. 370 Individual Payback Period — 1.1 years

Building Payback Period = Sum of Costs/Savings

D = (B + C)/A

87079

RS&H®

SUBJECT LETTERKENNY A.D.
ECO #6

DESIGNER G. F.

CHECKER [initials]

AEP NO 290-0379-001

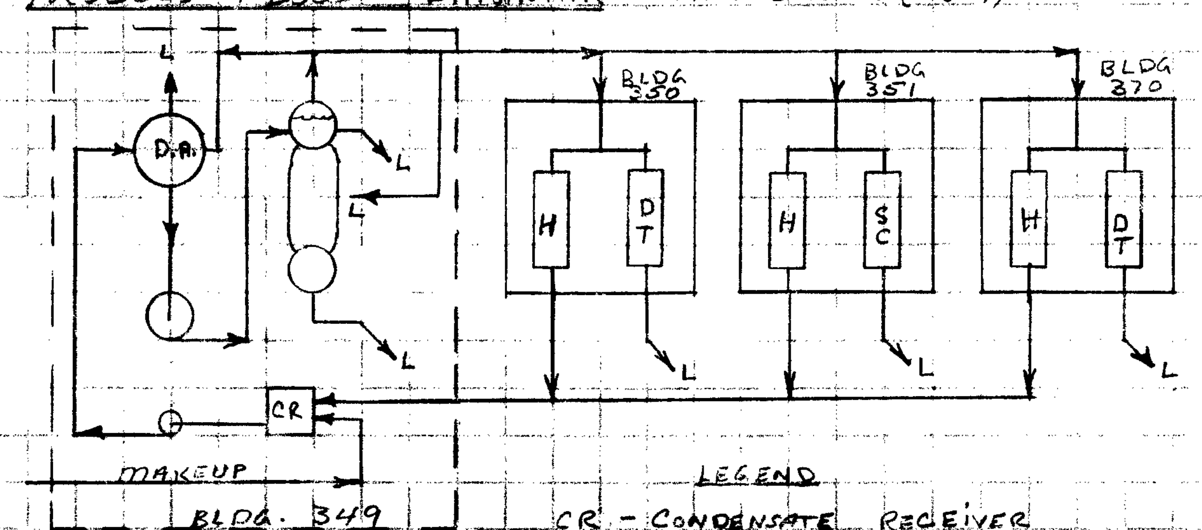
SHEET ____ OF ____

DATE ____

DATE ____

ECO#6 – REDUCE MAKEUP WATER REQUIREMENTS AT BLDG. 349

PROCESS FLOW DIAGRAM – MAIN BOILER (#349)



LEGEND

CR – CONDENSATE RECEIVER
DA – DEAERATING FEEDWATER HEATER
DT – DIP TANK HEATING
H – COMFORT HEATING
L – LOSS
SC – STEAM CLEANING.

STEAM LOSSES	HEAT RECOVERABLE	CONDENSATE RECOVERABLE
1. D.A. VENT	NO	NO
2. CONTINUOUS BLOWDOWN	YES	NO
3. BOTTOM BLOWDOWN	YES	NO
4. SOOT BLOWER	NO	NO
5. ATOM. STEAM	NO	NO
6. BLDG 350 DIP TANKS	YES	NO
7. BLDG 351 STEAM CLEAN	NO	NO
8. BLDG 370 DIP TANKS	YES	NO

SUBJECT LETTER KENNY A.D.
ECO #6

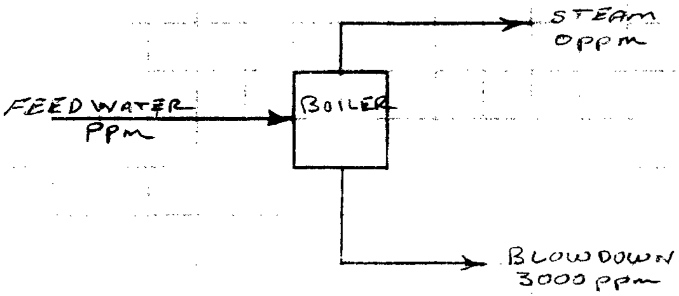
AEP NO
SHEET 2 OF

DESIGNER
DATE
CHECKER
DATE

HEAT RECOVERY FROM BOILER BLOWDOWN (Items 2 & 3)

DETERMINE BLOW DOWN FLOW

ASSUME: 3000 ppm TDS BOILER WATER (ABMA STD)
: 30 ppm IN FEEDWATER



Σ water = 0 = FEEDWATER − STEAM FLOW − BLOW DOWN = $m_f - m_s - m_B$

Σ SOLIDS = 0 = FEEDWATER × CONC. − STEAM FLOW × CONC. − BLOWDOWN × CONC

$$0 = m_f \times C_f - m_s C_s - m_B C_B$$

$$0 = m_f C_f - (m_f - m_B) C_s - m_B C_B \quad (C_s \rightarrow 0)$$

$$0 = m_f C_f - m_B C_B$$

$$m_B = m_f \frac{C_f}{C_B} = m_f \frac{30}{3000} = .001\, m_f$$

SO Blowdown ≈ .1% of STEAM FLOW

TOTAL STEAM PRODUCTION

$$\text{TOTAL STEAM PRODUCTION} = \frac{\text{TOTAL FUEL CONSUMPTION}}{\text{BOILER EFF} \times \Delta H}$$

$$= \frac{188\,578 \text{ MBTU/yr}}{.8 \times (1188.1 - (.8 \times 148 + .2 \times 28))}$$

= 221.5 million LBS STEAM / yr

TOTAL BLOW DOWN

$$221.5 \times 10^6 \times .001 = 221.5 \times 10^3 \text{ LBS/YR.}$$

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SUBJECT LEAD
ECO #6

DESIGNER

CHECKER

AEP NO

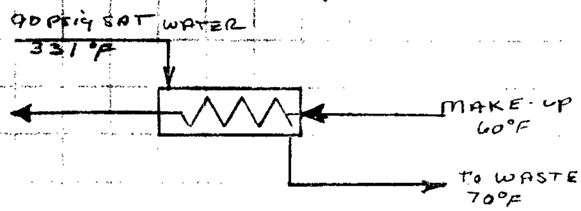
SHEET OF

DATE

DATE

RECOVERABLE ENERGY IN BLOW DOWN

ASSUME: 10° ΔT COLD END APPROACH
90 psig BOILER PRESSURE
MAKE-UP WATER TEMP = 60°F



$\dot{Q} = \dot{w} c_p \Delta T = \frac{221.5 \times 10^3 \text{ LBS/yr} \times (331 - 70)}{0.8 \times 10^6} = 72.3$ MBTU #6 OIL

VALUE OF RECOVERED ENERGY

72.3 MBTU/yr × \$6.61/MBTU = \$478. /yr.

CONSTRUCTION COST = \$9297

PAYBACK = $\frac{\$9297}{\$478/\text{yr}}$ = 19.4 YEARS => NOT RECOMMENDED

RS&H

SUBJECT LEAD ECO #6 | AEP NO ___
SHEET ___ OF ___
DESIGNER ___ | DATE ___
CHECKER ___ | DATE ___

HEAT RECOVERY FROM DIP TANK CONDENSATE.

DIP TANK STEAM CONSUMPTION

DURING NON-WORK SUMMERTIME WEEKENDS THE ONLY STEAM CONSUMERS ARE THE DIP TANKS IN BUILDINGS 350 & 370. SINCE THESE ARE THE ONLY CONSUMERS AND THE CONDENSATE IS DUMPED, THE MAKEUP FLOW IS EQUAL TO THE STEAM FLOW AND THE CONDENSATE FLOW.

1990 AUGUST WEEKEND MAKEUP FLOW DATA

DATE	MAK-UP FLOW (GPD)
4	2891
5	2800
11	2800
12	2800
18	3200
19	3300
25	4000
26	3300
TOTAL	25100
AVERAGE (GPD)	3140
AVERAGE (#/HR)	1090

THERE ARE 11 HEATED TANKS TOTALING 19,200 GAL. THE TANKS OPERATE AT APPROXIMATELY THE SAME TEMPERATURE. THE STEAM CAN BE ASSUMED TO BE CONSUMMED AS A FUNCTION OF TANK CAPACITY. THE CONDENSATE TEMPERATURE IS EQUAL TO THE TANK TEMPERATURE

$$\frac{1090 \text{ \#/HR}}{19200 \text{ gal}} = 0.0568 \text{ \# STEAM/HR/GAL}$$

R S & H

SUBJECT: LEAD ECO #6 AEP NO: SHEET: OF:
DESIGNER: DATE:
CHECKER: DATE:

350 N

4 TANKS @ 3000 gal ea = 12,000 gal
2 TANKS @ 500 gal ea = 1,000 gal
13,000 gal

TOTAL STEAM CONSUMPTION

13,000 gal X 0.0568 #STEAM/HR/gal = 738 LBS STM/HR.

RECOVERABLE ENERGY IN CONDENSATE
ASSUME: 68°F INDOOR TEMP., 10° H/X APPROACH.
738 LBS STM/HR X (180 − 78) = 75,300 BTU/HR

ANNUAL HEAT RECOVERY

$$\frac{75300 \text{ BTU/HR}}{10^6 \text{ BTU/MBTU} \times 0.8} \times 6687 \text{ HR/YR} = 629 \text{ MBTU/YR \#6 OIL}$$

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SUBJECT LEAD ECO #6

DESIGNER

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AEP NO

SHEET OF

DATE

DATE

350 S

2 TANKS @ 1600 gal (ea) = 3200 gal

TOTAL STEAM CONSUMPTION

3200 gal x 0.0568 #STM/HR/gal = 182 LBS STM/HR

RECOVERABLE ENERGY IN CONDENSATE

182 LBS STM/HR x (180 − 78) = 18500 BTU/HR

ANNUAL HEAT SAVED

$\frac{18500 \text{ BTU/HR}}{10^6 \text{ BTU/MBTU} \times 0.8} \times 6687 \text{ HRS/YR} = 155$ MBTU/YR #6 OIL

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SUBJECT LEAD ECO #6

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AEP NO

SHEET ____ OF ____

DATE

DATE

370

3 TANKS @ 1000 gal @ = 3000 gal

TOTAL STEAM CONSUMPTION

3000 gal x 0.0568 #S/HR·gal = 170 LBS STM/HR

RECOVERABLE ENERGY IN CONDENSATE

170 LBS STM/HR x (180 - 72) = 18400 BTU/HR

ANNUAL ENERGY RECOVERY

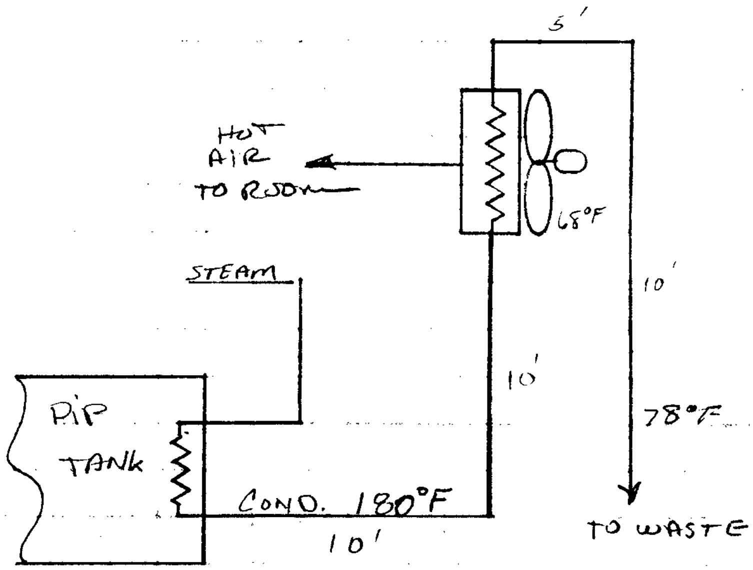
$\frac{18400 \text{ BTU/HR}}{10^6 \text{ BTU/MBTU} \times 0.8} \times 6687 \text{ HRS/YR} = 154 \frac{\text{MBTU}}{\text{YR}}$ #6 oil

SUBJECT LEAD
ECO #6

DESIGNER
CHECKER

AEP NO
SHEET OF
DATE
DATE

DIP TANK CONDENSATE HEAT RECOVERY



1 HYDRONIC HEATER,
35 ft - 1" ø SCH 40 PIPE,
3 1" ø " " ELS.
NO INSULATION

ONE UNIT REQUIRED @ EACH GROUP OF DIP TANKS, 3 ~~TOTAL~~.

TOTAL ENERGY SAVED = 629 + 155 + 154 = 938 MBTU/YR

TOTAL CONSTRUCTION COST $2701

QRIP Calculations

Present energy use = {(738 + 182 + 170) #/hr} * 6687 hr/yr * 1050 Btu/lb

= 7653 MBtu/yr * 4.41 $/MBtu = $33,800/yr

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	1
	9 AM - 5 PM	1
	5 PM - 1 AM	1
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Total Operation Hours While Heating (and corrected for working days/week)	4776	118,470
Avg outdoor temp while heating (F)	45.0	

7472
− 785
6687 HRS of HEATING

05/16/91

ECO Construction Cost Estimate Calculations

ECO Name: Condensate heat recovery - dip tank heat exchanger

ECO #: 6

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$1,310
Labor		$274
	Subtotal bare costs	$1,584
FICA Insurance (20% of Labor)		$55
Sales Tax (6.5% of Material)		$85
	Subtotal	$1,724
Overhead (15%)		$259
	Subtotal	$1,983
Profit (10%)		$198
	Subtotal	$2,181
Bond (1%)		$22
	Subtotal	$2,203
Contingency (10%)		$220
Subtotal (Construction Cost Input For LCCID *)		$2,423
SIOH (5.5% of Construction Cost)		$133
	Subtotal	$2,556
Design (6% of Construction Cost)		$145
Total Project Cost		$2,701

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO. | ESTIMATOR | CHECKED BY

DIP TANK COND HEAT RECOV. ECO #6 SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
1 HYDRONIC HEATER							
MEANS No. 1556304000	3	EA	31	93	415	1250	1340
1" SCH 40 PIPE	35	LF	3.84	134	1.49	52	186
1" " " ELS	3	EA	15.65	47	1.30	4	51
				274		1310	1580

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE : 1980 O—

05/16/91

ECO Construction Cost Estimate Calculations

ECO Name: Condensate heat recovery - blow down heat exchanger

ECO #: 6

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$3,340
Labor		$1,980
	Subtotal bare costs	$5,320
FICA Insurance (20% of Labor)		$396
Sales Tax (6.5% of Material)		$217
	Subtotal	$5,933
Overhead (15%)		$890
	Subtotal	$6,823
Profit (10%)		$682
	Subtotal	$7,505
Bond (1%)		$75
	Subtotal	$7,580
Contingency (10%)		$758
Subtotal (Construction Cost Input For LCCID *)		$8,338
SIOH (5.5% of Construction Cost)		$459
	Subtotal	$8,797
Design (6% of Construction Cost)		$500
Total Project Cost		$9,297

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.	ESTIMATOR	CHECKED BY

SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
BLOWDOWN HEAT RECOVERY - ECO 6	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
BLOWDOWN HEAT H/X							
MEANS ITEM NO							
155601180	1	ea	185	185	2160	2160	2350
2" ø SCH 40 PIPE	200	LF	5.75	1150	2.91	582	1730
2" ø CAL. SIL INSULATION	200	LF	2.22	444	2.22	444	890
2" ø STEEL ELS.	10	EA	20	200	15.7	157	360
				1980		3340	5330

ENG FORM 150
1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

ECO # 8

Reflectors for Fluorescent fixtures in Building 370

Assumptions:

1. The Fluorescent lights in the casing repair area are on 2 shifts, 5 days per week (4160 hr/yr)

2. Two lamps and one ballast will be removed from each fixture.

3. The ballasts uses 20 % of the lamp energy which is 16 watts for 2, 40-watt lamps.

Current Energy Consumption:

$$450 \text{ Fixt.} \times 4 \frac{\text{lamps}}{\text{fixt}} \times 40 \frac{\text{watt}}{\text{lamp}} \times 1.2 \times \frac{1 \text{ kw}}{1000 \text{ w}} = 86.4 \text{ kw}$$

$$86.4 \text{ kw} \times 4160 \text{ hr/yr} = 359{,}424 \text{ kwh/yr}$$

Energy consumption with reflectors:

$$450 \text{ fixt.} \times 2 \frac{\text{lamp}}{\text{fixt.}} \times 40 \frac{\text{w}}{\text{lamp}} \times 1.2 \times \frac{1 \text{ kw}}{1000 \text{ w}} = 43.2 \text{ kw}$$

$$43.2 \text{ kw} \times 4160 \text{ hr/yr} = 179{,}712 \text{ kwh/yr}$$

Energy Savings

$$(359{,}424 - 179{,}712) \frac{\text{kwh}}{\text{yr}} = \underline{179{,}712 \text{ kwh/yr}}$$

$$179{,}712 \text{ Kwh/yr} \times 3413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ mBtu}}{10^6 \text{ Btu}} = \underline{613.4 \frac{\text{mBtu}}{\text{yr}}}$$

Energy Cost Savings:

$$179{,}712 \text{ kwh/yr} \times \$0.0373/\text{Kwh} = \underline{\$6703/\text{yr}}$$

Project Implementation Cost:

Total Project Cost = $\underline{\$35{,}699}$

See Cost Estimate sheets for details

Simple Payback:

Payback = Cost ÷ Savings

= $35,699 ÷ $6,703 /yr

Payback = $\underline{5.3 \text{ years}}$

05/14/91

ECO Construction Cost Estimate Calculations

ECO Name: Reflectors For Fluorescent Fixtures In Building 370

ECO #: 8

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$11,250
Labor		$9,000
	Subtotal bare costs	$20,250
FICA Insurance (20% of Labor)		$1,800
Sales Tax (6.5% of Material)		$731
	Subtotal	$22,781
Overhead (15%)		$3,417
	Subtotal	$26,198
Profit (10%)		$2,620
	Subtotal	$28,818
Bond (1%)		$288
	Subtotal	$29,106
Contingency (10%)		$2,911
Subtotal (Construction Cost Input For LCCID *)		$32,017
SIOH (5.5% of Construction Cost)		$1,761
	Subtotal	$33,778
Design (6% of Construction Cost)		$1,921
Total Project Cost		$35,699

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED May 6, 1991	SHEET 1 OF
PROJECT ENERGY ENGINEERING ANALYSIS	BASIS FOR ESTIMATE	
LOCATION Letterkenny Army Depot	☒ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☐ OTHER (Specify)	
ARCHITECT ENGINEER REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO.	ESTIMATOR W. T. Todd	CHECKED BY

Reflectors SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
specular, aluminum reflector for 2'x4' Flourescent fixture.	450	Ea	20	9,000	25	11,250	$20,250

Source: Fluor-Tech Inc. Mr. Darryl Masters
P.O. Box 819
Pismo Beach, CA 93448

Assume two hours per fixture for installation (maximum) at $10 per hour.

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—516140

Eco #8

RS&H

Telephone Call Confirmation

Project No. 290-0379-001

Local ___ (L.D.) ___ (Placed) ___ Rec'd. ___ Date 5-3-91

B. Todd Conversed With Daryl Masters

Of Fluor-Tech Inc. Regarding Reflectors for LEAD

Ph: 800-423-9206 Fax: 805-773-6665

FTI does custom fabrication of reflectors for Fluorescent light fixtures. For an accurate quote he needs to see pictures of the particular type of fixtures to be retrofitted. Material costs will be about \$3.15 per s.f. of reflector. Installation costs will vary greatly depending upon if the lamp connector posts have to be moved or not.

For the fixtures at LEAD Bldg. 370 FTI would cut slots in the reflectors directly above the lamps to provide some uplighting.

FTI
P.O. Box 819
Pismo Beach, CA 93448

Distribution:

3/89

RS&H

SUBJECT LETTERKENNY A.D. ECO 9

AEP NO 290-0379-001

SHEET 1 OF

DESIGNER G.F.

DATE

CHECKER

DATE

ECO #9 Paint Booth Fan Control : Bldg 350, Booth #61

CURRENT ENERGY COSTS

NO. 6 OIL

ASSUME: 68°F EXHAUST AIR, 2SHIFT OPERATION
74,233 BTU/CFM/YR.
12141 CFM EXHAUST FLOW
BOILER EFFICIENCY = 0.8
F491 Fuel prices except for Q

HEAT LOSS

$$HL = \frac{74{,}233 \text{ B/CFM/YR} \times 12141 \text{ CFM}}{0.8 \times 10^6} = 1127 \text{ MBTU/YR}$$

HEAT LOSS COST

1130 MBTU/YR x $4.41/MBTU = $4983/YR

ELECTRICITY

ASSUME: 2 HP MOTOR (BKA, INC. REPORT)

ENERGY CONSUMED

2 HP x .746 KW/HP x 16H/d x 5d/w x 52 w/YR = 6210 KWH
= 21. MBTU/YR

COST

6210 KWH x $0.0373/KWH = $230/YR

TOTAL COST

$4983/YR + $230/YR = $5213/YR

SAVINGS

ASSUME: FAN IS OFF FOR ½ TIME

RS&H

SUBJECT LEAD ECO #9

AEP NO

SHEET 2 OF

DESIGNER

DATE

CHECKER

DATE

SAVINGS CONT.

No. 6 OIL

ENERGY

$\frac{1127 \text{ MBTU/YR}}{2} = 564 \text{ MBTU/YR}$

COST

564 MBTU/YR x $4.41/MBtu = $2487/yr

ELECTRICITY

ENERGY

$\frac{6210 \text{ kWh/yr}}{2} = 3110 \text{ kWh/YR} = 11 \text{ MBTU/YR}$

COST

3110 kWh/yr x $0.0373/kWh = $120/yr.

TOTAL SAVINGS

COST SAVINGS = OIL SAVINGS + ELEC. SAVINGS

= $2487/yr + $120/yr

= $2607/yr

ENERGY SAVINGS = $564 \frac{\text{MBtu}}{\text{yr}} + 11 \frac{\text{MBtu}}{\text{yr}}$

= 575 MBtu/yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	350
Paint Booth No.:	2527
Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	5 HP
Exhaust Air Flow:	25,959 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	74,233 Btu/cfm-Yr
Operating Shifts:	2 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	2409 MBtu/Yr
Heating Energy Cost =	$10,624 /Yr
Current Electric Use =	53 MBtu/Yr
Electricity Cost =	$580 /Yr
Current Energy Use =	2462 MBtu/Yr
Current Energy Cost =	$11,204 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	1205 MBtu/Yr
Heating Cost Savings =	$5,314 /Yr
Electric Energy Savings =	27 MBtu/Yr
Electric Cost Savings =	$295 /Yr
Total Energy Savings =	1232 MBtu/Yr
Total Energy Cost Savings =	$5,609 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	37
Paint Booth No.:	280

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	3 HP
Exhaust Air Flow:	18,318 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	74,233 Btu/cfm-Yr
Operating Shifts:	2 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	1700 MBtu/Yr
Heating Energy Cost =	$7,497 /Yr
Current Electric Use =	32 MBtu/Yr
Electricity Cost =	$350 /Yr
Current Energy Use =	1732 MBtu/Yr
Current Energy Cost =	$7,847 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	850 MBtu/Yr
Heating Cost Savings =	$3,749 /Yr
Electric Energy Savings =	16 MBtu/Yr
Electric Cost Savings =	$175 /Yr
Total Energy Savings =	866 MBtu/Yr
Total Energy Cost Savings =	$3,924 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	37
Paint Booth No.:	468

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	2 HP
Exhaust Air Flow:	11,152 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	74,233 Btu/cfm-Yr
Operating Shifts:	2 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	1035 MBtu/Yr
Heating Energy Cost =	$4,564 /Yr
Current Electric Use =	21 MBtu/Yr
Electricity Cost =	$230 /Yr
Current Energy Use =	1056 MBtu/Yr
Current Energy Cost =	$4,794 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	518 MBtu/Yr
Heating Cost Savings =	$2,284 /Yr
Electric Energy Savings =	11 MBtu/Yr
Electric Cost Savings =	$120 /Yr
Total Energy Savings =	529 MBtu/Yr
Total Energy Cost Savings =	$2,404 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	37
Paint Booth No.:	470

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	3 HP
Exhaust Air Flow:	12,069 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	74,233 Btu/cfm-Yr
Operating Shifts:	2 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	1120 MBtu/Yr
Heating Energy Cost =	$4,939 /Yr
Current Electric Use =	32 MBtu/Yr
Electricity Cost =	$350 /Yr
Current Energy Use =	1152 MBtu/Yr
Current Energy Cost =	$5,289 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	560 MBtu/Yr
Heating Cost Savings =	$2,470 /Yr
Electric Energy Savings =	16 MBtu/Yr
Electric Cost Savings =	$175 /Yr
Total Energy Savings =	576 MBtu/Yr
Total Energy Cost Savings =	$2,645 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	370
Paint Booth No.:	200

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	5 HP
Exhaust Air Flow:	17,100 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	35,618 Btu/cfm-Yr
Operating Shifts:	1 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	761 MBtu/Yr
Heating Energy Cost =	$3,356 /Yr
Current Electric Use =	26 MBtu/Yr
Electricity Cost =	$284 /Yr
Current Energy Use =	787 MBtu/Yr
Current Energy Cost =	$3,640 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	381 MBtu/Yr
Heating Cost Savings =	$1,680 /Yr
Electric Energy Savings =	13 MBtu/Yr
Electric Cost Savings =	$142 /Yr
Total Energy Savings =	394 MBtu/Yr
Total Energy Cost Savings =	$1,822 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	370
Paint Booth No.:	412

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	1.5 HP
Exhaust Air Flow:	6,147 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	35,618 Btu/cfm-Yr
Operating Shifts:	1 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	274 MBtu/Yr
Heating Energy Cost =	$1,208 /Yr
Current Electric Use =	8 MBtu/Yr
Electricity Cost =	$88 /Yr
Current Energy Use =	282 MBtu/Yr
Current Energy Cost =	$1,296 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	137 MBtu/Yr
Heating Cost Savings =	$604 /Yr
Electric Energy Savings =	4 MBtu/Yr
Electric Cost Savings =	$44 /Yr
Total Energy Savings =	141 MBtu/Yr
Total Energy Cost Savings =	$648 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	370
Paint Booth No.:	3877

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	2 HP
Exhaust Air Flow:	11,956 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	35,618 Btu/cfm-Yr
Operating Shifts:	1 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	532 MBtu/Yr
Heating Energy Cost =	$2,346 /Yr
Current Electric Use =	11 MBtu/Yr
Electricity Cost =	$120 /Yr
Current Energy Use =	543 MBtu/Yr
Current Energy Cost =	$2,466 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	266 MBtu/Yr
Heating Cost Savings =	$1,173 /Yr
Electric Energy Savings =	6 MBtu/Yr
Electric Cost Savings =	$66 /Yr
Total Energy Savings =	272 MBtu/Yr
Total Energy Cost Savings =	$1,239 /Yr

ECO #9
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/14/91

Building Number:	370
Paint Booth No.:	4298

Heating Fuel Type:	#6 Fuel Oil
Heating Fuel Cost:	$4.41 /MBtu
Boiler Efficiency:	80%
Electricity Cost:	$10.94 /MBtu
Exhaust Fan Motor:	7.5 HP
Exhaust Air Flow:	18,592 CFM
Makeup Percentage:	100%
Exhaust Air Temp.:	68 °F
O A Heating Load:	35,618 Btu/cfm-Yr
Operating Shifts:	1 /Day
Operating Days:	5 /Week

Current Energy Use:

Current Heating Energy =	828 MBtu/Yr
Heating Energy Cost =	$3,651 /Yr
Current Electric Use =	40 MBtu/Yr
Electricity Cost =	$438 /Yr
Current Energy Use =	868 MBtu/Yr
Current Energy Cost =	$4,089 /Yr

Savings if fan is turned off 50% of the time:

Heating Energy Savings =	414 MBtu/Yr
Heating Cost Savings =	$1,826 /Yr
Electric Energy Savings =	20 MBtu/Yr
Electric Cost Savings =	$219 /Yr
Total Energy Savings =	434 MBtu/Yr
Total Energy Cost Savings =	$2,045 /Yr

ECO #9 Project Summary
Fan Controls For Open Paint Booths
Letterkenny Army Depot
10/21/91

						4.41	4.41	10.94				
		Energy Savings (MBtu/Yr)				Energy Cost Savings ($/Yr)				CURRENT COSTS		
Building Number	Booth Number	#5 Oil	#6 Oil	Elect	Total	#5 Oil	#6 Oil	Elect	Total	FUEL OIL	ELEC.	TOTAL
350	61		564	11	575	$0	$2,487	$120	$2,608	$4,983	$230	$5,213
350	2527		1205	27	1232	$0	$5,314	$295	$5,609	$10,624	$580	$11,204
37	280	850		16	866	$3,749	$0	$175	$3,924	$7,497	$350	$7,847
37	468	518		11	529	$2,284	$0	$120	$2,405	$4,564	$230	$4,794
37	470	560		16	576	$2,470	$0	$175	$2,645	$4,939	$350	$5,289
370	200		381	13	394	$0	$1,680	$142	$1,822	$3,356	$284	$3,640
370	412		137	4	141	$0	$604	$44	$648	$1,208	$88	$1,296
370	3877		266	6	272	$0	$1,173	$66	$1,239	$2,346	$120	$2,466
370	4298		414	20	434	$0	$1,826	$219	$2,045	$3,651	$438	$4,089
Total Project		1928	2967	124	5019	$8,502	$13,084	$1,357	$22,944	$43,168	$2,670	$45,838

$ 21,600

ECO 9

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.25
	9 AM - 5 PM	0.75
	5 PM - 1 AM	0
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating (and corrected for working days/week)	1465	35,618
Avg outdoor temp while heating (F)	45.0	

Eco 9

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16

Room or Supply Air Conditions - Winter	68
Air Quantity (cfm)	1
Hour Fractions 1 AM - 9 AM	0.375
9 AM - 5 PM	1
5 PM - 1 AM	0.625
Operation Days Per Week	5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	518	-4	1.08	1	0	0
65	69	296	217	278	502	1	1.08	1	1	542
60	64	269	196	236	444	6	1.08	1	6	2,880
55	59	249	191	209	415	11	1.08	1	12	4,930
50	54	221	193	202	402	16	1.08	1	17	6,949
45	49	218	193	206	404	21	1.08	1	23	9,151
40	44	237	236	239	474	26	1.08	1	28	13,317
35	39	289	246	286	533	31	1.08	1	33	17,849
30	34	304	194	258	469	36	1.08	1	39	18,244
25	29	184	106	152	270	41	1.08	1	44	11,956
20	24	124	65	90	168	46	1.08	1	50	8,334
15	19	75	32	57	96	51	1.08	1	55	5,274
10	14	54	13	26	50	56	1.08	1	60	2,994
5	9	18	3	9	15	61	1.08	1	66	1,013
0	4	9	0	2	5	66	1.08	1	71	330
-5	-1	3	0	1	2	71	1.08	1	77	134
-10	-6	1	0	0	0	76	1.08	1	82	31
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	4766					103,927
Total Operation Hours While Heating (and corrected for working days/week)					3035					74,233
Avg outdoor temp while heating (F)					45.0					

09/25/91

ECO Construction Cost Estimate Calculations

ECO Name: Walk-in Spray Booth Fan Control

ECO #: 9

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$1,179
Labor	$1,683
Subtotal bare costs	$2,862
FICA Insurance (20% of Labor)	$337
Sales Tax (6.5% of Material)	$77
Subtotal	$3,276
Overhead (15%)	$491
Subtotal	$3,767
Profit (10%)	$377
Subtotal	$4,144
Bond (1%)	$41
Subtotal	$4,185
Contingency (10%)	$419
Subtotal (Construction Cost Input For LCCID *)	$4,604
SIOH (5.5% of Construction Cost)	$253
Subtotal	$4,857
Design (6% of Construction Cost)	$276
Total Project Cost	$5,133

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- ☐ CODE A (No design completed)
- ☐ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.:

ESTIMATOR: G.F.

CHECKED BY:

WALK-IN SPRAY BOOTH FAN CONTROL SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
OCCUPANCY SENSOR	1	EA	25	25	80	80	105
CONDUIT ½" ø	50	LF	2.97	149	.96	48	197
WIRE 2-14	0.5	CLF	26.78	13	6.22	3	16
Subtotal For 1 Booth				187		131	318
x No. of Booths				x9		x9	
Total Bare Costs				$1,683		$1,179	$2,862

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1980 O—510148

RS&H

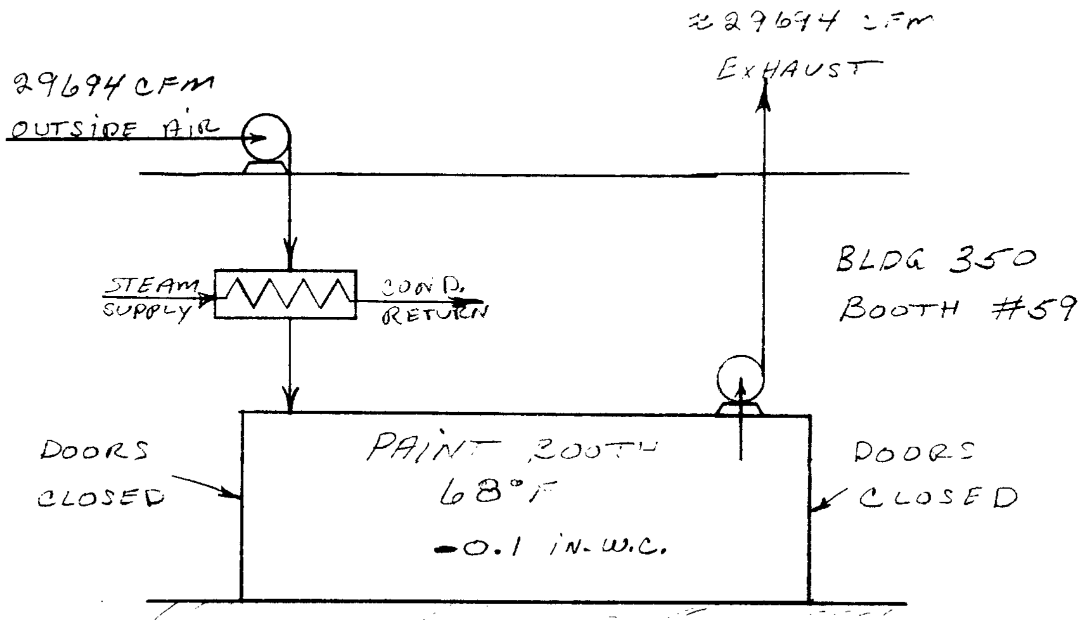
SUBJECT: LEAD ECO #10 AEP NO 290-0379-001

SHEET 1 OF

DESIGNER: G. Fallon DATE

CHECKER: P. Hutchins DATE

ECO #10 PAINT BOOTH AIR FLOW CONTROL



CALCULATE CURRENT HEAT LOSS

ASSUME: 68°F EXHAUST TEMP
29,694 CFM (LEAD, PAINT BOOTH STUDY, CKA, 1997, 1994)
BOTH FANS CAN BE SHUT DOWN FOR 50% OF THE TIME.
24 H/d, 5 d/wk OPERATION
118,470 BTU/CFM/YR (HEAT LOSS CALC., ENCLOSED)
0.8 BOILER EFFICIENCY.

$$\text{CONSUMPTION} = \frac{118470\ \text{BTU/CFM}\cdot\text{YR} \times 29694\ \text{CFM}}{0.8 \times 10^6\ \text{BTU/MBTU}} = 4{,}400\ \text{MBTU/YR}$$

SAVINGS #6 OIL

#6 OIL

ENERGY = 4,400 MBTU/YR X 0.5 = 2200 MBTU/YR

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SUBJECT: LEAD ECO #10
AEP NO:
SHEET: 2 OF:
DESIGNER: G.F.
DATE:
CHECKER:
DATE:

ECO 10 (CONT.)

CALCULATE CURRENT ELECTRICAL CONSUMPTION

ASSUME: TOTAL ΔP = 5.0 IN W.C (2.5" IN & 2.5" OUT)

FAN & MOTOR EFF = 0.6 $\frac{2545}{6356} = 0.4$

$$\text{FAN ENERGY} = \frac{.4 \times \text{FLOW} \times \text{HEAD}}{0.6} = \frac{.4 \times 29694\ \text{CFM} \times 5}{0.6} = 99081\ \text{BTU/Hr}$$

$$\text{ANNUAL ENERGY} = \frac{99081\ \text{B/Hr} \times 24\ \text{H/d} \times 5\ \text{d/wk} \times 52\ \text{w/YR}}{10^6\ \text{BTU/MBTU}} = \boxed{618\ \text{MBTU/YR}}$$

SAVINGS

ENERGY ELEC

618 MBTU/YR × 0.5 = **309 MBTU/YR ELEC**

COST ELEC

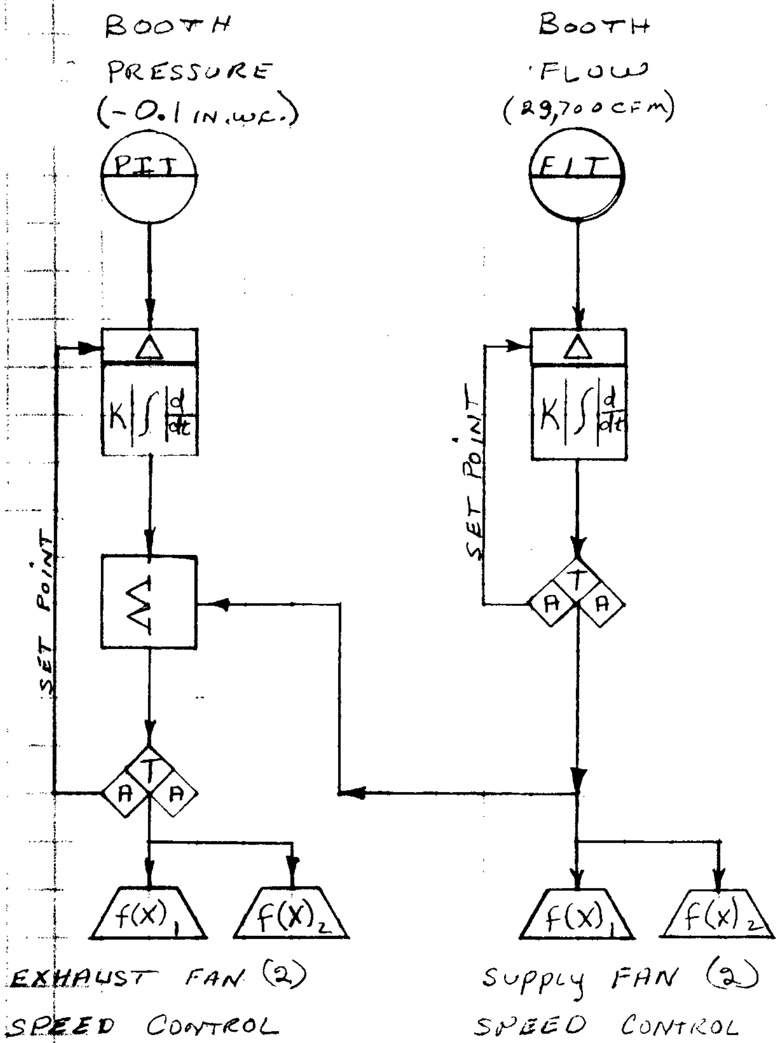
309 MBTU/YR × $10.94/MBTU = **$3382/YR ELEC.**

TOTAL SAVINGS

FROM pg 1: #6 OIL — 2200 MBTU/YR
ELEC — 309 MBTU/YR

NOTE: THE ABOVE TECHNIQUE WAS APPLIED TO LARGE PAINT SPRAY BOOTHS IN BLDGS 350 & 320 USING SPREAD SHEET SOFTWARE TO GENERATE A PAYBACK ON EACH BOOTH. THE RESULTS ARE SHOWN ON THE SUMMARY SHEET.

SUBJECT LETTERKENNY A-D.
AEP NO
SHEET 3 OF
DESIGNER
DATE
CHECKER
DATE



1) WHEN BOTH LARGE DOORS ARE CLOSED BOTH CONTROL LOOPS ARE OPERATING & CONTROLING

2) WHEN EITHER LARGE DOOR IS OPEN, BOTH FAN SPEEDS ARE REDUCED TO A MINIMUM, AUTOMATICALLY

3) THIS CONTROL SCHEME ASSURES DESIGN FLOW THROUGH THE BOOTH AT A SLIGHTLY NEGITIVE PRESSURE.

FLOW & PRESSURE WILL BE MAINTAINED REGARDLESS OF BUILDING NEGATIVE PRESSURE, SEASON OF YEAR, OR REASONABLE DEGREE OF SYSTEM CLEANLINESS.

LETTERKENNY ARMY DEPOT
LARGE PAINT BOOTH FAN CONTROL
SUMMARY

R E C O M M E N D E D

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION HOURS PER WEEEK	#6 FUEL SAVED (MBTU)	ELEC SAVED (MBTU)	COST SAVED ($/YR)	CONST. COST ($)	PAYBACK (YRS)
350	59	29694	120	2199	309.1	$13,078	$23,713	1.8
350	60	29694	120	2199	309.1	$13,078	$23,713	1.8
SUBTOTAL		59388	120	4397	618	$26,156	$47,426	1.8

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION HOURS PER WEEEK	#2 FUEL SAVED (MBTU)	ELEC SAVED (MBTU)	COST SAVED ($/YR)	CONST. COST ($)	PAYBACK (YRS)
320	3880	58876	40	1311	204.3	$8,762	$23,713	2.7
320	4378	29172	40	649	101.2	$4,342	$23,713	5.5
320	4379	27805	40	619	96.5	$4,138	$23,713	5.7
320	4380	27805	40	619	96.5	$4,138	$23,713	5.7
320	4381	27805	40	619	96.5	$4,138	$23,713	5.7
320	4382	27805	40	619	96.5	$4,138	$23,713	5.7
320	4383	27805	40	619	96.5	$4,138	$23,713	5.7
320	4384	27805	40	619	96.5	$4,138	$23,713	5.7
SUBTOTAL		254878	40	5674	884	$37,932	$189,704	5.0

GRAND TOTAL	#6 FUEL	4397	1503	$64,088	$237,130	3.7
	#2 FEUL	5674				

N O T   R E C O M M E N D E D

BUILDING NUMBER	BOOTH NUMBER	AIR FLOW (CFM)	OPERATION HOURS PER WEEEK	#2 FUEL SAVED (MBTU)	ELEC SAVED (MBTU)	COST SAVED ($/YR)	CONST. COST ($)	PAYBACK (YRS)
320	3930	2000	40	36	6.9	$253	$23,713	93.6
320	3931	2000	40	36	6.9	$253	$23,713	93.6

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SUBJECT ECO # 10 | AEP NO
SHEET ___ OF ___
DESIGNER P. Hutchins | DATE
CHECKER | DATE

QRIP Calculations Using FY92 Fuel Oil Prices

Current energy use:

#6 Fuel Oil = $\frac{HLF * cfm * 4.41\$/MBtu}{0.8 \cdot 10^6}$

= $\frac{118,470 \text{ Btu/cfm yr} * 59,388 \text{ cfm} * 4.41}{0.8 * 10^6}$ = \$ 38,800

#2 Fuel Oil = $\frac{118,470 * 254,878 \times 4.98}{0.8 * 10^6}$ = \$ 188,000

Electricity = $\frac{CFM \cdot \Delta P}{6356 * \eta_F} \cdot 2545 \text{ Btu/hp-hr} * \text{hrs/yr.}$

= $\frac{254,878 * 5 * 2545 * 24 h/d * 5 d/w * 52 w/yr}{6356 * 0.6}$

= 5307 MBtu

Cost = 5307 * 10.94 \$/MBtu = \$ 35,000

TOTAL COST = \$ 261,800

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter	68
Air Quantity (cfm)	1
Hour Fractions 1 AM - 9 AM	1
9 AM - 5 PM	1
5 PM - 1 AM	1
Operation Days Per Week	5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Total Operation Hours While Heating (and corrected for working days/week)	4776	118,470
Avg outdoor temp while heating (F)	45.0	

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter	68
Air Quantity (cfm)	1
Hour Fractions 1 AM - 9 AM	0.25
9 AM - 5 PM	0.75
5 PM - 1 AM	0
Operation Days Per Week	5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating (and corrected for working days/week)	1465	35,618
Avg outdoor temp while heating (F)	45.0	

10/01/91

ECO Construction Cost Estimate Calculations

ECO Name: Paint Booth Air Flow Control

ECO #: 10

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$113,210
Labor		$25,630
	Subtotal bare costs	$138,840
FICA Insurance (20% of Labor)		$5,126
Sales Tax (6.5% of Material)		$7,359
	Subtotal	$151,325
Overhead (15%)		$22,699
	Subtotal	$174,024
Profit (10%)		$17,402
	Subtotal	$191,426
Bond (1%)		$1,914
	Subtotal	$193,340
Contingency (10%)		$19,334
Subtotal (Construction Cost Input For LCCID *)		$212,674
SIOH (5.5% of Construction Cost)		$11,697
	Subtotal	$224,371
Design (6% of Construction Cost)		$12,760
Total Project Cost		$237,131

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION:

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- ☐ CODE A (No design completed)
- ☒ CODE B (Preliminary design)
- ☐ CODE C (Final design)
- ☐ OTHER (Specify)

DRAWING NO.: COST FOR ONE BOOTH

ESTIMATOR: G. F

CHECKED BY: P. Hutchins

SPRAY BOOTH CONTROLS SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
VARI-FREQ DRIVES (1)	4	ea	185	740	1781	7124	7864
COPPER TUBING (2)	300	ft	2.42	726	.78	234	960
FLOW/INDICATING XMTR (2)	1	ea	25	25	1000	1000	1025
PRESSURE/INDICATING XMTR (2)	1	ea	25	25	1000	1000	1025
PROGRAMABLE LOGIC (3)	1	LOT		200		800	1000
LIMIT SWITCHES (1)	2	eA	32	64	42.00	84	148
WIRE 2-14 (2)	2	CLF	26.78	53.57	6.22	12.44	66
CONDUIT ½" ϕ (2)	200	LF	2.97	594	.96	192	786
CONTROL CABINET (2)	1	ea	135	135	875	875	1010
				2563		11321	13884
(1) GRAINGER							
(2) MEANS							
(3) VENDOR QUOTE							
				X10		X10	X10
For 10 booths				25,630		113,210	138,840

ENG FORM 150
1 AUG 59

(ER 1110-345-730))

PREVIOUS EDITION MAY BE USED

(TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—516140

NOTE: VENDOR ADVISES EQUIPMENT BELOW CAN ACCOMODATE 2 BOOTHS. THEREFOR EACH BOOTH COSTS ≈ $1000.00

Cameron & Barkley Company

Flexible Manufacturing Systems
10200 Alton Box Rd., Box 26879
Jacksonville, FL 32218
(904) 757-0211

CamBar

GEORGE FALLON
REYNOLD & SMITH & HILLS
4651 SALISBURY RD.
JACKSONVILLE FL, 32256

MODICON COMPACT 984 CONFIGURATION

		CONTROLLER HARDWARE		
1	1	PC-0984-120 1.5K Compact-984 CPU	400.00	400.00
		MISC ITEMS		
2	1	AS-MEEP-000 EEPROM Memory Card	~~200.00~~	~~200.00~~
		I/O MODULES		
3	1	AS-BADU-205 +/-10V,+/-20mA analog input module	375.00	375.00
4	1	AS-BDAP-209 115 VAC Output Module	160.00	160.00
5	1	AS-BDAU-202 4-20 mA Analog Input	435.00	435.00
6	1	AS-BDEP-209 115 VAC Input Module	115.00	115.00
7	1	AS-P120-000 120 VAC - 24 VDC Power Converter	200.00	200.00
		HOUSINGS		
8	1	AS-HDTA-200 primary subrack	165.00	165.00
9	1	AS-HDTA-201 secondary subrack - 5 module	165.00	165.00
		CABLES		
10	1	AS-WBXT-201 Bus Extension Cable	70.00	70.00
		TOTAL AMOUNT:		~~2285.00~~ $2085.00

NOTE: ALL MODICON EQUIPMENT COMES WITH A THREE YEAR WARRANTY.
PLEASE REFER TO THIS QUOTATION NUMBER. #99-910515-P004

MARK J. WALKER
SYSTEMS SPECIALIST

ECO # 11

BLAST BOOTH FAN SHUTOFF (BOOTH 49)

REF 1. LEAD, EEAP, RSH, 1981, VOL 2, PROJ-H, CALC. pg V-6

CURRENT ENERGY CONSUMPTION

ELECTRICITY

ASSUME: FLOW = 44,000 CFM (REF. 1)
ΔP DUCTWORK & BAGS = 5 IN.W.C.
η FAN & MOTOR = .6

$$FAN\ HP = \frac{ACFM \times S.P.}{6356 \times \eta} = \frac{44000 \times 5.0}{6356 \times .6} = 58\ HP$$

KW = .746 X HP = 43 KW

ENERGY CONSUMED

ASSUME: 3 SHIFT/day, 5 d/wk

43 kw x 24 HR/d x 5 d/wk x 52 wk/yr = 268,000 kwhr./YR
916 MBTU/YR

COST OF ENERGY

916 MBTU/YR x $10.94/MBTU = $10,000 /YR.

SAVINGS

ASSUME: BLASTING OCCURS FOR ONLY 1/2 TIME

ENERGY

916 MBTU/YR x .5 = 458 MBTU/YR (elec.)

COSTS

458 MBTU/YR x $10.94/MBTU = $5010/YR

ECO - 11 (CONT)

BLAST BOOTH FAN SHUT-OFF (BOOTH 50)

REF 2: LEAD, EEAP, RSH, 1981, VOL 2, PROJ-H, CALC. pg VI-1

CURRENT ENERGY CONSUMPTION

ASSUME: FLOW = 56,000 CFM (REF 2)
ΔP DUCT & BAGS = 5 IN. W.C.
η FAN & MOTOR = 0.6

$$\text{FAN HP} = \frac{\text{ACFM} \times \text{S.P.}}{6356 \times \eta} = \frac{56{,}000 \times 5}{6356 \times 0.6} = 73.4 \text{ HP}$$

$$\text{KW} = .746 \text{ KW/HP} \times \text{HP} = .746 \times 73.4 = 54.8 \text{ KW}$$

ENERGY CONSUMED

ASSUME 3 SHIFT/DAY, 5d/WK, 52WK/YR

54.8 KW x 24 H/d x 5d/WK x 52WK/YR = 342,000 KWH/YR.

$$342{,}000 \text{ KWH/YR} \times \frac{3413 \text{ BTU/KWH}}{10^6 \text{ BTU/MBTU}} = 1170 \text{ MBTU/YR}$$

1170 * 10.94 = $12,800/yr

SAVINGS

ASSUME BLASTING OCCURS FOR ½ TIME

ENERGY

1,170 MBTU/YR x 0.5 = 583 MBTU/yr (elec.)

COST

583 MBTU/YR x $10.94/MBTU = $6380/YR

RS&H®

SUBJECT LEAD ECO #11 | AEP NO
SHEET 3 OF 5
DESIGNER | DATE
CHECKER | DATE

ECO-11 CONT

BLAST BOOTH FAN SHUT-OFF (BOOTH 2544)

REF 3: LEAD, FEAP, RSH, 1981, VOL. 2, PROJ-H, CALC. pg VII-1

CURRENT ENERGY CONSUMPTION

ASSUME: FLOW = 44,000 CFM (REF 3)

ΔP DUCT & BAGS = 5 IN. W.C.

η FAN & MOTOR = 0.6

VALUES ARE SAME AS BOOTH 49 (pg. 11-1) SO SAVINGS WILL BE THE SAME.

Energy savings = 458 MBtu/yr (elec.)

ECO. (CONT.)

BLAST BOOTH FAN SHUTOFF BLDG 37

REF 4: LEAD, EEAP. RSH, 1981, VOL. 2, PROJ H, CALC. pg X-1

FAN MOTOR HP = 20 (REF 4)

CURRENT ENERGY CONSUMED

ASSUME: 2 SHIFT OPERATION

20 HP × .746 KW/HP × 16 H/d × 5d/w × 52 w/yr = 62100 KWH

62100 KWH/YR × 3413 BTU/KWH / 10⁶ BTU/MBTU = 212 MBTU/YR

212 * 10.94 = $2319

SAVINGS

ASSUME: BLASTING OCCURS ½ TIME,

ENERGY

212 MBTU/YR × 0.5 = 106 MBTU/YR ELEC

COST

106 MBTU/YR × $10.94/MBTU = $1160/YR

RS&H®

SUBJECT: LEAD ECO#11 | AEP NO:
SHEET 5 OF 5
DESIGNER: | DATE:
CHECKER: | DATE:

SUMMARY
SAVINGS

BLDG	BOOTH	ENERGY (MBTU ELEC/L.L.)	ENERGY COST SAVINGS ($)
350	49	458	5010
350	50	583	6380
350	2544	458	5010
37	—	106	1160
TOTAL		1,610	17,600

CONSTRUCTION COST

FOR ALL 4 BOOTHS = $6530

PAYBACK

$$\frac{\$7280}{\$17600/YR} = 0.41 \text{ YRS.}$$

QRIP Calc's

Current energy use: $10,000 + $12,800 + $12,800 + $2319
= $37,919

05/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Building 350 &37 blast booth fan control

ECO #: 11

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$1,150
Labor		$2,850
	Subtotal bare costs	$4,000
FICA Insurance (20% of Labor)		$570
Sales Tax (6.5% of Material)		$75
	Subtotal	$4,645
Overhead (15%)		$697
	Subtotal	$5,342
Profit (10%)		$534
	Subtotal	$5,876
Bond (1%)		$59
	Subtotal	$5,935
Contingency (10%)		$594
Subtotal (Construction Cost Input For LCCID *)		$6,529
SIOH (5.5% of Construction Cost)		$359
	Subtotal	$6,888
Design (6% of Construction Cost)		$392
Total Project Cost		$7,280

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

☐ CODE A (No design completed)
☐ CODE B (Preliminary design)
☐ CODE C (Final design)
☐ OTHER (Specify)

DRAWING NO.

ESTIMATOR: G. F.

CHECKED BY: P Hutchins

AUTO SHUT DOWN BLAST BOOTH FANS. SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
LIMIT SWITCHES	2	ea	32	64	42	84	148
WIRE 2-14	2	CLF	26.78	54	6.22	12	66
CONDUIT ½" ø	200	LF	2.97	594	.96	192	786
COST PER BOOTH				712		288	1000
4 BOOTHS.				x 4		x 4	x 4
				2850		1150	4000

ENG FORM 150
1 AUG 59

(ER 1110-345-730)

PREVIOUS EDITION MAY BE USED

(TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE : 1959 O—516140

RS&H

SUBJECT Letterkenny Army Dep. AEP NO

SHEET ____ OF ____

DESIGNER G. Fallon DATE

CHECKER DATE

ECO #12

SAMPLE CALCULATIONS FOR PAYBACK ON FUEL SWITCH FROM NO. 2 F.O. TO NO. 5 F.O.

BLDG. 2 1990 #2 F.O. CONSUMPTION = 74,632 gal

ENERGY RELEASED (FUEL CONSUMPTION DATA - LEAD FUEL CONSUMPTION REPORT, 1990)

74632 X 0.138690 MBTU/gal = 10,400 MBTU/YR

COST OF NO. 2 FUEL

10,400 MBTU/YR X $7.43/MBTU = $76,900/YR

COST OF EQUIV. NO. 5 FUEL OIL

10400 MBTU/YR X $6.61/MBTU = $68,400/YR.

COST SAVING

$76,900 - $68,400 = $8500/YR

CONSTRUCTION COST

$12,495 per BOILER X 2 BOILERS/BLDG = $25,000

PAYBACK

$$\frac{\$25,000}{\$8500/YR} = 2.94 \text{ YRS.}$$

THE ABOVE CALCULATIONS WERE USED IN SPREADSHEED SOFTWARE TO CALCULATE THE PAYBACK FOR EACH OF THE BOILER ROOMS. THE RESULTS ARE ON THE SUMMARY SHEET.

290-0379-001
ECO #12
G. Fallon

LETTERKENNY ARMY DEPOT
BOILER FUEL CONVERSION FROM
NUMBER 2 F.O. TO NO 5 F.O.
SUMMARY

FUEL BTU VALUES

FUEL OIL NUMBER	BTU CONTENT (BTU/GAL)	FUEL COST ($/GAL)	FUEL COST ($/MBTU)
2	138,690	$1.03	$7.43
5	149,690	$0.99	$6.61

R E C O M E N D E D

BLDG NO.	FUEL TYPE (NO)	ANNUAL CONSUMP (GAL)	ANNUAL CONSUMP (MBTU)	ANNUAL COST ($/YR)	ANNUAL #5 COST ($/YR)	ANNUAL SAVINGS ($/YR)	NO BLRS PER BLDG (NO)	COST PER BLR HOUSE ($)	PAYBACK (YRS)
2	2	74632	10351	$76,871	$68,456	$8,415	2	$24,990	3.0
320	2	63295	8778	$65,194	$58,057	$7,137	2	$24,990	3.5
37HP	2	49993	6934	$51,493	$45,856	$5,637	2	$24,990	4.4
8	2	46446	6442	$47,839	$42,603	$5,237	2	$24,990	4.8
Total		234366	32504	$241,397	$214,972	$26,425	8	$99,960	3.8

N O T   R E C O M M E N D E D

BLDG NO.	FUEL TYPE (NO)	ANNUAL CONSUMP (GAL)	ANNUAL CONSUMP (MBTU)	ANNUAL COST ($/YR)	ANNUAL #5 COST ($/YR)	ANNUAL SAVINGS ($/YR)	NO BLRS PER BLDG (NO)	COST PER BLR HOUSE ($)	PAYBACK (YRS)
3751	2	11119	1542	$11,453	$10,199	$1,254	1	$12,495	10.0
4756	2	9576	1328	$9,863	$8,784	$1,080	1	$12,495	11.6
10	2	13704	1901	$14,115	$12,570	$1,545	2	$24,990	16.2
5249	2	6550	908	$6,747	$6,008	$739	1	$12,495	16.9
3810	2	13027	1807	$13,418	$11,949	$1,469	2	$24,990	17.0
2360	2	12634	1752	$13,013	$11,589	$1,424	2	$24,990	17.5
3626	2	5778	801	$5,951	$5,300	$651	1	$12,495	19.2
3700	2	5109	709	$5,262	$4,686	$576	1	$12,495	21.7
1466	2	9338	1295	$9,618	$8,565	$1,053	2	$24,990	23.7
5647	2	4372	606	$4,503	$4,010	$493	1	$12,495	25.3
5250	2	2644	367	$2,723	$2,425	$298	1	$12,495	41.9
5313	2	2510	348	$2,585	$2,302	$283	1	$12,495	44.2
2755	2	4293	595	$4,422	$3,938	$484	2	$24,990	51.6
3812	2	2116	293	$2,179	$1,941	$239	1	$12,495	52.4
3311	2	1979	274	$2,038	$1,815	$223	1	$12,495	56.0
2702	2	1601	222	$1,649	$1,469	$181	1	$12,495	69.2
4341	2	1540	214	$1,586	$1,413	$174	1	$12,495	72.0
3321	2	1185	164	$1,221	$1,087	$134	1	$12,495	93.5
3387	2	909	126	$936	$834	$102	1	$12,495	121.9
3170	2	137	19	$141	$126	$15	1	$12,495	808.9

05/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Boiler conversion to No5 fuel oil

ECO #: 12

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$5,120
Labor		$2,101
	Subtotal bare costs	$7,221
FICA Insurance (20% of Labor)		$420
Sales Tax (6.5% of Material)		$333
	Subtotal	$7,974
Overhead (15%)		$1,196
	Subtotal	$9,170
Profit (10%)		$917
	Subtotal	$10,087
Bond (1%)		$101
	Subtotal	$10,188
Contingency (10%)		$1,019
Subtotal (Construction Cost Input For LCCID *)		$11,207
SIOH (5.5% of Construction Cost)		$616
	Subtotal	$11,823
Design (6% of Construction Cost)		$672
Total Project Cost		$12,495

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

IEC
since 1939

6855 Phillips Parkway Drive South • Jacksonville, Florida 32256

904/262-4700 • FAX 904/262-4604

ILLINGWORTH
ENGINEERING
COMPANY
manufacturers agent

May 2, 1991

Reynolds, Smith & Hills
4651 Salisbury Road
Jacksonville, Florida 32256
ATTN: Mr. George Fallin

Dear Mr. Fallin:

Concerning your conversation with John Ring, I am sending you an estimated figure for the total of parts and labor to perform an oil conversion on the following:

60" Cleaver-Brooks Boiler..................$12,495.00
If required, add for No. 6 oil heater........$1,431.25

78" Cleaver-Brooks Boiler...................$13,900.00
If required, add for No. 6 oil heater........$3,256.25

96" Cleaver-Brooks Boiler...................$15,110.00
If required, add for No. 6 oil heater........$6,581.25

Please bear in mind, the prices listed above are just estimated figures and are not meant to be used as a hard copy quote.

I have based these figures on the diameter size of the boiler only. Pricing may vary according to the model and serial number of the unit.

The labor included is for the installation of the conversion kit only and does not reflect any other extended work or travel time.

I hope this information will be useful to you. If we can help you any further, please feel free to call.

Sincerely,

Dewayne L. Drinnon

Dewayne L. Drinnon
Parts Department

12-4

ECO # 13

Install Energy Efficient Lamps in Building 370

Assumptions:

1. The lights in the casing repair area are on for two shifts, 5 days per week (4,160 hrs/yr)

2. The existing fixtures and ballasts will remain in place.

3. There are no ballast savings when changing to 34-watt lamps.

Current energy consumption:

$$450 \text{ fixtures} \times 4 \frac{\text{lamps}}{\text{fixture}} \times 40 \frac{\text{watts}}{\text{lamp}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 72 \text{ kw}$$

$$72 \text{ kw} \times 4160 \text{ hrs/yr} = 299{,}520 \text{ kwh/yr}$$

Energy consumption with 34-watt lamps:

$$450 \text{ fixt.} \times 4 \frac{\text{lamp}}{\text{Fix}} \times 34 \frac{\text{watt}}{\text{lamp}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 61.2 \text{ kw}$$

$$61.2 \text{ kw} \times 4{,}160 \text{ hr/yr} = 254{,}592 \text{ kwh/yr}$$

Energy Savings:

$$299{,}520 \text{ kwh/yr} - 254{,}592 \text{ kwh/yr} = \underline{44{,}928 \text{ kwh/yr}}$$

$$44{,}928 \frac{\text{Kwh}}{\text{yr}} \times 3413 \frac{\text{Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = \underline{153.3 \text{ MBtu/yr}}$$

Energy Cost Savings:

$$44{,}928 \text{ Kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$1676/\text{year}}$$

Project Cost:

Total project cost = $\underline{\$20{,}502}$

See cost estimate sheets for details

Simple Payback:

Payback = Cost ÷ Savings = $20,502 ÷ $1,676/yr

<u>Payback = 12.2 years</u>

05/14/91

ECO Construction Cost Estimate Calculations

ECO Name: Energy Efficient Lamps In Building 370

ECO #: 13

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$5,490
Labor	$6,030
Subtotal bare costs	$11,520
FICA Insurance (20% of Labor)	$1,206
Sales Tax (6.5% of Material)	$357
Subtotal	$13,083
Overhead (15%)	$1,962
Subtotal	$15,045
Profit (10%)	$1,505
Subtotal	$16,550
Bond (1%)	$166
Subtotal	$16,716
Contingency (10%)	$1,672
Subtotal (Construction Cost Input For LCCID *)	$18,388
SIOH (5.5% of Construction Cost)	$1,011
Subtotal	$19,399
Design (6% of Construction Cost)	$1,103
Total Project Cost	$20,502

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/17/91	SHEET OF
PROJECT: ENERGY ENGINEERING ANALYSIS	BASIS FOR ESTIMATE: [X] CODE A (No design completed) [ ] CODE B (Preliminary design) [ ] CODE C (Final design) [ ] OTHER (Specify)	
LOCATION: Letterkenny Army Depot		
ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.		
DRAWING NO. NA	ESTIMATOR: W. T. Todd	CHECKED BY

34-W Fluor. SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
4' long, 35 watt, rapid start, cool white lamps	1800	Ea.	3.35	6030	3.05	5490	$11,520

Source: Means Electrical Cost Data 1991
Labor: Page 9
Mat: Page 201

ENG FORM 150
1 AUG 59
(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)
* U.S. GOVERNMENT PRINTING OFFICE: 1959 O—516148

ECO # 14

Energy Efficient Frequency Converters in Building 370

Assumptions:

1. The converters operate near full load for 1 shift, 50% load for 1 shift and at no load on nights and weekends.

2. The operating efficiencies of solid state and motor-generator type frequency converters are:

	Solid State	Motor-gen.
Full load eff.	94%	85%
50% load eff.	92 %	70 %

Sorce: Teledyne Inet telcon

3. The no load KW input is calulated using the following equation:

$$KW_{NL} = \left[KW_{FL} - (KW_{FL} \times Eff_{FL})\right] \times 0.80$$

Sorce: Teledyne Inet and Controlled Systems

Calculations:

The output rating for the existing motor-generator type frequency converters is 60 KW.

Full load KW input = 60kw ÷ 0.85 = 70.6 KW

Frequency Converters (Continued):

50% load KW input = 60 kw × .5 ÷ 0.70 = 42.9 kw

No load KW input = [60 kw − (60 kw × .85)] × 0.8

KW_{NL} = 7.2 kw

Current energy use =

1st Shift = 70.6 kw × 2080 hr/yr = 146,848 Kwh/yr

2nd Shift = 42.9 kw × 2080 hr/yr = 89,232 kwh/yr

Nights/Wkends = 7.2 kw × 4600 hr/yr = 33,120 kwh/yr

Total = 146,848 + 89,232 + 33,120 = 269,200 kwh/yr

Current energy Cost:

Cost = 269,200 Kwh/yr × 0.0373 $/kwh = $10,041/yr

Energy use for a 60 kw Solid State frequency Converter:

Full load KW input = 60 kw ÷ 0.94 = 63.8 kw

50% load KW input = 60 kw × .5 ÷ 0.92 = 32.6 kw

No load KW input = [60 kw − (60 kw × .94)] × .8

KW_{NL} = 3.6 kw × .8 = 2.9 kw

Frequency Converters (Continued):

1st Shift = 63.8 kw × 2080 hr/yr = 132,704 kwh/yr

2nd Shift = 32.6 kw × 2080 hr/yr = 67,808 kwh/yr

Nights/wkends = 2.9 kw × 4600 hr/yr = 13,340 kwh/yr

Total = 132,704 + 67,808 + 13,340 = 213,852 kwh/yr

Cost = 213,852 kwh/yr × 0.0373 $/kwh = $7977/yr

Energy savings by converting from motor-generator type to solid state frequency converters:

269,200 kwh/yr − 213,852 kwh/yr = 55,348 kwh/year per unit

55,348 kwh/yr·unit × 3 units = 166,044 kwh/yr = 567 MBTU/yr

Cost Savings:

$10,041/yr − $7977/yr = $2,064/yr·unit

$2,064/yr·unit × 3 units = $6,192/yr

Construction Cost:

Project Cost = $155,842 (See cost estimate sheet)

Simple Payback:

$155,842 ÷ $6,192/yr = 25.2 years

RS&H®

SUBJECT: ECO # 14 - Frequency Convertors

DESIGNER: P. Hutchins

CHECKER:

AEP NO

SHEET OF

DATE: 10/1/91

DATE

MAINTENANCE COSTS - LEAD

TYPE	AGE	MAINTENANCE TOTAL	MAINTENANCE ANNUAL
SOLID STATE	2	$ 25	$ 13
	2	0	0
	2	9000	4500
	1	1471	1471
	3	4045	1348
	3	1461	487
	3	1627	542
	3	1402	467
	3	1800	600
TOT	22	$ 20,831	$ 9428

Rotary ↓

AGE	TOTAL
6	$ 1861
6	2235
6	884
6	1377
22	7621
12	4571
16	9214
16	6884
16	3416
15	2848
21	4451
31	3824

(continued)

	AGE	TOTAL
	21	5570
	33	2236
	10	4382
	9	2056
	7	2819
	6	2200
TOT	259	$ 68,449

Avg annual maintenance

Solid state — $ 9428

Rotary - $ 264

FREQUENCY CONVERTORS
MAINTENANCE DATA

LETTERKENNY I.D. NO.	TYPE	MANUFACTURE	ACQ. COST.	TOTAL MAINT. COST	PURCHASE DATE
L6208	SOLID STATE	PACIFIC POWER	22560–	25.–	89 NEW
LN6409	SOLID STATE	HUNTINGTON BEACH	23481–	0–	89 NEW
LM6547	" "	CALIFORNIA	214349–	EST. 9000.–	89 NEW
N9308	" "		388907–	1471.–	90 NEW
M6989	" "	CONTROLLED SYS.	24787–	4045.–	~~88~~ NEW
M6990	" "	FAIRMONT WVA.	24787–	1461–	88 New
M6991	" "		24787–	1627–	88 New
M6992	" "		24787–	1402–	88 New
M6993	" "		24787–	1800–	88 New
5301	ROTARY	KATO MFG.	51300–	1861–	85 New
5302	"	MANKATO MINN.	51300–	2235–	85 New
5303	"		51300–	884–	85 New
5304	"		51300–	1377–	85 New
3022	"	HOLLINGSWORTH	9144–	7621	59
3023	"	"	8840–	4571	69
3381	"	"	9046–	9214	75 Rebuilt
3383	"	"	9046–	6884	75 Rebuilt
3386	"	"	9046–	3416	75 Rebuilt
3575	"	"	9046–	2848	76 Rebuilt
3838	"	"	9046	4451	70 Rebuilt
4027	"	"	9046–	3824	60 Rebuilt
4034	"	"	9046–	5570	70 Rebuilt
4450	"	"	9046–	2236	58 Rebuilt
4675	"	"	9046–	4382	81 Rebuilt
4767	"	"	9046–	2056	82 Rebuilt
528	"	"	9046–	2819	84 Rebuilt
5362	"	"	9046–	2204	85 Rebuilt

05/14/91

ECO Construction Cost Estimate Calculations

ECO Name: Energy Efficient Frequency Converters For Building 370

ECO #: 14

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$90,000
Labor	$3,000
Subtotal bare costs	$93,000
FICA Insurance (20% of Labor)	$600
Sales Tax (6.5% of Material)	$5,850
Subtotal	$99,450
Overhead (15%)	$14,918
Subtotal	$114,368
Profit (10%)	$11,437
Subtotal	$125,805
Bond (1%)	$1,258
Subtotal	$127,063
Contingency (10%)	$12,706
Subtotal (Construction Cost Input For LCCID *)	$139,769
SIOH (5.5% of Construction Cost)	$7,687
Subtotal	$147,456
Design (6% of Construction Cost)	$8,386
Total Project Cost	$155,842

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED 4-15-91 **SHEET** OF

PROJECT ENERGY ENGINEERING ANALYSIS

LOCATION Letterkenny

ARCHITECT ENGINEER REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR W.T. Todd

CHECKED BY

Solid State F.C.'s SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
60 KW output, solid state frequency converter	3	EA	1000	3,000	30000	90,000	#93,000
Source: Teledyne Inet (Vendor) telephone conversation							

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

ECO #14

HUNTER **Telephone Call Confirmation**

Project No. 290-0379-001

Local ______ (L.D.) ______ (Placed) ______ Rec'd. ______ Date 3/15/91

W. Todd Conversed With Mike Sever (Atlanta)

Of Teledyne Inet Regarding Frequency Converters

404/952-7363

Motor-generator units ~60 kw

Cost $30,000 - $35,000

MTBF = 40,000 hours for horizontal shaft (bearings fail)

MTBF = 150,000 hours for vertical shaft

Full load eff ~ 85%

1/2 load eff ~ 79%

No load Kw = [60 - (60 × .85)] × 0.8 = 7.2

Solid State units ~ 60 kw

Cost ~ $30,000

MTBF = 12,000 to 8,000 hours (printed circuit boards fail)

Full load eff = 94%

1/2 load eff = 92%

No load Kw = [60 - (60 × .94)] × .8 = 2.9

Distribution:

HUNTER Form 102 3/89

ECO #14
From Teledyne Inet
Catalog

OPERATING COSTS

Operating costs are just as important as initial capital costs. Let us compare only two 50KVA/40KW 400Hz solid state units (as required by a single 3090-400) with equivalent motor generator type units as follows (assume both are running at 70% load which is very typical):

	SOLID STATE	ROTARY MG
Rating of each unit	50KVA/40KW	50KVA/40KW
Output KW (rated)	2 X 40KW	2 X 40KW
Output KW (operating)	2 X 28	2 X 28
Efficiency at operating KW	.92	.73
Input KW (output/eff)	60.87	76.71
KW-hrs per year	533221	671980
Utility Bill @ $0.10/KWhr	$53,322.1	$67,198.0

It is therefore clear that the difference in operating costs is $67,198 - 53,322 = $13,876 for only a single computer!

If 5 such CPU's are needed, the 10-year savings are $693,800.00 -- no small change! In fact the net 10-year savings far exceeds the initial total purchase cost of the 10 solid state units (2 per CPU).

The above calculations do not take into account that the user also needs to put in additional HVAC equipment in the computer room to handle the extra heat dissipated by the 10 MG's.

How much capacity would you need? This is a simple calculation. Simply multiply the difference in input KW's (76.71 - 60.87 = 15.84KW) by 3412 to get the BTU's per hour (54,046). This number divided by 12,000 yields the required HVAC tonnage i.e. 54,046/12000 = 4.5 tons. For 5 CPU's you would need 22.8 tons of additional cooling not to mention the extra electric power needed to run the additional cooling units continuously.

The bottom line therefore is that the operating costs are not just reflected in your utility bills every month, they also require additional capital expense for extra cooling units, additional electric power used by the cooling units, as well as additional space for such in the computer room.

ECO #14

Controlled Systems

Incorporated
1106 Chamberlain • Fairmont, W. Va. 26554 • 304/366-5144 • Fax: 304/366-5231

April 3, 1991

R S & H
4651 Salisbury Road
Jacksonville, FL 32256

ATTN: Bill Todd

RE: Frequency Converter Info.

Dear Mr. Todd:

Pursuant to our recent conversation, please find the enclosed product literature which includes our solid state frequency converter. As I stated during our conversation, the efficiency of our units is normally 90% or greater. Efficiency of a motor generator set usually runs between 60 and 85% efficient, depending on the load of the generator. With no load on a generator a great deal of energy is wasted. With a CSI solid state unit with no load loss would be around 5%. Using solid state units there are no moving parts to wear out, no bearings to grease or oil to change as in motor generator sets. This alone could save maintenance cost and down time.

If I can be of any further assistance please do not hesitate to contact me. Thank you for your interest in Controlled Systems Solid State Frequency Converters.

Sincerely,

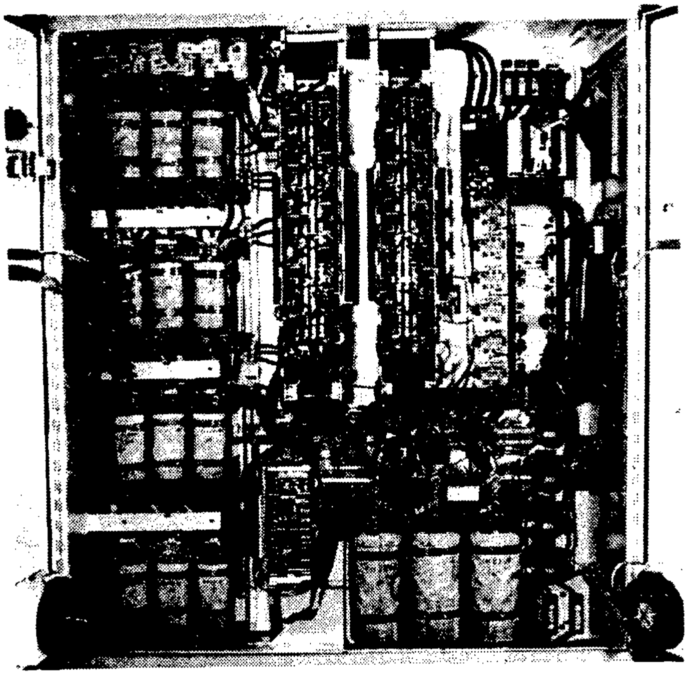
CONTROLLED SYSTEMS, INC.

Frank Pazdric
Frank Pazdric
Assistant Sales Manager

cjm

ECO #14

SOLID STATE FREQUENCY CONVERTERS



Indoor, 90 KVA unit for radar application

SPECIFICATIONS

Input Voltage - 3 phase, optional 208 to 600VAC ± 10%, 50 or 60HZ

Input Frequency - 50 or 60Hz

Input Protection - Overcurrent, short circuit, phase loss, phase sequence, over/under voltage

Output Power Rating - 7½-600KVA, based on a power factor of 0.8 lagging

Output Voltage - 1 phase or 3 phase, wye or delta, optional 115 to 600 VAC

Output Frequency - 50, 60, or 400 Hz. Other frequencies available upon request

Voltage Adjustment - Standard, ± 15% of rated output

Frequency Stability - ± .01% over full temperature range (unaffected by load)

Frequency Transients - None

Voltage Regulation - ± 1%

Voltage Modulation - Does not exceed 1% with a stable rated load

Phase Seperation - 120° ± 1% for balanced load
120° ± 4% for 33% unbalanced load

Crest Factor - 1,414 ± 5%

Voltage Transient Response - IAW MIL-STD 704D and DOD-STD-1399

Total Harmonic Distortion - IAW MIL-STD-704D Typically ~~2.0%~~ < 5%

Overload Capacity - 125% 1HR [redacted], 150% for 5 minutes, 200% for 10 seconds

Protection - Electronic overload, short circuit, over/under voltage

Efficiency - [redacted] at full load, 90% [redacted]

No load losses - Less than 5% of rated output power

The Controlled Systems' Solid State Power Supply converts 3 phase 50 or 60Hz input power to 3 phase fixed frequency sinusoidal output with very low distortion. Applications include power for aircraft, computers, radar, lazers, avionics labs, welders, test stands, UPS, and OEM equipment.

STANDARD FEATURES

Input circiut breaker with enclosure door interlock
Door mounted ± 15% output voltage trim
Door mounted Start and Stop/Reset pushbuttons
Door mounted indicators - 1. Input Power ON
2. Run Condition
3. Fault (overload)
4. Output Under voltage
5. Output Over voltage
6. Load ON
Output voltmeter with 3 phase select switch
Output ammeter with 3 phase select switch
Input/output isolation
Digital display and LED diagnostic indicators to aid trouble shooting
Heatsink over-temperature protection
Modular construction
High efficiency - [redacted]% 95 at full load

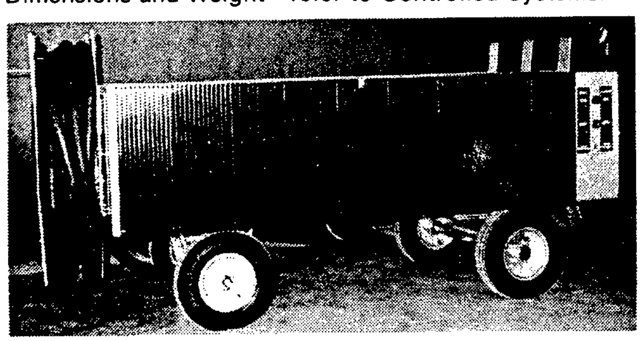
STANDARD OPTIONS

Automatic multiple unit paralleling
Auto line drip compensation
Auto-Restart
Expanded operating temperature range — 40° C to +50° C
Output circuit breaker w/shunt trip protection
Audible alarm and alarm silence button
Output frequency meter - Analog or Digital
Elapsed time meter
Input voltmeter with 3 phase select switch
Input ammeter with 3 phase select switch
± 10% output frequency trim
Sound absorption material for even lower audible noise
Dual isolated outputs, single voltage
Dual voltage outputs

Acoustical Noise - Less than 70 DBA at 1 meter
Operating Temperature Range - 0° to 40° C standard -40° C to + 50° C optional
Humidity - 0 to 95% non-condensating
Altitude - 5,600 feet maximum
Cooling - Forced or natural convection
Enclosure Configurations - upright (shown above), mobile low profile flatback (shown below) or low profile flatpack suitable for fixed mounting. Other configurations available.

Enclosure Types - Nema 3R, 4, 4X or 12

Dimensions and Weight - refer to Controlled Systems.



Hand Towable 60 KVA flatpack unit for hanger application.

RS&H

Telephone Call Confirmation

Project No. 290-0379-001

Local ____ L.D. ✓ Placed ____ Rec'd. ✓ Date 10/8/91

P. Hutchins Conversed With Brad Cook

Of LEAD - Elec. Maint-Production Regarding Frequency Convertors

- BC has maintenance data for FCs that he will fax to me

- Kato rotary type is their most reliable

- Solid state - Controlled Systems - not good clean source
  - Pacific Power - very good, but prints are proprietary so co. must do maint.

Distribution:

3/89

ECO # 15

Modular offices for personnel in Buildings 65, 8 & 9

Assumptions:

1. The indoor temperature for these warehouses is currently maintained at 68 °F.

2. The heating for these buildings is provided by the boilers in building 5, which burn fuel oil # 2.

3. The operation hours for these buildings are 8 hours per day, 5 days per week (2080 hrs/yr.)

4. The warehouse temperature can be reduced to 55 °F while maintaining 68 °F in the modular offices.

5. The modular offices will also be cooled to 75 °F during the summer months.

6. The average indoor temperature during the summer months is currently about 80 °F.

7. Since the wall and roof U-values and the infiltration rate do not change, the heat losses from the buildings is determined by the indoor-outdoor temperature difference and the amount of time heating is required.

Current energy consumption:

Annual fuel oil deliveries*:

FY 87	=	71,478 gal/yr
FY 88	=	63,607
FY 89	=	27,283
FY 90	=	46,446
Total		208,814 gal/4 years

* from Letterkenny Army Depot, Fuel Consumption Report, Building 8 boilers.

Average fuel oil consumption $= \frac{208{,}814 \text{ gal}}{4 \text{ years}} = 52{,}203$ gal/yr

Buildings 6, 8 and 9 are approximately the same size so the energy use for each building is about:

$52203 \text{ gal/yr} \div 3 = 17{,}401$ gal/yr per building

$17{,}401 \text{ gal/yr} \times 0.13869 \frac{\text{mBtu}}{\text{gal}} = 2413$ mBtu/yr per bldg.

TOTAL USE FOR ALL BLDGS = 2413 × 3 = 7239 mBtu/yr

Energy Savings:

Bin temperature data were used to calculate the potential energy savings when the indoor temperature is reduced from 68 °F to 55 °F.

From the spreadsheet calculations the sum of the (indoor temperature − average outdoor temperature) × hours of occurrence for 68 °F is: 153,752 degree hours per year

This value corresponds to the total current energy use.

The degree hours for 55 °F indoor temperature is:

82,338 degree hours

$$\text{Energy savings} = \frac{153{,}572 \text{ deg hrs} - 82{,}338 \text{ deg hrs}}{153{,}572 \text{ deg hrs}} = 0.46$$

$$\text{Energy Savings} = 2413 \frac{\text{MBtu}}{\text{Yr}} \times 0.46 = \underline{1110 \frac{\text{MBtu}}{\text{Yr}} \text{ ea. for bldgs. 8 \& 9}}$$

Savings for bldg. 6 s will be 50% of the above value since half the bldg. is offices.

Additional Energy Use:

To maintain office temperature an electric a/c and heating unit will be utilized. It's energy use is:

$Q = UA\Delta T$

U_{wall}:

air film	R = 0.68	From 1989 ASHRAE Fund.
1/8" hardboard	R = 0.125 ÷ 1.2 = 0.10	
3" air space	R = 0.90	
1/8" hard board	R = 0.10	
air film	R = 0.68	
	R_T = 2.46	

$U_w = 1/R_T = 0.41$ Btu/hr·ft²·°F

$U_{window} = 1.10$ Btu/hr·ft²·°F (1989 ASHRAE Fundamentals)

$U_{ceiling}$:

air film	R = 0.76	from 1989 ASHRAE Fund.
1/2" Acc. Tile	R = 1.25	
air film	R = 0.76	
	R_T = 2.77	

$U_{ceiling} = 1/R_T = 0.36$ Btu/hr·ft²·°F

Wall area = $A_w = (10' \times 8' + 12' \times 8') \times 2 = 352\ ft^2 - A_{wi}$

Window area = $A_{wi} = 3' \times 3' \times 6 = 54\ ft^2$

Ceiling area = $A_c = 10' \times 12' = 120\ ft^2$

$$Q = U_w \times A_w \times \Delta T + U_{wi} \times A_{wi} \times \Delta T + U_c \times A_c \times \Delta T$$

$\Delta T_w = 68°F - 55°F = 13°F$ winter

$\Delta T_s = 80°F - 75°F = 5°F$ summer

$$Q = (0.41 \times 298 + 1.10 \times 54 + 0.36 \times 120)\ \frac{Btu}{hr \cdot °F} \times \Delta T$$

$$Q_s = 224.8\ \frac{Btu}{hr \cdot °F} \times 5°F = 1124\ Btu/hr$$

$$Q_w = 224.8\ \frac{Btu}{hr \cdot °F} \times 13°F = 2922\ Btu/hr$$

Heating hours = 1,465 hours/year (from bin data)

Heating energy = $1465\ hr/yr \times 2922\ Btu/hr = \underline{4.3\ mBtu/yr}$

$$4.3\ \frac{mBtu}{yr} \times 10.94\ \$/mBtu = \underline{\$47/year}$$

Cooling hours = $9\ hr/day \times 260\ day/yr - 1465\ hr/yr = 875\ hr/yr$

Cooling efficiency: assume an EER of $8\ Btu/watt$

Cooling energy = $1124\ Btu/hr + 1500\,w \times \frac{3.413\ Btu/hr}{w}$ (appliance & people load) $= 6224\ \frac{Btu}{hr \cdot Bldg}$

Cooling energy = $6244\ Btu/hr \div 8\ \frac{Btu}{w} \times \frac{1\,kw}{1000\,w} \times 875\ hr/yr = 683\ kwh/yr \cdot Bldg$

Cooling energy = 683 $\frac{kwh}{yr} \times \frac{3413\ Btu}{kwh} \times \frac{MBtu}{10^6 Btu}$ = 2.3 MBtu/yr·Bldg

2.3 MBtu/yr × 10.94 $/MBtu = $25 /yr·Bldg.

Total additional energy use = $(4.3 \frac{MBtu}{Yr \cdot B} + 2.3 \frac{MBtu}{Yr \cdot B}) \times 3\ Bld. = 20 \frac{MBtu}{Yr}$

Total additional energy cost = $(47 \frac{\$}{Yr \cdot B} + 25 \frac{\$}{Yr \cdot B}) \times 3\ Bldg. = \$216 /yr$

Energy Cost Savings:

1110 $\frac{MBtu}{yr}$ × 4.98 $/MBtu = $5528/yr for bldgs. 8 & 9

1110 $\frac{MBtu}{Yr}$ × 4.98 $/MBtu × 0.5 = $2764 /yr for bldg 6 s

Net Energy Savings:

#2 Fuel oil	:	1110 $\frac{MBtu}{Yr \cdot Bl.}$ × 2.5 Bl.	=	2775 MBtu/yr
Elec	:	(4.3 + 2.3) × 3	=	(20) MBTu/yr

Net Energy Savings = Energy Savings − Add. energy use

= 2,775 MBtu/yr − 20 MBtu/yr

= 2,755 MBtu/yr

Net Energy Cost Savings:

Net energy cost savings = $5528/Yr * 2.5 Bldgs. − $216/yr

= $13,600 /yr

Project Cost:

Total Project Cost = $26,037

See cost estimate sheets for details

Simple Payback:

Payback = Cost ÷ Savings

= $26,037 ÷ $13,600/yr

Payback = 1.9 years

QRIP Calc.s

Present energy use = 7239 MBtu/yr #2 fuel oil
cost = 7239 × 4.98 = $36,100/yr

Proposed method = 4464 MBtu/yr #2 fuel oil
20 MBtu/yr electricity
cost = 4464 × 4.98 + 20 × 10.94
= $22,500

ENERGY AUDIT OF INDUSTRIAL FACILITIES
LETTERKENNY ARMY DEPOT

Operation hours per day =	24
Operation days per week =	7
Indoor Air Temperature (F) =	55

Hour Fractions:	1 AM - 9 AM	1
	9 AM - 5 PM	1
	5 PM - 1 AM	1

Temperature Range		Hours of Occurrence 2-9	10-17	18-1	Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
70	74	247	237	301	785	-17	0	0
65	69	296	217	278	791	-12	0	0
60	64	269	196	236	701	-7	0	0
55	59	249	191	209	649	-2	0	0
50	54	221	193	202	616	3	1,848	1,848
45	49	218	193	206	617	8	4,936	4,936
40	44	237	236	239	712	13	9,256	9,256
35	39	289	246	286	821	18	14,778	14,778
30	34	304	194	258	756	23	17,388	17,388
25	29	184	106	152	442	28	12,376	12,376
20	24	124	65	90	279	33	9,207	9,207
15	19	75	32	57	164	38	6,232	6,232
10	14	54	13	26	93	43	3,999	3,999
5	9	18	3	9	30	48	1,440	1,440
0	4	9	0	2	11	53	583	583
-5	-1	3	0	1	4	58	232	232
-10	-6	1	0	0	1	63	63	63
-15	-11	0	0	0	0	68	0	0
Totals		2798	2122	2552	7472		82338	82338

Total operation hours while heating
corrected for working days/week = 4546 Hours/Yr

Total degree hours per year corrected for
working days per week = 82338 Degree hours

Average outdoor temperature while heating = 36.9 F

05/14/91

ECO Construction Cost Estimate Calculations

ECO Name: Modular Offices For Buildings 6-South, 8 and 9

ECO #: 15

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$14,385
Labor	$1,080
Subtotal bare costs	$15,465
FICA Insurance (20% of Labor)	$216
Sales Tax (6.5% of Material)	$935
Subtotal	$16,616
Overhead (15%)	$2,492
Subtotal	$19,108
Profit (10%)	$1,911
Subtotal	$21,019
Bond (1%)	$210
Subtotal	$21,229
Contingency (10%)	$2,123
Subtotal (Construction Cost Input For LCCID *)	$23,352
SIOH (5.5% of Construction Cost)	$1,284
Subtotal	$24,636
Design (6% of Construction Cost)	$1,401
Total Project Cost	$26,037

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED 4/19/91

SHEET OF

PROJECT
ENERGY ENGINEERING ANALYSIS

LOCATION
LetterKenny Army Depot

ARCHITECT ENGINEER
REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.

ESTIMATOR W. T. Todd

CHECKED BY

Modular Office SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
ET-120 10'x12' in							
plant office	3	Ea	160	480	4395	13185	
Shipping from Florida	3	Ea	—	—	250	750	
Electric wiring	3	Ea	200	600	150	450	
Sub total				1080		14,385	#15,465

ENG FORM 150
1 AUG 59

(ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

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Jacksonville, FL 32247-0432
(904) 791-9042 Fax: (904) 358-3906

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JAX, FL. 32216
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Salesman: DAN
Cust Contact: BILL
Phone Number: 279-2281
Fax Number: 279-2491
Customer PO:

Date 4-12-91
Quote #
Order #
Inv #

Qty.	Unit	Stock #	Description	U	Cat.	Unit Wgt.	Total Weight	Unit List	Total List	Disc.	Unit Cost	Total Cost	Unit Sell	Total Sell
1	EA.	ET-120	10'x12' IN-PLANT											
			OFFICE BUILDING COMPLETE											
			WITH THE FOLLOWING:											
			1-STD. DOOR, 6-WINDOWS,											
			1-HVAC UNIT, 4-110V OUTLETS,											
			1-220V OUTLETS, 1-LIGHT SWITCH											
			2-4 TUBE FLOURESCENT FIXTURES,											
			1-4 CIRCUIT BREAKER BOX						$4669.00					$4395.0
			ABOVE PRICE F.O.B. HIALEAH, FL.											
			ALLOW 3WKS A.R.O. DELIVERY											
			Delivery Charges											

T.W. T.L.

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15-9

ENERGY AUDIT OF INDUSTRIAL FACILITIES
LETTERKENNY ARMY DEPOT

Operation hours per day = 24
Operation days per week = 7

Indoor Air Temperature (F) = 60

Hour Fractions: 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Temperature Range		Hours of Occurrence 2-9	10-17	18-1	Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
70	74	247	237	301	785	-12	0	0
65	69	296	217	278	791	-7	0	0
60	64	269	196	236	701	-2	0	0
55	59	249	191	209	649	3	1,947	1,947
50	54	221	193	202	616	8	4,928	4,928
45	49	218	193	206	617	13	8,021	8,021
40	44	237	236	239	712	18	12,816	12,816
35	39	289	246	286	821	23	18,883	18,883
30	34	304	194	258	756	28	21,168	21,168
25	29	184	106	152	442	33	14,586	14,586
20	24	124	65	90	279	38	10,602	10,602
15	19	75	32	57	164	43	7,052	7,052
10	14	54	13	26	93	48	4,464	4,464
5	9	18	3	9	30	53	1,590	1,590
0	4	9	0	2	11	58	638	638
-5	-1	3	0	1	4	63	252	252
-10	-6	1	0	0	1	68	68	68
-15	-11	0	0	0	0	73	0	0
Totals		2798	2122	2552	7472		107015	107015

Total operation hours while heating
corrected for working days/week = 5195 Hours/Yr

Total degree hours per year corrected for
working days per week = 107015 Degree hours

Average outdoor temperature while heating = 39.4 F

ENERGY AUDIT OF INDUSTRIAL FACILITIES
LETTERKENNY ARMY DEPOT

Operation hours per day = 24
Operation days per week = 7

Indoor Air Temperature (F) = 68

Hour Fractions:
1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Temperature Range		Hours of Occurrence 2-9	10-17	18-1	Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
70	74	247	237	301	785	-4	0	0
65	69	296	217	278	791	1	791	791
60	64	269	196	236	701	6	4,206	4,206
55	59	249	191	209	649	11	7,139	7,139
50	54	221	193	202	616	16	9,856	9,856
45	49	218	193	206	617	21	12,957	12,957
40	44	237	236	239	712	26	18,512	18,512
35	39	289	246	286	821	31	25,451	25,451
30	34	304	194	258	756	36	27,216	27,216
25	29	184	106	152	442	41	18,122	18,122
20	24	124	65	90	279	46	12,834	12,834
15	19	75	32	57	164	51	8,364	8,364
10	14	54	13	26	93	56	5,208	5,208
5	9	18	3	9	30	61	1,830	1,830
0	4	9	0	2	11	66	726	726
-5	-1	3	0	1	4	71	284	284
-10	-6	1	0	0	1	76	76	76
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	7472		153572	153572

Total operation hours while heating
corrected for working days/week = 6687 Hours/Yr

Total degree hours per year corrected for
working days per week = 153572 Degree hours

Average outdoor temperature while heating = 45.0 F

ENERGY AUDIT OF INDUSTRIAL FACILITIES
LETTERKENNY ARMY DEPOT

Operation hours per day = 8
Operation days per week = 5

Indoor Air Temperature (F) = 68

Hour Fractions: 1 AM - 9 AM 0.25
9 AM - 5 PM 0.75
5 PM - 1 AM 0

Temperature Range		Hours of Occurrence 2-9	10-17	18-1	Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
70	74	247	237	301	240	-4	0	0
65	69	296	217	278	237	1	791	237
60	64	269	196	236	214	6	4,206	1,286
55	59	249	191	209	206	11	7,139	2,261
50	54	221	193	202	200	16	9,856	3,200
45	49	218	193	206	199	21	12,957	4,184
40	44	237	236	239	236	26	18,512	6,143
35	39	289	246	286	257	31	25,451	7,959
30	34	304	194	258	222	36	27,216	7,974
25	29	184	106	152	126	41	18,122	5,146
20	24	124	65	90	80	46	12,834	3,669
15	19	75	32	57	43	51	8,364	2,180
10	14	54	13	26	23	56	5,208	1,302
5	9	18	3	9	7	61	1,830	412
0	4	9	0	2	2	66	726	149
-5	-1	3	0	1	1	71	284	53
-10	-6	1	0	0	0	76	76	19
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	2291		153572	46172

Total operation hours while heating corrected for working days/week = 1465 Hours/Yr

Total degree hours per year corrected for working days per week = 32980 Degree hours

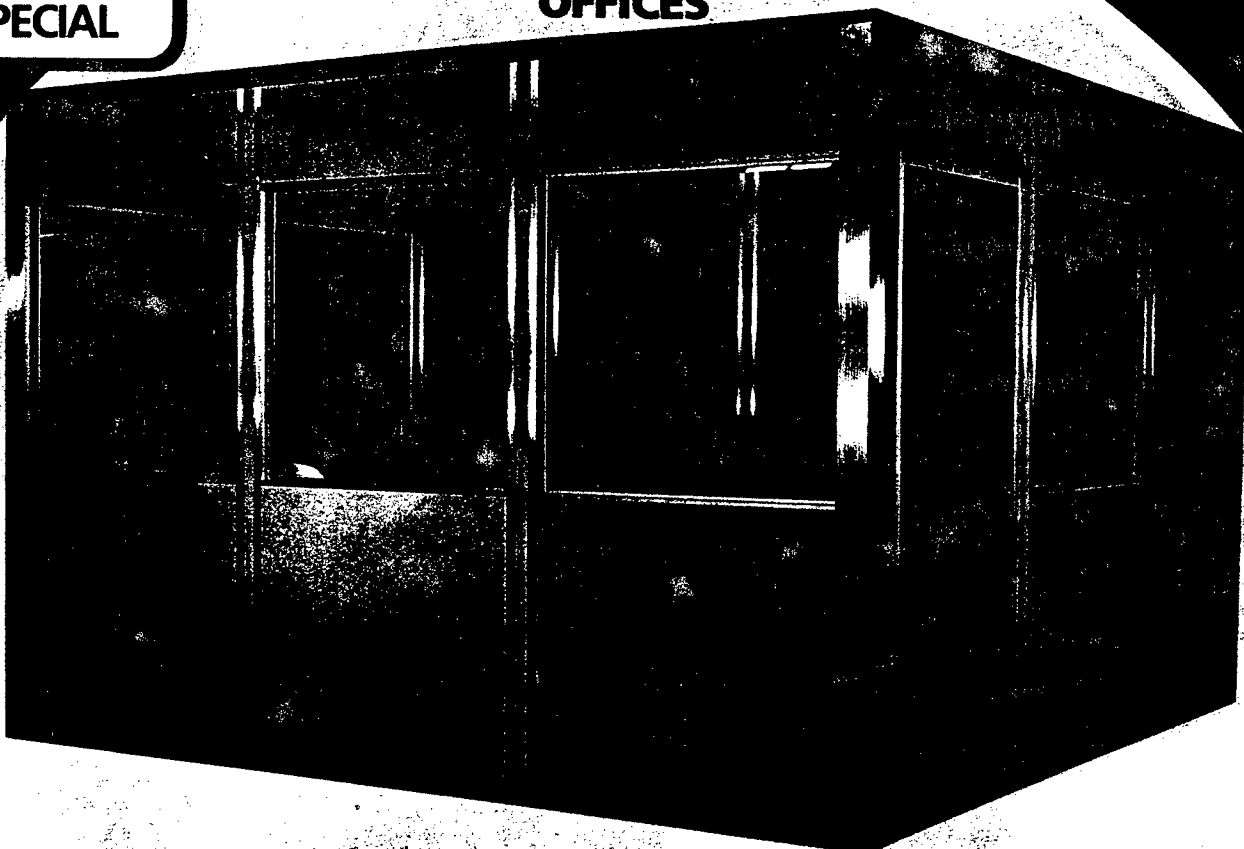
Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT
FUEL CONSUMPTION REPORT
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 1					SERVES BUILDINGS: 1, 2									FUEL TYPE: 5
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
** BOILER LOCATION: BUILDING 2					SERVES BUILDINGS: 4, 7									FUEL TYPE: 2
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
** BOILER LOCATION: BUILDING 3					SERVES BUILDINGS: 3, 5									FUEL TYPE: 5
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
** BOILER LOCATION: BUILDING 8					SERVES BUILDINGS: 6, 8, 9									FUEL TYPE: 2
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
** BOILER LOCATION: BUILDING 10					SERVES BUILDINGS: 10									FUEL TYPE: 2
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
** BOILER LOCATION: BUILDING 12					SERVES BUILDINGS: 12, 13, 14									FUEL TYPE: 5
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
** BOILER LOCATION: BUILDING 37HP					SERVES BUILDINGS: 37									FUEL TYPE: 2
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
** BOILER LOCATION: BUILDING 37N					SERVES BUILDINGS: 37									FUEL TYPE: 5
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

TIGER SPECIAL

ECONO-THREE
OFFICES



National ECONO-THREE modular in-plant offices are designed for applications where cost is a major consideration.

Although low in price, these attractive enclosures offer full 3" thick, 3-ply wall panels constructed of ⅛" 4 mil vinyl-clad hardboard (each side) over a kraft honeycomb core. All panels are completely interchangeable and reuseable.

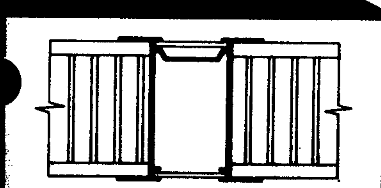
Features include pre-hung, pre-finished oak woodgrain doors, pre-painted steel-ribbed roof deck and one-piece mill-finished extruded aluminum connection and corner posts allowing fast on-site assembly.

System incorporates all of National's quality features including exclusive "Wire-Pak" modular snap-together, six-wire wiring system. Offices are also available in vision tower and two-story versions.

SEE PAGES 16 THROUGH 19 FOR CONSTRUCTION DETAILS.

SEE PAGE 26 FOR ARCHITECTURAL SPECIFICATIONS.

15-14



MODEL SELECTION CHART

ET64	8x8	958	ET320	16x20	2734
ET80	8x10	1012	ET336	12x28	2966
ET96	8x12	1246	ET384	12x32	3310
ET100	10x10	1260	ET388	16x24	3148
ET120	10x12	1418	ET400	20x20	3190
ET144	12x12	1590	ET448	16x28	3534
ET160	10x16	1734	ET480	20x24	3646
ET192	12x16	1934	ET512	16x32	3934
ET200	10x20	2050	ET560	20x28	4102
ET240	12x20	2278	ET640	20x32	4558
ET256	16x16	2334	ET720	20x36	5014
ET288	12x24	2622	ET800	20x40	5470

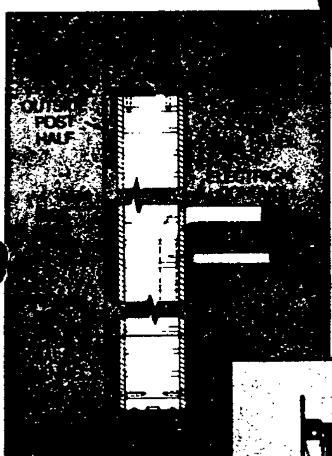
ENCLOSUR

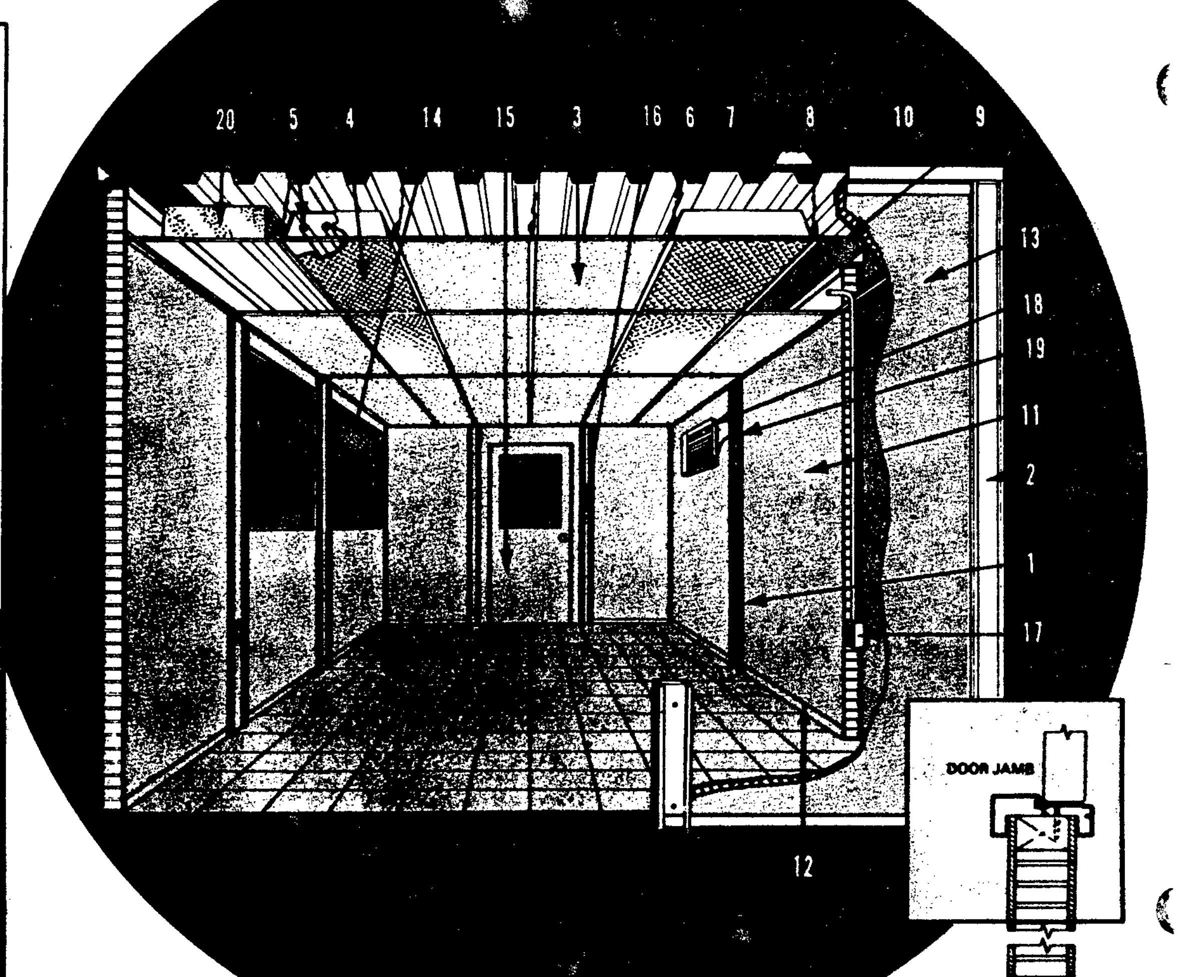
NATIONAL'S VERSATILE

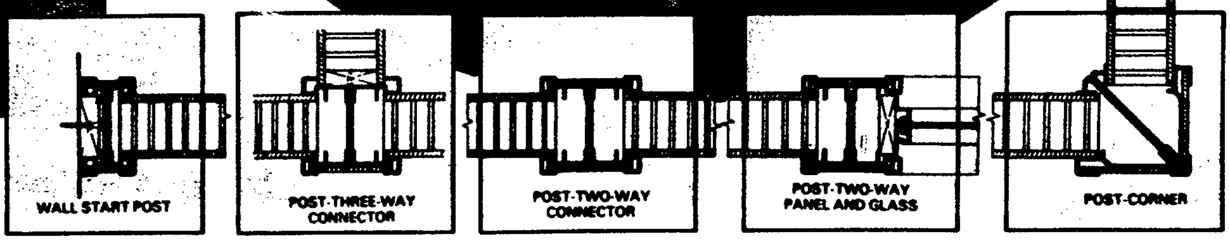
V10™ POST SYSTEM

IS A UNIQUE STRUCTURAL CONCEPT THAT SERVES AS THE KEY ELEMENT OF NATIONAL'S MODULAR BUILDING SYSTEMS.

The V10 Post System was specially designed to be used in ten different ways: 1) as a wall start; 2) as a finished end; 3) as an in-line post; 4) as a 3-way post; 5) as a 4-way post; 6) as a corner post; 7) as an electrical raceway; 8) as a housing for steel inserts; 9) as a battan strip; 10) as a shelf standard when pierced.





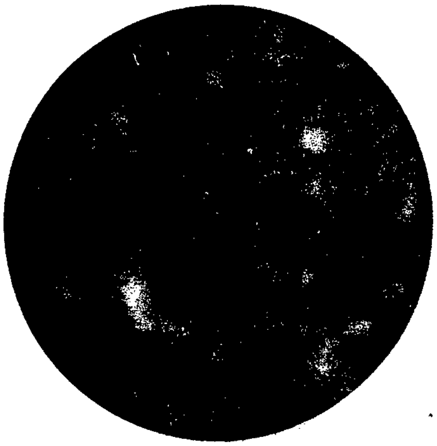


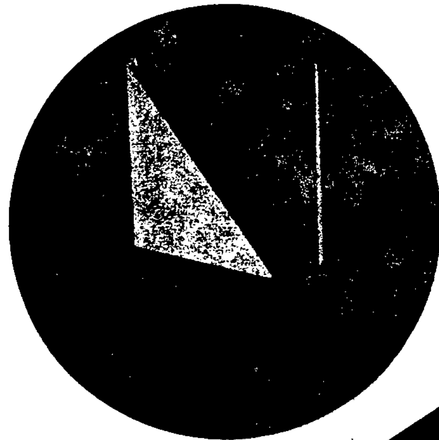
1. **POSTS:** Extruded anodized aluminum with spring-held vinyl-clad feature strips to match interior/exterior panel facings (see V10™ information above).
2. **CORNER POSTS:** Massive two-piece anodized aluminum with matching vinyl-clad feature strips assure fastest possible assembly of corners.
3. **CEILING:** Attractive, white, random fissured, vinyl-faced fiberglass tile, easily cleaned to retain permanent beauty.
4. **INDIRECT LIGHTING:** Luminous fixture panels, as required, provide efficient, soft overall lighting without dark areas.
5. **CONCEALED LIGHTS:** Fluorescent, four-tube, lay-in troffer-type fixtures. Average 100 foot candles of illumination.
6. **TIE WIRES:** Fasten to roof deck with self-tapping screws and to ceiling grid main T's.
7. **ROOF DECK:** Designed to achieve optimum structural efficiency in 22 gauge steel (painted), provides clear spans up to 12 feet (20 feet with 6-inch joists).
8. **ROOF DECK END CLOSURES:** Rubber seals inserted in roof flutes contain heat and conditioned air. Insures dust-free interior.
9. **CEILING GRID:** White enameled "T" support system forms a rigid frame for light fixtures and ceiling tiles.
10. **PANEL CAPS:** Anodized aluminum panel caps incorporating fascia provide finishing touch to panels as seen from exterior.
11. **WALLS:** A full 3-inch thick with honeycomb core affords structural rigidity and effective "Sound Conditioning." 3/16-" tempered hardboard facings, clad in choice of "DIAMOND-COAT" vinyl colors and finishes, retain beauty with minimum maintenance.
12. **CONTINUOUS BASE CHANNEL:** Heavy anodized aluminum base channel (fastened to floor) supports and secures wall panels. Trims bottom on interior and exterior.
13. **REMOVABLE PANELS:** Special design feature of panels allows easy removal providing access for large equipment, or replacement of damaged panels, without dismantling enclosure.
14. **WINDOWS:** Optional choice of picture, sliding or pass-thru (with or without shelf). All provided with tempered safety glass.
15. **DOORS:** Attractively faced in harmonizing vinyl. Pre-hung in aluminum jamb, complete with hardware, solid 20-inch by 30-inch door lite, and/or with 18-inch by 12-inch anodized aluminum grille are optional.
16. **WALL SWITCH:** Light switches are conveniently placed and attractive, conforming to National Code.
17. **WALL OUTLETS:** Conduit run with junction box, outlet or switch, cover plate offset fitting, conduit to reach ceiling plenum and connectors. All pre-assembled in interior posts to create vertical electric raceway.
18. **COMFORT CONTROL OPTIONS:** Include air conditioners (from 5,000 BTU to 12,000 BTU); 8-inch exhaust fan (wall-mounted), 180 CFM; heater up to 5,600 watts (Heat, off or fan) wall-mounted; anodized aluminum louver 12-inch by 18-inch.
19. **AIR CONDITIONER OUTLET:** 110 or 220 volt. (Breaker panel provided with the office kit allows separate circuit for air conditioner operation.)
20. **ENERGY-SAVER CONSTRUCTION (Optional):** Includes wall panels constructed of 3/16-inch vinyl-clad facings (each side) with an insulating polystyrene foam core (1 lb. density) and a 6-inch thick fiberglass blanket of insulation layed into the plenum area. Provides R-12 wall and R-19 roof rating.

SEE PAGE 26 FOR ENGINEERING AND ARCHITECTURAL SPECIFICATIONS

15-15

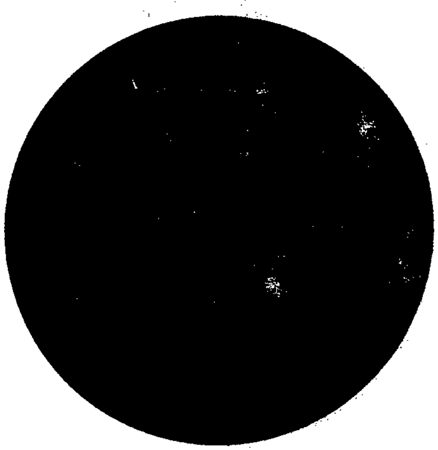
CONSTRUCTION DETAILS

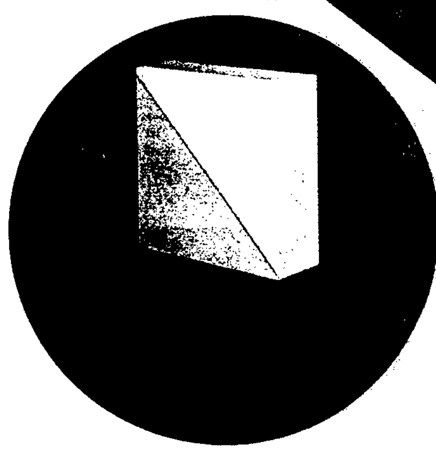


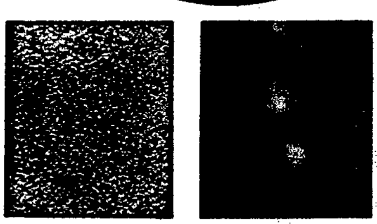


PANEL CONSTRUCTION DETAILS

NOTE:
Other facings such as (but not limited to) .032-inch aluminum, and panel cores utilizing steel studs and urethane are also available.







409-SAND NC-251-HICKORY

STANDARD INTERIOR PANEL FINISHES – National offices are available in the standard vinyl finishes as shown at left. These and all optional finishes (except 801, 803 and 812 textured films) incorporate National's exclusive DIAMOND COAT™ described above.

401 SNOW WHITE | NC-159 PECAN | NC-150 WALNUT | NC-254 OAK | NC-156 ROSEWOOD | NC-157 NATURAL TEAK | 801 TAN CALCUTTA | 803 BEIGE CALCUTTA | 812 GREY CALCUTTA

OPTIONAL INTERIOR PANEL FINISHES
National laminates their own vinyl-clad panels and can provide the widest selection of colors and woodgrains in the industry. Cork and chaulk board facings are also available on request. Other finishes (not shown) can be supplied... contact the factory. See actual swatch samples for exact color and finish.

15-16

ECO # 16

Utilize Natural Gas for Boilers in Buildings 1, 2, 3, 8, 37, 57, 320, 349, 423 and 2360.

Assumptions:

1. LEAD will pay for all pipeline construction and the addition of dual fuel burners on boilers.
2. Peoples Natural Gas will provide natural gas for \$4.00 per MCF (\$3.88 per MBtu).
3. The boiler efficiency is 80% for both natural gas and fuel oil burners.
4. The energy saved from heating the fuel oil in the tanks is negligible.
5. The energy content of natural gas is #1,031,000 Btu/MCF.

Current Energy Use:

Fuel oil consumption data (from ADDS) for each building was compiled on a computer spreadsheet.

For FY90, the 10 buildings to be converted to natural gas used 89.5% of the total heating energy at LEAD.

$$\#2 \text{ fuel oil use} = 263{,}269 \frac{gal}{Yr} \times 0.13869 \frac{MBtu}{gal} = 36{,}513 \frac{MBtu}{Yr}$$

$$\#5/6 \text{ fuel oil use} = 1{,}513{,}589 \frac{gal}{Yr} \times 0.14969 \frac{MBtu}{gal} = 226{,}569 \frac{MBtu}{Yr}$$

Total = 36,513 $\frac{mBtu}{yr}$ x 226569 $\frac{mBtu}{yr}$ = 263,082 mBtu/yr

Current Energy Cost :

#2 oil : 36,513 $\frac{mBtu}{yr}$ x 4.76 \$/mBtu = \$173,802 /yr

#5/6 oil : 226,569 $\frac{mBtu}{yr}$ x 4.61 \$/mBtu = \$1,044,483 /yr

Total cost = \$271,292/yr + \$1,497,621/yr = \$1,218,285 /yr

Energy Cost Utilizing Natural Gas:

263,082 $\frac{mBtu}{yr}$ x \$3.88/mBtu = \$1,020,758/yr

Energy Cost Savings:

\$1,218,285/yr - \$1,020,758/yr = \$197,527 /yr

Project Implementation Cost:

Total project Costs = \$2,552,513

See cost estimate sheet for details

Simple Payback

\$2,552,513 ÷ \$197,527/yr = 12.9 years

Letterkenny Army Depot
Fuel Oil Consumption Data (from ADDS)

May 7, 1991

Building Number	Convert To NG	FY 89 Use (Gal) FO#2	FO#5&6	TOTAL	FY 90 Use (Gal) FO#2	FO#5&6	TOTAL
1	Yes	0	56283	56283	0	51106	51106
2	Yes	36249	0	36249	74632	0	74632
3	Yes	0	50260	50260	0	30766	30766
8	Yes	27283	0	27283	46446	0	46446
10		19868	0	19868	13704	0	13704
12		0	17866	17866	0	14482	14482
37	Yes	57679	0	57679	49993	0	49993
37	Yes	0	16543	16543	0	25167	25167
37	Yes	0	38542	38542	0	33966	33966
57	Yes	21585	0	21585	16269	0	16269
57	Yes	0	31486	31486	0	0	0
57	Yes	0	0	0	0	41995	41995
320	Yes	76995	0	76995	63295	0	63295
349	Yes	0	843457	843457	0	1150848	1150848
349	Yes	0	0	0	0	24654	24654
423	Yes	0	84806	84806	0	103610	103610
1466		10992	0	10992	9338	0	9338
2360	Yes	14189	0	14189	12634	0	12634
2360	Yes	0	71843	71843	0	51477	51477
2384		1228	0	1228	0	0	0
2702		1898	0	1898	1601	0	1601
2755		8386	0	8386	4293	0	4293
3170		230	0	230	137	0	137
3311		3112	0	3112	1979	0	1979
3321		3626	0	3626	1185	0	1185
3387		1076	0	1076	909	0	909
3626		6984	0	6984	5778	0	5778
3700		5861	0	5861	5109	0	5109
3751		5707	0	5707	11119	0	11119
3810		12274	0	12274	13027	0	13027
3812		2309	0	2309	2116	0	2116
4341		2104	0	2104	1540	0	1540
4756		11632	0	11632	9576	0	9576
5249		9713	0	9713	6550	0	6550
5250		0	0	0	2644	0	2644
5313		3276	0	3276	2510	0	2510
5316		0	21693	21693	0	12100	12100
5647		7835	0	7835	4372	0	4372
AMMO		120638	0	120638	97110	0	97110
Total Gal/Yr		472729	1232779	1705508	457866	1540171	1998037
Total MBtu/Yr		65563	184535	250097	63501	230548	294050
Gal/Yr To NG		233980	1193220	1427200	263269	1513589	1776858
MBtu/Yr To NG		32451	178613	211064	36513	226569	263082
% FO To NG		49.5%	96.8%	84.4%	57.5%	98.3%	89.5%

CONSTRUCTION COST ESTIMATE

DATE PREPARED: May 8, 1981

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE

- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.:

ESTIMATOR: W. T. Todd

CHECKED BY:

N.G. Conversion SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
Pipeline construction with measuring, heating, Odorization and regulating station.							
			PNG Estimate - 4/89				$1,825,000
			ENR Esclation rate to 1/91				x 1.036
				Subtotal			$1,890,700
Burner replacement for boilers in buildings 1, 2, 3, 8, 37, 57, 320, 349, 423 and 2360							
			PNG Estimate - 4/89				$384,700
			ENR Esclation Rate to 1/91				x 1.036
				Subtotal			$398,549
Total Construction Costs ≈							$2,289,249
				SIOH (5.5%)			$125,909
				Subtotal			$2,415,158
				Design (6%)			$137,355
			TOTAL PROJECT COST				$2,552,513
ENR INDEX:		4/89 = 2621					
		1/91 = 2716					

ENG FORM 150
1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE : 1980 0—516140

ECO #16.

RS&H **Telephone Call Confirmation**

Project No. 290-0379-001

Local ____ (L.D.) ____ (Placed) ____ Rec'd. ____ Date 5-8-91

Bill Todd ____ Conversed With Bill Becker → Tom Broderick

Of Peoples Natural Gas Co. - PA ____ Regarding Nat. Gas Service for LEAD
412-471-5100

Bill Becker was out of the office so I spoke with Tom Broderick:

Bill B. is the most knowledgeable person about the LEAD project.

Jim Coconia is PNG's main contact at LEAD.

There is now some capital constraints at PNG - so they will not be co-funding the pipeline construction.

PNG will provide LEAD with N.G. at $4.00/mcf

The energy content of their N.G. is over 1,000,000 Btu/mcf

Bill Becker will call me back tomorrow.

Distribution:

RS&H®

SUBJECT Project D Update
LEAD
DESIGNER [initials]
CHECKER

AEP NO 290-0379-001
SHEET 1 OF
DATE 4/19/91
DATE

ECO # D-UP Heat Recovery - Bldgs 37 & 350

Calculations Summary

	Energy Savings (MBtu) #2	#5	#6	Elec	Capital Cost (1/91 $)	Payback (yrs.)
D (1)	–	–	1166	(357)	$ 127,403	34
D (2)	–	1083	–	(393)	159,579	56
D (3)	425	–	–	–	41,284	13
Totals	425	1083	1166	(750)	$ 328,266	18

RS&H	SUBJECT Project D Update (1) Heat Rec. P.B. #61, Bldg 350	AEP NO	
	DESIGNER PFH	SHEET 2	OF
	CHECKER	DATE 3/19/91	
		DATE	

ECO # D-UP(1) Paint Booth Exhaust Heat Recovery in Bldg 350

Energy Calculations P.B #61 Heat Recovery, Bldg 350

Energy savings were changed based on the following:

		from:	to:
Indoor temp	=	60F	65F
Operating Hrs	=	2 shifts, 6da/wk	2 shifts, 5da/wk
Boiler Sys. Eff	=	0.74	0.80
Heat Rec Eff	=	0.69	0.64
ACFM	=	13,700	12,141

Using the analysis found in The Paint and Drying Booths, BKA, Vol II, pps. 106-114) the following was found:

Existing booth energy use

Make-up air heat (p. 111) = 1363 / 0.80 = 1704 MBtu/yr #6 fuel oil

Fan Energy Use =

$$\frac{\$1255}{0.0381(\$/kwh)} \cdot \frac{3413\,Btu}{kwh} \cdot \frac{MBtu}{10^6\,Btu} = 112\text{ MBtu Electricity}$$

(p. 111)

New booth energy use

Make up air heat (p. 110) = 430 / 0.80 = 538 MBtu/yr. #6 fuel oil

Fan energy use (p. 110) =

$$\frac{\$5240}{\$0.0381/kwh} \cdot \frac{3413}{10^6} = 469\text{ MBtu electricity}$$

RS&H®

SUBJECT ______
DESIGNER RA
CHECKER ______

AEP NO ______
SHEET 3 OF ______
DATE 2/19/91
DATE ______

Energy Savings

#6 Fuel oil : 1704 - 538 = 1166 MBTU

Electricity : 112 - 469 = (357) MBtu

Cost Estimate (p. 112)

$ 119,053 BKA Report July 87

Escalated to 1/91 using ENR Bldg Cost Indicies =>

$119,053 * 2716 ÷ 2538 = $127,403

$$\text{Payback} = \frac{\$127{,}403}{1166 * \$6.61 - 357 * \$10.94} = 34 \text{ years}$$

RS&H	SUBJECT Project D(2) Update	AEP NO	
		SHEET 4	OF
	DESIGNER PFH	DATE 4/19/91	
	CHECKER	DATE	

ECO D-UP(2)

Energy Calculations P.B. #280, Bldg. 37

The original energy savings were changed to correct for the following:

	from RSH	from BKA	to:
Req'd CFM	16,500	18,894	18,318
Indoor temp	80°F		68°F
Boiler Sys. Eff.	0.74	0.40	0.80
Opn Hrs			
# shifts	1	varies	2
days/wk	6	varies	5
Opn. Hrs while Htg.	1300	–	3000

The energy savings were taken from the "Paint and Drying Booth" Report by BKA, Vol II pp. 22-31.

Existing energy use (p. 28)

Make-up air (68°F, 3000 opn hrs)

$= 1689 \div 0.80 \quad = \quad \underline{2111}$ MBTU/yr. #5 F.O.

Fan energy:

$$\frac{\$1383}{0.0381\ \$/kWh} \cdot \frac{3413\ \text{Btu/kwh}}{10^6\ \text{Btu/MBtu}} = \underline{124}\ \text{MBtu/yr elec.}$$

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SUBJECT Project D(k) Update

DESIGNER

CHECKER

AEP NO

SHEET 5 OF

DATE

DATE

New Energy Use

Make-up air (p. 27)

822 ÷ 0.80 = 1028 MBtu/yr #5 F.O.

Fan Energy

$$\frac{\$5773}{0.0381\ \$/kwh} \cdot \frac{3413}{10^6} = 517 \text{ MBtu/yr elec.}$$

Savings

#5 F.O. : 2111 - 1028 = 1083 MBtu/yr #5

Elec. : 124 - 517 = (393) MBtu/yr elec

Cost Estimate : p (29)

$ 149,121 6/87

Escalate using ENR indicies

$$\$149{,}121 \cdot \frac{2716}{2538} = \$159{,}579 \quad (1/91 \$)$$

Payback

$$\frac{159{,}579}{1083 * 6.61 - 393 * 10.94} = 56 \text{ years}$$

RS&H

SUBJECT	Project D Update (3) Heat Rec. Engine Test Cells B. 37	AEP NO	
DESIGNER	PFH	SHEET	6 OF
		DATE	3/13/91
CHECKER		DATE	

ECO # D-UP(3)

Energy Calculations

The energy savings were changed based on the following:

	from:	to:
Boiler Sys. Eff.	0.74	0.80
Tests / yr	240	875

Current Energy use

37 gal / test = 5.14 MBTU * 875 tests/yr = 4498 MBtu/yr

Energy Recovery

Exh gas energy rec	=	1.07 MBTU	4.31 MBTU/test
Dynamometer cooling	=	1.44 MBTU	
Engine cooling water	=	1.80 MBTU	4.31 * 875 = 3771 MBtu/yr

Energy is recovered at ~30 gpm of 180°F water. The report estimates a continuous use of steam for steam clean areas of 35 gpm per hose * 3 hoses = 105 gpm. Current operation is estimated to be much less than this and intermittant.

RS&H

SUBJECT Project D(3) Update
AEP NO
SHEET 7 OF
DESIGNER [initials]
DATE 3/19/91
CHECKER
DATE

Calculate the amount of energy used at the Bldg 37 High pressure boiler. This is estimated using the fuel use of the past three years.

$$\text{Avg. fuel use \#2 F.O.} = \frac{46{,}505 + 67{,}296 + 57679}{3} \approx 57{,}000 \frac{gal}{yr}$$

$$\text{Avg. steam use} = 57{,}000\,gal \cdot 138{,}700 \frac{Btu}{gal} \frac{MBtu}{10^6 Btu} \div 0.80 \text{ (boiler eff.)}$$

$$= \underline{9880} \frac{MBtu}{yr} \text{ steam}$$

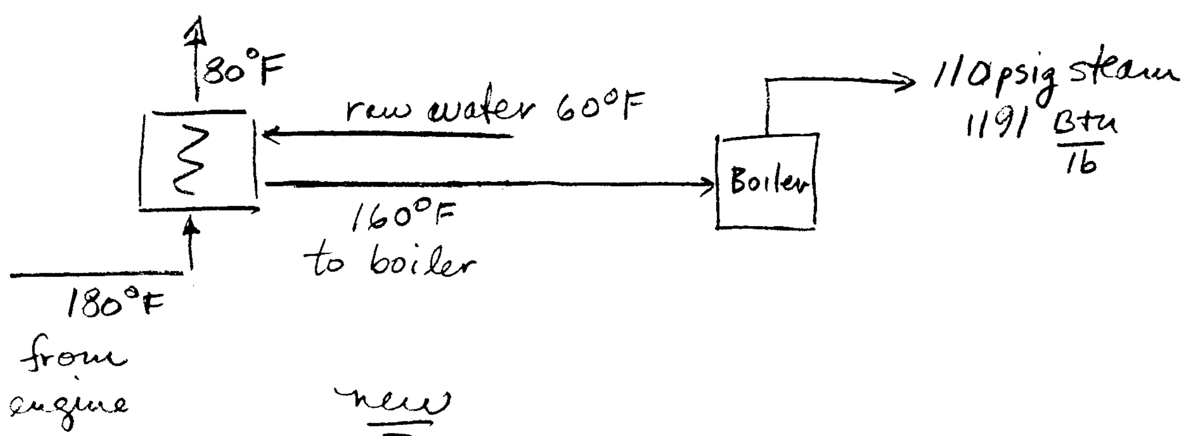
Because the steam use is intermittant a new design is recommended with a heat exchanger in the loop. In this design heat is extracted only when "steam" cleaning is operational. Otherwise, the engine and dynamometer exit water is cooled by the existing cooling tower.

The exhaust gas heat recovery is also removed since sending this heat to the cooling tower may exceed the cooling tower capacity.

The new energy recovery values become

Dynamometer cooling - 1.44 MBtu/test
Engine cooling water - 1.80 "
Total 3.24 MBtu/test × 875 tests = 2835 MBtu/yr.

However the amount of heat that can be useful in the preheating of boiler feedwater is much less than this. The diagram below can help demonstrate this.



In the existing system the boiler heats 60°F water to 110 psig steam.

$$\Delta h = 1191 - 28 = 1163 \text{ Btu/lb}$$

In the new system the heat recovery system will heat the raw water from 60°F to 160°F (Δh = 100 Btu/lb) and the boiler will heat the 160°F water to 110# steam ($\Delta h = 1191 - 128$) = 1063.

The maximum energy savings is therefore

$$100 * \frac{1163-1063}{1163} = \underline{8.6\%}$$

RS&H

SUBJECT Project D(3) Update | AEP NO
SHEET 9 OF
DESIGNER PFH | DATE
CHECKER | DATE

If one assumes that "steam" cleaning is operational half of the time during engine testing the annual savings becomes -

$$9830 \frac{MBtu}{yr} * 0.086 * 0.50 = \underline{425} \frac{MBtu}{yr}$$

#2 F.O.

Cost Estimate

Assume that the exhaust gas heat exchanger and associated piping is approximately equivalent to the newly-required heat exchanger (between boiler feed water and ~~two~~ hot engine and dynamometer cooling water. The 1980 estimate is escalated to present.

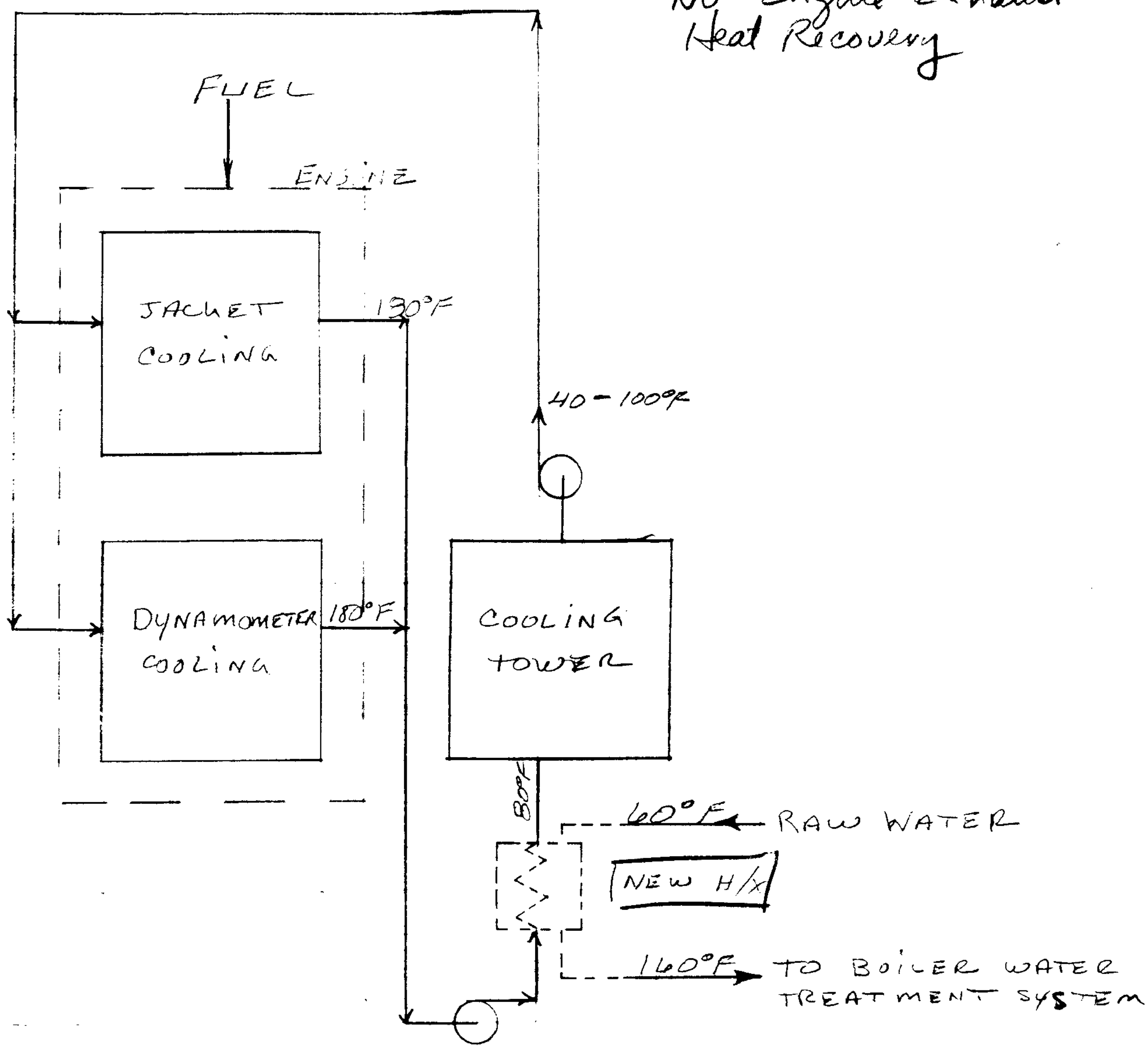
$29,701 · 1.39 = $41,284 (1/91 $)
(Vol 1, p. D(3) III-10)

$$\text{Payback} = \frac{\$41,284}{425 * 7.43} \approx \underline{13.1 \text{ years}}$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT: Project D (3) Update
AEP NO:
SHEET: 10 OF:
DESIGNER: PFH
DATE:
CHECKER:
DATE:

Revised Design with New Heat Changer and No Engine Exhaust Heat Recovery



NOTE: IF CONDENSATE RETURN TO HEATING BOILERS IS BELOW 160°F, DUMPING IT IN FAVOR OF THIS WARM WATER MAY BE ADVISEABLE

ECO #D-UP

LETTERKENNY ARMY DEPOT
FUEL CONSUMPTION REPORT
IN GALLONS

BLDG	YEAR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEARLY TOTAL
** BOILER LOCATION: BUILDING 1			SERVES BUILDINGS: 1, 2											FUEL TYPE: 5
1	FY87	4545	2640	728	2810	3401	6278	10899	6000	17985	2112	3989	8052	69439
1	FY88	0	21786	9197	4575	16052	4647	10351	225	2472	0	0	0	69305
1	FY89	294	5623	9885	2697	16802	3138	10534	706	91	1321	1027	4165	56283
1	FY90	6864	10838	851	8832	15574	2377	-1	4007	0	1386	378	0	51106
** BOILER LOCATION: BUILDING 2			SERVES BUILDINGS: 4, 7											FUEL TYPE: 2
2	FY87	896	732	4206	9777	9384	8246	2710	2636	3836	3636	2916	190	49165
2	FY88	8018	943	10711	12793	27167	15963	12033	8226	4936	21796	4113	1233	127932
2	FY89	2112	6053	602	2783	11941	1044	10607	1107	0	0	0	0	36249
2	FY90	5131	14811	17118	20647	4276	4882	2137	0	0	1220	4410	0	74632
** BOILER LOCATION: BUILDING 3			SERVES BUILDINGS: 3, 5											FUEL TYPE: 5
3	FY87	756	6275	908	6695	15	1361	1931	2617	4275	8198	15139	5951	54121
3	FY88	3368	6455	13284	11511	3649	7043	4445	6164	392	0	0	0	56311
3	FY89	0	12449	4999	4672	17211	5886	2140	1230	0	179	228	1266	50260
3	FY90	3787	1852	2154	7188	11293	4493	-1	0	0	0	0	0	30766
** BOILER LOCATION: BUILDING 8			SERVES BUILDINGS: 6, 8, 9											FUEL TYPE: 2
8	FY87	1088	7035	13054	16931	13780	9278	9475	163	0	0	123	551	71478
8	FY88	0	8435	10865	1249	24192	0	4246	77	0	3544	3534	7465	63607
8	FY89	9612	4042	2798	4808	446	4719	336	522	0	0	0	0	27283
8	FY90	3614	8846	9613	11906	7665	1679	3123	0	0	0	0	0	46446
** BOILER LOCATION: BUILDING 10			SERVES BUILDINGS: 10											FUEL TYPE: 2
10	FY87	254	66	77	96	129	65	106	83	0	356	250	0	1482
10	FY88	530	1177	4509	3631	2993	3240	637	619	0	206	121	58	17721
10	FY89	103	1982	3918	4290	2413	2534	910	215	0	300	2703	500	19868
10	FY90	0	1315	4433	4942	2225	789	0	0	0	0	0	0	13704
** BOILER LOCATION: BUILDING 12			SERVES BUILDINGS: 12, 13, 14											FUEL TYPE: 5
12	FY87	1794	1732	833	2938	4103	2987	961	31	62	4	92	184	15721
12	FY88	369	2414	3949	4405	3537	2370	1547	131	0	0	0	0	18722
12	FY89	800	2507	4263	2818	3824	2596	789	269	0	0	0	0	17866
12	FY90	675	3428	2929	1432	2430	3067	521	0	0	0	0	0	14482
** BOILER LOCATION: BUILDING 37HP			SERVES BUILDINGS: 37											FUEL TYPE: 2
37HP	FY87	3506	3583	2147	6008	4366	3582	3763	4823	1153	5113	3037	5424	46505
37HP	FY88	4633	4840	5453	6893	6583	7643	2435	5611	6266	7803	2280	6856	67296
37HP	FY89	2625	5712	6551	6816	8100	5837	5824	1110	1108	3660	6957	3379	57679
37HP	FY90	5486	9712	5367	4934	5666	9263	8553	1012	0	0	0	0	49993
** BOILER LOCATION: BUILDING 37N			SERVES BUILDINGS: 37											FUEL TYPE: 5
37N	FY87	101	1477	4097	4079	4300	3586	1307	155	0	0	40	40	19182
37N	FY88	731	3099	1571	2750	10474	4706	4820	156	312	624	1248	960	31451
37N	FY89	1920	1951	266	3412	4256	3531	1084	123	0	0	0	0	16543
37N	FY90	1553	5008	7038	1798	2996	5695	1079	0	0	0	0	0	25167

EN

RS&H

SUBJECT: Project E-Update LEAD
AEP NO: 290-0379-001
SHEET 1 OF 2
DESIGNER: PFH
DATE: 3/20/91
CHECKER:
DATE:

ECO # E-UP Vapor Barrier for Dehumidified Warehouses
Energy Calculations from EEAP Vol 1

Existing energy use	=	317,197 kwh/yr	
Energy use with seal		155,389 kwh/yr	
Savings	=	161,303 kwh/yr	p. E-V-29

Total energy savings for 12 uninsulated warehouses

Existing energy use	3,409,867 kwh	
Energy use with seal	1,670,431 "	
	1,739,436 "	p. E-V-30B

1,739,436 kwh · 3413 Btu/kwh = 5937 MBtu/yr Electricity

Cost Estimate: p. E-V-36, 38, 39, 44 EEAP by RSH

		July 1980	July 1983	Jan 1991
CWE	:	$573,942	$806,347	$799,398
Design	=	32,864	41,224	45,774
Project Cost		$606,806	$847,571	$845,172

In the original report July 1980 estimates were escalated to July 1983 at 12% per year, and those values are shown here. July 1980 estimates are escalated to January 1991 using ENR Building cost indicies.

ENR Indicies July 1980 = 1950, Jan 1991 = 2716

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SUBJECT Project E - Update

AEP NO

SHEET 1 OF 2

DESIGNER

DATE

CHECKER

DATE

Additional costs -

Sealant life expantancy is about 10-15 years

Should be applied again with one coat

Cost is 1/2 the construction cost

= 758,002/2 = $379,001

E-UP-2

10/09/91

ECO Construction Cost Estimate Calculations

ECO Name: Vapro Barrier for Dehumidified Warehouses

ECO #: E-UP

1991 ECO "bare" costs (from cost estimate sheet)		
Material		$129,051
Labor		$334,920
	Subtotal bare costs	$463,971
FICA Insurance (20% of Labor)		$66,984
Sales Tax (6.5% of Material)		$8,388
	Subtotal	$539,343
Overhead (15%)		$80,902
	Subtotal	$620,245
Profit (10%)		$62,025
	Subtotal	$682,270
Bond (1%)		$6,823
	Subtotal	$689,093
Contingency (10%)		$68,909
Subtotal (Construction Cost Input For LCCID *)		$758,002
SIOH (5.5% of Construction Cost)		$41,690
	Subtotal	$799,692
Design (6% of Construction Cost)		$45,480
Total Project Cost		$845,172

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

RS&H

Telephone Call Confirmation

(215) 425-6607

Project No. 290-0379-001

Local ______ L.D. ✓ Placed ✓ Rec'd. ______ Date 10/4/91

P. Hutchins Conversed With Bob Casty

Of IPA Systems Regarding DRYCON Sealant

- BC will send literature

- Can get prices from
  Glen Rexrod
  Triboro Concrete
  Dallastown, PA (near Harrisburg)
  (717) 246-3095

- Prices received from Ed McCarthy in Philadelphia
  ~ 1.75/SF for contracted price
  ~ 0.45/SF for materials
  these values work very close to original estimate
  escalated to date using ENR indicies

Distribution:

E-UP-4

3/89

RS&H

Telephone Call Confirmation

Project No. 290-0379-001

Local ______ L.D. ✓ Placed ______ Rec'd. ✓ Date 10/1/91

P. Hutchins Conversed With Merv Richardson

Of LEAD Regarding Dehumidified Warehouses

- MR verified that the following warehouses are dehumidified ~~and~~, not heated, and do not have interior wall insulation

#'s 11, 18, 31, 32, 34, 41, 44, 52, 53, 55, 56 (47?)

Distribution:

E-UP-5

3/89

RS&H®

SUBJECT LEAD ECO # G-UP

AEP NO 290-0379-001

SHEET ____ OF ____

DESIGNER G. Fallon

DATE ____

CHECKER ____

DATE ____

ECO # G-UP

UPDATE BLDG 350N DIP TANK EXHAUST HEAT RECOVERY

ASSUMPTION CHANGES

TANK NO.	FLOW (CFM) 1980 (5)	FLOW (CFM) 1991 (4)	TEMPERATURE 1980 (5)	TEMPERATURE 1991 (2)	OPERATING HRS 1980 (5)	OPERATING HRS 1991 (3)	BOILER EFF 1980 (5)	BOILER EFF 1991
2512 (1)	14000	—	83	—	2270	—	.74	—
2514	15660	9360	83	68	2270	8760	.74	.8
2516	25560	6450	83	68	2270	8760	.74	.8
2518	14,000	9360	83	68	2270	8760	.74	.8
2520	12,186	12600	83	68	2270	8760	.74	.8
NG274 (1)	—	9360	—	68		8760	—	.8
TOTALS	81,406	47,160						

NOTE: (1) TANK NO. 2512 HAS BEEN CONVERTED TO A NON-VENTED APPLICATION, BUT TANK NO NG 274 HAS BEEN ADDED. SO THE NUMBER OF TANKS REMAINS THE SAME.

(2) DESIGN TEMPERATURE IS USED PER LEAD REQUEST

(3) OPERATING HOURS WHILE HEATING CHANGE. OSHA REGS REQUIRE CONTINUOUS OPERATION WITH TANKS UN-COVERED

(4) VOLUMES ARE DESIGN VALUES. (LEAD DIP TANK SURVEY)

(5) LEAD EEAP, RSH, 1980

CURRENT HEAT LOSS (TANK 2514)

$$Q = \frac{9360 \text{ CFM} \times 165858 \text{ BTU/YR·CFM}^{*}}{0.8 \times 10^{6} \text{ BTU/MBTU}} = 1940 \text{ MBTU/YR}$$

* FROM BIN TEMP METHOD, ENCLOSED.

ENERGY SAVINGS

HEAT EXCHANGER REMAINS 66% EFFICIENT

1940 MBTU/YR × 0.66 = **1280 MBTU/YR**

COST SAVINGS

1280 MBTU/YR $6.61/MBTU = $8470/YR. (FY91$)
$5907/yr (FY92$)

ADDITIONAL FAN ENERGY

FAN OPERATING COST FROM EEAP COMPUTER PRINTOUT.

SUPPLY FAN ($154.02/YR) # 2514 EEAP Vol 2 p. G-V-18

FAN ENERGY CONSUMPTION IS DIRECTLY PROPORTIONAL TO FAN FLOW

$$\frac{\$154.02/YR}{\$0.03/KWH} \times \frac{3413\ BTU/KWH}{10^6\ BTU/MBTU} \times \frac{9360\ CFM}{15660\ CFM} = 10.47\ MBTU/YR$$

EXHAUST FAN ($157.59/YR)

$$\frac{\$157.59/YR}{\$0.03/KWH} \times \frac{3413\ BTU/KWH}{10^6\ BTU/MBTU} \times \frac{9360\ CFM}{15660\ CFM} = 10.71\ MBTU/YR$$

TOTAL FANS (ADDITIONAL CONSUMPTION)

10.47 MBTU/YR + 10.71 MBTU/YR = **21.18 MBTU/YR**

THE ABOVE METHOD WAS APPLIED TO THE OTHER TANKS USING SPREADSHEET SOFTWARE. THE RESULTS ARE ON THE SUMMARY PAGE.

LETTERKENNY ARMY DEPOT
ECO # G-UP
BUILDING 350 N DIP TANK
EXHAUST HEAT RECOVERY
SUMMARY

Tank Number	Flow (cfm)	Energy Savings No 6 F.O. (MBTU/yr)	Energy Savings ELEC (MBTU/yr)	(FY91 $) Cost Savings ($/yr)	Const. Cost (1991 $)	Payback (years)
2514	9360	1281	-21	8234	47589	5.8
2516	6480	887	-15	5700	47589	8.3
2518	9360	1281	-21	8234	47589	5.8
2520	12600	1724	-29	11084	47589	4.3
NG 274	9360	1281	-21	8234	47589	5.8
TOTAL	47160	6453	-107	41487	237945	5.7
				$28,578 (FY92 $)		8.3

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter	68
Air Quantity (cfm)	1
Hour Fractions 1 AM - 9 AM	1
9 AM - 5 PM	1
5 PM - 1 AM	1
Operation Days Per Week	5

	Temp.	Hours of Occurrence			Total	Delta				Total
	Range	2-9	10-17	18-1	Hours	H or T	Const.	CFM	BTU/HR	BTU
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858
Total Operation Hours While Heating (and corrected for working days/week)					4776					118,470
Avg outdoor temp while heating (F)					45.0					

6-UP-4

05/17/91

ECO Update Construction Cost Estimate Calculations

ECO Name: EXHAUST HEAT RECOVERY, BUILDING 350 N DIP TANKS

ECO #: G-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)	
Material	$79,415
Labor	$20,368

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $79,415 x 1.393 =$110,611
Labor = $20,368 x 1.393 = $28,369
Total =$110,611 + $28,369 =$138,980

Bare 1991 Escalated Costs	$138,980
FICA Insurance (20% of Labor)	$5,674
Sales Tax (6.5% of Material)	$7,190
Subtotal	$151,844
Overhead (15%)	$22,777
Subtotal	$174,621
Profit (10%)	$17,462
Subtotal	$192,083
Bond (1%)	$1,921
Subtotal	$194,004
Contingency (10%)	$19,400
Subtotal (Construction Cost Input For LCCID *)	$213,404
SIOH (5.5% of Construction Cost)	$11,737
Subtotal	$225,141
Design (6% of Construction Cost)	$12,804
Total Project Cost	$237,945

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

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SUBJECT ECO # G-UP

AEP NO 290-0379-001

SHEET ____ OF ____

DESIGNER P. Hutchins

DATE 10/4/91

CHECKER ____

DATE ____

- If ECO#3, Dip Tank Covers with Variable Speed Drives on Exhaust Fans, is implemented, savings for this ECO will be significantly changed. ECO#3 basically reduces the full load operating hours from 8760 hrs/yr to 16 hrs/da, 5 da/wk, 52 wk/yr.

- Calculate the energy savings change

With ECO#3 implemented, the exhaust fans will operate full load for 16 hrs/da, 5 da/wk and a 1% load the remainder.

The new HLF (heat loss factor, heating req'd per cfm of OSA) is calculated from attached spreadsheets.

Opn hrs.	HLF (kBtu/cfm/yr)
24 hr/da, 7 da/wk	165.9
16 hr/da, 5 da/wk (1st & 2nd Shifts)	73.3
24 h/da, 2 da/wk	47.4
8 hr/da, 5 da/wk (3rd shift)	45.2

New HLF = (1.0)(73.3) + (47.4)*(0.01) + (45.2)(0.01) = 74.2
1st & 2nd shifts   weekends   3rd shift

- New savings is the ratio of HLF's = OLD SAVINGS * $\frac{HLF_{NEW}}{HLF_{OLD}}$

$$= 6453 \frac{MBTU}{yr} * \frac{74.2}{165.9} = 2886 \frac{MBTU}{yr}$$

ECO# G-UP WITH ECO #3 IMPLEMENTED

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: ECOGUPA
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.062
INSTALLATION & LOCATION: LETTERKENNY A.REGION NOS. 3 CENSUS: 1
PROJECT NO. & TITLE: ECO G-UP-A DIP TANK EXHAUST HEAT RECOVERY
FISCAL YEAR 1991 DISCRETE PORTION NAME: TOTAL PROJECT
ANALYSIS DATE: 10-04-91 ECONOMIC LIFE 25 YEARS PREPARED BY: P. HUTCHINS

1. INVESTMENT

A. CONSTRUCTION COST	$	213404.
B. SIOH	$	11738.
C. DESIGN COST	$	12805.
D. SALVAGE VALUE COST	-$	0.
E. TOTAL INVESTMENT (1A + 1B + 1C - 1D)	$	237947.

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 10.94	-107.	$ -1171.	15.11	-17687.
B. DIST	$ 4.76	0.	$ 0.	21.31	0.
C. RESID	$ 4.61	2886.	$ 13304.	25.22	335538.
D. NAT G	$ .00	0.	$ 0.	20.70	0.
E. COAL	$ .00	0.	$ 0.	15.93	0.
F. TOTAL		2779.	$ 12134.		$ 317851.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.53
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F5 X .33) $ 104891.
A IF 3D1 IS = OR > 3C GO TO ITEM 4
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) ______
C IF 3D1B IS = > 1 GO TO ITEM 4
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YRS ECONOMIC LIFE))$ 12134.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) $ 317851.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.34
(IF < 1 PROJECT DOES NOT QUALIFY)

7. SIMPLE PAYBACK PERIOD (ESTIMATED) SPB=1F/4 19.61

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 16 (ECO #3 implemented) 1st & 2nd shift

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.25
9 AM - 5 PM 1
5 PM - 1 AM 0.75

Operation Days Per Week 5

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	525	-4	1.08	1	0	0
65	69	296	217	278	500	1	1.08	1	1	539
60	64	269	196	236	440	6	1.08	1	6	2,853
55	59	249	191	209	410	11	1.08	1	12	4,871
50	54	221	193	202	400	16	1.08	1	17	6,908
45	49	218	193	206	402	21	1.08	1	23	9,117
40	44	237	236	239	475	26	1.08	1	28	13,324
35	39	289	246	286	533	31	1.08	1	33	17,836
30	34	304	194	258	464	36	1.08	1	39	18,021
25	29	184	106	152	266	41	1.08	1	44	11,778
20	24	124	65	90	164	46	1.08	1	50	8,123
15	19	75	32	57	94	51	1.08	1	55	5,150
10	14	54	13	26	46	56	1.08	1	60	2,782
5	9	18	3	9	14	61	1.08	1	66	939
0	4	9	0	2	4	66	1.08	1	71	267
-5	-1	3	0	1	2	71	1.08	1	77	115
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	4736					102,644

Net heat loss corrected for working days/week (Btu/cfm*yr) = 73,317

Total Operation Hours While Heating
(and corrected for working days/week) = 3008

Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24 (ECO #3 implemented) - weekend -

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Operation Days Per Week 2

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm*yr) = 47,388

Total Operation Hours While Heating
(and corrected for working days/week) = 1911

Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8 (THIRD SHIFT) ECO#3 implemented

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 0.75
9 AM - 5 PM 0
5 PM - 1 AM 0.25

Operation Days Per Week 5

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	261	-4	1.08	1	0	0
65	69	296	217	278	292	1	1.08	1	1	315
60	64	269	196	236	261	6	1.08	1	6	1,690
55	59	249	191	209	239	11	1.08	1	12	2,839
50	54	221	193	202	216	16	1.08	1	17	3,737
45	49	218	193	206	215	21	1.08	1	23	4,876
40	44	237	236	239	238	26	1.08	1	28	6,669
35	39	289	246	286	288	31	1.08	1	33	9,651
30	34	304	194	258	293	36	1.08	1	39	11,372
25	29	184	106	152	176	41	1.08	1	44	7,793
20	24	124	65	90	116	46	1.08	1	50	5,738
15	19	75	32	57	71	51	1.08	1	55	3,883
10	14	54	13	26	47	56	1.08	1	60	2,843
5	9	18	3	9	16	61	1.08	1	66	1,038
0	4	9	0	2	7	66	1.08	1	71	517
-5	-1	3	0	1	3	71	1.08	1	77	192
-10	-6	1	0	0	1	76	1.08	1	82	62
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2737					63,213

Net heat loss corrected for working days/week (Btu/cfm*yr) = 45,152

Total Operation Hours While Heating
(and corrected for working days/week) = 1769

Average outdoor temperature while heating = 45.0 F

RS&H®

SUBJECT: Project H - Update
LEAD
DESIGNER: PA
CHECKER:

AEP NO: 290-0379-001
SHEET: 1 OF
DATE: 3/22/91
DATE:

ECO # H-UP Baghouse Insulation and Air Return (#350 & #37)

Summary Baghouse Insulation

CFM	Bldg #	Baghouse #	Savings #5/6 F.O (MBtu/yr)	(1/91) $ Savings	Project Cost (6/80 $)	Project Cost (1/91 $)	(1/91) Payback (yrs)
44,000	350	49	511 (#6)	$3378	$21,636	$30,074	8.9
4460	350	50 (3)	981 (#6)	6484	37,556	52,203	8.1
41800	350	2544	351 (#6)	2320	16,663	23,162	10.0
6000	1 *	120	298 (#5)	1970	11,038	15,343	7.8
2115	1 *	1586	33 (#5)	549	4563	6343	11.6
12,000	37 *	1294	764 (#5)	5050	9409	13,079	2.6
			2988	$19,751	$100,864	$140,204	7.1
			(#6) 1843 / 1145 (#5)				

* Includes insulation and return of exhausted air

RS&H

SUBJECT: Project H - Update | AEP NO:
DESIGNER: PFH | SHEET: 2 OF
CHECKER: | DATE: 3/20/91
DATE:

ECO # H-UP Baghouse Insulation and Air Return (#350 & #37)

Energy Calculations - Bldg 350 - Baghouse 49

Energy savings calculations were adjusted due to the following:

	from	to
Indoor temp	55°F (ΔT=12.5)	68°F (ΔT=23)
Radiation Losses	calculated	0
Opn Hrs while htg.	2270	3000
Avg. Amb. temp while htg (F)	42.5	45
Boiler Sys. Eff	0.74	0.80

Heat Loss w/o insul.

	cond	rad.		total
Inlet duct (p. H-V-3)	$31{,}160\left(\frac{23.0}{12.5}\right)$	11,209 (0)	=	57,334
Baghouse (p. H-V-5)	$26{,}266\left(\frac{23.0}{12.5}\right)$	19,355 (0)	=	48,329
Outlet duct	$20{,}487\left(\frac{23.0}{11.5}\right)$	7353 (0)	=	42,836
Total				148,499

Heat loss with insulation

$$= 1290\left(\frac{23.0}{12.5}\right) + 3178\left(\frac{23.0}{12.5}\right) + 1963\left(\frac{23.0}{11.5}\right) = -12{,}147$$

136,352 Btu/hr.

Fuel savings = Heat loss * winter HRS opn ÷ Boiler sys eff
= 136,352 * 3000 ÷ 0.80 ÷ 10^6 = 511 MBtu/yr. #6 fuel oil

Capital Cost (p. H-V-10) = CWE + Design (6%) = $20,411 + 1225 = $21,636 6/80 $
Esc to 1/91 => 21,636 * 1.39 = $30074

RS&H®	SUBJECT Project H - Update	AEP NO	
		SHEET 3	OF
	DESIGNER PFH	DATE 3/21/91	
	CHECKER	DATE	

Bldg 350 - Baghouse 50 (three baghouses)

Energy savings calculations were adjusted for the following:

	from	to
Indoor temp.	55° (ΔT=12.5)	68°F (ΔT=23)
Radiation losses	Calculated	0
Opn hrs. while htg.	2270	3000
Avg. outdoor temp. while htg.	42.5	45.0
Boiler Sys Eff	0.74	0.80

Heat Loss (Btu/hr) w/o insulation

	Cond.	Rad.		total
Inlet duct (p. H-VI-3)	$85,518\left(\frac{23.0}{12.5}\right)$	+ 29,506 (0)	=	157,353
Baghouse (1) (p. H-VI-4)	$21,542\left(\frac{23.0}{11.35}\right)$	+ 36,986 (0)	=	43,653
Small Baghouses (2) (p. H-VI-6)	$7811 * 2\left(\frac{23.0}{10.3}\right)$	+ 5718 * 2 (0)	=	34,884
Outlet Duct (p. H-VI-6)	$18,980\left(\frac{23.0}{9.9}\right)$	+ 6778 (0)	=	44,095

TOTAL Heat loss 279,985

Heatloss with insul. = $9932\left(\frac{23.0}{12.5}\right)$ 18,275

Heat loss reduction 261,710

Fuel Savings = $\left(261,710 \frac{Btu}{hr}\right)(3000\ hrs) \div 0.80 \div 10^6 = 981 \frac{MBtu}{yr}$ #6 F.O.

Cost = 35,430 + 2126 (design) = $37,556 (6/80$)

p. H-VI-9 Esc to 1/91 ⇒ 37,556 * 1.39 = $52,203

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SUBJECT ECO# H-UP

DESIGNER PFH

CHECKER

AEP NO

SHEET 4 OF

DATE 3/21/91

DATE

Building 350 - Baghouse 2544

Energy calculations were adjusted for the following:

	from	to
Indoor temp.	55°F (ΔT = 12.5)	68°F (ΔT = 23.0)
Radiation losses	Calculated	0
Boiler System Eff.	0.74	0.80

Heat Loss w/o insulation (Btu/hr)

	ind.	rad.	total
Inlet duct p. H-VII-1	17,915 (23.0 / 12.5)	+ 6449 (0)	= 32,964
Baghouse p. H-VII-2	24,247 (23.0 / 12)	+ 17,841 (0)	= 46,473
Exh. duct p. H-VII-4	11,185 (23.0 / 11)	+ 4009 (0)	= 23,387

Total heat loss w/o insul. 102,824

total w/ insul. = 4980 (23.0 / 12.5) = - 9163
p. H-VII-5

Total heat loss reduction 93,661

Fuel savings = (93,661)(3000) ÷ 0.80 ÷ 10^6 = 351 MBtu/yr #6 F.O.

Cost = 15,720 + 943 (design) = $16,663 (6/80 $)

p. H-VII-6

Esc. to 1/91 => 16,663 * 1.39 = $23,162

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SUBJECT ECO #H-UP

AEP NO

SHEET 5 OF

DESIGNER PFH

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CHECKER

DATE

Bldg 1 - Baghouses (2) -

Return exhausted air Baghouse #120

Energy calculations were adjusted for boiler system eff of 0.74 to 0.80.

Make-up air fuel = $328\left(\frac{0.74}{0.80}\right)$ = 303 MBtu/yr
p. H-VIII-2

Heat Losses fuel = 5.7 MBtu $\left(\frac{0.74}{0.80}\right)$ = 5 MBtu/yr
p. H-VIII-4

Net fuel 298 MBtu/yr

Costs

Project Cost = 10,413 + 625 = $11,038 (6/80 $)
p. H-VIII-5

Esc. to 1/91 => 11,038 × 1.39 = $15,343

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SUBJECT: ECO # H-UP

AEP NO:

SHEET: 6 OF:

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DATE:

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DATE:

Bldg 1 - Baghouse #1586 (small)

Return exhaust and insulate

Adjust calcs for boiler system eff = 0.80

Fuel saved = 59.2 MBTU $\frac{0.14}{0.80}$ = 83 MBTU/yr.
p. H-IX-3

Cost = 4305 + 258 (design) = $4563 (6/80 $)
p. H-IX-4

Esc to 1/91 => 4563 * 1.39 = $6343

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SUBJECT ECO # H-UP
DESIGNER PFH
CHECKER
AEP NO
SHEET 7 OF
DATE
DATE

Bldg 37 - Baghouse #1294 - Return Exhaust & Insulate

Energy calculations are changed for:

	from	to
boil sys eff	0.74	0.80
opn hrs. (heating season)	1300	4160/2

Fuel saved = 516 MBtu/yr $\left(\frac{0.74}{0.80}\right)\left(\frac{4160/2}{1300}\right)$ = 764 MBtu/yr
(p. H-X-3)

#5 F.O.

Cost = $8876 + 533 = $9409 (6/80 $)
(p. H-X-4)

Esc to 1/91 ⇒ 9409 * 1.39 = $13,079

RS&H®

SUBJECT: Project I - Update
Paint Booth Exh Heat Recovery
DESIGNER: PA
CHECKER:

AEP NO: 290-0379-001
SHEET: 1 OF
DATE:
DATE:

ECO # I-UP Large Paint Booth Exhaust Heat Recovery (Bldg 350)

Energy Calculations

The original energy savings were changed to correct for the following:

	from: RSH	from: BKA	to:
Req'd CFM	42,150	53,450	53,450
Indoor temp.	68°F	varies	68°F
Boiler Sys. eff.	0.74	0.40	0.80
Opn. Hours			
# shifts	2	varies	2
days/wk	6	varies	5
Opn Hrs. while Htg.	2270	—	3000

The results were taken from the "Paint and Drying Booth" Report by BKA, Vol. II, ppgs. 83-105.

Existing energy use (p.90)

Make-up air: (3000 opn hrs while heating)

2321×2 ÷ 0.80 = 5803 MBTU/yr. #6 F.O

Fan energy:

$\frac{\$1933 \times 2}{0.0381 \$/kwh} \cdot \frac{3413}{10^6}$ = 346 MBTU/yr elec.

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SUBJECT: Project I - Update LEAD
DESIGNER: PEH
CHECKER:
AEP NO:
SHEET 2 OF
DATE:
DATE:

New energy use:

Make-up air (p. 89)

$840 * 2 \div 0.80 = 2100$ MBtu/yr. #6

Fan Energy (p. 89)

$\$ \frac{8130 * 2}{0.0381} \cdot \frac{3413}{10^6} = 1457$ MBtu/yr. elec.

Savings:

#6 F.O. : 5803 - 2100 = 3703 MBtu/yr

Elec : 346 - 1457 = (1111) MBtu/yr

Cost Estimate: (p. 91)

\$ 189,030 * 2 = \$ 378,060 (6/87)

Escalate using ENR indicies

$\$378,060 \cdot \frac{2716}{2538} = \$404,575$ (1/91 \$)

$\text{Payback} = \frac{404,575}{3703 * 6.61 - 1111 * 10.94} = 32.8$ yrs

RS&H®

SUBJECT Project J- Update
LEAD
DESIGNER PFH
CHECKER

AEP NO 290-0379-001
SHEET 1 OF
DATE 3/26/91
DATE

ECO # J-UP Medium Paint Booth Exhaust Heat Recovery (#350)

Energy Calculations - Bldg 350 P.B. # 2527

The original energy savings values were changed to correct for the following:

	From RSH	From BKA	To:
CFM	27,287	25,959	25,959
Indoor temp. (F)	80	varies	68
Boiler Sys. Eff.	0.74	0.40	0.80
Opn. Hrs.			
# shifts	1	varies	2
days/wk	5	varies	5
Opn while htg. (hrs)	1300	-	3000

The results were taken from the "Paint & Drying Booth Report", BKA, pp. 115-124, Vol II.

Existing Energy Use

Make up air: 2254 ÷ 080 = 2818 MBtu/yr #6 F.O.

Fan Energy: $\frac{\$1779}{0.0381\,\$/kWh} \cdot \frac{3413\text{ Btu}}{kWh} \cdot \frac{MBtu}{10^6\text{ Btu}}$ = 159 MBtu/yr. elec

New Energy Use

Make up air: 706 ÷ 0.80 = 883 MBtu/yr #6 F.O.

Fan Energy: $\frac{7426}{0.0381} \cdot \frac{3413}{10^6}$ = 665 MBtu/yr elec

RS&H

SUBJECT: Project J - Update
P.B 2527 Bldg 350 - LEAD

DESIGNER: PFH

CHECKER:

AEP NO:

SHEET: 2 OF

DATE:

DATE:

Fuel Savings:

2818 - 883 = 1935 MBtu/yr #6 F.O

Elec 159 - 665 = (506) MBtu/y elec.

Capital Cost

Escalate 6/87 to 1/91

$$\$189{,}030 \cdot \frac{2716}{2538} = \$202{,}287$$

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SUBJECT	Project J - Update	AEP NO	
	LEAD	SHEET	3 OF
DESIGNER	PFH	DATE	
CHECKER		DATE	

Energy Calculations   Bldg 350 P.B. # 2511

Changes:

	FROM RSH	FROM BKA	TO
CFM	24,000	27,156	27,156
Indoor temp. (F)	80	varies	65
Boiler Syst. Eff.	0.74	0.40	0.30
Opn Hrs.			
# shifts	1	varies	2
days/wk	5	varies	5
Opn. hrs while htg.	1300	–	2700

Results from BKA Report pp 125 - 134

Existing Fuel Use

Make-up air : 2122 ÷ 0.80 = 2653 MBtu/yr #6 F.O.

Fan Energy : $\frac{\$1768}{0.0381} \cdot \frac{3413}{10^6}$ = 158 MBtu/yr elec.

New

Make-up Air : 755 ÷ 0.80 = 944 MBtu/yr #6 F.O.

Fan : $\frac{\$7435}{0.0381} \cdot \frac{3413}{10^6}$ = 662 MBtu/yr Elec.

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SUBJECT Project J - Update
LEAD
DESIGNER PFH
CHECKER

AEP NO
SHEET 4 OF
DATE
DATE

Fuel Savings #6 FO.

2653 - 944 = 1709 MBTu/yr.

Elec

158 - 662 = (504) MBtu/yr.

Capital Cost

Escalate 6/87 to 1/91

$$\$189{,}030 \cdot \frac{2716}{2538} = \$202{,}287$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT Window & Wall Insulation
LEAD
DESIGNER W. T. Todd
CHECKER

AEP NO 290-0379-001
SHEET 1 OF
DATE April 30, 1991
DATE

ECO UPDATE # N-UP

Window and wall insulation in Buildings 422, 424, 426, 433 & 436

Assumptions:

1. The indoor air temperature is maintained at 68°F 24 hrs/da, 7 da/wk during coldest winter mos., DEC-FEB. During spring & fall 68°F 8 hrs/da, 5 da/wk. Otherwise 50°F.

2. The heat loss factor is for infiltration. The average outdoor temperature while heating is 45°F. (See spreadsheet calculations using bin temperatures)

3. Existing wall U-value is 0.30 Btu/hr·ft²·°F.
New wall U-value (with insulation) is 0.13 Btu/hr·ft²·°F.
Existing window U-value is 1.10 Btu/hr·ft²·°F.
New window U-value (with insulation) is 0.08 Btu/hr·ft²·°F.
— Reference 1981 RS+H EEAP

4. The boiler/heating system efficiency is 30%.

5. Infiltration savings for insulation and weatherstripping:
Walls => 0.054 cfm/ft² of wall area
Windows => 0.54 cfm/linear foot of operable window area
doors => 3.7 cfm/linear foot of door perimeter
— Reference 1981 RS+H EEAP / ASHRAE Fundamentals, 1981

6. These buildings are heated 24 hours per day, 7 days per week. During the spring & fall the boiler pressures are reduced on nights and weekends. The result is lower indoor temperatures as discussed in (1).

REYNOLDS, SMITH AND HILLS
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SUBJECT	Window + Wall Insulation	AEP NO	
	LEAD	SHEET 2	OF
DESIGNER	WTT	DATE	
CHECKER		DATE	

Calculations:

$Q = U \cdot A \cdot \Delta T$ conduction
$Q = Cfm \cdot HLF$ infiltration

The wall, window and door measurements were taken from the 1981 EEAP (Volume 4), entered on a spreadsheet for calculations. (Refer to attached spreadsheet)

Wall area to be insulated = 28,814 Ft^2

Window area to be insulated = 8,582 Ft^2

window perimeter to be weatherstripped = 5,735 Ft

Door perimeter to be weatherstripped = 1,024 Ft

Conduction Savings:

Walls ⇒ $28814\ Ft^2 \times (0.30 - 0.13)\frac{Btu}{hr \cdot Ft^2 \cdot °F} \times (80.1 + 27.3)$ kBtu/sf/u-val

= 526 MBtu/yr

Windows ⇒ $8582\ Ft^2 \times (1.10 - 0.08)\frac{Btu}{hr \cdot Ft^2 \cdot °F} \times (80.1 + 27.3)$ kBtu/sf/u-val

$Q_{windows}$ = 940 mBtu/yr

Infiltration Savings: HLF = (86.5 + 29.5) = 116 kBtu/cfm/yr.

Walls ⇒ $28,814\ Ft^2 \times 0.054 \frac{Cfm}{Ft^2} \times 0.116 \frac{MBtu}{Cfm \cdot Yr} = 180 \frac{MBtu}{Yr}$

Windows ⇒ $5735\ Ft \times 0.54 \frac{CFm}{Ft} \times 0.116 \frac{MBtu}{Cfm \cdot Yr} = 36 \frac{MBtu}{Yr}$

Doors ⇒ $1204\ Ft \times 3.70 \frac{CFm}{Ft} \times 0.116 \frac{MBtu}{Cfm \cdot Yr} = 517 \frac{MBtu}{Yr}$

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LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

WALL HEAT CONDUCTION PROGRAM - DECEMBER THRU FEBRUARY

Normal Building Temperature (F)	68
Building Setback Temperature (F)	68
Wall Area (sq ft)	1
U Value - Existing Wall	2.00
- New Wall	1.00
- Delta U	1.00

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	1	0	0	1
	9 AM - 5 PM	1	0	0	1
	5 PM - 1 AM	1	0	0	1
Total Hours Per Day		24	0	0	24
Days Per Week		7	7	0	0
Total Normal Hours Per Week		168			

Temp. Range		Hours of Occurrence 1-8	9-16	17-24	Total Hours	Delta T Norm	Setback	Heating Hours Norm	Setback	Heating Load (kBtu)
70	74	0	0	0	0	0	0	0	0	0.00
65	69	0	0	1	1	1	1	1	0	0.00
60	64	1	5	4	10	6	6	10	0	0.06
55	59	6	10	8	24	11	11	24	0	0.26
50	54	8	27	14	49	16	16	49	0	0.78
45	49	14	56	33	103	21	21	103	0	2.16
40	44	50	116	84	250	26	26	250	0	6.50
35	39	135	169	161	465	31	31	465	0	14.42
30	34	178	150	178	506	36	36	506	0	18.22
25	29	133	85	112	330	41	41	330	0	13.53
20	24	71	58	63	192	46	46	192	0	8.83
15	19	58	29	72	159	51	51	159	0	8.11
10	14	51	12	17	80	56	56	80	0	4.48
5	9	15	3	9	27	61	61	27	0	1.65
0	4	9	0	2	11	66	66	11	0	0.73
-5	-1	3	0	1	4	71	71	4	0	0.28
-10	-6	1	0	0	1	76	76	1	0	0.08
-15	-11	0	0	0	0	81	81	0	0	0.00
Totals		733	720	759	2212			2212	0	80.09

N-UP-2a

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

WALL HEAT CONDUCTION PROGRAM - SPRING AND FALL

Normal Building Temperature (F)		68
Building Setback Temperature (F)		50
Wall Area (sq ft)		1
U Value - Existing Wall		2.00
- New Wall		1.00
- Delta U		1.00

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	0.25	0.75	0	1
	9 AM - 5 PM	0.75	0.25	0	1
	5 PM - 1 AM	0	1	0	1
Total Hours Per Day		8	16	0	24
Days Per Week		5	5	2	2
Total Normal Hours Per Week		40			

Temp. Range		Hours of Occurrence 1-8	9-16	17-24	Total Hours	Delta T Norm	Setback	Heating Hours Norm	Setback	Heating Load (kBtu)
70	74	5	46	25	76	0	0	26	50	0.00
65	69	15	71	48	134	1	0	41	93	0.04
60	64	36	102	75	213	6	0	61	152	0.37
55	59	73	137	117	327	11	0	86	241	0.95
50	54	116	151	143	410	16	0	102	308	1.63
45	49	150	145	163	458	21	3	104	354	3.25
40	44	174	128	160	462	26	8	100	362	5.49
35	39	182	87	129	398	31	13	79	319	6.60
30	34	129	42	70	241	36	18	46	195	5.16
25	29	63	12	22	97	41	23	18	79	2.55
20	24	21	4	7	32	46	28	6	26	1.00
15	19	6	0	1	7	51	33	1	6	0.25
10	14	0	0	0	0	56	38	0	0	0.00
5	9	0	0	0	0	61	43	0	0	0.00
0	4	0	0	0	0	66	48	0	0	0.00
-5	-1	0	0	0	0	71	53	0	0	0.00
-10	-6	0	0	0	0	76	58	0	0	0.00
-15	-11	0	0	0	0	81	63	0	0	0.00
Totals		970	925	960	2855			669	2186	27.28

N-up-2b

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

INFILTRATION PROGRAM - SPRING AND FALL

Normal Building Temperature (F) 68

Building Setback Temperature (F) 50

Infiltration (cfm) 1

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	0.25	0.75	0	1
	9 AM - 5 PM	0.75	0.25	0	1
	5 PM - 1 AM	0	1	0	1
Total Hours Per Day		8	16	0	24
Days Per Week		5	5	2	2
Total Normal Hours Per Week		40			

Temp. Range		Hours of Occurrence 1-8	9-16	17-24	Total Hours	Delta T Norm	Setback	Heating Hours Norm	Setback	Heating Load (kBtu)
70	74	5	46	25	76	0	0	26	50	0.00
65	69	15	71	48	134	1	0	41	93	0.04
60	64	36	102	75	213	6	0	61	152	0.40
55	59	73	137	117	327	11	0	86	241	1.03
50	54	116	151	143	410	16	0	102	308	1.76
45	49	150	145	163	458	21	3	104	354	3.51
40	44	174	128	160	462	26	8	100	362	5.93
35	39	182	87	129	398	31	13	79	319	7.13
30	34	129	42	70	241	36	18	46	195	5.57
25	29	63	12	22	97	41	23	18	79	2.75
20	24	21	4	7	32	46	28	6	26	1.08
15	19	6	0	1	7	51	33	1	6	0.27
10	14	0	0	0	0	56	38	0	0	0.00
5	9	0	0	0	0	61	43	0	0	0.00
0	4	0	0	0	0	66	48	0	0	0.00
-5	-1	0	0	0	0	71	53	0	0	0.00
-10	-6	0	0	0	0	76	58	0	0	0.00
-15	-11	0	0	0	0	81	63	0	0	0.00
Totals		970	925	960	2855			669	2186	29.47

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

INFILTRATION PROGRAM - DECEMBER THROUGH FEBRUARY

Normal Building Temperature (F)	68
Building Setback Temperature (F)	68
Infiltration (cfm)	1

		Normal Hours	Setback Hours	Normal Hours	Setback Hours
Hour Fractions	1 AM - 9 AM	1	0	0	1
	9 AM - 5 PM	1	0	0	1
	5 PM - 1 AM	1	0	0	1
Total Hours Per Day		24	0	0	24
Days Per Week		7	7	0	0
Total Normal Hours Per Week		168			

Temp. Range		Hours of Occurrence 1-8	9-16	17-24	Total Hours	Delta T Norm	Setback	Heating Hours Norm	Setback	Heating Load (kBtu)
70	74	0	0	0	0	0	0	0	0	0.00
65	69	0	0	1	1	1	1	1	0	0.00
60	64	1	5	4	10	6	6	10	0	0.06
55	59	6	10	8	24	11	11	24	0	0.29
50	54	8	27	14	49	16	16	49	0	0.85
45	49	14	56	33	103	21	21	103	0	2.34
40	44	50	116	84	250	26	26	250	0	7.02
35	39	135	169	161	465	31	31	465	0	15.57
30	34	178	150	178	506	36	36	506	0	19.67
25	29	133	85	112	330	41	41	330	0	14.61
20	24	71	58	63	192	46	46	192	0	9.54
15	19	58	29	72	159	51	51	159	0	8.76
10	14	51	12	17	80	56	56	80	0	4.84
5	9	15	3	9	27	61	61	27	0	1.78
0	4	9	0	2	11	66	66	11	0	0.78
-5	-1	3	0	1	4	71	71	4	0	0.31
-10	-6	1	0	0	1	76	76	1	0	0.08
-15	-11	0	0	0	0	81	81	0	0	0.00
Totals		733	720	759	2212			2212	0	86.49

N-WP-2d

Heating Energy Savings = Σ Cond. Savings + Σ Infil. Savings

= 526 + 940 + 180 + 36 + 517

Heating Energy Savings = **2199 mBtu/yr**

Fuel Oil # 5 Savings:

Fuel Oil Savings = Energy Savings ÷ System Eff.

= 2199 mBtu/yr ÷ 0.80

Fuel Oil Savings = **2749 mBtu/yr**

Energy Cost Savings:

Cost Savings = 2749 mBtu/yr x $4.76/mBtu

Cost Savings **$13,085 /yr**

Project Cost:

Total Project Cost = $129,262 See Cost Estimate Sheets for details

Simple Payback:

Payback = $129,262 ÷ $13,085/yr = **9.9 years**

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Window & Wall Insulation In Bldgs. 422, 424, 426, 433 & 436

ECO #: N-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)	
Material	$19,508
Labor	$32,041

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $19,508 x 1.393 = $27,171
Labor = $32,041 x 1.393 = $44,627
Total = $27,171 + $44,627 = $71,798

Bare 1991 Escalated Costs	$71,798
FICA Insurance (20% of Labor)	$8,925
Sales Tax (6.5% of Material)	$1,766
Subtotal	$82,489
Overhead (15%)	$12,373
Subtotal	$94,862
Profit (10%)	$9,486
Subtotal	$104,348
Bond (1%)	$1,043
Subtotal	$105,391
Contingency (10%)	$10,539
Subtotal (Construction Cost Input For LCCID *)	$115,930
SIOH (5.5% of Construction Cost)	$6,376
Subtotal	$122,306
Design (6% of Construction Cost)	$6,956
Total Project Cost	$129,262

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4/24/91 from 10/7/80	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.:

ESTIMATOR: W. T. Todd

CHECKED BY:

Window/Wall Ins. SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
Spray Paint Windows	8582	SF	0.05	429.10	0.02	171.64	
1 5/8" metal Studs	8582	SF	0.28	2402.96	0.13	1115.66	
3 1/2" Batt Insulation	8582	SF	0.10	858.20	0.18	1544.76	
1/8" Hard board	8582	SF	0.62	5320.84	0.24	2059.68	
Subtotal				9011.10		4891.74	13,902.84
Weatherstrip Windows	5735	LF	0.58	3326.30	0.67	3842.45	
Weatherstrip personel doors	234	LF	0.49	114.66	0.57	133.38	
Weatherstrip overhead doors	970	LF	0.69	669.30	0.80	776.00	
Subtotal				4110.26		4751.83	8,862.09
1" Spray on insulation	28814	SF	0.29	8356.06	0.20	5762.80	
1x3 Wood Furring	12428	SF	0.23	2858.44	0.09	1118.52	
1/8" Hardboard	12428	SF	0.62	7705.36	0.24	2982.72	
Subtotal				18919.86		9864.04	28,783.90
Total "Bare" Costs				$32041		$19508	$51,549

ENG FORM 150
1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—516148

CONSTRUCTION COST ESTIMATE	DATE PREPARED 10-17-80	SHEET N-32 OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: LETTERKENNY, CHAMBERSBURG, PA

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [X] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO. 400 SERIES | ESTIMATOR PULLIAM | CHECKED BY

R 4.4 SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
1" SPRAY-ON - LOWER HALF WITH FURRING & HARDBOARD:							
1" INSULATION	6000	S.F.	0.29	1740	0.20	1200	2940
1x3 FURRING	3000	S.F.	0.23	690	0.09	270	960
1/8" HARDBOARD	3000	S.F.	0.62	1860	.24	720	2580
SUB-TOTAL				4290		2190	6480
LABOR BURDEN	22%			944		—	944
SALES TAX	5%			—		110	110
SUB-TOTAL				5234		2300	7534
O.H. & PROFIT	25%		7534				1884
BOND	1%		9418				94
CONTINGENCY	10%		9512				951
SIOH	5%		10463				523
TOTAL				$10986 ÷	6000 =	$1.83/S.F	$10986
				$1.83/S.F.			
SPRAY-ON INSULATION ONLY:							
1-2" SPRAY-ON INSULATION					TOTAL	$ .82/S.F.	

ENG FORM 150 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT) • GOVERNMENT PRINTING OFFICE

N-UP-6

CONSTRUCTION COST ESTIMATE	DATE PREPARED 10-7-80	SHEET VI-31 OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: LETTERKENNY, CHAMBERSBURG PA.

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [X] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: | ESTIMATOR: | CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
COVER WINDOWS W/ METAL STUDS, 3" BATTS & 1/8" HARDBOARD							
SPRAY PAINT WINDOWS	1	S.F.	0.05	0.05	0.02	0.02	0.07
1 5/8" METAL STUDS	1	S.F.	0.28	0.28	0.13	0.13	0.41
3 1/2" BATT INSULATION	1	S.F.	0.10	0.10	0.18	0.18	0.28
1/8" HARD BOARD	1	S.F.	0.62	0.62	0.24	0.24	0.86
SUB-TOTAL				1.05		0.57	1.62
LABOR BURDEN @	22%			0.23		—	0.23
SALES TAX @	5%			—		0.03	0.03
SUB-TOTAL				1.28		0.60	1.88
O.H & PROFIT @	25%		1.88				0.47
BOND @	1%		2.35				0.02
CONTINGENCY @	10%		2.37				0.24
SIOH @	5%		2.61				0.13
TOTAL				$2.74 / S.F.			2.74
WEATHER-STRIPPING : Windows, and Personel + Overhead Doors							
WEATHERSTRIP WINDOWS						TOTAL	$2.06/ft
WEATHERSTRIP PERSONNEL DOORS						TOTAL	1.74/ft
WEATHERSTRIP OVERHEAD DOORS						TOTAL	2.46/ft

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE : 1959 O—510148

Letterkenny Army Depot
Insulate Wall And Windows - Buildings 422, 424, 426, 433 & 436

	Building #	422	424	426	433	436	Totals
1	Total Uninsulated Wall Area (SqFt)	12150	13920	8700	8863	0	43633
2	Total Window Area (SqFt)	3159	3725	4062	1072	978	12996
3	Total Door Area (SqFt)	722	646	448	985	237	3038
4	Total Wall Area Below 8' (SqFt)	3808	5568	5568	2800	2136	19880
5	Operable Window Area (SqFt)	1048	1154	1420	438	354	4414
6	Op. Window Perimeter (Ft)	1140	1597	1846	700	452	5735
7	Total Door Perimeter (Ft)	210	338	240	300	116	1204
8	Overhead Door Perimeter (Ft)	144	294	196	240	96	970
9	Wall Area For Insulation (1-2-3)	8269	9549	4190	6806	0	28814
10	Wall Area For Hardboard (4-3-5)	2038	3768	3700	1377	1545	12428
11	Window Area For Insulation (2-5)	2111	2571	2642	634	624	8582
12	Window Perimeter For W-strip (6)	1140	1597	1846	700	452	5735
13	Door Perimeter For W-strip (7)	210	338	240	300	116	1204

Conduction Savings

	Area	dU	dT	Hr/Yr		Savings
Insulate Walls	28814	0.17	23	6687		753.4 Mbtu/Yr
Insulate Windows	8582	1.02	23	6687		1346.3 Mbtu/Yr
					Subtotal	2099.7 Mbtu/Yr

Infiltration Savings

	Area or Length	Cfm Reduction	HLF	Savings
Insulate Walls	28814 SqFt	0.054 Cfm/SF	0.17	258.1 Mbtu/Yr
W-Strip Windows	5735 Ft	0.54 Cfm/Ft	0.17	513.8 Mbtu/Yr
W-Strip Doors	1204 Ft	3.7 Cfm/Ft	0.17	739.1 Mbtu/Yr
			Subtotal	1510.9 Mbtu/Yr
			Total	3610.6 Mbtu/Yr

SUMMARY

Heating Energy Savings	3610.6 Mbtu/Yr
Fuel Oil Savings	4513.2 Mbtu/Yr
Energy Cost Savings	29832 $/Year
Total Project Cost	129645 $
Simple Payback	4.3 Years

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Operation Days Per Week 7

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm*yr) = 165,858

Total Operation Hours While Heating
(and corrected for working days/week) = 6687

Average outdoor temperature while heating = 45.0 F

ECO UPDATE # R-UP

Replace Mercury Vapor lights with High Pressure Sodium in Buildings 31, 32, 33, 34, 41, 42, 43 & 44

This project was originally designed for replacement of fluorescent and mercury vapor lighting with new high pressure sodium lighting. Due to the high initial cost and low savings potential the payback was 118.9 years.

In this re-analysis the fluorescent fixtures are not considered for replacement due to the low watt per fixture difference between them and the HPS fixtures. Assume 1 shift per day operation.

Current energy use:

There are 873 fixtures in the subject buildings utilizing 175w - Mercury vapor lamps.

The total input watts per fixture (with ballasts) is 205 watts.

$$873 \text{ Fixt.} \times 205 \frac{\text{watt}}{\text{Fixt.}} \times \frac{1 \text{ Kw}}{1000 \text{ w}} \times 2080 \frac{\text{hr}}{\text{Yr}} = 372{,}247 \text{ Kwh/yr}$$

Energy Consumption with 100w HPS Fixtures:

Total input watts with ballast = 130 watts/fixture

$$873 \text{ Fixt.} \times 130 \frac{\text{w}}{\text{Fixt.}} \times \frac{1 \text{ Kw}}{1000 \text{ w}} \times 2080 \frac{\text{hr}}{\text{Yr}} = 236{,}059 \text{ Kwh/yr}$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT Change MV to HPS Lights LEAD
DESIGNER W. T. Todd
CHECKER
AEP NO.
SHEET 2 OF
DATE
DATE

Energy Savings:

$372247 \frac{Kwh}{Yr} - 236,059 \frac{Kwh}{Yr} = \underline{136,188\ Kwh/Yr}$

$136,188 \frac{Kwh}{Yr} \times 3413 \frac{Btu}{Kwh} \times \frac{1\ MBtu}{10^6\ Btu} = \underline{464.8\ MBtu/Yr}$

Energy Cost Savings:

$464.8 \frac{MBtu}{Yr} \times 10.94\ \$/MBtu = \underline{\$5,085\ /yr}$

Implementation Cost:

Total Project Cost = $\underline{\$303,532}$

See cost estimate sheets for details

Simple Payback:

Payback = $\$303,532 \div \$5085/yr = \underline{59.7\ years}$

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: HPS Lighting In Buildings 31, 32, 33, 34, 41, 42, 43 & 44

ECO #: R-UP

Year of original cost estimate: 1980

ECO "bare" costs (from original cost estimate)	
Material	$87,300
Labor	$38,412

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $87,300 x 1.393 =$121,593
Labor = $38,412 x 1.393 = $53,501
Total =$121,593 + $53,501 =$175,094

Bare 1991 Escalated Costs	$175,094
FICA Insurance (20% of Labor)	$10,700
Sales Tax (6.5% of Material)	$7,904
Subtotal	$193,698
Overhead (15%)	$29,055
Subtotal	$222,753
Profit (10%)	$22,275
Subtotal	$245,028
Bond (1%)	$2,450
Subtotal	$247,478
Contingency (10%)	$24,748
Subtotal (Construction Cost Input For LCCID *)	$272,226
SIOH (5.5% of Construction Cost)	$14,972
Subtotal	$287,198
Design (6% of Construction Cost)	$16,334
Total Project Cost	$303,532

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE	DATE PREPARED 4-25-91	SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.:

ESTIMATOR: W. T. Todd

CHECKED BY: P. Hutchins

Change MV to HPS SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
100 w HPS Lamps and							
Fixtures *	873	EA.	44	38412	100	87300	#125,712
(includes removal of							
MV fixture)							

* Source – 1980 Cost Estimate from Letterkenny EEAP (see R-UP-6:10)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—516148

Letterkenny Army Depot
Lighting Modifications
Buildings 31, 32, 33, 34, 41, 42, 43 & 44

04/25/91

	Existing			Proposed	
Building No.	2-40w Fl	4-40w FL	175w MV	70w HPS	100w HPS
31	0	0	165	0	165
32	0	0	165	0	165
33	0	0	0	0	0
34	0	0	165	0	165
41	0	0	165	0	165
42-S	0	0	15	0	15
42-N	0	0	33	0	33
43	0	0	0	0	0
44	0	0	165	0	165
Total Fixt.	0	0	873	0	873
Input Watts	92	184	205	88	130
Total Watts	0	0	178965	0	113490
Total KW	0.0	0.0	179.0	0.0	113.5
Hours/Year	2080	2080	2080	2080	2080
KWH/Year	0	0	372247	0	236059

SUMMARY

	Existing	Proposed	Savings
Total Annual KWH	372247	236059	136188 Kwh/Yr
Annual Energy Cost	13885	8805	$5,080
Annual Maint. Cost	0	0	$0
Total Annual Cost	13885	8805	$5,080

R-IV23 or IV319

REYNOLDS, SMITH & HILLS
ARCHITECTS ENGINEERS PLANNERS

PROJECT: MODIFICATION TO BLDG. 41 (TYPICAL OF 31, 32, 34, 44)

SHEET ____ OF ____

LOCATION: LETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA.

A E FILE NO. 80122-000

CONSTRUCTION COST ESTIMATE

DATE: 10/6/80

BASIS FOR ESTIMATE: ☑ PRE-DESIGN STUDY ☐ SCHEMATIC DESIGN ☐ DESIGN DEVELOPMENT ☐ FINAL DESIGN

ESTIMATOR: RLS

CHECKER:

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	REMOVAL OF EXISTING MERCURY				
	VAPOR LAMP FIXTURES (L)	165	EA.	4.00	660
	REPLACEMENT WITH H.P.S. FIXT (L)	165	EA.	40.00	6600
	(LOW-BAY) (M)	165	EA.	100.00	16,500
	TOTAL				$23,760
	LABOR TOTAL				7,260
	MATERIAL TOTAL				16,500

RSH 52B (APR 70)

R-VP-6

REYNOLDS, SMITH & HILLS
ARCHITECTS ENGINEERS PLANNERS

PROJECT: MODIFICATION TO BLDG. 42

SHEET ____ OF ____

LOCATION: LETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA.

A E FILE NO.

CONSTRUCTION COST ESTIMATE

DATE: 10/6/80

BASIS FOR ESTIMATE: ☑ PRE-DESIGN STUDY ☐ SCHEMATIC DESIGN ☐ DESIGN DEVELOPMENT ☐ FINAL DESIGN

ESTIMATOR: RLS

CHECKER:

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	SOUTH PART				
	REMOVAL OF EXISTING FIXTURES				
	175 W. MERCURY VAPOR (L)	15	EA.	4	60.00
	2-LAMP 4 FT. FLUOR. (L)	66	EA.	4	264.00
	4-LAMP 4 FT. FLUOR. (L)	20	EA.	4	80.00
	REPLACEMENT WITH H.P.S. FIXT. (L)	54	EA.	40	2160.00
	(M)	54	EA.	100	5400.00
	1/2" CONDUIT (54x15') (L)	810	L.F.	.1388	112.43
	(M)	810	L.F.	.66	534.60
	#12 WIRE (54x15x2) (L)	1620	L.F.	.1024	165.89
	(M)	1620	L.F.	.0793	128.47
	2 FT. CONDUIT STEM 3/4" R.G.S. (L)	54	EA.	12.61	680.94
	ETC. (M)	54	EA.	4.49	242.46
	NORTH PART				
	REMOVE EXISTING FIXT.				
	4-LAMP 4 FT. FLUOR. (L)	10	EA.	4	40.00
	175 W. MERCURY VAPOR (L)	33	EA.	4	132.00
	REPLACE WITH H.P.S. FIXT (L)	43	EA.	40	1720.00
	(LOW-BAY) (M)	43	EA	100	4300.00
	CONDUIT STEMS 2' RGS (L)	10	EA	12.61	126.10
	(M)	10	EA.	4.49	44.90
	TOTAL BLDG. 42 LABOR (L)				5541.36
	MATERIAL (M)				10,650.43

RSH 52B (APR 70)

R-IV25 of V39

REYNOLDS, SMITH & HILLS
ARCHITECTS ENGINEERS PLANNERS

PROJECT: MODIFICATION TO BLDG. 43 (TYPICAL OF 33)

SHEET ____ OF ____

LOCATION: LETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA

A E FILE NO.

CONSTRUCTION COST ESTIMATE

DATE: 10/6/80

BASIS FOR ESTIMATE

☑ PRE-DESIGN STUDY ☐ SCHEMATIC DESIGN ☐ DESIGN DEVELOPMENT ☐ FINAL DESIGN

ESTIMATOR: RLS CHECKER:

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	REMOVAL OF EXISTING FLUOR. FIXT. (L)	250	EA.	4	1000.00
	REPLACEMENT WITH H.P.S. FIXT. (L)	250	EA.	40	10,000.00
	(M)	250	EA.	100	25,000.00
	3' CONDUIT STEMS (RGS) (L)	250	EA.	14.22	3555.00
	(M)	250	EA.	5.27	1317.50
	LABOR (L)				14,555.00
	TOTAL BLDG. 33 (43) MAT'L (M)				26,317.50

RSH 52B (APR 70)

R-IV26 or V39

REYNOLDS, SMITH & HILLS
ARCHITECTS ENGINEERS PLANNERS

PROJECT: MODIFICATION TO BLDGS. 31, 32, 33, 34, 41, 42, 43, 44

SHEET ____ OF ____

LOCATION: LETTERKENNY ARMY DEPOT, CHAMBERSBURG, PA.

A E FILE NO.

CONSTRUCTION COST ESTIMATE

DATE: 10/6/80

BASIS FOR ESTIMATE: ☑ PRE-DESIGN STUDY ☐ SCHEMATIC DESIGN ☐ DESIGN DEVELOPMENT ☐ FINAL DESIGN

ESTIMATOR: RLS

CHECKER:

ITEM NO.	DESCRIPTION	NO. OF UNITS	UNIT	UNIT PRICE	ESTIMATED COST
	BLDG. NO.			LABOR	MATERIAL
	31			7260	16,500.
	32			7260	16,500.
	33			14,555	26,317.50
	34			7260	16,500.
	41			7260	16,500.
	42			5541.36	10,650.43
	43			14,555.00	26,317.50
	44			7260	16,500.
	TOTAL			70,951.36	145,785.43
	+ LABOR, FICA & OTHER TAXES @ 22%			15,609.30	
				86,560.66	
	+ SALES TAX @ 5%				7289
					153,075
	TOTAL LABOR + MAT'L				239,636
	+ CONTRACTOR'S OH & PROFIT @ 25%				59,909
					299,545
	+ BOND @ 1%				2995
					302,540
	+ CONTINGENCIES @ 10%				30,254
					332,794
	+ SIOH @ 5%				16,640
	TOTAL C.W.E. (FY 80)				349,434
	TOTAL				

RSH 52B (APR 70)

From 1980 EEAP

TABLE I-1

COMPARISON OF EXISTING AND PROPOSED LIGHTING SYSTEMS
FOR BUILDINGS 31, 32, 33, 34, 41, 42, 43, and 44

BUILDING	EXISTING FIXTURES[1]			PROPOSED FIXTURES	
	FLUORESCENT		MERCURY	HIGH PRESSURE SODIUM	
	2-F40	4-F40	175 Watt	70 Watt	100 Watt
31			165		165
32			165		165
33	250			250	
34			165		165
41			165		165
42 (South)	66	20	15		54
42 (North)		10	33		43
43	250			250	
44			165		165

[1]Existing fixtures from field survey.

Letterkenny Army Depot
Lighting Modifications
Buildings 31, 32, 33, 34, 41, 42, 43 & 44

04/25/91

	Existing			Proposed	
Building No.	2-40w Fl	4-40w FL	175w MV	70w HPS	100w HPS
31	0	0	165	0	165
32	0	0	165	0	165
33	250	0	0	250	0
34	0	0	165	0	165
41	0	0	165	0	165
42-S	66	20	15	0	54
42-N	0	10	33	0	43
43	250	0	0	250	0
44	0	0	165	0	165
Total Fixt.	566	30	873	500	922
Input Watts	92	184	205	88	130
Total Watts	52072	5520	178965	44000	119860
Total KW	52.1	5.5	179.0	44.0	119.9
Hours/Year	2080	2080	2080	2080	2080
KWH/Year	108310	11482	372247	91520	249309

SUMMARY

	Existing	Proposed	Savings
Total Annual KWH	492039	340829	151210 Kwh/Yr
Annual Energy Cost	18353	12713	$5,640
Annual Maint. Cost	4955	9064	($4,109)
Total Annual Cost	23308	21777	$1,531

RS&H®

SUBJECT	Project G-E Update Paint Booth Exh Heat Rec	AEP NO	290-0379-001
		SHEET	1 OF
DESIGNER	PFH	DATE	4/23/91
CHECKER	W.T. Todd	DATE	

ECO # G-E-UP Paint Booth Exhaust Heat Recovery - Bldg 1N

Energy Calculations P.B # 1010

The original energy savings were changed to correct for the following

	FROM: RSH	FROM: BKA	TO:
Req'd cfm	16,717	14,400	14,400
Indoor temp.	30°F	varies	68°F
Boiler Sys. Eff.	0.74	0.65	0.80
Opn. Hours			
# shifts	1	varies	1
days/wk	5	varies	5
Opn hrs. while htg.	1300	-	1450

Ref: "EEAP Increment G", Vol 2, p. E-I-1 (RSH)
"Paint and Drying Booth Report", Vol II, pp. 1→11 (BKA)

The results were taken from the BKA Report

Existing energy use (p. 8)

Make-up air htg. (1450 opn. hrs while heating, 68°F)

603 ÷ 0.80 = 754 MBtu/yr #5 F.O.

Fan energy

$\frac{\$493}{0.0381\ \$/kwh} \cdot \frac{3413}{10^6} = 44$ MBtu/yr elec

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SUBJECT Project 6-E Update
P.B. 1010 Bldg 1N
DESIGNER PFH
CHECKER

AEP NO
SHEET 2 OF
DATE
DATE

New Energy Use

Make-up air (p. 7)

195 ÷ 0.80 = 244 MBtu/yr #5 F.O.

Fan energy (p. 7)

$\frac{2060}{0.0381} * \frac{3413}{10^6}$ = 185 MBtu/yr elec

Savings

#5 F.O. : 754 - 244 = 510 MBtu/yr

Elec : 44 - 185 = (141) MBtu/yr.

Cost Estimates (p. 9) Escalate using ENR indicies

\$119,052 (6/87\$) * $\frac{2716}{2538}$ = \$127,402 (1/91 \$)

Payback = $\frac{\$127,402}{510 * 6.61 - 141 * 10.94}$ =

$\frac{127,402}{1829}$ = 69.9 yrs.

RS&H

SUBJECT Project G-F Update
Paint Booth Exh. Ht. Recovery
DESIGNER PH.
CHECKER W.T. Todd

AEP NO 290-0379-001
SHEET 1 OF
DATE 4/25/91
DATE

ECO #G-F-UP Paint Booth Exhaust Heat Recovery

Energy Calculations

Bldg # 14
P. B. # 252

The original energy savings were changed to correct for the following:

	From: RSH	From: BKA	To:
Req'd CFM	12,970	9221	9221
Indoor Temp.	80°F	varies	68°F
Boiler Sys. Eff.	0.74	0.65	0.80
Opn. Hrs			
# shifts	1	varies	1
days/wk	5	varies	5
Opn hrs. while htg.	1300	–	1450

Ref: "EEAP, Increment G, Vol 2", RSH, p. F-V-1 &
"Paint and Drying Booth Report", Vol II, BKA, p. 12-21

The following results were taken from the BKA Report

Existing energy use: (p. 18)

Make-up air heating

386 ÷ 0.80 = 483 MBtu/yr #5 F.O.

Fan Energy

$\frac{\# 316}{0.0381 \#/kWh} \cdot \frac{3413}{10^6}$ = 28 MBtu/y Elec

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SUBJECT: Project G-F Update
P.B. # 252 Bldg 14
DESIGNER: PH
CHECKER:

AEP NO
SHEET 2 OF
DATE
DATE

New Energy Use

Make-up air heating (p. 17)

126 ÷ 0.8 = 158 MBtu/yr #5 F.O.

Fan energy

$\frac{\$1319}{0.0381} \cdot \frac{3413}{10^6}$ = 118 MBtu/yr Elec.

Savings

#5 F.O. : 483 - 158 = 325 MBtu/yr

Elec. : 28 - 118 = (90) MBtu/yr

Cost Estimates (p. 19) Escalate using ENR indicies

\$96,396 (6/87\$) * $\frac{2716}{2538}$ = \$103,157 (1/91 \$)

Payback = $\frac{103,157}{325 * 6.61 - 90 * 10.94}$

= $\frac{103,157}{1164}$ = 88.6 yrs

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SUBJECT	Project G-G Update Paint Booth Exh. Ht Recovery	AEP NO	290-0379-001
		SHEET	1 OF
DESIGNER	P. Hutchins	DATE	4/25/91
CHECKER	W.T. Todd	DATE	

ECO # G-G-UP Paint Booth Exhaust Heat Recovery

Bldg. # 37

Energy Calculation P.B. # 486

The original energy savings were changed to correct for the following:

	From: RSH	BKA	To:
Req'd CFM	12,886	11,152	11,152
Indoor temp.	80°F	varies	68°F
Boiler Sys. Eff.	0.74	0.65	0.80
Opn Hrs			
# shifts	1	-	1
days/wk	5	-	5
Opn hrs while htg.	1300	varies	1450

Ref.: "EBAP, Increment G, Vol 2", RSH, p. G- & "Paint and Drying Booth Report", Vol II, BKA, p. 32-42

The following results were taken from the BKA Report

Existing energy use: (p. 38)

Make-up air heating - 467 ÷ 0.80 = 583 MBtu/yr #5 F.O.

Fan energy - $\frac{\$382}{0.0381 \$/kwh} \cdot \frac{3413}{10^6}$ = 34 MBtu/yr Elec

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SUBJECT Project G-G Update
Bldg 37 P.B. # 486
DESIGNER PFH
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New Energy Use (p. 37)

Make-up air htg - 152 ÷ 0.80 = 190 MBtu/yr #5 F.O.

Fan energy - $\frac{\$1595}{0.0381} \cdot \frac{3413}{10^6}$ = 143 MBtu/yr Elec.

Energy savings

#5 F.O. - 583 - 190 = 393 MBtu/yr. #5 F.O.

Elec. - 34 - 143 = (109) MBtu/yr Elec.

Cost Estimates (p. 39) Escalate using ENR indicies

\$ 119,053 (6/87\$) * $\frac{2716}{2538}$ = \$127,403 (1/91\$)

Payback = $\frac{\$127,403}{393 * 6.61 - 109 * 10.94}$

= $\frac{127,403}{1405}$ = 91 years

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SUBJECT	LETTERKENNY A.D.	AEP NO	290-0379-001
	ECO # G-I-UP	SHEET	1 OF 2
DESIGNER	G.F.	DATE	
CHECKER		DATE	

ECO # G-I-UP

UPDATE BUILDING 350 SOUTH DIP TANK HEAT RECOVERY.

ASSUMPTIONS	1981 (1) (MEASURED)	1991 (2) (DESIGN)
EXHAUST FLOW (CFM)	7557	11,000
EXHAUST TEMP (°F)	80	68
BOILER EFF	0.74	0.80
OPN HRS	1465	1465

(1) LEAD EEAP, RSH 1980, INCREMENT G, VOL. 2, pg I-IV-1

(2) LEAD DIP TANK SURVEY. LEAD BLDG DESIGN TEMPERATURES.

ENERGY REQUIRED TO HEAT EXHAUST AIR

$$q = \frac{35618 \text{ BTU/YR/CFM} \times 11000 \text{ CFM}}{10^6 \text{ BTU/MBTU}} = 392 \text{ MBTU/YR}$$

NOTE: 35618 BTU/YR/CFM WAS DERIVED USING BIN TEMP. METHOD. SEE PAGE G-I-UP-3

ENERGY RECOVERED WITH HEAT EXCHANGER

$$Q_R = Q_E \times \eta_{H/X}$$

WHERE: Q_R = ENERGY RECOVERED

Q_E = ENERGY EXHAUSTED

$\eta_{H/X}$ = EFFICIENCY OF HEAT EXCHANGER = 0.69, pg I-IV-3 OF EEAP

Q_R = 392 MBTU/YR × 0.69

= 270 MBTU/YR.

FUEL SAVED

270 MBTU/YR / 0.8 = 338 MBTU/YR #6 F.O.

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ECO # G-I-UP
DESIGNER G.F.
CHECKER

AEP NO
SHEET 2 OF 2
DATE
DATE

FUEL COST SAVINGS

339 MBTU/YR X 6.61 $/MBTU = 2230 $/YR

ELECTRICITY

ADDITIONAL FAN ENERGY REQUIRED

FAN ENERGY IS DIRECTLY PROPORTIONAL TO FLOW. ORIGINAL 1981 CALC'S SHOW 53.6 MBTU/YR (ELEC) TO MOVE 7557 CFM AIR.

$$Q_{(ELEC)} = 53.6 \frac{MBTU}{YR} \times \frac{11{,}000\ CFM}{7557\ CFM} = 73.0\ MBTU/YR$$

ADDITIONAL FAN ENERGY COST

$$78\ MBTU/YR \times 10.94 \frac{\$}{MBTU} = 854\ \$/YR \text{ ADDITIONAL}$$

NET COST SAVINGS

2230 $/YR − 854 $/YR = 1380 $/YR

PAYBACK

$$PAYBACK = \frac{CONSTRUCTION\ COST}{ANNUAL\ SAVINGS} = \frac{\$42{,}405}{\$1380/YR} = 30.8\ YEARS.$$

05/09/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Building 350s dip tank heat exhaust recovery - update

ECO #: G-I-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)	
Material	$13,766
Labor	$5,269

Escalation to 1991

Escalation rates from Engineering News Record:

From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $13,766 x 1.290 = $17,753
Labor = $5,269 x 1.290 = $6,795
Total = $17,753 + $6,795 = $24,548

Bare 1991 Escalated Costs	$24,548
FICA Insurance (20% of Labor)	$1,359
Sales Tax (6.5% of Material)	$1,154
Subtotal	$27,061
Overhead (15%)	$4,059
Subtotal	$31,120
Profit (10%)	$3,112
Subtotal	$34,232
Bond (1%)	$342
Subtotal	$34,574
Contingency (10%)	$3,457
Subtotal (Construction Cost Input For LCCID *)	$38,031
SIOH (5.5% of Construction Cost)	$2,092
Subtotal	$40,123
Design (6% of Construction Cost)	$2,282
Total Project Cost	$42,405

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

ECO# G-I-UP

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.25
	9 AM - 5 PM	0.75
	5 PM - 1 AM	0
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865
Total Operation Hours While Heating (and corrected for working days/week)					1465					35,618
Avg outdoor temp while heating (F)					45.0					

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SUBJECT LETTERKENNY A.D.
ECO #J-UP

DESIGNER G.F.

CHECKER

AEP NO 290-0379-001

SHEET 1 OF 2

DATE 4-25-91

DATE

ECO G-J-UP - BLDG 320 STEAM SUPPLY

1990 BLDG 320 FUEL CONSUMPTION (#2 OIL)

MO	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
GAL	6844	8494	3607	21073	6236	10041	2415	4535
MBTU	949	1180	500	2920	865	1390	335	636

	YEAR	GAL	MBTU
TOTAL	1990	63295	8780

ASSUME: a) EQUAL BOILER EFFICIENCIES = 80%
b) EQUAL ELECTRICAL CONSUMPTION

COST OF NO. 2 FUEL OIL

8780 MBTU/YR x $7.43/MBTU = $65,200/YR

COST OF NO. 6 FUEL OIL

8780 MBTU/YR x $6.61/MBTU = $58,000/YR

COST SAVINGS

$65,200/YR - $58,000/YR = $7160/YR

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Building 320 steam line

ECO #: G-J-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)	
Material	$340,499
Labor	$135,510

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material	=$340,499	x	1.290	=$439,124
Labor	=$135,510	x	1.290	=$174,760
Total	=$439,124	+	$174,760	=$613,884

Bare 1991 Escalated Costs	$613,884
FICA Insurance (20% of Labor)	$34,952
Sales Tax (6.5% of Material)	$28,543
Subtotal	$677,379
Overhead (15%)	$101,607
Subtotal	$778,986
Profit (10%)	$77,899
Subtotal	$856,885
Bond (1%)	$8,569
Subtotal	$865,454
Contingency (10%)	$86,545
Subtotal (Construction Cost Input For LCCID *)	$951,999
SIOH (5.5% of Construction Cost)	$52,360
Subtotal	$1,004,359
Design (6% of Construction Cost)	$57,120
Total Project Cost	$1,061,479

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

ECO UPDATE # G-N-UP

Install warehouse door seals on Buildings 2 & 4

Assumptions

1. The space temperature is maintained at 68°F during the heating season.

2. The boiler system efficiency is 80%.

3. Buildings 2 and 4 are heated 24 hours per day, 7 day per week.

4. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)

5. The average crack width is 1/2" around the top and sides of the sliding and roll-up doors. The crack width at the bottom is 1/2" for the sliding doors and 1/4" for the roll-up doors.

6. Installing warehouse door seals will reduce the crack width by 50%.

7. Building 2 is heated by #5 fuel oil from the boilers in building 1. Building 4 is heated by #2 fuel oil from the boilers in building 2.

Infiltration Rate

$I = C_v \times A \times V$ ASHRAE Fundamentals, 1981, pg. 22.6

C_v = Wind direction factor = 0.35 for diagonal wind

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SUBJECT Warehouse Door Seals
LEAD
DESIGNER WTT
CHECKER

AEP NO.
SHEET 2 OF
DATE
DATE

V = Wind velocity $= 10\frac{mi}{hr} \times 5280\frac{ft}{mi} \times \frac{1\,hr}{60\,min} = 880\ ft/min$

A = Area of opening = perimeter × crack width

Building 2 has : 32 Roll-up doors, 8'×10.25'
6 " " " 10'×10.25'
5 " " " 12'×10.25'
1 " " " 16'×10.25'

$$A_2 = [32 \times (8ft + 2 \times 10.25ft) + 6 \times (10ft + 2 \times 10.25ft) + 5 \times (12ft + 2 \times 10.25ft) + 16ft + 2 \times 10.25ft] \times 0.5in \times \frac{1ft}{12in} + (32 \times 8ft + 6 \times 10ft + 5 \times 12ft + 16ft) \times 0.25in \times \frac{1ft}{12in}$$

$$A_2 = [912\,ft + 183\,ft + 162.5\,ft + 36.5\,ft] \times 0.042\,ft + (392\,ft \times 0.021\,ft)$$

$$A_2 = 1294\,ft \times 0.042\,ft + 392\,ft \times 0.021\,ft$$

$$A_2 = 53.9\,ft^2 + 3.2\,ft^2 = \underline{62.1\,ft^2}$$

Building 4 has : 9 Roll-up doors, 10'×10.25'
7 Double Sliding Doors, 10'×10.25'

$$A_4 = [9 \times (10ft + 2 \times 10.25ft) + 7 \times (2 \times 10ft + 3 \times 10.25ft)] \times .5in \times \frac{1ft}{12in} + (9 \times 10ft) \times 0.25in \times \frac{1ft}{12in}$$

$$A_4 = (274.5ft + 355.25ft) \times .042ft + 90ft \times 0.021ft$$

$$A_4 = 26.3ft^2 + 1.9ft^2 = \underline{28.2\,ft^2}$$

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SUBJECT: Warehouse Door Seals
LEAD
DESIGNER: WTT
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SHEET 3 OF
DATE
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$I_2 = 0.35 \times 62.1\ ft^2 \times 880\ ft/min = \underline{19{,}127\ ft^3/min}$

$I_4 = 0.35 \times 28.2\ ft^2 \times 880\ ft/min = \underline{8{,}686\ ft^3/min}$

Heat Loss

$Q = 165{,}858$ Btu/cfm·year   from spreadsheet for 24 hrs/day

$Q_2 = 165{,}858 \frac{Btu}{cfm \cdot yr} \times 19{,}127\ cfm = \underline{3{,}172\ mBtu/yr}$

$Q_4 = 165{,}858 \frac{Btu}{cfm \cdot yr} \times 8{,}686\ cfm = \underline{1{,}441\ mBtu/yr}$

Current Energy Use

#5 oil $= 3172 \frac{mBtu}{yr} \div 0.8 = \underline{3{,}965\ mBtu/yr}$

#2 oil $= 1441 \frac{mBtu}{yr} \div 0.8 = \underline{1{,}801\ mBtu/yr}$

Energy Savings

Energy Savings will be directly proportional to the size of the crack width around the doors.

$A_2 (new) = 1294\ ft \times 0.021\ ft + 392\ ft \times 0.01\ ft = 31.0\ ft^2$

$A_4 (new) = 630\ ft \times 0.021\ ft + 90\ ft \times 0.01\ ft = 14.1\ ft^2$

Savings % (Bldg. 2) $= 31.0\ ft^2 / 62.1\ ft^2 = 50\%$

Savings % (Bldg. 4) $= 14.1\ ft^2 / 28.2\ ft^2 = 50\%$

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SUBJECT Warehouse Door Seals
LEAD
DESIGNER WTT
CHECKER
AEP NO
SHEET 4 OF
DATE
DATE

#5 oil Savings = 3965 mBtu/yr x 0.5 = 1982 mBtu/yr

#2 oil Savings: 1801 mBtu/yr x 0.5 = 900 mBtu/yr

Total = 1982 $\frac{mBtu}{yr}$ + 900 $\frac{mBtu}{yr}$ = 2,882 mBtu/yr

Energy Cost Savings

#5 oil : 1982 mBtu/yr x \$4.61/mBtu = \$9137/yr

#2 oil : 900 mBtu/yr x \$4.76/mBtu = \$4284/yr

Total = \$13,421/yr

Project Cost

Total Project cost = \$54238

See cost estimate sheets for details

Simple Payback

Payback = Cost ÷ Annual Savings - annual replacement costs (p. G-N-UP-5)

Payback = \$54,238 ÷ (13,421 - 6922)

Payback = 8.4 years

RS&H

SUBJECT ECO # G-N-UP

AEP NO. 290-0379-001

SHEET ____ OF ____

DESIGNER P. Hutchins

DATE 9/27/91

CHECKER ______

DATE ______

Calculate replacement costs for door seals over 25 year life

assume failure at 5 yrs.

then replace 1/5 every year

Annual cost is 34,612 ÷ 5 = $6922
(p. G-N-UP-5)

05/14/91

ECO Update Construction Cost Estimate
Calculations

ECO Name: Warehouse Door Seals For Buildings 2 and 4

ECO #: G-N-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)	
Material	$21,062
Labor	$3,672

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $21,062 x 1.290 = $27,163
Labor = $3,672 x 1.290 = $4,736
Total = $27,163 + $4,736 = $31,899

	Bare 1991 Escalated Costs	$31,899
FICA Insurance (20% of Labor)		$947
Sales Tax (6.5% of Material)		$1,766
	Subtotal	$34,612
Overhead (15%)		$5,192
	Subtotal	$39,804
Profit (10%)		$3,980
	Subtotal	$43,784
Bond (1%)		$438
	Subtotal	$44,222
Contingency (10%)		$4,422
Subtotal (Construction Cost Input For LCCID *)		$48,644
SIOH (5.5% of Construction Cost)		$2,675
	Subtotal	$51,319
Design (6% of Construction Cost)		$2,919
Total Project Cost		$54,238

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

N-V-7

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 6/22/81 | SHEET ___ OF ___

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: LETTERKENNY ARMY DEPOT, PENNSYLVANIA

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: WAREHOUSE DOOR SEALS {BLDGS 2 & 4}

ESTIMATOR: NEVCE

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
DOOR SEAL	2407	FT	1.525	3672.00	6.80	16,368.00	20,040.00
SEAL RETAINER	2407	FT	–		1.95	4694.00	4694.00
SUBTOTAL				3672.00		21,062.00	24734.00
FICA (22% OF LABOR)							808.00
SALES TAX (5% OF MATL)							1053.00
SUBTOTAL							26,595.00
OH & P (25%)							6649.00
SUBTOTAL							33,244.00
BOND (1%)							332.00
SUBTOTAL							33,576.00
CONTINGENCY (10%)							3358.00
DESIGN SUBTOTAL							36,934.00
SIOH (5%)							1847.00
'81 CWE							38,780.00

ENG FORM 150, 1 AUG 59 (ER 1110-345-730) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

U.S. GOVERNMENT PRINTING OFFICE 1960 O—518188

G-N-UP-6

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Operation Days Per Week 5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Total Operation Hours While Heating
(and corrected for working days/week) 4776 118,470

Avg outdoor temp while heating (F) 45.0

G-N-UP-7

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT Plastic Strip Curtains
LEAD
DESIGNER W. T. Todd
CHECKER

AEP NO 290-0379-001
SHEET 1 OF
DATE March 28, 1991
DATE

ECO UPDATE # G-P-UP

Install Strip Curtains in Buildings 2 & 4

Assumptions:

1. The space temperature is maintained at 68°F during the heating season.

2. The boiler system efficiency is 80%.

3. All doors are open a total of 0.25 hour each operating day.

4. Strip curtains reduce the heat loss though an open door by 85%. (Handbook of Energy Audits, Page 154)

5. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)

Infiltration Rate:

$I = Cv * A * V$ ASHRAE Fundamentals, 1981, pg 22.6

Cv = Wind direction factor = 0.35 (for diagonal winds)

A = Area of opening = $1\ ft^2$

V = Wind velocity $= 10 \frac{mi}{hr} \times \frac{5280\ ft}{mi} \times \frac{1\ hr}{60\ min} = 880\ ft/min$

$I = 0.35 * 1 ft^2 * 880 \frac{ft}{min} = \underline{308\ ft^3/min}$

for one square foot of area

Heat Loss:

$Q = 35{,}618 \ \text{Btu/yr}\cdot\text{cfm}$ see spreadsheet, for 8 hrs/day

$Q = 35{,}618 \frac{\text{Btu}}{\text{yr}\cdot\text{cfm}} \times 303 \frac{\text{cfm}}{\text{ft}^2} \times \frac{0.25\ \text{hr/day}}{8\ \text{hour/day}} \Rightarrow 0.34 \frac{\text{MBtu}}{\text{yr}\cdot\text{ft}^2}$

Building 2 has:
- 6 10'×10.25' doors
- 5 12'×10.25' doors
- 1 16'×10.25' doors

Building 4 has 16 10'×10.25' doors

Total area of opening for each building

$A_2 = 6 \times 10' \times 10.25' + 5 \times 12' \times 10.25' + 1 \times 16' \times 10.25' = 1394\ \text{ft}^2$

$A_4 = 16 \times 10' \times 10.25' = 1640\ \text{ft}^2$

Heat loss:

$Q \times A_2 = 0.34 \frac{\text{MBtu}}{\text{yr}\cdot\text{ft}^2} \times 1394\ \text{ft}^2\ (\text{Bldg. 2}) = 478\ \text{MBtu/yr}$

$Q \times A_4 = 0.34 \frac{\text{MBtu}}{\text{yr}\cdot\text{ft}^2} \times 1640\ \text{ft}^2\ (\text{Bldg. 4}) = 562\ \text{MBtu/yr}$

Current Energy Use:

- Assume building 2 is heated with #5 oil from the boilers in building 1.
- Building 4 is heated with #2 oil from the boilers in building 2.

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT: Plastic Strip Curtains
LEAD
DESIGNER: W. T. Todd
CHECKER:

AEP NO
SHEET 3 OF
DATE
DATE

Building 2:

#5 oil : 478 $\frac{mBtu}{yr}$ ÷ 0.8 = <u>598 mBtu/yr</u>

Building 4:

#2 oil = 562 $\frac{mBtu}{yr}$ ÷ 0.8 = <u>703 mBtu/yr</u>

<u>Energy Savings:</u>

Strip curtains reduce losses by 85%

#5 oil : 598 $\frac{mBtu}{yr}$ x .85 = <u>508 $\frac{mBtu}{yr}$</u>

#2 oil : 703 mBtu/yr x 0.85 = <u>598 $\frac{mBtu}{yr}$</u>

Total = 508 $\frac{mBtu}{yr}$ + 598 $\frac{mBtu}{yr}$ = <u>1106 $\frac{mBtu}{yr}$</u>

<u>Energy Cost Savings:</u>

#5 oil : 508 $\frac{mBtu}{yr}$ x \$6.61/mBtu = <u>\$3,358/yr</u>

#2 oil : 598 $\frac{mBtu}{yr}$ x \$7.43/mBtu = <u>\$4,443/yr</u>

Savings = \$3,358/yr + \$4,443/yr = <u>\$7,801 /year</u>

Project Cost:

Total Project Cost = $33,799

See ECO Update Estimate Sheet for details

Simple Payback:

Payback = Cost ÷ Savings

= $33,799 ÷ $7801 /yr

Simple Payback = 4.3 years

Calculate additional costs due to strip curtain replacement

Assume curtains replaced every 3 years

Therefore 1/3 will be replaced every year.

Annual costs = $21,569 ÷ 3 = $7190
(p. G-P-UP-5)

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Plastic Strip Curtains For Loading Doors In Buildings 2 & 4

ECO #: G-P-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)	
Material	$14,000
Labor	$1,512

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $14,000 x 1.290 = $18,055
Labor = $1,512 x 1.290 = $1,950
Total = $18,055 + $1,950 = $20,005

Bare 1991 Escalated Costs	$20,005
FICA Insurance (20% of Labor)	$390
Sales Tax (6.5% of Material)	$1,174
Subtotal	$21,569
Overhead (15%)	$3,235
Subtotal	$24,804
Profit (10%)	$2,480
Subtotal	$27,284
Bond (1%)	$273
Subtotal	$27,557
Contingency (10%)	$2,756
Subtotal (Construction Cost Input For LCCID *)	$30,313
SIOH (5.5% of Construction Cost)	$1,667
Subtotal	$31,980
Design (6% of Construction Cost)	$1,819
Total Project Cost	$33,799

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CASE 1 P-V-7

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 7/6/81

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot, Pennsylvania

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO. Buildings 2 & 4. Plastic curtain doors

ESTIMATOR: Nease

CHECKED BY

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
Plastic Curtain Doors	28	EA	54.00	1512.00	500.00	14,000.00	15,512.00
FICA (22% of Labor)							333.00
Sales Tax (5% of Matl)							700.00
SUBTOTAL							16,545.00
OH & P (25%)							4136.00
SUBTOTAL							20,681.00
Bond (1%)							207.00
SUBTOTAL							20888.00
Contingency (10%)							2089.00
DESIGN SUBTOTAL							22,977.00
SIOH (5%)							1149.00
1981 CWE							24,126.00
1983 CWE = (1981 CWE)(1.12²)(1.084)							32806.00

1981 DESIGN = (.06)(22,977.00) = 1379.00

1983 DESIGN = (1.12²)(1379) = 1730.00

ENG FORM 150, 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1959 O—510140

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.25
	9 AM - 5 PM	0.75
	5 PM - 1 AM	0
Operation Days Per Week		5

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating (and corrected for working days/week)	1465	35,618
Avg outdoor temp while heating (F)	45.0	

ECO UPDATE # G-U-UP

Install Storm Windows in Building 3

Assumptions:

1. The indoor air temperature is maintained at 68 °F during the heating season.

2. Building 3 is heated 24 hours per day, 7 days per week.

3. The total annual hours that Building 3 is heated is 6687 hours/year. The infiltration heat loss factor (HLF) is 0.1659 MBtu/yr. The average outdoor temperature while heating is 45 °F. Refer to bin temperature spreadsheet calculations for details.

4. The boiler / heating system efficiency is 80%.

5. Installing storm windows will reduce the infiltration cfm by 50%. Reference - 1981 ASHRAE Fundamentals, page 22.10.

6. The U-values for windows with and without storm windows are $0.50 \frac{Btu}{hr \cdot ft^2 \cdot °F}$ and $1.10 \frac{Btu}{hr \cdot ft^2 \cdot °F}$, respectively.

Data From 1981 EEAP:

Area of windows = 1977 ft^2

Infiltration for existing windows = 264 cfm (w/o storm sash)

Calculations:

Conduction energy savings:

$$Q_c = \Delta U \times A \times \Delta T$$

$$= (1.10 - 0.50)\frac{Btu}{hr \cdot ft^2 \cdot °F} \times 1977\ ft^2 \times (68-45)°F \times 6687\frac{hr}{yr} \times \frac{1\ mBtu}{10^6\ Btu}$$

$$= 0.60\frac{Btu}{hr \cdot ft^2 °F} \times 1977\ ft^2 \times 23°F \times 6687\frac{hr}{yr} \times \frac{1\ mBtu}{10^6\ Btu}$$

$$Q_c = 182.4\ mBtu/yr$$

Infiltration energy savings:

$$Q_I = CFM \times HLF$$

$$= (264\ CFM \times 0.5) * 0.1659\frac{mBtu}{CFM \cdot yr}$$

$$= 132\ CFM \times 0.1659\frac{mBtu}{CFM \cdot yr}$$

$$Q_I = 21.9\ \frac{mBtu}{yr}$$

Heating energy savings $= Q_c + Q_I$

$$= (182.4 + 21.9)\frac{mBtu}{yr}$$

$$= 204.3\ mBtu/yr$$

Fuel Oil # 5 savings:

$$204.3\ \frac{mBtu}{yr} \div 0.80 = \underline{255.4\ \frac{mBtu}{yr}}$$

Energy Cost Savings:

Cost Savings = 255.4 MBtu/Yr × \$4.61/MBtu

Cost Savings = **\$1177/year**

Project implementation costs:

Total project cost = **\$30,801**

See cost estimate sheets for details

Simple Payback:

Payback = Cost ÷ savings

= \$30,801 ÷ \$1177/yr

Payback = **26.2 years**

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Storm Windows For Building 3

ECO #: G-U-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)

Material	$7,651
Labor	$5,911

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $7,651 x 1.290 = $9,867
Labor = $5,911 x 1.290 = $7,623
Total = $9,867 + $7,623 = $17,490

Bare 1991 Escalated Costs	$17,490
FICA Insurance (20% of Labor)	$1,525
Sales Tax (6.5% of Material)	$641
Subtotal	$19,656
Overhead (15%)	$2,948
Subtotal	$22,604
Profit (10%)	$2,260
Subtotal	$24,864
Bond (1%)	$249
Subtotal	$25,113
Contingency (10%)	$2,511
Subtotal (Construction Cost Input For LCCID *)	$27,624
SIOH (5.5% of Construction Cost)	$1,519
Subtotal	$29,143
Design (6% of Construction Cost)	$1,657
Total Project Cost	$30,801

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

U-V-19

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 7/10/81

SHEET ___ OF ___

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: LETTERKENNY ARMY DEPOT, PENNSYLVANIA

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: STORM WINDOWS, BLDG. 3

ESTIMATOR: NEASE

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
INSTALL STORM WINDOW	1977	S.F.	2.99	5911.00	3.87	7651.00	13562.00
FICA (22% OF LABOR)							1300.00
SALES TAX (5% OF MATL)							383.00
SUBTOTAL							15,245.00
OH&P (25%)							3811.00
SUBTOTAL							19,056.00
BOND (1%)							191.00
SUBTOTAL							19,247.00
CONTINGENCY (10%)							1924.00
DESIGN SUBTOTAL							21,171.00
SIOH (5%)							1059.00
1980 CWE							22,230.00

1980 DESIGN = (.06)(21,171.00) = 1270.00

1984 DESIGN = (1.12^3)(1270) = 1784.00

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE 1980 O—

ENERGY AUDIT OF INDUSTRIAL FACILITIES
LETTERKENNY ARMY DEPOT

Operation hours per day = 24
Operation days per week = 7

Indoor Air Temperature (F) = 68

Hour Fractions: 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Temperature Range		Hours of Occurrence 2-9	10-17	18-1	Net Hours	Delta T	Total Deg Hrs	Net Deg Hrs
70	74	247	237	301	785	-4	0	0
65	69	296	217	278	791	1	791	791
60	64	269	196	236	701	6	4,206	4,206
55	59	249	191	209	649	11	7,139	7,139
50	54	221	193	202	616	16	9,856	9,856
45	49	218	193	206	617	21	12,957	12,957
40	44	237	236	239	712	26	18,512	18,512
35	39	289	246	286	821	31	25,451	25,451
30	34	304	194	258	756	36	27,216	27,216
25	29	184	106	152	442	41	18,122	18,122
20	24	124	65	90	279	46	12,834	12,834
15	19	75	32	57	164	51	8,364	8,364
10	14	54	13	26	93	56	5,208	5,208
5	9	18	3	9	30	61	1,830	1,830
0	4	9	0	2	11	66	726	726
-5	-1	3	0	1	4	71	284	284
-10	-6	1	0	0	1	76	76	76
-15	-11	0	0	0	0	81	0	0
Totals		2798	2122	2552	7472		153572	153572

Total operation hours while heating
corrected for working days/week = 6687 Hours/Yr

Total degree hours per year corrected for
working days per week = 153572 Degree hours

Average outdoor temperature while heating = 45.0 F

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 24

Room or Supply Air Conditions - Winter 68
Air Quantity (cfm) 1

Hour Fractions 1 AM - 9 AM 1
9 AM - 5 PM 1
5 PM - 1 AM 1

Operation Days Per Week 7

Temp. Range		Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta T	Const.	CFM	Btu /Hr	Total Btu
70	74	247	237	301	785	-4	1.08	1	0	0
65	69	296	217	278	791	1	1.08	1	1	854
60	64	269	196	236	701	6	1.08	1	6	4,542
55	59	249	191	209	649	11	1.08	1	12	7,710
50	54	221	193	202	616	16	1.08	1	17	10,644
45	49	218	193	206	617	21	1.08	1	23	13,994
40	44	237	236	239	712	26	1.08	1	28	19,993
35	39	289	246	286	821	31	1.08	1	33	27,487
30	34	304	194	258	756	36	1.08	1	39	29,393
25	29	184	106	152	442	41	1.08	1	44	19,572
20	24	124	65	90	279	46	1.08	1	50	13,861
15	19	75	32	57	164	51	1.08	1	55	9,033
10	14	54	13	26	93	56	1.08	1	60	5,625
5	9	18	3	9	30	61	1.08	1	66	1,976
0	4	9	0	2	11	66	1.08	1	71	784
-5	-1	3	0	1	4	71	1.08	1	77	307
-10	-6	1	0	0	1	76	1.08	1	82	82
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	7472					165,858

Net heat loss corrected for working days/week (Btu/cfm*yr) = 165,858

Total Operation Hours While Heating
(and corrected for working days/week) = 6687

Average outdoor temperature while heating = 45.0 F

ECO UPDATE # G-V-UP

Install Loading Dock Seals on Building 2

Assumptions

1. The space temperature is maintained at 68 °F during the heating season.

2. The boiler system efficiency is 80%.

3. Building 2 is operated for 8 hours per day and 5 days per week.

4. Of the existing 32 loading dock doors, 12 have had loading dock seals previously installed.

5. On an average day 12 of the 32 loading dock doors are used for 2 hours each.

6. Installing loading dock seals will reduce the gap between the truck and the door from 3" to 0.25 inches.

7. The average winter wind velocity is 10 mph. (1987 Statistical Abstract of the United States)

Infiltration Rate

$I = C_v * A * V$ ASHRAE Fundamentals, 1981, pg. 22.6

C_v = Wind direction factor = 0.35 for diagonal winds

V = Wind velocity $= 10 \frac{mi}{hr} \times \frac{5280\,ft}{mi} \times \frac{1\,hr}{60\,min} = 880\ ft/min$

A = Area of opening for 12 doors

$A = 12 \times [8\ ft/side \times 2\ sides + 10.25\ ft/side \times 2\ sides] * 3\ in \times \frac{1\ ft}{12\ in}$

$A = 12 \times (16\ ft + 20.5\ ft) \times 0.25\ ft = 109.5\ ft^2$

$I = 0.35 \times 109.5\ ft^2 \times 880\ ft/min = \underline{33{,}726\ ft^3/min}$

Heat Loss

$Q = 35{,}618\ Btu/yr.cfm$ From spreadsheet, for 8 hrs/day

$Q = 35{,}618\ \frac{Btu}{yr.cfm} \times 33{,}726\ cfm \times \frac{2\ hr/day}{8\ hr/day} = 300\ \frac{MBtu}{yr}$

Current energy use

Assume building 2 is heated by #5 oil from the boilers in building 1

#5 oil : 300 mbtu/yr ÷ 0.8 = 375 MBtu/yr

Energy Savings

Energy savings will be directly proportional to the size of the opening between the truck and the door.

$Savings\ \% = \frac{3'' - 0.25''}{3''} \times 100 = 92\%$

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT Loading Dock Seals
LEAD
DESIGNER WTT
CHECKER
AEP NO
SHEET 3 OF
DATE
DATE

#5 oil : $375 \frac{mbtu}{yr} \times 0.92 = 345$ mBtu/yr

Energy Cost Savings

5oil : $345 \frac{mBtu}{yr} \times \$4.61/mBtu = \$1590/yr$

Project Cost

Total project cost = $28,833

for 20 loading dock seals, see estimates for details

Simple Payback

$$\text{Payback} = \frac{\text{cost}}{\text{savings}} = \frac{\$28,833}{\$1590/yr} = 18.1 \text{ years}$$

'V'-V-4

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 6/24/81

SHEET ___ OF ___

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot, Pennsylvania

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [x] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.: Building 2 Warehouse Dock-seals

ESTIMATOR: A.L. Nease

CHECKED BY:

SUMMARY	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
Dock seal McGuire # TS-583/100	32	Dan.	84.15	2693.00	575.00	18,400.00	21,093.00
FICA (22% of labor)							592.00
Sales Tax (5% of mat'l)							920.00
Subtotal							22,605.00
OH&P (25%)							5651.00
Subtotal							28,256.00
Bond (1%)							283.00
Subtotal							28,539.00
Contingency (10%)							2854.00
Design subtotal							31,393.00
SIOH (5%)							1570.00
1981 CWE							32,963.00
1984 CWE = (32,963)(1.12²)(1.084) =							44,822.00

1981 Design = (.06)(31,393) = 1884.00

1983 Design = (1.12²)(1884) = 2363.00

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE

G-V-UP-5

05/14/91

ECO Update Construction Cost Estimate Calculations

ECO Name: Loading Dock Seals For Building 2

ECO #: G-V-UP

Year of original cost estimate: 1981

ECO "bare" costs (from original cost estimate)	
Material	$11,500
Labor	$1,683

Escalation to 1991

Escalation rates from Engineering News Record:
From 6/80 to 1/91 = 1.393
From 6/81 to 1/91 = 1.290

Material = $11,500 x 1.290 = $14,831
Labor = $1,683 x 1.290 = $2,170
Total = $14,831 + $2,170 = $17,001

Bare 1991 Escalated Costs	$17,001
FICA Insurance (20% of Labor)	$434
Sales Tax (6.5% of Material)	$964
Subtotal	$18,399
Overhead (15%)	$2,760
Subtotal	$21,159
Profit (10%)	$2,116
Subtotal	$23,275
Bond (1%)	$233
Subtotal	$23,508
Contingency (10%)	$2,351
Subtotal (Construction Cost Input For LCCID *)	$25,859
SIOH (5.5% of Construction Cost)	$1,422
Subtotal	$27,281
Design (6% of Construction Cost)	$1,552
Total Project Cost	$28,833

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

LETTERKENNY ARMY DEPOT ENERGY AUDIT OF INDUSTRIAL FACILITIES

Operation Hrs/Day = 8

Room or Supply Air Conditions - Winter		68
Air Quantity (cfm)		1
Hour Fractions	1 AM - 9 AM	0.25
	9 AM - 5 PM	0.75
	5 PM - 1 AM	0
Operation Days Per Week		5

	Temp. Range	Hours of Occurrence 2-9	10-17	18-1	Total Hours	Delta H or T	Const.	CFM	BTU/HR	Total BTU
70	74	247	237	301	240	-4	1.08	1	0	0
65	69	296	217	278	237	1	1.08	1	1	256
60	64	269	196	236	214	6	1.08	1	6	1,388
55	59	249	191	209	206	11	1.08	1	12	2,441
50	54	221	193	202	200	16	1.08	1	17	3,456
45	49	218	193	206	199	21	1.08	1	23	4,519
40	44	237	236	239	236	26	1.08	1	28	6,634
35	39	289	246	286	257	31	1.08	1	33	8,596
30	34	304	194	258	222	36	1.08	1	39	8,612
25	29	184	106	152	126	41	1.08	1	44	5,557
20	24	124	65	90	80	46	1.08	1	50	3,962
15	19	75	32	57	43	51	1.08	1	55	2,355
10	14	54	13	26	23	56	1.08	1	60	1,406
5	9	18	3	9	7	61	1.08	1	66	445
0	4	9	0	2	2	66	1.08	1	71	160
-5	-1	3	0	1	1	71	1.08	1	77	58
-10	-6	1	0	0	0	76	1.08	1	82	21
-15	-11	0	0	0	0	81	1.08	1	87	0
Totals		2798	2122	2552	2291					49,865

Total Operation Hours While Heating (and corrected for working days/week)	1465	35,618
Avg outdoor temp while heating (F)	45.0	

G-V-UP-6

OTHER CALCULATIONS

Low Cost/No Cost Projects

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SUBJECT: Close Cargo Doors LCNC #1
DESIGNER: W. T. Todd
CHECKER:
AEP NO. 290-0379-001
SHEET ____ OF ____
DATE
DATE

LCNC #1

Close cargo doors when not in use - Buildings 2, 5, 6, 19 & 320

From the calculations for ECO #6-P-UP

Infiltration rate is 308 CFM/Ft² of opening

Average door opening is about 100 Ft²

$$308 \frac{CFM}{Ft^2} \times 100\,Ft^2 \times 35{,}613 \frac{Btu}{CFM\cdot Yr} \times \frac{1\,Yr}{2080\,hr} \times \frac{1\,MBtu}{10^6\,Btu} = 0.53 \frac{MBtu}{hr}$$

Assume one door is open unnecessarily 15 min/day in each of the five buildings =

$$5 \times 15\,min/day \times 5 \frac{day}{wk} \times \frac{52\,wk}{Yr} \times \frac{1\,hr}{60\,min} = 325\,hr/Yr$$

$$0.53\,MBtu/hr \times 325\,hr/Yr = 172\,MBtu/Yr$$

Calc Fuel Oil Savings

#5/6	: Bldgs 2, 5	2/5 × 172 = 69 MBTU × 4.41 =	$303/yr
#2	: Bldgs 6, 19, 320	3/5 × 172 = 103 MBTU × 4.98 =	$514/yr
			$817/yr.

Material Cost = $0

Labor cost = $0

Turn Off Unneeded Lights

1) Building 320 & 370 Paint Booths

$$9 \text{ booths} \times 24 \frac{\text{Fixt}}{\text{booth}} \times \frac{3 \text{ lamps}}{\text{fixt}} \times \frac{40 \text{ watts} \times 1.2}{\text{lamp}} \times \frac{2 \text{ hrs}}{\text{day}} \times \frac{260 \text{ Day}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}}$$

= 22,913 kwh/yr

22,913 kwh/yr × \$0.0373/kwh = **\$855/yr**

$$1 \text{ booth} \times 8 \frac{\text{Fixtures}}{\text{booth}} \times \frac{150 \text{ w}}{\text{Fixture}} \times \frac{2 \text{ hrs}}{\text{day}} \times \frac{260 \text{ day}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 624 \text{ kwh/yr}$$

624 kwh/yr × \$0.0373/kwh = **\$23/year**

2) Building 5-North recieving area:

$$15 \text{ lamps} \times 200 \frac{\text{watts}}{\text{lamp}} \times 2080 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 6240 \text{ kwh/yr}$$

6240 kwh/yr × \$0.0373/kwh = **\$233/yr**

3) Building 6 North at conveyor:

$$4 \text{ Fixt} \times 96 \frac{\text{watt}}{\text{Fixt}} \times 8760 \frac{\text{hr}}{\text{yr}} \times \frac{1 \text{ kw}}{1000 \text{ w}} = 3364 \text{ kwh/yr}$$

3364 kwh/yr × \$0.0373/kwh = **\$125/year**

4) Building 4 & Bldg 19 exterior lights

$2 \text{ lamps} \times 200 \frac{W}{\text{lamp}} \times 12 \text{ hr/day} \times 365 \frac{\text{day}}{\text{yr}} \times \frac{1 \text{ KW}}{1000 W} = 1752 \text{ kwh/yr}$

$1752 \frac{\text{kwh}}{\text{yr}} \times \$0.0373/\text{kwh} = \$65/\text{yr}$

5) Building 7 over bin rows

$616 \text{ Fixtures} \times 48 \frac{W}{\text{Fixt}} \times \frac{1 \text{ Kw}}{1000 W} \times 2 \text{ hr/day} \times 260 \frac{\text{day}}{\text{yr}} = 15{,}375 \text{ kwh/yr}$

$15{,}375 \text{ Kwh/yr} \times \$0.0373/\text{kwh} = \$573/\text{yr}$

Total energy savings = 50,268 kwh/yr

$50{,}268 \frac{\text{kwh}}{\text{yr}} \times \frac{3413 \text{ Btu}}{\text{kwh}} \times \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 172 \text{ mBtu/yr}$

Total Cost Savings = \$1874/yr

Total Project Cost = \$0

RS&H

SUBJECT Insulate Steam Pipes | AEP NO
SHEET 1 OF 4
DESIGNER P. Hutchins | DATE 5/29/91
CHECKER | DATE

LCNC #3 Insulate Steam Pipes

Summary

Bldg #	Costs: Mat.	Costs: Labor (hrs)	Costs: Lab $	Savings: MBTU	Savings: $
7	$1862	43	$695	865	$4308
422 / 424	$3192	74	$1197	702	3496
Totals	$5054	117	$1892	1567	$7804

Labor trade – pipefitter

Buildings 7, 422 and 424 are currently overheated due to the presence of uninsulated steam supply pipes along the building ceilings and partially along walls. Energy can be saved by insulating these lines and allow the unit heaters and accompanying thermostats to control indoor setpoints.

Insulate Steam Pipes in Building 7

Current Energy Use:

Building 7 and Building 4 are both served by the boilers in Building 2. The average Annual Fuel oil #2 use for these two buildings is 71,995 gallons per year. Assume Building 7 uses about 1/3 of the heating energy since Building 4 is used for shipping and receiving operations.

$$71{,}995 \frac{gal}{yr} \times 1/3 \times 0.13869 \frac{MBtu}{gal} = 3325\ MBtu/yr$$

#2 fuel oil

Energy Savings:

Previous experience has shown that savings are approximately 2% to 3% per °F of overheating.

$81°F - 68°F = 13°F$ overheating in Bldg. 7

$13°F \times 0.02 \frac{\text{Savings }\%}{°F} = 0.26 \Rightarrow 26\%$ savings

$3325 \frac{MBtu}{Yr} \times 0.26 = \underline{865\ MBtu/yr}$

Energy Cost Savings:

$865\ MBtu/yr \times \$4.98/MBtu = \underline{\$4308/yr}$

Project Cost: 350 ft, 4" pipe, 2" f.g. ins. with all service jacket

Material = $1862
Labor = 43 hrs (pipefitter)
Lab $ = $695 (@ $16.17/hr, LEAD)

Source: Means Mech. Cost Data, 1991 page 178

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SUBJECT Insulate Steam Pipes LCNC #3

AEP NO

SHEET 3 OF 4

DESIGNER P. Hutchins

DATE 5/29/91

CHECKER

DATE

Insulate Steam Pipes - Bldgs 422 & 424

- Calculate current energy use

Buildings 422 and 424 receive steam from boilers in Bldg 423. This boiler serves several other buildings. Annual fuel use is estimated by averaging the boiler fuel consumption from the past four years and allocating the same on a square foot basis among the various buildings.

#5 Fuel Oil use FY87-90

$$\frac{(90{,}044 + 122{,}030 + 84{,}806 + 103{,}610)}{4} \text{ gal/yr}$$

$$* 149{,}690 \frac{\text{Btu}}{\text{gal}} * \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} = 14{,}987 \frac{\text{MBtu}}{\text{yr}}$$

Bldgs Served	sf	Est. Energy Use (MBtu) #5 F.O.
421	15,963	2570
422	12,321	1985
424	18,928	3049
426	18,928	3049
431	13,601	2191
433	7300	1176
436	4436	715
437	1566	252
TOTALS	93,043	14,987

RS&H

SUBJECT Insulate Steam Pipes
Bldg 422 & 424
DESIGNER P. Hutchins
CHECKER

AEP NO
SHEET 4 OF 4
DATE 5/29/91
DATE

Calculate energy savings

Previous experience and an often-used rule-of-thumb states that energy use for space heating varies about 2% per °F of indoor setpoint.

Bldgs 422 & 424 temperatures varied from 74F to 82F during the site survey. Using 78F as an average, the annual fuel savings will be

$$\left(1985 + \frac{3049^{(1)}}{2}\right)(78F - 68F) * 0.02 = 702 \text{ MBtu/yr. \#2 fuel oil*}$$

(1) Only about half of Bldg 424 was overheated due to exposed steam pipes.

- Energy cost savings = 702 * 4.98 = $ 3496/yr.

- Calc. project cost

600 ft, 4" pipe, 2" fiberglass insul. with all service jacket

Material = $ 3192
Labor = 74 hours, pipefitter
Lab.$ = $ 1197 ($16.17/hr)
LEAD

Source: Means Mech. Cost Data, 1991, p. 178

* Savings are #2 Fuel Oil since these boilers are being changed to #2

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SUBJECT: Turn Off F-C's in 370 LCNC #4
AEP NO. 290-0379-001
SHEET 1 OF 1
DESIGNER: W.T. Todd
DATE
CHECKER
DATE

LCNC #4

Turn off frequency converters when not in use

No load kw input for Frequency converters:

M-6 = 7.2 kw/FC × 7 FC = 50.4 kw

Solid state = 2.9 kw/FC × 3 FC = 8.7 kw

The F-C's are not used 1 shift per day or on weekends

$(8\ \text{hr/day} \times 5\ \frac{\text{days}}{\text{wk}} + 24\ \text{hrs/day} \times 2\ \frac{\text{day}}{\text{wk}}) \times 52\ \frac{\text{wk}}{\text{yr}}$

$(40\ \text{hr/wk} + 48\ \text{hr/wk})\ 52\ \text{wk/yr} = 4576\ \text{hr/yr}$

Savings = (50.4 kw + 8.7 kw) × 4576 hr/yr

= 59.1 kw × 4576 hr/yr = 270,442 kwh/yr

Cost Savings = 270,442 $\frac{\text{Kwh}}{\text{yr}}$ × \$0.0373/kwh = \$10,087/year

Total Project Cost = \$0

LCNC #5

Fix Strip Curtains at Conveyor Entrance - Building 6

The strip curtains are in place, but they have been folded up which exposes the opening.

From the calculations for ECO #6-P-UP

infiltration is 308 cfm/ft² of opening

$10 \text{ ft}^2 \text{ opening} \times 308 \frac{\text{cfm}}{\text{ft}} = 3080 \text{ cfm}$

Current Energy Use:

$3080 \text{ cfm} \times 0.165858 \frac{\text{MBtu}}{\text{cfm} \cdot \text{yr}} \div 0.8 = 639 \frac{\text{MBtu}}{\text{yr}}$

Energy Savings: 85% with strip curtains

$639 \frac{\text{MBtu}}{\text{yr}} \times 0.85 = \underline{543 \text{ MBtu/yr}}$ fuel oil #2

Energy Cost Savings:

$543 \text{ MBtu/yr} \times \$4.98/\text{MBtu} = \underline{\$2704/\text{yr}}$

Project Cost:

Material = \$0, Labor = 0.25 MH × \$16.76/MH = \$4

Total Project Cost = **\$4**

LCNC #6

Install Motion Sensors to Control Lighting - Building 431

Current Energy Use:

Operating hours = 6am – 4:30 pm, 5 days/wk

$10.5\ hr/day \times 5\ \frac{day}{wk} \times 52\ wk/yr = 2730\ hr/yr$

$85\ Fixt \times 192\ W/Fixt \times \frac{1\ kW}{1000\ W} \times 2730\ hr/yr = 44{,}554\ kWh/yr$

Energy Savings:

Assume each lab is only occupied for 5 hrs/day

$Savings = \frac{10.5-5}{10.5} = 0.52 \Rightarrow 52\%$

$44{,}554\ kWh/yr \times 0.52 = \underline{23168\ kWh/yr} \times \frac{3413\ MBtu}{10^6\ kWh} = \underline{79.1\ MBtu/yr}$

Energy Cost Savings:

$23168\ kWh/yr \times \$0.0373/kWh = \underline{\$864/yr}$

labor - electrician

Project Cost:

Material: 7 sensors @ \$50 each = \$350

Labor: 7 sensors × 2 hrs × \$16.76/hr = \$235

Total Project cost = \$585

LCNC #6 - Continued

Motion sensors for Building 14 (shipping & receiving)

Operating hours : 40 hrs/week, 2080 hrs/yr

$$48 \text{ Fixtures} \times 192\ \text{w/fixt} \times \frac{1\ \text{kw}}{1000\ \text{w}} = 9.216\ \text{kw}$$

Energy savings: If lights are off for 25% of the day

$$9.216\ \text{kw} \times 2080\ \text{hr/yr} \times 0.25 \times 3413\ \frac{\text{Btu}}{\text{kwh}} \times \frac{1\ \text{MBtu}}{10^6\ \text{Btu}} = 16.4\ \text{MBtu/yr}$$

Energy Cost Savings

$$16.4\ \text{MBtu/yr} \times 10.94\ \text{\$/MBtu} = \$179/\text{year}$$

Project Cost

1 sensor @ \$50 each = \$50

1 sensor × 2 manhours @ \$16.76/MH = \$34

Total cost = \$84

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SUBJECT Repair Steam Leaks
LCNC # 7
DESIGNER W. T. Todd
CHECKER
AEP NO 290-0379-001
SHEET 1 OF
DATE 5-30-91
DATE

Repair Steam Leaks

A 1/8" (0.125") opening in a 15 psig steam valve or fitting wastes about 250 MBtu/yr of steam (from chart on following page.)

$250 \frac{MBtu}{Yr} \div 0.80 = 312 \frac{MBtu}{Yr}$ fuel oil savings per leak

Assuming all leaks are steam produced by #5 or #6 fuel oil:

$312 \frac{MBtu}{Yr. leak} \times \$4.41/MBtu = \$1376/yr$ per leak

Total of 3 leaks 1376 * 3 = $ 4128

Project Cost:

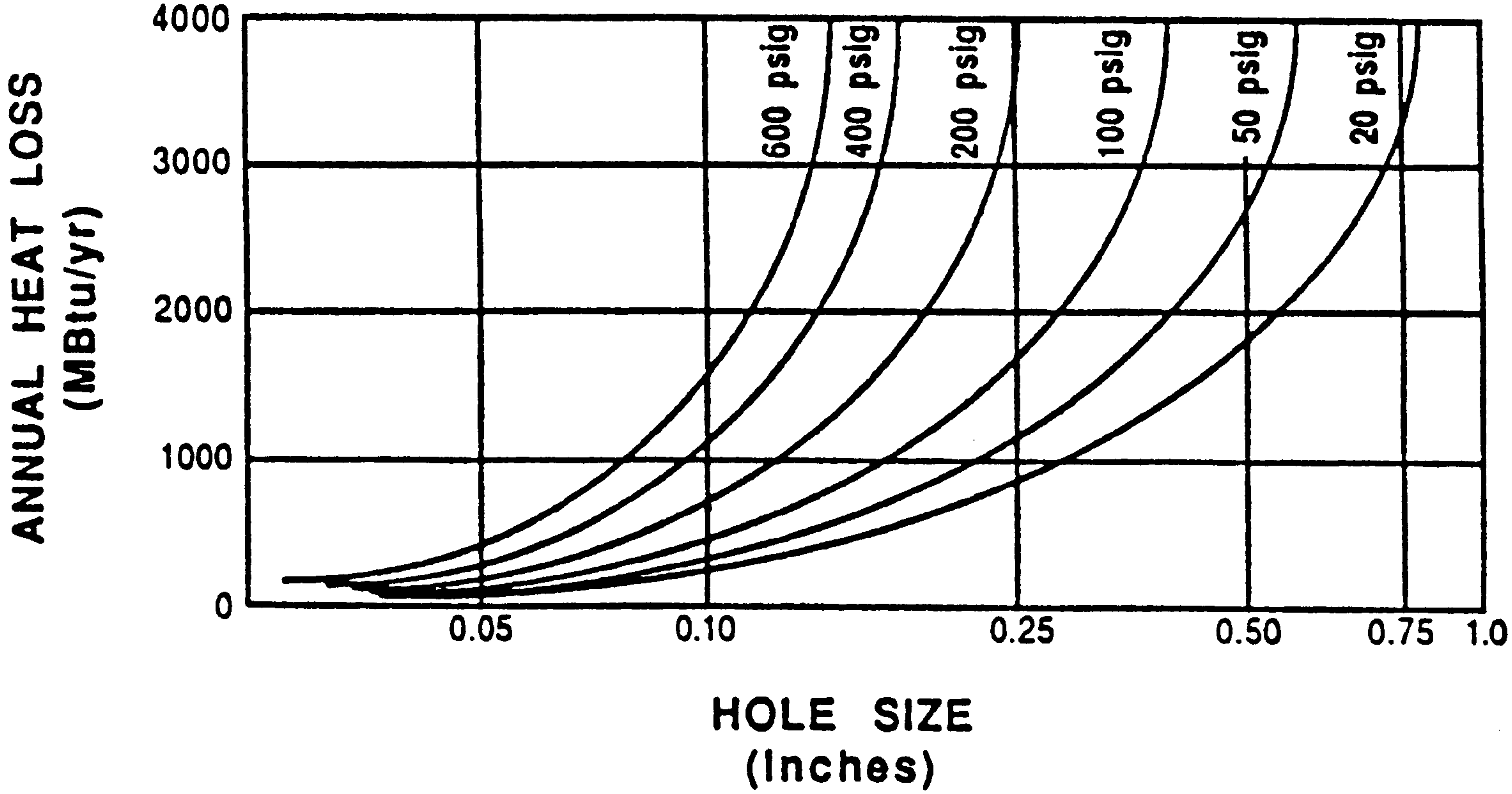
Assume all leaks are from 4" valves *

Labor: 5.33 manhours per valve * 3 valves = 16 manhours
16 * 16.17* = $259

Mat: 4" Multipurpose valve = $635 / valve * 3 = $1905

* From Means 1991 Mechanical Cost Data, pg 200

CALCULATED HEAT LOSS DUE TO STEAM LEAKS



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SUBJECT Repair Air Leaks LCNC #8
AEP NO 290.0379-001
SHEET 1 OF
DESIGNER W. T. Todd
DATE
CHECKER
DATE

LCNC #8
Repair Compressed Air Leaks

Energy & Cost Savings:

From ASHRAE, a 1/32" hole wastes \$252/yr at \$0.04/kwh

For LEAD: $\$252/\text{yr} \times \frac{0.0373\ \$/\text{kwh}}{0.04\ \$/\text{kwh}} = \underline{\$235/\text{yr per leak}}$

$\$235/\text{yr} \div 0.0373\ \$/\text{kwh} \times \frac{3413\ \text{mBtu}}{\text{kwh}} = \underline{22\ \text{mBtu/yr per leak}}$

Project Cost:

Labor: Util. Maint. @ 2 manhours × \$16.17/hr = \$32/leak

Materials: Fittings/Valves @ \$75 ea ⇒ \$75/leak

Assuming there are 50 leaks

Energy Savings:

50 × 22 mBtu/year = 1100 mBtu/year

50 × \$235/yr = \$11,750/year

Project Cost

50 × 2 MH = 100 manhours
Labor = 100 × \$16.17/hr = \$1617
Materials = 50 × \$75 = \$3750

LCNC #9 - Delamping in Bldg 424

Sewing table

There are 36, 3-tube fixtures over the sewing table and 10 more immediately to the north of the table. If half were disconnected the lighting level would be reduced from 100 fc to 50. Individual task lighting currently is available at each of the two sewing machines.

Calculate savings due to removing half of the fixtures

$$46 \text{ fixtures} * \frac{1}{2} * 3 \frac{\text{tubes}}{\text{fixture}} * 40 \frac{\text{watts}}{\text{tube}} * \frac{1 \text{ kw}}{1000 \text{ watts}}$$

$$* \frac{3413 \text{ Btu}}{\text{kw}} \cdot \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} * 5 \frac{\text{da}}{\text{wk}} * 9 \frac{\text{hrs}}{\text{da}} * \frac{52 \text{ wk}}{\text{yr}} =$$

21 MBtu electricity

Demand reduction $= \frac{46 * \frac{1}{2} * 3 * 40}{1000} = 2.76$ kw

Dollar savings for demand reduction =

$$2.76 \text{ kw} * \frac{\$6.59}{\text{kw} \cdot \text{mon}} * 12 \text{ mons} = \$218/\text{yr.}$$

Energy only elect. savings are \$6.53/MBtu

Total annual savings = \$218 + 6.53 * 21 = \$355/yr

RS&H

SUBJECT Over lighting in Bldg 424 AEP NO

SHEET 2 OF

DESIGNER PFA DATE 5/24/91

CHECKER DATE

Cutting Table

Currently the light level is 225 fc. Removing half of the fixtures will reduce the lighting level to about 110 fc.

Calculate energy savings -

$$50 \text{ fixtures} * \frac{1}{2} * \frac{3 \text{ tubes}}{\text{fixture}} * \frac{40 \text{ watts}}{\text{tube}} * \frac{1 \text{ kw}}{1000 \text{ watts}}$$

$$* \frac{3413 \text{ Btu}}{\text{kw}} \cdot \frac{1 \text{ MBtu}}{10^6 \text{ Btu}} * \frac{5 \text{ da}}{\text{wk}} * \frac{9 \text{ hrs}}{\text{da}} * \frac{52 \text{ wk}}{\text{yr}} =$$

$$= \underline{24} \text{ MBtu/yr}$$

$$\text{Demand reduction} = \frac{50 * \frac{1}{2} * 3 * 40}{1000} = \underline{3 \text{ kw}}$$

Demand reduction dollar savings =

$$3.00 \text{kw} * \frac{\$6.59}{\text{kw} \cdot \text{mn}} * 12 \text{ mos} = \$\underline{237}/\text{yr}$$

Electricity energy savings only are at \$6.53/MBtu

$$\text{Total annual savings} = \$237 + \$6.53 * 24 = \$\underline{394}/\text{yr.}$$

RS&H

SUBJECT Overlighting - Bldg 424

DESIGNER P.F.H.

CHECKER

AEP NO

SHEET OF

DATE 5/28/91

DATE

Bldg 424 Totals

Annual elec. savings = 24 + 21 = 45 MBtu

Annual Cost savings = 394 + 355 = $749/yr

Cost of delamping

$\frac{\frac{1}{3}\text{ hr}}{\text{fixture}} * 96 \text{ fixtures} * \frac{\$16.76}{\text{hr}} = \$536$

Labor hrs - 32 hrs (electrician)

O&M Recommendations

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SUBJECT LEAD O+M #1
34-W Fluorescent Lamps
DESIGNER W. Todd
CHECKER

AEP NO 290-0379-001
SHEET 1 OF 1
DATE
DATE

Upon failure, replace 40-watt fluorescent lamps with 34-watt fluorescent lamps.

Energy Savings:

$$(40-34)\frac{\text{watt}}{\text{lamp}} \times 1\text{ lamp} \times \frac{1\text{ kw}}{1000\text{ w}} \times 2340\text{ hr/yr} = \underline{14\text{ kwh/yr}}$$

Energy Cost Savings:

$$14\text{ kwh/yr} \times \$0.0373/\text{kwh} = \underline{\$0.52/\text{yr}}$$

Project Cost:

Material = \$3.05 - \$2.24 = \$0.81/lamp
Source: Means Electrical Cost Data, 1991, pg 201

Add'n Labor = \$0

Payback

pay back = \$0.81 ÷ \$0.52/yr = 1.56 years

Lamp Life ≈ 20,000 hrs ÷ 2340 hr/yr ≈ 8.5 years

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SUBJECT LEAD O&M #2
Energy-Eff. Ballasts
DESIGNER W. Todd
CHECKER

AEP NO 290-0379-001
SHEET 1 OF 1
DATE
DATE

Upon failure, replace standard fluorescent ballast with energy-efficient ballast.

Energy Savings:

$(96-83)\ ^{w}/_{2\text{-lamp Fixt}} \times \frac{1\ kw}{1000\ w} \times 2340\ ^{hr}/_{yr} = \underline{30.4\ ^{Kwh}/_{yr}}$

Energy Cost Savings:

$30.4\ ^{Kwh}/_{yr} \times \$0.0373/_{yr} = \underline{\$1.13/yr}$

Project Cost:

Material: $(\$21.94 - \$15.86) \times 1.076 = \underline{\$6.54}$
Source 5/87 vendor quote - escalated to 1/91

Labor = $0 => No additional Cost

Payback

Payback = $6.54 ÷ $1.13/yr = 5.8 years

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SUBJECT LETTER KENNY A. D
F.O. TANK OVER HEAT.

DESIGNER

CHECKER

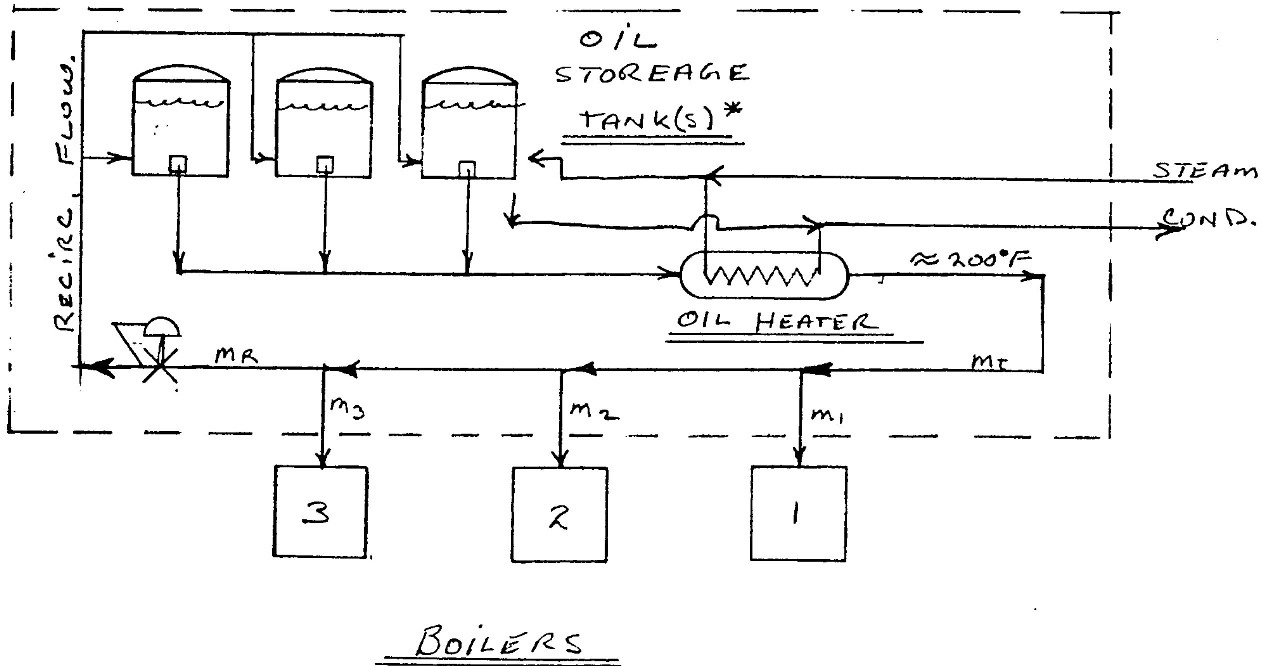
AEP NO 290-0379-001

SHEET ______ OF ______

DATE

DATE

FUEL TANK OVERHEATING – AUXILIARY STEAM USE - #349



*OIL STORAGE TANKS ARE INSULATED AND HEATED.

- Problem – The oil storage tanks are over-heated in the summer time. Temperatures reach 200°F when only 130°F is required.
- Calculate energy savings

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SUBJECT: O&M Savings #6 F.O. Heating

DESIGNER:

CHECKER:

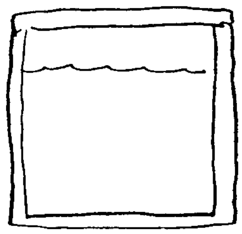
AEP NO:

SHEET ___ OF ___

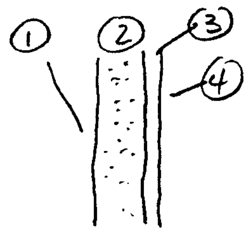
DATE:

DATE:

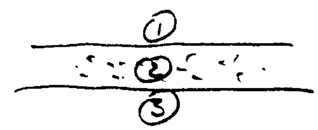
- Tank heat loss



walls



top



Walls

	R
① outside air film	0.25
② 6" foam insul.	30.00
③ steel	—
④ inside film	0.68
$\Sigma R =$	30.93

$$U = \frac{1}{\Sigma R} = 0.032$$

Top

	R
① outside air film	0.25
② 6" foam insul.	30.00
③ inside film	0.25
$\Sigma R =$	30.50

$$U = \frac{1}{\Sigma R} = 0.033$$

Tank size ≈ 15' high & 18' diam.

Heat loss = $Q = U\,A\,\Delta T$ For difference between 190F & 130F

$$Q = \left[(0.032)(\pi \cdot 18 \cdot 15) + \left(\pi \frac{18}{2}\right)(0.033)\right](190 - 130)$$

$$= 1820 \text{ Btu/hr}$$

Fuel savings = 90 da · 24 h/da · 1820 Btu/hr ÷ 1E6 = 4 MBtu

Cost savings = \$15/yr — negligible

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SUBJECT O&M Savings - Frequency Converters - B. 370
DESIGNER P. Hutchins
CHECKER

AEP NO 290-0379-001
SHEET ____ OF ____
DATE 1/10/92
DATE

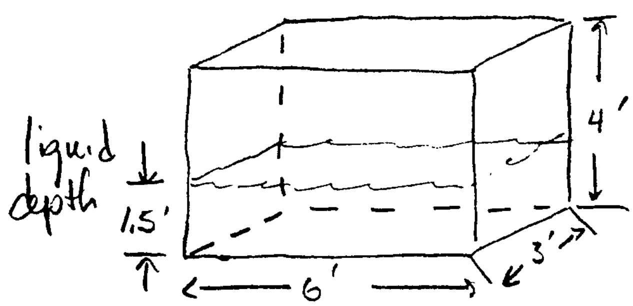
- Energy use of frequency converters on nights and weekends is 33,120 kwh/yr (see ECO #14, Vol. II, p. 14-2)

- Annual energy savings is

$$33{,}120 \frac{kwh}{yr} \times 0.0373 \frac{\$}{kwh} = \$1235/yr$$

- Calculate energy use in vapor degreasers

A typical tank is about 3' x 6' x 4' and holds 200 gallons of 1,1,1 TCE. The liquid is heated to ~ 80°F. The liquid depth is 1.5 ft.



$$200 \text{ gal} * \frac{\text{cf}}{7.5 \text{ gal}} = 26.7 \text{ cf}$$

$$\frac{26.7}{18} \frac{\text{cf}}{\text{sf}} = \underline{1.5 \text{ ft}} \quad \text{liquid depth}$$

- Calculate heat loss

Tank Side

air ‖ liq

	R-Value
Outside air film	1.35
Steel plate	~
ΣR =	1.35

$$u = \frac{1}{\Sigma R} = 0.74$$

Horizontal Surface

h is estimated at 500 Btu/hr/ft²/°F
ref.: Heat Transfer, Holman p. 13.

SUBJECT O&M Savings - V.D. AEP NO

SHEET OF

DESIGNER DATE

CHECKER DATE

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- Heat loss from tank sides

$Q_S = U \cdot A \cdot \Delta T =$

$A = 6 * 1.5 * 2 + 3 * 1.5 * 2 = 27$ sf

$Q_S = (0.74)(27)(80-65) = 300$ Btu/hr

- Heat loss from surface of liquid

$Q_L = h \cdot A \cdot \Delta T$

$= (500)(18)(15)$

$= 135{,}000$ Btu/hr

- Calculate annual fuel use for heating

#6 Fuel Oil $= (Q_S + Q_L) \times 8760 \frac{hrs}{yr} \div$ blr eff

$= (300 + 135{,}000) * 8760 \div 0.80$

$= 148$ MBtu/yr

Cost $= 148 \times \$4.4/\text{MBtu} = \$650/\text{yr}$

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SUBJECT: O&M Savings - V.D.
AEP NO
SHEET ____ OF ____
DESIGNER
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- Calculate cooling energy use:

Cooling energy requirements at peak capacity are ~1 kW (source: Ultracool)

Elec: 1 kW * 0.75 utilization * 8760 hr/yr =

6570 kWh/yr

Costs: 6570 kWh/yr * \$0.0373/kWh = \$250/yr

Total annual energy costs:

#6 F.O + Elec =

\$650 + \$250 = \$900/yr.

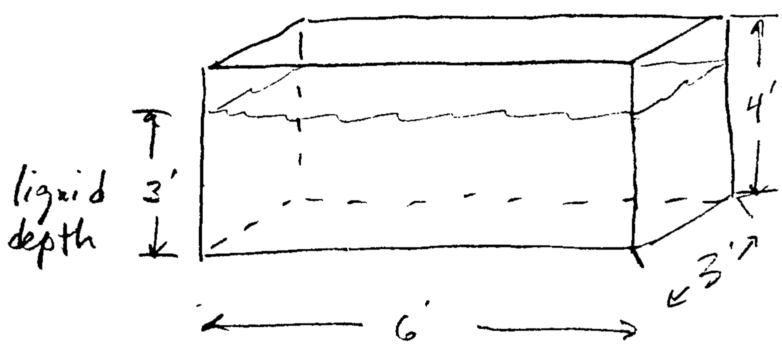
RS&H®

SUBJECT: O&M Savings - V.D.
AEP NO: ____
SHEET ____ OF ____
DESIGNER: ____
DATE: ____
CHECKER: ____
DATE: ____

- Calculate energy use in V.D. with non-toxic solvent

Cooling is not required - Liquid should be heated to about 120°F.

- Calculate heat loss from tank



Tank Sides — air || liq.

Horizontal Surface

	R-value (Tank Sides)	Horizontal Surface
outside air film	1.35	0.17
steel plate	~	–
ΣR	1.35	0.17
$U = \frac{1}{\Sigma R}$ =	0.74	5.9

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SUBJECT: O&M Savings U.D.

AEP NO

SHEET ____ OF ____

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Total surface area (vertical) is:

$A_H = 3 * 3 * 2 + 6 * 3 * 2 = \underline{54 \text{ sf.}}$

Total heat loss from tank sides =

$Q_S = U \cdot A \cdot \Delta T = (0.74)(54)(120-70) \approx$

$\underline{2000 \text{ Btu/hr}}$

Heat loss from surface of liquid ≈

$Q_L = h \cdot A \cdot \Delta T = (5.9)(18)(50) = 5310 \text{ Btu/hr.}$

Calculate annual fuel use for heating:

$\#6 \text{ F.O.} = (Q_S + Q_L) * 8760 \frac{\text{hrs}}{\text{yr}} \div \text{blr eff}$

$(2000 + 5310) * 8760 \frac{\text{hrs}}{\text{yr}} \div 0.80 = 44 \frac{\text{MBtu}}{\text{yr.}}$

$\text{Cost} = 44 \frac{\text{MBtu}}{\text{yr.}} * \frac{\$4.4}{\text{MBtu}} \approx \underline{\$200/\text{yr}}$

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SUBJECT O&M Savings - V.D.

AEP NO
SHEET ____ OF ____
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Calculate energy savings

= $900 − $200 = $700/yr per tank

For all 9 tanks

$700 * 9 = $6300/yr.

Protecting The Future With Environmentally Safe Products

P-T TECHNOLOGIES, INC.

Office: 813-726-4644 • FAX: 813-725-9544 • Toll-Free 800-441-7874

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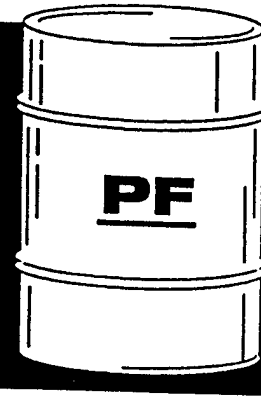
V - 201

PF™



A SAFE 100% VOLATILE INDUSTRIAL DEGREASER SOLVENT

An Outstanding Replacement for 1,1,1 Trichloroethane, Freon, MEK, Acetone, Mineral Spirits, and Other Potentially Harmful Solvents.

PF is a full strength solvent degreaser that combines safety, cleaning effectiveness, and total evaporation (typically less than 25 parts per million non-volatile residue). During PF's formulation, user safety and environmental compatability were prime considerations.

PF may be used as a 1 for 1 replacement for almost all of the hazardous solvents used in industry. For most applications, PF offers full strength solvent effectiveness without any environmental or personnel concerns. It evaporates at a slightly slower rate than water. Complete evaporation may be achieved within 5 minutes by using forced air or wiping dry with a clean cloth.

PF does not contain any halogenated solvents or suspected carcinogens, teratogens or mutagens. PF, as it is shipped from the factory, is not listed or defined as a hazardous waste; therefore, for most applications, PF does not require the use of hazardous chemical waste handling and disposal methods. PF is classified as a combustible liquid (TCC FLASH POINT of over 140° F.) It is combustible under specific conditions not encountered during routine industrial use.

PF may be used for nearly all industrial applications where a 100% volatile solvent is preferred. Whether the application is wipe or spray on, tank or pail dipping, parts washers, ultrasonic, or flow rinsing, PF can be used to remove hydrocarbon, silicone, or polyethylene based greases, oils, tars, or gels.

PF has passed common carrier aircraft metals compatability testing, and is safe to use prior to painting, and on painted surfaces.

PF is available in packages that meet any industrial situation. PF may be purchased in pints or quarts with optional trigger sprays, 1 gallon jugs, 3.5gallon pails, 5 gallon pails, and 55 gallon drums. Larger bulk containers are available upon special request.

PT TECHNOLOGIES, INC.

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RS&H **Telephone Call Confirmation**
(717) 267-9506

Project No. 290-0379-001

Local ____ L.D. ✓ Placed ✓ Rec'd. ____ Date 12/13/91

P. Hutchins Conversed With Craig Musser

Of LEAD Regarding Vapor Degreasers

CM said that there are 9 VD's at LEAD

Bldg 37	3	(1 here is just being activated)
Bldg 370	1	
Bldg 350	2	
Bldg 1N	3	
	9	

	COST
In FY 91 8200 gallons of 1,1,1 TCE was disposed	$13,200
2800 pounds of sludge was disposed	$9000

CM is getting the purchase cost of 1,1,1 TCE

The advantages of a vapor degreaser are:

- Vapor carries dirt away from part, condenses and falls into bottom of tank
- Fast
- Dries very clean

Mike Miles should tell me more about VD supplier - Ultracool (X5304)

Distribution:

I-20k

3/89

RS&H **Telephone Call Confirmation**

Project No. 290-0379-00#

Local ______ L.D. ✓ Placed ✓ Rec'd. ______ Date 1/9/92

P. HUTCHINS Conversed With Bob Canavan

Of PT Technologies Regarding Degreasers

- PT leaves less than 1000 parts/million residue
- Only restrictions are · Jet Engines & Electronic Bds
- Cannot be heated above 120°F due to combustibility problems
- Does not dissolve in water therefore must be treated usually in incinerator (20,000 Btu/hr)
- TCE won't be available in a few year
- Non-hazardous petroleum distallate
  $50/60 per drum cost
- Costs · small quantities $640 / 55 gal drum
  5-10 drums $530
  >10 $500
- Annual use will be 1/2 of TCE
- Army inst. using PF - Sharpe, Redstone, Aberdeen

Distribution:

3/89

RS&H

Telephone Call Confirmation
(717) 267-5304

Project No. 290-0379-00

Local ______ L.D. ✓ Placed ✓ Rec'd. ______ Date 1/8/92

P. HUTCHINS Conversed With Mike Miles

Of LEAD Regarding VAPOR DEGREASERS

MM:

Ultracool Royce Staffer

(215) 367-2019

Al Hartman

$500 maintenance / ~~[illegible]~~ tank / yr.

Each machine has its own ~~unit~~ Refrig. Unit

Carl Henry X9116

Distribution:

V - 20 m

3/89

RS&H

Telephone Call Confirmation

(215) 367-2019

Project No. 290-0379-001

Local ____ L.D. ✓ Placed ✓ Rec'd. ____ Date 1/8/92

P. HUTCHINS Conversed With Al Hartman / Royce Staffer

Of Ultracool Regarding Vapor Degreasers

Cooling Energy Use

tank size	Compressor Motor		Cooling Cap (Btu/hr)	Energy Use (watts)
3' x 6'	1 hp	-40°F	2600	1000
4' x 8'	2 hp	-40°F	5390	1600

TCE Boils at ~ 165°F

Distribution:

3/89

RS&H

SUBJECT: OEM Energy Savings — Pneu vs Elec. Tools
DESIGNER: Hutchins
CHECKER:
AEP NO
SHEET OF
DATE
DATE

Pneumatic vs. Electric Tools

- Calculate energy requirements for pneumatic tool and compare to electric tool

- Calculate pneumatic tool energy requirements

  A 1 hp air motor requires 25 CFM at 70-90 psig, ref: Scales Air Compressor Corp. Carle Place, NY

Energy Use Pneumatic $E_p = \dfrac{\frac{23\ Bhp}{100\ CFM} \times 25\ CFM \times 0.746\ \frac{kW}{Bhp}}{0.9}$

motor eff = 0.9
compressor eff = 23 Bhp / 100 CFM

$E_p = 4.77\ kW$

- Calculate comparable electric tool energy requirements

$E_e = \dfrac{1\ Bhp \times 0.746\ \frac{kW}{Bhp}}{0.9} = 0.83\ kW$

$E_p / E_e = 4.77\ kW / 0.83\ kW = \underline{5.75}$

Therefore, electric tools use about 1/6 the energy of a pneumatic tool.

RS&H

SUBJECT: O&M Savings – Pneum. Tools vs Elec

DESIGNER: Hutchinie

CHECKER:

AEP NO

SHEET ____ OF ____

DATE

DATE

- Calculate dollar savings per tool

Assume 1 hp air motor use 25 CFM
Operates 4 hr/da
Elec. Cost = \$0.0373/kWh

$$Cost_p = 23\ \frac{bhp}{100\ CFM} \times 25\ CFM \times 4\ \frac{hr}{da} \times 50\ \frac{wk}{yr} \times 5\ \frac{da}{wk} \times 0.746\ \frac{kW}{bhp} \div 0.9 \times \frac{\$0.0373}{kWh}$$

$$= \$178\ /tool/yr.$$

$$Cost_e = 1\ bhp \times 0.746\ \frac{kW}{bhp} \times 4\ \frac{hr}{da} \times 50\ \frac{wk}{yr} \times 5\ \frac{da}{wk} \div 0.9 \times \frac{\$0.0373}{kWh} = \$31\ /tool$$

Savings are ≈ \$150 per tool per year.

Solar Energy Evaluations

Solar Energy Applications

Assumptions:

1. Hot water for processes such as dip tanks and pressure washing can be supplied by flat plate type collectors.

2. Solar collector efficiency is 65%.

3. The solar energy will be displacing fuel oil #2 which currently costs $7.43 per MBtu.

4. The maximum direct radiation available to a sun-follower at 40° North lattitude is 3180 Btu per square foot per day. (ASHRAE, 1991 Applications, page 30.10)

5. The percent possible sunshine for Harrisburg, PA is 59%. (Weather Almanac, 4th Ed., pgs 674-689.

Energy Savings: (Per sq. ft. of collector)

$$3180 \frac{Btu}{SF \cdot day} \times 0.65 \times 0.59 \times 260 \frac{days}{Yr} \times \frac{1 \, MBtu}{10^6 \, Btu} = 0.317 \frac{MBtu}{SF \cdot Yr}$$

Energy Cost Savings:

$$0.317 \frac{MBtu}{SF \cdot Yr} \times \$7.43 / MBtu = \$2.36 / SF \cdot Yr$$

REYNOLDS, SMITH AND HILLS
ARCHITECTS • ENGINEERS • PLANNERS
INCORPORATED

SUBJECT Solar
LEAD
DESIGNER W.T. Todd
CHECKER

AEP NO
SHEET 2 OF
DATE
DATE

Project Implementation Cost:

Total Project Cost = \$25,752 See cost estimate sheets for details

\$25,752 ÷ 210 ft² collector surface = \$122.63/sf

Simple Payback:

Payback = Cost ÷ Savings

Payback = \$122.63/sf ÷ \$2.36/sf·yr = 52.0 years

This project is not reommended.

05/29/91

ECO Construction Cost Estimate Calculations

ECO Name: Solar Energy Process Heating Applications

ECO #: N/A

1991 ECO "bare" costs (from cost estimate sheet)	
Material	$8,822
Labor	$5,865
Subtotal bare costs	$14,687
FICA Insurance (20% of Labor)	$1,173
Sales Tax (6.5% of Material)	$573
Subtotal	$16,433
Overhead (15%)	$2,465
Subtotal	$18,898
Profit (10%)	$1,890
Subtotal	$20,788
Bond (1%)	$208
Subtotal	$20,996
Contingency (10%)	$2,100
Subtotal (Construction Cost Input For LCCID *)	$23,096
SIOH (5.5% of Construction Cost)	$1,270
Subtotal	$24,366
Design (6% of Construction Cost)	$1,386
Total Project Cost	$25,752

* The SIOH costs (5.5%) and Design costs (6.0%) are automatically added in the Life Cycle Cost In Design (LCCID) analysis program.

CONSTRUCTION COST ESTIMATE

DATE PREPARED: 5-28-91

SHEET OF

PROJECT: ENERGY ENGINEERING ANALYSIS

LOCATION: Letterkenny Army Depot

ARCHITECT ENGINEER: REYNOLDS, SMITH AND HILLS A.E.P., INC.

BASIS FOR ESTIMATE:
- [X] CODE A (No design completed)
- [ ] CODE B (Preliminary design)
- [ ] CODE C (Final design)
- [ ] OTHER (Specify)

DRAWING NO.:

ESTIMATOR: W. T. Todd

CHECKED BY: P. Hutchins

Solar SUMMARY	QUANTITY NO. UNITS	UNIT MEAS.	LABOR PER UNIT	LABOR TOTAL	MATERIAL PER UNIT	MATERIAL TOTAL	TOTAL COST
Solar, Closed Loop,							
Hot Water System							
Item 2750	1	Ea	6200	6200	9450	9450	15650
less item C	2	Ea	18	(36)	19	(38)	(74)
" " C-1	1	Ea	183	(183)	407	(407)	(590)
" " D-1	1	Ea	65	(65)	105	(105)	(170)
" " E-2	1	Ea	40	(40)	65	(65)	(105)
" " N-1	1	Ea	11	(11)	13	(13)	(24)
Sub Total				$5865		$8822	$14,687

* Source: 1991 Means Mechanical Cost Data, Page 313
System includes 10 Black Chrome Collectors ⇒ 210 ft^2
Controls and Components for space heating were removed from the costs.

ENG FORM 150 1 AUG 59 (ER 1110-345-730)) PREVIOUS EDITION MAY BE USED (TRANSLUCENT)

* U.S. GOVERNMENT PRINTING OFFICE . 1959 O—510146

PROJECT IMPLEMENTATION CALCULATIONS

Filename : LTRERGY.W01

Effects of Project Implementation

YR	ELC	FSD	FSR	NAG	OTH	TOTAL
USE(MBTU)						
FY87	163,813	89,803	213,230	0	3,316	470,162
FY88	165,759	112,242	232,519	0	989	511,509
FY89	170,053	101,576	219,479	0	661	491,769
FY90	169,931	107,320	188,578	0	6,664	472,493
FY91	173,117	139,736	147,914	0	6,110	466,877
FY92	173,117	139,736	147,914	0	6,110	466,877
FY93	173,117	139,736	147,914	0	6,110	466,877
FY94	167,038	131,287	111,650	0	6,110	416,085
FY95	164,398	131,287	111,650	0	6,110	413,445
FY96	164,398	18,032	0	218,369	6,110	406,909
COST($)						
FY87	1,943,000	486,000	997,000	0	24,000	3,450,000
FY88	2,152,000	526,000	854,000	0	12,000	3,544,000
FY89	1,712,000	476,000	806,000	0	7,000	3,001,000
FY90	1,774,000	433,000	668,000	0	20,000	2,895,000
FY91	1,921,954	1,038,238	977,712	0	20,163	3,958,067
FY92	1,904,287	698,680	650,822	0	20,163	3,273,952
FY93	1,904,287	698,680	650,822	0	20,163	3,273,952
FY94	1,837,418	656,435	491,260	0	20,163	3,005,276
FY95	1,808,378	656,435	491,260	0	20,163	2,976,236
FY96	1,808,378	90,160	0	847,272	20,163	2,765,973

ELC	FSD	NAG	OTHR	TOT
164,398	45,751	190,305	6,110	406,564
1,808,378	90,160	847,272	20,163	2,765,973

SAVINGS BY PROJECT

	10.94	4.98	4.41	3.88	
ECO #	ELEC	FSD	FSR		COST
9	124		4895		$22,944
11	1610				$17,613
6			938		$4,137
3	2496		26034		$142,116
1	366				$4,004
15	-20				($219)
10	1503	5674	4397		$64,090
FY93	6079	5674	36264		$254,685
5	2640		6536		$57,705
16					