MEETING OF THE BOARD OF TRUSTEES
OF THE EVERGREEN STATE COLLEGE

1020 East Fifth
Olympia, Washington
May 28, 1969

The meeting of the Board of Trustees was called to order by Chairman Al E. Saunders on May 28, 1969, at 3:15 PM.

All Trustees were present.

Staff Members Present: Charles J. McCann - President
Dean E. Clabaugh - Vice President for Business
Jerry L. Schillinger - Director of Facilities Planning
Dick Nichols - Information Services Officer
Rita Brackenbush - Secretary

Others Present: Robert Patterson - Assistant Attorney General
Warren A. Brown - Division of Engineering & Architecture
R. A. Strecker - Division of Engineering & Architecture
Wallace Bailey - Division of Engineering & Architecture
K. E. Richardson - Durham, Anderson & Freed
Don Grugel - Quinton-Budlong
J. J. Gilgan - Quinton-Budlong
A. Warren Lippitt - Quinton-Budlong
Bob Platt - Quinton-Budlong
William J. Carkeek - Puget Sound Power & Light
Wallace W. Quistorff - Puget Sound Power & Light
Harold R. Van Valin - Puget Sound Power & Light
R. H. Lindgren - G. E. Wieland & Associates
G. E. Wieland - G. E. Wieland & Associates
Vern Strieck - Washington Natural Gas Company
Richard Stampfler - Washington Natural Gas Company
Lanny Wuerch - Washington Natural Gas Company
Floyd Conway - State Representative

News Media: Bob McCleod - KGY radio
Joyce Nelson - Daily Olympian
Dale Nelson - Associated Press

Motion 1. 69-8 Mrs. Tourtellotte moved approval of the minutes of the May 1 meeting as distributed; seconded by Mr. Schmidt and carried.

Determination of a quorum was followed by introduction of guests.

Warren Brown was asked to present the fuel study review and recommendation of the Division of Engineering and Architecture (attached), after which Mr. Hadley introduced a letter received this date from Puget Sound Power & Light Company. Upon questioning, this letter directed to the Trustees was withdrawn (attachment to original minutes).

Trustee Hadley expressed appreciation to Quinton-Budlong, the Division of Engineering and Architecture and Puget Sound Power & Light Company for the work they have done in connection with the fuel study for the college. Mr. Hadley felt that the press should know that the college is planning to spend $370,000 annually with Puget Power while only $59,000 would go to the gas company.

Motion 2. 69-21

Mr. Hadley moved that the energy sources for heating and air conditioning requirements for the academic buildings and other structures of The Evergreen State College be based on the application of a remote central heating and chilling plant using a combination of natural gas-heavy oil stand-by fired steam boilers for primary heating requirements and electrically driven centrifugal chillers for primary cooling requirements, with underground distribution tunnels. Seconded by Mr. Schmidt and carried.

Motion 3. 69-22

Mrs. Tourtellotte moved that the engineering firm of Bouillon, Christofferson and Schairer, Seattle, be appointed designer for the central heating and air conditioning plant, with the specification that Bouillon, Christofferson and Schairer subcontract the architectural design of the central heating and air conditioning plant to the firm of Bennett & Johnson, all subject to satisfactory negotiation of fees. Motion was seconded by Mr. Schmidt and carried.

Warren Brown of the Division of Engineering and Architecture commented on the competency of these firms, prompted by Mr. Hadley's question as to whether or not the firms had been interviewed. President McCann added that the college staff had also interviewed the architectural firm.

Motion 4. 69-23

Mrs. Tourtellotte moved that the architectural firm of Bennett & Johnson, Olympia, be appointed designer for garages, shops and corporation yard, subject to satisfactory negotiation of fees. Seconded by Mr. Schmidt and carried.

Upon President McCann's recommendation, the Chairman of the Board voiced commendation of Mr. Warren Brown and his staff (Mr. Strecker and Mr. Bailey) for the long extra hours put in this last month on the fuel study report.

Motion 5. 69-24

Mrs. Tourtellotte moved that the budget summary presented by the President (attached) for the operations beginning July 1, 1969 for the following two-year period be approved and adopted. Mr. Hadley seconded and the motion carried.

President McCann reported that the academic planning committee will be held in Olympia on Friday and Saturday, May 30 and 31. Representation

has been increased by the addition of two student members. All Trustees were invited to attend and will receive a report of the meetings.

The President announced a conference on residence halls to be held in Olympia on June 20 and 21. Conferees will include residence directors of state colleges and universities, a leading theorist from the University of Florida, the Dean of Students from Grinnell College, and four students.

Dick Nichols was asked to brief the Board on the groundbreaking ceremonies of June 9. Events are to include a ceremony at 10:30 AM with comments by Governor Evans, President McCann, Chairman Al Saunders acting as master of ceremonies, Senator Sandison and Senator Lewis. Radio and television coverage is planned.

Jerry Schillinger, Director of Facilities Planning, announced that schematics of various construction projects might be available for review in July.

Dean Clabaugh, Vice President for Business, explained the ramifications of the higher education personnel act which takes effect July 1.

July 12 was set for the next Board meeting in conjunction with the Joint Boards meeting to be held in Seattle.

The meeting was adjourned at 4:30 PM by Chairman Al Saunders.

AL E. SAUNDERS, Chairman

MRS. NEAL TOURTELLOTTE, Secretary

Attachments (3)

State of Washington
DANIEL J. EVANS GOVERNOR

DEPARTMENT OF GENERAL ADMINISTRATION
WM. E. SCHNEIDER DIRECTOR

DIVISION OF ENGINEERING AND ARCHITECTURE
WARREN A. BROWN SUPERVISOR

219 GENERAL ADMINISTRATION BUILDING OLYMPIA, WASHINGTON 98501

May 26, 1969

Board of Trustees
The Evergreen State College
Olympia, Washington

Re: Energy Sources and the System for Heating and Air Conditioning

Dear Madam and Gentlemen:

As requested by the Board of Trustees of The Evergreen State College, the Division of Engineering and Architecture has reviewed the energy study reports submitted by Quinton Engineers and Puget Sound Power and Light Company. Additional information has been received from both firms since the Board of Trustees' meeting of May 1, 1969, and a meeting with representatives of The Evergreen State College, Quinton Engineers, Puget Sound Power and Light Company, and the Division of Engineering and Architecture was held on May 23, 1969.

Our recommendations are - the application of a remote central heating and chilling plant using combination natural gas - heavy oil fired steam boilers for primary heating requirements and electrical driven centrifugal chillers for primary cooling requirements, with an underground distribution tunnel for the academic complex. We also recommend that in the development of the central plant concept that strong consideration be given to expanding the central utility plant to provide maintenance shops and offices for applicable physical plant staff.

The two detailed reports we have received and reviewed are in some areas in wide disagreement. An attempt to close this gap has been difficult - figures in numerous instances are based on judgement, opinions, theories, assumptions, etc. It is our opinion, based on past experience in related fields, that the estimated costs set forth in the Quinton Engineers' report, are closer to correct for either system (all-electric vs. central plant) than the figures set forth in the electric utility company report. Minor revisions have been made and errors in certain calculations have been corrected; however, the basic conclusions of Quinton Engineers and those of Puget Sound Power and Light Company remain unchanged.

We strongly discourage the acceptance of a system in which the College becomes "locked-in" to the use of one source of energy. A central plant concept, initially using natural gas and oil could, if necessary, in later years be converted to, say, primary electric fuel, raw coal or liquified coal (de-ashed and de-suphurized coal). We believe that within a decade or two liquid purified coal will be available from local coal fields and in future years will become a primary fuel to replace natural gas and oil fields should their source be exhausted.

We must admit that the dollar figures set forth by the electric utility company for an all-electric system appear to be extremely attractive; however, we are not persuaded that such a system is in the best interest of the Owner. In anything economic there is no limit to the number of schemes, theories, assumptions, etc. most of which appear to be logical. Somehow, however, the schemes, etc., undergo mutations when put into practice.

The area of student housing should be mentioned. It has been stated that if it were not for the dormitories the all-electric system would be considerably more attractive in cost. Suffice it to say - what would the consequences be if an all-electric concept is used and student housing (presently planned for 3,160 students) is increased by 25 to 50 per cent.

Attached is Appendix A and B.

Very truly yours,

WARREN A. BROWN, A.I.A.
Supervisor

WAB:he

cc: Dr. Charles J. McCann, President, The Evergreen State College
Mr. Dean E. Clabaugh, Vice President For Business, The Evergreen State College

May , 1969

APPENDIX A
THE EVERGREEN STATE COLLEGE

SUMMARY COMPARISON SYSTEM A AND SYSTEM D

ITEM	ALL ELECTRIC - 5 PLANTS (SYSTEM A)	CENTRAL PLANT (SYSTEM D)
1. Current cost per unit of energy consumed.	466,000 BTU/dollar (Assuming 100% Efficiency)	1,815,000 BTU/dollar (Assuming 64% Efficiency)
2. Future cost of energy.	Hydro-electric power rates are lower than other parts of the country. Rates will increase when power demands must be met with thermal or nuclear plants. As the region develops, conditions will approach those in the mid west and east.	Gas rates on Schedule 85 have decreased since 1961, however, it is questionable that this downward trend will continue. As the firm gas market expands, interruptions are expected to be more frequent and of longer duration.
3. Availability of fuel - considering both resources and distribution facilities.	Future power demands will be provided by thermal or nuclear plants. Intertie with the south will ease but will not relieve peak load problems. Distribution should not be a problem.	More gas must be made available to this area if the interruptible gas supply is to improve. If this is not done, more reliance must be placed on the secondary fuel - heavy oil.
4. Initial costs of installation - using a standard of equipment to provide low maintenance and long life.	High standard of equipment and controls must be provided if the higher unit cost energy is to be efficiently used and maintenance costs kept low. The estimated costs of the Quinton report appears to be more realistic than those of the Puget Sound Power and Light Company report.	Initial costs of central plant and distribution will be higher than the All Electric System but not to the extent noted in the Puget Sound Power and Light Company report.
5. Operation costs	Considering the energy costs, heat reclaim equipment operation and maintenance costs, the operation costs will be higher than that of a central plant.	Considering the lower energy costs and lower maintenance of larger sized equipment, the operation costs will be less than the All Electric System.

APPENDIX B
THE EVERGREEN STATE COLLEGE

Regardless of the final primary fuel selected by the Board of Trustees certain criteria for systems must be established and used for all current and future mechanical systems.

For example - for either fuel selected:

1. Air systems must permit free-cooling with appropriate outdoor temperatures.

2. A decision on the type of terminal units must be made, say, single duct with terminal reheat.

3. Air filters - type and efficiency.

4. Exhaust air, BTU reclaim.

5. Method of heating domestic hot water.

6. Mechanical equipment isolation and attenuation.

7. Supplemental heating for window walls.

8. Water saving devices.

9. Water treatment.

10. Chilled water - building systems should be designed for, say 44^{o} supply water and 60^{o} return water using building loop circulating pump and three-way mixing valve. Two-way modulating valve control or equivalent should be considered on utilization coils for minimum system demand.

For example - for All Electric System:

1. Complete heat reclaim equipment.

2. Standby or supplemental heating equipment.

These items are imperative and cannot be deleted from any building program regardless of the building budget.

PUGET SOUND POWER & LIGHT COMPANY

10608 Northeast 4th Street
Bellevue, Washington 98004
May 28, 1969

Board of Trustees
The Evergreen State College
1020 East Fifth
Olympia, Washington 98501

Attention of Dr. Charles J. McCann, President

Gentlemen:

The sole purpose of this letter is an attempt to be of maximum benefit to the State of Washington in the selection of the finest energy system available today for the Evergreen State College. We have until this late date conscientiously attempted to respect each individual in his assigned responsibility relative to this project in anticipation that the final outcome would best serve the purposes of the College. It now regretfully appears that continuance of this stance will jeopardize our personal and Company's prime responsibility, that of service to the community.

It is quite difficult for us to anticipate a decision at today's Board Meeting in favor of a total electric design after being exposed to the completely unprofessional manipulation of engineering data we have observed since being invited to develop an energy systems proposal by the College Administration through their representative engineers. They have consistently refused to use experience data, only for the apparent reason that it disproves every aspect of their unfounded conclusions.

The following is a brief summary of some of the significant developments we have experienced over the past few months to illustrate the point:

1. We were told by your representatives on several occasions that Washington Natural Gas Co. was going to submit a study. It turned out in reality that your representative engineers were preparing the gas central plant study for the gas company, all the time implying to us that their purpose was to evaluate two studies on an unbiased basis, one from us and one from Washington Natural Gas Co. On one occasion we were told the Gas Company was making final refinements to their proposal and would submit it that afternoon. Another time we were told in effect the Gas Company was going all out to submit a proposal that would be difficult to surpass. We now know these statements were not based on fact. It wasn't until we pressed your representatives for a copy of our competitor's report that it was very reluctantly divulged that there was no study submitted.

2. Your representatives initially supplied the basic rules which were to govern the various studies. We found it necessary to revise our study three times due to changing of the rules. These changes were apparently to steer the final results into your representative's predetermined inclinations, that of tailoring the outcome to favor a central gas system.

3. There were a number of mistakes and gross inconsistencies within your representatives' study which were called to their attention. To the best of our knowledge their study has not been revised in an attempt to correct all these items and thus arrive at the most accurate answer possible for you to evaluate.

4. The proponents of the gas central system have consistently prefaced their conclusions with "it is my feeling the cost will be this or that." They have been unwilling to accept our documented cost figures from actual experience. In every case our documentation has disproved their undocumented estimates. They were careful to interpret the phrase "I feel" as meaning "my best judgment". However, judgment is based on most recent comparable experience — thus back to documented evidence as a valid basis for a study of this nature.

Feelings are only valid in the areas of unknowns, which are intangible. Economic values cannot validly be tied to intangibles. Yet the comparative economic difference between our study and the Quinton study is totally attributable to unknowns. Two representative examples of intangibles are depreciation on a 100-year basis and escalation on no-interest money.

5. It is apparent that the Quinton study anticipates developing a monument to the Mechanical Engineers Profession at the expense of the youth of the State of Washington and the taxpayers. This is exemplified by Mr. Lippitt's comment "This central heating system will be a gold-gilt plant." In order to justify the high cost of the central plant they have chosen to go completely beyond reason and sound engineering judgment in their escalation of costs related to the total electric system.

6. The original parameters also included a remote central gas system with heat reclaim supplying 210° water for heating, which in Quinton Engineer's judgment was the optimum of the central gas plants proposed. Our team convinced Mr. Lippitt in a matter of minutes that this system was not workable.

7. Some of the engineers in the Northwest are quite disturbed regarding a list of Mechanical Engineering Firms that are qualified to design heating systems for individual buildings that are tied onto a gas central plant. This list has been circulating for the past several weeks in spite of the fact the decision of Energy System selection has not yet been made by you. Also, a department head for the State of Washington

has informed us the decision for a central plant was made many weeks ago. This implies that all of our efforts and monies expended in an attempt to assist the College in this decision have been pointless.

We can conclude from the foregoing that it is possible to manipulate figures and numbers, advertently or inadvertently, which will arrive at conclusions which do not represent the best interest of the client. As an example, the proponents of the central heating plant resorted to 100-year amortization periods in violation of the 50-year parameters in an attempt to balance off the excessive costs of the central plant. The central plant recommendation, in essence, is based on a single individual's opinion.

Puget Power's study, on the other hand, was developed through a team effort comprised of four firms associated with the heating and cooling industry. It was necessary for these four companies to independently arrive at a common conclusion prior to a recommendation of a total electric system, which in this instance will save the Evergreen State College $7,000,000. Richard M. Stern, Consulting Engineers, developed the mechanical for the total electric system. Thomas E. Sparling and Associates developed the energy and electrical equipment costs. G. E. Wieland and Associates developed the gas central plant system analysis. (It is interesting to note that Quinton Engineers used the Wieland study as the basis of their central plant analysis.) The purpose of our developing both studies was to determine as quickly as possible whether or not the total electric approach warranted further development. Puget Power's function in the team effort was to evaluate energy costs that would be consistent with acceptable standards of economics as exemplified by our early recommendation against a total electric remote central plant. So, you can recognize that our recommendation for a total electric system is a result of many competent engineers agreeing in a common conclusion.

We are positive that the experience of the exposures to these studies have broadened the concepts of all participants. Had the information we have developed to date been available at the outset of the study, our exposure indicates that all participants would join in a recommendation for a total electric system.

It is beyond our (and others) comprehension that the coffers of the State are so full as to permit gambling with $7,000,000 in excess costs in a heating plant not related to the real purpose of the College.

As an alternative to a decision by you to pick up the $7,000,000 savings, we sincerely suggest and recommend that you seriously consider submitting Puget Power's study and Quinton's study to a competent unbiased private consulting engineering firm equally experienced in the

design of both systems for their evaluation and recommendation. Once this assignment has been made, there must be no voluntary communication with the assigned firm by all interested parties. Opposition to this arrangement by any interested party will immediately identify the validity of their position.

You will find attached all the correspondence that has been submitted from our office subsequent to the May 1 Board of Trustees meeting.

Sincerely yours,

Harold R. Van Valin

H. R. VAN VALIN
Supervisor, Technical Services

Attach.
cc: Mr. Warren A. Brown, Supervisor
Department of Engineering and Architecture
State of Washington
General Administration Building
Olympia, Washington 98501

Remarks by Richard M. Stern, Consulting Engineer
presented to Puget Power by memo pursuant to the
May 23rd meeting held in Mr. Warren Brown's offices
in Olympia.

1. Tradition has favored coal, oil, and gas fired central campus systems with their tremendously expensive distribution systems.

2. The more favorable power rates of the Pacific Northwest lend more impetus and foundation to adoption of total electric for Evergreen College; in comparison to the higher rates of Pennsylvania which in the past three years have led University of Pittsburg in their new Johnstown campus, Massachusetts and its Bentley College, and others to proceed with total electric after extensive feasibility studies.

3. Evergreen will be the first large college in our state not handicapped by previous commitment, and accordingly an ideal example for demonstration of the economic and esthetic advantages of all electric.

4. The studies submitted and which are the bases of our approach, resulted in both engineering firms recognizing the advantages to the college and to the state and its taxpayers in the adoption of the all electric for reliability, and lowest installed as well as owning and operating costs.

5. Indications of the correctness of the all electric is evidenced by the experience of Bouillon, Christofferson and Schairer, nationally prominent consulting engineers responsible for the design of the new IBM Building in Seattle, where inherent simplicity with the heat reclaim use resulted in exceptionally low mechanical costs for such a building. This building is comparable in area to several of the college buildings. The reasonable costs for the Oregon buildings mentioned in the letter from W. Bruce Morrison & Assoc., prominent consulting engineers in Portland, are representative of somewhat smaller buildings in the college.

6. We most adamantly disagree with Quinton Engineers' stand that the proposed electric system will result in any higher cost of building; and the 75¢ per sq.ft. mentioned by them, and the key example of the loaded costs they have employed for comparisons, is the opposite of all experience with such systems.

7. The University of Pittsburg campus analyzed in the October 1968 issue of "Actual Specifying Engineer," the Bloomington, Minnesota campus on which comparative bids were actually taken before acceptance of all electric, and the careful studies by Syska & Hennessy for Bentley College, as well as the letters attached and referred to in the foregoing verify the fallacy of additional cost with heat reclaim.

8. The simplicity provided by means of a non-changeover system with terminal reheat, and variable volume for cooling control usually eliminates double duct, 3 or 4 pipe induction, and the like from competition.

9. Consulting engineers in Oregon have used heat reclaim more extensively than here, and we respectively suggest you may wish to communicate with some of them, as well as the authors of the letters enclosed. In addition to Bruce Morrison, there are Omer Jacobson, Keith Kruchek, and J. Donald Kroeker that can be mentioned as experienced consulting engineers in this field.

PUGET SOUND POWER & LIGHT COMPANY

PUGET POWER BUILDING - GLENCOURT 4-6363
BELLEVUE, WASHINGTON
98004

May 1, 1969

Mr. Warren A. Brown
Supervisor
Department of Engineers & Architects
State of Washington
General Administration Building
Olympia, Washington 98501

Dear Mr. Brown:

I am taking this opportunity to bring to your attention several significant developments that took place in the process of assembling our Energy Systems Study for the Evergreen State College.

Puget Power was led to believe by Quinton Engineers, Ltd. that your Department commissioned them to make an unbiased energy system recommendation to the State based on their evaluations of energy systems presentations prepared by the respective fuel suppliers.

We were told on several occasions by Quinton's Office, in effect, that Washington Natural Gas Company was going "all out" to provide a study that would sell Evergreen State College on a gas system. Within the last few days we have discovered that the Gas Company, in fact, had submitted no study of their own. For this reason, among others, it appears to us that the outcome of the Quinton study was preconceived from the start in favor of a gas central heating system.

Quinton Engineers, Ltd. supplied the parameters for the Energy Systems Study. When it became obvious that these parameters did not develop into Quinton's predetermined inclinations, they proceeded to change the parameters, apparently to tailor the outcome to favor a Central Gas System.

There are many inconsistencies and mistakes in Quinton's "Evergreen State College Report and Recommendations for the Selection of the Energy Source and the Type of Primary System for Heating and Air Conditioning" dated

April 11, 1969. A list of some of these having significant bearing on Quinton's comparative first costs and total annual costs are as follows:

1. System A Comparative First Cost, Page 1 of 4.

   A. Double glazing for dorms in lieu of single should be at $1.50/sq. ft.

   B. Cost of resistance heating for dorms should be taken at $1.00/sq. ft.

   C. Using low temperature heat versus steam should be taken at $0.25/sq. ft.

2. System A Comparative First Cost, Page 2 of 4 - Escalation is contrary to the parameters and higher than taken with System D.

3. System A Comparative First Cost, Page 3 of 4 - Installed Life. Depreciation taken up to 100 years contrary to parameters. Life taken for comparable items not consistent between systems.

4. System "D" Comparative First Cost, Page 1 of 4 - Cost of boilers is too low (Quinton's cost taken from Puget Power's study which used 18,000 pounds/hour instead of 30,000).

5. Refer to Quinton's Energy Calculations in Appendix "B".

   A. Efficiency is applied incorrectly in developing all gas usage for System D.

   B. The credits for dormitory space heating under System D are higher than the credits allowed for System A.

   C. All domestic hot water for the campus during the winter months was taken for 21.7 days per month for the gas system, but for 30 days per month for the electric system.

D. The domestic hot water for the dormitories was omitted for the winter months for the electric system.

E. Reclaim heat for the winter months was erroneously charged against the total electric system twice.

F. The comparative pumping energy costs charged against the gas central system was approximately 22% of what it should be.

The above list is representative, however by no means exhaustive. We are available to explain the above items in complete detail or answer any questions you may have regarding any part of the study upon your request. If the opportunity is given for all questions to be answered, your decision will clearly favor the Total Electric System A.

Sincerely yours,

Harold R. Van Valin

HAROLD R. VAN VALIN
Supervisor, Technical Services

PUGET SOUND POWER & LIGHT COMPANY
10608 Northeast 4th Street
Bellevue, Washington 98004
May 23, 1969

Mr. Warren A. Brown
Supervisor
Department of Engineering
and Architecture
State of Washington
General Administration Building
Olympia, Washington 98501

Attention: Mr. W. L. Bailey

Gentlemen:

This letter is with reference to the Evergreen State College Energy Systems Study. Since today's meeting in your office is the first interchange of information (other than my May 13 letter to you) we have had on the subject since the May 1 Board of Trustee's Meeting, and due to the very few days left until the May 28 Board Meeting, it is absolutely essential we clear all questions immediately.

In anticipation of information you might need from us today, we are supplying to you the attached documented evidence to support costs we used for System A in our report.

We are also attaching revised computations in rough form which incorporate the necessary changes to the Quinton report as related to System A and System D and as outlined in our May 13 letter to you. The format for these computations is taken directly from the Quinton study.

We are hopeful this will answer all your questions. However, should you require further information regarding any detail of our study, let us know immediately so we can supply it to you prior to May 28.

Sincerely yours,

Harold R. Van Valin

H. R. VAN VALIN
Supervisor
Technical Services

Enc.

BELKNAP GLASS COMPANY

WHOLESALERS-JOBBERS

NORTHWEST DISTRIBUTORS ✱ LIBBEY-OWENS-FORD GLASS CO. ✱ OWENS-ILLINOIS

1000 VALLEY STREET
SEATTLE, WASHINGTON 98109
TELEPHONE MA. 4-0700

May 22, 1969

Mr. R. Stern

Dear Mr. Stern:

Regarding your inquiry as to the cost of using insulated glass over single glass.

I call to your attention that if you specify thermopane, standard sizes, in large enough quantities - three thousand and over- units, your insulated glass cost against your single glass cost using crystal will not add to your cost of perimeter glass for a building, more than 50¢ to $1.00 per square foot.

Using insulated glass, I need not add or elaborate on the value in heat-loss saving and general saving over the lifetime usage of the building. The secret of using insulated glass is that of standard sizes and specifying glass sealed DSA or SSA units.

For particular details on maximum sizes, if you are interested, please contact me and I will add further information for your benefit, on specifying.

Very truly yours,

Charles M. Anderson

CMA/bt

MEMORANDUM COPY FROM

BOUILLON, CHRISTOFFERSON & SCHAIRER
Consulting Engineers 505 Washington Building • Seattle, Washington 98101

TO RICHARD M. STERN DATE MAY 16, 1969

REF. IBM Building - Seattle

SUBJECT Heat Pump Cost Differences

This is in regard to your question concerning added costs for providing the heat reclaim heat pump cycle in the IBM Building.

The Owners of the building did not want a "changeover" type perimeter system. Our first thoughts, therefore, were to consider a 3-pipe or 4-pipe induction unit or fan coil system.

We then found that, because the building is exactly square, it had real good geometry for a boot strap system, in that the interior zone areas were about equal to the perimeter zone areas, and we had almost a minimum of outside wall area per square foot of floor area.

While we did not make a formal, bound report of our studies of cost differences, our findings at that time (1963) indicated that we could put in a 2-pipe non-changeover heat reclaim heat pump system for only about $15000 more than for an equivalent non-changeover conventional system. The added costs were mainly for the double bundle condenser units on each of the two machines; some extra control costs; the cost of winterizing the cooling towers, a little extra cost for pumps and piping. There were also, of course, some offsetting costs for 2-pipe versus 3-pipe, the elimination of heating system convertors, and so on.

The building contains about 265,000 square foot gross (202,506 net) not including garage. Our probid estimate of the mechanical (total) was about $1,400,000. When the dust had settled, the low mechanical bid on which contracts were signed was only $1,090,842. Of this, the HVAC portion was about $3.30 per square foot. In view of the amazingly low bids at that time, any added costs for the heat pump feature was simply lost in the shuffle.

By . . . . . .
L. F. Christofferson

LFC:lu

00148

EVERGREEN STATE COLLEGE

CENTRAL HEATING PLANT

Power requirements/year

Space heating pumps/yr. 1,250,000

Domestic H.W. heating pumps/yr 821,407

Total 2,062,407

100 psig steam boiler

Steam 400,000 ppy = 5,062,407 lbs

= 1,640,550,000 Btu

Boiler room: 1,640,000 Btu x (350 Tons) / 5.0 x 3200 x .55 = 1,640,000 kWH

Condensate pump = 10 hp motor x .746 / 2.3 x 3200 x .65 = 1,640,000 kWH/yr.

Misc. pumps = 20,000 kWH/yr.

Total power = 1,800,000 kWH/yr.

1,800,000 - 552,240 = 1,247,760 kWH net diff

1,247,760 kWH x $0.0073 = $9,108.00

00167

The Evergreen State College Energy Systems Study

Quinton Study Cost Analysis Revised

System A First Cost

		Total Installed Cost
Refrig. & Heat Recovery Plants 4200 T @ $104.04 X 1.25 X 1.25	=	682,894
Tunnels & Piping to Connect Acad. Bldgs. 650' X $300 (Access Ways only)	=	195,000
Primary chiller piping & H.W. Piping within Bldgs at $22/ft. each pipe	=	168,000
Central Control - 42 additional points @ $100/pt.	=	4,200
Water Treatment (A/C System only)	=	12,200
Heat Storage Tanks	=	90,000
Double Glazing For Dorms in lieu of single $1.50/sq ft.	=	310,800
Added Mech. Rm. Space + Inside Heat Storage Tank Space	=	82,000
Cost of Resistance Htg for Dorms - 1,072,200 X 1.00	=	1,072,200
Added cost of Mech. Systems in Academic Bldgs. For using Low Temp. Heat Vs Steam & 200° water 1,325,800 X $0.25/sq ft.	=	331,450
Power Wiring and Controls	=	176,000
Heat Reclaim For Dorms (60% Heat Recovery) & Bldgs @ $15,000/Bldg.	=	80,000
Total	=	$3,009,744

Cost For 1 Plant (1/5)(3,009,744) = $601,949

System A Annual Cost

1. Depreciation =	$3,009,744 ÷ 50 yrs =	60,195
2. Risk For Self Insurance (Tunnels and Piping and storage tanks excluded)	1½% x 2,556,744 =	38,351
3. Electric -	Winter	223,968
	Summer	237,136
4. Supplies & Misc.		5,000
5. Maintenance & Replacement		
Building & Tunnels	277,000 @ 1%	2,770
Remaining	2,732,744 @ 2.5%	68,319
6. Operating Labor -	5 men X 1.33 X 12,000	79,800
	Total	$715,539

System D Annual Cost

Depreciation	$5,462,059 ÷ 50 yrs	=	$109,241
Risk For Self Insurance (Tunnels & Piping & Direct Buried Conduit Excluded)	1½% X 3,294,559	=	49,418
Gas Fuel -	Winter (Allow 1 month on oil)	=	40,365
	Summer	=	21,788
Oil Fuel -	1 month winter @ $0.0953/Therm	=	13,988
Electric -	Winter	=	171,336
	Summer	=	207,738
Supplies & Misc.		=	5,000
Maintenance & Replacement			
	Building & Tunnel $1,614,250 X 1%	=	16,143
	Remainder 3,847,809 X 2.5%	=	96,195
Operating Labor	4 Men @ 15,000 X 1.33	=	79,800
	3 Men @ 12,000 X 1.33	=	47,880
	Total		$858,892

Comparisons Between Systems A and D.

I First Costs

System D - $5,462,059

System A - 3,009,744

Difference Favoring System A - $2,452,315

II Total Owning-Operating Costs over 50 years

System D - 42,944,600

System A - 35,776,950

Difference Favoring System A - $7,167,650

The Evergreen State College Energy Systems Study

Quinton Study Cost Analysis Revised

System A First Cost

		Total Installed Cost
1. Refrigeration and Heat Recovery Plants 4032X$143.76X1.25X1.25	=	905,687
2. Tunnels and Piping to Connect Acad. Bldgs. 650'X$300 (Access Ways only)	=	195,000
3. Primary Chiller Piping and H.W. Piping within Bldgs. at $22/ft. each pipe	=	168,000
4. Central Control – 42 additional points @$100/pt.	=	4,200
5. Water Treatment (A/C System only)	=	12,200
6. Heat Storage Tanks	=	90,000
7. Double Glazing for Dorms in lieu of single $1.50/sq.ft.	=	310,800
8. Added Mech. Room Space + Inside Heat Storage Tank Space	=	82,000
9. Cost of Resistance Heating for Dorms - 1,072,200 sq.ft.X$1.00	=	1,072,200
10. Comparative Costs of Mech. Systems in Academic Bldgs. for using Low Temp. Heat vs Steam is a standoff and thus considered to be nil	=	No Addition
11. Power Wiring and Controls	=	176,000
12. Heat Reclaim for Dorms (60% Heat Recovery) 8 Bldgs. @$10,000/Bldg.	=	80,000
TOTAL	=	$3,096,087

Cost for 1 Plant (1/5) (3,427,527) = $685,505

System A Annual Cost

1.	Depreciation = $3,096,087 ÷ 50 years	=	$ 61,922
2.	Risk for Self Insurance 1½%X$2,643,087 (Tunnels and Piping and storage tanks excluded)	=	39,646
3.	Electric - Winter	=	223,968
	Summer	=	237,136
4.	Supplies and Miscellaneous	=	5,000
5.	Maintenance and Replacement		
	Building and Tunnels 277,000 @1%	=	2,770
	Remaining 2,819,087 @2.5%	=	70,452
6.	Operating Labor - 5 men X1.33X12,000	=	79,800
	TOTAL	=	$720,694

System D Annual Cost

1.	Depreciation $5,488,059 ÷ 50 years	=	$109,761
2.	Risk for Self Insurance 1½%X3,298,559 (Tunnels and Piping and Direct Buried Conduit Excluded)	=	49,478
3.	Gas Fuel - Winter (Allow 1 month on oil)	=	40,365
	Summer	=	21,788
4.	Oil Fuel - 1 month winter @$0.0953/Therm	=	13,988
5.	Electric - Winter	=	171,336
	Summer	=	207,738
	Pumping & Misc. Costs charged to System D	=	9,108 *
6.	Supplies and Miscellaneous	=	5,000
7.	Maintenance and Replacement		
	Building and Tunnels $1,614,250X1%	=	16,143
	Remainder 3,873,809X2.5%	=	96,845
8.	Operating Labor - 4 men @ 15,000X1.33	=	79,800
	3 men @ 12,000X1.33	=	47,880
	TOTAL		$869,230

* Represents 1,248,000 KWH overlooked in the Quinton Study.

COST SUMMARY

FIRST COST

GAS	$5,488,059
ELECTRIC	3,096,087

ELECTRIC FIRST COST SAVINGS $2,391,972

OPERATING COSTS

GAS	$37,973,441
ELECTRIC	32,938,613

ELECTRIC OPERATING COST SAVINGS $5,034,828

TOTAL OWNING-OPERATING COST SUMMARY

GAS	$43,461,500
ELECTRIC	$36,034,700
ELECTRIC OWNING-OPERATING SAVINGS	$ 7,426,800

Remarks by Richard M. Stern, Consulting Engineer
presented to Puget Power by memo pursuant to the
May 23rd meeting held in Mr. Warren Brown's offices
in Olympia.

1. Tradition has favored coal, oil, and gas fired central campus systems with their tremendously expensive distribution systems.

2. The more favorable power rates of the Pacific Northwest lend more impetus and foundation to adoption of total electric for Evergreen College; in comparison to the higher rates of Pennsylvania which in the past three years have led University of Pittsburg in their new Johnstown campus, Massachusetts and its Bentley College, and others to proceed with total electric after extensive feasibility studies.

3. Evergreen will be the first large college in our state not handicapped by previous commitment, and accordingly an ideal example for demonstration of the economic and esthetic advantages of all electric.

4. The studies submitted and which are the bases of our approach, resulted in both engineering firms recognizing the advantages to the college and to the state and its taxpayers in the adoption of the all electric for reliability, and lowest installed as well as owning and operating costs.

5. Indications of the correctness of the all electric is evidenced by the experience of Bouillon, Christofferson and Schairer, nationally prominent consulting engineers responsible for the design of the new IBM Building in Seattle, where inherent simplicity with the heat reclaim use resulted in exceptionally low mechanical costs for such a building. This building is comparable in area to several of the college buildings. The reasonable costs for the Oregon buildings mentioned in the letter from W. Bruce Morrison & Assoc., prominent consulting engineers in Portland, are representative of somewhat smaller buildings in the college.

6. We most adamantly disagree with Quinton Engineers' stand that the proposed electric system will result in any higher cost of building; and the 75¢ per sq.ft. mentioned by them, and the key example of the loaded costs they have employed for comparisons, is the opposite of all experience with such systems.

7. The University of Pittsburg campus analyzed in the October 1968 issue of "Actual Specifying Engineer," the Bloomington, Minnesota campus on which comparative bids were actually taken before acceptance of all electric, and the careful studies by Syska & Hennessy for Bentley College, as well as the letters attached and referred to in the foregoing verify the fallacy of additional cost with heat reclaim.

8. The simplicity provided by means of a non-changeover system with terminal reheat, and variable volume for cooling control usually eliminates double duct, 3 or 4 pipe induction, and the like from competition.

9. Consulting engineers in Oregon have used heat reclaim more extensively than here, and we respectively suggest you may wish to communicate with some of them, as well as the authors of the letters enclosed. In addition to Bruce Morrison, there are Omer Jacobson, Keith Kruchek, and J. Donald Kroeker that can be mentioned as experienced consulting engineers in this field.

W. BRUCE MORRISON & ASSOCIATES, INC.
CONSULTING ENGINEERS
234-0548
2007 S. E. ASH STREET
PORTLAND, OREGON 97214

May 20, 1969

Mr. Richard M. Stearns
Consulting Engineer
5121 N.E. 68th Street
Seattle, 15, Washington

Dear Mr. Stearns:

Over recent years this office has designed three mechanical systems incorporating a system of the heat of recovery principle, utilizing heat from the installed building lighting system. These buildings were the Electro Scientific Industries office space and the Teamster Union Office Building, both located in the Portland area. These two structures were modifications of the total heat of light concept, utilizing heat buildup in a plenum area above the space ceiling line. Our last project, the two building complex for the Oregon Educational Association is designed around the Barber-Colman full heat of light concept, for its total 35,000 square feet of office area.

A cost analysis for the design systems, comparing them to more conventional systems, generally of the multi-zone type, was done for each of the projects. We found the system initial costs to be comparable and within the budget range for the project.

Operating costs have proven satisfactory from the owner's standpoint.

If additional information is required, please contact us at any time.

Very truly yours,

W. BRUCE MORRISON & ASSOCIATES, INC.

Sidney Tucker

Sidney E. Tucker
set;hs

MEMORANDUM COPY FROM

BOUILLON, CHRISTOFFERSON & SCHAIRER
Consulting Engineers 505 Washington Building • Seattle, Washington 98101

TO RICHARD M. STERN DATE MAY 16, 1969

REF. IBM Building - Seattle

SUBJECT Heat Pump Cost Differences

This is in regard to your question concerning added costs for providing the heat reclaim heat pump cycle in the IBM Building.

The Owners of the building did not want a "changeover" type perimeter system. Our first thoughts, therefore, were to consider a 3-pipe or 4-pipe induction unit or fan coil system.

We then found that, because the building is exactly square, it had real good geometry for a boot strap system, in that the interior zone areas were about equal to the perimeter zone areas, and we had almost a minimum of outside wall area per square foot of floor area.

While we did not make a formal, bound report of our studies of cost differences, our findings at that time (1963) indicated that we could put in a 2-pipe non-changeover heat reclaim heat pump system for only about $15000 more than for an equivalent non-changeover conventional system. The added costs were mainly for the double bundle condenser units on each of the two machines; some extra control costs; the cost of winterizing the cooling towers, a little extra cost for pumps and piping. There were also, of course, some offsetting costs for 2-pipe versus 3-pipe, the elimination of heating system converters, and so on.

The building contains about 265,000 square feet gross (202,506 net) not including garage. Our prebid estimate of the mechanical (total) was about $1,400,000. When the dust had settled, the low mechanical bid on which contracts were signed was only $1,090,842. Of this, the HVAC portion ran about $3,30 per square foot. In view of the amazingly low bids at that time, any added costs for the heat pump feature was simply lost in the shuffle.

By Chris
L. F. Christofferson

LFC:lu

00129

Comparisons Between Total Electric System A

and Gas Central Plant System D

1. Flexibility with System A is superior to System D.

   a. System A need be designed to match original construction without concern for future expansion, which is an unknown. When and as expansion takes place, it becomes very straight forward to provide mechanical plant within the additional construction to take care of the needs. This precludes the need of guessing in the unknown; spending today's dollars for a plant that may never be used or running the risk of a central plant that is too small or investing in plant capacity that becomes obsolete before it can be used.

   b. Inherent within System A is the capability of designing all new construction increments with latest proven and tried mechanical design innovations which may not be known about during prior building design. This is not practical with System D.

   c. Either central control or de-centralized automatic control arrangements offer no problems of adaptability with System A.

2. Diversity Factor is at its comparitive optimum with System A. It has been shown many times by actual in-operation experience data that as the number of load increments increases for a given total load served, the diversity factor improves. This fact, coupled with 100% outside air and 100% standby resistance heat capabilities, makes System A superior to System D with respect to diversity.

3. Maintainability System A is designed such that each load cluster is served by two units, one chiller and one heat pump. Routine maintenance can readily be scheduled on the units of each plant on a staggered basis such that continuity of heating and cooling service is absolute. Heating and cooling service will be continuous during any emergency by the built-in capability of 100% outside air and 100% standby resistance heating.

   System A sacrifices nothing compared to System D in equipment design, equipment accessability, environment for maintenance or corrosion control of piping systems. It should be noted that System D does include a central plant building which provides space for distracting activities which do not promote good maintenance procedure habits.

4. Reliability is superior with System A compared to System D. As already stated, System A sacrifices nothing compared to System D in

the areas of design, useful life, diversity, or operating environment. In fact, dropping one out of 3 pieces of equipment from operation, with System D under full load conditions, would put a minimum of one-third of the campus out of operation. This could not happen to the total electric System A as System A is two separate heating systems.

With System A design, 100% resistance standby heating is provided and one chiller failure would drop only approximately one-ninth of the cooling load at design conditions which could be handled on a temporary basis with 100% outside air.

5. Efficiency The Quinton study allowed annual efficiencies or performance coefficients (c.o.p.) as follows:

1. Gas Central System D - 63.7%

2. System A - Electric Resistance - 100.0%

Heat Pump c.o.p. - 3.46%

Approximate Annual Average c.o.p. = 2.23

3. Approximate ratio of annual average electric c.o.p./gas efficiency = 2.23/0.637 = 3.50

Thus, the Quinton study indicates 3.50 times as much gas input energy required as electric input energy for the same amount of output usable heating requirements. This is conservatively in favor of the gas system since 63.7% efficiency has not been documented. In fact, all available in-operation data indicates a much lower annual efficiency to be more realistic. Using this comparison, gas at 3.5 cents per therm is equivalent to electricity at 0.657 cents/KWH of energy. The incremental electric heating energy cost is 0.73 cents/KWH. This makes firm electric energy 11% more expensive than interruptible gas energy. This 11% difference is more than all used up in standby energy costs and added pumping costs, both chargeable to System D. Thus, using the Quinton Study, it is developed that gas heating energy is more expensive than electric heating energy when evaluated on the same bases.

6. Vibration and Noise The modern heavy duty rotating equipment proposed for System A is being installed at all elevation levels within today's high-rise buildings. The mounting of this equipment is designed to sufficiently dampen vibrations and noises such that there is no problem of disturbances transmitted to other parts of the buildings. These systems can be observed in operation within today's modern buildings, illustrating that there need be no more concern with vibration and noise in System A that with System D. This may be verified by contacting Mr. Robin Towne, leading Pacific Northwest acoustical engineer.

7. Obsolescence is potentially a far greater problem with System D than with System A. If System D becomes obsolete due to increasing fuel costs, which are directly related to fuel availability, or due to innovations in systems design, the cost to convert energy systems with System D will be prohibitively expensive. Fossil fuel fired heating systems are on their way out as exemplified by the number of total electric systems being installed.

The combination of electric energy availability at leveling cost trends, high reliability, unexcelled flexibility, best efficiency, finest in diversity and excellent maintainability inherent with System A all indicate that the total electric approach will be more modern in 50 years than it will be the day the college opens. System A inherently will take advantage of heating, cooling and control technological advances through all phases plus any unforeseen growth in the future of the college.

READERS' FORUM

Your comments and letters on ideas expressed in these columns are invited.

New Evidence Confirms Boiler Inefficiency

Pittsburgh heating specialist gives more proof of Paul Rickert's claims that flame heating systems operate at about one-half the efficiency for which they are given credit.

Editor: In support of the knowledge that evidence is needed to convince architects and experienced engineers of the true facts regarding efficiencies of various fuels and heating systems, the following is submitted as additional information to be added to the existing data.

The actual story has to do with building heating and compares only the quantities of energies supplied to one building for space heating under practically identical conditions of use and control.

The comparisons of energy supply to a downtown Pittsburgh office building follow.

For a number of years the Allegheny County Steam Heating Company, a subsidiary of Duquesne Light Company, had supplied the House Building at Smithfield Street and Fort Pitt Boulevard with District Steam for space heating. This was one of approximately 450 small and large buildings which purchase District Steam in the Pittsburgh Golden Triangle area.

Due to a number of unfortunate misunderstandings the District Steam service contract was terminated by the customer and a modern 100 H.P. gas-fired steam boiler installed.

It should be understood that the only changes that took place were to lock closed the Steam Company service valve, install the new boiler, connect the fire box chamber with breeching to an existing chimney and connect the new boiler steam outlet into the basement steam main.

In the two consecutive years of heating shown below—one of District Steam and one of Gas-Fired Boiler—no significant changes in occupancy, internal loads, maintained temperature or changes in heating requirements took place. It was a sim-

continued on page 18

Study was made on building in the foreground.

(Continued from page 16
please disregard last 3 lines, page)

ple substitution of gas fired private steam generation for purchased steam supply.

Delivered steam to the building heating system was at two to five P.S.I.G. saturated, in both cases. Thermostat control of the entire 12 floors was on one zone from the same thermostat in both cases.

The efficiencies revealed by this investigation gave some extremely enlightening information to the building management, Union Real Estate Co. of Pennsylvania who operates a large number of properties.

Basic Building Data:

Building size—12 floors, 723,250 cubic feet volume; calculated heat loss, 2982 lbs/hr.; temperature difference, 0-70° F. Conventional 2 pipe steam and gravity return piping system. Single zone thermostat control.

It is of interest and it is enlightening to report that on several occasions during severe weather, a gas meter-building heat loss short test was made. During this time when the boiler was under practically continuous firing, it was converting metered B.T.U.'s of 1030 per C.F. to calculated building loss at a ratio of 1.27:1 or at 79% boiler efficiency.

This verifies the fact that boiler efficiencies do in fact reach approximately 80 per cent during short intervals in periods of extreme cold weather. However, these maximum efficiencies are of little value because it is in fact the overall seasonal efficiencies with which we are concerned. This investigation indicates that despite factory test efficiencies as high as 80 per cent, the overall seasonal efficiencies are actually in the order of 50 per cent.

Several important observations are plain from the comparative data:

1. The seasonal boiler efficiency in converting available B.T.U. into useable steam when compared to previous steam consumption was just under 50% for the heating season.

2. The *rate* of District Steam consumption and therefore the building heat requirement was very constant throughout the season while the *rate* of gas consumption was highest during spring and fall and improved during colder weather. This is due to losses incurred in frequent start-ups and shut-downs, and the time interval between these. This is one of the prime reasons for the change from short period efficiency to heating season efficiency.

3. This comparison shows seasonal boiler efficiency or conversion of B.T.U.'s supplied a building into useable heat in a typical wet heat system. The above operating data confirms a number of previous articles arriving at the same conclusion.

It does not, however, show the actual end use requirements of the offices to be heated which on electric heating would be substantially less because heat would be delivered directly to the spaces by wire. Piping distribution losses in the building would thus be eliminated.

Considerable other data on this operation is available but the consecutive heating seasons shown at the time of changeover represent almost identical conditions in building requirements. The seasonal gas utilization efficiency of 50% substantiates other studies by Mr. Clayton B. Hershey, Consulting Engineer of Harrisburg, Pennsylvania, Mr. Harry Yopp in Atlanta, Georgia, Mr. Paul H. Rickert, M.E., of Lebanon, Pa., and others. *W. L. Stepp, Heating Specialist, Duquesne Light Co., Pittsburgh, Pa.* 00324

ACTUAL COMPARATIVE DATA
2 Consecutive Years

	DISTRICT STEAM			PRIVATE BOILER OPERATION			
	M Lbs. Metered & Billed	Degree Days	Lbs./D.D.	M.C.F. Metered & Billed	Degree Days	M.C.F. /D.D.	Monthly Efficiency
October	60	302	200	239.4	145	1.651	
November	461	590	780	(12/10)	-		.42
December	890	1108	812	1511.6	1035	1.461	
January	859	1088	790	1895.9	1428	1.33	.56
February	755	947	795	1377.9	1030	1.34	.59
March	563	728	773	1488.0	1031	1.44	.50
April	257	338	760	576.4	275	2.10	.34
May	64	95	670	320.5	198	1.62	.40
Season Totals	3917	5196		7409.7	5142		

CALCULATIONS

Average .7538 M Lbs./D.D. 1.441 M.C.F./D.D. Weighted Avg. = .491
B.T.U. supplied per degree day:
District Steam = 728,171 B.T.U. Natural Gas = 1,484,230 B.T.U.
Heating Season Supply and Utility Charge Basis:
3917 M Lbs. × 966* B.T.U./Lb. = 3,783,822 M.B.T.U.
Steam Supplied/Season
7409. M.C.F. × 1030# B.T.U./Cu. Ft. = 7,631,991 M.B.T.U.
Gas Supplied/Season

$$\frac{\text{3,783,822 M.B.T.U. Steam Supplied}}{\text{7,631,991 M.B.T.U. Gas Supplied}} = .496, \text{ Seasonal Conversion Efficiency}$$

* *Saturated Steam @ 2 lbs. gage—966 B.T.U./lb.*
\# *Natural Gas—1030 B.T.U./cu. ft.*

ABOUT HEATING EFFICIENCIES

In the December 1963 and January and February 1964 issues of Electric Heating Journal an article was published that may have more lasting effect on the electric heating industry than any article published thus far this decade. Authored by Paul Rickert, the article, entitled "The True Facts About Flame Heating System Efficiencies," proved that flame heating systems operate in the field at between 40 and 45 per cent efficiency, even though design data in available standard references indicate a much higher efficiency. The Metropolitan Edison Co. engineer's study placed electric heat in a much more favorable, and accurate, position when compared to fossil fuels.
This letter, from Heating Specialist W. L. Stepp, Duquesne Light Co., Pittsburgh, adds more proof to Rickert's claims by comparing the actual performance of a steam heating system under various conditions.

THE EVERGREEN STATE COLLEGE
BUDGET SUMMARY -- 1969-71 Biennium

Employment Summary	1st Year	2nd Year
Man Years	31.3	90.5
Average Man-Year Cost	$ 13,621	$ 13,546
Summary by Program		
Gen. Administration & Gen. Expense	$ 390,780	$ 637,279
Student Services	43,200	196,151
Plant Operation & Maintenance	75,001	177,994
Library	77,925	185,037
Instruction & Departmental Research	139,280	618,934
Annual Total	$726,186	$1,815,395
Biennium Total	$2,541,581	
Summary by Object		
Salaries & Wages	$426,350	$1,225,876
Contract Personal Services	35,000	45,000
Other Contractual Services	101,000	176,911
Travel	47,700	87,000
Supplies & Materials	30,000	73,000
Equipment	43,500	85,000
Retirement & Benefits	42,636	122,608
Annual Total	$726,186	$1,815,395
Biennium Total	$2,541,581	

5-22-69

Employment Summary	1st Year	2nd Year
Man Years	16.5	32.0
Average Man-Year Cost	$ 13,845	$ 12,962
Summary by Object		
Salaries & Wages	$228,436	$414,799
Contract Personal Services	15,000	15,000
Other Contractual Services	60,000	85,000
Travel	33,000	44,000
Supplies and Materials	10,000	15,000
Equipment	21,500	22,000
Retirement & Benefits	22,844	41,480
Annual Total	$390,780	$637,279

Employment Summary	1st Year	2nd Year
Man Years	2.0	12.0
Average Man-Year Cost	$ 13,500	$ 11,830
Summary by Object		
Salaries & Wages	$ 27,000	$141,955
Contract Personal Services		
Other Contractual Services	3,000	12,000
Travel	2,000	6,000
Supplies and Materials	2,000	8,000
Equipment	6,500	14,000
Retirement and Benefits	2,700	14,196
Annual Total	$ 43,200	$196,151

Employment Summary	1st Year	2nd Year
Man-Years	3.0	10.0
Average Man-Year Cost	$13,637	$ 9,962
Summary by Object		
Salaries and Wages	$ 40,910	$ 99,621
Contract Personal Services		
Other Contractual Services	20,500	38,911
Travel	2,000	8,000
Supplies and Materials	5,000	10,000
Equipment	2,500	11,500
Retirement and Benefits	4,091	9,962
Annual Total	$ 75,001	$177,994

Employment Summary	1st Year	2nd Year
Man Years	5.3	10.5
Average Man-Year Cost	$ 11,445	$ 11,908
Summary by Object		
Salaries and Wages	$ 60,659	$125,034
Contract Personal Services		
Other Contractual Services	3,500	16,500
Travel	1,200	4,000
Supplies and Materials	3,000	20,000
Equipment	3,500	7,000
Retirement and Benefits	6,066	12,503
Annual Total	$ 77,925	$185,037

Employment Summary	1st Year	2nd Year
Man Years	4.5	26.0
Average Man-Year Cost	$ 15,410	$ 17,095
Summary by Object		
Salaries and Wages	$ 69,345	$444,467
Contract Personal Services	20,000	30,000
Other Contractual Services	14,000	24,500
Travel	9,500	25,000
Supplies and Materials	10,000	20,000
Equipment	9,500	30,500
Retirement and Benefits	6,935	44,467
Annual Total	$139,280	$618,934