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APPENDIX

STANDARD FORMAT OF THE ENERGY AUDIT FOR ENERGY CONSERVATION IN STATE BUILDING

Mistake number 1

Use Factor F from this table (Factor F is used for calculating the operating, variation, interest, profit, and VAT)

Advance Payment 15.00% Retention 5.00% Interest 10.00%

Budget		Period (month)	Percent (%) Operating	Variation	Interest 2	Profit	Factor	VAT	FACTOR F
less than	50000.00	3	10.00%	0.50%	2.98%	18.50%	1.31975	7.96%	1.42480
	100000.00	3	8.00%	0.50%	2.90%	17.50%	1.28900	7.96%	1.39160
	300000.00	3	6.50%	0.50%	2.83%	16.00%	1.25825	7.96%	1.35841
	500000.00	4	6.50%	0.50%	2.67%	13.00%	1.22667	7.96%	1.32431
	800000.00	5	6.50%	0.50%	2.56%	12.00%	1.21558	7.96%	1.31234
	1000000.00	6	6.50%	0.50%	2.45%	11.00%	1.20450	7.96%	1.30038
	2000000.00	9	6.00%	0.50%	2.18%	10.50%	1.19175	7.96%	1.28661
	5000000.00	12	6.00%	0.50%	1.90%	9.50%	1.17900	7.96%	1.27285
	10000000.00	15	6.00%	0.50%	1.63%	8.50%	1.16625	7.96%	1.25908
	20000000.00	16	5.00%	0.50%	1.52%	8.50%	1.15517	7.96%	1.24712
	40000000.00	17	5.00%	0.50%	1.41%	7.50%	1.14408	7.96%	1.23515
	60000000.00	18	4.30%	0.50%	1.31%	7.50%	1.13608	7.96%	1.22651
	100000000.00	20	4.00%	0.50%	1.12%	7.00%	1.12621	7.96%	1.21585
	150000000.00	22	3.50%	0.50%	0.93%	6.50%	1.11429	7.96%	1.20299
	200000000.00	24	3.50%	0.50%	0.76%	6.50%	1.11263	7.96%	1.20119
	250000000.00	26	3.50%	0.50%	0.60%	6.50%	1.11096	7.96%	1.19939
	300000000.00	30	3.50%	0.50%	0.26%	6.50%	1.10763	7.96%	1.19579
	400000000.00	36	3.50%	0.50%	-0.24%	6.50%	1.10263	7.96%	1.19039
	500000000.00	36	3.40%	0.50%	-0.24%	6.50%	1.10160	7.96%	1.18929
more than	500000000.00	36	3.30%	0.50%	-0.24%	6.50%	1.10058	7.96%	1.18818

If the budget is between the step in the table,use the interpolation to calculate the Factor F

Budget 2000000.00 baht Factor F 1.28661

Budget 1000000.00 baht Factor F 1.30038

Budget ___ baht Factor F 1.30038-[(___-1000000)/(2000000-1000000)]x(1.30038-1.28661)

Mistake number 2

Lifetime of Eqipment for calculating EIRR	Year
1 Reflector Luminary	10
2 Reflector	10
3 Compact Fluorescent (10,000) hours	
7-8 hours/day operating	5*
10-12 hours/day operating	4*
16 hours/day operating	3*
24 hours/day operting	2*
4 Fluorescent (8,000 hours)	
7-8 hours/day operating	4*
10-12 hours/day operating	3*
16 hours/day operating	2*
24 hours/day operting	1*
5 Electronics ballast	20
6 Low watt loss ballast	20
7 Air conditioner	15
8 Electronics thermostat	5
9 Insulation/Ceramic coating	15
10 Film	15

Remark * means the operating hour 250 days/year

Mistake number 4

Lumen per lamp of the high efficiency type using in the Easylux Program (program for calculating the illumination in the room)

18 watt	warm white	1350 lumen
32 watt	warm white	3350 lumen
18 watt	white	1350 lumen
36 watt	white	3350 lumen
18 watt	day light	1300 lumen
36 watt	day light	3250 lumen

Mistake number 3

Capacity selection for the new air conditioner (use only the high-light block only)

Capacity as the specification	U (Btu/hr) Size	Btu	Watt	EER	T (Btu/hr) Size	Btu	Watt	EER	A (Btu/hr) Size	Btu	Watt	EER
12000-13000	12000	12095	1129	10.71	13000	12963	1163	11.14	12500	12857	1171	10.97
16100-16600	18000	17913	1550	11.55					16000	17048	1591	10.71
18000-20000	20000	21417	1886	11.35	19000	18734	1733	10.8	18000	18236	1713	10.64
24000-25000	25000	26061	2359	11.04	25000	23958	2093	11.44	25000	24997	2278	10.97
28000	30000	30034	2975	10.1	30000	28712	2622	10.95	26000	27264	2830	9.63
32000-34000									32000	30944	3220	9.61
36000-38000	36000	34471	3500	9.85	36000	34400	3535	9.73	36000	35119	3562	9.86
42000-44000	42000	43345	4495	9.64					42000	41145	4263	9.65
	48000	45734	4627	9.88	48000	48778	4952	9.85	52000	50400	5250	9.6
									56000	55792	5640	9.89
					60000	56905	5747	9.9	60000	58752	6120	9.6
									62000	60808	6186	9.83

Mistake number 5

The revised report should use the blue cover and the white hoop for report and send to ECCT 2 times

1. First time, send 2 draft reports (after approved by ECCT)
2. Second time, sent 4 final reports (after approved by DEDP)

The sequence in each section

Section 1 The Energy Audit Report

1. Fly page and Cover
2. Letter of acception by building owner
3. Letter of approval by auditor
4. Letter of approval by ECCT
5. Technical data
6. Bill of quantity (BOQ)
7. Abstract
8. Contents
9. Chapter 1-5
10. Appendix A data from auditing
11. Appendix B OTTV and RTTV calculation
12. Appendix C data for controlled building
13. Appendix D data for government or state-owned building

Section 2

(Use the same cover as the energy audit report but use the "Appendix E and F " instead of " Energy Audit Report)

14. Appendix E iso-lux calculation
15. Appendix F Input of OTTV and RTTV

Section 3

Energy Conservation Improvment Drawing (use A3 paper only and combine the before and after improvement (Excluding the A3 Drawing of the lux calculation)

Section 4

Diskett 2 sets (1 set means energy audit report, energy conservation improvement drawing, and appendix)

Mistake number 6

The sequence of the Energy Conservation Improvement Drawing

1. Cover and fly page
2. Index sheet of the existing drawing
3. Existing drawing of all electrical equipment
4. Existing drawing of all air conditioning equipment
5. Index sheet of the after improving drawing
6. After improving drawing of improved electrical equipment
7. After improving drawing of improved air conditioning equipment
8. After improving drawing of film, insulation, and ceramic coating

Mistake number 8

1. The replacement should consider ceiling system, power supply, finishing, and satisfaction of the user
2. If the improving is complex the detail drawing should show in the energy conservation improvement drawing
3. The drawing must show the refrigirant line between FCU - CDU

Mistake number 9

1. The system are existing or after improving air conditioning, existing or after improving electrical system.
2. Show the number of room and type of ceiling in room in the bottom of the energy conservation improvemnet drawing. If room number 101 is the concrete ceiling, it shows 101 (C) in the bottom of drawing

Mistake number 7

The cover of the energy conservation improvment drawing should be written as this form

Energy Conservation Improving Drawing
Energy Conservation in Government or
State-owned Building Project
Building...
Address....
Bureau of Energy Regulation and Conservation
Department of Energy Development and Promotion
Ministry of Science, Technology, and Environment

LOGO

Bureau of Energy Conservation and Regulation

Department of Energy Development and Promotion

Ministry of Science, Technology, and Environment

LOGO

Energy Conservation Center of Thailand

Implenmenting Agency

Mistake number 10.

Sign the name of the engineer with the Engineering Licence number at least 2 sets in the final energy conservation improvement drawings as form of drawing

LOGO & NAME

Company...Auditor....

Mr.....Electrical Engineering Licence number...

Mr.....Mechanical Engineering Licence number...

Project	
Building Name	
Floor	
System	
Date	No. of Revision
Scale	Paper Size
Draftman	
Reviser	
Page	From

Mistake_12

Table of lighting system symbol

BALLAST		SIZE		MOUNTING		CEILING		COVER		REFLECTOR	
SYMBOL	def n	SYMBOL	def n	SYMBOL	def n	SYMBOL	def n	SYMBOL	def n	SYMBOL	def n
M	Magnetic		1x18		Surface	G	Gypsum Board	-	Bare	-	non reflector
D	Low Watt		2x18		Hanging	T	T-Bar	C	Clear	R	reflector
H	High Power		3x18		Recess	F	Floor/Concrete	S	Stripe		
E	Electronics		4x18		new fixture	W	Wood	O	Opal		
	only ballast		1x36			A	Asbestos Cement	L	Louver		
	replacement		2x36					P	Prismatic		
			3x36					B	Fish Bone		
			4x36								
			32 W								
			Incancescent...watt								
		O	compact Fl.								

Mistake 11

Table of air conditioning system symbol

symbol	description
C	Fancoil Unit Ceiling Type
S	Fancoil Unit Standing Type
W	Fancoil Unit wall Type
	Window Type
	Condensing Unit
P	Package Type
B	Bimetal Thermostat
T	Electronics Thermostat
CH	Chiller
	Three Phase
> xxxxx Btu	New Capacity

Mistake number 13

1. Use Ms Word or Ms Excel with font Cordia UPC and appropriate size in A4 Paper for report making.
2. Use Autocad Release 14 for Energy Conservation Improvement Drawing

Energy Audit Report

Energy Conservation in Government or State-owned Building

(Contract number ..../99)

Mistake number 14

The scale in energy conservation improvement drawing is used for the frame of building only excluding the symbol of equipment

Mistake number 15

The contract number between ECCT and DEDP

Building Name

Submitted to

Bureau of Energy Regulation and Conservation

Department of Energy Development and Promotion

Ministry of Science, Technology, and Environment

By

Energy Conservation Center of Thailand

Co-operate with

.....

Acception Letter

Energy Conservation Plan

ECCT is an Implementing Agency of DEDP to revise the potential of the energy conservation in the government or state-owned building. ECCT cooperates with ..... found that the low efficiency in the building as the enclosure.

Hereinafter .....building name.....accepts the list of energy conservation equipment and ready to join in the installation phase

Name .....

Signature (.....)

Title .....

This is the letter confirms that ECCT already check these item before send the report to the Department of Energy Development and Promotion

1. General data

1.1 Using area

1.2 Electrical energy consumption and cost per unit

1.3 Proportional of the energy using in each system

1.4 Average EER (Btu.hr/watt) before and after improving

1.5 Air conditioning system index (Btu.hr/m)^2

1.6 The illumination before and after improving

1.7 Average electrical index (Watt/m)^2

1.8 OTTV, RTTV , and input of OTTV and RTTV.

1.9 Number of equipment in air conditioning system conforms to the energy using and saving

1.10 Number of equipment in lighting system conforms to the energy using and saving

2. Energy conservation plan for air conditioning and lighting system

2.1 Saving, average electrical cost, percent of saving, number of improved equipment

2.2 EIRR

2.3 Cost of investment as median price

2.4 Factor F calculation

3. Bill of quantity

3.1 Check the number and median price of new equipment (material cost , labor cost, finishing cost ,miscelleneous cost

This report was already approved as the item 1, 2, and 3.

Reviser 1 .....

(.....)

Title .....

Reviser 2 .....

(.....)

Title .....

The revission of the energy audit report by Consultant Company

This is the letter confirms that consultant company already check these item before send the report to the Energy Conservation Center of Thailand

1. General data

1.1 Using area

1.2 Electrical energy consumption and cost per unit

1.3 Proportional of the energy using in each system

1.4 Average EER (Btu.hr/watt) before and after improving

1.5 Air conditioning system index (Btu.hr/m^2)

1.6 The illumination before and after improving

1.7 Average electrical index (Watt/m^2)

1.8 OTTV, RTTV , and input of OTTV and RTTV.

1.9 Number of equipment in air conditioning system conforms to the energy using and saving

1.10 Number of equipment in lighting system conforms to the energy using and saving

2. Energy conservation plan for air conditioning and lighting system

2.1 Saving, average electrical cost, percent of saving, number of improved equipment

2.2 EIRR

2.3 Cost of investment as median price

2.4 Factor F calculation

3. Bill of quantity

3.1 Check the number and median price of new equipment (material cost , labor cost, finishing cost ,miscelleneous cost

This report was already approved as the item 1, 2, and 3.

Reviser 1

(.....)

Title .....

Reviser 2

(.....)

Title .....

Technical Data

Energy using area	.....	m^2
Air conditioning area	.....	m^2
Energy consumption	.....	kWh/year
Average electrical energy cost	.....	baht per unit

This page is the conclussion about the enegy index of each system in the building both before and after improvement

proportion of the energy using in each system

Air conditioning system	.....	%
Lighting system	.....	%
Others	.....	%

	Before improving	after improving
Air conditioning system		
Average EER (Btuh/Watt)	.....	*
Average air conditioning system index (Btuh/m)^2	.....	**
Lighting system		
Illumination (lux)	.....	***
Average lighting system index (Watt/m)^2	.....	.....
Envelope system		
OTTV (Watt/m)^2		
1. Building...	.....	.....
2. Building...	.....	.....
RTTV (Watt/m)^2		
1. Building...	.....	.....
2. Building...	.....	

Mistake number 16

Calculate the average lighting system index as this formula

Existing (w/m^2) - kwh/year saving (w/m^2)

Remark 1. Air conditioner

1.1 Used air conditioner more than 8 years ..... sets

1.2 Used air conditioner >7-8 years ..... sets

1.3 .....

2. Measures of OTTV improvement cannot be implemented because ...

3. Measures of RTTV improvement cannot be implemented because ...

Mistake number 17

The OTTV and RTTV improvement measures cannot be implement because the following reasons

1. EIRR less than 9%
2. The OTTV and RTTV after improving is over the standard
3. The improper of the site

* The EER of new air conditioner lower than 25000 Btu/h is more than 10.6 Btu/h/Watt

The EER of new air conditioner up to 25000 Btu/h is more than 9.6 Btu/h/Watt

** The average capacity of air conditioner after improving is not less than the existing capacity

***The average illuminant after improving is higher than the existing illuminant from the assesment and the illuminant should not less than 350 lux in working plane of room.

Bill of Quantity

Energy Conservation in Government or State-owned Building

Address……..

Mistake number 18

1. The right mark means that blank should be filled in.
2. The wrong mark means that blank should not be filled in.
3. The finishing cost includes the miscelleneous cost

No.	Material	Quantity	Unit	Material Cost		Labor Cost		Removing Cost	Finishing Cost	Total
				Unit Price	Total	Unit Price	Total			
A	Lighting System									
1	Compact Fluorescent …….w				✓		✓	✗	-	
	total 1									
2	Reflector Luminary									
	Surface, Louver (Wide … cm)									
	type 1x36 w		set		✓		✓	✗	-	
	High Efficiency (Triphosphor Coating type) Fluorescent ….w		lamp							
	Finishing Cost	1	set						✓	
	total 2									
3	Electronics Ballast									
	18 W		each							
	36 W		each		✓		✓	✗	✗	
	total 3									
	total A									

Bill of Quantity

Energy Conservation in Government or State-owned Building

Address

No.	Material	Quantity	Unit	Material Cost		Labor Cost		Removing	Finishing	Total
				Unit Price	Total	Unit Price	Total	Cost	Cost	
B	Air Conditioning System									
1	High EER air conditionet with electronics thermostat									
	more than 12000 Btu/h		set							
	more than 60000* Btu/h		set		✓		✓	✓	✓	✓
			set							
			set							
	~~Finishing Cost~~	~~1~~	~~set~~							
	Total 1									
2	Ceramic Coating		sq.m							
	Total B									
	Total A and B									
	Factor F									
	Total in Word....									

Mistake number 19
The finishing cost of the air conditioner is 500 baht per each set

Mistake number 21
put the * mark after the capacity of the 3 phase air conditioner

Mistake number 22
show the list of the air conditioner in each capacity

Mistake number 20
Do not forget to fill in these blocks

*Factor F Calculation

Budget.....A..... Factor F.....M.....

Budget.....B..... Factor F.....N.....

Budget.....C..... Factor F.....N - [(C-B)/(A-B)] X (N-M).....

Energy Consumption ..... kWh/year

Proportion of the Energy Using of Each System

Air Conditioning System ..... %

Lighting System ..... %

Others ..... %

No.	Item	Before Improving	After Improving	Diference
1	60% Operating *Mistake number 23*			
1.1	Saving (kWh/year)	Before improving figure should be more than after improving		
1.2	Saving (Baht/year)			
1.3	Investment (baht)	Before improving figure should be less than after improving		-
1.4	Payback Period(year)			-
1.5	EIRR%	Before improving figure should be more than after improving		
1.6	Number of Luminary (set)	Before improving figure should be less than after improving		
1.7	Electronics Ballast (set)			
1.8	Number of Lamp (Lamp)			
1.9	Lighting System Index (watt/m)^2	Before improving figure should be more than after improving		
1.10	Illuminant (lux)	Before improving figure should be less than after improving		
2	100% Operating *Mistake number 24*			
2.1	Saving (kWh/year)			
2.2	Saving (baht/year)			
2.3	Payback Period(year)			-
2.4	EIRR%			-

Abstract

This report is apart of the Energy Conservation in Government or State-owned Building project which ECCT is the implement agency of the Department of the Department of Energy Development and Promotion to study the potential of the energy conservation. The Energy Conservation Center of Thailand co-operates with .....to audit and analyze the characteristic of the energy consumption in building.

In this report the measures of energy efficiency are analyzed and concluded hereinafter

1. Electrical and Thermal System

The energy conservation plan will save the energy .....baht/year by investing .....baht

The measures are

1. The high EER air conditioner with electronics thermostat replacement
2. Film coating
3. Ceramic coating
4. Lighting system
   - 4.1 Compact fluorescent replacement
   - 4.2 Electronics ballast replacement
   - 4.3 Reflector luminary replacement

The improving of the lighting system ,which the illuminantion should not less than the existing,invests ..... baht and saves .....baht. The EIRR is .....%. If the quality of life is improved as the commitment number 3/1998 (dated on 14 October 1998) of the committee of the Energy Conservation Fund, the investment increases .....baht. Thus the saving reduces to .....baht and the EIRR is.....% %

2. Envelope

Building.....

OTTV before improving	.....	watt/m^2
RTTV after improving	.....	watt/m^2
OTTV before improving	.....	watt/m^2
RTTV after improving	.....	watt/m^2

Mistake number 25
The same as table 5

Mistake number 26
The same as table 5 and should cost between 5 and 10 million baht

Mistake number 27
Measures of only electronics thermostat replacement is quit.

Mistake number 28
- The measures list here likes table 5
- The measures should cover both air conditioning and lighting system

Mistake number 29
The same as table 5.3

Mistake number 30and 31 The same as table 5.3 item 4

Mistake number 32
The same as table 5.3 item 6

Mistake number 33
- The OTTV after improving has to show here if the OTTV before improving is more than 55 watt/m^2
- If the measures can not be implemented, the reason should be explained

Mistake number 34
The same as appendix B

Mistake number 35
- The OTTV after improving has to show here if the OTTV before improving is more than 55 watt/m^2
- If the measure can not be implemented, the reason should be explained

Contents

Page

1. General data and characteristic of the building 1-1

2. Characteristic of the energy using 2-1

2.1 Electrical using in organization

2.2 Electrical using in building

2.3 Water using 2-n

3. Suggestion for energy conservation 3-1

3.1 Suggestion for electrical saving 3-1

3.1.1 Air conditioner maintenance 3-1

3.1.2 High EER air conditioiner with electronics thermostat replacement

3.1.3 Film coating

3.1.4 Insulation tiling

3.1.5 Ceramic coating

3.2 Suggestion for lighting saving

3.2.1 Compact fluorescent replacement

3.2.2 Reflector Luminary Replacement

3.2.3 Electronics Ballast Replacement

3.3 Suggestion for thermal saving

3.3.1 Boiler tuning

3.3.2 Boiler insulating

3.3.3 Condensate recovery 3-n

4. Potential of the Energy Conservation 4-1

5. Energy Conservation Plan 5-1

Mistake number 36

The measures of the air conditioner includes electronics thermostat

Mistake number 37

the list of the measures here likes the measures in the potential of the energy conservation

Mistake number 38

The thermal measures can be suggested if the overall budget of building is less than 3 million baht

Appendix

Page

Appendix A a-1

A.1 Electrical power distribution

A.2 Air conditioning system

A.3 Lighting system

Appendix B b-1

B.1 OTTV before improving

B.2 RTTV before improving

B.3 OTTV after improving

B.4 RTTV after improving b-n

Appendix C c-1

The data for controlled building

Appendix D d-1

The data for government or state-owned building

Appendix E e-1

Iso - lux calculation

Appendix F f-1

Input of OTTV and RTTV

Mistake number 39

Put the improvment drawing before improving in this section

Mistake number40

Put the picture of the luminary before improving and the iso-lux drawing in this section

Mistake number 41

Use software Q-Save only for

Mistake number 42

Check the completion of the data

Mistake number 43

The input after improving requires only th diferent data

1. General Data and Characteristic of the Building

1.1 General Data

Building name : .....

Address : .....

Telephone number : .....

Mistake number 44

Long distance code for provincial province

Characteristic : .....

Government time : From.....to.....total.....hr/day or.....hr/day

Working time From.....to.....total.....hr/day or.....hr/day

Opening time : .....

Employee : ..... person

Number of bed : ..... beds

Mistake number 45

Number of bed is used for hospital only

Using area : ..... m^2

Air conditioning area : ..... m^2

Name of cooperator : .....

Mistake number 46

Write the right title of the co-operator

Title or position : .....

Telephone number : .....

Facsimile Number : .....

1.2 Characteristic of the Building

Building ..... is the squar/rectangular building which has .....floors s .....years. The characteristic are

Wall : .....

Window : .....

Door : .....

Roof : .....

Floor : .....

Overhang : .....

Mistake number 47

The charactenstic should be completed and accorded to the data in the OTTV calculation

1.2.1 Characteristic of the Opaque Wall

Building

Mistake number 48
Write the name of building although there is only one

Characteristic	Type of material / Thickness (mm.)						
	layer 1	thickness	layer 2	thickness	layer 3	thickness	Color of outside
1.							
n.							

Mistake number 50
The example of the opaque wall characteristic are brick wall cement, brick eall with insulation, marble, concrete wall

Mistake number 49
The example of the color are light, medium, and dark

1.2.2 Characteristic of Transparent Wall

Building.....

Characteristic	Number of layer	Type of transparent wall/ Thickness (mm.)			Type of Overhang
		Thickness	Type	SC*	
1.					
n.					

Mistake number 51
The examples characteristic of transparent wall are normal, 2 layer, film coated glass, and bronze glass

Mistake number 52
The example characteristic of overhang are straight, dome, long overhang, and short overhang

* SC : Shading coefficient

1.2.3 Characteristic of Roof

Building....

Characteristic	Type of material / Thickness (mm.)						
	Layer 1	Thickness	Layer 2	Thickness	Layer 3	Thickness	Outside color
1.							
n. ...							

Mistake number 53

The example of the characteristic of roof are concrete, concrete with insulation, and others

1.2.4 Characteristic of the Building Envelope

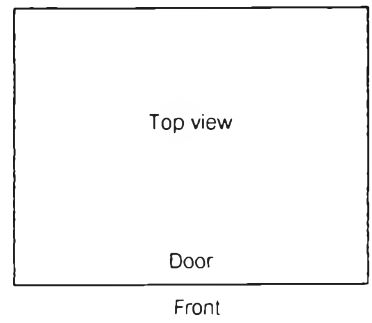
Building.....

Side	Direction	Opaque wall area (m2)		Transparent wall area (m2)		Proportion of'transparent to overall wall
		Air conditioning	total	Air conditioning	total	
Front Back Right Left						*Mistake number 54* Fix two digit of the decimal part

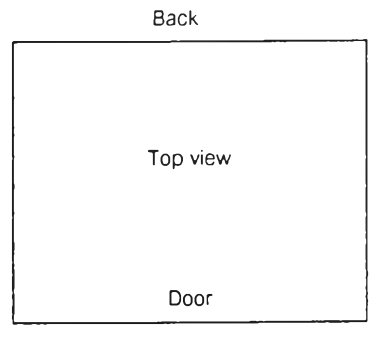
1.3 Building Picture

Mistake number 55

Four side of picture per each building

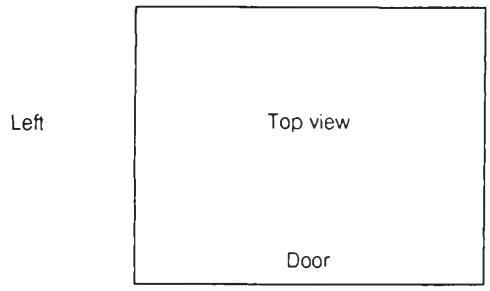


Front View

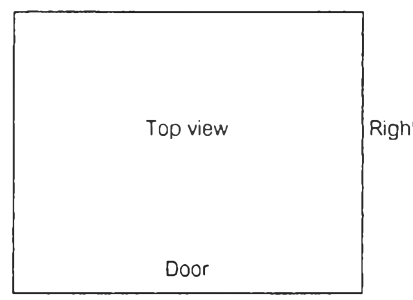


Back View

Building Picture



Left View



Right View

1.4 Location

The map in the organization

The map of building with north grid

2. Characteristic of the Energy Using

2.1 Energy Using in Organization

Energy Consumption		kWh/year
Peak Demand		kW
Load Factor		percent
Transformer Capacity		kVA
Voltage		Volt
Electrical Energy Index		kWh/m^2/year
Power Factor		
Electrical Energy Cost		baht/kWh

Mistake number 56
If there is no load factor or peak demand, write the - mark. Do not omit it.

Mistake number 57
PEA. 11,22,33 kV /230,400 kV
MEA. 12,24,66 kV/230,400 kV

Mistake number 58
The data here is the same as to the table 2.2.1

2.2 Energy Using in Building

Building..... used electrical energy ..... % of the organization or ..... kWh/year. The proportion of each system are

Air conditioning system	%
Lighting system	%
Others	%

Mistake number 59
The normal ratio are 60:20:20, 70 20 10, and 80 10:10. If there is abnormal, should show the reason

2.2.1 Energy Consumption Table

Month	Peak Demand (kWh)	Consumption (kWh)	Cost (baht)	Load Factor %	Cost per unit (baht/kWh)
	A	B		B X 100 / (A X hour in month)	
Total	-			-	
mounthly average	-			-	
yearly average	-	C		c.(kW maximumX8760)X100	

2.2.2 Graph of the Energy Consumption

2.2.3 Energy Using in Air Conditioning System

Mistake number 60
Write the building name

Mistake number 61
Separate each table for each building

Building.....

No.	Capacity (Btu.h)	Type	Number in each age						Total sets	Total (Btu)
			< 3	3 - 5	>5-6	>6-7	>7 - 8	> 8		
Total										

Air conditioning area m^2

Top floor air conditioning area m^2

Air conditioning index Btuh/m2

Energy consumption of air conditioning system kWh/year

Average EER of building Btuh/watt

Mistake number 62
Select the data from the table in A.2.2 of each building to calculate

Mistake number 63
Conclude from all building

Organization

No.	Capacity (Btu.h)	Type	Number in each age						Total sets	Total (Btu)
			< 3	3 - 5	>5-6	>6-7	>7 - 8	> 8		
Total										

Conclude

Total air conditioning area m^2

Top floor air conditioning area m^2

Total air conditioning index Btuh/m2

Total energy consumption of air conditioning system kWh/year

Total average EER of building Btuh/watt

Mistake number 64
Write the conclude table if there are more than one building

Mistake number 65
The same as table A.3.3

Mistake number 66
If the age of the air conditioner is more than the age of the building, please show the reason

2.2.4 Energy Using in Lighting System

The energy using in lighting system are concluded in the table below

No.	Type of lamp	Type of luminary	Type of cover	Lamp per luminary (Lamp/Luminary)	Number of Luminary	watt/luminary	Ballast loss (watt/Luminary)	Total watt (watt)
1								
2								
3								
4								
Total								

Mistake number 68

- The loss of ballast 18,20,32,36,40 w. is 10 w.
- The loss of the low watt loss ballast is 5.5 w.

Building.....

Using area m^2

Average lighting system index watt/m2

Energy consumption kWh/year

Conclusion

Mistake number 67

Conclude the data from every building and like A.4

Using area m^2

Average lighting system index watt/m2

Energy consumption kWh/year

2.3 Water Using

Volume	:	.....	m^3/year
Cost	:	.....	baht/m3
Water using index	:	.....	m3/man-year

Remark .....

Mistake number 69

m3/bed-year in the case of the hospital building

Mistake number 70

Show the reason of the case of no water using

3. Suggestion for Energy Conservation

3.1 Suggestion for Electrical Saving

3.1.1 Air Conditioner Maintenance

Data from Auditing

There are .....sets of existing air conditioner which have not been replaced. The capacity is .....ton and consume.....kWh/year. The non maintenance condition makes the energy consumption of the air conditioner more than the maintenance condition as the data in table below.

	The non maintenance air conditioner	The maintenance air conditioner	The difference data
EVAP TEMP	7.2 °C	7.2 °C	-
COND TEMP	54.4 °C	51 °C	3.4
AMBIENT	35 °C	35 °C	-
POWER (W.)	3700	3590	110
Btu	27900	29340	1440
Btu/Watt	7.52	8.17	0.63

(The data in table are quoted from technical data of Compressor energy efficiency)

$$\text{Saving} = \frac{0.63 \times 100}{8.17}$$

$$= 7.7 \ \%$$

Suggestion

The air conditioner always maintains for the efficiency of the heat transfer at condensing coil by the following procedure.

1. Monthly measure

- Use the compressed air to clean the condensing coil, evaporater coil, and filter.
- Check the controling system such as the temperature control system
- Record the energy consumption, current, voltage of compressor, motor, and fan

2. Every 6 month

- Do the big cleaning all coil by water cleaning.

After maintaint the air conditioner

Saving	=	.....	x	0.077	kWh/year
	=	....			
Saving in term of baht	=	....	x		baht/year
	=	.....			baht/year

Investment

The maintenance measure invests 700 baht/sets/year and 2000 baht for the air conditioner which the capacity is more than 60000 Btu.

Payback period	.....	year
Economic Investment Rate of Return	.....	%

3.1.2 The measure of high EER air conditioner with electronics thermostat replacement

Data from Auditing

There are ....sets of low EER air conditioner. The total capacity is.....Btu

Mistake number 72
Select the data from table 5.1 for saving calculation

Example of calculation

Select one of the air conditioner which the capacity is more than 25000 Btu for calculation

* EER (Energy Efficiency Ratio) of the example air conditioner = ... Btu/hr/Watt

= 12000/(..... x1000) kW/ton

= ..... kW/ton

Mistake number 71
The cost of removing the existing air conditioner with the capacity more than 60000 Btu is calculated as the appropnate of the condition of the site work

* EER (Energy Efficiency Ratio) of the high EER air conditioner = 9.6 Btu/hr/Watt

= 12000/(9.6 x1000) kW/ton

= 1.25 kW/ton

(kW/ton as stated is the energy consumption for the real cooling capacity 1 ton, not as the name plate)

Mistake number 73
Operating Factor is the same figure as the operating in appendix A-4

Saving = [(...-1.25)x...tonx hr/day x day/year x factor kW/year

= .... kW/year

Saving in term of baht = ... x.... baht/year

= .... baht/year

Mistake number 74
This formular for saving is used for only the capacity of the difference of the new and existing air conditioner is less than 6000 Btu. If the difference is more than 6000 Btu. use the following formular.
(existing kW/ton X existing ton - new kW/ton X new ton) X hr/day X day/year X factor

The air conditioner is replaced dual with the electronics thermostat

Saving = existing Btu /12000 X kW/ton x hr/day x day/year X factor X 0.13

= .... kWh/year

Saving in term of baht = ... x .... baht/year

= .... baht/year

Total energy saving = ... Kwh/year

Total saving in term of baht = ... baht/year

Mistake number 75
Use the same kW/ton of the same example air conditioner

Mistake number 76
The Btu for calculation bases on the existing for easy in calculation although the 13 % of saving is from the following concept
The existing air conditioner with exissting electronicmostat - The new air conditioner with new electronics thermostat

Example

Select one of the air conditioner which the capacity is less than 25000 Btu for calculation

* EER (Energy Efficiency Ratio) of the example air conditioner = ... Btu/hr/watt

= 12000/(..... x1000) kW/ton

= .... kW/ton

* EER (Energy Efficiency Ratio) of the high EER air conditioner = 10.6 Btu/hr/watt

= 12000/(10.6 x1000) kW/ton

= 1.13 kW/ton

(kW/ton as stated is the energy consumption for the real cooling capacity 1 ton, not as the Name Plate)

Saving = [(...-1.13)x...tonx hr/day xday/year x factor kW/year

= .... kW/year

Saving in term of baht = ... x.... baht/year

= .... baht/year

The air conditioner is replaced dual with the electronics thermostat

Saving = existing Btu /12000 X kW/ton x hr/day x day/year X factorX0.13

= .... kWh/year

Saving in term of baht = ... x ....

= .... baht/year

Total energy saving = ... kWh/year

Total saving in term of baht = ... baht/year

Suggestion

From auditing the low EER air condition should be replaced as the list of new air conditioner

There are .....sets as the location in the energy conservation improvement drawing. The saving after improving is.....kwh/year and ....baht/year

Mistake number 77

The same data as the list of new air conditioner

Mistake number 79

The investment data is the same as the investment in the table 5

Investment

The new high EER air conditioner are.....sets. The material cost is .....baht

The material cost is .....baht, the removing cost is .....baht, the cost of installation is....baht, and the finishing cost is .....baht

Payback period .... year

Economic Investment Rate of Return .... %

3.1.3 The measures of film coating

Data from Auditing

Building.....has the transparent wall .....m^2 and the opaque wall .....m^2.

The OTTV is.....watt/m^2 while the standatd figure is 55 watt/m^2. The overall existing transparent wall of the building is the .....mm glass.

Mistake number 79
In the energy conservation improvement drawing must show the area of film coating.

The shading coefficient of the existing transparent wall is

The shading coefficient after improvement reduces the OTTV to watt/m^2

The difference of OTTV = watt/m^2

Mistake number 80
The area of saving calculation is the same as the area in the OTTV calculation

The overall area of wall = m^2

The reduced heat = (....-....)x(....+...)x3,414/1000 Btu/hr

(1 kw of heat equals to 3414 Btu/hr)

= ..../12000 ton

The saving electrical energy

Mistake number 81
The hour for calculation should be less than12 hours of daylight shining

Mistake number 82
Transform the average EER to kw/ton for calculation

= .....x hr/dayk x day/year x operating factor of x kW/ton kWh/year

Mistake number 83
The reflectance of the new film should be less than 0.2

= .... kWh/year

= .... x ..... baht/year

= .... baht/year

Suggestion

The measure of film coating will reduce the heat gain from the outside. So the saving is ....kwh/year or .....baht/year.

Mistake number 84
There is no miscelleneous cost and the finishing cost in the film coating measures

Investment

The overall film area is .....m^2. The price of film coating is 950 baht/m^2

The total cost of investment is I

Mistake number 85
Area of film coating maybe more than the area of conditioning area

Payback period year

Economic Investment of Return %

Mistake number 86
If there is the existing film and the OTTV is more than 55 watt/sq.m., the auditor should check that the existing film could be removed or not.

Mistake number 87
The EIRR can be calculated for each or overall building to make the EIRR more than 9 %

3.1.4 The measures of insulation tiling

Data from Auditing

The area of the ceiling at the top floor which gain the heat without the insulation tiling is .....m^2

The capacity in the top floor is .....ton which consumes the electrical energy .....kW. The existing RTTV is.....W/m2

Suggestion

The ceiling of the top floor without the insulation tiling makes the high load to the air conditioner. So the insulation can reduce the heat gain in the building and the electrical energy consumption of the air conditioner.

After tiling the insulation the energy consumption of the air conditioning system reduces as the calculation

The RTTV before improving	= A		watt/m^2
The RTTV after improving	= B		watt/m^2
The difference of RTTV	= A-B		watt/m^2
Tiling area	= C		m^2
The reduced heat gain	=	(A-B)xCx3414/1000	Btu/hr
(1 kW heat equals to 3,414 Btu/hr)			
	=	..../12000	ton
Energy saving	=	.....x hr/day x day/year x operating factor x kW/ton	kWh/year
	=	....	kWh/year
	=	.... x	baht/year
	=	....	baht/year

Mistake number 88
The area for energy saving is the same as the ara for RTTV calculation

Mistake number 89
The measures of insulation is the first priority when RTTV of the building is more than 25 watt sq.m.. If the EIRR is less than 9% or it is difficult to tile the insulation, the measures of ceramic coating is the second priority. The OTTV and RTTV calculation still shown both measures of insulation and ceramic coating.

Mistake number 90
Select only one measures in the case of both of measures of insulation and ceramic coating can be implemented.

Mistake number 91
kW ton is calculated from the average EER from auditing.

Mistake number 93
The investment cannot include the miscelleneous cost and finishing cost

Investment

The air conditioning area at the top floor ceiling is.....m^2. The price is .....baht/m^2 The labor cost is .....baht/m^2. Total cost of investment is .....baht.

Payback period	year	
Economic Investment Rate of Return	%	

Mistake number 92
Show the real area of the film coating

3.1.5 The measures of ceramic coating

Data from Auditing

The capacity of the air conditioner on the top floor is .....Btu which consume energy ...kW/ton

The roof area which gain the heat is .....m^2 The RTTV is .....watt/m^2 which is higher than 25 watt/m^2 as stated in the act of energy conservation.

Mistake number 96

The median price of every color of ceramic coating is the same.

.....

.....

Mistake number 95

Show the calculation of the area for ceramic coating

Suggestion

After coatting the .....color ceramic on the roof, the RTTV reduces to .....watt/m^2

The load of air condjitioning system reduces too.

Mistake number 97

The area of ceramic coating is the same as the area of RTTV calculation

RTTV before improving	=	A	watt/m^2
RTTV after improving	=	B	watt/m^2
The difference of RTTV	=	A-B	watt/m^2
Ceramic coating area	=	C	m^2
The difference of RTTV	=	(A-B)xCx3414/1000	Btu/hr
(1kW of heat equals to 3414 Btu/hr)			
	=	..../12000	ton

Energy saving

Mistake number 94

The area of ceramic coating should consider the slope, the eaves, and the curl.

The double carved roof and the big or small carved roof which has 15-25 degree of slope, use the factor 1.06 to multiple into the non slope area and factor 1.02 to multiple into the non carved area. If the degree of slope is 25-30 degree the factor is 1.12 and 1.25

	=	.....x hr/day x day/year x factor x kw/ton	kWh/year
	=	.....	kWh/year
	=	..... x	baht/year
	=	.....	baht/year

Mistake number 99

The area in the investment is all of the roof because of the appropriation

Investment

The area of ceramic coating is.....m^2. The labor cost is .....baht/m^2

The total cost is .....baht

Mistake number 98

The area of ceramic coating should has the water drain

Payback period year

Economic Investment Rate of Return %

Mistake number 100
Simulate the illumination by software EASY LUX version 2.06 by selecting direct calculation

3.2 Suggestion for lighting saving

3.2.1 The measures of compact fluorescent replacement

Mistake number 101
This measures is used for compact fluorescent only

Mistake number 102
The replacement should consider the dimension and the installation of the compact fluorescent

Data from auditing

There are some of the incandescent lamp in the building which should change into compact fluorescent as the list below

Incandescent .... watt .... lamp

Suggestion

After replace the incandescent by the compact fluorescent the saving is

Saving = ... kwh/year

Mistake number 103
Use the age of compact fluorescent only 4 years for EIRR calculation

= ... kwh/year

Saving in term of baht = ... baht/year

= .... baht/year

Investment

The compact fluorescent with electronics ballast.....sets costs.....baht/sets

The labor cost is .....baht/lamp. Total cost is .....baht

Payback period year

Economic Investment Rate of Return %

Mistake number 104
The EIRR calculation should select the age of each equipment

3.2.2 The measures of reflector luminary replacement

Mistake number 105
The existing luminary can be replaced only the age is more than 3 years

Mistake number 106
Use the 32-18 = 14 watt for the saving from the replacement of the reflector luminary

Mistake number 107
The measures of reflector luminary replacement should replace the ballast and the lamp in that luminary

Data from Auditing

The existing luminary can be replaced with the reflector luminary as the list below.

Mistake number 108 Tthe hanger of the existing luminary should not use for the new reflector for the better distribution of the light.

- Reflector luminary ... x ... watt cover with..... install by.... ..... sets
  Change to ... x ... watt cover with..... install by.... ..... sets
- Reflector luminary ... x ... watt cover with..... install by.... ..... sets
  Change to ... x ... watt cover with..... install by.... ..... sets
- Reflector luminary ... x ... watt cover with..... install by.... ..... sets
  Change to ... x ... watt cover with..... install by.... ..... sets
- Reflector luminary ... x ... watt cover with..... install by.... ..... sets
  Change to ... x ... watt cover with..... install by.... ..... sets

Remark

The existing layout should be set and increase the reflector luminary as list.

1 Increase the reflector luminary ... x ... watt cover with..... install by.... ..... sets
2 Increase the reflector luminary ... x ... watt cover with..... install by.... ..... sets
3 Increase the reflector luminary ... x ... watt cover with..... install by.... ..... sets

Suggestion

The existing luminary was coverd by the opal cover which reduces the efficiency of the luminary.

If use the reflector luminary with silver coating, the half number of the lamp reduces with the same illumination.

Mistake number 109
The dimension of the new and existing luminary should be the same

Saving = ...
= ..... kWh/year

Saving in term of baht = ... x .....
= ..... baht/year

Mistake number 110
Show the lay out of the new reflector additional in the energy conservation improvement

Saving calculation
[Saving in one luminary x number of luminary] - [Energy consumption of the additional luminary X Additional lamp]

3.2.3 The measures of electronics ballast

Data from Auditing

The existing magnetic ballast in the building is listed here

Magnetic ballast 36 watt ... each

Magnetic ballast 18 watt ... each

Magnetic ballast 32 watt ..... each

Remark After improve the illumination, the electronics ballast must be increased as list below.

1. Electronics ballast 36 W type..x...each
2. Electronics ballast 18 W type..x...each

Suggestion

The existing magnetic ballast in the building can be replaced by the electronics ballast. The saving from changing the 36 W magnetic ballast to electronics ballast is 12 W .The saving from changing the 18 W magnetic ballast to electronics ballast is 7 W.

Saving = [(....x12)+(...x7)+(..X...x2)-(..Y...x3)]xhr/dayxday/yearXfactorX1.0/1000

= .... kW/year

Saving in term of baht = ... x ...

= ..... baht/yeat

Investment

Replace the magnetic ballast to electronics ballast

The price of 36 W electronics ballast is .....baht ....

Total is.....baht

The price of 18 W electronics ballast is .....baht ....

Total is.....baht

The labor cost is .....baht/each. Total cost is .....baht

Payback period

Economic Investment of Return

4. Potential for Energy Conservation

Item	Investment			Saving		Payback period (year)	Economic investment rate of return EIRR (%)
	Material cost (baht)	Labor cost (baht)	Total (baht)	(kWh/year)	(baht)		
Electrical Energy							
1. Air conditioning system							
1.1Air conditioner maintenance							
1.2 High EER air conditioner with electronics thermostat replacement							
Total							
2. Lighting system							
2.1Compact fluorescent replacement							
2.2 Reflector luminary replacement							
2.3 Electronics ballast replacement							
Total							
Conclussion							

Mistake number 117

Show all of the potential of measures here.

5. Energy Conservation Plan

Item	Investment			Saving		Payback period	Economic investment rate of return EIRR (%)
	Material cost (baht)	Labor cost (baht)	Total (baht)	(kWh/year)	(bahtyear)	(year)	
Electrical Energy	***Mistake number 123*** material cost from list of median price exclude VAT	***Mistake number 122*** Put the cost of removing + installation cost + finishing cost + miscelleneous cost in this block for air conditioning system.		***Mistake number 121*** kWh/year is on the left hand baht/year is on the right hand		***Mistake number 118.*** Show the payback period and the EIRR for each measures	
1. Air conditioning system							
1 1 High EER air conditioner with electronics thermostat replacement							
Total 1	***Mistake number 125*** material costfrom list of median price exclude VAT						
2. Lighting system		***Mistake number 124*** Put the installation cost +finishing cost + miscelleous cost				***Mistake number 119.*** Show the payback period and the EIRR for each measures	
2.1 Compact fluorescent replacement							
2.2	***Mistake number 126*** Material cost from median pricefrom list of median price exclude VAT						
Total 2						***Mistake number 120*** Show the payback period and the EIRR for the lighting system	
Conclussion							

3. Total 1-2 baht Factor F calculation

4. Factor F baht budget ..... baht Factor F

5. Total cost baht budget ..... baht Factor F

Word of the cost of investment baht **budget** ..... baht Factor F

Mistake number 127 Check the word of investment as the figure

Mistake number 128 The state ment number 2 is quoted from abstract

Remark: 1. High EER air conditioner can be replaced only the EIRR more than 9%only

2. Lighting system improvement should not make the illumination less than the existing by investing... baht. It saves.....baht and the EIRR is ..... %

If improve the quality of life as the commitment number 3/2541 (Number 15) of 14 October 1998, the cost of investment iscrease .....baht

The saving reduces to ...baht and the EIRR is... %

5.1 List of the new air conditioner for .....floor.....Building.....

No.	Number FC....	Phase	Capacity (Btu)	Location	EER	kW/ton	New Capacity (Btu)	Saving (kWh/year)	Saving (Baht)	Material cost	Misceleneous cost	Removing cost	Installation cost	Finishing cost	Total (baht)	Payback period	EIRR%
1	FC....																
2																	
3																	
4																	
Total																	

Mistake number 131 Show the total of each floor and of organization

Remark

Mistake number 132 Write remark in the bottom of the end of this table

1. The new capacity is not less than the existing capacity

2. The range of the same capacity.

    1. 12000 - 13000 Btu

    2. 16000 - 20000 Btu

    3. 24000 - 25000 Btu

    4. 32000 - 34000 Btu

    5. 36000 - 42000 Btu

Mistake number 130

Criteria of air conditioner replacement

1. EER/EIRR
2. The age is more than 8 years
3. Important of room
4. EIRR is more than 9 %

Mistake number 129

The payback period should be between 4 and 6 years

5.2 List of new lighting system

Building ....floor.....

No	Room	Existing Lamp			New lamp				Existing luminary					New luminary										Electronic ballast	
														Before improving					After improving						
		type	Watt	Number	type	Watt	number		Lamp per luminary	Type of install	Cover	Number	Average illumination	Lamp per luminary	Installation	Cover	Number	Average illumination	Lamp per luminary	Installation	Cover	Width (cm)	Number	Average illumination	18 W	36 W
							replace	increase																		
Total of floor....																									
Total only in the increased luminary room																									
Total in organization																									
Total only in the increased luminary organization																									

Mistake number 133
The data from simulation plus daylight

Mistake number.134
Data from auditing

Mistake number 132
The data from simulation plus daylight
by selecting only in the increased luminary room

5.3 Capability for lighting conservation

No.	Before improving		After improving		Average illumination	Saving		Investment	Payback period	EIRR
	Type	Number	Type	Number	(LUX)	(kWh/year)	(baht/year)	(baht)		(%)
1	Lamp 1.1 Before improving									
	Total 1.1									
	1.2 After improving									
	Total 1.2									
2	Electronics ballast 2.1 Before improving									
	Total 2.1									
	2.2 After improving									
	Total 2.1									

Capability for lighting conservation

No.	Before improving		After improving		Average illumination	Saving		Investment	Payback period	EIRR
	Type	Number	Type	Number	(LUX)	(Kwh/year)	(baht/year)	(baht)		(%)
3	Luminary with lamp 3.1Before improving									
	Total 3.1									
	3.2 After improving									
	Total 3.2									
	3.3 Measures of increased luminary									
	Total 3.3									
4	Total 1.1 + 2.1 + 3.1									
5	Total 1.2 + 2.2 + 3.2									
6	5 - 4									

A.1 electrical power distribution

A.1.1 single line diagram

Capacity of transformer kVA	Type	Voltage (kV)	Wire		Number of wire per phase
			Size (Sq.mm)	Length (m)	

Transformer auditing

Equipment	Capacity	Actual Load(kW)	V (Volt)	Ir (Amp)	Is (Amp)	It (Amp)	PF

Mistake number 135

Should not audit in the afternoon because the load is lower than actual

A.1.3 Detail of swiching device and size of main line

Switching device

Size.....AF.....AT

Type

Condition

Main line

Diameter

Type of line

Condition

Suggestion

Picture

Mistake number 136

Attatch the picture of switching device and main line

Data from substation

Equipment	**Capacity**	**Actual Load(kW)**	**v (Volt)**	**Ir (Amp)**	**Is (Amp)**	**It (Amp)**	**PF**

A.2 Air Conditioning System

Mistake number 137

The number of data from air conditioner must be more than shown in table A.2.2

A.2.1 Detail of Auditing

.....years air conditioner

No.	Number FC.....	Capacity (Btu)	Type	Register number	Actual Load (kW)	V (Volt)	Ir (Amp)	Is (Amp)	It (Amp)	PF.
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

A.2.2 EER data

A.1 ....years air conditioner

No.	Number FC.....	Location and capacity Btu/hr.	Area ft^2	Velocity ft/min	Air flow rate cfm	Humidity (% RH)		Temperature (C)		Enthalpy (h)		Diff.h	Btu/h 4.5*cfm*diff.h	WC (kW)	EER (Btu/h/W)	kW/ton
						R	S	R	S	R	S					

Mistake number 138

Separate the age of air conditioner as this list

1. - 3 years
2. 3-5 years
3. 5-6 years
4. 6-7 years

} Collect the data 10% of the number of each age. If the EER is low, the air conditiner should be replaced and show the data from auditing

5. 7-8 years
6. 8 years

} Replace all air conditioner in this range

Collect the data from all air conditioner if there are only 30 sets in the organization

Split type air conditioner

Capacity		.....	Btu/h
Power		.....	watt
Volume of air flow rate		.....	cfm
Temperature and humidity of air retum			
.....F, ...%			
Enthalpy : h_r		.....	Btu/lb
Temperature and humidity of air supply			
.....F, ...%			
Enthalpy : h_s		.....	Btu/lb

Cooling capacity	=	4.5XcfmX(h_r - h_s)	Btu/hr
	=	4.5X.....X(...-...)	Btu/hr
	=	.....	Btu/hr
Transform to kw of cooling	=	(..../12000)X3.517	kW
(1 ton of refrigerant = 3.517 kW)	=	(..../12000)X(.....)	kW
	=	.....	kW
COP	=	kW of Refrigerator / kW compressor	
	=	..../....	
	=	....	
EER	=	(Btu/h)/watt	
	=	..../....	
	=	....	

A. 3.1 Average illumination

Building ....

Floor ....

Room	Maximum	Minimum	Average	Daylight
Average illumination				

Conclussion

The average illumination of organization

A. 3.2 Drawing of illumination

A. 3.3 Picture of luminary in building

A.4 Conclussion of energy using

Mistake number 139
Use 1.45 kW/ton for calculation

Air conditioning system

Total capacity = ... Btu/hr

= ..... Ton

Energy consumption = ... x .....

= ..... kW

Percent of operation = ... % (A)

Percent of compressor operation = ... % (B)

Total operating factor = ... % (A) x (B)

Working period = ... x .....

Energy consumption = ...

= ..... kWh/year

Transform to percentage = ...

= ..... %

Lighting system

Load of lighting system = ... kW

Using factor = ... %

Working period = ... hr/year

Energy consumption = ...

= ..... kWh/year

Transform to percentage = ...

= ..... %

Others = 100 - ..... - ....

= .....

= ..... %

Mistake number 141

OTTV calculation should be done although the non-air conditioning area because the heat transfer value is the property of building. It maybe benefit to the air conditioning system in the future

RTTV calculation before and after improving

Mistake number 142

If the insulation tiling measures cannot be implemented, the auditor should,calculate the ceramic coating measure and show the RTTV after coating the ceramic.

Date .....

Section 1 General Data

1.1 Building name.....

1.2 Address.....

.....

Telephone number

Facsimile number

1.3 Type of building [✓] Office [ ] Hotel [ ] Hospital

[ ] Shopping center [ ] Educational institute [ ] Others

1.4 Period of working.....hr/day.....day/year

1.5 Number of room or bed

(1) Number of room in hotel

(2) Number of bed in hospital

1.6 Area using in each month

(1) Working Hour (hr)	(2) Area of building excluding car park area		(3) Hotel	(4) Hospital	
	Air conditioning m^2	Non air conditioning m2	Percent of serviced room per month	Number of patient (bed-day)	Number of patient (man)
Building A ... hr	.....	.....	-	-	-
Building B ... hr	.....	.....	-	-	-
.... hr	.....	.....	-	-	-
.... hr	.....	.....	-	-	-

(1) No.	(2) Name	(3) Register Number	(4) Valid of authority	
			Start date	End date

2.1 Data of area in building

(1) Building name	(2) Number of floor	(3) Height of floor (m)	(4) Car park area (m^2)	(5) Using area (m^2)	(6) Area of air conditioning (m^2)	(7) Proportional of transparent to overall area	(8) Age of Building (year)
Building... Building... Building...							
Total							
Total area of controlled building				m2			
Air conditioning area				m2			

2.2 Map of organization

Section 3

3.1 Electrical purchasing

Mistake number 143

Use the data of the last month shown in table 2.2.1

(1) Purchasing

Normal rate	30,407.00	kWh
TOD rate	-	kWh

(2) Peak demand

Normal rate	-	kWh
TOD rate		

Period	kWh
1)	
2)	
3)	

3.2 Energy using in each system

Mistake number 144

Use the data of the last month in table 2.2.1

(1) System	(2) Energy consumption (kWh)		(3) Percentage	(4) Remark
	Instrument	Assesment		
Air conditioning	-			
Lighting	-			
Others	-			
Total	-			

3.3 Fuel using

(1) Type of fuel	(2) Unit	(3) Volume	(4) Price (baht/unit)	(5) Cost of fuel (baht)	(6) Remark
1. Fuel oil	l				
2. Diesel oil	l				
3. Benzine oil	l				
4. Kerozene	l				
5. Liquid petroleum gas	kg				
6. Natural gas	million Btu				
7. Others	unit				
.....					
.....					
.....					
Total					

3.4 Fuel using in machine of equipment

(1) Name of equipment	(2) Quantity of fuel			(3) Price	(4) Cost of fuel	(5) Remark
	Type	Quantity	Unit	(baht/unit)	(baht)	
Boiler						
Autoclave						
Water heater						
Autoclave						
Other equipments						
.....						
.....						
.....						
Total						

3.5 Energy using for electrical energy production

[ ] Generate only electrical energy [ ] Generate electrical and thermal energy

(1) Capacity (kW)	(2) Quantity of main fuel consumption			(3) Hour of operating	(4) Quantity of production (kWh)	
	Type	Quantity	Unit	(hr)	For using	For selling

Type of energy	Unit	Quantity	Average heating value (MJ/unit)	Quantity of auxilliary heating (MJ)
1. Purchased electricity	kwh		3.6	
2. Fuel oil	l			
3. Diesel oil	l			
4. Benzine oil	l			
5. Kerozie oil	l			
6. Liquid petroleum gas	kg			
7. Natural gas	million Btu			
8. Others	unit			
.....				
.....				
.....				
Total				

Section 4 The machine installation for energy conservation

4.1 Machine or equipment

1. Transformer

Item	Unit 1	Unit 2	Unit 3	Unit 4
Type of transformer	[ ] Dry type [ ] Oil type	[ ] Dry type [ ] Oil type	[ ] Dry type [ ] Oil type	[ ] Dry type [ ] Oil type
Capacity (kVA)				
High voltage (kV)				
Low voltage (V)				
Cooling system				
Producer				
Installed year				
Location				
Remark				

Unitary air conditioning system

Item	Unit 21	Unit 22	Unit 23	Unit 24
Type of air conditioner				
Capacity Btu/hr				
Electncal power (kw)				
Brand name				
Date of installation				
Location of using				
Remark				

(3) Central air conditioner

Item			
Type of chiller			[ ] Water cooling [ ] Air cooling
Type of air compressor			
Capacity of air conditioner		ton/hr	
Capacity of air compressor		kW	
Type of water cooling equipment	Chilling water pump	kW	
		l/hr	
	Cooling water pump	kW	
		l/hr	
	Cooling tower	kW	
Type of air cooling equipment	Chiller pump	kW	
		l/hr	
	Air cooling fan	kW	
Brand name of chiller			
Date of installation			
Location			
Remark			

(4) Lighting system

4.1 Fluorescent lamp

(1) Lamp	(2) Ballast	(3) Cover	(4) Lamp per Luminary	(5) Number of Luminary	(6) watt per lamp (watt/luminary)	(7) Ballast lost (watt/luminary)	(8) Total power (watt)	(9) Opeating hour (hr/day)
Fluorescent lamp 58 watt	[ ] Hang [ ] Recess [ ] Others	[ ] Bare [ ] Opal [ ] Prismatic [ ] Others						
Fluorescent lamp 36 or 40 watt	[ ] Hang [ ] Recess [ ] Others	[ ] Bare [ ] Opal [ ] Prismatic [ ] Others	[ ] 36 watt [ ] 40 watt	[ ] 36 watt [ ] 40 watt				
Fluorescent lamp 32 watt	[ ] Hang [ ] Recess [ ] Others	[ ] Bare [ ] Opal [ ] Prismatic [ ] Others						
Fluorescent lamp 18,20 watt	[ ] Hang [ ] Recess [ ] Others	[ ] Bare [ ] Opal [ ] Prismatic [ ] Others	[ ] 18 watt [ ] 20 watt	[ ] 18 watt [ ] 20 watt				

4.2 The improvement about the energy conservation

(1) Type of lamp	(2) Number of lamp	(3) Power (watt/lamp)	(4) Ballast loss (watt/lamp)	(5) Total power (watt)	(6) Operating hour (hr/day)
Incandescent					
.....watt					
.....watt					
Tungsten and halogen lamp					
.....watt					
.....watt					
Compact fluorescent					
.....watt					
.....watt					
High pressure mercury lamp					
.....watt					
.....watt					
Metalhide lamp					
.....watt					
.....watt					
High pressure sodium lamp					
.....watt					
.....watt					
Low pressure sodium lamp					
.....watt					
.....watt					

(5) More than 5 kw consumed equipment

Item	Set 1	Set 2	Set 3	Set 4
Type of air conditioner				
capacity (kW)				
Voltage (V)				
Current (ampere)				
Phase				
Power factor (%)				
Efficiency (%)				
Date of installation				
Location				
Remark				

(6) Boiler

Item		Set 1	Set 2	Set 3
Type of boiler				
Designed capacity	Steam presure			
	Evaporating rate			
Outside figure	Width (m)			
	Length (m)			
	Height (m)			
	Diameter (m)			
Heat transfer surface				
Type of used fuel				
Rate of fuel consumption				
Efficiency (%)				
Brand name				
Date of installation				
Location				
Remark				

(7) Heat recovery system

Type of heat recovery	Condensate Recovery	The heat or heating gas recovery			Blow down system
		Condenser	Indoor	Stack	
Type of machine					
Type/model					
Number					
Temperature of recovery					
Percent of recovery					
Brand name					
Date of installation					
Remark					

Name of machine	autoclave	Condensator	Clothes dryer	Roll iron machine	Other
Type/model					
Number					
Pressure					
Quantity					
Brand name					
Date of installation					
Location					
Remark					

(9) Electrical generating

(9.1) Power generator

Item	Set 1	Set 2	Set 3	set 4
Type of engine				
Brake horse power				
rpm				
Type of fuel				
Stage of engine				
Brand name				
Date of installation				
Location				
Remark				

Item	Set 1	Set 2	Set 3	Set 4
Capacity (kW)				
Voltage (V)				
Current (amp)				
Power factor				
rpm				
Brand name				
Date of installation				
Location				
Remark				

(10) Other eqipment

Type and name of machine	Autoclave	Water heater	Distillation equipment	Clothes dryer	Other
Type/model					
Number					
Type of fuel					
Quantity of fuel consumption					
Brand name					
Date of installation					
Remark					

4.2 The improvement about the energy conservation

No.	Detail of improvement	Improving period		Investment (baht)	Saving			Remark
		Start Date	End Date		Type of energy	Number	Value (baht)	
Total								

Signature of cooperator

(.....)

Register Data

TSIC CODE .....

Title of building .....

Name of organization .....

Type of organization .....

Address .....

.....

.....

Mistake number 145 Put " - " in this line

Mistake number 146 Such as "Ministry or Department"

Mistake number 147 Such as "Energy Development and Promotion"

Mistake number 148 Such as "There are only three kinds of building " hospital, education institute, and government organization "

.....

.....

Energy data

Peak demand	.....	kW
Electrical energy	.....	kW/year
Thermal energy	.....	Million MJ/year
Date of data recording	.....	
Year of construction	.....	

☐ Old building ☐ New building

Name of cooperator .....

Data for Government of State-owned Building

Register Data

Year of data recording .....

TSIC CODE .....

Name of organization .....

Name of building

Number of building .....

Date of recording .....

Audit by CONSORTIUM.....

Mistake number 149

Use the data in latest year of recording

Mistake number 150

Write the name of the building not organization

Mistake number 151

Suppose 01, 02, ... for the building which has no number

Mistake number 152

Consortium mean the name of auditor

☐ Old building ☐ New building

1. Data of area in building

Number of floor	.....	floors
Height of each floor	.....	m
Car park area	.....	m^2
Total using area	.....	m^2
Air conditioning area	.....	m^2
Transparent area per overall area	.....	%
Age of building	.....	year

Register Data

Mistake number 153 Use the data of organization

2. Electrical energy using

System	Energy using (kwh)		Percentage
	Instrument	Assesment	
Air conditioning	-		
Lighting	-		
Others	-		

3. Energy conservation in building except air conditioning sfystem

No.	Measure	before improving	after improving	Unit
1	OTTV			W/m^2
2	RTTV			W/m^2
3	Lighting system index			W/m^2

4. Measures of air conditioning system

No.	Capacity (ton)	Type	Number	Total (ton)	kw/ton

Mistake number 154

Write the data of all improved air conditioner

Register Data

Suggestion for energy conservation

Measures	Investment (baht)	Saving			Saving (baht)
		kWh	LOE	GJ	
1. Air conditioninig system 1.1 High EER air conditioner replacement					
2. Envelope system 2.1 Film coating 2.2 Insulation tiling 2.3 Ceramic coating					
3. Lighting system 3.1 Compact fluorescent replacement 3.2 Reflector luminary replacement					

Mistake number 155
kWh X 3.6/36.6 = LOE

Mistake number 156
kWh X 3.6 /1000 = GJ

Measures	System	Payback Period (year)	FIRR(%)	EIRR(%)
High EER air conditioner replacement	Air conditioning		-	
Film coating	Envelope		-	
Insulation tiling	Envelope		-	
Ceramic coating	Envelope		-	
Compact fluorescent replacement	Lighting		-	
Reflector luminary replacement	Lighting		-	
Electronics ballast replacement	Lighting		-	

Vita

My name is Kua-anan Techato. I was born on the first of April 1974 at Amphur Muang, Yala province. I graduated in bachelor degree of engineering from mechanical engineering department, faculty of engineering, Price of Songkhla University in year 1995. Now I am a project engineer in the Energy Conservation Center of Thailand and Energy Efficiency Institute (Thailand).