ESL-TR-91/03-05

USE OF ENERGY MANAGEMENT AND CONTROL SYSTEMS FOR PERFORMANCE MONITORING OF RETROFIT PROJECTS

Preliminary Engineering Survey
U.S.D.O.E. Forrestal Building and Germantown Facility
March 1991
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EXECUTIVE SUMMARY

The purpose of this preliminary engineering survey of the USDOE Forrestal and Germantown facilities is to determine whether existing EMCSs can be used for monitoring energy retrofits, and in the case where this is not practical, to recommend a LoanSTAR- type monitoring system for this purpose. This preliminary engineering survey reports on the preliminary findings of a survey conducted at the USDOE Forrestal and Germantown facilities during March 27- 29, 1991.

The monitoring points contained in this report are subject to verification during the Detailed Design Task. Final cost estimates will be submitted upon completion of the Detailed Design Budget.

In the USDOE Forrestal building.

At the present time the USDOE Forrestal building does not have a functional EMCS. Water, natural gas, electricity, steam and chilled water are monitored daily at the building boundaries for internal tracking purposes. In order for the Forrestal staff to effectively analyze savings from energy retrofits, a multi-logger data acquisition system is recommended based on systems that are installed in the Texas LoanSTAR program.

Four separate proposals are presented:

(1) a fully-configured monitoring system, ($243,174),
(2) a system to monitor lighting loads only, ($199,658),
(3) a system to monitor whole-building loads and weather conditions only, ($104,830), and
(4) a system to monitor the daycare facility and weather conditions only ($102,830).

In the USDOE Germantown complex.

At the present time the USDOE Germantown complex does not have a functional EMCS. Water, electricity, steam and oil are monitored daily at the complex boundaries for internal tracking purposes. In order for the Germantown staff to effectively analyze savings from energy retrofits, a multi-logger data acquisition system is recommended based on systems that are installed in the Texas LoanSTAR program.

Three separate proposals are presented:

(1) a fully-configured monitoring system ($221,680),
(2) a system to monitor whole-complex loads and weather conditions only ($167,870), and
(3) a system to monitor the daycare facility and weather conditions only ($103,004).

Such systems could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

Data analysis options.

Since the recommended monitoring system will utilize software developed for the LoanSTAR program by Texas A&M it is recommended that DOE consider utilizing Texas A&M's analysis procedures on the data to be collected from the Forrestal and Germantown facilities.

The procedures for analyzing the impact of the planned retrofits are the Forrestal and Germantown facilities will emphasize the selection and development of effective baselining techniques to cover the anticipated savings from the planned retrofits. Some examples of baselilning techniques under investigation for the Texas LoanSTAR program include one, two, three, and four parameter regression models which relate energy usage to ambient dry bulb temperature. Other exploratory work includes the use of the Principal Componaly Analysis method for relating energy use to more than one environmental variable, hourly daytyping models for non-weather loads, and calibrated energy simulation models.

Such analysis procedures will need to be individually constructed for each facility and could be accomplished in a one- year time frame (roughly one person-year equivalent for each site) after the installation and acceptance of the monitoring systems.

INTRODUCTION

The Texas LoanSTAR Monitoring and Analysis Program (MAP) is responsible for monitoring energy conservation retrofits at various sites throughout Texas. An important part of this task is gathering pertinent energy consumption and weather data for a site to determine the effectiveness of the retrofit projects. For this purpose, LoanSTAR researchers have installed dedicated data loggers at over 40 retrofit sites. These devices are designed specifically to collect energy and/or weather data from appropriate sensors, store them, and transmit them via a telephone modem when polled, a task they perform quite well.

Although data loggers have proven effective in the data gathering process, it has been observed that many of their functions may be accomplished by Energy Management and Control Systems (EMCSs). While it is obvious that an EMCS should not be installed strictly for monitoring energy usage, an existing EMCS may provide an alternative monitoring solution to the installation of a dedicated data logger in sites so equipped.

The purpose of this preliminary engineering survey of the USDOE Forrestal and Germantown facilities is to determine whether existing EMCSs can be used for monitoring energy retrofits, and in the case where this is not practical, to recommend a LoanSTAR- type monitoring system for this purpose.

This preliminary engineering survey reports on the findings of a survey conducted at the USDOE Forrestal and Germantown facilities during March 27-29, 1991. This report is organized into two primary sections. The first section contains the findings for the Forrestal building, and the second section contains the findings for the Germantown complex, and the final section discusses data analysis options for the Forrestal and Germantown facilities.

THE USDOE FORRESTAL BUILDING

FULLY-CONFIGURED MONITORING SYSTEM

THE USDOE FORRESTAL BUILDING

At the present time the USDOE Forrestal building does not have a functional EMCS. Water, natural gas, electricity, steam and chilled water are monitored daily at the building boundaries for internal tracking purposes. In order for the Forrestal staff to effectively analyze savings from energy retrofits planned in the near future, a multi-logger data acquisition system is recommended be based on systems that are installed in the Texas LoanSTAR program.

Four separate proposals are presented in the following sections: a fully-configured monitoring system, a system to monitor lighting loads only, a system to monitor whole-building loads only, and a system to monitor the daycare facility only.

Fully-configured Monitoring System.

A fully-configured monitoring system consisting of five data loggers is recommended for monitoring purposes at the Forrestal building. Such a system would be capable of hourly monitoring of the following loads:

+ Whole-building electricity.
+ Whole-building natural gas.
+ Whole-building potable water.
+ Whole-building chilled water.
+ Whole-building steam and condensate.
+ Weather conditions (temperature, humidity, solar, & wind).
+ Lighting sub-metering.
+ Motor Control Center sub-metering.
+ Elevator sub-metering
+ Kitchen loads.
+ Selected computer loads.
+ Daycare whole-building electricity.
+ Daycare PV electricity.
+ Daycare heat pump loads.
+ Daycare lighting loads.
+ Daycare interior conditions.
+ Daycare DHW solar.

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a fully configured system would not exceed $243,174.

Forrestal - Southeast Building
Switchboard D&E Logger # 1, #2

05/02/91

Logger #1 Synergistics C180 with 16 kWh & 16 digital channels.

Switchboard D			
Elevator P5 & P6	2CTs	Elevators	2 kWh & comb. board
Elevator P13 & P14	2CTs		
Elevator P7, P8, P9	2CTs		
Elevator P10, P11, P12	2CTs		
Riser L38	12CTs	Risers	3 kWh & comb. board
Riser L44	9CTs		
Riser L54	12CTs		
MCC-9 L54	4CTs	MCC	2 kWh

AØ Transformers	18CTs	A - Transformers	1 kWh & 5 comb. boards
BØ Transformers	18CTs	B - Transformers	1 kWh & 5 comb. boards
CØ Transformers	18CTs	C - Transformers	1 kWh & 5 comb. boards

Logger #2 Synergistics C180 with 16 kWh & 16 digital channels.

Switchboard E			
Elevator P15 & P16	2CTs	Elevators	2 kWh & comb. board
Elevator P29 &P30	2CTs		
Elevator P17 & P18	2CTs		
Risers X38	9CTs	Risers	3 kWh & comb. board
Risers X46	9CTs		
Risers X54	9CTs		
Computer Chiller	3CTs	Computer	2 kWh
Computer	3CTs	Computer	3 kWh & comb. board
Computer	3CTs		
MCC-9-W38	3CTs	MCC	2 syn kWh
AØ Transformers	21CTs	A - Transformers	1 kWh & 5 comb. boards
BØ Transformers	21CTs	B - Transformers	1 kWh & 5 comb. boards
CØ Transformers	21CTs	C - Transformers	1 kWh & 5 comb. boards

Forrestal North Building
Switchboard A Logger #3

05/02/91

Logger #3 Synergistics C180 with 16 kWh & 16 digital channels.

Switchboard A			
Elevator P1 & P2	2CTs	Elevator	2 kWh & comb. board
Elevator P3 & P4	2CTs		
Riser F42	6CTs	Risers	3 kWh & 2 comb. boards
Riser D42	3CTs		
Riser D30	6CTs		
Riser D40	6CTs		
Riser F40	6CTs		
Ground Floor (West)	3CTs		
Ground Floor (East)	6CTs		
MCC-7-F36	2CTs	MCC	2 kWh & comb. board
MCC-G-1154	2CTs		
MCC-7-D46	2CTs		
Soff. Lighting	3CTs	Lighting	3 kWh
GA 301 RF Shield	3CTs	Security	1 Watt transducer, 1 dig
Emer. Operating Cntr.	3CTs	Emergency	1 Watt transducer, 1 dig

AØ Transformers	16CTs	A - Transformers	1 kWh & 4 comb. boards
BØ Transformers	16CTs	B - Transformers	1 kWh & 4 comb. boards
CØ Transformers	16CTs	C - Transformers	1 kWh & 4 comb. boards

Building kWh meter	Whole building kWh	1 dig
Bldg. Natural Gas Meter	Whole building N. G	1 dig
Building Water Meter	Whole building potable water	1 dig

Forrestal North Building
Switchboard B Logger #4

05/02/91

Logger #4 Synergistics C180 with 16 kWh & 16 digital channels.

Switchboard B			
Elevator P19, P20 & P21	2CTs	Elevator	2 kWh & comb. board
Elevator P22, P23, P24, & P28	2CTs		
Riser D15	6CTs	Risers	3 kWh & 2 comb. boards
Riser F15	3CTs		
Riser F30	6CTs		
Riser D19	3CTs		
Riser F19	6CTs		
Ground Floor (West)	6CTs		
Ground Floor (East)	3CTs		
MCC-7-D12	2CTs	MCC	2 kWh & comb. board
MCC-G-F7	2CTs		
MCC-7-F23 & MCC D23	2CTs		3 kWh
Soff. Lighting	3CTs	Lighting	
Telephone Room	3CTs	Telephone	2 kWh

AØ Transformers	16CTs	A - Transformers	1 kWh & 4 comb. boards
BØ Transformers	16CTs	B - Transformers	1 kWh & 4 comb. boards
CØ Transformers	16CTs	C - Transformers	1 kWh & 4 comb. boards

Forrestal Southwest Building
Switchboard C Logger #5

05/02/91

Logger #5 Synergistics C180 with 16 kWh, 16 digitals, & 16 analog inputs.

Switchboard C			
L11-6-R28,H28,L28	3CTs	Risers	3 kWh, 12 comb. board
L11-1-S18, S19, L11-S19	3CTs		
L11-6-616	3CTs		
L11-W14, L11-6-X18	3CTs		
L11-1-S11, S12	3CTs		
L11-6-W11, L11-1-68	3CTs		
MCC-G-W15	2CTs	MCC	2 kWh & comb. board
MCC-G-T8	2CTs		
750 KVA Transformer	9CTs	Kitchen	3 kWh
Daycare Feed	3CTs	Daycare Total	3 kWh
Daycare Lights	3CTs	Daycare Lights	1 dig
Daycare Heat Pump	12CTs	Daycare Heat Pump	1 dig

AØ Transformers	10CTs	A - Transformers	1 kWh & 3 comb. boards
BØ Transformers	10CTs	B - Transformers	1 kWh & 3 comb. boards
CØ Transformers	10CTs	C - Transformers	1 kWh & 3 comb. boards

CHW Btu	Whole-building CW	1 dig
CHW flow	Whole-building CW	1 dig
Steam Btu	Steam Btu	1 dig
Condensate flow	Condensate Flow	1 dig
Condensate Btu	Condensate Btu	1 dig

Weather Station Channels			
Wind		Wind	1 analog
Horizontal solar radiation		Horiz.Solar	1 analog
Tilted solar radiation		Tilted Solar	1 analog
Ambient relative humidity		Amb.R.H.	1 analog
Ambient temperature		Amb.Temp.	1 analog

Solar Evaluation Channels			
Solar input to H/X Btu		Solar Btu	1 dig
Solar H/X out Btu		Solar Btu	1 dig
DHW H/X total Btu		DHW Btu	1 dig
PV output kWh	3 CT	PV kWh	1 Watt transducer, 1 dig
4 Heat Pump R/A temp.		Heat Pump Temp.	4 analog
4 Heat Pump R/A humidity		Heat Pump R.H.	4 analog
Potable Water temp.		Potable Water	1 analog

DOE Forrestal Building:
Schedules and Milestones

05/02/91

TASK:	Months From Start of Contract								
	1 Mo.	2 Mo.	3 Mo.	4 Mo.	5 Mo.	6 Mo.	7 Mo.	8 Mo.	9 Mo.
#1	------->								
#2		------->	------->						
Report				*					
#3				------->					
#4					------->	------->			
Polling							*		
#5							------->	------->	------->

Item #1: Engineering and design.

Item #2: Detailed design and cost estimates.

Report: Final detailed budget.

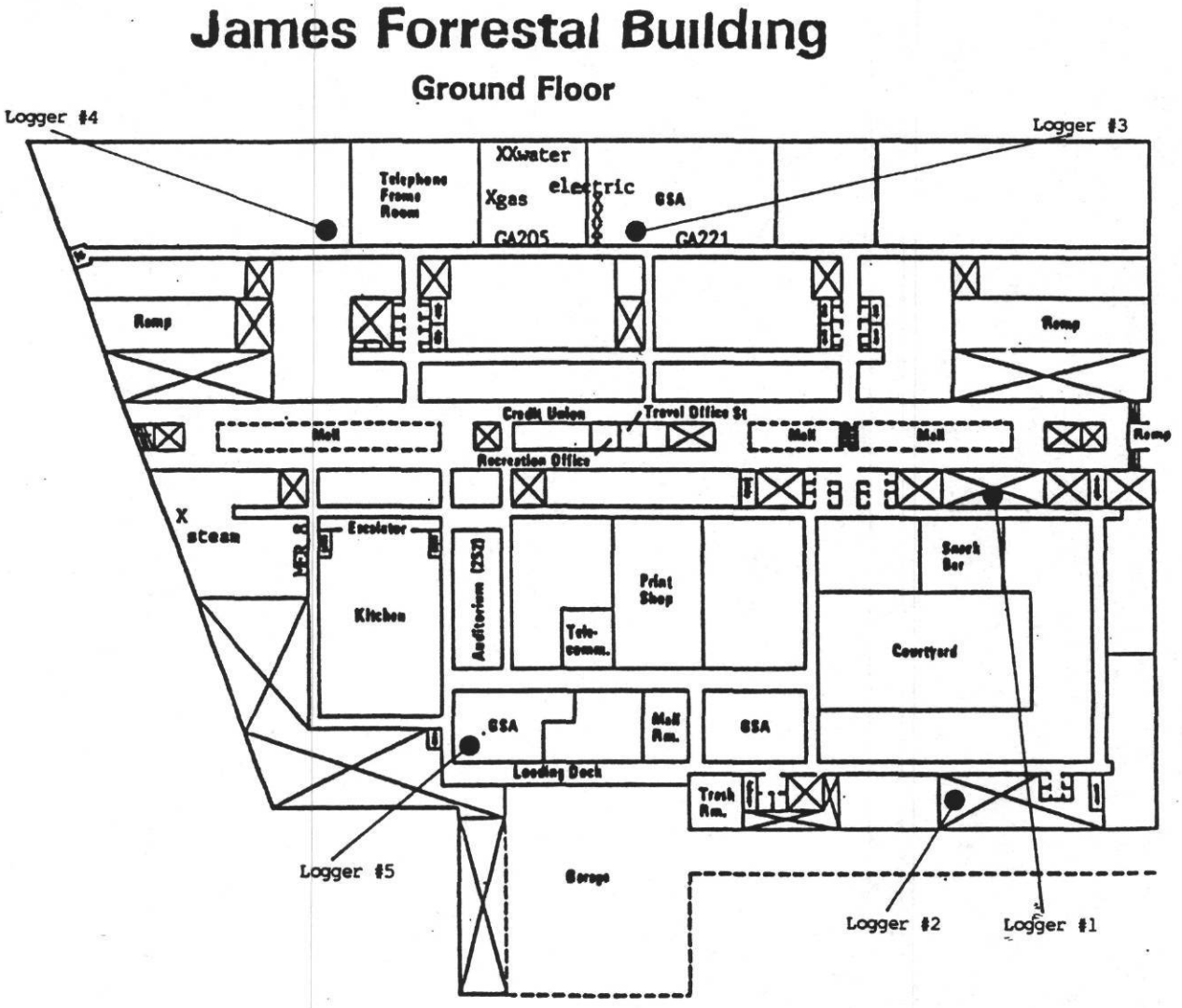
Item #3: Equipment procurement.

Item #4: Field installation.

Polling: Begin polling loggers, preliminary data available.

Item #5: Debugging, testing, final calibration, etc.

Figure 1: Floor plan of the USDOE Forrestal building. This figure shows a floor plan of the USDOE Forrestal building showing the location of the data loggers.



Forrestal Building Summary:
Full Proposal

05/02/91

Materials Estimate

$3,000 x	4	Synergistics C180s with kWh digital channels	$12,000
$3,900 x	1	Synergistics C180 with kWh digital & analog channels	$3,900
$5,000 x	1	Steam thermal meter	$5,000
$500 x	1	CHW thermal meter	$500
$1,500 x	1	Condensate meter	$1,500
$350 x	3	kWh transducers - including PV	$1,050
$1,000 x	1	Building Total Electric Pulse Conversion	$1,000
$500 x	1	Building Water Meter Pulse Conversion	$500
$500 x	1	Building Water Meter Pulse Conversion	$500
$1,500 x	1	Wind sensor	$1,500
$1,000 x	1	Horizontal solar radiation sensor	$1,000
$1,500 x	1	Tilt solar radiation sensor	$1,500
$1,200 x	1	Ambient relative humidity sensor	$1,200
$200 x	1	Ambient temperature sensor	$200
$200 x	1	Potable water temperature sensor	$200
$900 x	3	Solar system Btu meters	$2,700
$250 x	4	Plenum air temp sensors	$1,000
$750 x	4	Plenum relative humidity sensors	$3,000
$60 x	366	Current transformers (minimum)	$21,960
$50 x	79	Combination boards (minimum)	$3,950
		TOTAL EQUIPMENT	$64,160

Forrestal Building Summary:
Full Proposal

05/02/91

Ncat Supplies Estimate:
$3,000 Wire $400/1000 4 pr, $150/1000 2 pr
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$3,408

Ncat Subcontract labor Estimates:
$10,000 Electrician
-------- Hot Tap Contractor
$2,000 Steam Meter Installer
$2,500 Plumber

Ncat G&A on Subcontracts:
$1,450

Texas A&M Labor Estimates:
$5,000 Management
$3,000 Programming & Engineeering

Ncat Travel & Per Diem Estimate:
$12,000 Supplemental Living Allowance
$8,000 Travel to & from job

Ncat G&A Travel:
$5,000

Ncat Labor Estimates:
$20,000 Engineering Design & Labor
$40,000 Installation Labor
$10,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days
$2,580 2 people x 2 visits B/CS-DC
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supplies

10% Contingency:
$18,252

SUB-TOTAL: $222,462

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Forrestal Building

Fully Configured Monitoring System

		Rate	Amount	
A.	Senior Personnel			
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700
F.	Other Direct Costs Materials and Supplies		$1,200	

	Materials and Supplies		$1,200	
	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$157,254	
	Other		$0	
	Total Other Direct Costs			$159,254
G.	Total Direct Costs			$181,194
H.	Indirect Costs Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$199,658
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$199,658

THE USDOE FORRESTAL BUILDING

ALTERNATE #1

MONITORING OF LIGHTING LOADS ONLY

Alternate #1: Monitoring of Lighting Loads Only.

A monitoring system for monitoring the lighting loads at the Forrestal building is described in this section. Such a system would be capable of hourly monitoring of the following loads:

+ Lighting sub-metering.

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a system for monitoring the lighting loads would not exceed $199,658.

Forrestal Building Summary:
Alternate #1: Lighting Proposal

05/02/91

Materials Estimate

$3,000 x	4	Synergistics C180s with kWh digital channels	$12,000
$3,900 x	1	Synergistics C180 with kWh digital & analog channels	$3,900
$350 x	2	kWh transducers - including PV	$700
$1,500 x	1	Wind sensor	$1,000
$1,000 x	1	Horizontal solar radiation sensor	$1,000
$1,500 x	1	Tilt solar radiation sensor	$1,500
$1,200 x	1	Ambient relative humidity sensor	$1,200
$200 x	1	Ambient temperature sensor	$200
$60 x	345	Current transformers (minimum)	$20,700
$50 x	79	Combination boards (minimum)	$3,950
		TOTAL EQUIPMENT	$46,150

Forrestal Building Summary:
Alternate #1: Lighting Proposal (cont.)

05/02/91

Ncat Supplies Estimate:
$3,000 Wire $400/1000 4 pr, $150/1000 2 pr
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$2,508

Ncat Subcontract labor Estimates:
$8,000 Electrician
Hot Tap Contractor
Steam Meter Installer
Plumber

Ncat G&A on Subcontracts:
$800

Texas A&M Labor Estimates:
$5,000 Management
$3,000 Programming & Engineeering

Ncat Travel & Per Diem Estimate:
$10,000 Supplemental Living Allowance
$8,000 Travel to & from job

Ncat G&A Travel:
$4,500

Ncat Labor Estimates:
$16,000 Engineering Design Labor
$35,000 Installation Labor
$8,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days
$2,580 2 people x 2 visits B/CS-DC
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supplies

10% Contingency:
$14,296

SUB-TOTAL: $178,953

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Forrestal Building

System to Monitor Light Loads Only

A.	Senior Personnel	Rate	Amount	
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700
F.	Other Direct Costs			

	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$200,770	
	Other		$0	
	Total Other Direct Costs			$202,770
G.	Total Direct Costs			$224,710
H.	Indirect Costs Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$243,174
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$243,174

THE USDOE FORRESTAL BUILDING

ALTERNATE #2

MONITORING OF WHOLE-BUILDING LOADS ONLY

Alternate #2: Monitoring of Whole-building Loads Only.

A monitoring system for monitoring the whole-building loads at the Forrestal building is described in this section.

Such a system would be capable of hourly monitoring of the following loads:

+ Whole-building electricity.
+ Whole-building natural gas.
+ Whole-building potable water.
+ Whole-building chilled water.
+ Whole-building steam and condensate.
+ Weather conditions (temperature, humidity, solar, wind).

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a system for monitoring whole-building loads would not exceed $104,604.

Forrestal Building Summary:
Alternate #2: Whole-building Loads

05/02/91

Materials Estimate

$1,000 x	1	Synergistics Datamate 10	$1,000
$3,000 x	1	Synergistics C140 with kWh digital & analog channels	$3,000
$5,000 x	1	Steam thermal meter	$5,000
$500 x	1	CHW thermal meter	$500
$1,500 x	1	Condensate meter	$1,500
$1,000 x	1	Building Total Electric Pulse Conversion	$1,000
$500 x	1	Building Water Meter Pulse Conversion	$500
$500 x	1	Building Water Meter Pulse Conversion	$500
$1,500 x	1	Wind sensor	$1,500
$1,000 x	1	Horizontal solar radiation sensor	$1,000
$1,500 x	1	Tilt solar radiation sensor	$1,500
$1,200 x	1	Ambient relative humidity sensor	$1,200
$200 x	1	Ambient temperature sensor	$200
		TOTAL EQUIPMENT	$18,400

Forrestal Building Summary:
Alternate #2: Whole-building Loads (cont.)

05/02/91

Ncat Supplies Estimate:
$1,000 Wire $400/1000 4 pr, $150/1000 2 pr
$500 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$995

Ncat Subcontract labor Estimates:
$2,000 Electrician
Hot Tap Contractor
$2,000 Steam Meter Installer
$2,500 Plumber

Ncat G&A on Subcontracts:
$650

Texas A&M Labor Estimates:
$3,000 Management
$2,000 Programming & Engineeering

Ncat Travel & Per Diem Estimate:
$6,000 Supplemental Living Allowance
$4,000 Travel to & from job

Ncat G&A Travel:
$2,500

Ncat Labor Estimates:
$5,000 Engineering Design Labor
$8,000 Installation Labor
$3,000 Management

Texas A&M Travel & Per Diem:
$2,240 2 people x 2 visits x 5 days
$2,580 2 people x 2 visits B/CS-DC
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supplies

10% Contingency:
$5,655

SUB-TOTAL: $80,900

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Forrestal Building

System to Monitor Whole-Building Loads Only

		Rate	Amount	
A.	Senior Personnel			
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700
F.	Other Direct Costs Materials and Supplies		$1,200	

	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$62,200	
	Other		$0	
	Total Other Direct Costs			$64,200
G.	Total Direct Costs			$86,140
H.	Indirect Costs Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$104,604
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$104,604

THE USDOE FORRESTAL BUILDING

ALTERNATE #3

MONITORING OF THE DAYCARE FACILITY

Alternate #3: Monitoring the Daycare Facility Only.

A monitoring system for monitoring selected loads at the daycare center is described in this section.

Such a system would be capable of hourly monitoring of the following loads:

+ Weather conditions (temperature, humidity, solar, wind).
+ Daycare whole-building electricity.
+ Daycare PV electricity.
+ Daycare heat pump loads.
+ Daycare interior conditions.
+ Daycare DHW solar.

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a system for monitoring the daycare facilities would not exceed $102,830.

Forrestal Building Summary:
Alternate #3: Daycare Only

05/02/91

Materials Estimate

$3,900 x	1	Synergistics C180 with kWh digital & analog channels	$3,900
$1,500 x	1	Wind sensor	$1,500
$1,000 x	1	Horizontal solar radiation sensor	$1,000
$1,500 x	1	Tilt solar radiation sensor	$1,500
$1,200 x	1	Ambient relative humidity sensor	$1,200
$200 x	1	Ambient temperature sensor	$200
$200 x	1	Potable water temperature sensor	$200
$900 x	3	Solar system Btu meters	$2,700
$250 x	4	Plenum air temp sensors	$1,000
$750 x	4	Plenum relative humidity sensors	$3,000
$60 x	21	Current transformers (minimum)	$1,260
		TOTAL EQUIPMENT	$17,460

Forrestal Building Summary:
Alternate #3: Daycare Only (cont.)

05/02/91

Ncat Supplies Estimate:
$2,000 Wire $400/1000 4 pr, $150/1000 2 pr
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$1,023

Ncat Subcontract labor Estimates:
$2,000 Electrician
Hot Tap Contractor
Steam Meter Installer
$2,500 Plumber

Ncat G&A on Subcontracts:
$450

Texas A&M Labor Estimates:
$3,000 Management
$2,000 Programming & Engineeering

Ncat Travel & Per Diem Estimate:
$6,000 Supplemental Living Allowance
$4,000 Travel to & from job

Ncat G&A Travel:
$2,500

Ncat Labor Estimates:
$5,000 Engineering Design Labor
$8,000 Installation Labor
$3,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days
$2,580 2 people x 2 visits B/CS-DC
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supplies

10% Contingency:
$5,493

SUB-TOTAL: $79,126

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Forrestal Building

System to Monitor Day-Care Facility Only

A.	Senior Personnel	Rate	Amount	
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700
F.	Other Direct Costs Materials and Supplies		$1,200	

	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$60,426	
	Other		$0	
	Total Other Direct Costs			$62,426
G.	Total Direct Costs			$84,366
H.	Indirect Costs Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$102,830
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$102,830

THE USDOE GERMANTOWN COMPLEX

FULLY-CONFIGURED MONITORING SYSTEM

THE USDOE GERMANTOWN BUILDING

At the present time the USDOE Germantown complex does not have a functional EMCS. Water, electricity, steam and oil are monitored daily at the complex boundaries for internal tracking purposes. In order for the Germantown staff to effectively analyze savings from energy retrofits, a multi-logger data acquisition system is recommended based on systems that are installed in the Texas LoanSTAR program.

Three separate proposals are presented in the following sections: a fully-configured monitoring system, a system to monitor whole- complex loads only, and a system to monitor the daycare facility only.

Fully-configured Monitoring System.

A fully-configured monitoring system consisting of seven data loggers is recommended for monitoring purposes at the Germantown complex. Such a system would be capable of hourly monitoring of the following loads:

+ Whole-complex electricity.
+ Whole-complex oil use.
+ Whole-complex potable water.
+ Whole-complex chilled water.
+ Whole-complex steam , condensate, and boiler water.
+ Weather conditions (temperature, humidity, solar, wind).
+ Motor Control Centers sub-metering.
+ Selected computer loads.
+ Emergency Power Generators and fuel use.
+ Daycare whole-building electricity.
+ Daycare PV electricity.
+ Daycare heat pump loads.
+ Daycare interior conditions.
+ Daycare DHW solar.

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a fully configured system would not exceed $221,680.

DOE Germantown
Boiler RoomLogger #1

05/02/91

Logger # 1 1 Synergistics C140 with 8 kWh, 8 digital, 8 analog channels.

Boiler Room			
Boiler Feedwater		Boiler Feedwater	1 dig
Boiler Makeup Water		Boiler Makeup Water	1 dig
Steam Temp.		Steam Temperature	1 analog
Steam Pressure		Steam Pressure	1 analog
Potable Water		Potable Water	3 dig
Boiler Fuel Oil		Boiler Fuel Oil	1 dig
Boiler Room Electricity	3 CTs	Boiler Room Electricity	3 kWh
Generator Fuel Oil*		Generator Fuel Oil	1 dig
Generator Electricity*	3 CTs	Generator Electricity	3 kWh

*Also tied into this logger through 200' buried trench -- 35 kW Emergency Generator

DOE Germantown
Equipment Building/Daycare Loggers #2, #3

05/02/91

Logger # 2 Synergistics Datamate 20 with 8 digital channels.

Equipment Building			
Pepco Electric Meter		Whole-building Electric	1 dig
Potable Water		Potable Water	2 dig

Logger #3 Synergistics C180 with 16 digital, 15 kWh 16 analog channels.

Daycare Center:			
Total Electric	3 CTs	Whole-building Electric	3 kWh
Lighting	3 CTs	Lighting	3 kWh
Heat Pump Electric	12 CTs	Heat Pump Electric	3 kWh

Weather Station Channels			
Wind		Wind	1 analog
Horizontal Solar Radiation		Horizontal Solar	1 analog
Tilt Solar Radiation		Tilted Solar Radiation	1 analog
Ambient Relative Humidity		Ambient Relative Humidity	1 analog
Ambient Temperature		Ambient Temperature	1 analog

Solar Evaluation Channels			
Solar Input to Heater Btu		Solar panel Btu	1 dig
Heat Exchanger Output Btu		Solar H/X Btu	1 dig
Total DHW Output Btu		DHW Btu	1 dig
PV Output kWh	3 CTs	PV kWh	1 transducer, 1 dig
Heat Pump Air Temperature		Heat Pump Air Temperature	4 analog
Heat Pump Relative Humidity		Heat Pump Rel. Humidity	4 analog
Potable Water Temp. (CW & HW)		Potable Water Temp.	1 analog

DOE Germantown
Load Center 2/3 Logger #4

05/02/91

Logger # 4 1 Synergistics C180 Logger with 16 kWh & 16 digital channels.

Main Load Center			
E27-5 Computer	3 CTs	Computer	3 kWh
E27-3 Cooling Towers	2 CTs	Cooling Towers	2 kWh
E27-9 Chiller #1	2 CTs	Chiller #1 Electric	2 kWh
E27-10 Chiller #2	2 CTs	Chiller # 2 Electric	2 kWh
E27-11 MCC	2 CTs	MCC	2 kWh
Main Pepco Elec.		Whole-building electric	2 dig
Chiller #1 CW gal.		Chiller #1 gal.	1 dig
Chiller # 2 CW gal.		Chiller #2 gal.	1 dig
Chiller # 1 Load Btu		Chiller #1 Btu	1 dig
Chiller # 2 Load Btu		Chiller # 2 Btu	1 dig
Generator electric	3 CTs	Generator Electric	1 transducer, 1 dig
Generator Fuel Oil		Generator Electric	1 dig

DOE Germantown
Load Centers #1, #4, & 200 kW Generator
Loggers #5, #6, & #7

05/02/91

Logger # 5: Synergistics C140 with 8 digital, 8 kWh, 8 analog channels.

Load Center #4			
MCC 1	2 CTs	MCC 1	2 kWh
MCC2	2 CTs	MCC 2	2 kWh
Chiller	2 CTs	Chiller Electric	2 kWh
Chiller CW gal.		Chiller CW Gal.	1 dig
Chiller Load Btu		Chiller Btu	1 dig
100 kW Generator Electric		Generator Electric	1 Watt transducer, 1 dig
100 kW Generator Fuel Oil		Generator Fuel Oil	1 dig

Logger #6 Synergistics Datamate 10 - 4 digital.

Load Center #1			
MCC		MCC	1 dig

Logger #7 Synergistics Datamate 10 - 4 digital.

200 kW Emer. Generator room			
Em. Generator Electric	3CTs	Generator Electric	1 Watt transducer, 1 dig.
Em. Generator. Fuel Oil		Generator Fuel Oil	1 dig

DOE Germantown
Schedules and Milestones

05/02/91

TASK:	Months From Start of Contract								
	1 Mo.	2 Mo.	3 Mo.	4 Mo.	5 Mo.	6 Mo.	7 Mo.	8 Mo.	9 Mo.
#1	------>								
#2		------>	------>						
Report				*					
#3				------>					
#4					------>	------>			
Polling							*		
#5							------>	------>	------>

Item #1: Engineering and design.

Item #2: Detailed design and cost estimates.

Report: Final detailed budget.

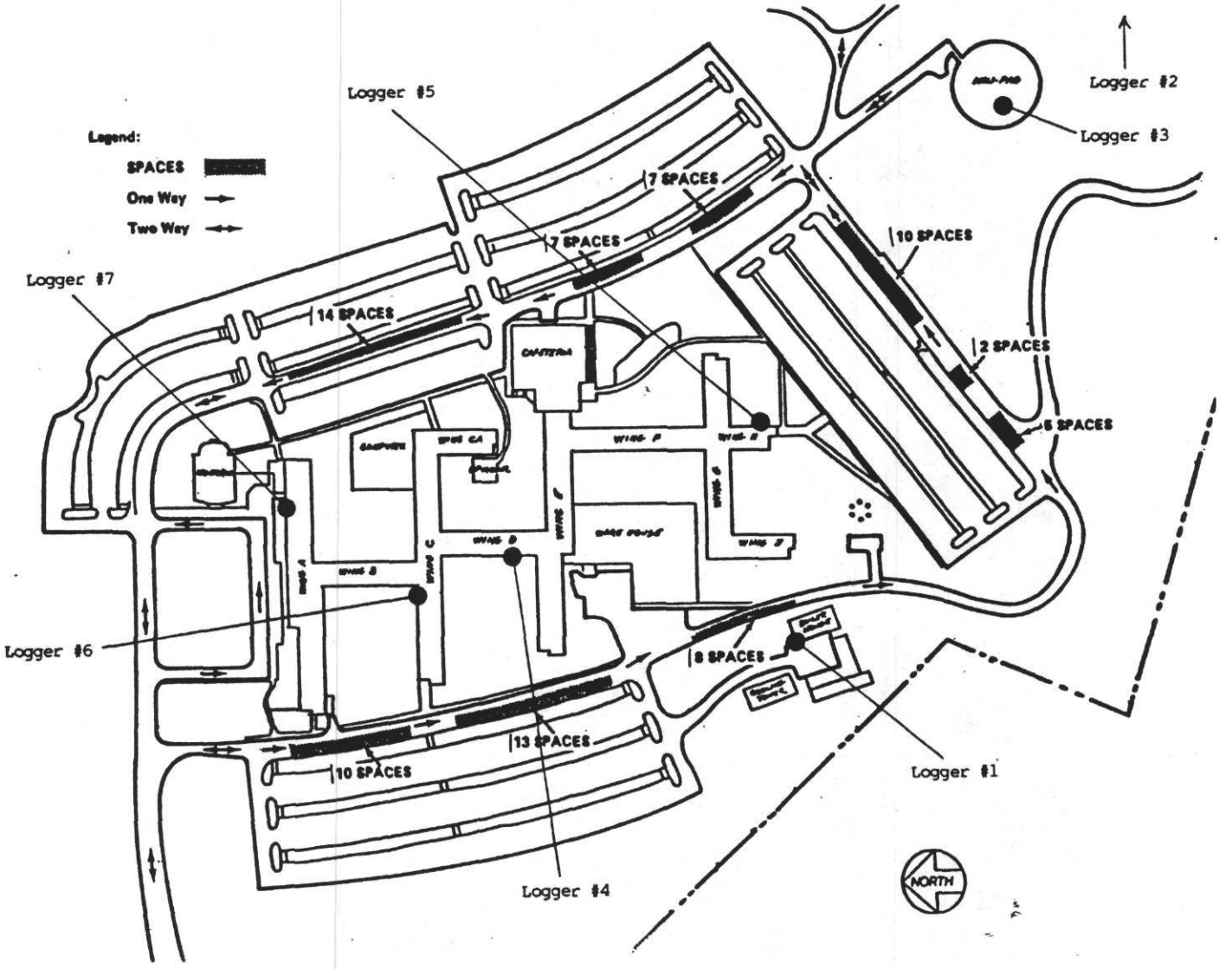
Item #3: Equipment procurement.

Item #4: Field installation.

Polling: Begin polling loggers, preliminary data available.

Item #5: Debugging, testing, final calibration, etc.

Figure 2. Plan View of the USDOE Germantown Complex. This figure is a plan view of the USDOE Germantown facility and shows the proposed data logger sites.



DOE Germantown Summary:
Full Proposal

05/02/91

Materials Estimate

$3,000 x	1	Synergistics C180 with kWh & digital channels	$3,000
$3,900 x	1	Synergistics C180 with kWh, digital & analog channels	$3,900
$3,000 x	2	Synergistics C140 with kWh, digital & analog channels	$6,000
$1,350 x	1	Synergistics Datamate 20	$1,350
$1,000 x	2	Synergistics Datamate 10	$2,000
$1,000 x	1	Steam temperature sensor	$1,000
$2,000 x	1	Steam pressure sensor	$2,000
$500 x	5	Building Water Pulse Conversion	$2,500
$1,500 x	2	Boiler Water Flow Meter	$3,000
$500 x	5	Fuel Oil Flow Senosrs	$2,500
$350 x	7	kWh Transducers	$2,450
$1,000 x	3	Building Total Electric Pulse Conversion	$3,000
$1,500 x	1	Wind Sensor	$1,500
$1,000 x	1	Horizontal Solar Radiation Sensor	$1,000
$1,500 x	1	Tilted Solar Radiation Sensor	$1,500
$1,200 x	1	Ambient Relative Humidity	$1,200
$200 x	1	Ambient Temperature	$200
$900 x	3	Solar System Btu Meters	$2,700
$250 x	4	Plenum Air Temp. Sensors	$1,000
$750 x	4	Plenum Relative Humidity Sensors	$3,000
$200 x	1	Potable Water Temp. Sensor	$200
$2,000 x	3	CHW Thermal Meters	$6,000
$60 x	56	Current Transformers	$3,360
		TOTAL EQUIPMENT	$54,360

DOE Germantown Summary:
Full Proposal (Cont.)

05/02/91

Supplies Estimate:
$3,000 Wire
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$2,819

Subcontract labor Estimates:
$10,000 Electrician
$3,000 Hot Tap Contractor
$3,000 Steam Meter Installer
$1,000 Plumber

Ncat G&A on Subcontracts:
$1,700

Texas A&M Labor Estimate:
$5,000 Management
$3,000 Programming, Engineering

Ncat Travel & Per Diem Estimate:
$12,000 Supplemental Living Allowance
$8,000 Travel to & from job

Ncat G&A Travel:
$5,000

Ncat Labor Estimates:
$20,000 Engineering Design & Labor
$30,000 Installation Labor
$8,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days.
$2,580 2 people x 2 visits B/CS-DC.
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supp.

10% Contingency:
$16,298

SUB-TOTAL: $200,976

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Germantown Complex

Fully Configured Monitoring System

		Rate	Amount	
A.	Senior Personnel			
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700
F.	Other Direct Costs			

	Materials and Supplies		$1,200	
	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$179,276	
	Other		$0	
	Total Other Direct Costs			$181,276
G.	Total Direct Costs			$203,216
H.	Indirect Costs Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$221,680
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$221,680

THE USDOE GERMANTOWN COMPLEX

ALTERNATE #1

MONITORING OF WHOLE-COMPLEX LOADS ONLY

Alternate #1: Monitoring of Whole-complex Loads Only.

A monitoring system for monitoring the whole-complex loads is described in this section.

Such a system would be capable of hourly monitoring of the following loads:

+ Whole-complex electricity.
+ Whole-complex natural gas.
+ Whole-complex potable water.
+ Whole-complex chilled water.
+ Whole-complex steam, condensate, and boiler water.
+ Weather conditions (temperature, humidity, solar, wind).

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a system for monitoring whole-complex loads would not exceed $167,870.

DOE Germantown Summary:
Alternate #1: Whole-complex Loads

05/02/91

Materials Estimate

$3,900 x	1	Synergistics C180 with kWh, digital & analog channels	$3,900
$3,000 x	2	Synergistics C140 with kWh, digital & analog channels	$3,000
$1,350 x	1	Synergistics Datamate 20	$1,350
$1,000 x	1	Steam temperature sensor	$1,000
$2,000 x	1	Steam pressure sensor	$2,000
$500 x	5	Building Water Pulse Conversion	$2,500
$1,500 x	2	Boiler Water Flow Meter	$3,000
$500 x	5	Fuel Oil Flow Senosrs	$1,500
$350 x	1	kWh Transducers	$350
$1,000 x	3	Building Total Electric Pulse Conversion	$3,000
$1,500 x	1	Wind Sensor	$1,500
$1,000 x	1	Horizontal Solar Radiation Sensor	$1,000
$1,500 x	1	Tilted Solar Radiation Sensor	$1,500
$1,200 x	1	Ambient Relative Humidity	$1,200
$200 x	1	Ambient Temperature	$200
$2,000 x	2	CHW Thermal Meters	$6,000
$60 x	20	Current Transformers	$1,200
		TOTAL EQUIPMENT	$34,200

DOE Germantown Summary:
Alternate #1: Whole-complex Loads (cont.)

05/02/91

Supplies Estimate:
$2,000 Wire
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$1,860

Subcontract labor Estimates:
$8,000 Electrician
$3,000 Hot Tap Contractor
$3,000 Steam Meter Installer
$1,000 Plumber

Ncat G&A on Subcontracts:
$1,500

Texas A&M Labor Estimate:
$5,000 Management
$2,000 Programming, Engineering

Ncat Travel & Per Diem Estimate:
$8,000 Supplemental Living Allowance
$6,000 Travel to & from job

Ncat G&A Travel:
$3,500

Ncat Labor Estimates:
$15,000 Engineering Design & Labor
$20,000 Installation Labor
$6,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days.
$2,580 2 people x 2 visits B/CS-DC.
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supp.

10% Contingency:
$11,406

SUB-TOTAL: $146,166

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Germantown Complex

System to Monitor Whole-Complex Loads Only

		Rate	Amount	
A.	Senior Personnel			
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700

F.	Other Direct Costs			
	Materials and Supplies		$1,200	
	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$125,466	
	Other		$0	
	Total Other Direct Costs			$127,466
G.	Total Direct Costs			$149,406
H.	Indirect Costs			
	Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$167,870
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$167,870

THE USDOE GERMANTOWN COMPLEX

ALTERNATE #2

MONITORING OF THE DAYCARE FACILITY ONLY

Alternate #2: Monitoring of the Daycare Facility Only.

A monitoring system for monitoring the daycare facility is described in this section.

Such a system would be capable of hourly monitoring of the following loads:

+ Weather conditions (solar, temperature, humidity, wind).
+ Daycare whole-building electricity.
+ Daycare PV electricity.
+ Daycare heat pump loads.
+ Daycare interior conditions.
+ Daycare DHW solar.

Such a system could be installed in 6 months (as shown in the Schedules & Milestones), and would include all necessary software, and hardware for polling and archiving the data.

The cost of a system for monitoring the daycare facilities would not exceed $103,004.

DOE Germantown Summary:
Alternate #2: Daycare Only

05/02/91

Materials Estimate

$3,900 x	1	Synergistics C180 with kWh, digital & analog channels	$3,900
$350 x	1	kWh Transducers	$350
$1,500 x	1	Wind Sensor	$1,500
$1,000 x	1	Horizontal Solar Radiation Sensor	$1,000
$1,500 x	1	Tilted Solar Radiation Sensor	$1,500
$1,200 x	1	Ambient Relative Humidity	$1,200
$200 x	1	Ambient Temperature	$200
$900 x	3	Solar System Btu Meters	$2,700
$250 x	4	Plenum Air Temp. Sensors	$1,000
$750 x	4	Plenum Relative Humidity Sensors	$3,000
$60 x	21	Current Transformers	$1,260
		TOTAL EQUIPMENT	$17,610

DOE Germantown Summary:
Alternate #2: Daycare Only (cont.)

05/02/91

Supplies Estimate:
$2,000 Wire
$1,000 Misc. Electrical Supplies

Ncat G&A on Supplies & Materials:
$1,031

Subcontract labor Estimates:
$2,000 Electrician
Hot Tap Contractor
Steam Meter Installer
$2,500 Plumber

Ncat G&A on Subcontracts:
$450

Texas A&M Labor Estimate:
$3,000 Management
$2,000 Programming, Engineering

Ncat Travel & Per Diem Estimate:
$6,000 Supplemental Living Allowance
$4,000 Travel to & from job

Ncat G&A Travel:
$2,500

Ncat Labor Estimates:
$5,000 Engineering Design & Labor
$8,000 Installation Labor
$3,000 Management

Texas A&M Travel & Per Diem:
$2,420 2 people x 2 visits x 5 days.
$2,580 2 people x 2 visits B/CS-DC.
$700 Ground transportation

Texas A&M Other Direct Costs:
$6,000 Computer Services
$2,000 Publication, Mat'l, Supp.

10% Contingency:
$5,509

SUB-TOTAL: $79,300

NOTE: Ncat Labor and G&A estimates reflect negotiated rates with the State of Texas.

Preliminary Engineering Survey
Department of Energy
Germantown Complex

System to Monitor Day-Care Facility Only

		Rate	Amount	
A.	Senior Personnel			
	Co-Principal Investigator D. Claridge 11% Time, 1 Month	$5,675	$625	
	Co-Principal Investigator J. Haberl 68% Time, 1 Month	$3,675	$2,500	
	Assistant Research Engineer J. Bryant 58% Time, 1 Month	$3,245	$1,875	
	Total Senior Personnel			$5,000
B.	Other Personnel			
	Computer Programmer 8.33% Time, 12 Months	$3,000	$3,000	
	Total Other Personnel			$3,000
	Total Salaries and Wages			$8,000
C.	Fringe Benefits 28% Faculty and Staff		$2,240	
	Total Fringe Benefits			$2,240
	Total Salaries, Wages and Fringe Benefits			$10,240
D.	Permanent Equipment			
	Computer with Appropriate Programming			$6,000
E.	Travel-Domestic			
	Travel to Washington, D. C. for Engineering Analysis			
	Air Fare:			
	College Station, TX to Washington, D. C. (2 People, 2 Visits Each)		$2,580	
	Per Diem: 2 Trips, 2 People/Trip, 5 Days/Trip @ $121/Day		$2,420	
	Rental Car: Mid-Size Sedan, 5 Days/Trip, 2 Trips		$700	
	Total Travel			$5,700

F.	Other Direct Costs			
	Materials and Supplies		$1,200	
	Publications Costs/Page Charges		$800	
	Consultant Services		$0	
	Computer Services		$0	
	Subcontract:		$0	
	National Center for Appropriate Technology (See Attached Detail)		$60,600	
	Other		$0	
	Total Other Direct Costs			$62,600
G.	Total Direct Costs			$84,540
H.	Indirect Costs			
	Indirect Cost Rate Negotiated With U.S. Department of Health & Human Services			
	Rate: 43.0% Modified Total Direct Cost	Base:	$42,940	$18,464
I.	Total Direct and Indirect Costs			$103,004
J.	Applicants Cost Sharing (if any)			$0
K.	Amount of This Request			$103,004