APPENDIX A

LIFE CYCLE COST ANALYSIS EXAMPLES

LIST OF EXAMPLES PAGE

ROADWAY/PARKING SURFACE 1

HVAC SYSTEM: CONVENTIONAL DESIGN 7

HVAC SYSTEM: ENERGY CONSERVATION 13

DOMESTIC HOT WATER HEATING SYSTEM: ENERGY CONSERVATION (SOLAR) 23

WASTEWATER TREATMENT FACILITY 28

ROADWAY/PARKING SURFACE

		PAGE
Alternative A:	Basic Input Data Summary	2
	Present Worth: One-Step Approach	3
Alternative B:	Basic Input Data Summary	4
	Present Worth: One-Step Approach	5
Summary		6

Project No. & Title PN 063 (FY84) Reserve Bldg.
Installation & Location Reserve Center, Virginia
Design Feature Roadway / Parking Surface
Alt. No. A Title Asphalt w/ 2" Wearing Surface

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

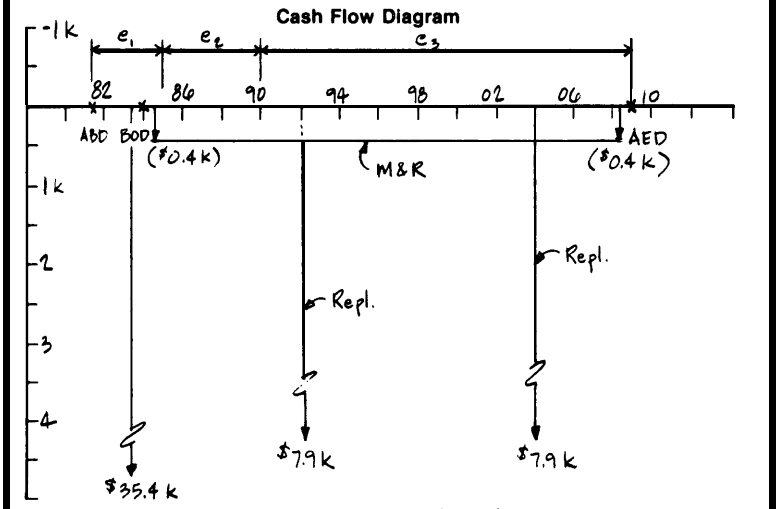
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jul 09
Midpoint of Construction		1 Jan 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jul 84
	Assumed for Analysis	1 Jul 84
DOE Region		3
Annual Discount Rate		10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun		
	82-85	85-90	90-09
All	0.00	0.00	0.00

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown.

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	35.4	1 Jan 84		Engineer's Project Estimate
Replacement (1" top.) yr 8	7.9	1 Jul 92		Eng. Est. - Backup Sheet
Replacement (1" top) yr 16	7.9	1 Jul 00		Eng Est. - Backup Sheet
M & R	0.4	1 Jan 85 - 1 Jan 09		Eng Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. & Title PN 003 (FY84) Reserve Bldg.
Installation & Location Reserve Center, Virginia
Design Feature Roadway / Parking Surface
Alt. No. A Title Asphalt w/ 2" Wearing Surface

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: ONE-STEP APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD	Cost On ABD	One Step Adj.Factor Table 1	Present Worth on ABD
Initial Investment Cost	2.0	35.4	0.8264	29.3
Replacement (1" top.) yr. 8	10.5	7.9	0.3676	2.9
Replacement (1" top.) yr. 16	18.5	7.9	0.1715	1.4

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jul 09
Midpoint of Construction	1 Jan 84
BOD for Analysis	1 Jul 84
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 82-85	85-90	90-09
All	0.00	0.00	0.00

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Total No. of Payments	Annual Cost on ABD	Total Nominal Cost on ABD	One Step Adjustment Factor* Table Factor x DOS Correction	Present Worth on ABD
M&R	25	0.4	10.0	0.2861 x $(1.008)^6$	3.0

	Initial Costs	Energy/Fuel Costs	M&R Costs	Other Costs	Total
Net Present Worth:	29.3 +	0.0 +	3.0 +	4.3 =	36.6

DA FORM 5605-5-R, DEC 86

*Use One-Step Table 2 for M&R costs (e = 0).
Use One-Step Table 3 for energy/fuel costs (e prescribed e value).

Sheet____ of____

Project No. & Title PN 063 (FY84) Reserve Bldg.
Installation & Location Reserve Center, Virginia
Design Feature Roadway / Parking Surface
Alt. No. B Title Asphalt w/ 3" Wearing Surface

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

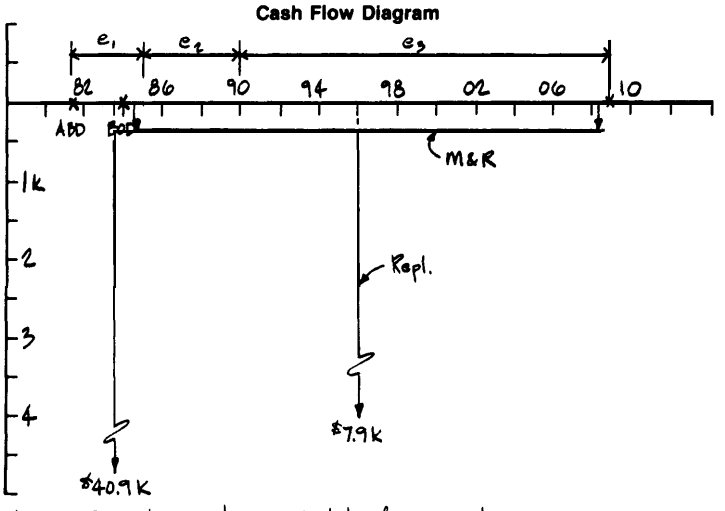
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jul 09
Midpoint of Construction		1 Jan 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jul 84
	Assumed for Analysis	1 Jul 84
DOE Region		3
Annual Discount Rate		10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-09
All	0.00	0.00	0.00

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	40.9	1 Jan 84		Engineer's Project Estimate
Replacement (1" top.) yr. 12	7.9	1 Jul 96		Eng. Est. — Backup Sheet
M&R	0.3	1 Jan 85 - 1 Jan 09		Eng. Est. — Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet_____ of_____

Project No. & Title PN 063 (FY84) Reserve Bldg.
Installation & Location Reserve Center, Virginia
Design Feature Roadway / Parking Surface
Alt. No. B Title Asphalt w/ 3" Wearing Surface

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: ONE-STEP APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD	Cost On ABD	One Step Adj.Factor Table 1	Present Worth on ABD
Initial Investment Cost	2.0	40.9	0.8264	33.8
Replacement (1" top.) yr. 12	14.5	7.9	0.2511	2.0

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jul 09
Midpoint of Construction	1 Jan 84
BOD for Analysis	1 Jul 84
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-09
All	0.00	0.00	0.00

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Total No. of Payments	Annual Cost on ABD	Total Nominal Cost on ABD	One Step Adjustment Factor* Table Factor x DOS Correction	Present Worth on ABD
M&R	25	0.3	7.5	$0.2861 \times (1.008)^6$	2.3

	Initial Costs		Energy/Fuel Costs		M&R Costs		Other Costs		Total
Net Present Worth:	33.8	+	0.0	+	2.3	+	2.0	=	38.1

DA FORM 5605-5-R, DEC 86

*Use One-Step Table 2 for M&R costs (e = 0).
Use One-Step Table 3 for energy/fuel costs (e = prescribed e value).

Sheet_____ of_____

LIFE CYCLE COST ANALYSIS
SUMMARY

Project No. & Title PN 063 (FY84) Reserve Bldg.
Installation & Location Reserve Center, Virginia
Design Feature Roadway / Parking Surface

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Date of Study 1 Jan 82

ALTERNATIVES ANALYZED

No.	Description/Title	Present Worth ☒ $ x 10³ ☐ $ x 10⁶				
		Initial	Energy	M&R	Other	Total
A	Asphalt w/ 2" Wearing Surface	29.3	0.0	3.0	4.3	36.6
B	Asphalt w/ 3" Wearing Surface	33.8	0.0	2.3	2.0	38.1

ECONOMIC RANKING

Rank	Alternative No. & Title	Economic Advantages of Top-Ranked Alternative		Basis for No. 1 Ranking
		LCC (PW) Difference (Dollars & Percent)	Other (Initial, Energy, Etc.)	
1	A Asphalt w/ 2" Wearing Surface	$1,500, 4%	Lower initial cost	Lower LCC (Uncertainty Not Relevant)
2	B Asphalt w/ 3" Wearing Surface			

KEY ASSUMPTIONS	NARRATIVE SUMMARY (Comments/Lessons Learned/Observations/Recommendations/Etc.)
	This LCCA is somewhat project independent and should therefore be used for comparison purposes with future roadway / parking surface LCCA's.

Key Participants - Name	Discipline	Organization	Telephone No.
Kenneth Anderson, PE	Civil	Blank Associates	(202) 555-0000

DA FORM 5605-2-R, DEC 86

Sheet _____ of _____

HVAC SYSTEM: CONVENTIONAL DESIGN

		PAGE
Alternative A:	Basic Input Data Summary	8
	Present Worth: Conventional Approach	9
Alternative B:	Basic input Data Summary	10
	Present Worth: Conventional Approach	11
Summary		12

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System - Conventional
Alt. No. A Title Const. Vol. w/ Recip. Chiller

LIFE CYCLE COST ANALYSIS BASIC INPUT DATA SUMMARY

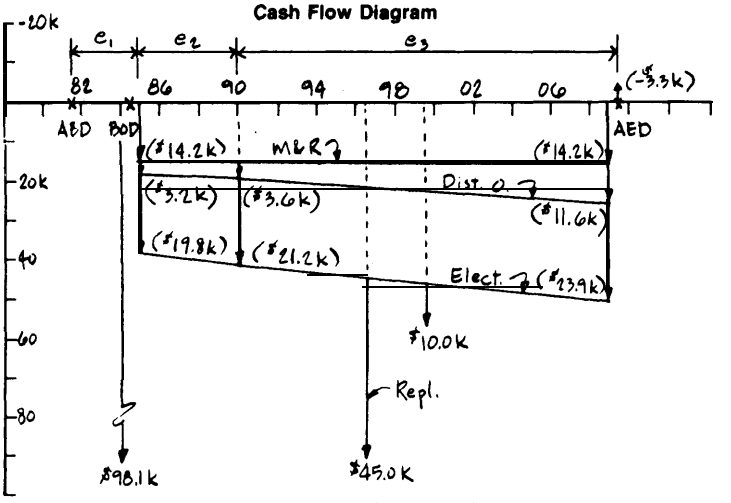
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	98.1	1 Jul 84		Engineer's Project Estimate
Replacement (Plant) yr. 12	45.0	1 Jan 97		Eng. Est. - Backup Sheet
Replacement (Fan) yr. 15	10.0	1 Jan 00		Eng. Est. - Backup Sheet
Salvage yr. 25	-3.3	1 Jan 10		Eng. Est. - Backup Sheet
Elect.	16.5	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
Dist. O.	2.9	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
M&R	14.2	1 Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System – Conventional
Alt. No. A Title Const. Vol. w/ Recip. Chiller

LIFE CYCLE COST ANALYSIS

31 December 1986

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

One-Time Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	0.5	98.1	$(1.0)^{2.5}$	98.1	$(\frac{1}{1.1})^{0.5}=0.7888$	77.3
Replacement/Maintenance	15.0	45.0	$(1.0)^{15}$	45.0	$(\frac{1}{1.1})^{15}=0.2394$	10.8
Replacement/Equipment	18.0	10.0	$(1.0)^{18}$	10.0	$(\frac{1}{1.1})^{18}=0.1800$	1.8
Salvage	25	280	$(1.0)^{28}$	33	$(\frac{1}{1.1})^{28}=0.0069$	0.2

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul – Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Annual Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 85-89	3.5	7.5	5	16.5	$(1.0528)^{3.5}$	19.8	4.278	84.7	$(\frac{1}{1.1})^{3}=0.7164$	60.7
② 90-09	8.5	27.5	20	16.5	$(1.0528)^{3.5}(1.0141)^{5}$	21.2	9.768	207.0	$(\frac{1}{1.1})^{8.5}=0.4448$	92.1
Dist. O. ① 85-89	3.5	7.5	5	2.9	$(1.0252)^{3.5}$	3.2	4.375	14.0	0.7164	10.0
② 90-09	8.5	27.5	20	2.9	$(1.0252)^{3.5}(1.0264)^{5}$	3.6	14.805	53.3	0.4448	23.7
M&R	3.5	27.5	25	14.2	$(1.0)^{3.5}$	14.2	9.985	141.8	0.7164	101.6

	Initial Costs	Energy/Fuel Costs	M&R Costs	Other Costs		Total
Net Present Worth	77	+ 187	+ 102	+ 12	=	378

DA FORM 5605-4-R, DEC 86

Sheet ____ of ____

Project No. & Title PN 175 (FY84) Admin. Bldg.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature HVAC System - Conventional

Alt. No. B Title Variable Air Vol w/ R. Chiller

LIFE CYCLE COST ANALYSIS BASIC INPUT DATA SUMMARY

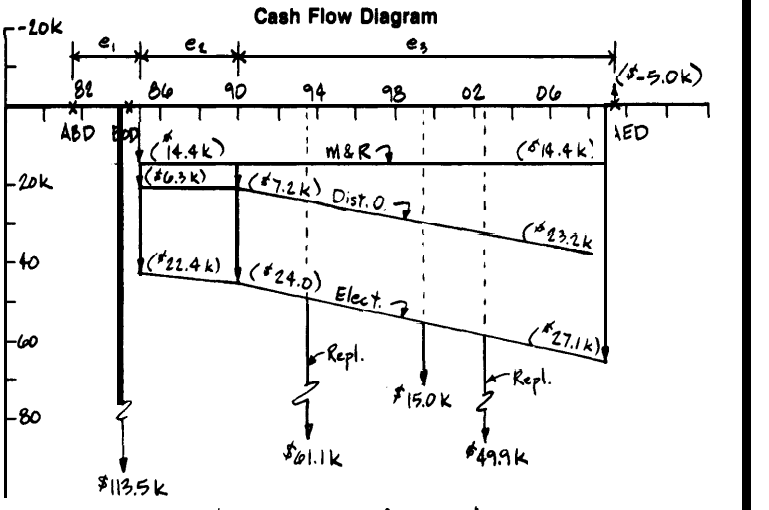
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	113.5	1 Jul 84		Engineer's Project Estimate
Replacement (Plant) yr. 9	61.1	1 Jan 94		Eng. Est. - Backup Sheet
Replacement (Fan) yr. 15	15.0	1 Jan 00		Eng. Est. - Backup Sheet
Replacement (Plant) yr 18	48.9	1 Jan 03		Eng. Est. - Backup Sheet
Salvage	-5.0	1 Jan 10		Eng. Est. - Backup Sheet
Elect.	18.7	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
Dist. O.	5.8	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
M & R	14.4	1 Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System - Conventional
Alt. No. B Title Variable Air Vol. w/ R. Chiller

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

31 December 1986

For use of this form, see TM 5-802-1; the proponent agency is USACE.

One-Time Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years From ABD	Cost on ABD	Escalation Factor	Escal.Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	2.5	113.5	$(1.0)^{2.5}$	113.5	$(\frac{1}{1.1})^{2.5}=0.778$	88.3
Replacement (Plant) yr. 9	12.0	61.1	$(1.0)^{12}$	61.1	$(\frac{1}{1.1})^{12}=0.319$	19.5
Replacement (Fan) yr. 15	18.0	15.0	$(1.0)^{15}$	15.0	$(\frac{1}{1.1})^{18}=0.180$	2.7
Replacement (Plant) yr. 18	21.0	48.9	$(1.0)^{21}$	48.9	$(\frac{1}{1.1})^{21}=0.135$	6.6
Salvage yr. 25	28.0	-5.0	$(1.0)^{28}$	-5.0	$(\frac{1}{1.1})^{28}=0.069$	-0.3

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Annual Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal.Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 85-89	3.5	7.5	5	18.7	$(1.0528)^{3.5}$	22.4	4.278	95.8	$(\frac{1}{1.1})^{3.5}=0.7164$	68.6
② 90-09	8.5	27.5	20	18.7	$(1.0528)^{3.5}(1.0141)^{5}$	24.0	9.768	234.4	$(\frac{1}{1.1})^{8.5}=0.4448$	104.3
Dist. O. ① 85-89	3.5	7.5	5	5.8	$(1.0252)^{3.5}$	6.3	4.375	27.6	0.7164	19.8
② 90-09	8.5	27.5	20	5.8	$(1.0252)^{3.5}(1.0264)^{5}$	7.2	14.805	106.6	0.4448	47.4
M&R	3.5	27.5	25	14.4	$(1.0)^{3.5}$	14.4	9.985	143.8	0.7164	103.0

Net Present Worth:	Initial Costs	+	Energy/Fuel Costs	+	M&R Costs	+	Other Costs	=	Total
	88	+	240	+	103	+	28	=	459

DA FORM 5605-4-R, DEC 86

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Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System - Conventional

Date of Study 1 Jan 82

LIFE CYCLE COST ANALYSIS SUMMARY

For use of this form, see TM 5-802-1; the proponent agency is USACE.

ALTERNATIVES ANALYZED

No.	Description/Title	Present Worth ☒ $ x 10³ ☐ $ x 10⁶				
		Initial	Energy	M&R	Other	Total
A	Const. Vol. w/ Recip. Chiller	77	187	102	12	378
B	Variable Air Vol. w/ R. Chiller	88	240	103	28	459

ECONOMIC RANKING

Rank	Alternative No. & Title	Economic Advantages of Top-Ranked Alternative		Basis for No. 1 Ranking
		LCC (PW) Difference (Dollars & Percent)	Other (initial, Energy, Etc.)	
1 2	A Const. Vol w/ Recip. Chiller B Variable Air Vol w/ R. Chiller	$81,000, 21%	Lower initial cost, Less energy consumption	Lower LCC

KEY ASSUMPTIONS	NARRATIVE SUMMARY (Comments/Lessons Learned/Observations/Recommendations/Etc.)

Key Participants - Name	Discipline	Organization	Telephone No.
William Smith, PE (Major USA, Ret.)	Mechanical	A-E Associates	(601) 555-3000
Roosevelt Brown, PE	Electrical	A-E Associates	(601) 555-3000

DA FORM 5605-2-R, DEC 86

Sheet ____ of ____

HVAC SYSTEM: ENERGY CONSERVATION

		PAGE
Alternative A:	Basic Input Data Summary	14
	Present Worth: Conventional Approach	15
Alternative B:	Basic input Data Summary	16
	Present Worth: Conventional Approach	17
Alternative C:	Basic Input Data Summary	18
	Present Worth: Conventional Approach	19
Alternative D:	Basic input Data Summary	20
	Present Worth: Conventional Approach	21
Summary		22

Project No. & Title PN 175 (FY 84) Admin. Bldg.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature HVAC System: Energy Conservation

Alt. No. A Title Const. Vol. w/ Recip. Chiller (no setback, no economy cycle)

LIFE CYCLE COST ANALYSIS

BASIC INPUT DATA SUMMARY

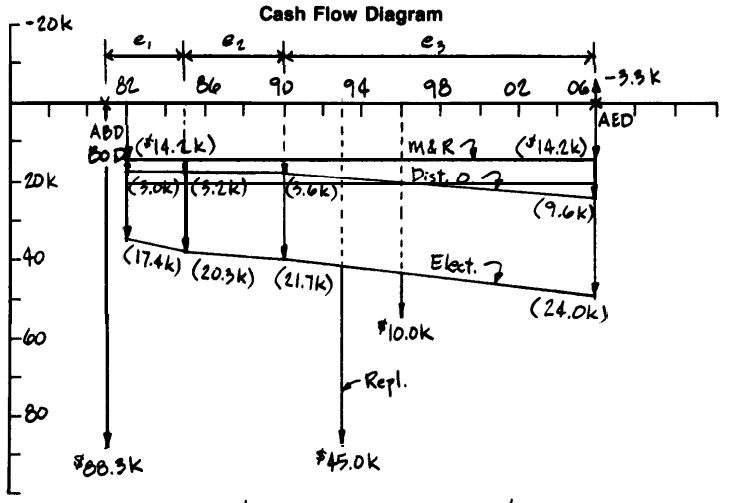
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		FEMP
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jul 81
Analysis End Date (AED)		1 Jul 06
Midpoint of Construction		N.A.
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jul 81
DOE Region		4
Annual Discount Rate		7%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	88.3 (98.1 less 10%)	1 Jul 84	1 Jul 81	Engineer's Project Estimate
Replacement (Plant) yr 12	45.0	1 Jan 97	1 Jul 93	Eng. Est. - Backup Sheet
Replacement (Fan) yr 15	10.0	1 Jan 00	1 Jul 96	Eng. Est. - Backup Sheet
Salvage yr 25	-3.3	1 Jan 10	1 Jul 06	Eng. Est. - Backup Sheet
Elect.	16.5	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
Dist. O.	2.9	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
M&R	14.2	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature HVAC System: Energy Conservation

Alt. No. A Title Const. Vol. w/ Recip. Chiller (no setback, no economy cycle)

Criteria Reference	FEMP
Analysis Base Date (ABD)	1 Jul 81
Analysis End Date (AED)	1 Jul 06
Midpoint of Construction	N.A.
BOD for Analysis	1 Jul 81
Annual Discount Rate	7%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.03
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Net Investment Cost	0	88.3	$(1.0)^0$	88.3	$(\frac{1}{1.07})^0 = 1.0$	88.3
Replacement (Plant) yr. 12	12	45.0	$(1.0)^{12}$	45.0	$(\frac{1}{1.07})^{12} = 0.444$	20.0
Replacement (Fan) yr. 15	15	10.0	$(1.0)^{15}$	10.0	$(\frac{1}{1.07})^{15} = 0.362$	3.6
Salvage yr. 25	25	-3.3	$(1.0)^{25}$	-3.3	$(\frac{1}{1.07})^{25} = 0.184$	-0.6

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 82-84	1.0	3.0	3	16.5	$(1.0528)^1$	17.4	2.732	51.4	0.9346	48.0
② 85-89	4.0	8.0	5	16.5	$(1.0528)^4$	20.3	4.504	91.4	0.7629	69.7
③ 90-06	9.0	25.0	17	16.5	$(1.0528)^4(1.0141)^5$	21.7	10.888	236.3	0.5439	128.5
Dist. O. ① 82-84	1.0	3.0	3	2.9	$(1.0252)^1$	3.0	2.876	8.6	0.9346	8.0
② 85-89	4.0	8.0	5	2.9	$(1.0252)^4$	3.2	4.609	14.7	0.7629	11.2
③ 90-06	9.0	25.0	17	2.9	$(1.0252)^4(1.0264)^5$	3.6	16.211	58.4	0.5439	31.8
M&R	1.0	25.0	25	14.2	$(1.0)^1$	14.2	12.469	177.1	0.9346	165.5

	Initial Costs	Energy Cost Costs	M&R Costs	Other Costs	
NPW	80	197	166	23	574

DA FORM 5605-4-R, DEC 86

Sheet ____ of ____

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System: Energy Conservation
Alt. No. B Title Const. Vol. w/ Recip. Chiller (setback & economy cycle)

LIFE CYCLE COST ANALYSIS BASIC INPUT DATA SUMMARY

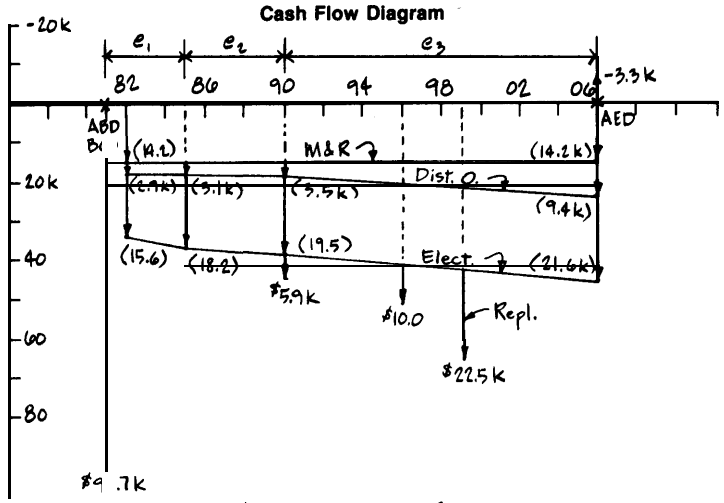
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		FEMP
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jul 81
Analysis End Date (AED)		1 Jul 06
Midpoint of Construction		N.A.
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jul 81
DOE Region		4
Annual Discount Rate		7%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	93.7 (104.1 less 10%)	1 Jul 84	1 Jul 81	Engineer's Project Estimate
Replacement (Plant) yr. 9	5.9	1 Jan 94	1 Jul 90	Eng. Est. - Backup Sheet
Replacement (Fan) yr. 15	10.0	1 Jan 00	1 Jul 96	Eng. Est. - Backup Sheet
Replacement (Plant) yr. 18	22.5	1 Jan 03	1 Jul 99	Eng. Est. - Backup Sheet
Salvage yr. 25	- 3.3	1 Jan 10	1 Jul 06	Eng. Est. - Backup Sheet
Elect.	14.8	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
Dist. O.	2.8	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
M&R	14.2	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. Title PN 175 (FY84) Admin. Bldg.
Installation Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System: Energy Conservation
Alt. No. B Title Const. Vol. w/ Recip. Chiller (setback & economy cycle)

31 December 986

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal.Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Net Investment Cost	0	93.7	$(1.0)^0$	93.7	1.0	93.7
Replacement (Plant) yr. 9	9	5.9	$(1.0)^9$	5.9	$(\frac{1}{1.07})^9 = 0.544$	3.2
Replacement (Fan) yr. 15	15	10.0	$(1.0)^{15}$	10.0	$(\frac{1}{1.07})^{15} = 0.362$	3.6
Replacement (Plant) yr. 18	18	22.5	$(1.0)^{18}$	22.5	$(\frac{1}{1.07})^{18} = 0.296$	6.7
Salvage yr. 25	25	-3.3	$(1.0)^{25}$	-3.3	$(\frac{1}{1.07})^{25} = 0.184$	-0.6

Criteria Reference	FEMP
Analysis Base Date (ABD)	1 Jul 81
Analysis End Date (AED)	1 Jul 06
Midpoint of Construction	N.A.
BOD for Analysis	1 Jul 81
Annual Discount Rate	7%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal.Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 82-84	1.0	3.0	3	14.8	$(1.0528)^1$	15.6	2.952	46.1	$(\frac{1}{1.07})^1 = 0.9346$	43.1
② 85-89	4.0	8.0	5	14.8	$(1.0528)^4$	18.2	4.504	82.0	0.7629	62.6
③ 90-06	9.0	25.0	17	14.8	$(1.0528)^4(1.0141)^5$	19.5	10.888	212.3	0.5439	115.5
Dist. O. ① 82-84	1.0	3.0	3	2.8	$(1.0252)^1$	2.9	2.876	8.3	0.9346	7.8
② 85-89	4.0	8.0	5	2.8	$(1.0252)^4$	3.1	4.609	14.3	0.7629	10.9
③ 90-06	9.0	25.0	17	2.8	$(1.0252)^4(1.0264)^5$	3.5	16.211	56.7	0.5439	30.8
M&R	1.0	25.0	25	14.2	$(1.0)^1$	14.2	12.469	177.1	0.9346	165.5

Net Present Worth:	Initial Costs	+ Energy/Fuel Costs	+ M&R Costs	+ Other Costs	= Total
	94	271	166	13	544

Sheet ____

Project No. & Title PN 175 (FY84) Admin. Bldg.

Installation & Location AEDE Ammo. Plant, Miss.

Design Feature HVAC System: Energy Conservat. or.

Alt. No. C Title Const. Vol. w/ Dbl. Bundle Chiller (no setback, no economy cycle)

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

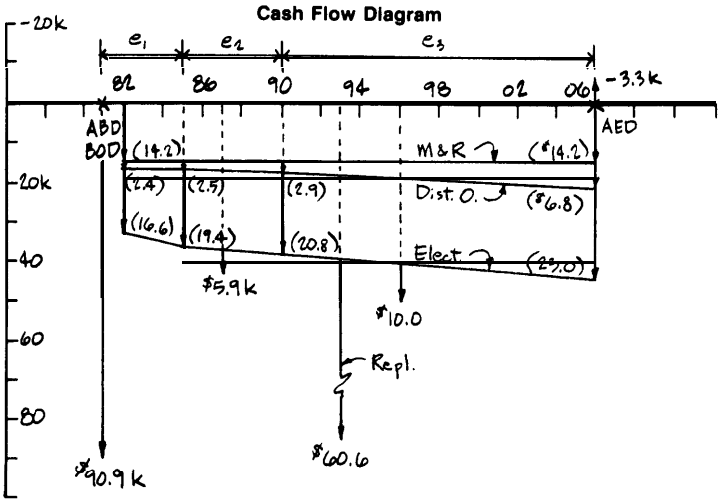
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		FEMP
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jul 81
Analysis End Date (AED)		1 Jul 06
Midpoint of Construction		N.A.
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jul 81
DOE Region		4
Annual Discount Rate		7%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	90.9 (101.0 less 10%)	1 Jul 84	1 Jul 81	Engineer's Project Estimate
Replacement (Plant) yr. 6	5.9	1 Jan 91	1 Jul 87	Eng. Est. - Backup Sheet
Replacement (Plant) yr. 12	60.6	1 Jan 97	1 Jul 93	Eng. Est. - Backup Sheet
Replacement (Fan) yr. 15	10.0	1 Jan 00	1 Jul 96	Eng. Est. - Backup Sheet
Salvage yr. 25	-3.3	1 Jan 10	1 Jul 06	Eng. Est. - Backup Sheet
Elect.	15.8	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
Dist. O.	2.3	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
M&R	14.2	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only.

Sheet_____ of_____

Project No. & Title PN 175 (FY84) Admin. Bldg.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature HVAC System: Energy Conservation

Alt. No. C Title Const. Vol. w/ Dbl. Bundle Chiller (no setback, no economy cycle)

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal.Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Net Investment Cost	0	90.9	$(1.0)^0$	90.9	$(\frac{1}{1.07})^0 = 1.0$	90.9
Replacement (Plant) yr. 10	6	5.9	$(1.0)^6$	5.9	$(\frac{1}{1.07})^6 = 0.6666$	3.9
Replacement (Fan) yr. 12	12	60.6	$(1.0)^{12}$	60.6	$(\frac{1}{1.07})^{12} = 0.4444$	26.9
Replacement (Plant) yr. 15	15	0.0	$(1.0)^{15}$	10.0	$(\frac{1}{1.07})^{15} = 0.3622$	3.6
Salvage yr. 25	25	-3.3	$(1.0)^{25}$	-3.3	$(\frac{1}{1.07})^{25} = 0.184$	-0.6

Criteria Reference	FEMP
Analysis Base Date (ABD)	1 Jul 81
Analysis End Date (AED)	1 Jul 06
Midpoint of Construction	N.A.
BOD for Analysis	1 Jul 81
Annual Discount Rate	7%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal.Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 82-84	1.0	3.0	3	15.8	$(1.0528)^1$	16.6	2.952	49.0	0.9346	45.8
② 85-89	4.0	8.0	5	15.8	$(1.0528)^4$	19.4	4.504	87.4	0.7629	66.7
③ 90-06	9.0	25.0	17	15.8	$(1.0528)^4(1.0141)^5$	20.8	10.888	226.5	0.5439	123.2
Dist. O. ① 82-84	1.0	3.0	3	2.3	$(1.0252)^1$	2.4	2.876	6.9	0.9346	6.4
② 85-89	4.0	8.0	5	2.3	$(1.0252)^4$	2.5	4.609	11.5	0.7629	8.8
③ 90-06	9.0	25.0	17	2.3	$(1.0252)^7(1.0464)^7$	2.9	16.211	47.0	0.5439	25.6
M&R	1.0	25.0	25	14.2	$(1.0)^1$	14.2	12.469	177.1	0.9346	165.5

	Initial Costs	Energy/Fuel Costs	M&R Costs	Other Costs	Total
Net Present Worth:	91	277	166	34	568

DA FORM 5605-4-R, DEC 86

Sheet ____ of ____

Project No. & Title PN 175 (FY84) Admin. Bldg.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature HVAC System: Energy Conservation

Alt. No. D Title Const. Vol. w/ Dbl. Bundle Chiller (setback & economy cycle)

LIFE CYCLE COST ANALYSIS

BASIC INPUT DATA SUMMARY

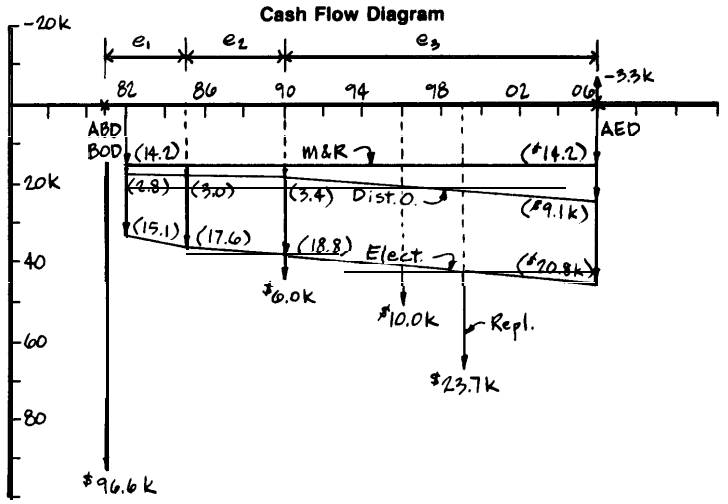
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		FEMP
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jul 81
Analysis End Date (AED)		1 Jul 06
Midpoint of Construction		N.A.
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jul 81
DOE Region		4
Annual Discount Rate		7%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	96.6 (107.3 less 10%)	1 Jul 84	1 Jul 81	Engineer's Project Estimate
Replacement (Plant) yr. 9	6.0	1 Jan 94	1 Jul 90	Eng. Est. - Backup Sheet
Replacement (Fan) yr 15	10.0	1 Jan 00	1 Jul 96	Eng. Est. - Backup Sheet
Replacement (Plant) yr 18	23.7	1 Jan 03	1 Jul 99	Eng. Est. - Backup Sheet
Salvage yr. 25	-3.3	1 Jan 10	1 Jul 06	Eng. Est. - Backup Sheet
Elect.	14.3	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
Dist. O.	2.7	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	BLAST Program Estimate
M&R	14.2	1 Jul 85 - 1 Jul 09	1 Jul 82 - 1 Jul 06	Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only

Sheet_____ of_____

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System: Energy Conservation
Alt. No. D Title Const. Vol. w/ Dbl. Bundle Chiller
(setback & economy cycle)

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal.Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Net Investment Cost	0	96.6	$(1.0)^0$	96.6	$\left(\frac{1}{1.07}\right)^0 = 1.0$	96.6
Replacement (Plant) yr. 9	9	6.0	$(1.0)^9$	6.0	$\left(\frac{1}{1.07}\right)^9 = 0.544$	3.3
Replacement (Fan) yr. 15	15	10.0	$(1.0)^{15}$	10.0	$\left(\frac{1}{1.07}\right)^{15} = 0.362$	3.6
Replacement (Plant) yr. 18	18	23.7	$(1.0)^{18}$	23.7	$\left(\frac{1}{1.07}\right)^{18} = 0.296$	7.0
Salvage yr. 25	25	-3.3	$(1.0)^{25}$	-3.3	$\left(\frac{1}{1.07}\right)^{25} = 0.184$	-0.6

Criteria Reference	FEMP
Analysis Base Date (ABD)	1 Jul 81
Analysis End Date (AED)	1 Jul 06
Midpoint of Construction	N.A.
BOD for Analysis	1 Jul 81
Annual Discount Rate	7%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Dist. O.	2.52	2.64	6.35
Other	0.00	0.00	0.00

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal.Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 82-84	1.0	3.0	3	14.3	$(1.0528)^1$	15.1	2.952	44.6	0.9346	41.7
② 85-89	4.0	8.0	5	14.3	$(1.0528)^4$	17.6	4.504	79.3	0.7629	60.5
③ 90-06	9.0	25.0	17	14.3	$(1.0528)^4(1.0141)^5$	18.8	10.888	204.7	0.5439	111.3
Dist. O. ① 82-84	1.0	3.0	3	2.7	$(1.0252)^1$	2.8	2.876	8.1	0.9346	7.6
② 85-89	4.0	8.0	5	2.7	$(1.0252)^4$	3.0	4.609	13.8	0.7629	10.5
③ 90-06	9.0	25.0	17	2.7	$(1.0252)^4(1.0264)^5$	3.4	16.211	55.1	0.5439	30.0
M&R	1.0	25.0	25	14.2	$(1.0)^1$	14.2	12.469	177.1	0.9346	165.5

Net Present Worth:	Initial Costs	+	Energy/Fuel Costs	+	M&R Costs	+	Other Costs	=	Total
	97	+	262	+	166	+	13	=	538

DA FORM 5605-4-R, DEC 86

Sh ____ ____

LIFE CYCLE COST ANALYSIS
SUMMARY

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature HVAC System: Energy Conservation

Date of Study 1 Jan 82

For use of this form, see TM 5-802-1; the proponent agency is USACE.

ALTERNATIVES ANALYZED

No.	Description/Title	Present Worth ☒ $ x 10³ ☐ $ x 10⁶				
		Initial	Energy	M&R	Other	Total
A	Const. Vol. w/ Recip. Chiller (no SB/EC)	88	297	166	23	574
B	Const. Vol w/ Recip. Chiller (with SB/EC)	94	271	166	13	544
C	Const Vol w/ Dbl. Bundle Chiller (no SB/EC)	91	277	166	34	568
D	Const. Vol w/ D. Bundle Chiller (with SB/EC)	97	262	166	13	538

ECONOMIC RANKING

Rank	Alternative No. & Title	Economic Advantages of Top-Ranked Alternative		Basis for No. 1 Ranking
		LCC (PW) Difference (Dollars & Percent)	Other (Initial, Energy, Etc.)	
1	D Const Vol w/ D. Bun. Chill (with SB/EC)	$6,000, 1%	Lower energy consumption	Designer's Choice
2	B Const. Vol w/ Recip. Chill (with SB/EC)			
3	C Const. Vol w/ D. Bun. Chill (no SB/EC)			
4	A Const. Vol w/ R. Chill (no SB/EC)			

KEY ASSUMPTIONS	NARRATIVE SUMMARY (Comments/Lessons Learned/Observations/Recommendations/Etc.)

Key Participants - Name	Discipline	Organization	Telephone No.
William Smith, PE (Major USA Ret.)	Mechanical	A-E Associates	(601) 555-3000
Roosevelt Brown, PE	Electrical	A-E Associates	(601) 555-3000

DA FORM 5605-2-R, DEC 86

Sheet ____ of ____

DOMESTIC HOT WATER HEATING SYSTEM: ENERGY CONSERVATION (SOLAR)

		PAGE
Alternative B-A:	Basic Input Data Summary	24
	Present Worth: Conventional Approach	25
Savings-To-investment Ratio (SIR) & Discounted Payback Calculation		26
Summary		27

Project No. & Title PN 175 (FY84) Admin. Bldg.

Installation & Location ABCDE Ammo. Plant, Miss.

Design Feature Domestic Hot Water Heating System

Alt. No. B-A Title Solar System Increment

LIFE CYCLE COST ANALYSIS

BASIC INPUT DATA SUMMARY

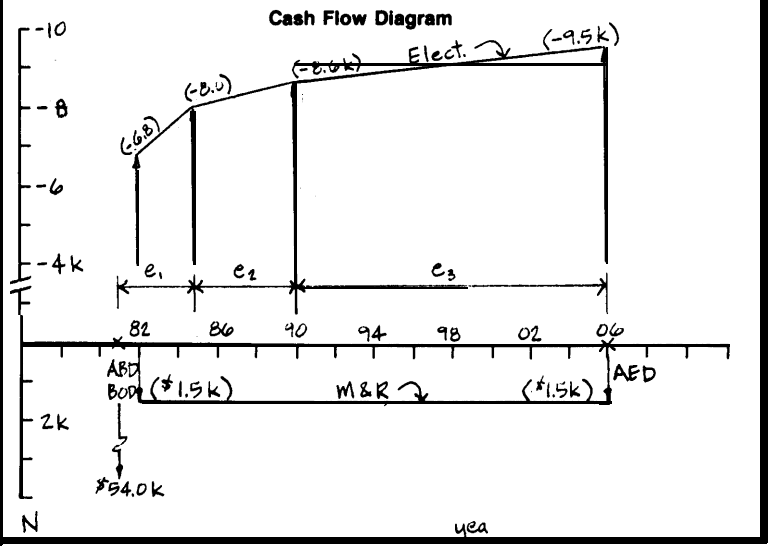
For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		FEMP
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jul 81
Analysis End Date (AED)		1 Jul 06
Midpoint of Construction		N.A.
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jul 81
DOE Region		4
Annual Discount Rate		7%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul – Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

Cash Flow Diagram



Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	54.0 (60.0 less 10%)	1 Jul 84	1 Jul 81	Engineer's Project Estimate
Elect.	-6.5	1 Jul 85 - 1 Jul 04	1 Jul 82 - 1 Jul 06	Eng. Est. – Backup Sheet
M&R	1.5	1 Jul 85 - 1 Jul 04	1 Jul 82 - 1 Jul 06	Eng. Est. – Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

31 December 1986

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. & Title PN 175 (FY 84) Admin. Bldg.
Installation & Location ABCDE Army Plant, Miss.
Design Feature Domestic Hot Water Heating System
Alt. No. B-A Title Solar System Increment

Criteria Reference	FEMP
Analysis Base Date (ABD)	1 Jul 81
Analysis End Date (AED)	1 Jul 06
Midpoint of Construction	N A
BOD for Analysis	1 Jul 81
Annual Discount Rate	7%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 81-85	85-90	90-06
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	0	54.0	$(1.0)^0$	54.0	$(1+i)^{-1} = 1.0$	54.0

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred) 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 82-84	1.0	3.0	3	-6.5	$(1.0528)^1$	-6.8	2.952	-20.1	0.7346	-18.8
② 85-89	4.0	8.0	5	-6.5	$(1.0528)^4$	-8.0	4.504	-36.0	0.7629	-27.5
③ 90-06	9.0	25.0	17	-6.5	$(1.0528)^4(1.0141)^5$	-8.6	10.888	-93.6	0.5439	-50.9
M&R	1.0	25.0	25	1.5	$(1.0)^1$	1.5	12.469	18.7	0.9346	17.5

	Initial Costs	Energy/Fuel Costs	M&R Costs	Other Costs	Total
Net Present Worth	54.0 +	-97.2 +	17.5 +	0.0 =	-25.7

DA FORM 5605-4-R, DEC 86

Sheet ____ of ____

LIFE CYCLE COST ANALYSIS

SAVINGS-TO-INVESTMENT RATIO (SIR) & DISCOUNTED PAYBACK CALCULATION

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. & Title: PN 175 (FY84) Admin. Bldg.
Installation & Location: ABCDE Ammo. Plant, Miss.
Design Feature: Domestic Hot Water Heating System
Baseline System: Elect. Hot Water Heating Syst.
Investment: Solar Hot Water Heating

SIR Calculation				Discounted Payback Calculation				
				Trial Values of Post-BOD Analysis Period, n(years)				
Element of Calculation	System	Type of Cost/Benefit		n = 17	n = 12	n = 13	n =	n =
PW of Operating & Maintenance Costs ☒ $ x 10³ ☐ $ x 10⁶	Base-line	Energy/Fuel						
		Other O&M						
		Total						
	Invest-ment	Energy/Fuel						
		Other O&M						
		Total						
	Δ	Net Savings	79.7	65.1	51.5	54.6		
PW of Capital Costs ☒ $ x 10³ ☐ $ x 10⁶	Base-line	Initial (MCP)						
		Replacements						
		Terminal						
		Other						
		Total Net						
	Invest-ment	Initial (MCP)						
		Replacements						
		Terminal						
		Other						
		Total Net						
	-Δ	Extra Investment	54.0	54.0	54.0	54.0		
SIR	Δ	Net Savings / Extra Investment	79.7 / 54.0 = 1.5	65.1 / 54.0 = 1.2	51.5 / 54.0 = 0.95	54.6 / 54.0 = 1.01		
Next Trial n Value (Years)	A = This SIR — 1.0		0.5	0.2	-0.05			
	B = This SIR — Last SIR*		1.5	-0.3	-0.25			
	C = Ratio of A to B		0.33	-0.67	+0.2			
	D = Last n* — This n		-25	8	5			
	E = Product of C & D		-8.3	-5.4	+1			
	F = Next n = This n + E		16.7	12	13			

DA FORM 5605-1-R, DEC 86

*In calculating First Trial n Value for Discounted Payback Calculation, Use Last SIR = Last n = 0.

Sheet _____ of _____

LIFE CYCLE COST ANALYSIS
SUMMARY

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. & Title PN 175 (FY84) Admin. Bldg.
Installation & Location ABCDE Ammo. Plant, Miss.
Design Feature Domestic Hot Water Heating System

Date of Study 1 Jan 82

ALTERNATIVES ANALYZED

No.	Description/Title	Present Worth ☒ $ x 10³ ☐ $ x 10⁶				
		Initial	Energy	M&R	Other	Total
A	Elect. Hot Water Heating Alone	–	–	–	–	–
B	Solar Heating w/ Elect. Backup	–	–	–	–	–
B-A	Solar System Increment	54.0	-97.2	17.5	0.0	-25.7

ECONOMIC RANKING

Rank	Alternative No. & Title	Economic Advantages of Top-Ranked Alternative		Basis for No. 1 Ranking
		LCC (PW) Difference (Dollars & Percent)	Other (Initial, Energy, Etc.)	
1	B Solar Heating w/ Elect. Backup	$25,700	Lower energy consumption	Lower LCC
2	A Elect. Hot Water Heating Alone			

KEY ASSUMPTIONS	NARRATIVE SUMMARY (Comments/Lessons Learned/Observations/Recommendations/Etc.)
	Savings-to-Investment Ratio (SIR) = 1.5
	Discounted Payback Period (DPP) = 13 years

Key Participants - Name	Discipline	Organization	Telephone No.
Rosevelt Brown, PE	Electrical	A-E Associates	(601) 555-3000
Stephen Kirk, AIA	Architectural	A-E Associates	(601) 555-3000

DA FORM 5605-2-R, DEC 86

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WASTEWATER TREATMENT FACILITY

		PAGE
Alternative A:	Basic Input Data Summary	29
	Present Worth: Conventional Approach	30
Alternative B:	Basic Input Data Summary	31
	Present Worth: Conventional Approach	32
Alternative C:	Basic input Data Summary	33
	Present Worth: Conventional Approach	34
Alternative D:	Basic input Data Summary	35
	Present Worth: Conventional Approach	36
Summary		37

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

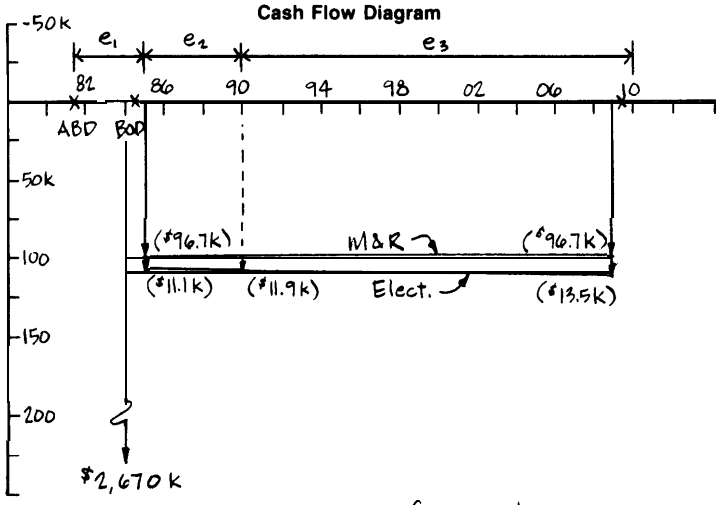
Project No. & Title PN 003 (FY84) Wastewater T.F.
Installation & Location Fort Oaks, Alabama
Design Feature Process
Alt. No. A Title Conventional Trickling Filter

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	2,670	1 Jul 84		Engineer's Project Estimate
Elect.	9.3	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
M&R	96.7	1 Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. & Title PN 003 (FY 84) Wastewater T.F.

Installation & Location Fort Oaks, Alabama

Design Feature Process

Alt. No. A Title Conventional Trickling Filter

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 81-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	2.5	2670	$(1.0)^{2.5}$	2670	$\left(\frac{1}{1.1}\right)^{2.5}=0.7888$	2104

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred) 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 85-89	3.5	7.5	5	9.3	$(1.0528)^{2.5}$	11.1	4.278	47.5	$\left(\frac{1}{1.1}\right)^{2.5}=0.7164$	34.0
② 90-09	8.5	27.5	20	9.3	$(1.0528)^{3.5}(1.041)^{5}$	11.9	9.768	116.2	$\left(\frac{1}{1.1}\right)^{8.5}=0.4448$	51.7
W.R.	3.5	17.5	25	96.7	$(1.0)^{3.5}$	96.7	9.985	965.5	0.7164	691.7

Net Present Worth:	Initial Costs	Energy/Fuel Costs	MaR Costs	Other Costs	Total
	2104 +	86 +	692 +	0 =	2882

DA FORM 5605-4-R, DEC 86

Sheet_____ of_____

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

For use of this form, see TM 5-802-1; the proponent agency is USACE.

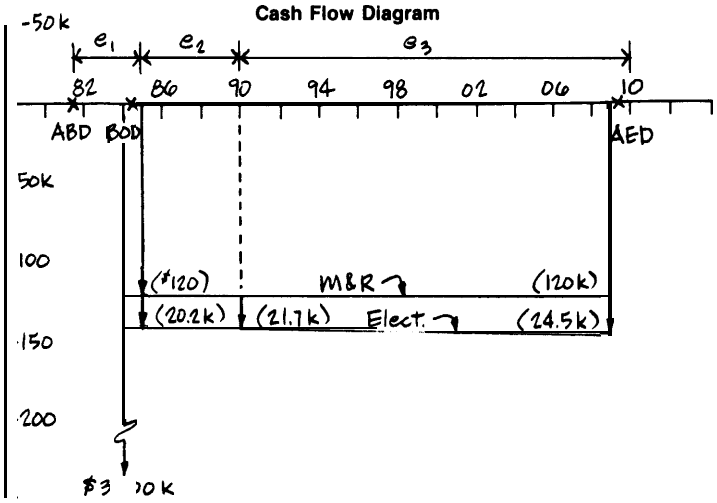
Project No. & Title PN 003 (FY 84) Wastewater T. F.
Installation & Location Fort Oaks, Alabama
Design Feature Process
Alt. No. B **Title** Innovative: Rotating Biological Contactors (RBC)

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Principal Assumptions

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	3,600	1 Jul 84		Engineer's Project Estimate
Elect.	16.9	Jul 85 - 1 Jul 09		BLAST Program Estimate
M&R	120	Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

Project No. & Title PH 003 (FY84) Wastewater T.F.

Installation & Location Fort Oaks, Alabama

Design Feature Process

Alt. No. B Title Innovative: Rotating Biological Contactors (RBC)

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Differential Escalation Rate per Year (%)

Type of Cost	Timeframe: Jul-Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶

	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	2.5	3600	$(1.0)^{2.5}$	3600	$\left(\frac{1}{1.1}\right)^{2.5}=0.788$	2837

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶

	Years from ABD: First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. ① 85-89	3.5	7.5	5	16.9	$(1.0528)^{2.5}$	20.2	4.278	86.4	$\left(\frac{1}{1.1}\right)^{2.5}=0.7164$	61.9
② 90-09	8.5	27.5	20	16.9	$(1.0528)^{3.5}/(1.0141)^{5}$	21.7	9.7068	212.0	$\left(\frac{1}{1.1}\right)^{8.5}=0.4448$	94.3
M&R	3.5	27.5	25	120	$(1.0)^{3.5}$	120	9.985	1198	0.7164	58

Net Present Worth:	Initial Costs	+	Energy/Fuel Costs	+	M&R Costs	+	Other Costs	=	Total
	2837	+	156	+	858	+	0	=	3851

DA FORM 5605-4-R, DEC 86

Sheet_____ of_____

LIFE CYCLE COST ANALYSIS
BASIC INPUT DATA SUMMARY

For use of this form, see TM 5-802-1; the proponent agency is USACE.

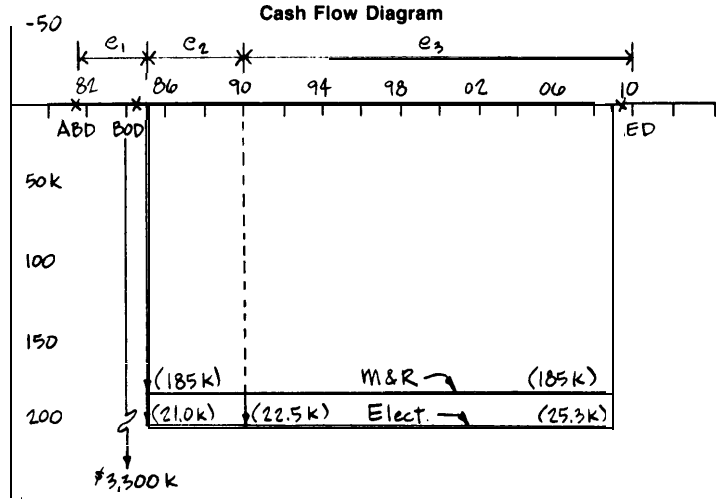
Project No. & Title PN 003 (FY 84) Wastewater T.F.
Installation & Location Fort Oaks, Alabama
Design Feature Process
Alt. No. C **Title** Innovative: Continuous Loop Reactor

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun		
	82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost	3,320	1 Jul 84		Engineer's Project Estimate
Elect.	17.5	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
M&R	185	1 Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply
**For Recurring Annual Costs, show date of first and last costs only.

Sheet _____ of _____

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. Title PN 003 (FY84) Wastewater T.E.
Installation & Location Fort Oaks, Alabama
Design "a" Process
Alt. No. C Title Innovative: Continuous Loop Reactor

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul-Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

One-Time Costs ☒ $ x 10³ ☐ $ x 10⁶	Years From ABD	Cost on ABD	Escalation Factor	Escal.Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	2.5	3320	$(1.0)^{2.5}$	3320	$(\frac{1}{1.1})^{2.5} = 0.788$	2616

Annual Costs ☒ $ x 10³ ☐ $ x 10⁶	Years from ABD First Incurred	Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal.Cost (Time First Incurred) 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect ① 85-89	3.5	7.5	5	17.5	$(1.0528)^{3.5}$	21.0	4.278	89.8	$(\frac{1}{1.1})^{3.5} = 0.7164$	64.3
② 90-09	8.5	27.5	20	17.5	$(1.0528)^{3.5}(1.0141)^{5}$	22.5	9.768	219.8	$(\frac{1}{1.1})^{19.5} = 0.4448$	97.8
M&R	3.5	27.5	25	185		185	9.985	1847	0.7164	1323

Net Present Worth:	Initial Costs	+	Energy/Fuel Costs	+	M&R Costs	+	Other Costs	=	Total
	2616	+	162	+	1323	+	0	=	4101

DA FORM 5605-4-R, DEC 86

LIFE CYCLE COST ANALYSIS

BASIC INPUT DATA SUMMARY

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Project No. & Title PN 003 (FY 84) Wastewater T.F.

Installation & Location Fort Oaks, Alabama

Design Feature Process

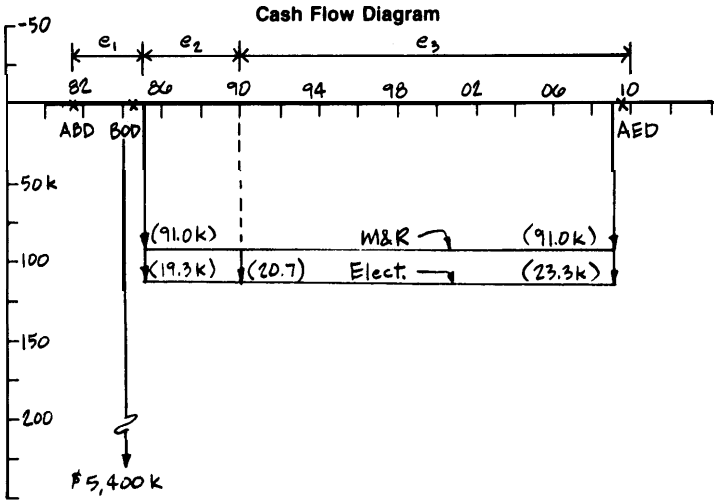
Alt. No. D **Title** Conventional: Land Spray Irrigation

Criteria Reference		HQDA
Date of Study (DOS)		1 Jan 82
Analysis Base Date (ABD)		1 Jan 82
Analysis End Date (AED)		1 Jan 10
Midpoint of Construction		1 Jul 84
Beneficial Occupancy Date (BOD)	Actual Projected	1 Jan 85
	Assumed for Analysis	1 Jan 85
DOE Region		4
Annual Discount Rate		10%

Type of Cost	Differential Escalation Rate per Year (%) Timeframe: Jul - Jun 82-85	85-90	90-10
Elect.	5.28	1.41	0.63
Other	0.00	0.00	0.00

Principal Assumptions

Cash Flow Diagram



Note: Time lines denote 1 Jul of year shown

Cost Element	Cost on ABD ☒ $ x 10³ ☐ $ x 10⁶	Time Cost Incurred** Actual Projected Dates	Dates for Analysis (If Different)*	Source(s) of Data
Initial Investment Cost①	5,400	1 Jul 84		Engineer's Project Estimate
Elect.	16.1	1 Jul 85 - 1 Jul 09		BLAST Program Estimate
M&R	91.0	1 Jul 85 - 1 Jul 09		Eng. Est. - Backup Sheet
① Includes 5[illegible]	[illegible]	[illegible]		

DA FORM 5605-3-R, DEC 86

*When 10 CFR436A Criteria Apply

**For Recurring Annual Costs, show date of first and last costs only.

Sheet_____ of_____

Project No. & Title PN 003 (FY84) Wastewater T.F.

Installation & Location Fort Oaks, Alabama

Design Feature Process

Alt. No. D Title Conventional : Land Spray Irrigation

LIFE CYCLE COST ANALYSIS

PRESENT WORTH: CONVENTIONAL APPROACH

For use of this form, see TM 5-802-1; the proponent agency is USACE.

Criteria Reference	HQDA
Analysis Base Date (ABD)	1 Jan 82
Analysis End Date (AED)	1 Jan 10
Midpoint of Construction	1 Jul 84
BOD for Analysis	1 Jan 85
Annual Discount Rate	10%

Differential Escalation Rate per Year (%)

Timeframe: Jul-Jun

Type of Cost	82-85	85-90	90-10
Elect	5.18	4	0.63
Other	0.00	0.00	0.00

One-Time Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years From ABD	Cost on ABD	Escalation Factor	Escal. Cost (Time Incurred)	Discount Factor	Present Worth on ABD
Initial Investment Cost	2.5	5400	$(1.0)^{2.5}$	5400	$(\frac{1}{1.1})^{2.5} = 0.788$	4255

Annual Costs (☒ $ x 10³ ☐ $ x 10⁶)	Years from ABD: First Incurred	Years from ABD: Last Incurred	Total No. of Payments	Annual Cost on ABD	Escalation Factor	Escal. Cost (Time First Incurred): 1st Ann. Cost in Series	Annual Series Eq Factor	Equiv. Single Cost	Discount Factor	Present Worth on ABD
Elect. (1) 85-89	3.5	7.5	5	16.1	$(1.0518)^{3.5}$	19.3	4.278	82.6	$(\frac{1}{1.1})^{3.5} = 0.7164$	59.2
(2) 90-09	8.5	17.5	10	16.1	$(1.0518)^{8.5}/(1.04)^{5}$	20.7	9.768	101.1	$(\frac{1}{1.1})^{8.5} = 0.4442$	44.9
W&R	3.5	27.5	25	91.0	$(1.0)^{3.5}$	91.0	9.985	908.6	0.7164	650.9

Initial Costs	Energy/Fuel Costs	M&R Costs	Other Costs	Total
4255 +	149 +	651 +	0 =	5055

Net Present Worth:

DA FORM 5605-4-R, DEC 86

Sheet_____ of_____

LIFE CYCLE COST ANALYSIS

SUMMARY

Project No. & Title PN 003(FY84) Wastewater T.F.

Installation & Location Fort Oaks, Alabama

Design Feature Process

Date of Study 1 Jan 82

For use of this form, see TM 5-802-1; the proponent agency is USACE.

ALTERNATIVES ANALYZED

No.	Description/Title	Present Worth ☒ $ x 10³ ☐ $ x 10⁶				
		Initial	Energy	M&R	Other	Total
A	Conventional Trickling Filter	2104	86	692	0	2882
B	Innovative: RBC	2837	156	858	0	3851
C	Innovative: Cont. Loop Reactor	2616	162	1323	0	4101
D	Conventional Land Spray Irrig.	4255	149	651	0	5055

ECONOMIC RANKING

Rank	Alternative No. & Title	Economic Advantages of Top-Ranked Alternative: LCC (PW) Difference (Dollars & Percent)	Other (Initial, Energy, Etc.)	Basis for No. 1 Ranking
1	A Conventional Trickling Filter	$536,000, 16%	Lowest initial cost, Least energy consumption	Lowest LCC
2	B Innovative: RBC			
3	C Innovative: Cont. Loop Reactor			
4	D Conventional Land Spray Irrig.			

KEY ASSUMPTIONS	NARRATIVE SUMMARY (Comments/Lessons Learned/Observations/Recommendations/Etc.)
	Alternative D would be a more competitive
	alternative if $2.5 million in land acquisition
	were not involved.
	115% of PW of alternative A = $3314 x 10³

Key Participants - Name	Discipline	Organization	Telephone No.
Bill Johnson, PE	Sanitary/Environ.	Environmental Eng.	(205) 525-1000
Ken Williams, PE	Mechanical	Environmental Eng.	(205) 525-1000
Steve Smith, PE	Electrical	Environmental Eng.	(205) 525-1000
Bob Washington, PE	Civil	Environmental Eng.	(205) 525-1000

DA FORM 5605-2-R, DEC 86

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