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FAA Technical Center Enhanced Airport Security System Project

Microwave Communications Subsystem Cost Benefit Analysis

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16. Abstract
A Life Cycle Cost/Cost Benefit Analysis based on a ten year period has been conducted on the Microwave Communications Subsystem of the Enhanced Airport Security System Project at Baltimore-Washington International Airport (BWI). The Life Cycle Cost of the subsystem is estimated at $49,073, as compared with a baseline system cost of $0. The primary benefit of this subsystem is in an increased level of airport and personnel safety.

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LIST OF ACRONYMS AND ABBREVIATIONS

BWI	Baltimore-Washington International Airport
CBS	Cost Breakdown Structure
COTS	Commercial Off-The-Shelf
DOT	Department of Transportation
DWG	Engineering Drawing
EASSP	Enhanced Airport Security System Project
FAATC	Federal Aviation Administration Technical Center
FCC	Federal Communications Commission
FRS	Fire Rescue Squad
HBS	Hardware Breakdown Structure
INSPC	Initial Spares and Consumables
INST	Installation
LCC	Life Cycle Cost
LCCA	Life Cycle Cost Analysis
MAA	Maryland Aviation Administration
MAN	Technical Manuals
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NDI	Non-Development Items
PME	Prime Mission Equipment

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

RAIDS	Ramp Area Intrusion Detection System
#REP	Number of Repairs
R&D	Research and Development
REPMTL	Repair Material
REPSP	Replenishment Spares
SFT	Software
SOC	Security Operations Center
TST	Testing

EXECUTIVE SUMMARY.

The Federal Aviation Administration Technical Center (FAATC) established the "Enhanced Airport Security System Project" (EASSP) at the Baltimore-Washington International Airport (BWI) as a Research and Development (R&D) Project in 1988. Installation of the EASSP equipment took place between late 1991 and early 1993. System evaluation and testing was completed in December of 1993.

The Microwave Communications Subsystem of the EASSP provides video and data links between BWI Terminal pier B and the Fire Rescue Service (FRS) headquarters building. It enables the FRS dispatcher to view the emergency exit doors and pier B secure area in order to release the exit door locks in the event of an emergency.

The purpose of this Life Cycle Cost Analysis/Cost Benefit Analysis is to present estimates of the total costs in all phases of the Microwave Communications Subsystem. This document details the assumptions, cost methodology, and data used in the analyses. Also addressed are the quantitative and qualitative benefits of the Microwave Communications Subsystem as compared to a baseline system.

The primary benefit of the Microwave Communications Subsystem lies in the increased level of safety provided by enabling the FRS personnel to monitor the emergency exit doors and be able to defeat the time-delayed opening controller in the event of an emergency. In the event of a fire in the pier, or if emergency personnel must enter the pier with emergency equipment, the Microwave Communications Subsystem could save lives by permitting immediate exit for the maximum number of people to escape a fire or allow emergency personnel to respond quickly to a potential life-threatening situation.

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1. INTRODUCTION

1.1 OBJECTIVES. This is the Life Cycle Cost Analysis (LCCA) for the Microwave Communications Subsystem of the Enhanced Airport Security System Project (EASSP) at Baltimore-Washington International Airport (BWI) for contract DFTA03-93-C-00042, Task Order 001. This report is formatted in accordance with U.S. Department of Transportation (DOT) Federal Aviation Administration (FAA) Order 1810.3 and presents estimates of the sum of the following costs: direct, indirect, recurring, non-recurring, and other related costs. These estimates are for the design, development, production, operation, maintenance, support, and phase-out of the Microwave Communications Subsystem of the EASSP.

1.2 SCOPE. This report presents the LCCA for the Microwave Communications Subsystem installed at pier B on the second floor of the BWI South Terminal and in the Fire Rescue Service (FRS) headquarters building dispatch room. Only equipment directly associated with the Microwave Communications Subsystem is analyzed. The screening point-to-FRS intercom system (except for the Audio Multiplexer transmitters and receivers), the fiber optic transmitter and video quadruplexer in the Security Operations Center (SOC), and the emergency exit doors at Screening Point B (with their associated magnetic locks and lock control electronics) are not part of the Microwave Communications System.

2. SYSTEM DESCRIPTION. The Microwave Communications Subsystem, as part of the Federal Aviation Administration Technical Center (FAATC) EASSP, provides video and data links between pier B and the FRS headquarters building. When the EASSP screening point and the revolving exit doors were installed, they provided a physical barrier between the secure and open areas of the terminal. At the same time emergency exit doors were also installed for safety reasons in the event of fire or other emergencies. Video cameras were installed to monitor all doors (exit and entry), as well as to view the secure areas of the pier. Switches for the magnetic locks are located at both pier B and the FRS headquarters building. The Microwave Communications Subsystem provides the video link between the pier cameras and the monitor at the FRS dispatcher console. This link enables FRS personnel to view the exit doors and the secure pier area on a 24-hour basis. The subsystem also provides a data link between the pier and the FRS dispatcher console that displays the magnetic door lock condition and enables FRS personnel to immediately release the door locks in the event of an emergency. The Microwave Communications Subsystem incorporates the following hardware elements.

2.1 PIER B EQUIPMENT. The Microwave Communications Subsystem is located in the telephone equipment room adjacent to the pier B screening point. The hardware consists of the baseband transmitter, the audio multiplexer receivers, and the fiber optic receiver and power transformer. The microwave transmitter antenna head is located on the communications tower on the roof of pier A. This equipment receives the fiber optic signals from the SOC, translates them to video and then transmits them via the microwave link to the FRS headquarters building. The multiplexer receivers translate the RS-232 encoded lock/unlock commands from an audio carrier to a digital signal and pass them to the exit door switch.

2.2 FRS EQUIPMENT. The hardware located in the dispatch office of the FRS headquarters building are: the baseband receiver, the audio multiplexer transmitters, the delay override switch, and the power transformer. The microwave receiver antenna head is located on the T-15 antenna tower, which is outside the FRS building. This equipment receives the video signals from the pier B transmitter and displays them on the dispatch console monitor. The multiplexer transmitters relay switch closure signals from the delay override switch and other status messages by encoding an RS-232 signal onto an audio carrier and transmitting it the to pier B door controller equipment.

A detailed Hardware Breakdown Structure (HBS) for the Microwave Communications Subsystem is presented in Table 1. EASSP Life Cycle Cost Hardware Breakdown Structure.

Table 1. EASSP Life Cycle Cost Hardware Breakdown Structure
Microwave Communications Subsystem

1. PIER B EQUIPMENT

   1.1 802-BMS MW Baseband Transmitter
   1.2 802-BMS MW Transmitter Antenna Head
   1.3 322 Audio Multiplexer Receiver (2)
   1.4 MR-10M/SMA Fiber Optic Receiver
   1.5 24VAC, 20VA Transformer

2. FIRE RESCUE SERVICE BUILDING EQUIPMENT

   2.1 802-BMS MW Baseband Receiver
   2.2 802-BMS MW Receiver Antenna Head
   2.3 T-15 Antenna Tower
   2.4 316 Audio Multiplexer Transmitter (2)
   2.5 A1-07J612-BO Delay Override Switch
   2.6 24VAC, 20VA Transformer

3. ASSUMPTIONS.

3.1 ECONOMIC YEAR OF ESTIMATE. This analysis is prepared using constant-year 1992 prices. To properly inflate these 1992-dollar estimates to present value dollars, use the yearly inflation rates published by the General Accounting Office or the methodology described in FAA-APO-82-1, "Economic Analysis of Investment and Regulatory Decisions--A Guide."

3.2 NON-RECURRING COSTS. All EASSP hardware and software is assumed to be Commercial Off-the-Shelf (COTS) or Non-development Items (NDI). Therefore, for the purpose of this analysis, no non-recurring costs are included.

3.3 PROGRAM LIFE CYCLE. For the purpose of this analysis, the program life cycle was assumed to be ten (10) years. The Production, Installation, and Test Phase of the project was assumed to be two (2) years - 1 January 1992 through 31 December 1993. The Operation and Support Phase was assumed to be seven (7) years - 1 January 1994 through 31 December 2000. The Termination Phase was assumed to be one (1) year - 1 January 2001 through 31 December 2001.

3.4 PROGRAM MANAGEMENT. For the purpose of this analysis, no program management costs are included. It is assumed that this subsystem will be installed in an operational environment; therefore, program management efforts are directly attributable to the life cycle costs of the hardware.

3.5 OPERATIONS/SUPPORT PERSONNEL. It is assumed that this subsystem will be installed at an operational airport as part of a total security system, which will be manned on a 24-hour per day basis. One operator will man the total system, of which this subsystem is assumed to require one tenth of one percent (.1%) of the operator's effort. The fully burdened cost of an operator is assumed to be $50 per hour and the system operating time is assumed to be 78,840 hours (see paragraph 3.6), for a total system operating cost of $3,942,000. The one tenth of one percent (.1%) of the total operator time apportioned to this subsystem results in a subsystem operations cost of $3,942. Support costs are a factor of the number of repair actions predicted, the mean time for each repair and the cost of support personnel. It is assumed that fully burdened costs for support personnel will be $65 per hour. The Mean Time To Repair (MTTR) and Number of Repairs (#REP) for each component of the subsystem are indicated in Table 3. Microwave Communications Subsystem HBS with Cost Estimates.

3.6 EQUIPMENT OPERATING HOURS PER YEAR. The EASSP equipment was assumed to operate full-time. Therefore, for the purposes of this analysis, the operating hours per year were assumed to be 8,760. Total operating time was assumed to be nine (9) years (excluding Termination Phase) or 78,840 hours.

3.7 ENERGY AND UTILITIES. The cost of energy and utility usage at BWI is included in the overall charges for building maintenance and overhead and, as such, is passed on to the tenants in their baseline rental fees. Power consumption is not a separate chargeable item. For the purpose of this analysis it was considered to be zero ($0).

3.8 RELIABILITY AND MAINTAINABILITY. The factors used herein for reliability (i.e. Failure Rates, Mean Time Between Failure (MTBF)) and maintainability (i.e. Mean Time To Repair (MTTR)) are derived from either best engineering estimates or from observed failures and/or repair actions. While attempts were made to obtain these data from the respective manufacturers, they stated that COTS equipment is not normally subjected to quantitative reliability or maintainability analyses. Failure data from field service and factory repair personnel are utilized to identify product improvement target areas, but are not quantified into reliability predictions. Therefore, the reliability data presented herein are not based on quantitative analyses, but on the analyst's best judgement and experience with similar hardware. For a detailed history of all failures and maintenance actions involving the EASSP hardware, refer to the monthly Maintenance Repair Reports prepared under this contract.

3.9 EQUIPMENT REPAIR COSTS. These estimates are for material only. Where an item must be replaced, the full cost of that item is assumed to be its repair cost. Where an assembly may be repaired by replacing a component, the cost assumed is that of an average (or highest failure rate) part. The number of repair actions is based on the MTBF, number of identical items, on-hand (initial) spares, and the total operating time. Where the number of repair actions is calculated to be less than one (1), it is assumed to be zero (0), otherwise any fraction will be raised to the next highest whole number.

3.10 PECULIAR SUPPORT EQUIPMENT. No peculiar (unique) support equipment was used to maintain the EASSP equipment. For the purposes of this analysis, the peculiar support equipment cost was assumed to be zero ($0).

3.11 COMMON SUPPORT EQUIPMENT. The total estimated cost of the EASSP common tools and test equipment (hand tools, multimeters, oscilloscope and various other generic test equipment) is $20,000. For the purpose of this analysis, an allocation of one tenth of the total program cost was assumed to be the cost apportioned to this subsystem.

3.12 INVENTORY MANAGEMENT AND STORAGE. For the purpose of this analysis, it was assumed that there were no charges for inventory management and storage. The EASSP equipment is not part of a military-type supply system and is managed by on-site personnel as part of their normal duties. Storage charges are assumed to not apply as the number of on-hand spares are extremely small in both quantity and size.

3.13 TRANSPORTATION AND PACKAGING. This cost element includes packaging, handling, and transportation of spares, repair parts and other materials between supply points, and the equipment to be maintained. Since all of the EASSP hardware is COTS, and many manufacturers include shipping costs in the price of their assemblies, this cost element is a very minor one. However, for the purposes of this analysis, it was assumed that two

percent (2%) of the cost of repairs may be allocated for packaging and shipping charges, either by manufacturers or by EASSP personnel returning components to the manufacturers for repair.

3.14 TERMINATION COSTS. This element collects costs associated with returning the airport to the condition it was before the EASSP equipment was installed. It includes dismantling and transporting any equipment from the site as well as site restoration costs. For the purpose of this analysis, it was assumed that the cost of termination was fifty percent (50%) of the cost of installing the hardware. All sub-elements of this cost category are included in this assumed percentage.

3.15 SALVAGE VALUE. Salvage value is defined as the cash value (on the commercial market) of the equipment after completion of its useful or programmed life. Due to projected advances in technology, and especially in electronics, from the start of the EASSP (assumed to be 1 January 1992) to the end of the system life (per paragraph 3.3, 31 December 2001), it was anticipated that the salvageable hardware would have diminished value. For the purposes of this analysis, the salvage value was assumed to be ten percent (10%) of the original cost (in 1992 dollars) of the hardware.

4. COST METHODOLOGY AND DATA.

4.1 COST BREAKDOWN STRUCTURE. The following Cost Breakdown Structure (CBS) was utilized to estimate the LCC for the analyzed subsystem. Details of the methodology and calculations used to arrive at each individual CBS element are contained in the description of the LCC model presented in Section 5, Cost Estimates.

COST BREAKDOWN STRUCTURE
(DOT FAA Order 1810.3)

$$LCC = C_1 + C_2 + C_3 + C_4 - C_5$$

C_1 NON-RECURRING COST

NOTE All EASSP hardware and software is assumed to be Commercial Off-the-Shelf (COTS) or Non-Development Items (NDI). Therefore, for the purpose of this analysis, no non-recurring costs are included.

C_2 PRODUCTION AND INSTALLATION

- $C_{2.1}$ Program Management
- $C_{2.2}$ Real Property Improvements
- $C_{2.3}$ Prime Mission Equipment
- $C_{2.4}$ Peculiar Support Equipment
- $C_{2.5}$ Common Support Equipment
- $C_{2.6}$ Equipment Installation and Test
- $C_{2.7}$ Initial Spares and Consumables
- $C_{2.8}$ Initial Training
- $C_{2.9}$ Data

C_3 RECURRING COSTS - OPERATION AND SUPPORT

- $C_{3.1}$ OPERATIONS COSTS
  - $C_{3.1.1}$ Personnel
  - $C_{3.1.2}$ Consumables
  - $C_{3.1.3}$ Energy and Utilities
  - $C_{3.1.4}$ Leases and Subcontracts
  - $C_{3.1.5}$ Operator Training

$C_{3.2}$ SUPPORT COSTS

$C_{3.2.1}$ Personnel

$C_{3.2.2}$ Replenishment Spares

$C_{3.2.3}$ Repair Material

$C_{3.2.4}$ Support Equipment Maintenance

$C_{3.2.5}$ Inventory Management and Storage

$C_{3.2.6}$ Transportation and Packaging

$C_{3.2.7}$ Recurring Training

C_4 TERMINATION COSTS

C_5 SALVAGE VALUE

4.2 COST DATA. The following cost data were utilized in the preparation of the LCC Analysis. Prices were extracted from the EASSP project inventory, 1 April 1993.

Table 2. Life Cycle Cost Analysis Data

HBS#	PRICE	DESCRIPTION
1.1	$2500	802-BMS MW Baseband Transmitter
1.2	350	802-BMS MW Transmitter Antenna Head
1.3	354	322 Audio Multiplexer Receiver (2)
1.4	307	MR-10M/SMA Fiber Optic Receiver
1.5	12	24VAC20VA Transformer
2.1	2500	802-BMS MW Baseband Receiver
2.2	350	802-BMS MW Receiver Antenna Head
2.3	609	T-15 Antenna Tower
2.4	263	316 Audio Multiplexer Transmitter (2)
2.5	5	A1-07J612-BO Delay Override Switch
2.6	12	24VAC20VA Transformer

5. COST ESTIMATES. The following is a detailed description of the LCCA model utilized for this analysis. Each element of the CBS is addressed along with the cost estimating relationships or formulae used to quantify that element. Table 3. Microwave Communications Subsystem HBS with Cost Estimates, contains the details of the HBS including MTBF, initial spares, repair costs and repair material estimates. Table 4. Life Cycle Cost Model, is the LCC model that calculates each cost element based on the formulae below.

$$LCC = C_1 + C_2 + C_3 + C_4 - C_5$$

C_1 = \$0 (see paragraph 3.2, Non-Recurring Costs)

$C_2 = C_{2.1} + C_{2.2} + C_{2.3} + C_{2.4} + C_{2.5} + C_{2.6} + C_{2.7} + C_{2.8} + C_{2.9}$ Where:

$C_{2.1}$ = \$0 (see paragraph 3.4, Program Management)

$C_{2.2}$ = \$0 (No Real Property Improvements were made or purchased in association with the EASSP).

$C_{2.3}$ = PME (Total of Prime Mission Equipment Cost - see Table 3. Microwave Communications Subsystem HBS with Cost Estimates)

$C_{2.4}$ = \$0 (see paragraph 3.10, Peculiar Support Equipment)

$C_{2.5}$ = \$2,000 (see paragraph 3.11, Common Support Equipment)

$C_{2.6}$ = (INST+TST) = \$20,115 Where:

INST = \$10,500 (Installation and initial alignment = 160 man hours @ \$50/hr, plus \$2,500 in materials (fabricated metal enclosures, coaxial cable, mounting hardware, concrete tower base, etc.))

TST = \$9,615 (There is no cost directly attributable to certification, commissioning or flight test that is not included in the INST costs. However, an FCC license was required for operation. The fee of \$9,615 was paid to Comsearch for the expenses of a license search, frequency survey, site survey and FCC license processing and tracking.)

$C_{2.7}$ = INSPC (Initial Spares and Consumables - see Table 4. Life Cycle Cost Model)

$C_{2.8}$ = \$0 (No initial maintenance or operational training is required for operation of this subsystem over and above normal familiarization that is accounted for in personnel costs)

$C_{2.9}$ = DATA (see Table 4. Life Cycle Cost Model)

$C_3 = C_{3.1} + C_{3.2}$ Where:

$C_{3.1} = C_{3.1.1} + C_{3.1.2} + C_{3.1.3} + C_{3.1.4} + C_{3.1.5}$ and
$C_{3.2} = C_{3.2.1} + C_{3.2.2} + C_{3.2.3} + C_{3.2.4} + C_{3.2.5} + C_{3.2.6} + C_{3.2.7}$

$C_{3.1.1}$ = \$3,942 (see paragraph 3.5, Operations/Support Personnel)

$C_{3.1.2}$ = \$0 (There are no consumable materials associated with this subsystem)

$C_{3.1.3}$ = \$0 (see paragraph 3.7, Energy and Utilities)

$C_{3.1.4}$ = \$0 (There are no leases or subcontracts associated with the operation or support of this subsystem)

$C_{3.1.5}$ = \$0 (There is no recurring training necessary to operate this subsystem)

$C_{3.2.1}$ = \$65 x 25 Hours (see Table 3. Microwave Communications Subsystem HBS with Cost Estimates) = \$1,625 (see paragraph 3.5, Operations/Support Personnel)

$C_{3.2.2}$ = REPSP (see Table 3. Microwave Communications Subsystem HBS with Cost Estimates)

$C_{3.2.3}$ = REPMTL (\$0 - included in REPSP costs - see Table 3. Microwave Communications Subsystem IIBS with Cost Estimates)

$C_{3.2.4}$ = \$0 (The EASSP common support and test equipment does not require maintenance)

$C_{3.2.5}$ = \$0 (see paragraph 3.12, Inventory, Management and Storage)

$C_{3.2.6}$ = REPSP x .02 (see paragraph 3.13, Transportation and Packaging)

$C_{3.2.7}$ = \$0 (There is no recurring training necessary to maintain this subsystem)

C_4 = (INST x .5) (\$10,500 x .5 = \$5250) (see paragraph 3.14, Termination Costs)

C_5 = PME x .10 (see Table 4. Life Cycle Cost Model, see paragraph 3.15, Salvage Value)

Table 3. Microwave Communications Subsystem HBS with Cost Estimates

HRS	PRICE	QTY	MTBF (HRS)	MTTR	INSPC	$/REPAIR	T PME $	INSPC $	#REP	REPSP
1.1	$ 2,500	1	75,000	4	0	$ 500	$ 2,500	$ 0	1	$ 500
1.2	350	1	90,000	1	0	350	350	0	0	0
1.3	354	2	50,000	1	0	354	708	0	4	1,416
1.4	307	1	50,000	1	0	307	307	0	2	614
1.5	12	1	30,000	1	0	12	12	0	3	36
2.1	2,500	1	75,000	4	0	500	2,500	0	1	500
2.2	350	1	90,000	1	0	350	350	0	0	0
2.3	609	1	100,000	4	0	100	609	0	0	0
2.4	263	2	50,000	1	0	263	526	0	4	1,052
2.5	5	1	75,000	1	0	5	5	0	1	5
2.6	12	1	30,000	1	0	12	12	0	3	36
TOTALS		13				$ 2,753	$ 7,879	$0		$ 4,159

DATA = DWG + MAN + SFT

DWG = $0 (DWG-ENG DRAWING, MAN-TECH MNLS, SFT-SOFTWARE)
MAN = $0 (SANDIA CONTRACTED BPLW ENGINEERING DRAWINGS)
SFT = $0 (IDENTIFIED INDIVIDUAL COSTS FOR MANUALS)
DATA = $0 (NO SOFTWARE)

Table 4. Life Cycle Cost Model

CBS	COST BREAKDOWN STRUCTURE ELEMENT	COST
C1	Non-Recurring Cost	$ 0
C2	Production and Installation	29,994
C2.1	Program Management	0
C2.2	Real Property Improvements	0
C2.3	Prime Mission Equipment	7,879
C2.4	Peculiar Support Equipment	0
C2.5	Common Support Equipment	2,000
C2.6	Installation and Test	20,115
C2.7	Initial Spares and Consumables	0
C2.8	Initial Training	0
C2.9	Data	0
C3	Recurring Costs - O&S	9,809
C3.1	Operations Costs	3,942
C3.1.1	Personnel	3,942
C3.1.2	Consumables	0
C3.1.3	Energy & Utilities	0
C3.1.4	Leases/Subcontracts	0
C3.1.5	Operator Training	0
C3.2	Support Costs	5,867
C3.2.1	Personnel	1,625
C3.2.2	Replenishment Spares	4,159
C3.2.3	Repair Material	0
C3.2.4	Support Equipment Maintenance	0
C3.2.5	Inventory Management & Storage	0
C3.2.6	Transportation & Packaging	83
C3.2.7	Recurring Training	0
C4	Termination Costs	10,058
C5	Salvage Value	788
Total Life Cycle Cost ($C_1 + C_2 + C_3 + C_4 - C_5$)		$ 49,073

6. COST BENEFIT ANALYSIS.

6.1 BASELINE SYSTEM DESCRIPTION. A baseline system for the Microwave Communications Subsystem at BWI does not exist. Prior to the EASSP installation there were not any emergency exit doors at pier B and; therefore, no requirement for FRS to monitor and have override capability for them. The only communication between FRS and the pier was through the existing fire alarm system. There was no requirement for a Microwave Communications (nor any other communications) system.

6.2 BASELINE SYSTEM LIFE CYCLE COST ESTIMATE. Since there is no baseline system for comparison, the Life Cycle Cost of a baseline system was assumed to be zero ($0).

6.3 COST COMPARISON. The Life Cycle Cost of the EASSP Microwave Communications Subsystem has been estimated at $49,073 (see Table 3). The Life Cycle Cost of the baseline system is estimated to be $0 (see paragraph 6.2). The cost of the enhanced over the baseline system is therefore $49,073. No cost savings are realized from the installation of the enhanced system.

6.4 BENEFITS. The benefits of the EASSP Microwave Communications Subsystem must be assessed by evaluating qualitative, vice quantitative, attributes since the cost of the enhanced system was more than the baseline. The primary benefit of the Microwave Communications Subsystem lies in the increased level of safety provided by enabling Fire Rescue Service personnel to monitor the emergency exit doors and be able to defeat the time-delay opening controller in the event of an emergency. The necessity for the Microwave Communications Subsystem is tied directly to the existence of the revolving exit doors, which prevent unauthorized personnel or contraband from entering the secure area of the pier. In the event of a fire in the pier, or if emergency personnel must enter the pier with emergency equipment, the Microwave Communications Subsystem could save lives by permitting immediate exit for the maximum number of people to escape a fire or allow emergency personnel to quickly respond to a potential life-threatening situation. This analysis does not attempt to quantify the value of safety or of lives saved in the event of an emergency. It remains to Federal, State and local authorities to assess the benefits of the added measures of safety achieved by the Microwave Communications Subsystem when balanced with the Life Cycle Cost of the EASSP.

7. REFERENCES. The following documents were either referenced herein or were utilized as source documents for this analysis.

a. U.S. Department of Transportation, Federal Aviation Administration ORDER 1810.3, Cost Estimation Policy and Procedures, 5/15/84 (Including Chg 1, 10/27/89);

b. U.S. Department of Transportation, Federal Aviation Administration ORDER 1810.1C, Major System Acquisition;

c. FAA-APO-82-1, Economic Analysis of Investment and Regulatory Decisions--A Guide;

d. Earles, Mary Eddins, Factors, Formulas, and Structures for Life Cycle Costing (Second Edition), Eddins-Earles Publishing, Concord, Mass, 1981; and

e. TTO-ORT-032A-80-V3-APF, Cost Effectiveness Program Plan for Joint Tactical Communications, Life Cycle Costing, Vol. III, Appendix F, TRI-TAC Life Cycle Cost Model, Joint Tactical Communications Office, Ft. Monmouth, NJ, January 1980.

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