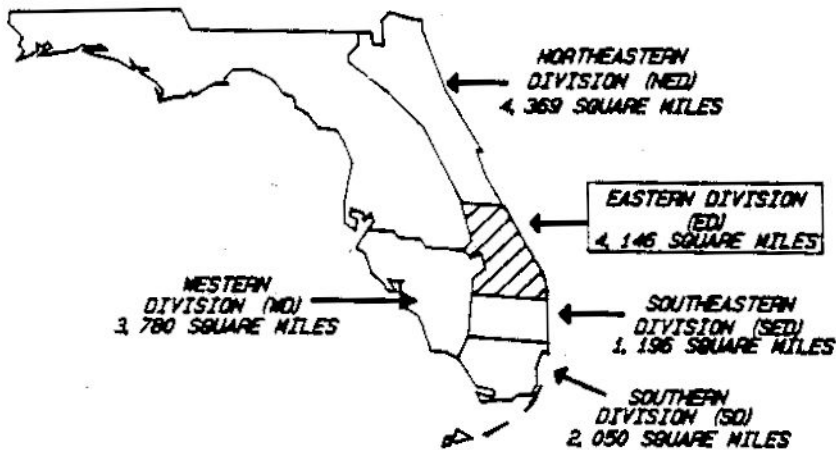
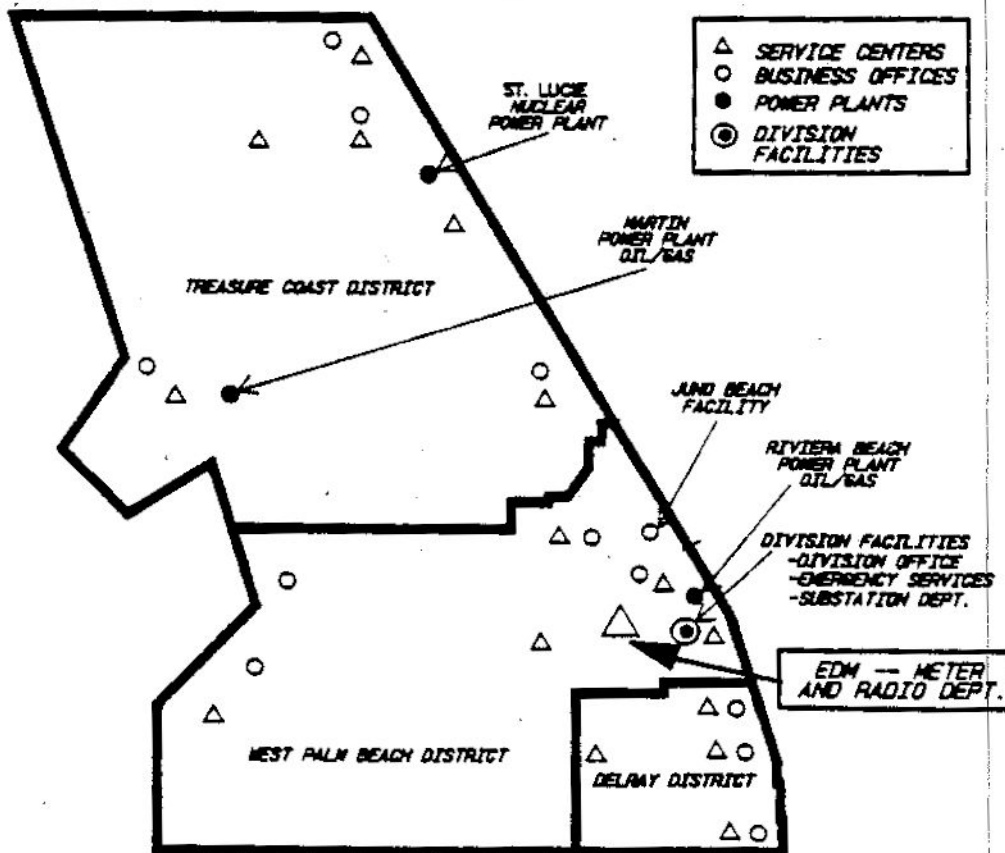


EASTERN DIVISION APPLICATION EXPERT PROJECT GROUP III CAROL M. CHINN



THEME:
REDUCTION OF
RADIO FAILURES
IN
EASTERN
DIVISION

EASTERN DIVISION METERS AND RADIO SERVICE TERRITORY



improvement action memorandum



IAM # 89917

INTERIM IAM

Team Code 70201 Loc. Symbol EDM Loc. Code 4580
 Team Leader CAROL M. CHINN Phone: 305 684-6718 Ext. _____
 Teams Members W. W. MERTENS, JR. _____
J. D. PAFFORD _____
J. G. PIERCE _____
B. A. SCOTT _____

SPECIFIC PROBLEM/OPPORTUNITY (put key words in blocks)

R	E	D	U	C	E		U	H	F		R	A	D	I	O		F	A	I	L	U	R	E	S				
---	---	---	---	---	---	--	---	---	---	--	---	---	---	---	---	--	---	---	---	---	---	---	---	---	--	--	--	--

ADDITIONAL EXPLANATION

IAM SKILL CODES

1) D V 1 0 5 2) 3)

KEYWORD

RADIO

Charles Womha
LEAD FACILITATOR

Carol M. Chinn
SUPERVISOR

01 04 88
DATE INTERIM IAM SUBMITTED

BRIEF DESCRIPTION OF FINAL SOLUTION (put key words in blocks)

DATE FINAL IAM SUBMITTED

ADDITIONAL EXPLANATION

BENEFITS/SAVINGS

Estimated Annual Savings \$ _____

Cost To Implement \$ _____

2

PROJECT PLANNING WORKSHEET - EASTERN DIVISION TEAMS																		
Theme or problem area : REDUCE RADIO FAILURES																		
Team name : FRED(FAILED RADIOS IN ED)										Team code : 70201				IAM # : 89917				
Team leader : CAROL M. CHINN										Phone : 684-6718				Work locn. : EDM				
Duration (mo/yr) : 1/88 Through (mo/yr) :										Total (months) :				Sponsor : R. COLLINS				
Mtgs.	1			2			3			4			5			6		
Month	Date (* if facil)	Mtg. units	% att.	Date (* if facil)	Mtg. units	% att.	Date (* if facil)	Mtg. units	% att.	Date (* if facil)	Mtg. units	% att.	Date (* if facil)	Mtg. units	% att.	Date (* if facil)	Mtg. units	% att.
Jan	7	2	100															
Feb	4	1	80	18	2	80	25	3	100									
Mar	10	1	80	17	1	100	24	1	80	31	4	80						
Apr	6	1	80	7	2	80	21	2	100	26	1	80						
May	5	1	80	9	1	100	17	1	80									
Jun																		
Jul																		
Aug																		
Sep																		
Oct																		
Nov																		
Dec																		

SCHEDULE -- PROJECTED ACTUAL													
O U T L I N E O F A C T I V I T I E S	Month/Year	12/87	1/88	2/88	3/88	4/88	5/88	6/88				COMMENTS	
	Reason for Improvement												CUSTOMERS GRAPH PERFORMANCE
	Current Situation												PARETO, CONTINGENCY TABLE, TARGET, INDICATOR
	Analysis												SECTIONALIZE RADIO, FMEA, PARETO
	Counter - measures												CM MATRIX, BARRIER & AIDS, ACTION PLAN
	Results												INDICATOR GRAPH
	Standard - ization												
	Future Plans												

* - PRESENTATION DATE

PPWS2/88

BACKGROUND

ORGANIZATION CHART

JOHN HUDIBURG
CEO

BOB TALLON
PRESIDENT

WAYNE BRUNETTI
EXEC VP

TED MOFFETT
ED VP

JOHN HART
ED CONST SVC MGR

RAY COLLINS
T & D MGR (OPER)

EASTERN DIVISION METERS AND RADIO

METER OPERATIONS

- 1-T&D SUPERVISOR
- 1-METER FOREMAN (WPB)
- 9-METERMEN "A" (WPB)
- 2-APPRENTICE METERMEN (WPB)
- 1-ELECTRONIC TECHNICIAN
- 1-LABORATORY METERMAN
- 1-DISPATCHER CLERK
- 1-OPER "A" CLERK STENO

TC & DR DISTRICT
10-METERMEN "A"

CAROL CHINN
DMOE

RADIO OPERATIONS

4-COMMUNICATIONS
& BATTERY MEN:

WALT MERTENS
JESSE PAFFORD
JOHN PIERCE
BRIAN SCOTT

THE QI TEAM

BACKGROUND

EASTERN DIVISION RADIO OPERATIONS

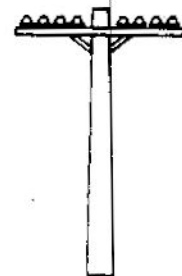
Eastern Division Radio Department is responsible for the land mobile radio requirements for the Division & three power plants. System design, project implementation, equipment budgeting, procurement and evaluation of related radio equipment are other responsibilities.

Also included are daily operation functions such as maintenance, repair and installation of two-way radio equipment, paging equipment, PA systems, nuclear disaster siren systems and radio and television interference (TVI) complaints.

We repair and maintain 545 mobile & portable radios for the following internal customers:



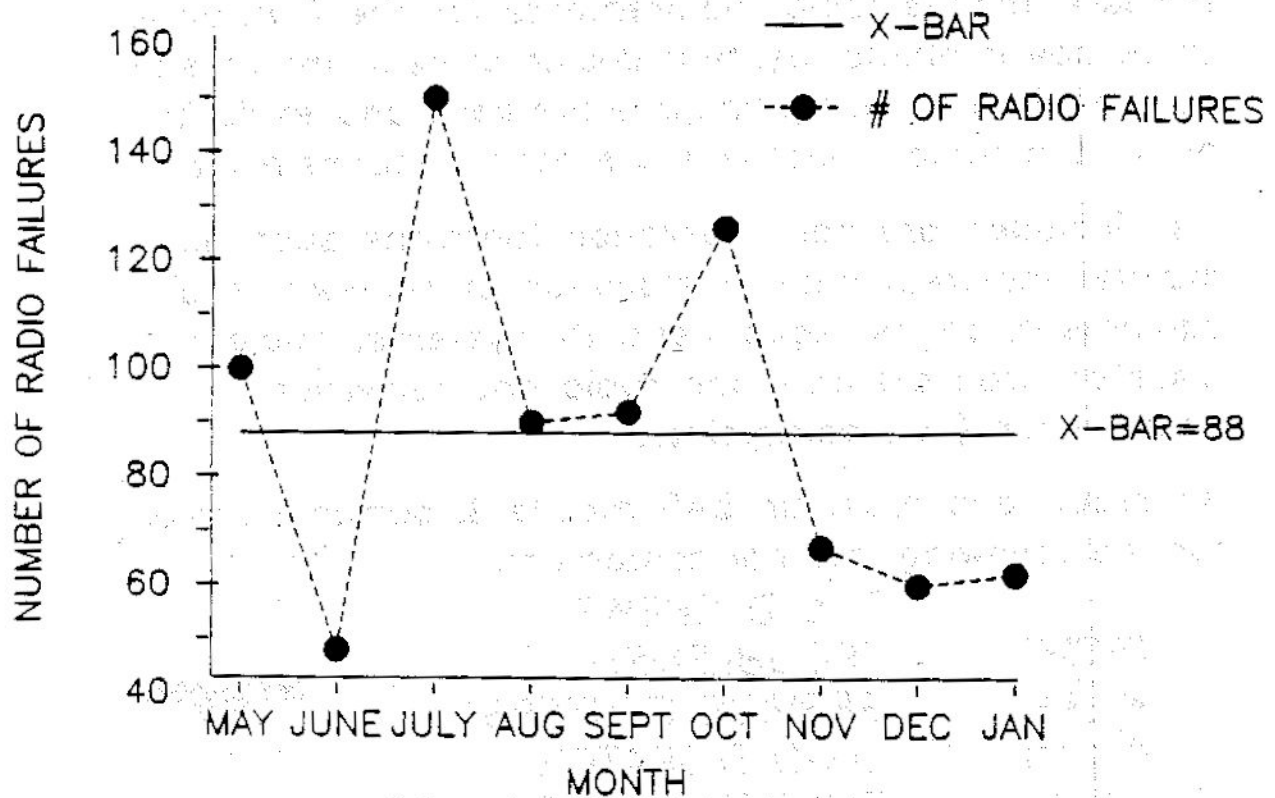
T & D CREWS
TROUBLEMEN
SERVICE CENTERS
LOAD DISPATCH
EMERGENCY SERVICES
T & D SUPERVISION
CONTRACT CREWS
C & D



DIV. RADIOS	SED	SD	ED	NE	WD	TOTAL
DIV. OPER	772	1515	545	975	680	4487
POWER PLNT	19	235	209	7	25	495
TOTALS	791	1750	754	982	705	4982

**EASTERN DIVISION RADIO FAILURES
MAY '87 TO JAN '88**

SOURCE: MAINTENANCE SUMMARIES

**DEFINITIONS****RADIO FAILURE:**

EACH OCCURRENCE OF A RADIO BEING TOTALLY INOPERABLE OR OPERATING INTERMITTENTLY AND REPAIRS ARE REQUESTED.

FAILED RADIO UNIT:

A SPECIFIC PIECE OF RADIO EQUIPMENT WHICH HAS FAILED

MAINTENANCE SUMMARY:

WORKSHEET WHICH TOTALS VARIOUS TYPES OF WORK DONE BY COMMUNICATIONS & BATTERYMEN (RADIOMEN). TOTALS ARE SOMETIMES ESTIMATED.

1

REASON
FOR IMPROVEMENT

FROM RADIO FAILURES GRAPH:

X-BAR=88 RADIO FAILURES PER MONTH

$$\frac{88 \text{ RADIO FAILURES}}{\text{MONTH}} \times \frac{12 \text{ MONTHS}}{\text{YEAR}} \times \frac{\text{EASTERN DIVISION}}{545 \text{ RADIOS}} =$$

TWO RADIO FAILURES PER RADIO EACH YEAR

RADIO FAILURESI. DIRECTLY CREATE:

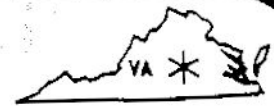
- 1) DELAYS IN RESPONSE TO TROUBLE CALLS AND RESTORING SERVICE
- 2) DELAYS IN CONSTRUCTION OF NEW SERVICES AND DAILY T&D OPERATIONS
- 3) OVERTIME COSTS IN RADIO DEPT DUE TO WORKLOAD FROM REPAIRS REQUIRED

II. INDIRECTLY CREATE:

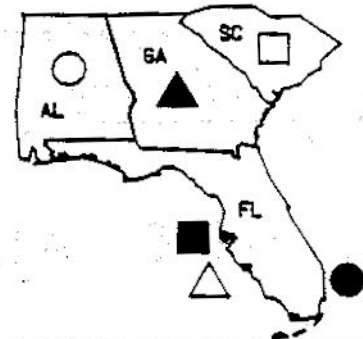
- 1) INCREASED DURATION OF CUSTOMER INTERRUPTIONS & SERVICE UNAVAILABILITY
- 2) DECREASED CUSTOMER SATISFACTION

THEREFORE THEME

REDUCE RADIO FAILURES IN EASTERN DIVISION



HOW DOES FPL COMPARE WITH OTHER UTILITIES
WITH REGARDS TO RADIO PROGRAMS?



UTILITY	MAP	NUMBER OF RADIOS	INVENTORY MAINTENANCE	RETIREMENT	FAILURE RATE
VIRGINIA POWER	*	4000	HARDCARD DBASE 3	15 YEAR CYCLE	NOT TRACKED
S. CAROLINA ELEC & GAS	□	1200	HARDCARD & FOCUS	10-12 YEAR CYCLE	NOT TRACKED
GEORGIA POWER	▲	4700	HARDCARD DBASE 3	VARIED	NOT TRACKED
ALABAMA POWER	○	4000	HARDCARD DBASE 3	10-15 YEAR CYCLE	NOT TRACKED
FPC	■	2500	HARDCARD DBASE 3	14 YEAR CYCLE	NOT TRACKED
TAMPA ELEC	△	700	HARDCARD DBASE 3	NEW 800 MEG SYS	NOT TRACKED
FPL	●	5000	HARDCARD & FOCUS	10-15 YEAR CYCLE	NOT TRACKED

SOURCE: FPL RADIO SYSTEM COORDINATOR
2/88 SURVEY

FPL HAS SIMILAR RADIO PROGRAMS AS OTHER UTILITIES.
THERE ARE NO UTILITY INDUSTRY STANDARDS FOR FAILURE RATES
OF RADIOS AVAILABLE....

LET'S START TRACKING ED RADIO PROBLEMS....

2 CURRENT SITUATION

TO COLLECT DATA ON ALL ASPECTS OF RADIO FAILURES A "TAG" WAS DESIGNED. THESE TAGS ARE BEING FILLED OUT FOR EACH RADIO FAILURE BY THE RADIOMEN AS OF JANUARY 4, 1988.

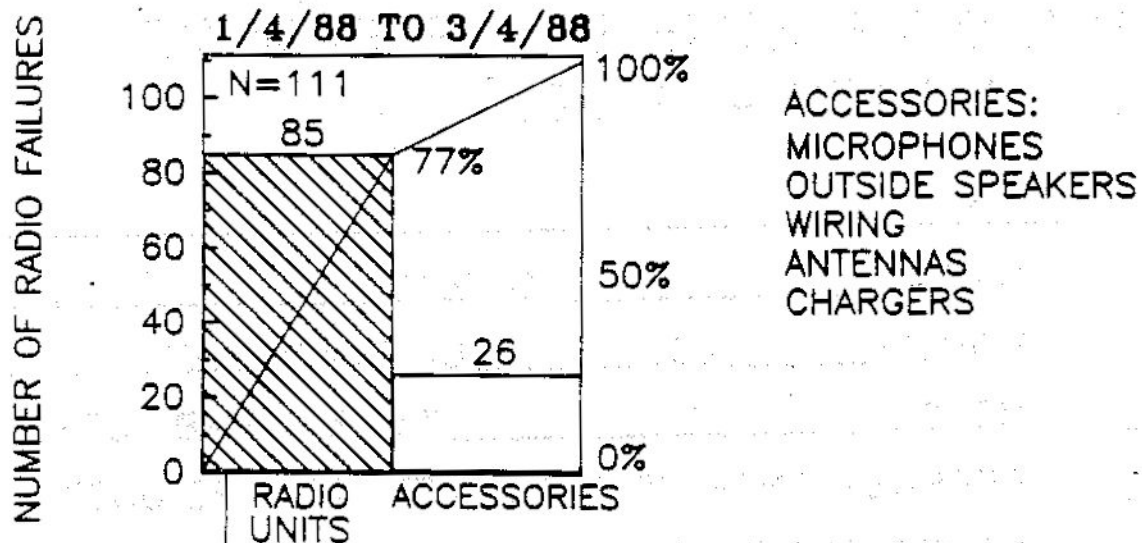
UNIT: _____ DATE/BY _____
VEHICLE _____ LOC _____ UNIT INSTALLED _____
MODEL _____ TX RX PWR OTHER
REPAIRS— SHOP OR FIELD NTF ADJ RETUNED
COMPONENT FAILED _____
HOURS _____ DATE/BY _____
REINSTALLED DATE/BY _____ VEHICLE _____

DATA FROM TAG IS COLLECTED AND INPUT INTO A "DBASE III PLUS" PROGRAM DESIGNED SPECIFICALLY FOR THIS PROJECT.

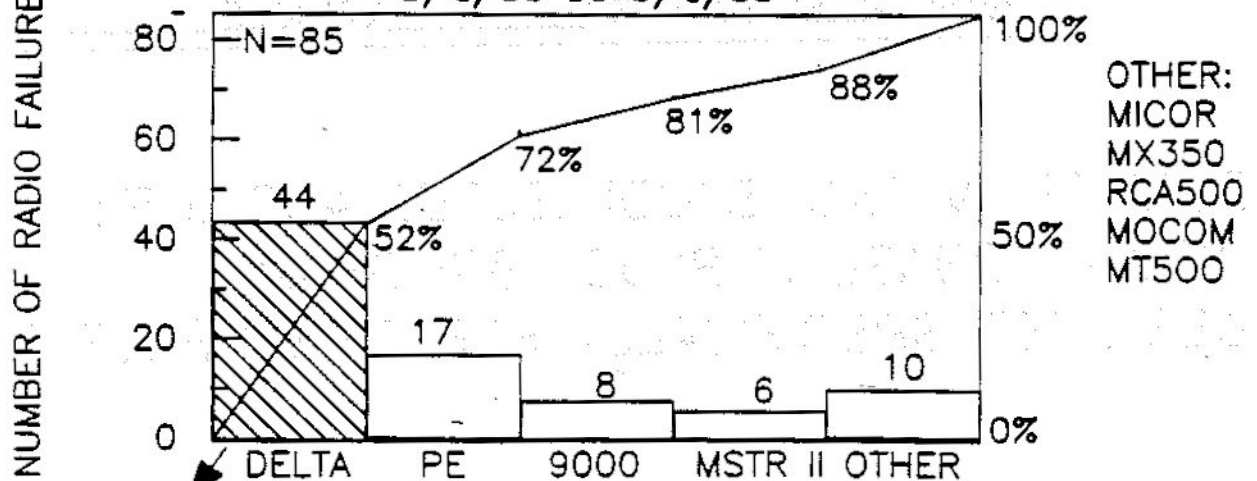
FN: CS1

LET'S LOOK AT THIS DATA IN A PARETO DIAGRAM:

EASTERN DIVISION RADIO FAILURES



EASTERN DIVISION RADIO FAILURES BY MODEL 1/4/88 TO 3/4/88



DELTA'S CAUSED 52% OF ALL MODEL RADIO FAILURES,
BUT.....

2 CURRENT SITUATION

IS THIS BECAUSE WE HAVE MORE DELTAS THAN ANY OTHER MODEL?
OR
ARE FAILED RADIO UNITS RELATED TO RADIO MODEL?

LET'S FIND OUT WITH A **CONTINGENCY TABLE:**
HYPOTHESES

H_0 : FAILED RADIO UNITS ARE INDEPENDENT OF RADIO MODEL.

H_a : FAILED RADIO UNITS ARE RELATED TO RADIO MODEL.

REJECTION REGION

CHI-SQUARED DISTRIBUTION

DEGREES OF FREEDOM = $(2-1)(6-1)=5$

ALPHA=.05

REJECTION REGION : CHI-SQUARED > 11.07

OBSERVED COUNTS (O_i)

UNITS	DELTA	9000	MSTR2	PE	X	OTHER	TOTAL
* FAILED	36	8	6	13	0	10	73
% FAILED	22	8	8	30	0	8	13
NON-FAILED	129	92	72	30	37	112	472
% NON-FAILED	88	92	92	70	100	92	87
TOTAL	165	100	78	43	37	122	545

* REPEATS EXCLUDED

EXPECTED COUNTS (E_i)

UNITS	DELTA	9000	MSTR2	PE	X	OTHER	TOTAL
FAILED	21	13	10	6	5	16	73
% FAILED	13	13	13	13	13	13	13
NON-FAILED	144	87	68	37	32	106	472
% NON-FAILED	87	87	87	87	87	87	87
TOTAL	165	100	78	43	37	122	545

CHI-SQUARED = $(O_i - E_i)^2 / E_i$:

$$[(36-21)^2/21] + [(8-13)^2/13] + [(6-10)^2/10] + [(13-6)^2/6] + [(0-5)^2/5] + [(10-16)^2/16] = 29.65$$

CONCLUSION: REJECT H_0 . WE HAVE SUFFICIENT EVIDENCE TO SHOW THAT FAILED RADIOS ARE RELATED TO RADIO MODEL. SO....

FN: CS3

2

CURRENT SITUATION

IF WE ALSO LOOK AT COMPANYWIDE IMPACT

DIVISIONS	ED	WD	NED	SED	SD	TOTAL
NO. OF DELTAS	165	83	182	12	6	450

THEN FROM OUR STRATIFIED DATA

PROBLEM STATEMENT

52% OF EASTERN DIVISION'S RADIO FAILURES ARE
CAUSED BY DELTA RADIO UNITS WHICH ARE FAILING AT A
RATE OF 22 DELTA'S PER MONTH.

TARGET

MANUFACTURER REPRESENTATIVE INDICATED DELTA RADIOS
SHOULD HAVE A 3 YR MTBF "MEAN TIME BETWEEN FAILURES"

SO.....

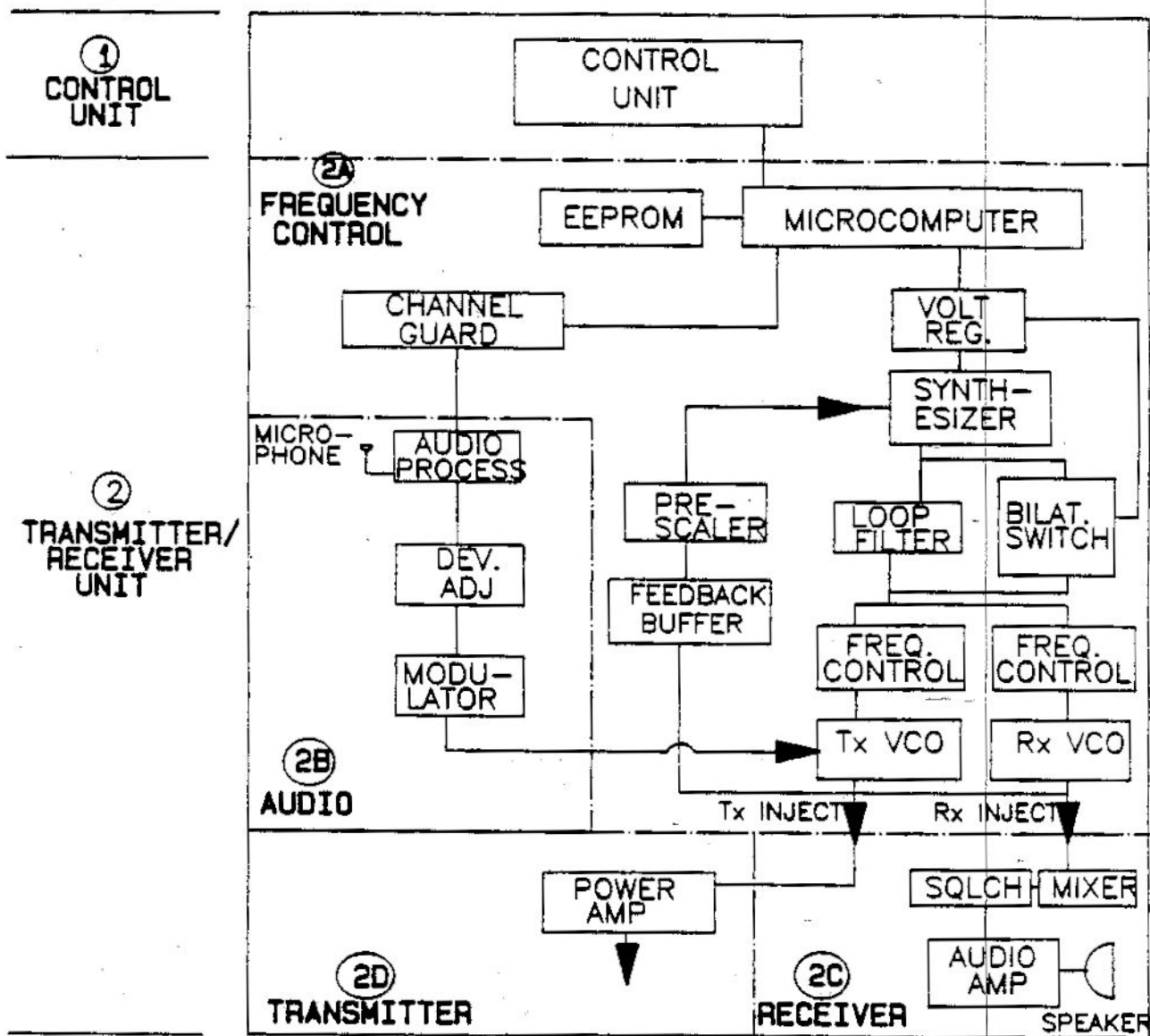
$165 \text{ DELTAS} / 3 \text{ YRS} \times \text{YR} / 12 \text{ MOS} = 4.58 \text{ DELTAS} / \text{MOS}$
OR LESS THAN 5 DELTA FAILURES PER MONTH
(80% REDUCTION FROM 22 PER MONTH)

INDICATOR

NUMBER OF DELTA RADIO FAILURES PER MONTH



LET'S TAKE A CLOSE LOOK AT THE DELTA-S950 RADIO



FROM THIS SECTIONALIZED VIEW OF THE DELTA RADIO
A "FAILURE MODES AND EFFECTS ANALYSIS" (FMEA)
IS PERFORMED.

FMEA - FAILURE MODES AND EFFECTS ANALYSIS

NO.	SECTION	FUNCTION	FAILURE MODE	ESTIMATED CAUSE	EFFECT OF FAILURE	DEGREE OF EFFECT				COUNTER-MEASURE
						FREQ.	SEVERE	DETECT	TOTAL	
1.	5450 CONTROL UNIT	INTERFACE BETWEEN RADIO & OPERATOR	MEMORY IN PROGRAM ALTERED	VOLTAGE SPIKES	DOES NOT OPERATE	8	9	8	576	• wire direct • add filter w/ 20v mov • repl. w/mech.
			SQUELCH PROBLEMS	MECHANICAL SWITCH FAILED	NOISE	2	3	9	54	• replace switch
			CHANGES CHANNELS ON ITS OWN	VOLTAGE SPIKES	ON WRONG CHANNEL	9	4	9	324	• add filter w/ 20v mov • wire direct • repl. w/mech.
			TRANSMITTER STAYS KEYED	BACKPLANE BRIDGE BAD CAPACITOR	LOCKS UP REPEATER	2	10	9	180	• resolder backplane • replace cap.
			FLASHES ON/OFF	BACKPLANE BRIDGE FUSE/HOLDER HEAT/ULTRAVIOLET	INTERMITTENT OPERATION	3	3	2	18	• repair backplane • repl. fuseholder • insulate w/ tape
			SWITCHES FAIL	CONTAMINATION DIRT, LIQUIDS	VARIED EFFECTS	4	6	2	48	• mounting position
			SCAN COMES ON W/ NO SCAN PROGRAMMED	VOLTAGE SPIKES	DON'T RECEIVE CHANNEL	7	2	7	16	• wire direct • add filter 20v mov • resolder backplane
			DOES NOT OPERATE UNTIL VEHICLE TURNS OFF/ON	WATCHDOG TIMER TRIES TO RESET & SAME TIME	NO TRANSMIT OR RECEIVE	4	7	7	196	• add 10k resistor • add diode
2.	TRANSMIT AND RECEIVE UNIT									
2.	FREQUENCY CONTROL	SETS FREQ & TONE FUNCTIONS FROM CONTROL UNIT	UNLOCKED FREQ.	VCO CHIP CAPACITORS MICROPROCESSOR	WON'T OPERATE	1	9	9	81	• replace cap and EEPROM
			INTERMITTENT TONE/TONE FAILS	TONE POTENTIOMETER FAILS	INTERMITTENT OR ZERO TRANSMIT	3	4	9	108	• replace pot. w/ new
			RADIO STAYS KEYED	U707 FAILED	LOCKS UP REPEATER	1	10	9	90	• replace U707

CONTINUED

FR: ANALYZ

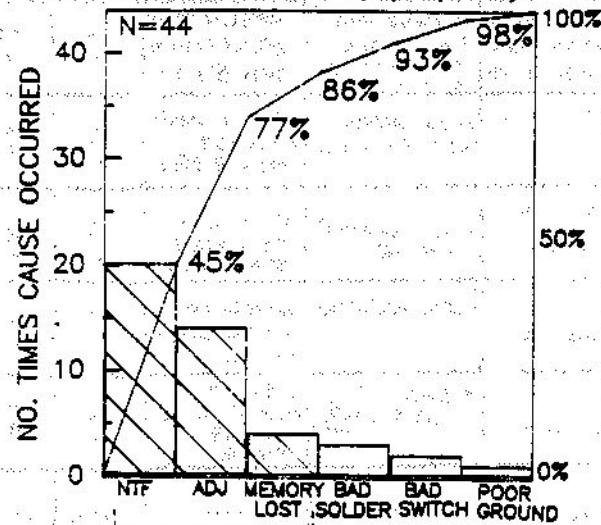
FMEA - FAILURE MODES AND EFFECTS ANALYSIS

NO.	SECTION	FUNCTION	FAILURE MODE	ESTIMATED CAUSE	EFFECT OF FAILURE	DEGREE OF EFFECT				COUNTER-MEASURE
						FREQ.	SEVERE	DETECT	TOTAL	
2 A.	FREQUENCY CONTROL	SETS FREQ. & TONE FUNCTIONS FROM CONTROL UNIT	SQUELCH INTER OR NO TRANSMIT OR NO RECEIVE	VOLTAGE REG FAILS DUE TO BAD CAPAC. 102	INTERMITTENT OPERATION OR NONE AT ALL	2	7	9	126	• adjust regulator • replace capacitor
2 B.	AUDIO	TRANSMITS AUDIO	TRANSMITS BUT NO AUDIO	MODULATION NOT FAULT	OTHER UNITS CANNOT HEAR OPER.	2	7	9	126	• replace potentiometer
	↓	↓	NOISE IN AUDIO	• ALTERNATOR WHINE	DIFFICULT TO UNDERSTAND AUDIO	3	3	9	81	• replace cap • add 68K 1/2 • 25W Resistor • 4.7uf cap
2 C.	RECEIVER	RECOVERS AUDIO FROM OTHER TRANSMITTERS	NO RECEIVE	• LOW VOLTAGE	OPERATOR CANNOT HEAR OTHER UNITS	8	5	8	320	• adjust regulators • retune
	↓	↓	BAD SQUELCH	• BAD CAP (.047uf)	OPERATOR HEARS NOISE ALL THE TIME	3	5	9	135	• replace capacitor w/ new
2 D.	TRANSMITTER	SENDS AUDIO TO OTHER UNITS	NONE	—	—	0	0	0	—	—
1 & 2	CONTROL UNIT / T/R UNIT	↑ ALREADY STATED	RADIO DOES NOT OPERATE	• LOW VOLTAGE DELIVERED • BAD FUSEHOLD.	PARTIAL OPERATION OR NONE AT ALL	9	6	6	324	• adj regulator • repl. fusehold • repl. w/ less sensitive radio

THE ABOVE ANALYSIS IS A RESULT OF NUMEROUS BRAINSTORMING SESSIONS AMONG TEAM MEMBERS AND OTHER RADIO DEPT PERSONNEL IN WESTERN AND NORTHEASTERN DIVISIONS. ALSO ON 2/25/88 A MEETING WAS HELD WITH OUR TEAM AND A REPRESENTATIVE FROM THE DELTA'S MANUFACTURER. FOLLOW-UP TECHNICAL SUPPORT MEMO'S AIDED IN DEVELOPING THE FMEA.

LET'S LOOK AT THE DATA GATHERED ON THOSE 44 RADIO FAILURES AND VERIFY IF THE CAUSES WITH THE HIGHEST "DEGREE OF EFFECT" FROM THE FMEA ARE OUR ROOT CAUSES.

**EASTERN DIVISION RADIO
DELTA FAILURE CAUSES
(1/4/88) TO (3/4/88)**



86% HAD NO ACTUAL RADIO HARDWARE FAILURES FOUND EITHER IN THE FIELD OR IN THE SHOP WHEN CHECKED.

THE PROBLEM WAS INTERMITTENT IN THE FIELD AND/OR THE CONDITIONS IN THE SHOP WERE DIFFERENT THAN THE VEHICLE AND THE FAILURE DIDN'T EXIST ON THE BENCH.

SO.....WE REVISITED THE TRUCKS THESE RADIOS WERE IN WHEN THEY FAILED PLUS OTHERS AND CHECKED ENVIRONMENTAL CONDITIONS:
VOLTAGE SPIKES, LOW VOLTAGE & FAULTY FUSEHOLDER

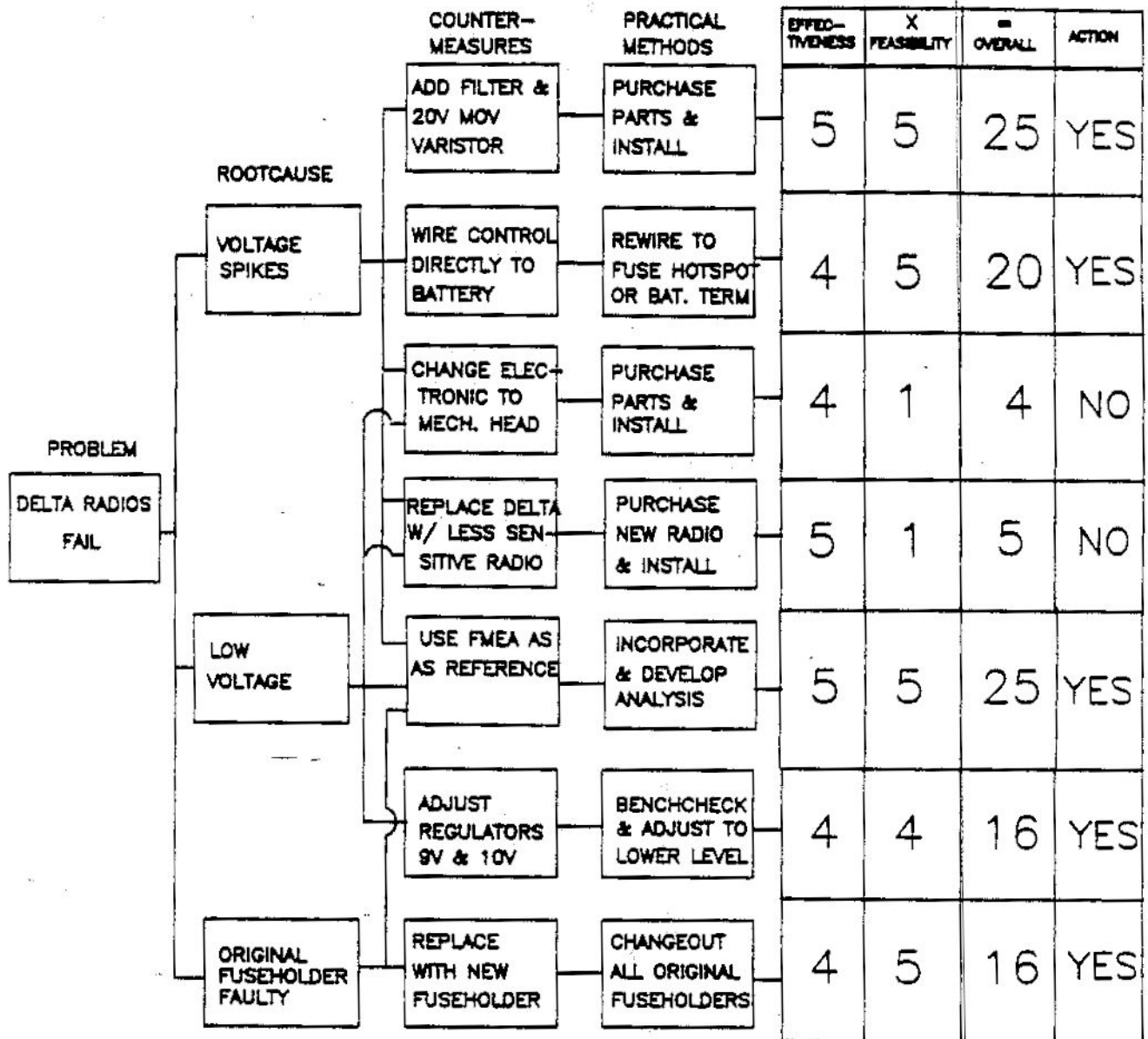
THESE ITEMS ARE THE CAUSES WHICH HAD THE HIGHEST DEGREE OF EFFECT AND CAN ONLY BE CHECKED IN THE FIELD.

ROOT CAUSE	FOUND IN FIELD
VOLTAGE SPIKES *	— 97% HAD NO FILTERS FOR SPIKE PROTECTION — 74% CONTROL HEADS WERE NOT WIRED DIRECT TO BATTERY 6% RADIO UNITS WERE NOT WIRED DIRECT TO BATTERY
LOW VOLTAGE *	— 56% HAD LOW VOLTAGE DELIVERED TO UNIT
FUSEHOLDER *	— 79% HAD ORIGINAL FAULTY FUSEHOLDER

NOTE: 34 VEHICLES CHECKED

* WE VERIFIED OUR ROOT CAUSES!

COUNTERMEASURES MATRIX



SCALE: 1 NONE 2 SOMEWHAT 3 MODERATE 4 VERY 5 EXTREME

4

COUNTERMEASURES

BARRIERS AND AIDS

COUNTERMEASURE	→ BARRIERS →	IMPACT	← AIDS ←	IMPACT
ADD FILTER & 20V MOV	• ADDITIONAL COST IN PARTS • ADDITIONAL COST IN LABOR	LOW	• LESS THAN \$20 FOR PARTS • CAN BE DONE IN COORDINATION WITH OTHER COUNTERMEASURES • LABOR COSTS WILL BE OFFSET BY REDUCTION IN AMOUNT OF REPAIR COSTS	LOW
WIRE CONTROL HEAD TO BATTERY	• MAY DRAIN BATTERY IF LEFT ON W/O VEHICLE ENGINE ON	MED	• RADIO OPERATES WITHOUT KEYS DURING EMERGENCY • NEGLIGIBLE PARTS COSTS • CAN BE DONE IN COORDINATION WITH OTHER COUNTERMEASURES • LABOR COSTS WILL BE OFFSET BY REDUCTION IN AMOUNT OF REPAIR COSTS	HIGH
USE FMEA AS REFERENCE			• ALL DIVISIONS CAN BENEFIT WITH QUICKER REPAIRS	HIGH
ADJ REGULATORS	• MUST REMOVE RADIO TO ADJ	MED	• EASY ADJ ONCE INSIDE RADIO	LOW
CHANGE ORIGINAL FUSEHOLDER			• NEGLIGIBLE PARTS COSTS • SIMPLE CHANGEOUT	LOW

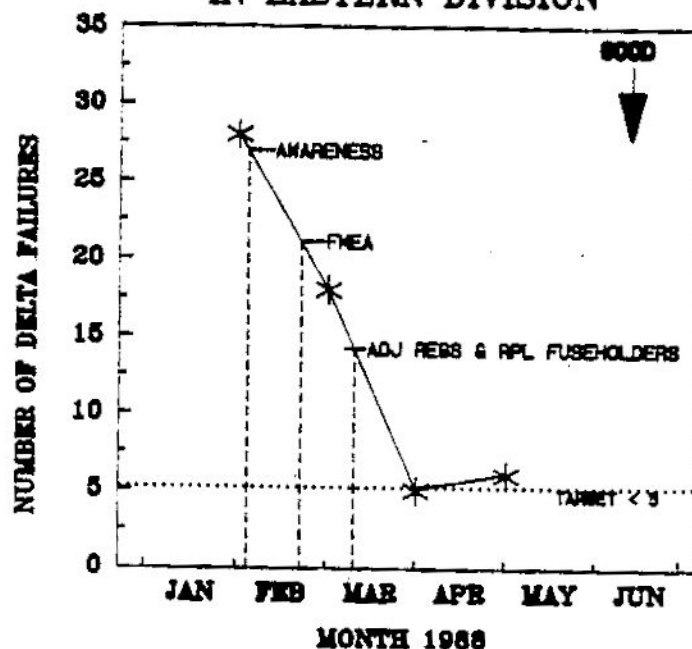
ACTION PLAN

WHAT	WHO	WHEN	WHERE	STATUS
BUY FILTERS & 20V MOV'S	MERTENS	WK OF 5/16	LOCAL VENDOR	ASSIGNED
INSTALL FILTERS & 20V MOV IN ALL VEHICLES	RADIOMEN	AS RADIOS FAIL OR ARE CHECKED IN FIELD	IN ALL DELTA'S WORKED ON IN ED	START 5/25/88
WIRE CONTROL UNIT TO BATTERY & ADD RELAY IF NEEDED	RADIOMEN	AS RADIOS FAIL OR ARE CHECKED IN FIELD	IN ALL DELTA'S WORKED ON IN ED	START 5/17/88
USE FMEA FOR REPAIR ANALYSIS	RADIOMEN	ONGOING	IN ALL DIVISIONS ULTIMATELY	STARTED 3/10/88 IN EASTERN DIV
ADJUST REGULATORS TO NEW SPECS	RADIOMEN	AS RADIOS FAIL & ARE BENCH-CHECKED	IN ALL DELTA'S WORKED ON IN ED	STARTED 2/25/88 IN EASTERN DIV
REPLACE ALL ORIGINAL FUSE-HOLDERS	RADIOMEN	AS RADIOS FAIL OR ARE CHECKED IN FIELD	IN ALL DELTA'S WORKED ON IN ED	STARTED 2/25/88 IN EASTERN DIV

WITH OUR COUNTERMEASURES UNDERWAY LET'S
LOOK AT OUR INDICATOR:

NUMBER OF DELTA FAILURES PER MONTH

NUMBER OF DELTA RADIO FAILURES
IN EASTERN DIVISION



- THE ABOVE GRAPH SHOWS A SIGNIFICANT DROP IN FAILURES FROM JANUARY THROUGH THE END OF MARCH. THIS CAN IN PART BE ATTRIBUTED TO:
 - HEIGHTENED AWARENESS AMONG THE RADIOMEN FROM WORKING ON THIS PROJECT
 - DEVELOPMENT & USE OF THE FMEA WHICH ADDRESSES THE MOST COMMON FAILURE MODES, CAUSES & COUNTERMEASURES
 - STARTED ADJUSTING REGULATORS & REPLACING FUSEHOLDERS
- WITH THE REST OF THE COUNTERMEASURES IN PLACE THE INDICATOR WILL CONTINUE TO BE MONITORED TO ASSURE COMPLIANCE WITH OUR TARGET OF LESS THAN 5 DELTA FAILURES PER MONTH.

PROCESS CONTROL SYSTEM IN DEVELOPMENT STAGE