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File: Sigint Studies
Study 13
55-7

REVIEW OF OVERHEAD SIGINT SYSTEMS AND PAST TACTICAL ELINT STUDIES

1 OCTOBER 1974

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OUTLINE

- HISTORY OF OVERHEAD SIGINT COLLECTION
- CURRENT OVERHEAD SIGINT SYSTEMS REVIEW
- PAST AEROSPACE TACTICAL ELINT STUDIES

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IN THE BEGINNING

- o THERE WAS NRL (FIRST LAUNCH ON 22 JUNE 1960)
  - DYNO SINGLE BALL POPPY SYSTEMS (ALIAS SOLRAD, GREB, LOFTI)
  - SHARED THOR/ABLESTAR BOOSTER WITH TRANSIT
  - NATIONALLY ADVERTISED AS RADIATION MONITORS
- o THE VULNERABILITY MONITORING PACKAGES (10 AUG 1960)
  - SOCTOP I-V ON DISCOVERERS 13, 15, 17, 22, AND 24
  - [redacted] 25X1
- o ENVIRONMENTAL SURVEY AND ABM RADAR SEARCH (11 OCT 1960)
  - FIRST WAS ON SAMOS I WHICH FAILED TO ORBIT
  - SIX ABM RADAR SEARCH SYSTEMS ON DISCOVERER IN 1961
  - 13 DEC 1961 DISCOVERER 36 HAD FIRST COMINT COPY [redacted] 25X1
  - MIGRATED TO PROGRAMS 989 AND 770 BY 1964

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THE 698 BK PROGRAM

- FIRST ELINT SIDELOBE COLLECTION SYSTEMS
  - NARROWBAND STEPPED RECEIVERS FOR SENSITIVITY
  - SMALL VERTICAL FOOTPRINT (150 NM DIAMETER FROM 270 NM ALTITUDE)

- RELIABILITY WAS VERY POOR
  - USED THOR/AGENA BOOSTER AFTER SAMOS II EXPERIMENT FAILED
  - AGENA LIFE AVERAGED 4 DAYS THROUGH 698 BK VIII IN 1964
  - RELIABILITY IMPROVEMENT PROGRAM BECAME 770 ON TAT/AGENA

- SECONDARY PAYLOAD WITH EMITTER LOCATION CAPABILITY
  - BIRD DOG AMPLITUDE MONOPULSE SYSTEMS ON 698 BK VI – VIII (1964)
  - SETTER PHASE INTERFEROMETER ON 770 HAD [redacted] ACCURACY 25X1

- PROGRAM 770 MATURED AS STRAWMAN WITH 7 LAUNCHES THROUGH 16 JULY 1971
  - 2.6 TO 3.2 GHz SETTER FOLLOWED BY 1.8 TO 3.3 GHz REAPER
  - 698 BK PAYLOAD REPLACED BY 0.125 TO 2.1 GHz THRESHER [redacted] LOC ACC)
  - AVERAGE SYSTEM LIFETIME WAS 400 DAYS

THE P-11 PIGGYBACK SATELLITES (P-989)

- SPIN STABILIZED WITH ROCKET BOOST TO LONG LIFE ORBIT
- FIRST TWO WERE VAN ALLEN BELT SCIENTIFIC PROBES (1963)
- 4 LAUNCHES PER YEAR THROUGH 1970/ 1.5 PER YEAR SINCE
- A LARGE VARIETY OF SIGINT EXPERIMENTS WERE FLOWN
- CURRENT SYSTEMS ARE MABELI, TOPHAT, URSALA, RAQUEL
  - MABELI FOR ABM RADAR PRECISION MAIN BEAM PARAMETERS (7339)
  - TOPHAT FOR 450-1000 MHz COMINT MAP AND COPY (7334/42)
  - URSALA FOR 2000-12000 MHz EOB [redacted] LOC ACC) (7338/40) 25X1
  - RAQUEL FOR 4000-18000 MHz SIGINT SEARCH AND TI (7341)

THE POPPY PROGRAM MATURES

MISSION	NO. SC	RF RANGE (MHz)	% RF OVERLAP	DATE	LIFE (DAYS)
7101	2		10 5	12 DEC 62	
7102	3		15	15 JUN 63	
7103	3		15	11 JAN 64	
7104			50	9 MAR 65	
7105			90 0	31 MAY 67	
7106			100 100	30 SEP 69	
7107			100 20	14 DEC 71	

25X1

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CURRENT OVERHEAD SIGINT SYSTEMS REVIEW

- o [redacted]
- o CURRENT PROGRAM 989 MISSIONS
- o 7107 POPPY [redacted] 25X1
- o [redacted]

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CURRENT PROGRAM 989

- LMSC PIGGYBACK SATELLITE
  - 3 FT. X 3 FT. X 1 FT., 600 LBS., 600 W-HR/DAY
  - 55 RPM SPIN STABILIZED WITH MAGNETIC CONTROL
  - 270 NM CIRCULAR ORBIT AT HOST INCLINATION (95°)

- GROUND SUPPORT BY USAF SATELLITE CONTROL FACILITY (SCF)
  - TIME DELAY COMMANDS FOR COLLECTION OVER USSR (1850 MHz)
  - THREE TAPE RECORDERS FOR DATA STORAGE (22 MINUTES @ 250 KHz)
  - THREE DATA LINKS FOR SCF DATA READOUT (2200-2300 MHz)
  - COMSAT DATA RETURN TO SUNNYVALE FOR PROCESSING

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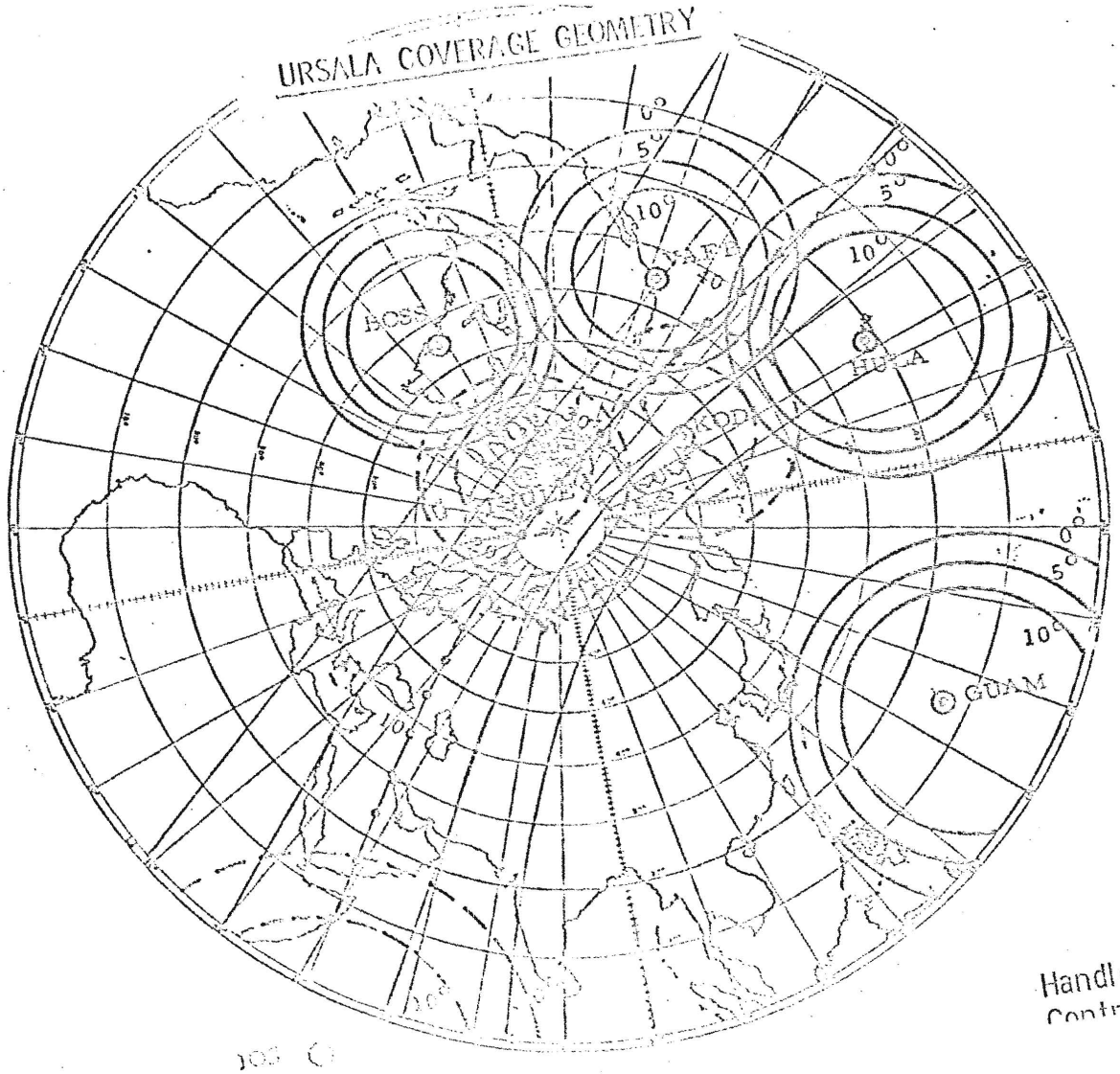
URSALA COVERAGE GEOMETRY



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MABELI

MABELI = MAIN BEAM TIVOLI

MISSION = PROVIDE POWER (± 0.5 DB), POLARIZATION, AND 0.75 MHz PREDETECTION COPY OF [redacted] DOG HOUSE, BIG SCREEN, AND TRY ADD 25X1

CONFIGURATION

- SPIN AXIS AND SPIN RATE CONTROL
- SPIRAL ANTENNAS WITH BOTH RIGHT AND LEFT-HAND CIRCULAR POLARIZATION
- 0.75 MHz SUPERHETERODYNE RECEIVER TO TRACK TARGET SIGNAL FREQUENCIES
- COMPARE POWER AND PHASE FOR POLARIZATION ELLIPSE
- RECOGNITION LOGIC FOR SIGNALS OF INTEREST
- DIGITAL LISTING OF INTERCEPT PARAMETERS
- 0.75 MHz PRE-DETECTION RECORDING OF INTERCEPT SIGNALS

SCHEDULE

- MABELI WAS LAUNCHED ON 20 JANUARY 1972 ON P-467

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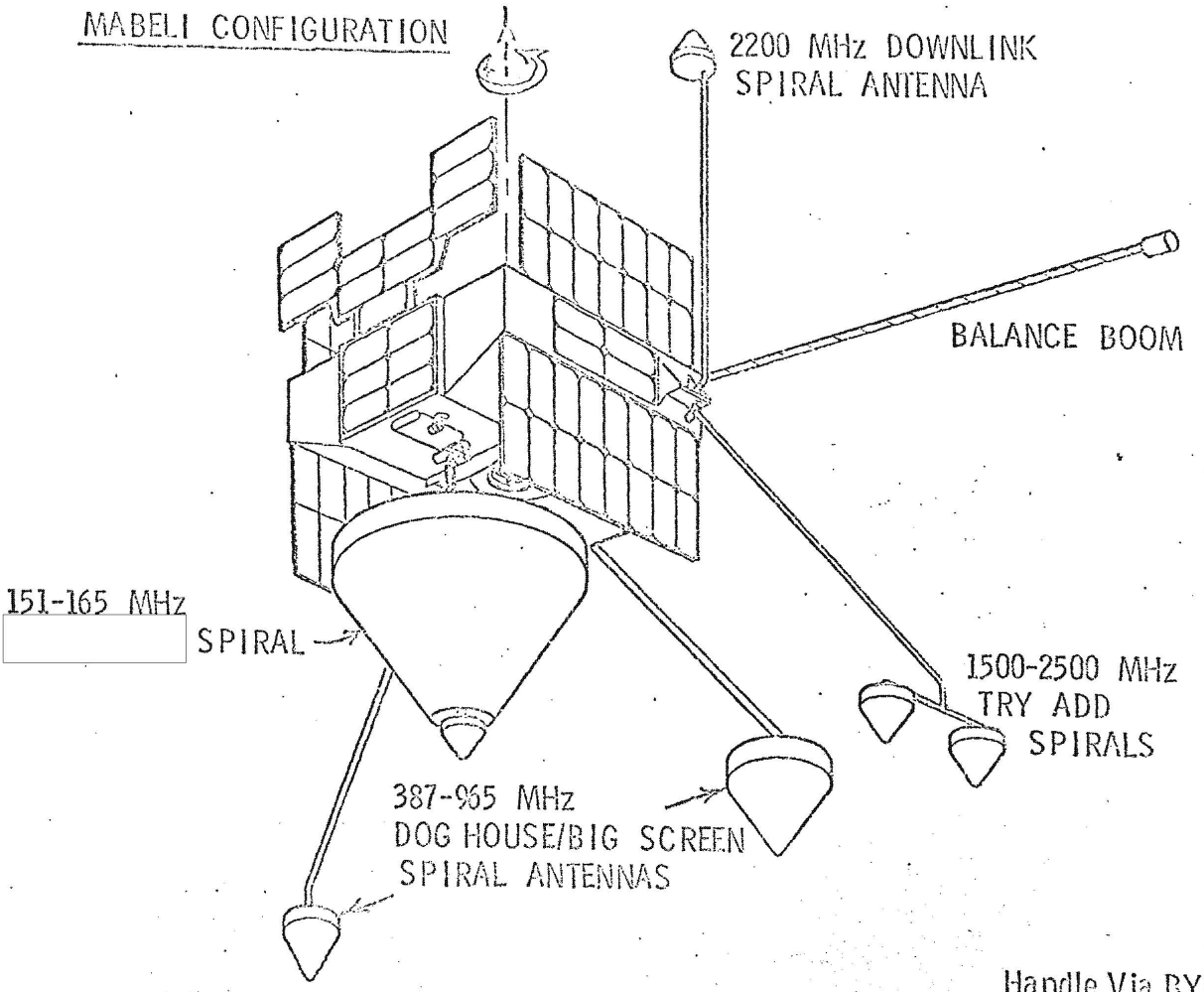
MABELI CONFIGURATION



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TOPHAT

MISSION = MAP AND COPY TROPOSCATTER LINKS OVER THE 450-1000 MHz RANGE

CONFIGURATION

- SPINNING INTERFEROMETER (ANGLE OF ARRIVAL FROM RF PHASE DIFFERENCE)
- BACK-TO-BACK PAIRS OF 450-1000 MHz CONICAL SPIRAL ANTENNAS
- STEPPED SUPERHETERODYNE RECEIVER (1 MHz STEPS)
- NARROW BAND RECEIVER FOR HIGH PRIORITY SIGNAL
- FDM RECOGNIZER AND DATA HANDLER TO SELECT AND RECORD 12 VOICE CHANNELS
- ENCRYPT VOICE AT 1.024 MBPS ON PLAYBACK
- MAPPING DATA IS IN 32 KBPS PCM DATA STREAM

SCHEDULE

- TOPHAT I LAUNCHED 18 NOVEMBER 1970 ON P-846
- TOPHAT II LAUNCHED 10 APRIL 1974 ON P-467

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URSALA

URSALA = UNIVERSAL RADAR SEARCH AND LOCATION ACQUISITION

CONFIGURATION

- SPINNING PENCIL BEAM AT 55 RPM
- MAGNETIC CONTROL OF SPIN AXIS AND SPIN RATE
- SIX FOOT DISH PLUS SIDELOBE INHIBIT, 2000-8000 MHz
- THREE FOOT DISH PLUS SIDELOBE INHIBIT, 4000-12000 MHz
- 2000 MHZ RECEIVER SWITCHED EACH HALF SPIN BETWEEN ANTENNAS AND RF BANDS
- BOTH CW AND PULSE FREQUENCY MEASURED TO $\pm$ 20 MHZ
- MONOPULSE BEAM SPLIT FOR $\pm 0.5^0$ ANGLE OF PULSE ARRIVAL MEASUREMENT
- PRIMARY DATA STREAM IS 245 KBPS BI-PHASE PCM (980 KBPS PLAYBACK)

SCHEDULE

- URSALA I LAUNCHED 7 JULY 1972 ON P-467
- URSALA II LAUNCHED 10 NOVEMBER 1973 ON P-467
- URSALA III READY FOR LAUNCH IN MARCH 1975
- URSALA IV READY FOR LAUNCH IN MARCH 1976

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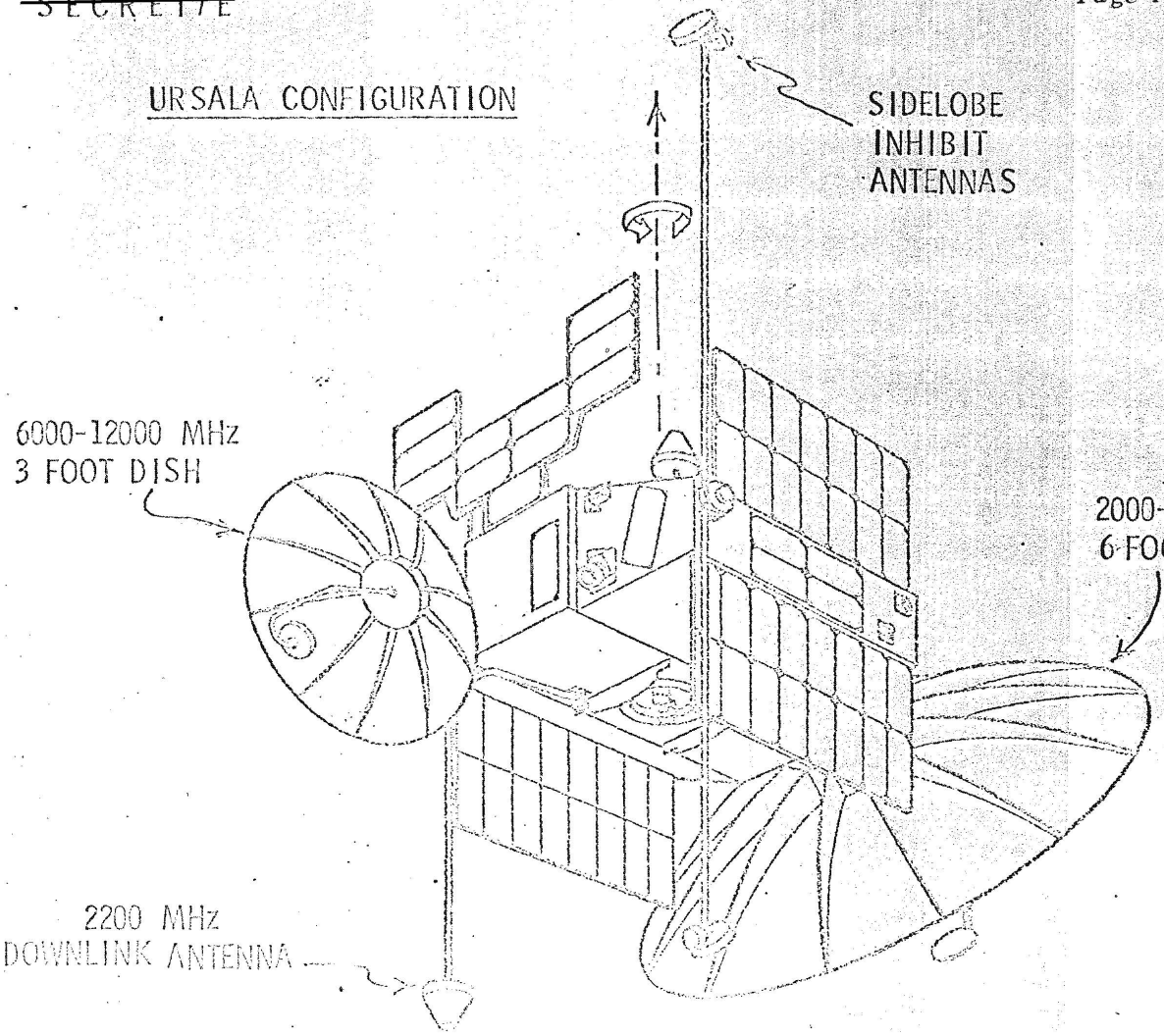
URSALA CONFIGURATION



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RAQUEL

RAQUEL = RADAR ACQUISITION EQUIPMENT WITH LOCATION

CONFIGURATION

- SPINNING PENCIL BEAM WITH MAGNETIC CONTROL (LIKE URSALA)
- THREE FOOT DISH PLUS MAIN BEAM ANTENNAS, 4000-8000 MHz
- THREE FOOT DISH PLUS MAIN BEAM ANTENNAS, 8000-12000 MHz
- TWO FOOT DISH PLUS MAIN BEAM ANTENNAS, 12000-18000 MHz
- 2000 MHz RECEIVER SWITCHED BETWEEN ANTENNAS AND RF BANDS
- ANGLE OF PULSE ARRIVAL TO $\pm 1^0$ BY PENCIL BEAM CENTROIDING
- FREQUENCY LOCK TO CW SIGNALS TO RECORD 0.75 MHz PRE-D DATA
- DISPERSIVE RECEIVER TO COMPRESS 13 MHz PRF-D DATA TO 0.75 MHz
- 256 KBPS PCM FOR FASE IN DIGITAL PROCESSING

SCHEDULE

- TO BE LAUNCHED 21 OCTOBER 1974 ON F-4G7

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7107 POPPY (PROGRAM 770-C)

25X1

- o LAST OF NRL [redacted] POPPY SYSTEMS
  - LAUNCHED 14 DEC 1971 ON THORAD/AGENA
  - [redacted]
  - 20 RECEIVERS OVER 153 TO 18,000 MHz AND 12 DOWN-LINKS AT 136 MHz
  - [redacted]
- o GROUND SUPPORT
  - ORBIT DETERMINATION BY CONUS NAV SPASUR NET
  - COMMAND, DATA TRANSPOND AND PROCESSING TERMINALS [redacted]

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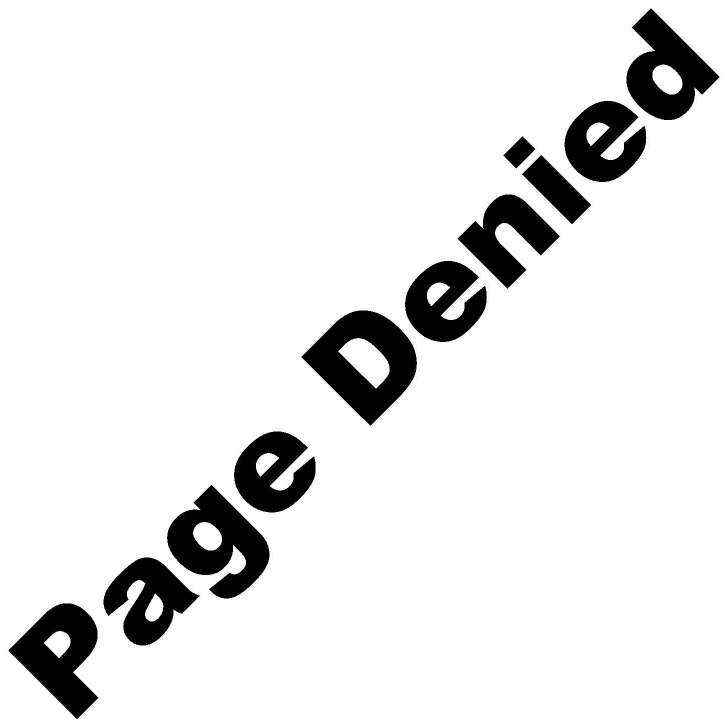

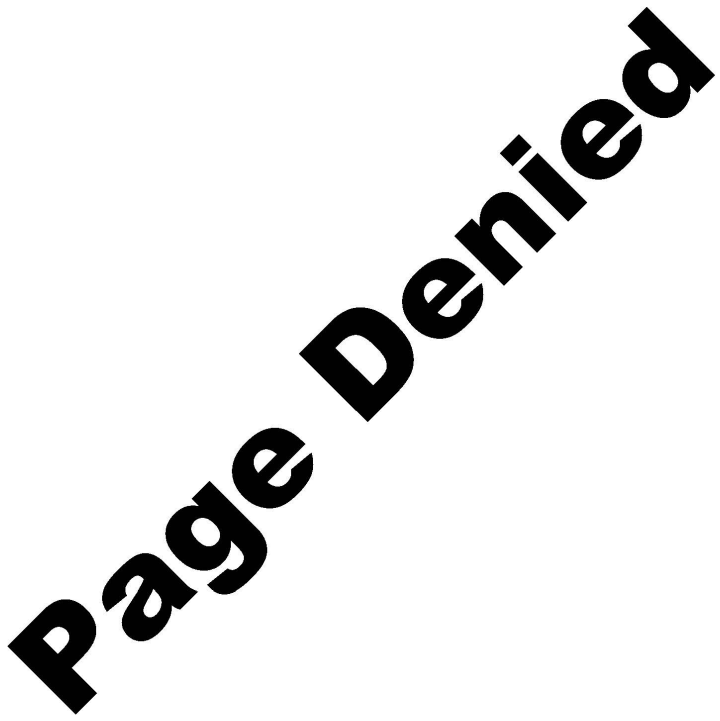

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OUTLINE

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EARLY TACTICAL ELINT ACTIVITIES

- LOCAL [redacted] OFFICE HAD EDL DESIGN ELINT ADD-ON TO LATE 60'S VERSION OF ACTIVE RADAR OCEAN SURVEILLANCE SYSTEM AT TIME OF INITIAL POPPY CONTRIBUTIONS TO OCEAN SURVEILLANCE 25X1
- OUTSTANDING CONTRIBUTION OF 770 REAPER SYSTEM TO ROUTINE EOB UPDATE LED TO SPECIAL TACTICAL ELINT TASKING IN LATE 60's OVER VIETNAM (PENDULUM) AND OTHER AREAS
- 989 OFFICE SPONSORED MAJOR ELINT OCEAN SURVEILLANCE STUDY WHICH RESULTED IN WIDELY GIVEN ROSALI BRIEFING IN OCTOBER 1970
- NRO REACTION TO ROSALI BRIEFING AND OTHER INPUTS WAS REASSIGNMENT OF CAPT. GEIGER TO STUDIES WHICH LED TO [redacted] DEFINITION 25X1
- LEVEL OF TASKING OF ALL OVERHEAD SYSTEMS FOR TACTICAL SUPPORT CONTINUES TO GROW

TACTICAL ELINT AND OCEAN SURVEILLANCE

- o [redacted] SPONSORED MAJOR TACTICAL ELINT STUDY COINCIDENT WITH PM-16 OCEAN SURVEILLANCE STUDY IN 1971

25X1

- o IN OCTOBER 1971 DR. KAHAL AND JOHN HUGHES FORMED JOINT NRO/DIA COMMITTEE TO PROVIDE DEFINITIVE ANSWERS ON TACTICAL ELINT
- o EXCOM GAVE [redacted]

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THE NRO/DIA TACTICAL ELINT STUDY

- o STUDY PANEL FORMED IN OCTOBER 1971
- o REQUIREMENTS AND TARGET RADARS DEFINED IN MARCH 1972
- o AEROSPACE EVALUATION COMPUTER PROGRAM DEVELOPED IN APRIL 1972
- o SATELLITE SYSTEM EVALUATION COMPLETED IN JUNE 1972
  - CURRENT AND ADVANCED VERSIONS OF [redacted] URSALA, POPPY
- o CONVENTIONAL SYSTEM EVALUATION COMPLETED IN MARCH 1974
  - 6 USAF (BIG TEAM, [redacted] SR-71, PELS, RF-4C, COMBAT APPLE)
  - 7 USN (ARIES, SEA WING, PICKET SHIPS, ETC.)
  - 4 USA (QUICKLOOK, AGTELUS, VANS, JEEPS)
  - 1 USM (GROUND TRIANGULATION)

25X1

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TACTICAL ELINT STUDY PANEL MEMBERS

NRO STAFF

COL. G. STUKHART (CHAIRMAN)

[redacted]

LCDR. R. GASSER

(CAPT. J. DRAIM)

PROGRAM OFFICES

PROG. A - MAJ. G. RUDOLPH

PROG. C - LCDR F. CLEARY

AEROSPACE - [redacted]

DIA

COL. D. WAGNER (REQMTS.)

NSA

[redacted] (EMITTER MODEL)

[redacted] (C, C, & C)

SERVICE REPRESENTATIVES

NIC - CDR. H. GAMBER

AF/INYSA - MAJ. C. LEONARD

ACSI - DR. W. HOWE

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ANNEX SECTION IV - TARGETING

CPT'S	GEOGRAPHIC AREA			REPORTING DELAY			INITIAL RESPONSE		
	ARMY	NAVY	AF	ARMY	NAVY	AF	ARMY	NAVY	AF
A LOCATE	300 NM OF BORDER	TASK GP AREAS	AIR COMP AREAS	6 HRS	0.3 HR	6 HRS	6 HRS	WNOO	12 HRS
B TRACK	150 NM OF BORDER	SAME AS A	SAME AS A	4 HRS	0.3 HR	6 HRS	4 HRS	WNOO	12 HRS
C TARGET	100 NM OF BORDER	SAME AS A	SAME AS A	0.5 HR	NRT	1 HR	1.5 HRS	WNOO	3 HRS
D PLATFORMS	300 NM OF BORDER	SAME AS A	SAME AS A	0.5 HR	0.3 HR	NRT	0.5 HR	WNOO	NRT
E EVENTS	750 NM OF BORDER	SAME AS A	SAME AS A	12 HRS	0.3 HR	NRT	12 HRS	WNOO	NRT
F PARAMETERS	750 NM OF BORDER	SAME AS A	SAME AS A	24 HRS	0.3 HR	6 HRS	24 HRS	WNOO	12 HRS

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JOINT MISSION EVALUATION CRITERIA

PARAMETER		SURVEILLANCE			EW			THREAT DET.			TARGETING		
		L	S	A	L	S	A	L	S	A	L	S	A
<u>GEOG. CVRG.</u>		WEIGHTED %			WEIGHTED %			WEIGHTED %			WEIGHTED %		
RPT'G. DELAY (MAX. HRS)	OPT.	24	0	12	1	0	0.5	0	0	0	0	0	0
	NOM.	48	8	24	12	3	6	2	1	0.1	1	0.1	0.01
	MIN.	60	20	168	48	7.5	24	24	2.5	3	24	1/3	0.1
<u>INIT. RESP.</u> (AVG. HRS.)	OPT.	12	0	12	12	5	0.5	0	6	0	0	0	0
	NOM.	48	24	24	24	6	6	2	12	0.1	1	0.2	0.1
	MIN.	60	72	48	48	24	24	24	24	8	24	4	1

GEOGRAPHIC COVERAGE WEIGHTS

LATITUDE RANGE	EVALUATION POINT	WEIGHT LAND & AIR	WEIGHT SEA
$80^{0}N - 30^{0}N$	$50^{0}N$	0.7	0.4
$30^{0}N - 0^{0}N$	$15^{0}N$	0.3	0.5
$0^{0}N - 40^{0}S$	$20^{0}S$	0	0.1

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CPT EVALUATION CRITERIA

PARAMETER		A LOCATE			B TRACK			C TARGET			D PLATE ID			E EVENT ID		
		L	S	A	L	S	A	L	S	A	L	S	A	L	S	A
TARGET MODEL COVERAGE		% MODEL			% MODEL			% MODEL			% MODEL			% MODEL		
LOC. ACC. (NM 2 σ)	OPT.															
	NOM.															
	MIN.															
CYRG. GAP (MAX. HRS)	OPT.	6	2	.1	1	.5	0	0	0	0	1	.5	0	0	.5	0
	NOM.	18	6	.5	5	1	.1	1.5	.25	.1	6	1	.1	2	1	1
	MIN.	48	24	6	10	2	.5	6	.5	1	24	2	5	6	6	6
PRF ACC. (EXP)	OPT.	-6	-7	-4	-6	-7	-4	-5	-7	-4	-7	-7	-7	-7	-7	-7
	NOM.	-3	-3	-3	-4	-6	-3	-3	-6	-3	-5	-6	-6	-5	-6	-6
	MIN.	-1	-2	-1	-2	-4	-1	-1	-5	-1	-3	-4	-4		-4	-4
SCAN ACC. (%)	OPT.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	NOM.	10	10	10	5	10	20	10	10	20	3	10	5	3	10	5
	MIN.	30	50	50	30	50	50	50	50	50	10	50	10	10	50	10
RF ACC. (%)	OPT.	.5	.1	.01	.5	.1	.01	.1	.1	.01	.2	.1	.01	.5	.1	.01
	NOM.	2	.5	.1	2	.5	.1	1	.5	.1	1	.5	.1	2	.5	.1
	MIN.	10	10	10	10	10	10	10	10	10	10	10	.5	10	10	.5
PW ACC. (%)	OPT.	1		1	1		1	1		1	1		1	1		1
	NOM.	10		10	10		10	10		10	10		10	10		10
	MIN.	50		50	50		50	50		50	50		50	50		50

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OTHER EVALUATION CRITERIA

CRITERION	OPT.	NOM.	MIN.	DESCRIPTION OF OPTIMUM
VULNERABILITY	.09	.070	.040	NOT SUSCEPTIBLE TO ECM
NEW FACILITIES	.11	.074	.048	NO NEW FACILITIES NOR FOREIGN SITES
DENSE ENVIRON.	.13	.088	.030	NO DEGRADATION IN DENSE ENVIRONMENT
SIMULTANEOUS CVG.	.14	.098	.048	3 SIMULTANEOUS AREAS OF 1000 NM DIA.
GROWTH CAPABILITY	.12	.080	.038	MEET ALL REQ'MTS. BY ADD'N OF SATELLITE
MULTIMISSION PENALTY	.12	.079	.032	OTHER MISSIONS DO NOT DEGRADE TACTICAL ELINT
RELIABILITY	.21	.145	.080	SYSTEM TYPE HAS LONG RELIABILITY RECOR
FALSE REPORTING	.08	.055	.030	NO DANGER OF FALSE REPORTS IN FAST REPORTING
SUM	1.0	.690	.346	

STRUCTURE OF TARGET MODEL EVALUATION

DIA / NSA / SERVICES	SERVICES	SERVICES	AEROSPACE
65 / 66 LAND BASED RADAR TYPES	ASSIGN WEIGHTS OF 0-5 TO EACH EMITTER FOR EACH CPT	ASSIGN % AND LENGTH ON-TIME TO EACH EMITTER FOR EACH EF	COMPUTE PROBABILITY OF INTERCEPT OF EACH EMITTER AND WEIGHTED SUM (SYSTEM SCORE) FOR EACH TARGET MODEL FOR EACH COLLECTION SYSTEM
62 / 73 SOVIET NAVAL EMITTER TYPES			
67 / 68 SOVIET A/C EMITTER TYPES			
3 TM's (194 EMITTERS)	X 6 = 18 TM's	X 4 = 72 TM's	12 COLLECTION SYSTEMS (more to come)

EVALUATION FORMULAS

- FOR EACH SYSTEM TO BE EVALUATED, FOR EACH OF THE SIX CPT'S, COMPUTE

$$[\text{CPT SCORE}] = \left([\%\ \text{TARGET MODEL}]^{a}\,[\text{LOG. ACC.}]^{b}\,[\text{SAMPLE TIME}]^{c}\,[\text{PARAM. ACC.}]^{d}\right)^{1/}$$

WHERE $a + b + c + d = 10$

- FOR EACH OF THE FOUR ELINT FUNCTIONS, FOR LAND, SEA, & AIR USING THE ESTIMATED EMITTER ON-TIME DUTY CYCLES (EMCON MODELS), COMPUTE

$$[\text{EF SCORE}] = \sum(W_i\,\text{CPT}_i)\left([\%\ \text{GEOG.}]^{l}\,[\text{RPTG. DELAY}]^{m}\,[\text{INIT. RESP.}]^{n}\right)^{1/10}$$

WHERE $l + m + n = 10$, $i = 1 - 6$, $\sum W_i = 1$

- FOR LAND, SEA, & AIR, COMPUTE AN OPERATIONAL PERFORMANCE SCORE

$$[\text{OPER. PERF.}] = [\text{OP}] = \sum (W_i\,\text{EF}_j),\ j = 1 - 4,\ \sum W_j = 1$$

- COMBINE LAND, SEA, & AIR FOR A FINAL PERFORMANCE SCORE,

$$[\text{PERF. SCORE}] = [\text{PS}] = \sum(W_k\,\text{OP}_k),\ k = 1 - 3,\ \sum W_k = 1$$

- COMPUTE A SCORE FOR OTHER EVALUATION CRITERIA $(= [\text{OEC}])$
- COMPUTE A FINAL SYSTEM SCORE $= \alpha[\text{PS}] + (1 - \alpha)[\text{OEC}]$ WHERE $\dfrac{\alpha\,[\text{PS}]}{(1-\alpha)\,[\text{OEC}]} = \dfrac{0.7}{0.3}$

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TARGET MODEL COVERAGE (TMC)

$$[\text{TMC SCORE}] = \frac{1}{N} \sum_i w_i \, n_i \, P_i$$

where w_i = ASSIGNED WEIGHT / EMITTER / CPT (0, 1, 2, 3, 4, OR 5)

n_i = COVERAGE OF EMITTER BY COLLECTION SYSTEM

$$n_i = \begin{cases} 0 \text{ IF NOT COVERED} \\ 0.5 \text{ IF MARGINALLY COVERED} \\ 1 \text{ IF FULLY COVERED (READILY INTERCEPTED)} \end{cases}$$

$N = \sum_i w_i$ = NORMALIZATION FACTOR

P_i = PROBABILITY THAT THE i^{th} EMITTER IS LOCATED TO THE REQUIRED ACCURACY WITHIN THE CPT SAMPLE TIME

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COMPUTATION OF P_i PER EMITTER

LET P_o = PROBABILITY THAT EMITTER IS ACTIVE (DUTY CYCLE)

T_o = TIME EMITTER IS ACTIVE WHEN ACTIVE

T_s = NOMINAL REQUIRED SAMPLE TIME PER CPT

T_a = AVERAGE TIME GAP BETWEEN LOOKS BY COLLECTION SYSTEM

T_d = COLLECTION SYSTEM DWELL TIME PER LOOK

T_r = REQUIRED TIME SPAN TO COLLECT LOCATION INFORMATION

THEN P_i IS THE LARGER OF $\left[1 - (1 - P_o)^{kl} (1 - r P_o)^{l}\right]$ OR $\dfrac{T_d - 2 T_r + T_o}{T_a + T_d}$

WHERE THE SECOND TERM IS THE P_i FOR EACH EMITTER TURN-ON

ALSO, $P_i = \begin{cases} 1 \text{ IF } P_o = 1 \text{ OR } T_o - 2 T_r > T_a \\ 0 \text{ IF } P_o = 0 \text{ OR } T_o < T_r \text{ OR } T_s < T_r \end{cases}$

LET n = AVERAGE NUMBER OF INDEPENDENT LOOKS PER TS

$$n = \frac{T_s}{T_a + T_d} \left[\frac{T_d - 2 T_r + T_o}{T_o}\right] = m \left[1 + \frac{T_d - 2 T_r}{T_o}\right] = (k + r)\, l$$

WHERE k = INTEGER PART OF m

r = FRACTIONAL PART OF m ($0 \leq r \leq 1$)

m = NUMBER OF DWELLS (REVISITS) PER T_s ($m = k + r$)

l = NUMBER OF INDEPENDENT INTERCEPT OPPORTUNITIES PER DWELL

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L A N D B A S E D

TACTICAL DUTY CYCLE MODEL

	TYPE	Surveillance T_{on}	Surveillance P_{on}	E.W. T_{on}	E.W. P_{on}	Threat Opport. Detection T_{on}	Threat Opport. Detection P_{on}	Targeting T_{on}	Targeting P_{on}
(1)	Early Warning	2 hr	.5	2 hr.	.5	2 hr.	.8	2 hr	.8
2	Height Finder	30 min	.1	30 min	.3	30 min.	.5	1 hr.	.8
3	GCI	30 min	.5	30 min.	.5	30 min.	.8	1 hr.	.8
(4)	SAM Acquisition	45 min	.1	45 min	.3	2 hr.	.5	2 hr.	.8
(5)	SAM Track-Guide M6	10 min	.01	10 min	.01	1.5	.1	1.5	.5
6	AAA	10 min	.01	10 min	.05	1.5	.1	5 min.	.5
7	Met ME	15 min	.25	15 min	.25	15 min.	.25	15 min.	.25
8	C/M C/B	5 min	.01	5 min.	.01	5 min.	.1	30 min.	.5
9	BS Close Air Support	30 min	.01	30 min	.01	30 min.	.1	1 hr	.5
10	AIM	3 hr.	.8	3 hr	.8	3 hr	.8	10 min	.5
11	Airfield P/A	30 min.	.25	30 min	.25	30 min	.25	30 min	.25
12	Airfield GCA	30 min.	.1	30 min	.1	30 min	.25	30 min	.25

~~SECRET / E~~

TARGET MODEL WEIGHTS

* FIXED THD DATA *
DOMAIN S WEIGHTS

T NO	TYPE	A	B	C	D	E
1	1	5.0	0.0	5.0	7.0	5.0
2	1	5.0	0.0	5.0	33.0	5.0
3	5	4.0	0.0	0.0	14.0	4.0
4	5	4.0	0.0	0.0	6.0	4.0
5	1	5.0	0.0	0.0	14.0	5.0
6	1	5.0	0.0	0.0	7.0	5.0
7	1	5.0	0.0	5.0	13.0	5.0
8	6	1.0	0.0	1.0	3.0	1.0
9	5	4.0	0.0	0.0	447.0	4.0
10	5	4.0	0.0	0.0	22.0	4.0
11	5	4.0	0.0	0.0	18.0	4.0
12	5	4.0	0.0	4.0	132.0	4.0
13	5	4.0	0.0	0.0	23.0	4.0
14	2	3.0	0.0	2.0	9.0	3.0
15	1	5.0	3.0	5.0	7.0	5.0
16	1	5.0	3.0	5.0	40.0	5.0
17	1	5.0	5.0	5.0	22.0	5.0
18	6	1.0	0.0	1.0	22.0	1.0
19	6	3.0	0.0	3.0	22.0	3.0
20	2	3.0	1.0	3.0	9.0	3.0
21	4	5.0	3.0	5.0	30.0	5.0
22	2	3.0	1.0	2.0	22.0	3.0
23	1	5.0	3.0	5.0	8.0	5.0
24	2	3.0	1.0	2.0	41.0	3.0
25	1	5.0	5.0	5.0	92.0	5.0
26	1	5.0	5.0	5.0	92.0	5.0
27	1	5.0	3.0	5.0	73.0	5.0
28	1	5.0	0.0	5.0	4.0	5.0
29	6	1.0	0.0	1.0	12.0	1.0
30	1	5.0	0.0	0.0	10.0	5.0
31	4	5.0	3.0	5.0	16.0	5.0
32	4	5.0	0.0	0.0	31.0	5.0
33	3	4.0	0.0	4.0	42.0	4.0
34	1	5.0	0.0	5.0	5.0	5.0
35	2	2.0	0.0	2.0	24.0	2.0
36	1	5.0	1.0	0.0	39.0	5.0

~~SECRET//E~~

ALL NOMINAL SYSTEM - CPT SCORES BY EF, DOMAIN

CPT		EF-1	EF-2	EF-3	EF-4
LAND	A	.58	.58	.58	.58
	B	--	.61	.61	.61
	C	--	--	--	.65
	D	.67	.67	.67	.67
	E	.64	.64	.64	.64
	F	.65	.65	.65	.65
SEA	A	.67	.67	.67	.67
	B	--	.67	.67	.67
	C	--	--	--	.73
	D	.67	.67	.67	.67
	E	.66	.66	.66	.66
	F	.66	.66	.66	.66
AIR	A	.67	.67	.67	.67
	B	--	.66	.66	.66
	C	--	--	--	.71
	D	.67	.67	.67	.67
	E	.62	.62	.62	.62
	F	.63	.63	.63	.63

~~SECRET//E~~

Handle Via BYEMAN

~~SECRET / E~~

ALL NOMINAL SYSTEM - SUMMARY SCORES

o BY ELINT FUNCTION (WTD. COMB. OF CPT'S TIMES EF CONTRIBUTIONS)

	EF-1	EF-2	EF-3	EF-4
LAND	.40	.41	.42	.41
SEA	.46	.45	.45	.55
AIR	.45	.42	.51	.59

o BY DOMAIN (WTD. COMB. OF EF'S)

LAND .41

SEA .47

AIR .50

o PERFORMANCE (WTD. COMB. OF DOMAINS)

PS = .46

o OTHER EVALUATION CRITERIA

OEC = .69

o FINAL SYSTEM SCORE = .51

Handle Via BYEMAN Control System O...

~~SECRET~~

25X1

~~SECRET / E~~

25X1

TACTICAL ELINT TARGET MODEL (Cont'd)

NAME	RF(GHz)	PRF	PW(μS)	SEC/SCAN	BW (DEG)	PWR (DBM)

25X1

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Control System Only

~~SECRET/E~~

SYSTEM EVALUATION INPUTS

NAME: J. Spence
DATE: 26 [illegible] current

25X1

CPT	DOM.	LOC. ERROR (NM)	SAMPLE TIME (HRS)	% GEO EF1	EF2	EF3	EF4
A	L	2	4				1
	S	50	4				
	A	3000	4				
B	L	Group Repeats ↓	↓	all nominal			
	S						
	A						
C	L						
	S						
	A						
D	L						
	S						
	A						
E	L						
	S						
	A						
F	L						
	S	NA	NA				
	A						

NSYST = 1 IGEO = 50°N

OTHER EVALUATION CRITERIA
OEC = .7683

PARAMETER MEASUREMENT ACCURACY
PRF = 10^{-6} SCAN = 100 %
RF = 0.01 % PW = 1 %

INIT. RESP. REST = 2 HRS (AVG.)
REP'T'G TIME REPT = 0.9 HRS (MAX.)

TIMING FOR P_i (HOURS)

PARAM	A	B	C	D	E	F
T_a	3.4	—	—	—	—	—
T_d	2.6	—	—	—	—	—
T_r L	0.9	—	—	—	—	—
S	3.1	—	—	—	—	—
A	0.01					

HANDLE VIA BYEMAN
CONTROL SYSTEM ON.

~~SECRET/E~~

SYSTEMS WHICH WERE EVALUATED

- [redacted]
- MAIN BEAM FAMILY
  - BASELINE - 7107 POPPY [redacted] 25X1
- URSALA FAMILY
  - BASELINE - URSALA-I
  - TACTICAL URSALA - 1, 3, 6, AND 12 BALLS
- SYSTEM MIXES
  - BASELINE SYSTEM MIX
  - COMBINATIONS OF BASELINE AND ADVANCED SYSTEMS FROM SEPARATE FAMILIES

Handle Via [illegible]
Control System O

EIGHTEEN CONVENTIONAL SYSTEMS EVALUATED

25X1

USAF RC-135 @ 35,000 FT -- BIG TEAM, [redacted] COMBAT APPLE
SET OF THREE PAVE NICKEL DRONES AT 70,000 FT.
SR-71 @ 75,000 FT, RF-4C AT 20,000 FT.

USN VQ SQDNS: EP-3 (ARIES) AT 20,000 FT, EA3B (SEA WING) AT 30,000 FT.
SHIPS: FOUR SYSTEM TYPES DEPLOYED THROUGHOUT THE FLEET

USA MOHAWK (OV-1) QUICK LOOK AIRCRAFT AT 10,000 FT.
TRIANGULATION VAN AND TRUCK SYSTEMS, ANGLE CUTS FROM JEEPS

MARINES TRIANGULATION FROM PAIRS OF GROUND BASED RECEIVERS

TCR DATA PROCESSING & FLOW TO USERS

- [redacted]

- URSALA I & II
  - DIGITIZE ONBOARD IN REAL TIME, STORE
  - READOUT TO FIRST AVAILABLE 60 FT. SCF SITE (GUAM, HULA, VAFB, BOS)
  - DATA RETURN TO [redacted] FOR PROCESSING
    - -- 1200 BPS LINES FOR SELECTED DATA
    - -- MAIL TAPES CONTAINING ALL DATA

25X1

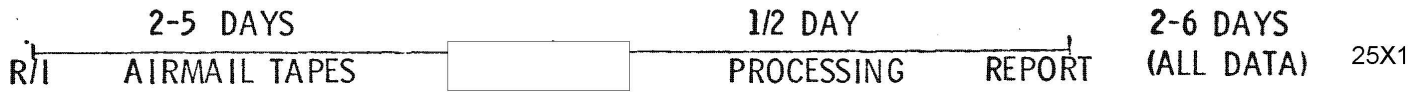
- FUTURE URSALA - AVAILABLE OPTIONS
  - READOUT TO ALL SCF SITES (ADD THULE & KODI)
  - ON-SITE DEINTERLEAVING, RETURN ALL DATA ON 1200 BPS LINES
  - RETURN ALL DATA TO [redacted] VIA COMSATS
  - ONBOARD PROCESSING - DIRECT READOUT TO USER

- POPPY
  - CONCEPTUALLY SAME AS [redacted] EXCEPT OPS PERFORMED AT EACH POPPY SITE

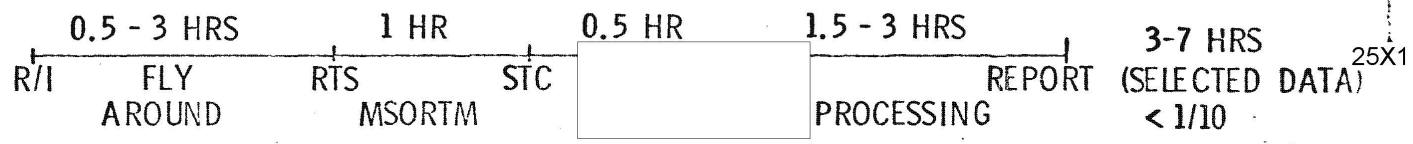
URSALA I DATA HANDLING TIME LINES

ROUTINE CAPABILITY

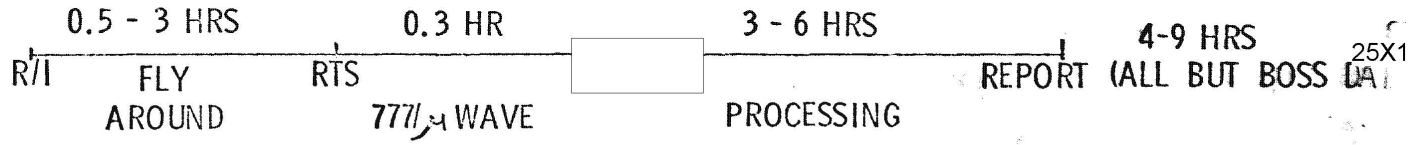
REPORTING DELAY



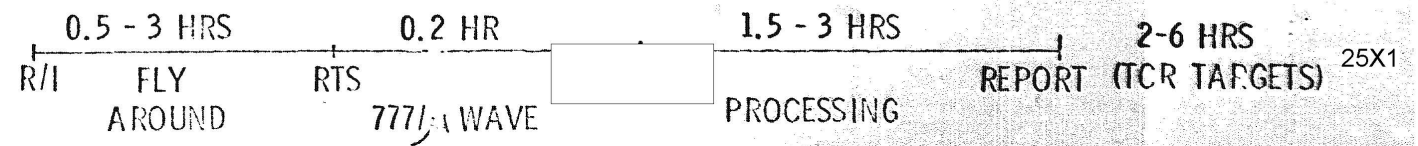
TCR (MSORTM)



ROUTINE (PHASE I 777)



TCR (PHASE I 777)



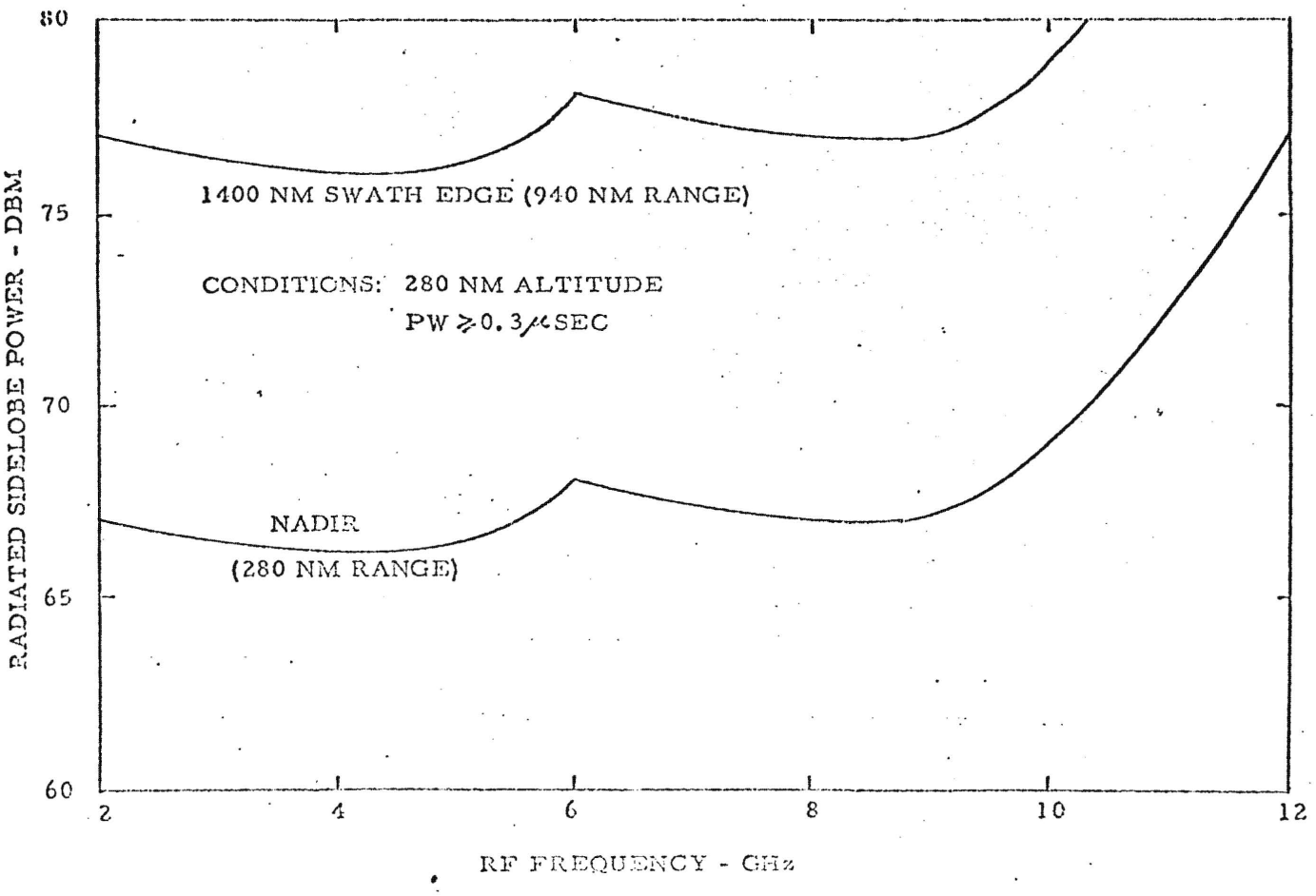
Handle Via Byeman
Control System Only

SYSTEM CAPABILITIES COMPARISON

PARAMETER	[redacted]	P-939 URSALA	[redacted] POPPY
RF RANGE (GHz)		0.7-1 / 1.75-12	0.153 - 18
GEOGRAPHIC COVERAGE		40^{0}S TO 80^{0}N	R/O SITE LIMITED
CONTACT FREQUENCY		≥TWICE DAILY	≥4 TIMES DAILY
ACCURACY (NM) LAND		[redacted]	[redacted]
30 KNOT SHIP			
600 MPH A/C			CAN'T LOCATE
QRC REPORTING DELAY		1-4 HOURS	0.5-2 HOURS
TRAFFIC HANDLING		GOOD	POOR
ILLUMINATION PROBLEMS		LOW DUTY CYCLE LOW ERP	NON HORIZON SCANNING NARROW BEAMS LOW DUTY CYCLE SHORT ON-TIMES LOW ERP

25X1

URSALA-I SENSITIVITY VS. FREQUENCY



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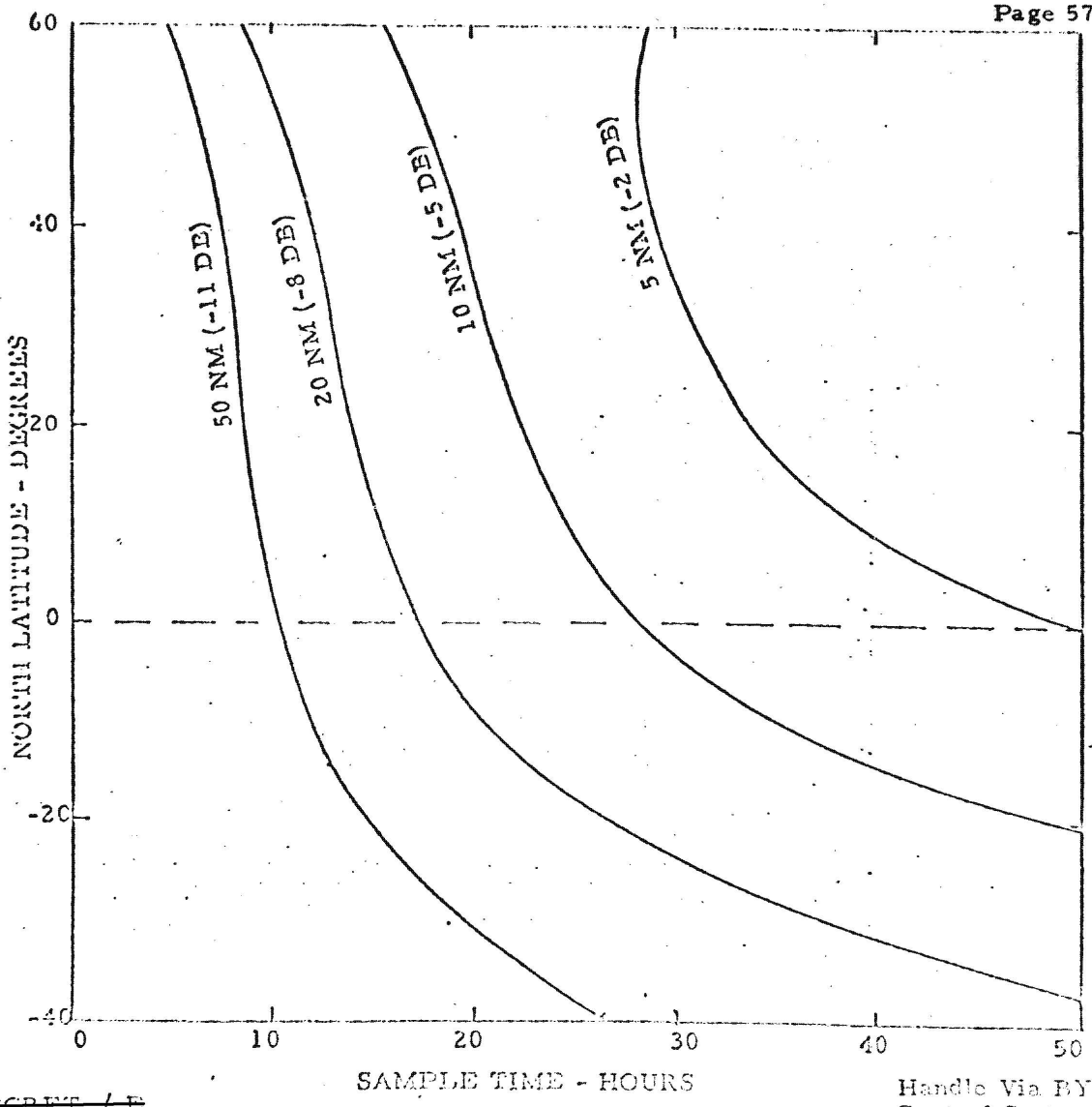

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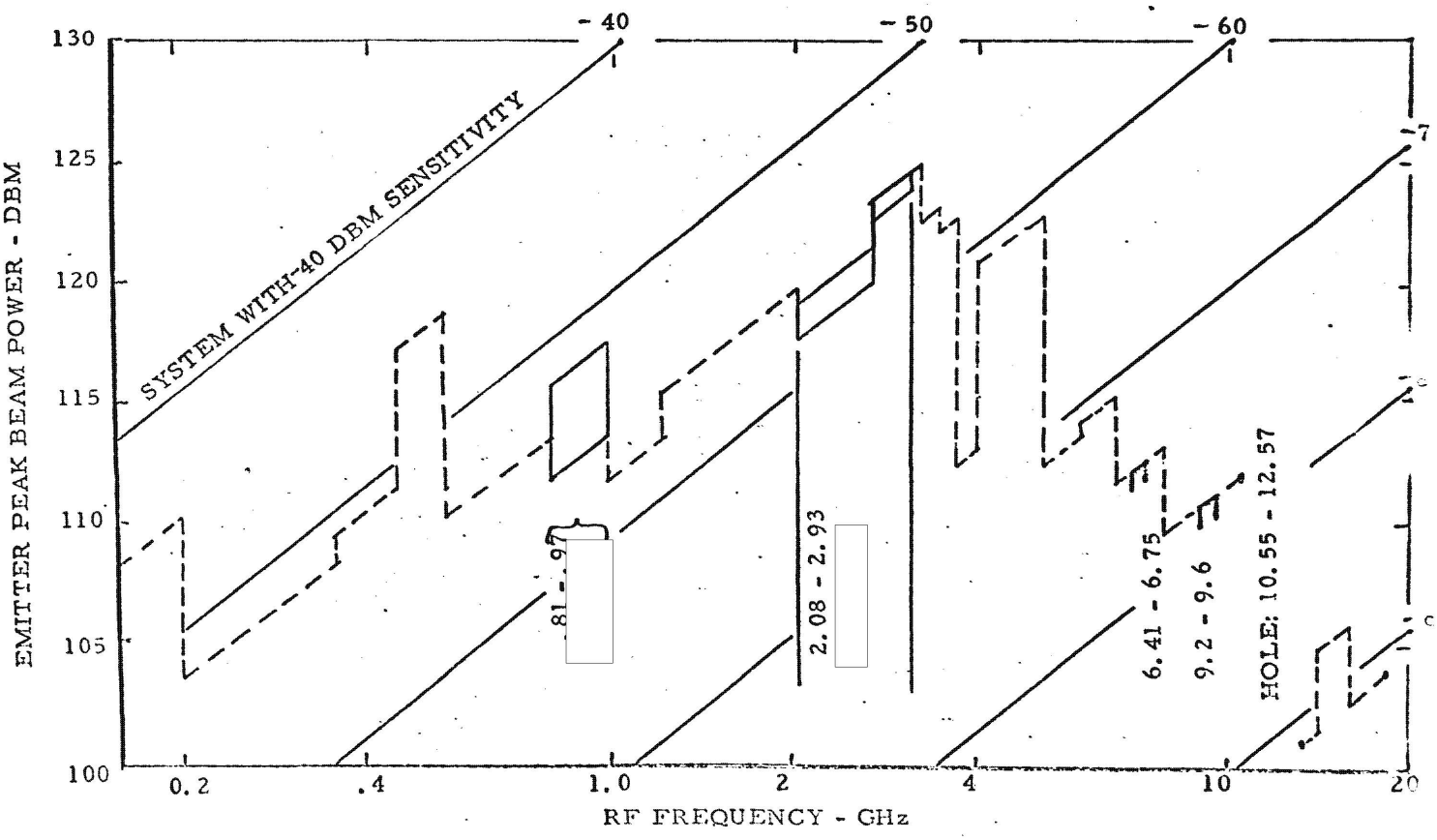
Control System Only

25X1

FIGURE 9. 7107 SYSTEM HORIZON ERP INTERCEPT CAPABILITY AT 3 DB EMITTER BEAM EDGE ASSUMING 3 DB POLARIZATION LOSS



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