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From: Director, U. S. Naval Research Laboratory, Washington 25, D.C.

To: Chief, Bureau of Naval Weapons

Subj: NRL Satellite Program Costs

Ref: (a) NAVWEPS ltr RTMB-WLC Ser 04213 of 17 Sept 1962

1. Reference (a) requests the estimated costs on various items of the program. The U. S. Naval Research Laboratory's normal cost breakdowns are not available in all the catagories requested; however, it is felt the following breakdown should suffice.

2. Satellite Development Costs

	November Launch 1962	March Launch 1963	July Launch 1963	July-September 1963 Long Lead Items	
	Two Payloads	Three Payloads	Three Payloads		
In-House Scientific Costs	538K	868K	855K		2261
In-House Fabrication Costs	324K	485K	476K	390K	1675
Procurements	914K	1,375K	1,140K	475K	3904
Launch Support	30K	30K	30K		90
TOTAL	1,806K	2,758K	2,501K	865K	7930K

This will cover the cost of the three launches in this fiscal year plus those long lead items required early in fiscal 1963. FY64

3. Ground Station Instrumentation

In-House Scientific Costs	120K
In-House Fabrication Costs	175K
Major Procurements	710K
Support for Field Stations	155K
TOTAL	1,160K

These costs cover the updating of the nine existing ground instrumentation complexes and the instrumentation required for the new system.

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BYEMAN-TALENT KEYHOLE CONTROL SYSTEMS JOINTLY

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4. Data Instrumentation Development

In-House Scientific Costs	50K
In-House Fabrication Costs	50K
Major Procurements	350K
Total	~~425~~ 450K

Since the data frequencies to be covered are subject to late selection from a large variety of possible band combinations, hardware to match this wide choice of bands must be developed and fabricated, so it will be available for later application in a minimum of time.

5. Totals

Satellite Development	7,930K
Ground Station Instrumentation	1,160K
Data Instrumentation Development	~~426~~ 450K
Total	~~9,561~~ 9,540K

6. Program costs at the Laboratory are not constant level figures, therefore it is not possible to state these for the various tasks. Cost estimates and time required for major procurements are difficult to arrive at in the present situation in the Electronic Market. Substantial savings can be had if longer delivery times can be tolerated. Therefore, it is desirable to make available as much of the funds as possible so that these savings can be realized by placing the major procurement orders as soon as possible in the program. It is desirable that at least 75% of the funds required should be available in the first half of the fiscal year and the remaining 25% as soon after 1 January as possible.

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[redacted]

[redacted]
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1st Payload = 7103A = #135 = 20" dia

4 Normal Exp

1 RD [redacted]

ant

17" 170-205 = B wide C wide = RED [redacted]

4" 820-1080 B Narrow

585-720 C narrow

½" conv 3800-4700 C wide

<7

>7 <14

>14 <=52

>52

Chan A = 136.500mc 60mw

IRIG Chan #5 & #6

2nd = 7103B = 12 = CR-VII 24" dia

(2) 18" Sec 165-180 may be 170-180 B-Narrow

(4) 5" 480-600 B-wide

(6) 3" 665-855 C-Wide

2500-3120 C narrow

Chan A = 136.890 100mw IRIG Chan 2 4 5 6 7

3rd = 7103C = 134 Gravity Gradient

(4) 3" Sonde 105-125 B Narrow

4 Spirals 1080-1350 B Wide

1200-1350 C wide

(6) 2" 1600-2000 C wide

(6) 5/8" 4700-5100 C [redacted]

Chan A ~~TOP SECRET~~ 60mw IRIG #3 & 4

1200 1230 1260 1290 1320 1350

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RD Fog Jumper

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	260 – 320	450 – 550	830 – 1080	2500 – 3120
110 SR VI (24")	N+S 10" 2 FILT. – 4.75" 2 DET. 1 – W	4 EQUAT. – 6" (Combined with N+S.) 12 FILT. – 3" 6 DET. 2 – W	6 ANT. – 36° – 4" 6 FILT. – 3.5" 6 DET. 2 – N	6 FILT.-DET. (3"x1"x.625") 1 – N

	230 – 290	480 – 580	665 – 855	3000 – 3650
130 DOSIMETER (24")	4 Equal N+S – 12" 6 FILT. – 5" 6 DET. 1 – W	6 ANT. 36° – 5" 6 FILT. 4.75" 6 DET. 2 – W	6 ANT. 36° – 5" 6 FILT. – 4" 6 DET. 2 – N	6 ANT. 36° 6 FILT. DET. – 3"x1"x.62" 1 – N 6 AMPL.

1. ALL DETECTORS 3.625" L. X .625" DIAM.
2. ALL AMPLIFIERS 2.375" x 3.5" x .9375

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9-13-63

7101 A&B

RANGE IN N. M.

BAND	TYPICAL RADAR	P_T	G_T	SLANT	GROUND	ALT.
01A/20-A	Tall King	P_T = 2 Meg w.	G_T = 30 db	5200	3400	2900
01B/21-A		P_T = 1 Meg w.	G_T = 21 db	4400	3100	2200
01B/24-B		P_T = 2 Meg w.	G_T = 23 db	2900	2400	1050
C1A-2 120-B		P_T = 1 Meg w.	G_T = 23 db	3250	2600	1300
01A-3 120-C	NeySA-C	P_T = .5 Meg w.	G_T = 27 db	2900	2400	1050
01B-3 120-C	"	" "	" "	2550	2200	850
01A-4 120-D	Token	P_T = 1 Mw.	G_T = 40 db	2700	2300	940
01B-4 121-D	Token	" "	" "	3050	2500	1170

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Premises on which present program is based:

1. Reliability of payload operation in orbit is of prime importance. The required reliability can be obtained in small simple satellites with redundant circuits for some functions.
2. Lead time must be shortened to an absolute minimum to provide the experimenter the opportunity to base the design of the next experimenteon data from the previous satellite in a program of many launches.
3. An average set of engineering parameters (i.e. thermal design, structure, power supply, telemetry) will satisfy the requirements of many experiments and therefore these should be standardized and stockpiled to reduce lead time and cost of satellites.
4. System design is an in-house function stressing reliability and simplicity.
5. Electronic components are developed and built "in-house" until manufacturers demonstrate sufficient reliability in commercial units.
6. Launches of multiple satellites on a large vehicle are preferred to construction of large satellites with many experiments because it provides greater flexibility, shorter lead time and will accommodate experiments that are incompatible with each other. Standardized engineering components can be utilized to provide these features.

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Items needed to make program operational

1. Planned vehicle program 12 months ahead.
2. Utilization of a developed, reliable vehicle system such as Thor-Able-Star or Thor-Agena. Launching operational payloads on the SCOUT vehicle during its development phase may delay the payload program six to twelve months.
3. Accelerated program parameters vehicle program based on four launches per year of Buckshot type providing 2 Greb packages per launch or 8 per year.
4. Each Greb payload would contain (a) one omnidirectional set of six elements each tuned to two bands and (b) one dipole pair of antennas providing two band coverage. D. L. output with short and long pulses on two transmitters provides output on all four channels simultaneously.
5. Utilization of the multiple payload principle. (This rules out Thor Delta and SCOUT because of limitations of solid fuel final stage.
6. A two to one expansion of satellite work at NRL is the maximum that can be tolerated and still maintain the stated parameters on which the present program is based.
7. Twenty additional people are required for Satellite Techniques Branch to do payload engineering. Scientific experiments will be drawn from many groups at NRL and elsewhere.
8. Space requirements for Satellite Techniques Branch will double. Total requirement will become 6,000 square feet.

late 1962 Sat Tech Branch paper

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4a 192-237 380-490 665-855 2000-2735 3 bands of overlap

4b 1215-290 575-710 830-1080 2601-3250

5a ~~165~~ 490-600 1080-1350 2600-3250 4 bands of next

5b 172-216 575-710 1250-1600 3000-3650

6a 72-88 230-300 1650-2050 3350-4100

6b 82-1000 270-350 1450-1750 3900-4700 4 bands

7a 100-125 300-380 750-920 4950-5050 2 bands overlap

7b 58-72 575-710 830-1080 4950-5050

KNOW WE HAVE BANDS WITH ACTIVITY

SURE

172

260-325

820-920

620

490

545

2000-4700

1350-1600

490-610

275

120-1350 Mult

100

200-220

3900-4050

1700

153-155

165

72-94

85-100

3250

2600

650

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On FY-64 Budget.	5170	5430
1st 1/2 Routine + Normal Major Costs	2108.5	1022.0
2nd 1/2 " + " " "	2251.1	1128.0
	4359.6	2200.0
New Requirements		
New Payload Data System	200.K	—
Collection System mod.	—	300
Increased Power Supply	100.	
Freq Extension		080K
Stabilization Damping	100	
Earth Aspect	30	
Future (3rd) Qual Control Unit	—	100K
	4789.6	2480
	60	725
	4849.6	3205

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HANDLE VIA
BYEMAN-TALENT-KEYHOLE
CONTROL SYSTEMS JOINTLY

~~TOP SECRET~~ [redacted]

Conlon's people want to enhance tapes beforehand; at first Bruce thot there were 4 levels of input to Audico, but this proved wrong; so possibly some benefit might accrue from a careful "pre-level-set" operation on the tapes; ideally, what is needed is an adjustable audico input of 4 or so levels ○ which is "computer set", but this is a long term R&D effort which should probably not be attempted unless it is certain that erroneous audico level setting is the problem.

[redacted] says it is not the problem, but that the real trouble is that they have changed (no more 704, Leesburg, Bogart) and now go directly from Audico into a 7090...and the new 7090 programs are not yet debugged...but thinks they will be in about 2 to 4 weeks. Further, [redacted] thinks the Audico is working quite well....& we can't disprove this now. Also, apparently [redacted] has operators which monitor Audico's input level, and adjust it accordingly. [redacted] thinks the first 2 sorts will work OK once new programs are debugged. The "second sort" program is giving the most trouble; Struve & Jim get their programmers from a "pool", since they are "staff". The 3rd part can never work until better data from the south.

Possible moves:

1. (Immediate). Have Conlon pre-set level of tapes...this has a slight chance of being helpful, but also runs a risk of losing signal-to-noise ratio(since FM demodulation req'd.) and if tried at all, should be on a sample basis only. NRL will be glad to work with Conlon on a procedure.

2. (Within a few weeks) Create multiple audico input levels & select the proper level by a 7090 program (this complication should not be tried until it is certain that it is Audico & not the 7090 that is now in trouble.

3. (Within a few months) Digitize (6 ~~level~~ bit suggested) all tapes rather than use audico...first sort now expensive but otherwise this scheme might work better that audico...and the newest digitizers are more suitable for the job.

4. (Within 12 to 24 months) "Enhance" (by on-line-multiple-processing) the original analog tapes by use of a spinning head and thence a digitizing scheme. This is "sort of blue-sky", but we are getting both a sp. hd. machine and a digital transport for such experiments.

5. Go to digits first off. undesirable for many reasons.

General comment: [redacted] ately, Bruce had no way of telling whether Conlon or [redacted] are right. These two men are "opposit

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(over)

and neither understands the [redacted]'s work. However, based on previous experience, a guess is that it is more probable that [redacted] & Struve are right; because they have learned quite a lot during the past couple of years; and, we are glad to say, are now including in their programs a number of things we have been asking for. Perhaps [redacted] could be asked to more publicly state a guess as to when his new programs will be debugged, & when he expects to have it working so that the situation could be reexamined at the stated time.

Incidentally, it is interesting to note that if [redacted] IS right, (that audico is OK & the trouble is primarily later... he says audico now works over 90% OK), then they have NO right to be suggesting that they must get the material in digital form!

BYE 61746-92

Misner to AOL on NSA processing late 62

TOP SECRET [redacted]

Command for 7103A,B,&C

		03-A	03-B	03-C
* "Address"	1	NL	NI	NJ
	2	NK	NK	NK
	3.	NJ	NJ	NL
	4.	NI	NL	NI
** DL#1**	(Note1)	ML(170-205)B_w	MI(158-180)Bn	MJ(105-125)B_n
DL#2		MK(575-720)C_n	MK(482-610)B_w	MK(1050-1360)B_w(NOTE-3)
DL#3		MJ(820-1080)B_n	MJ(660-865)C_w	ML(1580-2020)C_w
DL#4		MI(3800-4800)C_w	ML(2500-3120)C_n	MI(4650-5150)C_n
***TM ON.		JI	JI	JI
TM OFF		JK	JK	JK
EXECUTE		KI	KI	KI
****DL OFF(reset)		MN	MN	MN
R & D ON	(NOTE-2)	LJ(170-205) C_w notched	—	LJ(1060-1360) C_w notched NOTE-4
Rockets		—	LI	—
Conax		—	LK	—
Boom OUT		—	—	LI
BoomMotor Stop		—	—	LK
(SR) PA ON		—	LJ	—
(SR)PW ON		—	IJ	—

Note-1 - - [redacted] Experiment R & D.
NOTE-2 - - Command for R & D Esperiment
NOTE-3 - - [redacted] Experiment
NOTE-4 - - Command for FIX R & D Experiment

* Address is exclusive for each payload.
**DL # 1 is Band # 1 etc.
*** TM is Telemetry or Channel "A"
****Reset is when timer runs out or same thing by command.

HANDLE VIA
BYEMAN-TALENT-KEYHOLE [redacted]
CONTROL SYSTEMS JOINTLY

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COMMAND FUNCTIONS

	703A	703B	703C
	~~#1~~	~~#2~~	~~#3~~
* "Add" 1	NL	NI	NJ
"Add" 2	NK	NK	NK
"Add" 3	NJ	NJ	NL
"Add" 4	NI	NL	NI
** D. L. 1 Note △	ML 170-205 B_W	MI 158-180 B_N	MJ 105-125 B_N
D. L. 2	MK 575-720 C_N	MK 482-610 B_W	NK 1060-1360 B_W — ◈
D. L. 3	MJ 820-1080 B_N	MJ 660-865 C_W	ML 1680-~~2220~~ 2020 C_W
D. L. 4	MI 3800-4800 C_W	ML 2500-3120 C_N	MI 4650-5150 C_N
*** TM. ON	JI	JI	JI
TM. OFF	JK	JK	JK
EXECUTE	KI	KI	KI
PL off = **** RESET	MN	MN	MN
R & D ON	△ LJ 170-205 C wide (notched)	--	◈ LJ — 1060-1360 C wide (notched)
ROCKETS	--	LI	--
CONAX	--	LK	--
BOOM OUT	--	--	LI
MOTOR STOP	--	--	LK
PA ON	--	LJ	--
	--	IJ	--

Note * Add = Address

** D.L. 1 = Band #1 #2 etc.

*** TM. = Telemetry (Channel A)

**** Reset = When Timer goes off ELINT Experiment & Command System is RESET.

Note △ ◈

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FIG. 1

greater than 52 μseconds

FIG. 2

less than 7 μseconds

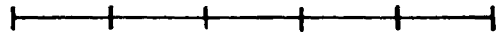
FIG. 3

greater than 7 μseconds
less than 14 μseconds

FIG. 4

greater than 14
less than 52 μseconds

SCALE



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