# NAVAL RESEARCH LABORATORY

WASHINGTON, D.C. 20390

IN REPLY REFER TO:

7920-287:RDM:lph BYE-*51906-71* 

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MEMORANDUM FOR DIRECTOR, PROGRAM C

Subj: Program C FY-72 Financial Program; information concerning

Ref:

2631

- (a) NRL ltr B-51904-70 of 1 May 1970
  - (b) DNRO memo to Director, Program C, B-12883-70 of 10 Jun 1970
  - (c) Director, Program C memo to DNRO, B-66449-70
     of 5 Nov 1970
  - (d) DNRO memo to Director, Program C, B-13396-70 of 17 Dec 1970
  - (e) DNRO memo to Director, Program C, B-12843-71 of 9 Jun 1971
  - (f) Director, Program C memo to DNRO, B-52259-71
     of 7 Jul 1971
  - (g) DNRO memo to Director, Program C, B-13117-70
    of 13 Oct 1970
  - (h) Director, Program C memo to DNRO, B-66387-70 of 17 Aug 1970
  - (i) Director, Program C memo to DNRO, B-52236-71
     of 26 Apr 1971
- Encl: (1) Personnel History of the POPPY Effort at NRL
   (2) Considerations Relating to Rising Costs in POPPY
   (3)

1. The first submission of budgetary estimates for FY 72 was provided by reference (a) where two options were offered, differing in technical plan, length of the development cycle, and cost. Reference (b) provided the initial FY-71 funding approvals for Mission 7107 with Option #1 being authorized. Reference (c) provided the information in written text that had previously been given to the NRO staff explaining a severe deficiency in the FY-71 financial program request. Reference (d) provided

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the FY-71 supplementary funding approvals for Mission 7107. Also included in reference (d) was a statement that related this FY-71 deficiency to the FY-72 budgetary estimate, recognizing that FY 72 would be between \$2 and \$3 million above budget; this is precisely what has happened.

2. Reference (e) provided the FY-72 initial funding approvals for Mission 7107. Several areas of the financial program were deferred pending further explanatory justification. For clarity, these areas are presented in tabular form and will be discussed in the paragraphs which follow.

|  | Line Item  | Request      | Approval     | Deferral        |
|--|--|--------------|--------------|-----------------|
|  | 7107 for FY 72                                   | •            |              |                 |
| 1.<br>2.                               | II-E. A-D Systems<br>III-B. New Systems<br>(O&M) | \$ 75K<br>37 | \$ 44K<br>34 | \$ 30.5K<br>3.0 |
| Augmentation for Ocean<br>Surveillance |  |              |              |                 |
| 3.                                     | II-A. Electronic Sys.                            | 573          | 388          | 185.0           |
| 4.                                     | III-B. New Systems<br>(O&M)                      | 48           | 30           | 18.0            |
| 5.                                     | IV-A. Facilities                                 | 49           | 0            | 49.0            |

Table I

a. Line Items 1, 2, and 4 of Table I were deferred due to inadequate justification of State College, Pennsylvania. For the past six years the HRB-Singer contractor at this location has been actively participating in the POPPY system designs and in the production of the operational software for the POPPY overseas sites. HRB has periodically provided the operational sites with technicians and resident engineers for exploiting the most recent technology as it has been transplantable from the laboratory to the operational site.

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This vital contractor role continues to support the development of hardware and software systems, which will enable the "timecritical data" to be selected and processed in near real-time at each of the digital sites. It is imperative that all of the essential elements of the computer systems be available at the contractor plant in order that the operational software can be conceived, edited, debugged, and, ultimately, reproduced. FY-72 requests reflected (1) the initial purchase costs of these hardware items and (2) the burden of Operation and Maintenance (O&M) imposed by these hardware items.

Each Line Item of Table I will be treated individually b. in the paragraphs to follow, with significant explanation offered toward their justification.

(1) Item 1 is a \$30.5K deferral under the heading of A-D Systems for State College. This is an initial purchase cost estimate for a remote operator terminal for the computer system so that two operators may address the main frame in the same time period. One advantage is that the computer may be time-shared without adversely influencing the higher priority effort. Another advantage is that the new system will effect significant improvement in the efficiency of the software development by providing greater time available for debugging and testing the various programs. The same type of system will be utilized in for operational purposes. HRB-Singer should develop the software routines so that this operational terminal will be usable.

(2) Item 2 is a \$3.0K deferral from the O&M burden of the Buffered Tape System required at State College in support of the software development and the training of site operator and maintenance personnel.

(3) Item 3 is \$185K which has been addressed in separate correspondence (reference (f)). This amount is required in order to extend the operational capability of by the addition of the the next most powerful sorting capability, i.e., sorting by

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(4) Item 4 is an \$18K estimate of the O&M burden imposed by the new computer system at State College. This new computer was justified and its O&M burden approved in reference (g).

(5) Item 5 is another item previously approved in reference (h) and reflects a \$49K burden for the raised computer decking and the physical security elements of the spaces for the POPPY installation in

a. The quotation from reference (e) which identifies concern for increasing personnel costs is stated below.

"While approval has been granted for the requested amounts for NRL salaries and overhead for Mission 7107, concern is expressed at the continuously increasing costs of NRL personnel which exceed costs attributable to pay raises."

Enclosure (1) will discuss the personnel needs, personnel utilization, overtime and overhead allocations for the past five years and will relate this personnel history to the FY-72 period as well as to the estimates provided in reference (i). When Director Program C submits this material to DNRO, it is requested that NRL participate in verbal discussions to further explain the data of this study. Important aspects of this study are listed below for perspective.

(1) Distinction of labor categories, per annum and per diem.

(2) Growth in magnitude of labor experienced in each category.

(3) Comparison of average salary over the past five years with the cumulative Federal and Civil Service salary escalation.

(4) Estimate of the future requirements for each of the labor categories.

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5. In conclusion, the many improvements made by the NRL team in technical development and operational capability of the POPPY system more than compensates for the increased costs in Program C. In fact, these significant accomplishments have placed the POPPY Mission 7107 on the threshold of \_\_\_\_\_\_ the time-critical data and

have received praise and endorsement from many quarters. The basic POPPY system philosophy of simple, long-lived spacecraft with flexible, responsive ground station capability for data processing has been demonstrated and will continue to be stressed in the future. Because of this philosophy, Mission 7105 has, throughout its four-year operational lifetime, continued to provide a wide variety of intelligence output that has been responsive to the changes in the priorities of the community. By virtue of the flexibility and continued evolution of the ground-based data processing technology, the achievements of POPPY are continuing to be exploited operationally.

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PERSONNEL HISTORY OF THE POPPY EFFORT AT NRL

The data in the following figures have been extracted from a detailed cost accounting system in use at NRL which identifies in each of the major work areas (both individually and collectively for the entire POPPY effort) the costs and man-hour experience on a monthly basis. Historically, the manpower information has been routinely presented and has been limited These costs have been divided into two to costs alone. categories: (1) Payload (NRL Salaries and Overhead) and (2) Ground Station (NRL Salaries and Overhead). Currently under discussion is a monthly status report from NRL to PM-16 which will make available to both the Program Manager and the NRO staff the costs and man-hours utilized in the POPPY effort. The lack of this information in the past has led to the present misunderstanding relative to the question of rising personnel costs at NRL on POPPY.

#### Per Annum Support

Per annum support includes the permanent professional staff working full time on the POPPY effort at NRL. The salary and man-year information for the per annum support is plotted in Fig. 1 where the solid line represents the past five years and the dashed line represents three years of estimated future requirements. Note in particular the small change in the curve at the top of the page over the past three years. The net change in man-year support for the total per annum category has only amounted to about 1/2 man per year increase. Also note that the per annum support wage category includes all the POPPY team except the Wage Board (per diem) personnel. In general, the per annum personnel are dedicated to the POPPY effort for long periods, so this work force is relatively stable.

#### Wage Board Support

The per diem support is only used as needed. During periods of reduced need, the salary and overhead costs are significantly reduced. The wide range of skills in this support eliminates the necessity of hiring onto the permanent staff certain talents that are only required periodically. Thus, use of this per diem supporting staff enhances the overall cost effectiveness of the work force in the POPPY effort at NRL.

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Examination of the data presented in Fig. 2 will disclose the amount of man-years and the costs for the Wage Board labor category at NRL over the past five years and an estimate for three years into the future. Note particularly the periodic fluctuation which reflects the two-year development cycle of POPPY. During the year when the manufacture and fabrication of the spacecraft is in progress, the use of this Wage Board (per diem) support is more extensive than during the next year when the POPPY mission is undergoing test and It is primarily these fluctuations of launch operations. effort that have raised (relative to FY 70) the overall personnel experience during FY 71. Note also that this cyclic variation of per diem support is projected into the future with a peak anticipated during the FY-73 period where the largest portion of the manufacture and fabrication of The labor-cost rate has risen

over the three-year period FY 68 through FY 71 from \$17,400 to \$20,820, an increase of \$3420/year, or less than 20%.

#### Total Labor History

Information presented in Figs. 3 and 4 summarizes the total manpower picture of the POPPY effort at NRL over the past five years and provides estimates for the next three years. Referring to the estimate of FY-72 personnel costs (Director, Program C memo to DNRO, B-52236-71 of 26 Apr 71), the following costs were identified:

|   | Mission 7107 |
|---|--------------|
| I. Spacecraft (Devl. Recurring<br>H. NRL Salaries & Overhead  | )<br>1105к   |
| II. Ground Station (Investment)<br>C. NRL Salaries & Overhead | 867K         |
| FY 72 Total   | <u>1972K</u> |

Consulting the data in Fig. 3, personnel costs for FY 72 are estimated to be about \$3118.5K. Thus, the difference between the extrapolation of history and the personnel costs requested by the Director, Program C, is only \$33.5K and is considered to be in excellent agreement.

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Figure 4 provides a compilation of data for all labor categories of the Program C support at NRL. This Figure shows that the per annum labor utilized at NRL has remained nearly constant over the past five years except for one period in FY 68 when several of the engineers were transferred within NRL for the development of one of the scientific spacecraft. Since FY 68 there has been an attempt to establish at NRL separate dedicated teams for each of the programs.

As history is indicative of the future, special attention must be given to the differences in the nature of the effort. Each year the POPPY effort is significantly different from the past year. There is some similarity between alternate years since POPPY is on a two-year development cycle. Therefore, it is not possible to compare FY 71 with FY 72 with any accuracy. FY 71 was an intensive period of manufacture, fabrication, and assembly of Mission 7107. By contrast, FY 72 will be devoted primarily to the pre-launch testing and documentation of the spacecraft so that the per diem labor team will be reduced in utilization. The man-year level of personnel required in support of Missions 7107 is expected to be reduced by about 4.2 man-years below that of FY 71.

In order to determine the manner in which the NRL promotion policy has influenced the general rising personnel costs, the study established an average candidate engineer whose annual salary in FY 67 most nearly equated to the FY-67 average for all per annum work at NRL in support of the POPPY effort. Then, this imaginary "Mr. Average FY 67" was moved forward through five years of Federal and Civil Service salary increases as shown in Table I and Fig. 5.

#### Table I

| Date     | Grade/Step | Salary  | Explanation              |
|----------|------------|---------|--------------------------|
| Jun 1967 | 12/1       | \$11306 | Beginning Salary         |
| Oct 1967 | 12/1       | 11843   | Federal Pay Raise (4.7%) |
| Jun 1968 | 12/2       | 12225   | Civil Service Ingrade    |
| Jul 1968 | 12/2       | 12986   | Federal Pay Raise (6%)   |
| Jun 1969 | 12/3       | 13392   | Civil Service Ingrade    |

Salary Escalation for Mr. Average (1967 to 1971)

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| Date   | Grade/Step                           | Salary                                      | Explanation   |
|--|--------------------------------------|---|---|
| Jul 1969<br>Dec 1969<br>Jun 1970<br>Jan 1971<br>Feb 1971 | 12/3<br>12/3<br>12/4<br>12/4<br>12/5 | \$14727<br>15611<br>16084<br>17044<br>17044 | Federal Pay Raise (10%)<br>Federal Pay Raise (6%)<br>Civil Service Ingrade<br>Federal Pay Raise (6%)<br>Removed from Shortage<br>Category Equivalent<br>General Schedule Rate |

Table I (Continued)

The conclusion is that this imaginary "Mr. Average FY 67" has, by virtue of the salary increases beyond the control of NRL, improved his salary in a manner very close to that of the average salary for the per annum team working on POPPY for this five-year period. The end points after five years as plotted on Fig. 5 show the average POPPY per annum salary at \$17,800/year while the "FY-67 man" has only risen to \$17,044/ year--a difference of only 4.43%. This is not rigorous proof of the nature of the promotional policy exhibited by NRL in behalf of the POPPY team, since over the past five years there have been some changes in personnel in this team. In addition, it presupposes that all Federal and Civil Service salary increases treat everyone alike. However, this is not always true, since the lower grades have been advanced in salary at a rate slightly faster than the more senior grades.

# Application of NRL Personnel

### Historic Requirements to the FY-72 Estimates

As the FY-72 period is studied, several areas of changing requirements for personnel are evident. For a period of over six years, HRB-Singer has had a staff of engineers resident at NRL assisting in the hardware and software development. Now, due to the relaxation of the NRL ceiling, these men can, for the first time in over four years, be considered for conversion to Civil Service status. Such recruitment is being started very slowly and its degree of success is not yet apparent. However, for purposes of this study it has been estimated that in FY 72 an increase of 4 1/4 man-years are being planned, two of them HRB-Singer conversions.

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Another area of difference in personnel requirements for FY 72 is in the area of increasing management and reporting requirements imposed on NRL for the POPPY effort. This will demand in the year ahead significantly different talents than have been displayed before, and in some instances these talents may not be available within the team now assembled.

In summary, the increase in personnel required in the permanent per annum staff of about 4 1/4 man years will be more than offset by a decrease in the per diem effort. The result will be an overall decrease for FY 72 of the total personnel man-year effort of about four man-years (Fig. 3).

Note that these graphs and financial estimates do not include the manpower or salaries required if the "Maneuverable Spin Stabilized Shuttle"  $(MS^3)$  concepts are approved.

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Figure 1

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Figure 2

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### CONSIDERATIONS OF COSTS IN POPPY

Concern was expressed in DNRO memorandum to Director, Program C, BYE-12843-71, of 9 June, regarding continuing cost growth of POPPY. It should be stated, for the record, that such cost increases are directly attributable to an extension of scope of POPPY and various technical improvements, all of which have resulted in significant and demonstrated increases in operational capabilities. In addition, other factors which are largely beyond the direct control of the POPPY community have contributed to the overall rise in costs. Some of the most notable examples of such factors are described in the following material.

# Extension of the Scope of POPPY

The traditional scope of the POPPY program has been extended into another operational area of high national interest: ocean surveillance. In response to a request by Sixth Fleet, POPPY has demonstrated (a) capability to locate and identify major Soviet naval combatants in the Mediterranean Sea and (b) capability of timely reporting to the Commander of the Sixth Fleet during high priority Soviet Fleet maneuvers as well as on a routine but still timecritical basis.

These demonstrated capabilities have resulted in this further augmentation of the program for ocean surveillance and increased the costs approximately \$2 million with another \$1/4 million being deferred for FY 72.

Such a major extension of the traditional scope of Program C was based on, and the direct result of, the continuing technical improvements to POPPY. During the past five years, for example, there have been major technical and operational improvements in both the POPPY ground stations and the spacecraft systems.

### Ground Station Improvements

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The spacecraft ELINT subsystems have been improved in a number of ways. Most notably, the ELINT subsystems have been isolated from the influence of the voltage and temperature environment by careful use of voltage regulators and temperature compensation in the Mission 7107 design. Thus, a great improvement in absolute accuracy will be provided in the parametric measurement of signal amplitude--practically removing the necessity of making corrections for the spacecraft environment.

Mission 7107 spacecraft design includes three data-link transmitters for the first time in POPPY, making simultaneous data transfer from 12 collection subsystems possible. Additionally, the spacecraft antenna subsystem, for this data transmission to the ground station, has been extensively modified and improved for Mission 7107. The antenna is mounted on an extendable boom which is deployed below the spacecraft, pointing in the vertical. The antenna radiation pattern has been shaped so that the signal is beamed toward the ground in a very regular and predictable manner. The result is that without appreciably increasing the transmitted power, the signal available at the collection site will be markedly increased, thus improving the quality of the data.

Added flexibility and versatility in the spacecraft systems will improve the operational potential of Mission 7107. Of particular importance in this area of technical improvement is the command system, which has undergone an extensive redesign to allow for the first time the contingency reassignment of any of the collection systems to any data transmitter. Thus if a spacecraft from Mission 7107 should lose a transmitter, all the receiver systems normally associated with it can be reassigned to another transmitter and the Mission will not suffer the continued loss of these collection systems. Spacecraft design has been optimized for reliability throughout the Mission 7107. For example, each collection subsystem has its own modulator instead of sharing one with from 4 to 6 other collection receiving systems.

The ELINT receiving systems have undergone several areas of redesign. For example, the frequency range from 9200 to

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9600 MHz is now covered by the conventional POPPY techniques as well as a new "comb filter," which utilizes twenty narrow and adjacent receiver systems (like a comb) having selectable spacing. By use of this system one of the most densely populated parts of the entire radar spectrum will, for the first time in POPPY, be reduced to the point where data density will present no major problem.

### Economic Growth Factors

Areas where the economic cost growth in the aerospace industry has increased the POPPY cost are found throughout the POPPY system. Notable among these is the extreme cost escallation being experienced in the procurement of flight batteries. The overhead burden for many of the aerospace product companies is soaring, so that the product costs are rising beyond expectation.

Personnel costs continue to escalate throughout the industry and the NRL Civil Service team for POPPY is no exception. This rising cost is beyond the control of POPPY management and is included in the category of Economic Growth Factors.

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