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FORWARD

This part of the overall POPPY/NRL/Navy discussion deals with the in-house load on people and space. The attempt is made to show that with the overall growth in operational capability and technology has even greater potential for the future.

It is also attempted to show that this project which is perhaps the largest in the Laboratory with its DX and QRC rating is straining all its personnel and needs the support of the Laboratory in overtime, personnel, and space.

The functional organization is outlined to put some perspective on the work and the work in the satellite tech, branch because it is in another Division left to Pete WILHELM to discuss.

Space Systems - This effort is the on-going work of Vince ROSE and Pete WILHELm. Thisgroup has produced all of the POPPY Payloads to date. The satellite techniques branch has grown as the sophistication of the payloads has grown, but, the full use overtime is still a mandatory requirement to the meeting of schedules and they could benefit significantly from having a "systems and scheduling" person responsible for continual technical input and planning from a big picture aspect. One man provides the entire ELINT system and he has two people helping; one on mechanical design and one on initial component testing, but, the entire ELINT package with the antennas and all the scheduling and technical coordination with Pete WILHELM are onthe shoulders of one individual. To put some of this into perspective for Launch 7106 there are 4 payloads covering a frequency spectrum of [redacted] This spectrum is broken into between about [redacted] per payload with each band being, in effect, a distinct receiver requiring a full evaluation and matching with a mating a similar band [redacted] For each of these receivers an antenna system of from [redacted] individual antennas must be designed with the composite azmith and elvation pattern variations held to tight to clearances along with complete horizontal and vertical polarization coverage. In most cases each antenna element is a distinct crystal video receiver from the antenna element thru to the detected video output which is combinedwith the other elements

to form the composite omni-directional vertical and horizontal polarized collection arrays. If you consider to obtain an order of magnitude on this effort a basic crystal video made up of an antenna, filter, cables, pre-amp, detector and video amplifier times [redacted] approximately [redacted] individual items to be selected, bought and tested. In actual count the total is over [redacted] items. Each filter etc. is tested at least twice over the entire temperature-frequency-power supply ranges with many are rejected and then must be re-tested after vender rework. Each band must then be assembled into complete individual crystal video receivers to obtain the overall matched gain antenna-pattern with temperature and voltage. These in turn are assembled with the other bands and tested for shading and inter-action between bands. This testing each payload requires over [redacted] Final checkout requires over [redacted] additional final antenna documentation patterns. This operation is the most vital and exacting operation and POPPY is the only system that has ever achieved this broad r.f. band omni-directional match. (See reference (a) for band by band detailes). After this the ELINT and the payload packages are integrated and the full system-tests run with careful band by band checks most tests. This electronics responsibility is tremendously tedious and demanding effort are carried mainly by one man and while he is doing a heroic effort he should have help, because each operation, for each payload is a serial operation and if he is off three days with the flu, the schedule slips 3 days or if he has an antenna problem which takes two weeks to solve, instead of a planned 3 days, the schedule slips 11 days etc. Other items such as a recent technical problem with Watkins Johnson on YIG filters took 40 weeks of re-testing and technical discussions. Over a 3 year period the Laboratory deducted this cost from Watkin Johnsons contract, but the point in terms of scheduling and launch date each delay is painful. To ease this tremendous burden the following is suggested (1) provide man full time to work on antenna measurements and array design. Mr. WITHROW has heloped Vince on a part time basis, but his

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overriding command-system requirements (discussed later) have taken most of his time. A second anechoic chamber (est cost $25K) will allow this work to be done in parallel (2) provide two good electronic technicians to assist in running the component check out and system checks. (3) provide personnel to the R&D group (discussed later) to specifically work on future hardware systems for the ELINT package. The other phase of this effort which has not been discussed at all is mechanical interfacing, design and construction ofmounting brackets for each of the over [redacted] items such as amplifiers, antennas, cable and electrical interconnection, command and data link definition and interfacing. In this area thereare a large number of details which should be recorded, drawings for the machine shop, wiring harness layout etc. At present hand sketchs and photographs are the only source of documentation and even these detract from mechanical assembly. To provide the appropriate documentation to duplicate systems at least a draftsman should be assigned to the group with an "E" clearance. These steps will not solve all the problems in building the ELINT Packages, but, theywill allow the payload ELINT effort which is now a serial operation to have a number of people helping and change some of the effort to a parallel operation.

Ground Stations - This is an ongoing function which encompasses many areas. A few of the aspects of this are (1) logistical support, (2) site deployment, (3) station up-grading, (4) software systems, etc. This effort is concerned with getting and keeping the ground stations fully operational. The following is a discription of the specific functions which are in progress under the direction of this group.

[redacted] deployment

A. Physical Plant Renovation

1. Up-date temperature and humidity control systems'
2. Procure, layout and install false floor
3. Remove existing inside walls and relocate new walls.
4. Complete renovation of electrical power system in operations area including air conditioning, regulated power for digital system, new main feeders to operations building, new power transformers, and a new emergency power system, layout power to all racks and equipment.

5. Layout, design, new addition to building

B. Receiving equipment

1. Assemble and checkout equipment for two receiving complexes consisting of H.F. receivers, RS=1A VHF receiver, Precision Frequency and time standards, display equipment,

2. Design, wire, and checkout wiring consoles as an example of the complexity of these consoles, between the equipment in the just the two receiving consoles there is over one and one third miles of coaxial cables.

3. Document all equipment used in receiving complex down to circuit schematics, maintenance proceedures, etc. Also the 1 1/3 miles of interconnecting coaxial cables and other power and control wire must be labled and the system documented.

4. Specify number and types of spares for all equipment necessary for 24 hour station operation. Develop backup spares for NRL inventory. Order all spares and distribute.

5. Organize shipping, installation and full operation checkout.

C. Digital Data Processing System

1. Order, check-out, run acceptance-tests on computers, ADD's, etc.

2. Assemble all equipment for systems check out and evaluation prior to shipping.

3. Evaluate and check all software

4. Organize shipping, and installation and full operational checkout down to paper tape winders, line printer ribbon etc.

5. Define all spares for entire equipment order complete complement of spares (over 1400 separate types with 5-50 items per type on the computer alone)

5. Install and operationally check out entire system.

D. Command system

1. Inspect, test, and evalute all equipment such as new Command tone generators, transmitter etc.

2. Assemble and ship electronics

3. Install, checkout, and bring to operational status

4. Evaluate, test, checkout new PCM system

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5. Develop familiarization, and training programs for field use of the PCM.

6. Assemble, install, and checkout [redacted] deployment

A. Physical Plant renovation

(Same basic redo as [redacted]

B. Receiving equipment

(Same new complexes and redo as [redacted]

C. Digital Data system

1. Assemble, checkout new ADD's, TIN's etc. ~~[redacted]~~ PTS.

2. Acceptance test disk, disk controller etc.

3. Check and evaluate computer hardware modifications, priority interupt system, real time clock, memory protect, etc.

4. Check and evaluate software for new system

5. Ship, install, rewire computer, checkout of operational system.

[redacted] deployment (pending)

A,B,C same requirements as [redacted] [redacted] deployment or relocation

Uncertain but, in all probability same as [redacted] [redacted]

A, B, same as [redacted] (currently underway) [redacted] currently unplanned but the deployment of the new payloads with [redacted] will probably force a [redacted] type deployment.

The next area in this group is logistical support of the above mentioned sites. Currently one man works full time in this effort sending out approximately 3500 items per year and maintaining a stock pile of over 10,000 items excluding, the digital equipment for which adequate physical space does not exist on the 3rd floor of building 56. ~~Previously, the "Light Tunnel" was used along with a trailer, but these are both not available.~~ The critical shortage lack of storage space state-side has required extra spares be stored in depth at the digital field station. This is not a great problem usually as since the site ~~the station~~ requests parts as they use them and they are put on order, but, occasionally this can cause serious operational

problems as message refers to indepth. The current logistic effort is in support of one digital-station and the old receiving complexes. With the deployment of the new receiving - digitizing complexes, however, on-site space will not be available for many complete digital system spares and the overall logistial support effort will increase as the digital stations have approximately 280 pieces of electronic equipment as compared to a non-digital station with approximately 175 components and the digital equipment is much more complex.

In addition to the overseas support, all the purchasing for the ELINT packages, the R&D work and the equipment which is built at the Laboratory is controlled by one man with typing help. Total number of purchase orders alone is 1400 ordered + shipped/yr and this equates to 6800 separate items and this equates to over 88,000 individual pieces to be handled (reference 1 gives a step by step the proceedure involved.)

To put into perspective what a strain on space and personnel the following examples are cited.

1. The assembly of the equipment for the is being done by model shop technicians at This requires hauling all the equipment to the site and requiring having the 2 technicians have to drive over 90 miles and spend 2 hours driving to work on the equipment. In addition, the engineer in charge must drive down almost daily to supervise, this is particularly a problem in using model shop technicians as each new job receives different technician help and the entire education process must start over again.

2. Of the operation down-time at the field stations, perhaps 80 % of the total down-time is caused by the having only one man carrying the tremendous ordering receiving, checking, re-shipping to field stations and follow up messages. For a specific example, apart for the BTM-9 digital recorder was priority messaged in and placed on emergency order, but, due to other priority orders it was impossible. The result was a 3 week delivery time and until it was received by the station a 4 week operational slow down where the station was unable to process % of its data.

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3. The installation schedule for the [redacted] has slipped 4 times in the last 3 months and the earliest operation date possible if all other items go right on schedule is the first of March instead of the end of September as originally planned. The field engineer who was to help in keeping the station going until the personnel could be trained (necessary due to the limited documentation and training) must depart will be leaving in July so one more schedule slip and our field engineer will be gone before the equipment is operational. The really sad part is that this equipment could be assisting the war in Vietnam if we had the space and manpower to getting out.

To ease this situation the following is suggested as an initial plan. First additional space for both logistic support and site equipment assembly. An estimate of 1200 square feet is enough to ease the initial problem. The second step is to make available (1) more person for the logistal support effort, and two Third (2) technicians in addition to the ones from the model shops for checkout, assembly, and evaluation of all the equipment and the receiving consoles. Fourth he should be (1) mechnical engineer, and Fifth (1) draftsman to be shared with the R&D group but working on the project full time. Sixth In addition, one programmer should be available to keep up on all the software details.

Operations - This is an undefined effort which is only being handled on a time-available basis. This is an area which is a very sensitive as it continually deals with the other groups such as NSG, NSA, NIC-2, the overseas stations and others. To put a perspective on the level of work up to the end of 1966 we average between 60 an 80 messages per year for 1967 we had 700 messages and for 1968 we will have onver 2500 messages. To keep this tremendous amount of highly classified traffic going to the right people for review and/or action, coordination answers and maintaining a filing system requires a full time "communicator." With more digital stations going operational the message traffic will go up considerably next year again. The steps to eliminate this bottle neck of message traffic are to get a person whose responsibility is to keeping all the E, SI, TK traffic controlled

and the other step is to get the vault space to allow the handling and storage of this equipment. (This is currently planned and should be pushed).

The other areas which require much more attention are documentation and training. The present system in the field is almost with documentation and the maintenance people must learn by experience which can be very time consuming and expensive on an operational system. There exists NO standard operating proceedure for the system in the field and while it has been helpful in getting the resourcefulness of the station into the POPPY system it has also had very costly and painful omissions and oversights and with more stations this may be the weak link in the system by providing sporadic, inconsistent, results. This problem is so involved with the field stations, NSG, and NRO that it requires definition even before personnel and space requirements can be established.

Research and Development group - This is the ongoing effort which provides the new equipment for this latest-in-technology space effort. This effort is very essential as most of the equipment and techniques needed for this type of a system are not available in any industry source and must be developed to keep this program in the strong technical position which is required for this to be one of the nations leading space programs. The actual work is very diverse in nature, ranging from micro-wave transistor amplifiers and complex digital systems to theoretical studies of orbital mechanics and future ELINT systems. The work usually is accomplished by the Laboratory starting a research project in solution of a specific problem and various facilities inside the Laboratory and within industry being called onto support the effort as it progresses to operational use. The net effect of these efforts have been outstanding, allowing the POPPY ELINT program in terms of national goals to produce very significant results. For example, (1) the complete Soviet ABM radar family has been intercepted by POPPY and defined in many aspects (2) High priority radars have been located in QRC fashion by the [redacted] field station [redacted] from the time of intercept. (3) the first space borne ELINT of Sino Soviet ships is being provided to the U.S. Navy. These are

the "Big Picture" results of careful painstaking R&D on new "linear phase" receivers, automatic noise controlling and [redacted] systems [redacted] tunnel diode amplifiers and even very mundain seeming, but highly critical flight tolerance coaxial cable and connectors. There are many ongoing R&D projects currently a few of which are listed below and in reference 1, but, with the current press of schedules which are already slipping badly, most effort and physical space (which as mentioned in the ground station discussion also is limiting) is being given to deployment at the expense of efforts which will provide POPPY with the technology to keep it going forward as one of the Navy's and the nations leading space programs. The biggest help in this effort would be more physical space, manpower help to the ground station group and the other groups which draw away from the R&D group. The physical space limitiation is very critical, however, as many delicate test setups must be torn down before complete, to make room for operational or other priority requirements and in some cases room is not available for the work at any time. The range of individual items is covered which are being worked on and the dates which this equipment is due is also listed inmany cases these items are slipping back very fast due to other schedule problems.

Analysis and ELINT- This is avery fruitful area which can have a very significant impact on the National and the Navy ELINT picture if full advantage can be taken of the information available from this program. There is a need for detail analysis of the signals and locations in support of providing an input to the Navy sea surveillance systems. Some of the more important aspects of this include the range of accuray as a function of payload spacing, ship motion station operational status, data densities, shipboard operations, coorelations between intercepts, coorelations between stations, etc. The technical intelligence area has also a large volume of information which can be assembled and made available. For example, the F.M recordings of the various ship threat radars which have been intercept by POPPY. These can be assembled for groups such as the

E.W. division's active and passive countermeasures branches and other groups which need the best information and a seeing and hearing this signals in various modes can give many hardware engineers a more complete insight into the threats than the sometimes vague or miss leading documents which ususlly are used. With the vary accurate measurements available from the computer system detailed in to very close prf measurements [redacted] giving insight into [redacted] The third area is keeping up with the General Search and EOB outputs. There is a real need to be on top of this very signiificat output of the POPPY program which is providing to NSA very important ABM emitter analysis such as [redacted] This inhouse capability is needed to keep up with the detailed analysis and to provide technical intelligence for other NRL operations such as Moon Bounce. The last item is the training and briefing capability for Senior personnel in commands and positions where a Navy inhouse "post graduate" ELINT Course in the latest Sino-Soviet emitter techniques and our own latest computer based analysis capabilities would be available. The steps needed to accomplish this are a vault space, two elint analysis/programers, a mathematician and a computer maintenance man. The last step is a computer for the Laboratory analysis vault. The computer analysis aspect is particularly exciting as this is opening a whole new field of research in high precision ELINT from space. Some of the unique new aspects are of the type or a recent location reported by [redacted]

Tt is this type of ELINT/ANALYSIS research NRL should be participating.

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