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GROUP 1
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5600:RDM:jch
BYE-26904-67
7 February 1967

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From: Director, U. S. Naval Research Laboratory, Washington, D. C. 20390
To: Director, Program "C"

Subj: Program "C" MISSIONS 7106 and 7107 ~~(TS)~~

Ref: (a) NRO memo to DNI BYE 52052-67 19 Jan 1967
(b) NRL ltr 5600:HOL:sr BYE ~~26914-66 of 30 Dec 1966~~ 26900-67 of 4 Jan 1967

Encl: (1) Detailed Design Plan for MISSION 7106 ~~(C)~~
(2) MISSION 7107 Design Concept Proposal ~~(S)~~

1. Reference (a) approves the 7106 concepts forwarded in reference (b) and requests detailed design planning and scheduling. Enclosure (1) addresses itself to these details and finalizes the design concepts.

2. In an attempt to be more responsive to the Soviet ABM/AES (SIGINT) collection problem, NRL prepared enclosure (2) which proposes a more advanced and flexible satellite concept. While the proposed concept outlined for 7107 (enclosure (2)) provides greatly increased responsiveness to the Soviet ABM/AES problem, it actually offers an enhanced collection capability also for General Search and Electronic Order of Battle purposes.

3. Reference (a) requested a detailed expenditure breakdown by fiscal year for 7106; however, this has not been included because the laboratory feels major savings could be effected in the programs by combining 7106 and 7107 developments so the redundant hardware for 7106 and 7107 could be contracted for simultaneously. Monetary savings resulting from quantity production would be significant, plus reduction in the long lead-time which must be overcome in all production procurements.

4. Because of the similarity in frequency bands covered and general concept, a mechanical design has been developed which would lend itself to production line type operation for both 7106 and 7107. Therefore, the laboratory would like approval for 7107 design concept so it could execute the programs essentially in parallel. Following the approval of 7107 concept, detailed cost breakdowns could be made by fiscal year as requested in reference (a).

5. In view of the national urgency of the Soviet ABM/AES collection problem, it is requested that a QRC Priority Designator be established for the programs. This would materially alleviate the procurement delays imposed by the Armed Services Procurement Regulations (ASPR) since the QRC Priority Designator allows certain exceptions to be made

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to meet the exigency of the situation. Conforming to the ASPR is one of the major procurement delays which the laboratory faces in meeting the schedules proposed.

6. As you are no doubt aware, serious restrictions are placed on all government laboratories with regard to the amount of overtime they are permitted to work. In order to meet the February 1968 date proposed for 7106 and the December 1968 date for 7107 consistent with the national urgency of this program, some relief from the present overtime restrictions may be necessary, especially in the face of the further restrictions being proposed by the Defense Department.

7. The Naval Research Laboratory recommends that the Director, Program "C" solict from NRO an immediate approval for the 7107 proposal and that the needs for the QRC status for the program, as well as relief for the overtime restrictions, be resolved.

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Subj: Detailed Design Plan for MISSION 7106 (C)

Ref: (a) NRL ltr 5600:414:RDM:jch, BYE 26909-66 of 6 Oct 1966
(b) NRL ltr 5600:HOL:sr, BYE 26914-66 of 30 Dec 1966
(c) NRL ltr 5600:HOL:sr, BYE 26900-67 of Jan 1967
(d) NRO memo to DNI BYE 52052-67 of 19 Jan 1967

1. Background:

References (a), (b), and (c), represent earlier concept proposals which have been formulated over the past year in the evolution of this Detailed Design Plan for MISSION 7106. The configuration for this mission has changed from two to four nearly identical satellites in order to be more responsive to the ABM/AES requirements by significantly increasing the satellite-time over the target. The major portions of the satellites' frequency coverage are identical so that production line procedures can be utilized to secure the earliest availability for launch schedule. As in the past, the satellites will leave the launch vehicle with velocity significantly different from Thus, in a minimum of time, will have completed the horizon transit

2. General Design Goals:

a. Separation rate between the satellites and the vehicle will be initially determined by the force of their respective separation springs. They will be designed to provide sufficient thrust that 7106A will separate from in a period of six months. A similar separation rate will be designed into the

b. Reliability - In January 7103 C satellite celebrated its third anniversary of operational usage with no degradation in performance. Two of the MISSION 7104 satellites remain in use after more than twenty-three months of intensive tasking. Using the same proven design concepts throughout, the lifetime expected for MISSION 7106 is one year minimum.

3. Mechanical Design Characteristics:

a. The structure proposed is the same 27-inch diameter multiface utilized in 7105 with a somewhat higher equatorial section.

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b. Three-axis stabilization on each satellite will be provided by means of the Gravity Gradient System with provision for both inversion and yaw turn-around by command.

d. Weight for each satellite is expected to be between 225 and 250 pounds or between 900 and 1000 pounds total for the four.

4. Orbital Requirements:

a. Orbital inclination: 70° $^{+0}_{-2}$

b. Average altitude: 500 $\pm$25 n. miles

c. Apogee - perigee variation: less than 25 n. miles

d. Launch vehicle specifications at injection:

(1) The vehicle must be oriented to within plus or minus 1° in pitch, roll, yaw. Pitch and yaw rates must be less than 0.1°/sec. The vehicle's acceleration profile must be such that the final maximum velocity (some time after separation) must not exceed the velocity at the time of separation by more than 0.02 ft/sec. This can be accomplished by separating the satellites after all residual thrusting (chuffing) has ceased.

e. Optimum launch time requirement:

(1) Orbital plane at right angles to that of MISSION 7105.

(2) Widest possible separation from the operating payloads of MISSION 7105, minimizing the interference of the common telemetry signals.

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5. SIGINT Coverage:

SIGINT collection (frequency) coverage for MISSION 7106 is shown in Table I:

TABLE I - Proposed Frequency Coverage for MISSION 7106

Band	7106A	7106B	7106C	7106D	Sens. dbm.
1	153 - 165	153 - 165	153 - 165	153 - 165	-47
2	165 - 200	165 - 200	165 - 200	165 - 200	-47
3	200 - 240	200 - 240	200 - 240	200 - 240	-50
4	240 - 290	240 - 290	240 - 290	240 - 290	-50
5	290 - 350	290 - 350	290 - 350	290 - 350	-50
6	350 - 450	350 - 450	350 - 450	350 - 450	-50
7	450 - 550	450 - 550	450 - 550	450 - 550	-50
8	550 - 650	550 - 650	550 - 650	550 - 650	-50 or -60
9	650 - 820	650 - 820	650 - 820	650 - 820	50 or -60
10	820 - 920	820 - 920	820 - 920	820 - 920	-50 or -60
11	920 - 1080	920 - 1080	920 - 1080	920 - 1080	-50 or -60
12	1080 - 1350	1080 - 1350	1080 - 1350	1080 - 1350	-50 or -60
13	1350 - 1850	1350 - 1850	1350 - 1850	1350 - 1850	-50 or -60
14	1800 - 2100	1800 - 2100	1800 - 2100	1800 - 2100	-53 or -65
15	2100 - 2580	2100 - 2580	2100 - 2580	2100 - 2580	-53 or -65
16	2580 - 2680	2580 - 2680	2580 - 2680	2580 - 2680	-53 or -65
17	2680 - 2930	2680 - 2930	2680 - 2930	2680 - 2930	-53 or -65
18	2930 - 3120	2930 - 3120	2930 - 3120	2930 - 3120	-53 or -65
19	3120 - 3300	3120 - 3300	3120 - 3300	3120 - 3300	-53 or -65
20	4900 - 5070	4900 - 5070	8600 - 9340	8600 - 9340	-75
21	5850 - 6700	5850 - 6700	9340 -10000	9340 -10000	-75

The primary emphasis for ABM collection is to provide complete coverage in all satellites from 153 to 3300 M.C. In addition, the ability to provide from 10 to 12 Db. more sensitivity selectably in any of the bands from 550 to 3300 M.C. is available on command. To reduce the clutter from the dense

6. An increased command capability is available to permit the selection of any of the 21 frequency bands covered in the satellites. Additionally, with the increased command capability, the individual bands from 153 to 3300 M.C.

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have been divided into 19 R.F. bands giving the frequency of the emitter to much closer tolerance. Each of the 19 R.F. bands covering 153 to 3300 M.C. will be either commandable individually or in any combination with either normal or the high sensitivity (where provided). Each R.F. band will have its discrete identification in the transponded data.

7. Increased Orbital Command Capability:

9. A carefully detailed technical analysis of the design and schedule has been made for this MISSION and is presented in the graphical form attached.

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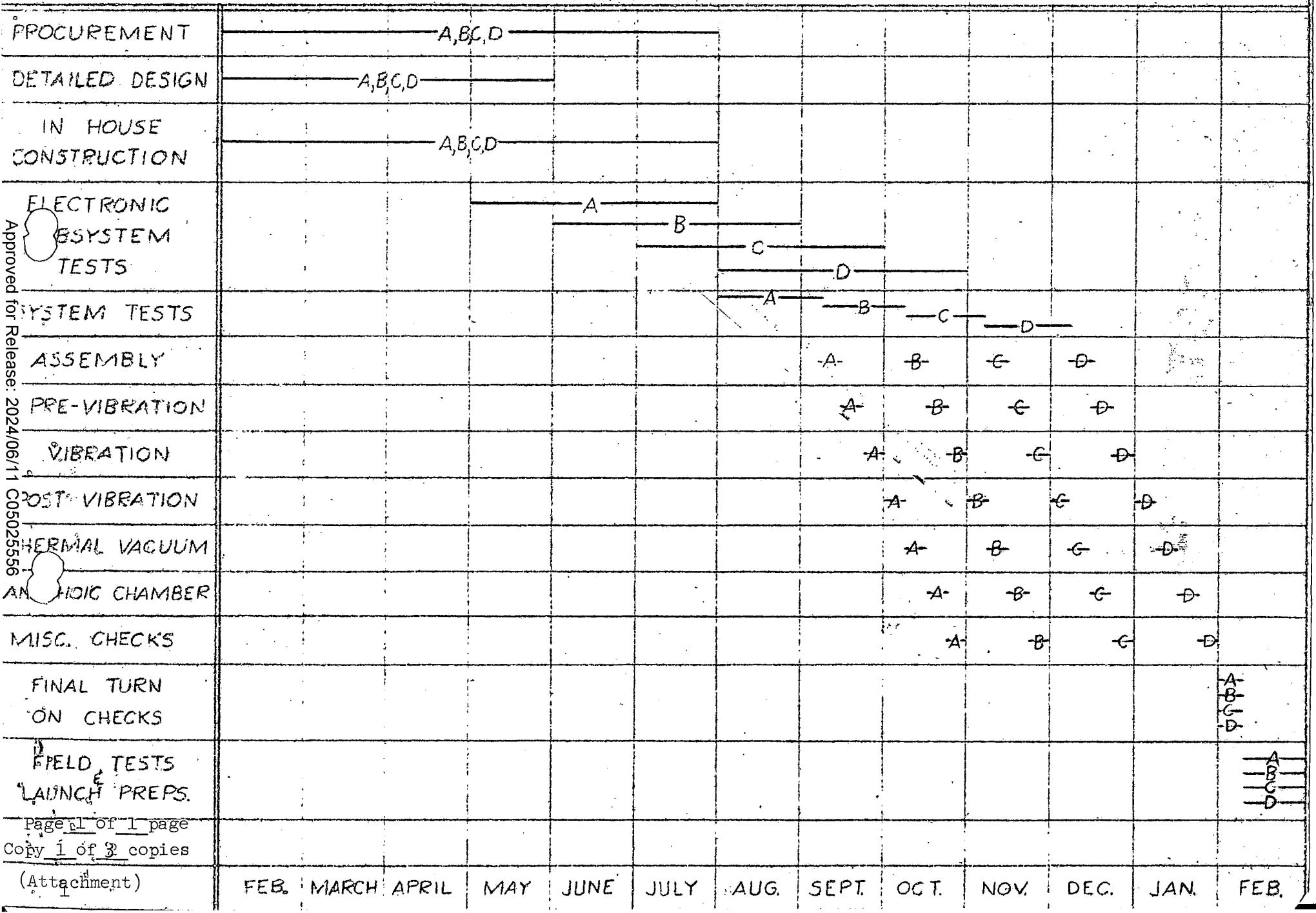
COMPRENSIVE SCHEDULE FOR 7106



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(Attachment) 1

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7 February 1967

Subj: MISSION 7107 Design Concept Proposal (C)

Ref: (a) NRL ltr 5600:414:RDM:jch, BYE 26909-66 of 6 Oct 1966
(b) NRL ltr 5600:HOL:sr, BYE 26914-66 of 30 Dec 1966
(c) NRL ltr 5600:HOL:sr, BYE 26900-67 of Jan 1967
(d) NRO memo to DNI, BYE 52052-67 of 19 Jan 1967

1. MISSION 7107 proposes to utilize and preserve all the basic attributes of the previous POPPY satellites, i.e., long life, high probability of intercept (no frequency or antenna scanning are employed), high reliability, freedom from spurious signal components, etc., as well as provide an additional channel in each satellite for providing digitilized data on a pulse by pulse basis reading the frequency from channelized filters, [redacted] and signal amplitude data. Complete frequency coverage will be provided from 153 to 10,000 M.C. with additional coverage in 14500 to 15200 and 34,600 to 35,000 M.C. Bands. Enhanced sensitivity in three steps for bands from 350 to 3300 M.C. and selectable quadrant coverage from 550 to 5100 M.C. capable of programmable changes throughout the orbit are also provided in MISSION 7107 satellites. The selectable quadrant coverage will eliminate the unwanted clutter from Western European emitters while intensifying collection over the Soviet and China heartlands. With the increased altitude (600 n.m.) these [redacted] of satellites can provide 18 additional long looks (18 minutes horizon to horizon) per day over any point in the areas of interest.

2. MISSION [redacted] is proposed as four satellites designed to optimize the responsiveness to the ABM/AES problem, by extending the basic POPPY concepts for [redacted] wide-open frequency coverage over the complete spectrum from 153 to 10,000 M.C. These four satellites will all be stabilized in three axis by gravity gradient stabilization schemes and provided with on-board micro-thrusters [redacted]

3. Orbital Requirements:

a. Altitude of 600 nautical miles average +25 n. mi.

b. Inclination: 65 $^{+0}_{-2}$ degrees

c. Apogee-perigee variation to be less than 25 n. mi.

d. Separation attitude and altitude conditions required at injection are those provided by the present Agena Launch Vehicle.

e. Optimum Launch Time - required that (1) the orbital plane must be at right angles to that of MISSION 7106, and (2) widest possible separation from operating satellites of MISSION 7106 so that telemetry frequency interference will be a minimum.

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4. Satellite Specifications:

a. Four satellites

b. Twenty-seven-inch diameter with extended equatorial section.

c. All satellites are to be three axis gravity gradient stabilized.

d. Station-Keeping - by means of fore and aft micro-thrusters located on the flight line to control the separation rates and ultimately space the satellites relative to each other

e. Weight - estimated to be between 250 and 275 for each of the satellites, giving a total expected weight for the four of between 1000 and 1100 pounds.

5. SIGINT frequency collection bands proposed for MISSION 7107 are given in Table No. 1 below:

Band	7107A	7107B	7107C	7107D	Sensitivity
1	153 - 165	153 - 165	153 - 165	153 - 165	-47
2	165 - 200	165 - 200	165 - 200	165 - 200	-47
3	200 - 240	200 - 240	200 - 240	200 - 240	-50
4	240 - 290	240 - 290	240 - 290	240 - 290	-50
5	290 - 350	290 - 350	290 - 350	290 - 350	-50
6	350 - 450	350 - 450	350 - 450	350 - 450	-50, 55, or 60
7	450 - 550	450 - 550	450 - 550	450 - 550	-50, 55, or 60
8	550 - 650	550 - 650	550 - 650	550 - 650	-50, 55, or 60
9	650 - 835	650 - 835	650 - 835	650 - 835	-50, 55, or 60
10	830 - 920	830 - 920	830 - 920	830 - 920	-50, 55, or 60
11	920 - 1080	920 - 1080	920 - 1080	920 - 1080	-50, 55, or 60
12	1080 - 1350	1080 - 1350	1080 - 1350	1080 - 1350	-50, 55, or 60
13	1350 - 1850	1350 - 1850	1350 - 1850	1350 - 1850	-50, 55, or 60
14	1850 - 2100	1850 - 2100	1850 - 2100	1850 - 2100	-53, 58, or 65
15	2100 - 2680	2100 - 2680	2100 - 2680	2100 - 2680	-53, 58, or 65
16	22680 - 2930	2680 - 2930	2680 - 2930	2680 - 2930	-53, 58, or 65
17	2930 - 3120	2930 - 3120	2930 - 3120	2930 - 3120	-53, 58, or 65
18	3120 - 3300	3120 - 3300	3120 - 3300	3120 - 3300	-53, 58, or 65
19	5800 - 6500	5070 - 5800	3300 - 4100	4100 - 4900	-65
20	4900 - 5070	4900 - 5070	4900 - 5070	4900 - 5070	-75
21	6400 - 6900	6400 - 6900	6400 - 6900	6400 - 6900	-75
22	6900 - 7900	6900 - 7900	7900 - 8700	7900 - 8700	-75
23	8700 - 9340	8700 - 9340	8700 - 9340	8700 - 9340	-75
24	9340 - 10000	9340 - 10000	9340 - 10000	9340 - 10000	-75
25	14500 - 14800	14500 - 14800	14800 - 15200	34600 - 35000	-100

(a) The frequency range from 550 to 920 M.C. will employ channelized filters in 7107A, giving approximately 20 M.C. resolution upon command.

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The channelized filters with 20 M.C. bandwidth will cover the range from 920 to 1850 M.C. in 7107B.

The channelized filters giving 30 M.C. bandwidth will be incorporated in 7107C from 1850 to 4100 M.C.

[redacted]

(c) A separate digitized data channel will be provided to handle the data on a pulse by pulse basis from the channelized filter experiments on 7107A, B, and C. In 7107D the digitized data channel will furnish the data from a parametric measurement of either incoming signal amplitude or pulse width in 128 discrete increments.

6. By optimizing the analog to digital conversion in the field, it is anticipated that location accuracies of [redacted]

7. If approval to proceed with the design concept is forthcoming by 15 February, it is anticipated a December 1968 launch date could be met.

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BYE #26904-7

To DNI

6 February 1967

Subj: Detailed Design Plan for MISSION 7106

Ref: (a) NRL ltr 5600:414:RDM:jch, BYE 26909-66 of 6 Oct 1966
(b) NRL ltr 5600:HOL:sr, BYE 26914-66 of 30 Dec 1966
(c) NRL ltr 5600:HOL:sr, BYE 26900-67 of Jan 1967
(d) NRO memo to DNI BYE 52052-67

1. Background:

References (a), (b), and (c), represent earlier concept proposals which have been formulated over the past year in the evolution of this Detailed Design Plan for MISSION 7106. The configuration for this mission has changed from two to four nearly identical satellites in order to be more responsive to the ABM/AES requirements by significantly increasing the satellite-time over the target. The major portions of the satellites frequency coverage are identical so that production line procedures can be utilized to secure the earliest availability for launch schedule. As in the past, the satellites will be [redacted] will leave the launch vehicle with velocity significantly [redacted] Thus, in a minimum of time, [redacted] satellites will have completed the horizon transit [redacted] reaches the horizon for the collection site

2. General Design Goals:

a. Separation rate between each of the satellites and the vehicles will be initially determined by the force of their respective separation springs. They will be designed to provide sufficient thrust that 7106A will separate from its [redacted] by about 350 n. miles in a period of six months [redacted]

b. Reliability - In January 7103, C satellite celebrated its third annual anniversary of operational usage with no degradation in performance. Two of the MISSION 7104 satellites remain in use after more than twenty-three months of intensive tasking. Using the same proven design concepts throughout, the lifetime expected for MISSION 7106 is one year minimum.

3. Mechanical Design Characteristics:

a. The structure proposed is the same 27 inch diameter Multiface utilized in 7105 with some-what higher equatorial section

b. Three axis stabilization on each satellite will be provided by means of the Gravity Gradient System with provision for both inversion and Yaw turn-around by command.

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c. Station-Keeping capability will be provided by fore and aft micro-thrusters to control the separation rates and to achieve

d. Weight for each satellite is expected to be between 225 and 250 pounds or between 900 and 1000 pounds total for the four.

4. Orbital Requirements:

a. Orbital Inclination: 70° $^{+0}_{-2}$

b. Average altitude: 500 ±25 n. miles

c. Apogee - perigee variation: less than 25 n. miles

d. Launch vehicle specifications at injection:

(1) The vehicle must be oriented to within plus or minus 1° in pitch, roll, yaw. Pitch and Yaw rates must be less than 0.1°/sec. The vehicle's acceleration profile must be such that the final maximum velocity (some time after separation) must not exceed the velocity at the time of separation by more than 0.02 ft/sec. This can be accomplished by separating the satellites after all residual thrusting (chuffing) has ceased

e. Optimum Launch time requirement:

(1) Orbital plane at right angles to that of MISSION 7105.

(2) Widest possible separation from the operating payloads of MISSION 7105 minimizing interference of the common telemetry signals.

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5 ELINT Coverage:

ELINT collection (frequency) coverage for MISSION 7106 is shown in Table I:

TABLE I - Proposed Frequency Coverage for MISSION 7106

Band	7106A	7106B	7106C	7106D	Sens.
1	153 - 165	153 - 165	153 - 165	153 - 165	-47
2	165 - 200	165 - 200	165 - 200	165 - 200	-47
3	200 - 240	200 - 240	200 - 240	200 - 240	-50
4	240 - 290	240 - 290	240 - 290	240 - 290	-50
5	290 - 350	290 - 350	290 - 350	290 - 350	-50
6	350 - 450	350 - 450	350 - 450	350 - 450	-50
7	450 - 550	450 - 550	450 - 550	450 - 550	-50
8	550 - 650	550 - 650	550 - 650	550 - 650	-50 or -
9	650 - 820	650 - 820	650 - 820	650 - 820	-50 or -
10	820 - 920	820 - 920	820 - 920	820 - 920	-50 or -
11	920 - 1080	920 - 1080	920 - 1080	920 - 1080	-50 or -
12	1080 - 1350	1080 - 1350	1080 - 1350	1080 - 1350	-50 or -
13	1350 - 1850	1350 - 1850	1350 - 1850	1350 - 1850	" " "
14	1800 - 2100	1800 - 2100	1800 - 2100	1800 - 2100	" " "
15	2100 - 2580	2100 - 2580	2100 - 2580	2100 - 2580	" " "
16	2580 - 2680	2580 - 2680	2580 - 2680	2580 - 2680	" " "
17	2680 - 2930	2680 - 2930	2680 - 2930	2680 - 2930	" " "
18	2930 - 3120	2930 - 3120	2930 - 3120	2930 - 3120	" " "
19	3120 - 3300	3120 - 3300	3120 - 3300	3120 - 3300	" " "
20	4900 - 5070	4900 - 5070	8600 - 9340	8600 - 9340	-75
21	5850 - 6700	5850 - 6700	9340 - 10000	9340 - 10000	-75

The primary emphasis for ARM collection is to provide complete coverage in 11 satellites from 153 to 3300 M.C. In addition, the ability to provide from 10 to 12 Db more sensitivity selectably in any of the bands from 550 to 3300 M.C. is available on command. To reduce the clutter from the dense sections of Europe, selectable 90° quadrants can be picked in conjunction with the high sensitivity [redacted] The usual omnidirectional coverage will be available at the standard sensitivity also. All additional collection bands beside the primary ARM collection band will be [redacted] in two satellites to provide the [redacted] all frequency bands covered.

6. An increased command capability is available to permit the selection of any of the 21 frequency bands covered in the satellites. Additionally, with the increased command capability, the individual bands from 153 to 3300 M.C.

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have been divided into 19 R.F. bands giving the frequency of the emitter to much closer tolerances. Each of the 19 R.F. bands covering 153 to 3300 M.C. will be either commandable individually or in any combinations with either normal or the high sensitivity (where provided). Each R.F. band will have its discrete identification in the transponded data.

7. Increased Orbital Command Capability:

MISSION 7106 will have a stored command capability which will permit data tasking on all orbits over the Soviet Union utilizing only the [redacted] command sites. The system will be capable of turning the experiments on at any one of 16 possible 10 minute intervals (between 0 minutes and 160 minutes) after the real time command was received.

8. These proposed modifications to the design details for MISSION 7106 are offered to optimize the responsiveness to the ABM problem. However, it is desirable not to modify too radically the basic concepts of the POPPY system such as the wide-open omnidirectional frequency coverage for the general search and [redacted] capability in the bands of major interest. These features, combined with an ability to read-out in the field for specific geographic locations, as outlined in reference (b), have all been retained in these detailed design goals for MISSION 7106 and will assist the NRO in arriving at a solution to the current ABM/AES problems.

9. A carefully detailed technical analysis of the design and schedule has been made for this MISSION and is presented in the graphical form attached.

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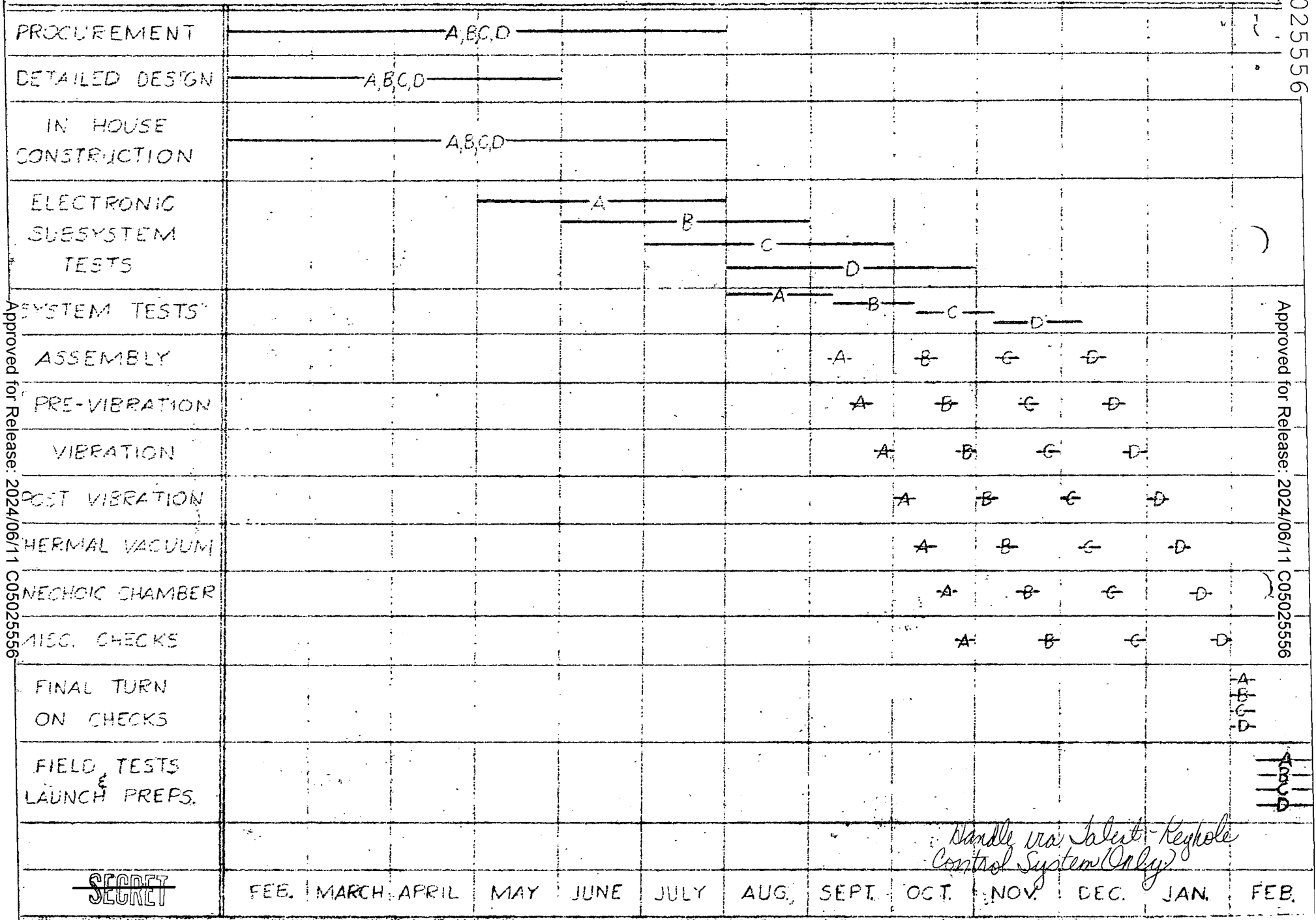
COMPRENSIVE SCHEDULE FOR 7106



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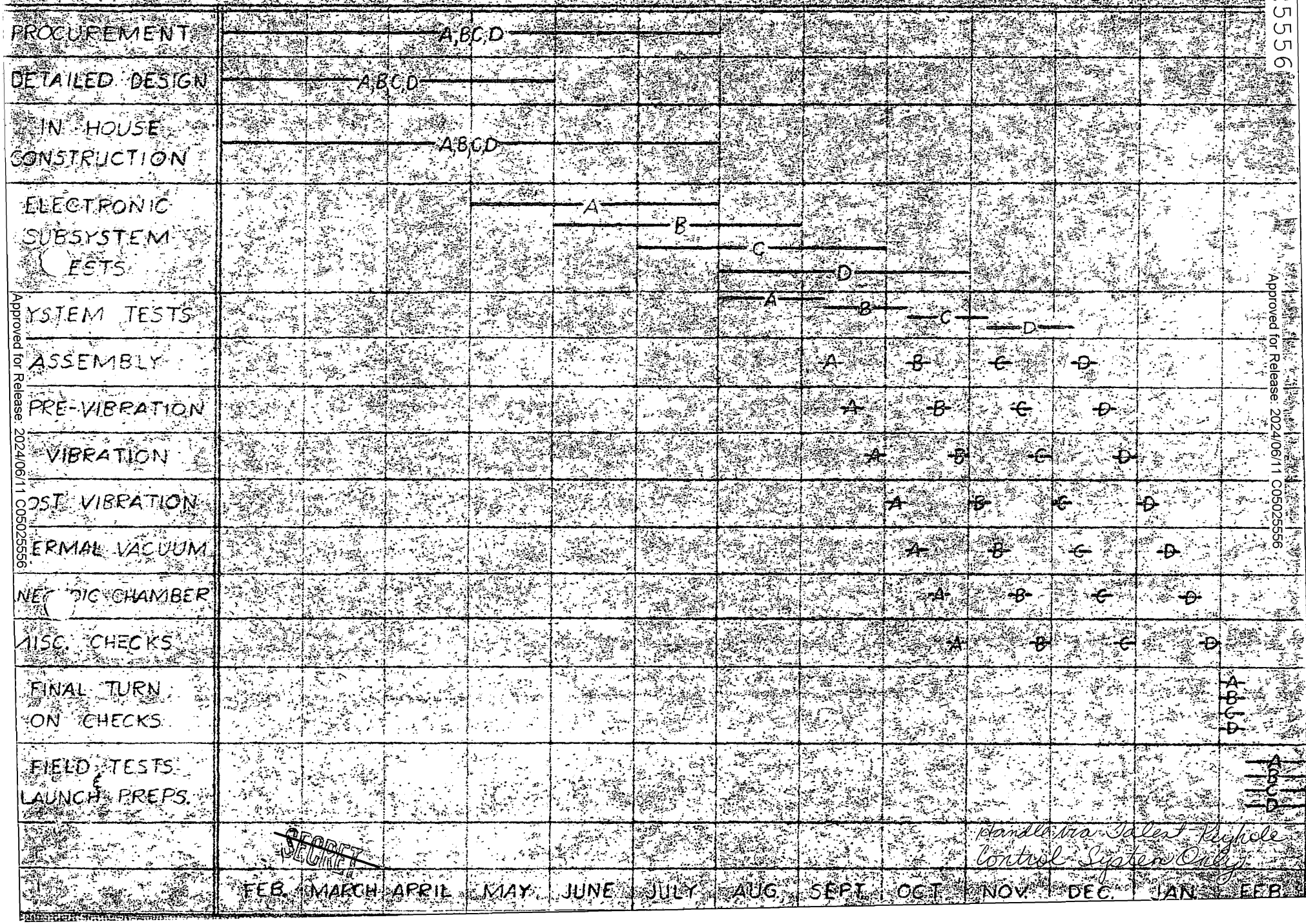
COMPRENSIVE SCHEDULE FOR 7106



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