MOL Program Review
2 April 1966
MOL SYSTEM WEIGHT STATUS

INTRODUCTION
GEMINI B
LABORATORY VEHICLE
MISSION PAYLOAD
SUMMARY & LAUNCH VEHICLE PERFORMANCE

L. M. WEEKS
B. MOSS
L. M. WEEKS

SECRET SPECIAL HANDLING

INTRODUCTION
L. M. WEEKS

SECRET SPECIAL HANDLING
WEIGHT REDUCTION EFFORT

SECRET

0 AEROSPACE & INDUSTRY TIGER TEAMS

0 DESIGN CHANGES

0 SPECIFICATION CHANGES
GEMINI B

CURRENT WEIGHT STATUS

AND

WEIGHT IMPROVEMENT ITEMS
## GEMINI B RECOMMENDED WEIGHT REDUCTION

<table>
<thead>
<tr>
<th></th>
<th>WEIGHT SAVING</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1.</td>
<td>RETRO ROCKET CIRCUITRY SHRAPNEL</td>
</tr>
<tr>
<td>*2.</td>
<td>WIRE BUNDLE CLEAN UP</td>
</tr>
<tr>
<td>**3.</td>
<td>CHANGE TO MIL-W-81044 WIRE</td>
</tr>
<tr>
<td>**4.</td>
<td>REDUCE ECS PUMP HARDWARE</td>
</tr>
</tbody>
</table>

**75**

* INCORPORATED IN MAC BASELINE

** TO BE INCORPORATED IN MAC BASELINE
POSSIBLE WEIGHT CHANGES REQUIRING FURTHER STUDY

- REDUCE RE-ENTRY MODULE $O_2$ 17
- REDUCE LOITER TIME 0 TO 150
- REDESIGN MAIN CHUTE ATTACHMENT 15
- MOVE LiOH CARTRIDGE TO LOW POINT MOUNTING 5
- REPLACE GEMINI COOLANT PUMPS WITH NEW
  PUMPS
  / LEM PUMP 45
  / HIGH/LOW CAPACITY NEW (40) LAB
- REPLACE ASCENT OXYGEN WITH INTERFACE 20
  WITH LABORATORY CRYOGENICS

SECRET SPECIAL HANDLING
### GEMINI B WEIGHT IMPROVEMENT, Continued

#### SUMMARY

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
<th>Over/Under Target</th>
</tr>
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<tbody>
<tr>
<td>Target Weight</td>
<td>5660</td>
<td></td>
</tr>
<tr>
<td>Weight with Recommended Change</td>
<td>5579</td>
<td>-81</td>
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</table>

#### SPECIFICATION WEIGHT

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>GEMINI B</td>
<td>5660</td>
<td>5579</td>
</tr>
<tr>
<td>GFE Personnel</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Contingency</td>
<td>290</td>
<td>290</td>
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<tr>
<td>Total</td>
<td>6450</td>
<td>6369</td>
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</table>
LABORATORY VEHICLE WEIGHT STATUS

OUTLINE

WEIGHT HISTORY

CURRENT WEIGHT

WEIGHT REDUCTIONS - COSTS

SUMMARY
LABORATORY VEHICLE SYSTEM SEGMENT WEIGHT HISTORY

WEIGHT - POUNDS

12,000 13,000 14,000 15,000 16,000

December 1965

January February March April

1966

ADD COMPUTER INCREASE POWER, INSTRUMENTATION & PROPULSION

ADD AUTOMATIC MODE

SPECIFICATION WEIGHT

(13,555 Lbs)

SP/DR & DESIGN CHANGES

AUTOMATIC MODE RECOMMENDED CHANGES TO BE INCORPORATED
**LABORATORY VEHICLE SYSTEM SEGMENT WEIGHT STATUS**

1 MARCH 1966

<table>
<thead>
<tr>
<th>WEIGHT (POUNDS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BODY STRUCTURE - INCLUDES MISSION MODULE STRUCTURE (2140 LBS)</td>
</tr>
<tr>
<td>ENVIRONMENT PROTECTION</td>
</tr>
<tr>
<td>ACTS PROPULSION</td>
</tr>
<tr>
<td>PRIME POWER SOURCE</td>
</tr>
<tr>
<td>POWER CONVERSION AND DISTR.</td>
</tr>
<tr>
<td>ACTS ELECTRONICS</td>
</tr>
<tr>
<td>INSTRUMENTATION &amp; DATA MGMT</td>
</tr>
<tr>
<td>COMMUNICATIONS</td>
</tr>
<tr>
<td>ENVIRONMENTAL CONTROL</td>
</tr>
<tr>
<td>PERSONNEL PROVISIONS</td>
</tr>
<tr>
<td>CONTROLS, PANELS AND DISPLAYS</td>
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**TOTAL DRY WEIGHT**

11,429

<table>
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<tr>
<th>WEIGHT (POUNDS)</th>
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<tbody>
<tr>
<td>RESIDUAL PROP. &amp; SERVICE ITEMS</td>
</tr>
<tr>
<td>RESERVE PROP. &amp; SERVICE ITEMS</td>
</tr>
<tr>
<td>IN-FLIGHT LOSSES (ATMOSPHERE, REACTANTS &amp; PROPELLANT)</td>
</tr>
</tbody>
</table>

**TOTAL FLUIDS**

(4027)

**TOTAL WEIGHT**

15,456
**LABORATORY VEHICLE SYSTEM WEIGHT**

**SPO RECOMMENDED WEIGHT CHANGES**

**INCORPORATED IN DAC BASELINE**

<table>
<thead>
<tr>
<th>Description</th>
<th>Pounds</th>
<th>Cost ($1000)</th>
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<tbody>
<tr>
<td>1. ELIMINATE TWO TRANSLATIONAL THRUSTERS</td>
<td>-25</td>
<td>-420</td>
</tr>
<tr>
<td>2. REDUCE SAFETY FACTOR FOR ALL TANKS FROM 2.22 TO 2.0</td>
<td>-50</td>
<td>+50</td>
</tr>
<tr>
<td>3. REDUCE PROPELLANT TANK CAPACITY FROM 2400 TO 2200 LBS</td>
<td>-40</td>
<td>-14</td>
</tr>
<tr>
<td>4. REPLACE CYLINDRICAL PRESSURANT TANKS WITH SPHERICAL TANKS &amp; INCREASE ALLOWABLE STRESS LEVELS ON PRESSURANT &amp; PROPELLANT TANKS</td>
<td>-80</td>
<td>+60</td>
</tr>
<tr>
<td>5. ELIMINATE EMERGENCY BATTERY REQUIREMENTS</td>
<td>-105</td>
<td>-270</td>
</tr>
<tr>
<td>6. REDUCE AVERAGE POWER &amp; TANK CAPACITY FROM 1900 WATTS TO 1650 WATTS (RETAIN 10% REACTANT RESERVE)</td>
<td>-270</td>
<td>-68</td>
</tr>
<tr>
<td>7. INCREASE ALLOWABLE CO₂ PRESSURE</td>
<td>-15</td>
<td>-35</td>
</tr>
<tr>
<td>8. REMOVE WASTE WATER STORAGE PROVISIONS</td>
<td>-10</td>
<td>-24</td>
</tr>
<tr>
<td>9. REMOVE THE 10% ATMOS RESERVES &amp; TANKS</td>
<td>-35</td>
<td>-21</td>
</tr>
<tr>
<td>10. ELIMINATE GAS PROVISIONS FOR EVA &amp; PROVISIONS FOR REPRESSURIZATION</td>
<td>-55</td>
<td>-28</td>
</tr>
<tr>
<td>11. REDUCE METABOLIC OXYGEN REQ. (3000 TO 2600)</td>
<td>-20</td>
<td>-7</td>
</tr>
<tr>
<td>12. REDUCE WEIGHT OF CREW CONDITIONING EQUIPMENT</td>
<td>-25</td>
<td>-7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>-730</td>
<td>-749</td>
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**RE-ESTIMATION AUTOMATIC MODE DESIGN AND MISC. CHANGES**

- 224

- 954
LABORATORY VEHICLE SYSTEM SEGMENT WEIGHT SUMMARY

18 MARCH 1966

WEIGHT (POUNDS)

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>BODY STRUCTURE - INCLUDES MISSION MODULE STRUCTURE</td>
<td>4255</td>
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<tr>
<td>ENVIRONMENT PROTECTION</td>
<td>380</td>
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<tr>
<td>ACTS PROPULSION</td>
<td>814</td>
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<tr>
<td>PRIME POWER SOURCE (1.65 KW)</td>
<td>1652</td>
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<tr>
<td>POWER CONVERSION &amp; DISTRIBUTION</td>
<td>371</td>
</tr>
<tr>
<td>ACTS ELECTRONICS</td>
<td>273</td>
</tr>
<tr>
<td>INSTRUMENTATION &amp; DATA MANAGEMENT</td>
<td>1011</td>
</tr>
<tr>
<td>COMMUNICATIONS</td>
<td>198</td>
</tr>
<tr>
<td>ENVIRONMENTAL CONTROL</td>
<td>894</td>
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<tr>
<td>PERSONNEL PROVISIONS</td>
<td>506</td>
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<tr>
<td>CONTROLS, PANELS &amp; DISPLAYS</td>
<td>435</td>
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TOTAL DRY WEIGHT 10,789

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>RESIDUAL PROP. &amp; SERVICE ITEMS</td>
<td>385</td>
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<tr>
<td>RESERVE PROP. &amp; SERVICE ITEMS</td>
<td>102</td>
</tr>
<tr>
<td>IN-FLIGHT LOSSES (ATMOSPHERE, REACTANTS, &amp; PROPELLANT)</td>
<td>3,226</td>
</tr>
</tbody>
</table>

TOTAL FLUIDS (3,713)

TOTAL WEIGHT 14,502
<table>
<thead>
<tr>
<th></th>
<th>DESCRIPTION</th>
<th>CHANGE</th>
<th>WEIGHT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>REMOVE COMMON BULKHEAD - INCLUDES HATCHES, ECS, ETC.</td>
<td>- 460</td>
<td>- 1890</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>INTEGRATE EQUIPMENT SUPPORT STRUCTURE &amp; USE MAG-LITH ALLOY</td>
<td>- 50</td>
<td>+ 158</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CHANGE TUNNEL MATERIAL TO MAG-LITH ALLOY</td>
<td>- 25</td>
<td>+ 16</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>USE DOMED TUNNEL HATCH IN LIEU OF FLAT</td>
<td>- 10</td>
<td>+ 14</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>IMPROVE DESIGN OF METEOROID SHIELD</td>
<td>- 20</td>
<td>+ 15</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>USE TETHERING IN PLACE OF RAILS FOR EVA</td>
<td>- 10</td>
<td>- 12</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>REDUCE PROPELLANT TO 2110 LBS (TANK CAP = 2200 LB)</td>
<td>- 90</td>
<td>+ 1035</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>REDESIGN PRATT &amp; WHITNEY FUEL CELL</td>
<td>- 165</td>
<td>+ 1560</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>USE SUBCRITICAL CRYOGENIC STORAGE (OXYGEN ONLY)</td>
<td>- 135</td>
<td>+ 1500</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>USE RIBBON TYPE WIRING (30 GAGE) FOR LOW VOLTAGE APPLICATIONS (INSTRUMENTATION, ETC.)</td>
<td>- 30</td>
<td>+ 31</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>CHANGE MOLECULAR SIEVE FROM 3 TO 2 BED UNIT</td>
<td>- 20</td>
<td>- 145</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>SIMPLIFY TEMP CONTROL SYS. SAVE 11 LBS DRY WT PLUS A 110 LBS POWER REDUCTION (POWER WT SAVING NOT INCL. IN SUMMATION)</td>
<td>- 10</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>USE WASTE HEAT FOR HEATING GEMINI - ADD 10 LBS DRY WT, SAVE 140 LBS POWER SYS (POWER WT SAV NOT INCL IN SUMMATION)</td>
<td>+ 10</td>
<td>+ 71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>-1015</td>
<td>+2353</td>
<td></td>
</tr>
</tbody>
</table>
**LABORATORY VEHICLE WEIGHT SUMMARY**

INCLUDING RECOMMENDED WEIGHT REDUCTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>CURRENT WEIGHT - 18 MARCH 1966</td>
<td>14,502</td>
</tr>
<tr>
<td>DIRECTED CHANGES NOT YET INCORPORATED</td>
<td>-1,015</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>13,487</strong></td>
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### Possible Weight Changes Requiring Further Study

#### (Not Additive)

#### Special Handling

<table>
<thead>
<tr>
<th>Possible Weight Reductions</th>
<th>Pounds</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Raised O₂/He Pressure (Total 7 PSI)</td>
<td>-80</td>
<td>+100</td>
</tr>
<tr>
<td>2. One Hour Repressurization</td>
<td>-45</td>
<td></td>
</tr>
<tr>
<td>3. Redesign Mission Module Structure at the Booster Interface to Replace 8 Bolts Separation with Shaped Charge, and Distribute Loads Equally</td>
<td>-125</td>
<td></td>
</tr>
<tr>
<td>4. Fuel Cells - Operate Two Hot and One on Warm Standby</td>
<td>-56</td>
<td>+75</td>
</tr>
<tr>
<td>5. 95 Percent Winds</td>
<td>-80</td>
<td></td>
</tr>
<tr>
<td>6. Beryllium Unpressurized Compartment</td>
<td>-85</td>
<td>+5,000</td>
</tr>
<tr>
<td>7. Beryllium Mission Module</td>
<td>-530</td>
<td>+24,000</td>
</tr>
<tr>
<td>8. Mag-Lith Mission Module Frames</td>
<td>-45</td>
<td>+500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Weight Increases</th>
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</thead>
<tbody>
<tr>
<td>1A. Use Nitrogen in lieu of Helium for Diluent</td>
</tr>
<tr>
<td>2A. Blast Shield</td>
</tr>
</tbody>
</table>
LABORATORY VEHICLE

WEIGHT SUMMARY

SECRET

SPECIAL HANDLING

- SIGNIFICANT WEIGHT REDUCTION DESIGN & SP/DR CHANGES DIRECTED
  - COST INCREMENT LOW
  - ADDITIONAL REDUCTIONS - DIFFICULT & COSTLY
- ADDITIONAL POSSIBLE WEIGHT REDUCTIONS IDENTIFIED
- 13,555# SPEC WEIGHT CAN BE MET AT BEGINNING PHASE II
MOL WEIGHT AND PERFORMANCE HISTORY

SPECIAL HANDLING

- (32.6) T-III/M; 80°; 80/155
- (32.571) OV W/CONTINGENCY
- CONTINGENCY (4010 LBS)
- (28.561) ORBITAL VEHICLE (W/O CONTINGENCY)
- (7) 26016
- ADD AUTO MODE COMPUTER PROPULSION
- SPO/AEROSPACE DIRECTED CHANGES
- (13.555) LAB VEHICLE (W/O CONTINGENCY)
- (8.433) MISSION PAYLOAD (W/O CONTINGENCY)
- (6.160) GEMINI & CREW (W/O CONTINGENCY)
- (0.413) LAB CREW EQUIP (W/O CONTINGENCY)

SEPT O N D J F M A M 1965 1966
<table>
<thead>
<tr>
<th>Component</th>
<th>Current Weight* (Including Contingencies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEMINI B</td>
<td>6450 (6160 + 290)</td>
</tr>
<tr>
<td>GEMINI B SEGMENT</td>
<td></td>
</tr>
<tr>
<td>CREW AND CREW EQUIPMENT SEGMENT</td>
<td>5930 (5660 + 270)</td>
</tr>
<tr>
<td></td>
<td>520 (500 + 20)</td>
</tr>
<tr>
<td>LABORATORY VEHICLE</td>
<td>15988 (13968 + 2020)</td>
</tr>
<tr>
<td>LABORATORY MODULE SEGMENT</td>
<td></td>
</tr>
<tr>
<td>CREW EQUIPMENT SEGMENT</td>
<td>15495 (13555 + 1940)</td>
</tr>
<tr>
<td></td>
<td>493 (413 + 80)</td>
</tr>
<tr>
<td>MISSION PAYLOAD</td>
<td>10133 (8433 + 1700)</td>
</tr>
<tr>
<td>TOTAL ORBITAL VEHICLE</td>
<td>32571 (28561 + 4010)</td>
</tr>
<tr>
<td>LAUNCH VEHICLE (T-III M; WTR LAUNCH)</td>
<td></td>
</tr>
<tr>
<td>80°; 80/130</td>
<td>32,800</td>
</tr>
<tr>
<td>80°; 80/155</td>
<td>32,600</td>
</tr>
</tbody>
</table>

* TOTAL (ACTUAL + CONTINGENCY)
TITAN IIIM LAUNCH VEHICLE STATUS

PERFORMANCE STATUS

• BASELINE -- 31,680 LB (80/130 N.M. -- 80° INCLINATION -- PERIGEE PLACEMENT)

• HIGH CONFIDENCE PERFORMANCE IMPROVEMENT ITEMS -- 1128 LB TOTAL
  / VELOCITY MARGIN BASED ON 3σ INSTEAD OF 2.5% RSS -- 700 LB
  / STAGE I ULLAGE REDUCTION (5097 LB PROPELLANT WEIGHT INCREASE) -- 306 LB
  / STRUCTURE ASSOCIATED WITH 55 LB/SEC TVC INJECTANT VALUES (INSTEAD OF 103 LB/SEC) -- 122 LB

• ADDITIONAL PERFORMANCE IMPROVEMENT ITEMS UNDER CONSIDERATION -- 1100 LB TOTAL
  / 10° NOSE CONE ON SRM'S -- 300 LB
  / SRM AFT SKIRT REDESIGN -- 200 LB
  / CONDITIONED PROPELLANTS (45° F) -- 300 LB
  / SRM HEATER BLANKETS (90° F) -- 300 LB
MANIRED RE-ENTRY VEHICLIE WEIGHT GROWTH HISTORY
ALL DEVELOPMENT PHASES

VEHICLE WEIGHT VARIATION (% OF CONTRACT OR PROGRAM INITIATION WEIGHT)

O = PUBLISHED DATA

SECRET
SPECIAL HANDLING

DISMANTLE 125
MOL CONTINGENCY

DEMO - ZTD
(REGISTERED VERSION)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Launch Vehicle</td>
<td>32,600 LBS</td>
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<tr>
<td>(80°; 80/155)</td>
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</tr>
<tr>
<td>Perigee Altitude</td>
<td>80 N.M.</td>
</tr>
<tr>
<td>Orbit Repeatability</td>
<td>7.5 Days</td>
</tr>
<tr>
<td>Mission Duration</td>
<td>30 Days</td>
</tr>
</tbody>
</table>

**Graph:**

- **MOL Flyable Inclinations**
- **Special Handling**
- **Launch Vehicle:** 32,600 LBS (80°; 80/155)
- **Perigee Altitude:** 80 N.M.
- **Orbit Repeatability:** 7.5 Days
- **Mission Duration:** 30 Days

**Graph Details:**

- **OV Inert Weight Contingency Percentage (4010 LBS):**
  - 5.8% at 93°
  - 11.8% at 89°

**Weights:**

- 28,561 LBS (EST. ACTUAL)
- (EST. ACT. + CONT.) 32,571 LBS
WEIGHT & PERFORMANCE SUMMARY

- 28,561# PRESENT ESTIMATE

- 4,010# CONTINGENCY PROVIDED (20%)

- 20% CAN BE HELD (OR BEATEN) DURING PHASE II
  IF NO SIGNIFICANT SPEC/PROGRAM CHANGES

- WEIGHT CONTROL BOARD ESTABLISHED

- TIHM LAUNCH VEHICLE & ORBITING VEHICLE COMPATIBLE
WEIGHTS
<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>540</td>
<td>Tracking Mirror Drive</td>
</tr>
<tr>
<td>551</td>
<td>Data Recorder</td>
</tr>
<tr>
<td>191</td>
<td>Console (4)</td>
</tr>
<tr>
<td>061</td>
<td>Acquisition</td>
</tr>
<tr>
<td>011</td>
<td>Navigation</td>
</tr>
<tr>
<td>124</td>
<td>Band, TM</td>
</tr>
<tr>
<td>226</td>
<td>Command and ADF, Wide</td>
</tr>
<tr>
<td>367</td>
<td>Electrical</td>
</tr>
<tr>
<td>214</td>
<td>Thermal Control</td>
</tr>
<tr>
<td>217</td>
<td>True</td>
</tr>
<tr>
<td>271</td>
<td>Secondary Structure</td>
</tr>
<tr>
<td>151</td>
<td>Crew Doors</td>
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<tr>
<td>292</td>
<td>Suspension</td>
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<tr>
<td>314</td>
<td>Tracking Mirror</td>
</tr>
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<td>982</td>
<td>Structure</td>
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<tr>
<td>782</td>
<td>Film 4 Bracket</td>
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<tr>
<td>226</td>
<td>Handle</td>
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<td>052</td>
<td>Canvas 4 Film</td>
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<td>071</td>
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<tr>
<td>232</td>
<td>Laboratory</td>
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<tr>
<td>2578</td>
<td>Structure Class</td>
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**Weight Summary**

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<tr>
<td>9178</td>
<td>Aerospace</td>
</tr>
<tr>
<td>9178</td>
<td>Optics</td>
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**Weight Summary**

<table>
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<th>Code</th>
<th>Description</th>
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<tr>
<td>0935</td>
<td>Weight</td>
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**Note:**
- Release: 4 July 2016
- Issue: 5.00-5.01
Figure 3-1. In-Line Configuration
MISSION MODULE
## Weight Improvement Study Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELETE IMU</td>
<td>30</td>
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<tr>
<td>INVAR BARREL</td>
<td>159</td>
</tr>
<tr>
<td>ACQUISITION - TV TO OPTICAL</td>
<td>72</td>
</tr>
<tr>
<td>LOUVRE CLOSURE IN PLACE OF APERTURE DOOR</td>
<td>50</td>
</tr>
<tr>
<td>REFINE CONSOLE DESIGN</td>
<td>120</td>
</tr>
<tr>
<td>REARRANGE GIMBALING OF TRACKING MIRROR</td>
<td>125</td>
</tr>
<tr>
<td><strong>BERYLLIUM SUPPORT STRUCTURE</strong></td>
<td><strong>300</strong></td>
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<tr>
<td><strong>TILT MIRROR ROLL AXIS</strong></td>
<td><strong>52</strong></td>
</tr>
<tr>
<td>CERVIT FOR T/M AND PRIMARY</td>
<td>402</td>
</tr>
<tr>
<td>REDESIGN TRACKING AND PRIMARY MIRROR</td>
<td>800</td>
</tr>
<tr>
<td>CHANGE FROM LEAP FROG TO SPECIALIST</td>
<td>50</td>
</tr>
<tr>
<td>DELETE R/V</td>
<td>376</td>
</tr>
<tr>
<td>DELETE READOUT</td>
<td></td>
</tr>
<tr>
<td>WIDE BAND DATA TRANSMISSION LINK</td>
<td>168</td>
</tr>
<tr>
<td>ONBOARD PROCESSING AND BIMAT</td>
<td>172</td>
</tr>
</tbody>
</table>
DATA RETRIEVAL
UNRESOLVED DATA RETRIEVAL CONSIDERATIONS

- MANNED
  - READOUT
  - NUMBER AND TYPE OF RECOVERY VEHICLE
  - FILM PACKAGES ABOARD THE GEMINI B
  - NUMBER AND TYPES OF CAMERAS AND FILM

- UNMANNED
  - NUMBER AND TYPE OF RECOVERY VEHICLES
  - MISSION DURATION
  - ALTITUDE

SECRET/SPECIAL HANDLING
SECRET-SPECIAL HANDLING

READOUT REQUIREMENTS

BASELINE: CREWMEN EDIT SELECTED FRAMES FOR READOUT

ASSUMPTIONS: RELIABLE, LOW WEIGHT / POWER, USE PAST EXPERIENCE

QUESTIONS:

SECURITY (CRYPTOGRAPHIC OR PRIVATE)

RESOLUTION (MULTIPLE OPTION ?)

QUANTITY

TARGET SIZE

TIME DELAY (TRACKING STATION PROCESSING)

SECRET-SPECIAL HANDLING
SECURITY

- MOL-DORIAN REQUIRES MAXIMUM POSSIBLE SECURITY
- SENSITIVITY OF MAN'S ROLE IN RECONNAISSANCE
- PROTECT KNOWLEDGE OF HIGH RESOLUTION CAPABILITY
- PROTECT USER'S INTEREST IN SPECIFIC TARGETS

NONENCRYPTED NARROW BEAM SYSTEM PROVIDES INADEQUATE PROTECTION

- UNAUTHORIZED STATION CAN BE LOCATED NEAR AUTHORIZED READOUT STATIONS
- SIMPLER INTERCEPTION STATION FEASIBLE BECAUSE
  - CAN OPERATE AT SHORTER RANGES AND STILL NULLIFY SECURITY OBJECTIVES
  - CAN OPERATE WITH LESS QUALITY MARGIN FOR WEATHER AND OTHER DEGRADATIONS
  - CAN COMMENCE OPERATIONS LATER WITH STATE-OF-ART IMPROVEMENTS
DIGITAL READOUT

- MORE RELIABLE CONFIGURATION
  - FIXED ANTENNA
  - LOWER SCAN SPEED
- COMPATIBLE WITH SCF STANDARD
  - PROGRAM 266 COMMITTED TO 20 MBPS
- CRYPTO SECURITY
- SUFFICIENT QUANTITY
  - 1.3 SQUARE INCHES PER MINUTE
  - 1200 PICTURES IN 30 DAYS (1 X 1 INCH CHIPS, 8-4 MIN. PASSES PER DAY)

---SECRET-SPECIAL HANDLING

---SECRET-SPECIAL HANDLING
QUALITY/QUANTITY

- READOUT SYSTEM SHOULD PRESERVE MAXIMUM RESOLUTION
  - DETAIL IMPORTANT IN TECHNICAL INTELLIGENCE
  - EVALUATION OF PHOTOGRAPHIC PERFORMANCE WHILE IN FLIGHT

- QUANTITY SHOULD NOT BE EXCESSIVE
  - RESPONSE TIME FOR TECHNICAL INTELLIGENCE LESS CRITICAL
    THAN FOR SURVEILLANCE
  - READOUT REDUCES TARGET YIELD IN A CLUSTER
  - DEMANDS ON CREW

SECRET - SPECIAL HANDLING
SECRET-SPECIAL HANDLING

SYSTEM OPTIONS

- DIRECT APPLICATION OF SP HARDWARE DEVELOPMENT
  - CBS - NTL ANALOG SYSTEM

- FOR IMPROVED SECURITY AND SCF COMPATIBILITY
  - SIMPLIFIED CBS SCANNER
  - CRYPTO UNIT NOW UNDER NSA CONTRACT
  - 20 MBPS DIGITAL LINK (SCF STANDARD)
### Readout System Approaches

<table>
<thead>
<tr>
<th>Video Readout Bandwidth</th>
<th>Wide Band Analog</th>
<th>Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulating Baseband</td>
<td>100 MCPS</td>
<td>1 MCPS</td>
</tr>
<tr>
<td>RF Spectrum Width</td>
<td>100 MCPS</td>
<td>20 MCPS</td>
</tr>
<tr>
<td>Carrier Frequency Band</td>
<td>650 MCPS</td>
<td>20 MCPS</td>
</tr>
<tr>
<td>Stations</td>
<td>10.7 to 11.7 GC</td>
<td>2.2 to 2.3 GC</td>
</tr>
<tr>
<td>Vehicle Antenna</td>
<td>One - Inland Near Wash, DC</td>
<td>NHS, VTS, KTS, IHTS</td>
</tr>
<tr>
<td>Security</td>
<td>Steerable 3 ft. dish</td>
<td>Fixed-Broad Beam</td>
</tr>
<tr>
<td>Readout Rate</td>
<td>133 in²/min.</td>
<td>1 1/3 in²/min.</td>
</tr>
<tr>
<td>Quantity per Day</td>
<td>@ 4 1/2 x 9 25-Pictures</td>
<td>@ 1 x 1 40 Pictures</td>
</tr>
<tr>
<td>Weight</td>
<td>100 Pounds</td>
<td>75 Pounds</td>
</tr>
<tr>
<td>Film Processing</td>
<td>275</td>
<td>100</td>
</tr>
<tr>
<td>Scanner and Data Processor</td>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>Transmitter and Antenna</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>450 Pounds</td>
<td>195 Pounds</td>
</tr>
</tbody>
</table>

---

SECRET SPECIAL HANDLING
STANDARD SATELLITE DISH AND PREAMPLIFIER AVAILABLE AT VANDENBERG, NEW BOSTON AND HAWAII

IF REQUIREMENT CAN BE SHARED WITH ANOTHER PROGRAM

PROVIDE 60 FOOT DISH AT A FOURTH STATION

DATA RECORDING

PROVIDE RECEIVER AND TAPE RECORDER AT READOUT STATIONS

SHARE RECORDING CAPABILITY WITH OTHER PROGRAMS

IMAGE RECONSTRUCTION

PRIMARY IMAGE RECONSTRUCTION AT USER FACILITIES

SECONDARY CAPABILITY AT BTS AND VIS

---SECRET--SPECIAL HANDLING

---SECRET--SPECIAL HANDLING
CONCLUSIONS

SECURITY: [Redacted]

RESOLUTION: SINGLE MODE - [Redacted] (CONSERVATIVE)

QUANTITY: 1200 SQUARE INCHES IN 30 DAYS

TARGET SIZE: MINIMUM DIMENSION ONE TO TWO INCHES
READOUT PER PASS - 5 SQUARE INCHES
NOTE: ONE INCH (FILM) EQUALS 1000 FEET (GND)

RELIABILITY: 20 MBPS SCF STANDARD (LEAD PROGRAM -- 266)
FIXED VEHICLE ANTENNA
RELATIVELY LOW SCAN SPEED

TIME DELAY: MULTIPLE STATIONS (NHS, VTS, HTS, PLUS ONE)
LOCAL PROCESSING AT VTS AND HTS
SECRET SPECIAL HANDLING

RECOMMENDATIONS

• USE 20 MBPS ENCRYPTED LINK
• ASSIGN RESPONSIBILITY FOR COMPLETE SYSTEM TO SINGLE CONTRACTOR
• SPECIFIC CONTRACTOR TO BE IDENTIFIED LATER
FILM RETURN CONCEPTS

- UP TO 12,000 FEET (220 LBS) OF EXPOSED FILM
- BASELINE SPECIFIES 350 LBS FOR R/V'S, LAUNCHER AND SUPPORTS
  - SINGLE 33" MK-V (60 LBS TO 70 LBS CAPABILITY)
  - UP TO 3 SMALLER R/V'S (∼20 LBS EACH)
- BALANCE RETURNED IN GEMINI B
SECRET SPECIAL HANDLING

CONSIDERATIONS

- WEIGHT
- RELIABILITY, SAFETY
- SECURITY
  - POSITIVE PHYSICAL CONTROL
  - SPECIAL PROVISIONS FOR CUES
- EARLY OR PERIODIC RETURN
  - QUALITY CHECK
  - PERISHABLE DATA
  - MISSION REPLANNING
- GEMINI B CAPABILITY AND CONSTRAINTS

SECRET SPECIAL HANDLING
### Early or Periodic Return

<table>
<thead>
<tr>
<th>1st Week</th>
<th>2nd Week</th>
<th>3rd Week</th>
<th>4th Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td></td>
</tr>
</tbody>
</table>

- Launch will be scheduled for good weather at least during the first week.
- All target areas accessible during first week.
- First week return could have considerable effect on subsequent mission plans.
- Return at end of 2nd week would effect only last week operation.
- Return at end of 3rd week will have no effect.

---

SECRET SPECIAL HANDLING

SECRET SPECIAL HANDLING
PROGRAM OBJECTIVES

- INTEGRAL LAUNCH
- 30 DAY MANNED DURATION
- 80 - 97° INCLINATION
- 80 N. MI. PERIGEE
- [REDACTED]
- 1500 TARGETS/MISSION
- DUAL MODE CAPABILITY
  (MANNED & UNMANNED)
INCLINATION CONSIDERATIONS
(30 DAY MISSION)

TARGET LATITUDE = 55° N

RANGE OF SUN ANGLES FOR SUN-SYNCHRONOUS ORBIT

MINIMUM SUN ANGLE FOR i = 80°

LAUNCH DATE

NRO APPROVED FOR RELEASE 1 JULY 2015
GROWTH CONSIDERATIONS

- OTHER MISSION APPLICATIONS

- DORIAN MISSION
  - IMPROVED ECONOMICS
  - IMPROVED PERFORMANCE
ELINT APPLICATION

- BASIC FUNCTIONS
  - PROVIDE POINTING DATA TO LARGE OPTICS (THROUGH PTS)
  - ON-CALL, HIGH PRIORITY TI COLLECTION

- INTERFEROMETRIC ANTENNA SYSTEM FOR POINTING, ABOVE 3.5 GC
  HIGH GAIN DISH (3 FT DIAMETER) FOR TI OBJECTIVE

- WEIGHT - 300 LBS - MINIMUM CAPABILITY TO 800 MAXIMUM CAPABILITY

- POWER - 20 WATTS MISSION AVERAGE WITH PEAKS TO 300 WATTS
### ECONOMIC FACTORS

**PRESENT PROGRAM**

<table>
<thead>
<tr>
<th>MANNED MODE</th>
<th>RECURRING COST (MILLIONS/LAUNCH)</th>
<th>MEAN MISSION DURATION (DAYS)</th>
<th>COST/DAY (MILLIONS/DAY)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GEMINI</strong></td>
<td>19.0</td>
<td>80 NM</td>
<td>3.1</td>
</tr>
<tr>
<td><strong>LABORATORY</strong></td>
<td>29.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MISSION MODULE</strong></td>
<td>19.0</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td><strong>TRACKING, RECOVERY &amp; LAUNCH VEHICLE</strong></td>
<td>6.0 ([P&lt;sub&gt;R&lt;/sub&gt; = 0.95])</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LAUNCH VEHICLE</strong></td>
<td>18.2</td>
<td>70 NM</td>
<td>4.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>91.2</td>
<td>([P&lt;sub&gt;R&lt;/sub&gt; = 0.95])</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>UNMANNED MODE</th>
<th>RECURRING COST (MILLIONS/LAUNCH)</th>
<th>MEAN MISSION DURATION (DAYS)</th>
<th>COST/DAY (MILLIONS/DAY)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RECOVERY SECTION</strong></td>
<td>4.0</td>
<td>70 NM</td>
<td></td>
</tr>
<tr>
<td><strong>LABORATORY</strong></td>
<td>25.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MISSION MODULE</strong></td>
<td>17.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TRACKING, RECOVERY &amp; DATA REDUCTION</strong></td>
<td>3.0 ([P&lt;sub&gt;R&lt;/sub&gt; = 0.77])</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td><strong>LAUNCH VEHICLE</strong></td>
<td>18.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>67.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COST EFFECTIVENESS
PRESENT PROGRAM
150 DAYS/YR ON ORBIT

YEARS OF OPERATION
BILLIONS OF DOLLARS

MANNED (70 NM)
MANNED (80 NM)
UNMANNED (70 NM)
GROWTH AVENUES

INTEGRAL LAUNCH

- Boosters
  - LDC-1
  - LDC 1 AND 2

PROGRAM IMPLICATIONS

- Subsystem life extension
- Booster development
- Orbiting vehicle modification

RENDEZVOUS

- THIC (U)

- Subsystem life extension
- Resupply vehicle
- Rendezvous and docking provisions
### Extension of Orbiting Vehicle Life

**Vehicle Life May Be Extended By:**

<table>
<thead>
<tr>
<th>Methods</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsystem Redundancy</td>
<td>Inflexible; Diminishing Returns</td>
</tr>
<tr>
<td>Stretch Testing Existing Components</td>
<td>Limited by Fundamental Design</td>
</tr>
<tr>
<td>Manned Maintenance, Repair, and Replacement (IV and EV)</td>
<td>Flexible; Requires Careful Design Provisions</td>
</tr>
<tr>
<td>New Subsystem Developments</td>
<td>Time Limited</td>
</tr>
</tbody>
</table>

- Combinations of methods appear most effective for MOL
- Studies required to define optimum approaches
LARGE CORE TITAN III

- **PAYLOADS** ($i = 80^\circ; 80/130$ **ORBIT**)
  - LDC 1/7 SEG. --- 44,000 LBS.
  - LDC 1 & 2/7 SEG. --- 50,000 LBS.

- **TIUC (U) DEVELOPMENT PROVIDES**
  - 15:1 NOZZLES
  - 7 SEGMENT SOLIDS

- **LDC 1 CHANGES**
  - STRUCTURES
  - PROPULSION SYSTEM
  - CONTROL SYSTEM
RESUPPLY VEHICLE DESCRIPTION
(TYPICAL 60 DAY DESIGN)

INTERFACE CONNECTIONS
- ACTS CONTROL SIGNAL
- ELECTRICAL POWER
- COMMUNICATIONS
- INSTRUMENTATION
- ATMOSPHERE O₂ & H₂
- WATER
- FILM TRANSPORT

RESUPPLY VEHICLE
- ATTITUDE CONTROL (ACTS PROPULSION)
- PRIME POWER SYSTEM
- LIFE SUPPORT EXPENDABLES
- DATA SYSTEM

M/AM VEHICLE
- LIFE SUPPORT SYSTEM
- ATTITUDE CONTROL ELECTRONICS
- COMMUNICATIONS & DATA HANDLING
- ENVIRONMENTAL CONTROL

EST. WT. = 28.4K

FUNCTIONS - DOCKED
## ECONOMIC FACTORS

### GROWTH AVENUES

<table>
<thead>
<tr>
<th></th>
<th>Nonrecurring Costs (Millions)</th>
<th>Recurring Costs (Millions)</th>
<th>Mean Mission Duration (Days)</th>
<th>Cost/Day (Millions/Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNMANNED - TIIIC (U)</strong></td>
<td></td>
<td>67.2</td>
<td>34</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>INTEGRAL LAUNCH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- LDC - 7 SEG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- VEHICLE MODIFICATIONS</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- SUBSYSTEM EXT.</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- BOOSTER DEV.</td>
<td>50</td>
<td>96</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>180</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RENDEZVOUS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- TIIIC (U)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- SUBSYSTEM EXT.</td>
<td>120</td>
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<tr>
<td>- RESUPPLY VEH.</td>
<td>230</td>
<td>OV 96</td>
<td>20</td>
<td>(2 - 4)</td>
</tr>
<tr>
<td>- REND. &amp; DOCKING</td>
<td>50</td>
<td>RS 53</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>- PAD</td>
<td>60</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>460</strong></td>
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</tbody>
</table>
COST EFFECTIVENESS
GROWTH PROGRAMS
3 SHOT RULE

YEARS OF OPERATION

BILLIONS OF DOLLARS

<table>
<thead>
<tr>
<th></th>
<th>YEARLY NO. OF LAUNCHES</th>
<th>COST PER DAY</th>
<th>DAYS PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIIIC (U) REND.</td>
<td>6</td>
<td>$1.5M</td>
<td>280</td>
</tr>
<tr>
<td>LDC 1 INTEGRAL</td>
<td>3</td>
<td>$1.9M</td>
<td>150</td>
</tr>
<tr>
<td>TIIIC (U) AM</td>
<td>5</td>
<td>$2.0M</td>
<td>170</td>
</tr>
<tr>
<td>LDC 1 AM</td>
<td>4</td>
<td>$1.7M</td>
<td>168</td>
</tr>
</tbody>
</table>
COST EFFECTIVENESS
GROWTH PROGRAMS
~ 280 DAYS/YR

<table>
<thead>
<tr>
<th>YEARS OF OPERATION</th>
<th>BILLIONS OF DOLLARS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

YEARLY NO. OF LAUNCHES | COST PER DAY
TIIIC (U) REND. | 6 | $1.5M
LDC 1 INTEGRAL | 7 | $1.9M
TIIIC (U) AM | 8 | $2.0M
LDC 1 AM | 6 | $1.7M
RENDEZVOUS/RESUPPLY - POSSIBLE DEVELOPMENT AND FOLLOW-ON

MILESTONE REF
BASIC MOL FLIGHTS
R/R DEV. FLIGHTS
RSV OPS. DEMONSTRATION
P. II

<table>
<thead>
<tr>
<th>CY 66</th>
<th>CY 67</th>
<th>CY 68</th>
<th>CY 69</th>
<th>CY 70</th>
<th>CY 71</th>
<th>CY 72</th>
<th>CY 73</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 67</td>
<td>FY 68</td>
<td>FY 69</td>
<td>FY 70</td>
<td>FY 71</td>
<td>FY 72</td>
<td>FY 73</td>
<td></td>
</tr>
</tbody>
</table>

FUNDING ESTIMATE ~ MILLIONS $/YR

TOTAL 3.505 BILLION $
INCLUDING BASIC
INTEGRAL LAUNCH LDC T-III - POSSIBLE DEVELOPMENT AND FOLLOW-ON

MILESTONE REF
BASIC MOL FLIGHTS
INITIAL LDC
FOLLOW-ON LDC

FY 67 | FY 68 | FY 69 | FY 70 | FY 71 | FY 72 | FY 73

TOTAL
2.721 BILLION $
INCLUDING BASIC
ADVANCED SENSOR CONSIDERATIONS
ADVANCED SENSOR PAYLOAD WEIGHTS

- ROSS CORRECTOR (IN-LINE)
- CASSEGRAIN (IN-LINE)
- CASSEGRAIN (PITCHING)

*WEIGHT INCLUDES
- COCKPIT EQUIPMENT
- R/V's (6)
- R/V RACKS & LAUNCH PROVISIONS
- FILM
- CONTINGENCY (20%)
POSSIBLE ADVANCED GROWTH CONFIGURATIONS

**INTEGRAL LAUNCH (i = 90)**

LDC 1 & 2

\[6,200 + 14,800 + 18,000 = 49,000\]

**RENDEZVOUS (i = 97)**

LDC 1

\[6,200 + 17,800 + 18,000 = 42,000\]

\[6,200 + 35,800 = 42,000\]
POSSIBLE MOL/DORIAN SYSTEM EVOLUTION

INTEGRAL LAUNCH

TIHIC (U)
12.7K P/L
50d

LDC 1
12.7K P/L
100M$

LDC 1 & 2
18.0 K P/L
45d

RENEZVOUS

TIHIC (U)
12.7K P/L
140M$

LDC 1
18.0 K P/L
15/60d 20/70d

NOTE:
- ALL FIGURES IN MILLIONS OF DOLLARS
- NO ADVANCED SENSOR DEVELOPMENT COSTS INCLUDED
CONCLUSIONS

- Present program meets the existing requirements
- Large core booster will allow more cost effective Dorian operation and be amortized in first 70 days of operation
- Large core booster program can be phased with minimum program disruption
- Large core booster program provides a sound basis for more advanced sensor system and other mission applications
- If requirements approach 300 days on orbit/year, rendezvous is more cost effective than large core integral launch
RECOMMENDED ACTIONS

• CONTRACTOR STUDIES
  • EXTENDED LIFE SUBSYSTEMS
  • LARGE CORE BOOSTER (PHASE I)
  • RESUPPLY VEHICLE
  • ORBITAL VEHICLE MODS FOR RENDEZVOUS AND DOCKING
  • ALTERNATIVE DEVELOPMENT PROGRAM APPROACHES
  • ORBITAL VEHICLE MODS FOR INTEGRAL LAUNCH

• TECHNOLOGY PROGRAMS
  • ADVANCED SENSOR TECHNOLOGY STUDIES

• OTHER MISSIONS
MOL PERFORMANCE IMPROVEMENT PLAN
MOL PERFORMANCE IMPROVEMENT PLAN

OBJECTIVES

- First launch uprated booster - July '70
- Payload capability ≈ 40,000 LBS
- Orderly vehicle development
- Minimize FY '66 & FY '67 commitment
- Plan which does not require immediate redirection of present launch vehicle in order to avoid two independent developments

Ideally - provide plan in which Delta development cost (over present program) essentially independent of time
SECRET SPECIAL HANDLING

MOL PERFORMANCE IMPROVEMENT PLAN

- LAUNCH VEHICLE GROWTH STEPS

III MOL
EXPANDED STAGE I
EXPANDED STAGE II
156" SOLIDS

SAME STAGE II
NEW STAGE II
SAME STAGE II
SAME STAGE II

SAME SOLIDS
SAME SOLIDS
SAME SOLIDS
SAME SOLIDS

NEW STAGE I
SAME STAGE I
SAME STAGE I
SAME STAGE I

STEP I 42°-44,000
STEP II 45°-50,000
STEP III 62°-68,000

PL (80° 80/130) 32,000

NO EXTENDED STAGE I OR STAGE II BURN DURATION
MOL PERFORMANCE IMPROVEMENT PLAN

• VEHICLE SIZING CONSIDERATIONS

- CONSTRAINTS
  • EXISTING TRANSPORTATION SYSTEMS - AIR AND GROUND
  • 15:1 MOL ENGINES (BURNTIME ≤ 200 SEC + 30°)
  • TITAN III C FABRICATION TECHNIQUES
  • MOL 7-SEGMENT SOLIDS
  • MOL PAYLOAD
  • MINIMUM CHANGES TO MOL STAGE II
  • GROWTH TO 156" SOLIDS AND LARGER DIA PAYLOAD

- CONCLUSIONS
  • DIAMETER = 15'
  • 4-15:1 ENGINES
  • LENGTH = 80.7' (STAGE I/II SEPARATION TO ENGINE EXIT PLANE)
  • \( W_p = 670,000 \) LBS (USABLE)
  • MOL STAGE II WITHOUT CHANGE
**MOI PERFORMANCE IMPROVEMENT PLAN**

**SEQUENCE OF EVENTS - STEP I CONFIGURATION (80°-80/130 NM)**

1. **T=0** START SOLIDS (LQ)
2. **T=2 SEC** START TWO S/A's

**TIMELINE**

- **T=90 SEC** H=68,500 FT 
  START TWO S/A's
- **T=126 SEC** H=148,600 FT 
  SRM SHUTDOWN & STAGING
- **T=185 SEC** H=263,300 FT 
  SHUTDOWN TWO STAGE I SUBASSEMBLIES
- **T=280 SEC** H=404,200 FT 
  STAGE I SHUTDOWN
  START STAGE II, STAGE II STAGING
- **T=490 SEC** H=80 NM 
  STAGE II BURNOUT

---

**WTR LAUNCH**

80° INCL / BOX 130 NM
## Trajectory Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LDC</th>
<th>T-III M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Acceleration - g's</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STG 0 - Start/B.O.</td>
<td>1.48/3.74</td>
<td>1.60/3.35</td>
</tr>
<tr>
<td>STG 1 - Start/B.O.</td>
<td>1.95/3.39</td>
<td>1.30/4.13</td>
</tr>
<tr>
<td>STG II - Start/B.O.</td>
<td>0.84/1.94</td>
<td>0.90/2.40</td>
</tr>
<tr>
<td><strong>Dynamic Pressure - lb/ft^2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>841</td>
<td>900</td>
</tr>
<tr>
<td>Time at Max Q (sec)</td>
<td>60</td>
<td>56.0</td>
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<tr>
<td>Velocity at Max Q (ft/sec)</td>
<td>2058</td>
<td>2092</td>
</tr>
<tr>
<td>Mach No. at Max Q</td>
<td>1.55</td>
<td>1.59</td>
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<tr>
<td>STG 0 - STG I Staging</td>
<td>71.3</td>
<td>32.5</td>
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<tr>
<td>STG I - STG II Staging</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>
## MOL Performance Improvement Plan

**Staging (Stage 0/Stage 1)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LDG</th>
<th>T-III M</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conditions at Staging</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altitude (FT)</td>
<td>148,600</td>
<td>166,800</td>
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<tr>
<td>Mach No.</td>
<td>5.80</td>
<td>5.52</td>
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<tr>
<td>Q (LB/FT²)</td>
<td>71.3</td>
<td>32.5</td>
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<tr>
<td>α (DEG)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>β (DEG)</td>
<td>0.39</td>
<td>0.39</td>
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<tr>
<td>Stg I Thrust (LB)</td>
<td>1,047,563</td>
<td>519,000</td>
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<tr>
<td>Axial Acceleration (G's)</td>
<td>1.95</td>
<td>1.3</td>
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<tr>
<td>1 Aft Staging Rocket Failure</td>
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<tr>
<td>70,000 LB SRM Residual Thrust</td>
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<td></td>
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<tr>
<td>Initial Clearance (FT)</td>
<td>1.14</td>
<td>0.9</td>
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<tr>
<td><strong>Physical Parameters</strong></td>
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</tr>
<tr>
<td>SRM Jettison Weight (LB/Motor)</td>
<td>95,291</td>
<td>95,291</td>
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<tr>
<td><strong>Staging Results</strong></td>
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<tr>
<td>Clearance Aft Core Engine Bell (FT)</td>
<td>2.0*</td>
<td>2.2</td>
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<tr>
<td>Time to Clear</td>
<td>2.0*</td>
<td>2.6</td>
</tr>
</tbody>
</table>

*Estimated
SPECIAL HANDLING

MOL PERFORMANCE IMPROVEMENT PLAN

- STAGING (STAGE I/STAGE II)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>LDC</th>
<th>T-III M</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDITIONS AT STAGING</td>
<td></td>
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</tr>
<tr>
<td>• MIN ENGINE SHUTDOWN IMPULSE ONE S/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MAX ENGINE SHUTDOWN IMPULSE OTHER S/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SLOW STAGE II THRUST BUILDUP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• θ ERROR (DEG)</td>
<td>-1°</td>
<td>-1°</td>
</tr>
<tr>
<td>• CRITICAL PLANE</td>
<td>PITCH</td>
<td>PITCH</td>
</tr>
<tr>
<td>• Q (LB/FT²)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>• VELOCITY (FT/SEC)</td>
<td>16,446</td>
<td>16,353</td>
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<tr>
<td>• ALTITUDE (FT)</td>
<td>354,365</td>
<td>381,000</td>
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<tr>
<td>PHYSICAL PARAMETERS</td>
<td></td>
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<tr>
<td>• STAGE I WEIGHT (LB)</td>
<td>36,784</td>
<td>17,806</td>
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<tr>
<td>• STAGE I MOMENT OF INERTIA (SLUG-FT²)</td>
<td>1.97 x 10⁶</td>
<td>0.25 x 10⁶</td>
</tr>
<tr>
<td>• STAGE I DOME AREA (FT²)</td>
<td>177</td>
<td>78.5</td>
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<tr>
<td>• MOMENT ARM, DOME TO C.G. (FT)</td>
<td>40.9</td>
<td>35.8</td>
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<tr>
<td>STAGING RESULTS</td>
<td></td>
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<tr>
<td>• Δ TIME TO CLEAR (SEC)</td>
<td>0.42*</td>
<td>0.31</td>
</tr>
<tr>
<td>• MIN ENGINE BELL CLEARANCE (FT)</td>
<td>1.0*</td>
<td>1.2</td>
</tr>
</tbody>
</table>

*ESTIMATED
SECRETSPECIAL HANDLING

MOL PERFORMANCE IMPROVEMENT PLAN

- VEHICLE CONFIGURATION

-LENGTHEN ARMS
-NEW SHEAR FITTING (SRM SIDE)

MOL STAGE II

STA 278.3”

MOL 7 SEG SOLIDS

NEW STAGE I TANKS,
STRUCTURE, PROPELLANT
FEED & PRESSURE LINES

LARGER ACTUATORS (GROUND START)

LARGER BOATTAIL

FOUR 15:1 ENGINES & NEW
ENGINE TRUSS

PRESENT

80.7’

IMPROVED

78.6’

NRO APPROVED FOR
RELEASE 1 JULY 2015
MOL PERFORMANCE IMPROVEMENT PLAN
TECHNICAL CONCLUSIONS - STEP I

• PERFORMANCE (80°-80/130 NM)
  - 42,000-44,000 LB (4-15:1 STAGE I ENGINES)

• VEHICLE ENVIRONMENT
  - VIBRATION LEVELS ≤ T-III C OR T-III M EXCEPT IN COMPARTMENT IA
  - G'S AND MAX Q WITHIN CAPABILITY OF MOL/GEMINI/TITAN III CORE
    (STAGE II UNMODIFIED)

• STRUCTURES
  - STAGE I REQUIRES COMPLETE TEST PROGRAM
  - ALL STAGE II LOADS WITHIN CAPABILITY OF TITAN III M

• STAGE I FABRICATION
  - FABRICATION TECHNIQUE IDENTICAL TO PRESENT TITAN III
  - TOOLING MODS REQUIRED
MOL PERFORMANCE IMPROVEMENT PLAN
TECHNICAL CONCLUSIONS-STEP I (CONT'D)

• PROPULSION

/NO ADDITIONAL ENGINE DEVELOPMENT (OVER PRESENT MOL PROGRAM) REQUIRED

• DEVELOPMENT OF MODULAR FRAME COMPATIBLE WITH MMC INTERFACE
• MOUNTING OF BOTH AUTOGNENOUS SYSTEMS ON MODULAR ENGINE ASSEMBLY
• BATTLESHIP TEST PROGRAM AT AGC REQUIRED
  /MC SUPPLIED TANKS
  /SEQUENCED START AND SHUTDOWN
  /HYDRAULIC SYSTEM PERFORMANCE
  /FEED SYSTEM DYNAMICS
  /TRUSS INTEGRITY AND DYNAMICS
  /BASE HEATING
• STAND MODIFICATION (E-5)
  /SUPERSTRUCTURE FOR NEW TANKS
  /REINFORCE FOR INCREASED THRUST
  /NEW DEFLECTOR PLATE
  /MODIFY INSTRUMENTATION
  /PIPING MODIFICATIONS
MOI PERFORMANCE IMPROVEMENT PLAN

TECHNICAL CONCLUSIONS - STEP I (CONT'D)

- STAGING Q/I
  - SATISFIES TITAN III STAGING CRITERIA

- STAGING I/II
  - CLEARANCE ADEQUATE WITHOUT RAILS

- FLIGHT CONTROLS
  - STAGE I ACTUATOR, HYDRAULIC RESERVOIR, & ELEC. MOTOR PUMP REDESIGN REQUIRED
  - STAGE II UNCHANGED

- POGO
  - CAN BE ELIMINATED BY BASIC DESIGN
    - LARGE OXIDIZER FEED LINES
    - HIGHER FUEL TANK PRESSURE

- GROUND SYSTEMS
  - CRITERIA MODS ONLY TO ILG
  - NO SAFETY CONSTRAINTS DUE TO EXPLOSIVE HAZARD, ACOUSTICS OR TOXICITY
MOL PERFORMANCE IMPROVEMENT PLAN

- TRANSPORTATION

- "SUPER GUPPY" REQUIRED FOR STAGE I
  AIR TRANSPORTATION TO WTR

- ROAD TRANSPORTATION
  - NEW TRANSPORTER
  - ENGINES HUNG AT WTR

- SECRET

- SPECIAL HANDLING
# TITAN III MOL SCHEDULE - STEP I

<table>
<thead>
<tr>
<th>CY 66</th>
<th>CY 67</th>
<th>CY 68</th>
<th>CY 69</th>
<th>CY 70</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

- **FACILITY PREP. & CONSTR.**
- **AGE INSTALL. & GR. SYST. TEST**
- **START MAJOR FAB-ARTS 6 & 7**
- **IMPROVEMENT PROGRAM**
  - **SIZING STUDIES** (PHASE "O")
  - **PHASE IB SPECS & COSTS**
  - **BATTLESHIP TEST PROGRAM**
  - **FIRST FIRING**
  - **PHASE II GO-AHEAD**
  - **COMPLETE BATTLESHIP PROGRAM**
  - **1ST LAUNCH**

---

*NRO APPROVED FOR RELEASE 1 JULY 2015*
# MOL Performance Improvement Plan

## Cost Estimates - Step I

### MMC

- **Sizing Studies**
  - CY 66: 0.50
  - CY 67: 0.50
  - CY 68: 1.00

- **Facility Criteria Changes**
  - CY 69: 1.00
  - CY 70: 3.00

- **Phase I B Spec Preparation Development Program**
  - CY 66: 0.50
  - CY 67: 3.00
  - CY 68: 3.50
  - CY 69: 6.50
  - CY 70: 8.00

### AGC

- **Sizing Studies**
  - CY 66: 0.30
  - CY 67: 1.60

- **Facility Criteria Changes**
  - CY 68: 3.00
  - CY 69: 4.00
  - CY 70: 2.00

- **Phase I B Spec Preparation Development Program**
  - CY 66: 0.30
  - CY 67: 1.00
  - CY 68: 2.60
  - CY 69: 6.00
  - CY 70: 7.50

<table>
<thead>
<tr>
<th>Year</th>
<th>F Y 66</th>
<th>F Y 67</th>
<th>F Y 68</th>
<th>F Y 69</th>
<th>F Y 70</th>
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<tbody>
<tr>
<td>FY 67</td>
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<td>6.00</td>
<td>7.50</td>
<td>8.50</td>
<td>10.50</td>
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<tr>
<td>FY 68</td>
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<td>19.00</td>
<td>7.50</td>
<td></td>
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<tr>
<td>FY 69</td>
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<td>13.50</td>
<td>19.00</td>
<td>7.50</td>
<td></td>
</tr>
<tr>
<td>FY 70</td>
<td>300</td>
<td>2.60</td>
<td>6.00</td>
<td>7.50</td>
<td></td>
</tr>
</tbody>
</table>

\[ \Sigma = \$ 45.60 \times 10^6 \]

1. Flight hardware, propellants & facility mods not included.
MOL PERFORMANCE IMPROVEMENT PLAN
LAUNCH VEHICLE RECOMMENDATIONS - STEP I

- COMMIT TO IMPLEMENTATION OF PERFORMANCE IMPROVEMENT PLAN UP TO JULY '67
- REQUIRES ADDITIONAL $3.0 \times 10^6
- CONTINUE STUDIES TO PROVIDE SMALL PAYLOAD INCREASES WITH PRESENT MOL LAUNCH VEHICLE
- EVALUATE RESULTS AT CRITICAL CHECK POINTS PRIOR TO JULY '67
  - FINAL RECOMMENDATION ON SMALL PAYLOAD INCREASES ~ SEPT '66
  - SUBMISSION OF LDC SPEC'S AND FIXED PRICE COSTS ~ DEC '66
  - RE-EXAMINE REQUIREMENT - JULY '67
GEMINI B

DATA RETURN CAPABILITY
GEMINI B DATA RETURN CAPABILITY

- REQUIREMENTS
  - UP TO 240 POUNDS OF PRIMARY DATA
  - TRANSPORTED IN IDENTICAL PACKAGES
  - TAKE UP EITHER IN GEMINI OR IN LABORATORY
  - APPROXIMATELY 40 POUNDS OF SECONDARY DATA
  - MINIMUM CHANGE TO GEMINI

- GEMINI CONSTRAINTS
  - VOLUME
  - C.G.
  - WEIGHT
GEMINI B DATA RETURN CAPABILITY

GEMINI B VOLUME CONSTRAINTS

EJECTION SEAT CLEARANCE

FORWARD AFT FLOOR

FORWARD AFT SIDE WALLS

FORWARD AFT PRESSURE BULKHEAD

SECRET SPECIAL HANDLING
GEMINI B DATA RETURN CAPABILITY

○ PRIMARY DATA PACKAGE
  / WEIGHT
  ○ 60 POUNDS OF DATA
  ○ 70 POUNDS TOTAL
  / FITS A, B & C LOCATIONS (ONE EACH)

○ ALTERNATE PRIMARY DATA PACKAGE
  / WEIGHT
  ○ 60 POUNDS OF DATA
  ○ 70 POUNDS TOTAL
  / ONE PACKAGE IN A&B COMBINED
  / FITS C LOCATION (TWO)

○ SECONDARY DATA PACKAGE
  / TOTAL WEIGHT 30-50 POUNDS
  / USE AS "GLOVE COMPARTMENT"
  / D LOCATION

SECRET SPECIAL HANDLING
GEMINI B DATA RETURN CAPABILITY

- THREE PRIMARY DATA PACKAGES
- SECONDARY DATA BEHIND SEAT
GEMINI B DATA RETURN CAPABILITY

- SPACECRAFT C.G. - CASE I
- THREE PRIMARY DATA PACKAGES
- A & B IN GEMINI AT LAUNCH

DATA WEIGHT - POUNDS

ABORT C.G.

UPPER CONSTRAINT

25 LBS BALLAST

LAUNCH

LOWER HEATING CONSTRAINT

SECRET

SPECIAL HANDLING
GEMINI B DATA RETURN CAPABILITY

- SPACECRAFT C.G. - CASE II
- THREE PRIMARY DATA PACKAGES
- NO DATA IN GEMINI AT LAUNCH

Graph showing:
- Upper Constraint
- Lower Heating Constraint
- Data Weight (Pounds)
- RE-ENTRY MODULE C.G. - INCHES

Points:
- LAUNCH
- ABORT C.G.
- Data Weight Range 0 to 350 pounds
GEMINI B DATA RETURN CAPABILITY

- Four packages of primary data
  - Two primary shapes
  - Two alternate shapes

- Secondary data behind seat
GEMINI B DATA RETURN CAPABILITY

SPACECRAFT C.G. - CASE III
TWO PRIMARY AND TWO ALTERNATE DATA PACKAGES
NO DATA IN GEMINI AT LAUNCH

DATA WEIGHT - POUNDS

RE-ENTRY MODULE C.G. - INCHES

UPPER CONSTRAINT

LOWER HEATING CONSTRAINT

25 POUND BALLAST

SECRET
SPECIAL HANDLING
CONCLUSIONS

- CAN RETURN - 180 POUNDS PRIMARY DATA
- THREE IDENTICAL PACKAGES
- PLUS 30 - 50 POUNDS SECONDARY DATA
- VOLUME IS AVAILABLE
- WITH ONLY MINOR MODIFICATIONS TO GEMINI
- CAN HANDLE C.G. PROBLEM

- CAN RETURN - 240 POUNDS PRIMARY DATA
- FOUR PACKAGES OF TWO SHAPES
- PLUS 30 - 50 POUNDS SECONDARY DATA
- VOLUME IS AVAILABLE
- REQUIRES MORE SEAT MODIFICATIONS
- C.G. PROBLEM WILL PROBABLY REQUIRE ADDING BALLAST ON ORBIT
CAMERAS

- BASELINE SPECIFIES TWO CAMERAS
  - ONBOARD PROCESSING
  - READOUT
  - OTHER FILM (COLOR, HI SPEED, IR/COLOR)

- CURRENT SINGLE CAMERA WITH PLATTEN AND LOOPERS OCCUPIES A SPACE OF 36" X 24" X 24"

- LIMITATIONS IN LABORATORY DICTATE SINGLE CAMERA

- THIS REQUIRES A SINGLE PLATTEN CAPABLE OF BEING MOVED BACK FROM THE ROSS CORRECTOR FAR ENOUGH TO ACCEPT THE SECONDARY FILM AND FILTERS

- THIS HAS THE DISADVANTAGE THAT THE SECONDARY FILM WOULD NOT HAVE ACROSS THE FORMAT IMC

SECRET/SPECIAL HANDLING
WEIGHT, SPACE AND READOUT CHIP SIZE OF 1" X 1" INDICATE A 5" WIDTH MAY BE PREFERABLE

SECRET/SPECIAL HANDLING

FILM

- BASELINE
  - PRIMARY -- 9" 3404 X (SO-362) THIN BASE
  - SECONDARY -- WIDTH -- UNSPECIFIED
    TYPE -- 3404 X COLOR, HI SPEED, IR/COLOR

SECRET/SPECIAL HANDLING
FILM HANDLING AND RECOVERY APPROACH

REQUIREMENTS

24,000 FEET OF 9" FILM

6 RV's 33" DIAMETER (MODIFIED MARK 5) - 70 LBS FILM

STATUS

MECHANICAL ASPECTS OF FILM TRANSPORT SIMILAR TO PREVIOUS DESIGNS
RECOMMENDED BASELINE (MANNED AUTOMATIC)

- READOUT
  - ONBOARD PROCESSING
  - 20 MBPS INCRYPTED DATA LINK
- SINGLE CAMERA MOVABLE PLATTEN
  - 9" FILM PRIMARY
  - 5" FILM SECONDARY
- SINGLE 33" R/V (MK-V)
- RECOVERY VEHICLE AND READOUT DESIGNED TO PERMIT EASY REMOVAL PRIOR TO LAUNCH

FILM PACKAGES FOR GEMINI B

- EXACT WEIGHT AND CONFIGURATION OF FILM PACKAGES UNRESOLVED
  - WILL BE RESOLVED PENDING FURTHER WORK WITH MCDONNELL

SECRET/SPECIAL HANDLING
RECOMMENDED BASELINE (UNMANNED)

- SIX RECOVERY VEHICLES
- EXTEND MISSION DURATION TO 40 DAYS
- ALTITUDE (MINIMUM)