Verify this is the correct version for the pending operation (training, simulation or flight).
Electronic copies of FDF books are available. URL: http://mod.jsc.nasa.gov/do3/FDF/index.html
List of Implemented Change Requests (482s):

RNDZ-1297
RNDZ-1298
RNDZ-1301
RNDZ-1302
RNDZ-1303
RNDZ-1305

Incorporate the following:

1. Replace v & vi
2. Replace 1-3 & 1-4, 1-7 thru 1-10
3. Replace 2-5 thru 2-8
4. Replace 4-11 thru 4-14, 4-17 thru 4-20
5. Replace 8-3 thru 8-6

Prepared by: Ray Bazzarelli
Book Manager

Approved by: [Signature]
Lead, Rendezvous Guidance and Procedures
Group

Accepted by: [Signature]
Chief, Orbit Dynamics Branch

Encl: 24 pages

File this PCN immediately behind the front cover as a permanent record
MISSION OPERATIONS DIRECTORATE

RENEZVOUS
STS-123

FINAL
November 6, 2007

PREPARED BY:

Ray Bigonesse
Book Manager

APPROVED BY:

Steve R. Walker
Lead, Rendezvous Guidance and Procedure Group

ACCEPTED BY:

R. T. Gavin
Chief, Orbit Dynamics Branch

This document is under the configuration control of the Crew Procedures Control Board (CPCB). All proposed changes must be submitted via FDF Workflow Crew Procedure Change Request (CR) to DO3/FDF Manager.

Additional distribution of this book, for official use only, may be requested in writing to DO3/PMO Administrator. The request must include justification and requester's name, organization, position, and phone number. Contractor requests are made through the NASA or DOD organization supported. Deletions, reduction in quantity, or change of address may be submitted to DO3/FDF Management Office, 281-244-1184.
Incorporates the following:

<table>
<thead>
<tr>
<th>482#:</th>
<th>RNDZ-1278</th>
<th>RNDZ-1283 (P)</th>
<th>RNDZ-1286</th>
<th>RNDZ-1287</th>
<th>RNDZ-1288</th>
<th>RNDZ-1290</th>
</tr>
</thead>
<tbody>
<tr>
<td>P – Partial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AREAS OF TECHNICAL RESPONSIBILITY**

- **Book Manager**: DM34/R. Bigonesse 281-483-7613
- **Rendezvous Guidance and Procedures**: DM34/T. Rickerl 281-483-1922
- **Flight Dynamics**: DM32/J. Mendeck 281-483-8020
- **Rendezvous Design**: USA/S. Snyder 281-282-4351
- **PROX OPS Design**: USA/J. Pascucci 281-282-2808
- **Flight Design**: USA/S. Staas 281-483-4696
- **Rendezvous Training**: DT35/J. Frank 281-244-7846
- **APDS**: DF52/J. Dake 281-483-6538
NOTE
This checklist is the controlling crew document for the ISS-1E rendezvous and separation. The Rendezvous Timeline begins at Ti -3:00 hr and continues through docking. This is a complete stand-alone document. The Separation Timeline begins 45 min prior to undock and continues through 1:15 after undock.

Timeline pages assume an FD3 rendezvous and undocking on FD10. Lighting is based on planned rendezvous altitude of 205 nm. Targeting I-Loads are based on 210 nm.
<table>
<thead>
<tr>
<th>ACRONYMS</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZ, AZM</td>
<td>Azimuth</td>
</tr>
<tr>
<td>D/N</td>
<td>Day/Night</td>
</tr>
<tr>
<td>EL, ELEV</td>
<td>Elevation</td>
</tr>
<tr>
<td>IAH</td>
<td>Inertial</td>
</tr>
<tr>
<td>LOS</td>
<td>Line of Sight</td>
</tr>
<tr>
<td>LVLH</td>
<td>Local Vertical, Local Horizontal</td>
</tr>
<tr>
<td>R</td>
<td>Range</td>
</tr>
<tr>
<td>(\cdot) R, RDOT</td>
<td>Range Rate</td>
</tr>
<tr>
<td>R, RBAR</td>
<td>Radius Vector (toward Earth)</td>
</tr>
<tr>
<td>RNDZ</td>
<td>Rendezvous</td>
</tr>
<tr>
<td>RR</td>
<td>Rendezvous Radar</td>
</tr>
<tr>
<td>SK</td>
<td>Stationkeeping</td>
</tr>
<tr>
<td>ST, STRK</td>
<td>Star Tracker</td>
</tr>
<tr>
<td>(\bar{V}, VBAR)</td>
<td>Velocity Vector (direction of orbital travel)</td>
</tr>
<tr>
<td>(\pm X, Y, ZLV)</td>
<td>(\pm X, Y,) or Z Local Vertical ((\pm X, Y,) or Z toward Earth)</td>
</tr>
<tr>
<td>(X, Y, ZPOP)</td>
<td>(X, Y,) or Z orbiter body axis Perpendicular to Orbit Plane (aligned with the angular momentum vector)</td>
</tr>
<tr>
<td>(\pm X, Y, ZVV)</td>
<td>(\pm X, Y,) or Z orbiter body axis along the LVLH Velocity Vector</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>Sign Off</td>
<td>123/FIN</td>
</tr>
<tr>
<td>ii</td>
<td>123/FIN</td>
</tr>
<tr>
<td>iii</td>
<td>123/FIN</td>
</tr>
<tr>
<td>iv</td>
<td>123/FIN</td>
</tr>
<tr>
<td>v</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>vi</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>vii</td>
<td>123/FIN</td>
</tr>
<tr>
<td>viii</td>
<td>123/FIN</td>
</tr>
<tr>
<td>ix</td>
<td>123/FIN</td>
</tr>
<tr>
<td>x</td>
<td>123/FIN</td>
</tr>
<tr>
<td>xi</td>
<td>123/FIN</td>
</tr>
<tr>
<td>xii</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-1</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-2</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-3</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-4</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>1-5</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-6</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-7</td>
<td>123/FIN</td>
</tr>
<tr>
<td>1-8</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>1-9</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>1-10</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-1</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-2</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-3</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-4</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-5</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>2-6</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-7</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-8</td>
<td>123/FIN 1</td>
</tr>
<tr>
<td>2-9</td>
<td>123/FIN</td>
</tr>
<tr>
<td>2-10</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-1</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-2</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-3</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-4</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-5</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-6</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-7</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-8</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-9</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-10</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-11</td>
<td>123/FIN</td>
</tr>
<tr>
<td>3-12</td>
<td>123/FIN</td>
</tr>
<tr>
<td>4-1</td>
<td>123/FIN</td>
</tr>
<tr>
<td>4-2</td>
<td>123/FIN</td>
</tr>
</tbody>
</table>

* – Omit from flight book
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5-27</td>
<td>123/FIN</td>
<td>8-1</td>
</tr>
<tr>
<td>5-28</td>
<td>123/FIN</td>
<td>8-2</td>
</tr>
<tr>
<td>5-29</td>
<td>123/FIN</td>
<td>8-3</td>
</tr>
<tr>
<td>5-30</td>
<td>123/FIN</td>
<td>8-4</td>
</tr>
<tr>
<td>5-31</td>
<td>123/FIN</td>
<td>8-5</td>
</tr>
<tr>
<td>5-32</td>
<td>123/FIN</td>
<td>8-6</td>
</tr>
<tr>
<td>5-33</td>
<td>123/FIN</td>
<td>8-7</td>
</tr>
<tr>
<td>5-34</td>
<td>123/FIN</td>
<td>8-8</td>
</tr>
<tr>
<td>5-35</td>
<td>123/FIN</td>
<td>8-9</td>
</tr>
<tr>
<td>5-36</td>
<td>123/FIN</td>
<td>8-10</td>
</tr>
<tr>
<td>5-37</td>
<td>123/FIN</td>
<td>8-11</td>
</tr>
<tr>
<td>5-38</td>
<td>123/FIN</td>
<td>8-12</td>
</tr>
<tr>
<td>5-39</td>
<td>123/FIN</td>
<td>8-12a</td>
</tr>
<tr>
<td>5-40</td>
<td>123/FIN</td>
<td>8-12b</td>
</tr>
<tr>
<td>5-41</td>
<td>123/FIN</td>
<td>8-13</td>
</tr>
<tr>
<td>5-42</td>
<td>123/FIN</td>
<td>8-14</td>
</tr>
<tr>
<td>6-1</td>
<td>123/FIN</td>
<td>8-15</td>
</tr>
<tr>
<td>6-2</td>
<td>123/FIN</td>
<td>8-16</td>
</tr>
<tr>
<td>6-3</td>
<td>123/FIN</td>
<td>8-17</td>
</tr>
<tr>
<td>6-4</td>
<td>123/FIN</td>
<td>8-18</td>
</tr>
<tr>
<td>6-5</td>
<td>123/FIN</td>
<td>8-19</td>
</tr>
<tr>
<td>6-6</td>
<td>123/FIN</td>
<td>8-20</td>
</tr>
<tr>
<td>6-7</td>
<td>123/FIN</td>
<td>8-21</td>
</tr>
<tr>
<td>6-8</td>
<td>123/FIN</td>
<td>8-22</td>
</tr>
<tr>
<td>6-9</td>
<td>123/FIN</td>
<td>8-23</td>
</tr>
<tr>
<td>6-10</td>
<td>123/FIN</td>
<td>8-24</td>
</tr>
<tr>
<td>6-11</td>
<td>123/FIN</td>
<td>8-25</td>
</tr>
<tr>
<td>6-12</td>
<td>123/FIN</td>
<td>8-26</td>
</tr>
<tr>
<td>6-13</td>
<td>123/FIN</td>
<td>8-27</td>
</tr>
<tr>
<td>6-14</td>
<td>123/FIN</td>
<td>8-28</td>
</tr>
<tr>
<td>7-1</td>
<td>123/FIN</td>
<td>8-29</td>
</tr>
<tr>
<td>7-2</td>
<td>123/FIN</td>
<td>8-30</td>
</tr>
<tr>
<td>7-3</td>
<td>123/FIN</td>
<td>8-31</td>
</tr>
<tr>
<td>7-4</td>
<td>123/FIN</td>
<td>8-32</td>
</tr>
<tr>
<td>7-5</td>
<td>123/FIN</td>
<td>8-33</td>
</tr>
<tr>
<td>7-6</td>
<td>123/FIN</td>
<td>8-34</td>
</tr>
<tr>
<td>7-7</td>
<td>123/FIN</td>
<td>8-35</td>
</tr>
<tr>
<td>7-8</td>
<td>123/FIN</td>
<td>8-36</td>
</tr>
<tr>
<td>7-9</td>
<td>123/FIN</td>
<td>8-37</td>
</tr>
<tr>
<td>7-10</td>
<td>123/FIN</td>
<td>8-38</td>
</tr>
<tr>
<td>7-11</td>
<td>123/FIN</td>
<td>8-39</td>
</tr>
<tr>
<td>7-12</td>
<td>123/FIN</td>
<td>8-40</td>
</tr>
<tr>
<td>7-13</td>
<td>123/FIN</td>
<td>8-41</td>
</tr>
<tr>
<td>7-14</td>
<td>123/FIN</td>
<td>8-42</td>
</tr>
<tr>
<td>7-15</td>
<td>123/FIN</td>
<td>8-43</td>
</tr>
<tr>
<td>7-16</td>
<td>123/FIN</td>
<td>8-44</td>
</tr>
<tr>
<td>7-17</td>
<td>123/FIN</td>
<td>9-1</td>
</tr>
<tr>
<td>7-18</td>
<td>123/FIN</td>
<td>9-2</td>
</tr>
<tr>
<td>7-19</td>
<td>123/FIN</td>
<td>CC 9-3</td>
</tr>
<tr>
<td>7-20</td>
<td>123/FIN</td>
<td>CC 9-4</td>
</tr>
<tr>
<td>7-21</td>
<td>123/FIN</td>
<td>CC 9-5</td>
</tr>
<tr>
<td>7-22</td>
<td>123/FIN</td>
<td>CC 9-6</td>
</tr>
<tr>
<td>7-23</td>
<td>123/FIN</td>
<td>CC 9-7</td>
</tr>
<tr>
<td>7-24</td>
<td>123/FIN</td>
<td>CC 9-8</td>
</tr>
</tbody>
</table>

* – Omit from flight book
<table>
<thead>
<tr>
<th>TITLE</th>
<th>Ref. Page</th>
<th>Card No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCS BURN (+X, -X, Multi-axis) (Front)</td>
<td>CC 9-3</td>
<td>RNDZ-1a/123/O/A</td>
</tr>
<tr>
<td>RENDEZVOUS PRPLT PAD (Back)</td>
<td>CC 9-4</td>
<td>RNDZ-1b/123/O/A</td>
</tr>
<tr>
<td>KU OPS (Front)</td>
<td>CC 9-5</td>
<td>RNDZ-2a/123/O/A</td>
</tr>
<tr>
<td>KU OPS (Back)</td>
<td>CC 9-6</td>
<td>RNDZ-2b/123/O/A</td>
</tr>
<tr>
<td>APPROACH (Front)</td>
<td>CC 9-7</td>
<td>RNDZ-3a/123/O/B</td>
</tr>
<tr>
<td>VBAR APPROACH (Back)</td>
<td>CC 9-8</td>
<td>RNDZ-3b/123/O/B</td>
</tr>
<tr>
<td>C/L CAMERA TARGET ALIGNMENT (+VBAR) (Front)</td>
<td>CC 9-9</td>
<td>RNDZ-4a/123/O/A</td>
</tr>
<tr>
<td>C/L CAMERA TARGET ALIGNMENT (+VBAR) (Back)</td>
<td>CC 9-10</td>
<td>RNDZ-4b/123/O/A</td>
</tr>
<tr>
<td>DOCKING SEQUENCE (Front)</td>
<td>CC 9-11</td>
<td>RNDZ-5a/123/O/A</td>
</tr>
<tr>
<td>DOCKING SEQUENCE (Back)</td>
<td>CC 9-12</td>
<td>RNDZ-5b/123/O/A</td>
</tr>
<tr>
<td>STOPWATCH RDOT CONVERSION (Front)</td>
<td>CC 9-13</td>
<td>RNDZ-6a/123/O/A</td>
</tr>
<tr>
<td>STOPWATCH RDOT CONVERSION (Back)</td>
<td>CC 9-14</td>
<td>RNDZ-6b/123/O/A</td>
</tr>
<tr>
<td>GPC/MDM FAILURE RESPONSE DURING RNDZ</td>
<td>CC 9-15</td>
<td>RNDZ-7a/123/O/B</td>
</tr>
<tr>
<td>RNDZ REF DATA (Back)</td>
<td>CC 9-16</td>
<td>RNDZ-7b/123/O/A</td>
</tr>
<tr>
<td>C/L CAMERA CORRIDOR AND ALIGNMENT</td>
<td>CC 9-17</td>
<td>RNDZ-8a/123/O/A</td>
</tr>
<tr>
<td>CAMERA A/D RANGE RULER</td>
<td>CC 9-18</td>
<td>RNDZ-9a/123/O/A</td>
</tr>
<tr>
<td>C/L CAMERA ZOOM CALIBRATION (RING READY FOR DOCK)</td>
<td>CC 9-19</td>
<td>RNDZ-10a/123/O/A</td>
</tr>
<tr>
<td>FLIGHT SUB ANG RULER</td>
<td>CC 9-20</td>
<td>RNDZ-13a/123/O/A</td>
</tr>
<tr>
<td>V10 MONITOR CORRIDOR</td>
<td>CC 9-21</td>
<td>RNDZ-14a/123/O/A</td>
</tr>
<tr>
<td>A31P PGSC DISPLAY OF C/L CAMERA CORRIDOR AND ALIGNMENT</td>
<td>CC 9-22</td>
<td>RNDZ-15a/123/O/A</td>
</tr>
<tr>
<td>A31P PGSC CAMERA A/D RANGE RULER</td>
<td>CC 9-23</td>
<td>RNDZ-16a/123/O/B</td>
</tr>
<tr>
<td>RCS FAILURE RESPONSE DURING PROX OPS</td>
<td>CC 9-25</td>
<td>RNDZ-17a/123/O/B</td>
</tr>
<tr>
<td>RCS/DPS/EPS FAILURE IMPACTS</td>
<td>CC 9-26</td>
<td>RNDZ-17b/123/O/A</td>
</tr>
</tbody>
</table>

* – Omit from flight book
<table>
<thead>
<tr>
<th>CONTENTS</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLIGHT RULES SUMMARY &amp; FLIGHT PROFILE</td>
<td>1-1</td>
</tr>
<tr>
<td>FLIGHT RULES SUMMARY</td>
<td>1-2</td>
</tr>
<tr>
<td>RNDZ/PROX OPS BREAKOUT PROCEDURES OVERVIEW</td>
<td>1-2</td>
</tr>
<tr>
<td>RNDZ BURN SOLUTION SELECTION GUIDELINES</td>
<td>1-3</td>
</tr>
<tr>
<td>ENGINE SELECTION GUIDELINES</td>
<td>1-3</td>
</tr>
<tr>
<td>FAILURE/RESPONSE SUMMARY</td>
<td>1-4</td>
</tr>
<tr>
<td>ORBT RENDEZVOUS PROFILE</td>
<td>1-5</td>
</tr>
<tr>
<td>POST Ti PROFILE</td>
<td>1-6</td>
</tr>
<tr>
<td>TERMINAL PHASE, RPM, AND TORVA</td>
<td>1-7</td>
</tr>
<tr>
<td>VBAR APPROACH</td>
<td>1-8</td>
</tr>
<tr>
<td>UNDOCKING, TORS/TORF, AND FINAL SEPARATION</td>
<td>1-9</td>
</tr>
<tr>
<td>UNDOCKING/SEPARATION TIMELINE</td>
<td>2-1</td>
</tr>
<tr>
<td>MANEUVER PADS</td>
<td>3-1</td>
</tr>
<tr>
<td>RENDEZVOUS TIMELINE</td>
<td>4-1</td>
</tr>
<tr>
<td>CONTINGENCY OPS</td>
<td>5-1</td>
</tr>
<tr>
<td>RNDZ OMS BURN</td>
<td>5-3</td>
</tr>
<tr>
<td>SENSOR FAIL</td>
<td>5-7</td>
</tr>
<tr>
<td>S TRK NAV – HIGH INITIAL RESID</td>
<td>5-8</td>
</tr>
<tr>
<td>FLTR MINUS PROP</td>
<td>5-9</td>
</tr>
<tr>
<td>COAS NAVIGATION</td>
<td>5-10</td>
</tr>
<tr>
<td>BACKOUT/BREAKOUTS</td>
<td>5-11</td>
</tr>
<tr>
<td>VBAR CORRIDOR BACKOUT</td>
<td>5-12</td>
</tr>
<tr>
<td>BREAKOUT</td>
<td>5-14</td>
</tr>
<tr>
<td>SHUTTLE NOSE IN-PLANE BREAKOUT (R &lt; 700 ft)</td>
<td>5-16</td>
</tr>
<tr>
<td>RNDZ BREAKOUT</td>
<td>5-18</td>
</tr>
<tr>
<td>EXPEDITED SEPS</td>
<td>5-19</td>
</tr>
<tr>
<td>SHUTTLE EMERGENCY SEPARATION</td>
<td>5-21</td>
</tr>
<tr>
<td>ANY ATTITUDE SEPARATION</td>
<td>5-23</td>
</tr>
<tr>
<td>Ti DELAY BURN</td>
<td>5-27</td>
</tr>
<tr>
<td>RNDZ NAV RECOVERY</td>
<td>5-29</td>
</tr>
<tr>
<td>TGT ITER</td>
<td>5-30</td>
</tr>
<tr>
<td>LOSS OF COMM</td>
<td>5-31</td>
</tr>
<tr>
<td>DEGRADED CONTROL</td>
<td>5-33</td>
</tr>
<tr>
<td>DEGRADED +X TRANSLATION</td>
<td>5-35</td>
</tr>
<tr>
<td>-X TRANSLATION</td>
<td>5-36</td>
</tr>
<tr>
<td>LOSS OF FORWARD SIDE-FIRING JETS</td>
<td>5-37</td>
</tr>
<tr>
<td>ONE FxD JET</td>
<td>5-38</td>
</tr>
<tr>
<td>BOTH FxD JETS (SAME SIDE)</td>
<td>5-39</td>
</tr>
<tr>
<td>VRCS</td>
<td>5-41</td>
</tr>
<tr>
<td>REFERENCE DATA</td>
<td>6-1</td>
</tr>
<tr>
<td>ISS RNDZ OPS DAP CONFIGURATIONS</td>
<td>6-2</td>
</tr>
<tr>
<td>POST-CONTACT THRUST (PCT) REFERENCE DATA</td>
<td>6-3</td>
</tr>
<tr>
<td>TARGETING DATA</td>
<td>6-4</td>
</tr>
<tr>
<td>POST NC</td>
<td>6-6</td>
</tr>
<tr>
<td>Ti</td>
<td>6-7</td>
</tr>
<tr>
<td>MC3</td>
<td>6-8</td>
</tr>
<tr>
<td>TCS REFLECTOR VISIBILITY DURING APPROACH</td>
<td>6-9</td>
</tr>
<tr>
<td>HHL AIMING LOCATIONS</td>
<td>6-10</td>
</tr>
<tr>
<td>SHUTTLE CENTERLINE TARGET</td>
<td>6-11</td>
</tr>
<tr>
<td>ISS ATTITUDE CONTROL SYSTEM MODING INDICATORS</td>
<td>6-12</td>
</tr>
<tr>
<td>RANGING CHARTS</td>
<td>6-13</td>
</tr>
<tr>
<td>COAS SUBTENDED ANGLES (DEG) VS RANGE (FT)</td>
<td>6-14</td>
</tr>
</tbody>
</table>
RENDEZVOUS TOOLS................................................................. 7-1
CCTV CONFIG FOR DOCKING/UNDOCKING ........................................... 7-2
RNDZ TOOLS CHECKOUT............................................................. 7-4
  TROUBLESHOOTING......................................................... 7-5
HAND-HELD LIDAR CHECKOUT.................................................. 7-6
  STOW.............................................................. 7-6
  OPS.......................................................... 7-7
RPOP INITIALIZATION............................................................... 7-8
  OPS......................................................... 7-9
  FUNCTION KEY SUMMARY........................................... 7-11
  KEYSTROKE SUMMARY.............................................. 7-15
TRAJECTORY DATA SOURCE OPTIONS.............................................. 7-16
TCS ACTIVATION ........................................................................... 7-18
  MANUAL ACQUISITION.................................................. 7-19
  DEACTIVATION....................................................... 7-20
  LIMITS........................................................................ 7-21
TRAD FAIL RANGE AND RANGE RATE DETERMINATION .................... 7-21
  NOMINAL OPS......................................................... 7-21
RADAR FAIL .............................................................................. 7-22
TCS FAIL .............................................................................. 7-22
HHL FAIL .............................................................................. 7-22
PCMMU/WINDECOM FAIL...................................................... 7-23
PGSC FAIL (NO PROP, NO TCS).................................................. 7-23

APDS .................................................................................... 8-1
APDS NOMINAL............................................................. 8-3
  DOCKING MECHANISM INITIALIZATION...................................... 8-4
    POWERUP......................................................... 8-5
    POWERDOWN................................................... 8-6
    PREP........................................................................ 8-7
  UNDOCKING PREP..................................................... 8-7
  DOCKING RING EXTENSION............................................. 8-8
    RETRACTION (NOT MATED)............................................... 8-9
  AIRLOCK FAN ACT AND ODS VOLUME PREP........................... 8-10
  POST DOCKING HATCH LEAK CHECK.................................. 8-11
  AIRLOCK PREP FOR INGRESS – BYPASS CONFIG .................. 8-12
    – BOOSTER FAN ACTIVE........................................ 8-12a
  APDS OFF-NOMINAL ................................................................ 8-13
    POWER FAILED OFF (STATUS LTS OFF).......................... 8-14
    DAMPING FAILED ON.................................................. 8-15
    CAPTURE LT FAILED ON........................................... 8-15
    FIXERS FAILED ON.................................................. 8-16
    OFF LT FAILED ON................................................... 8-18
    OFF........................................................................ 8-18
    RING FAILS TO DRIVE................................................ 8-19
    DRV CMD OFF......................................................... 8-19
    FINAL POSITION LT FAILED ON..................................... 8-20
    FORCE RING ALIGNMENT........................................... 8-20
    CLUTCH NOT 'LOCK'.................................................. 8-20
    APDS CIRCUIT PROTECT OFF LT FAILED OFF.................. 8-21
    HOOKS 1(2) OPEN LT FAILED ON................................ 8-21
      NOT CLOSED WITHIN SINGLE MTR TIME.................. 8-22
    READY TO HOOK LT FAILED ON ................................ 8-23
    HOOKS 1(2) CLOSED LT FAILED ON................................ 8-23
    LATCHES OPEN LT FAILED OFF.................................... 8-24
    APDS POWER FAILED OFF........................................... 8-24
    DOCKING MECHANISM DEMATE/REMANTE.......................... 8-25
    ODS HOOKS OPEN – CONTINGENCY.................................. 8-27
PMA 2/3 HOOKS OPEN – CONTINGENCY ................................................................. 8-30
APDS FAILED CAPTURE RECONFIG ................................................................. 8-33
PMA 2/3 HOOKS CLOSE .................................................................................... 8-35
OPEN ............................................................................................................. 8-37
REFERENCE DATA .......................................................................................... 8-39
APDS FAILURE/IMPACT MATRIX .................................................................... 8-40
(TLM) ............................................................................................................. 8-43
CUE CARD CONFIGURATION .......................................................................... 9-1
FLIGHT RULES SUMMARY & FLIGHT PROFILE

FLIGHT RULES SUMMARY ............................................................................................ 1-2
RNDZ/PROX OPS BREAKOUT PROCEDURES OVERVIEW ........................................ 1-2
RNDZ BURN SOLUTION SELECTION GUIDELINES .................................................... 1-3
  ENGINE SELECTION GUIDELINES ....................................................................... 1-3
  FAILURE/RESPONSE SUMMARY ........................................................................... 1-4
ORBT RENDEZVOUS PROFILE .................................................................................... 1-5
  POST Ti PROFILE .................................................................................................. 1-6
TERMINAL PHASE, RPM, AND TORVA ...................................................................... 1-7
VBAR APPROACH ........................................................................................................ 1-8
UNDOCKING, TORS/TORF, AND FINAL SEPARATION .............................................. 1-9
### FLIGHT RULES SUMMARY

#### RNDZ/PROX OPS BREAKOUT PROCEDURES OVERVIEW

<table>
<thead>
<tr>
<th>RANGE BREAKOUT REQD</th>
<th>BREAKOUT PROCEDURE AND SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to Ti</td>
<td>Discontinue RNDZ burns; specific breakout only on MCC call</td>
</tr>
<tr>
<td>Ti - 5 Minutes</td>
<td>If GO for Ti not received, Perform Ti Delay Burn, 5-27</td>
</tr>
<tr>
<td>Between Ti and TORVA init (+X burns to start TORVA are complete)</td>
<td>RNDZ BREAKOUT (CONTINGENCY OPS), 5-18 3 fps retrograde</td>
</tr>
<tr>
<td>Between TORVA init (+X burns to start TORVA are complete) and Vbar arrival</td>
<td>SHUTTLE NOSE IN-PLANE BREAKOUT (CONTINGENCY OPS), 5-16 1.5 fps ±X burn, followed in 30 min by 4.3/3.6 fps retrograde/out-of-plane burn (posigrade if second approach is desired)</td>
</tr>
<tr>
<td>Between Vbar arrival and contact OR Between undock and flyaround start</td>
<td>VBAR BREAKOUT (CONTINGENCY OPS), 5-14 If RNG &lt; 150 ft, back out to 150 ft. When RNG &gt; 150 ft, perform 1.5 fps radial up burn in LO Z, followed in 28 min by 3.0 fps posigrade/retrograde burn</td>
</tr>
<tr>
<td>During flyaround</td>
<td>SHUTTLE NOSE IN-PLANE BREAKOUT (CONTINGENCY OPS), 5-16 1.5 fps ±X burn, followed in 30 min by 4.3/3.6 fps retrograde/out-of-plane burn (posigrade if second approach is desired)</td>
</tr>
<tr>
<td>Otherwise:</td>
<td>SEP MANEUVER (ORB OPS), Perform 1 fps away from target, followed in 2 min by 2 fps out of plane, followed in 15 min by 3 fps posigrade</td>
</tr>
</tbody>
</table>

#### SHUTTLE BACKOUT

| Prior to docking                                      | See VBAR CORRIDOR BACKOUT (CONTINGENCY OPS), 5-12                   |
RNDZ BURN SOLUTION SELECTION GUIDELINES

<table>
<thead>
<tr>
<th>BURN</th>
<th>SOLUTION PRIORITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>All burns prior to, but not including, NCC</td>
<td>1) Ground solution</td>
</tr>
<tr>
<td>NCC &amp; Ti</td>
<td>1) Onboard FLTR solution if STRK or RR NAV converged* (for COAS, use step 2 below)</td>
</tr>
<tr>
<td></td>
<td>2) Onboard FLTR solution if it agrees with ground solution**</td>
</tr>
<tr>
<td></td>
<td>3) Onboard PROP solution if it agrees with ground solution</td>
</tr>
<tr>
<td></td>
<td>4) Ground solution</td>
</tr>
<tr>
<td>Post-Ti midcourse corrections</td>
<td>1) Onboard solution</td>
</tr>
</tbody>
</table>

*For the purpose of burn solution selection, NAV is converged if for the present sensor in acquisition (RR or STRK), at least 40 marks have been accepted with state vector position update of less than 0.5 Kft for at least the last 4 marks; or if state vector updates are small and stable. These criteria do not apply to COAS NAV

**Burn solutions are considered to be in agreement if delta Vs differ by no more than the ‘final-ground’ limits for each axis

RNDZ BURN ENGINE SELECTION GUIDELINES

<table>
<thead>
<tr>
<th>DELTA V</th>
<th>ENGINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 fps</td>
<td>RCS – Primary technique is multi-axis</td>
</tr>
<tr>
<td>4 to 6 fps</td>
<td>RCS – Primary technique is +X</td>
</tr>
<tr>
<td>&gt; 6 fps</td>
<td>OMS – Single engine</td>
</tr>
</tbody>
</table>
## RNDZ FAILURE/RESPONSE SUMMARY

<table>
<thead>
<tr>
<th>FAILURE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sensor data (RR, STRK, or COAS) during RNDZ and no visual acquisition</td>
<td>Breakout Burn by MC2 + 20 min</td>
</tr>
<tr>
<td>Good sensor data (RR, STRK, or COAS) during RNDZ, but no visual or RR acquisition</td>
<td>Breakout Burn by MC2 + 24 min</td>
</tr>
<tr>
<td>Target &gt; 30 deg from COAS horizontal at start of radar fail correction</td>
<td>Breakout ASAP; use RNDZ BREAKOUT (CONTINGENCY OPS), 5-18, until RBAR arrival</td>
</tr>
<tr>
<td>Prop quantities violate bingo numbers on RNDZ PRPLT PAD (Cue Card) or Orbiter systems malfunctions require breakout</td>
<td>Breakout per overview on 1-2</td>
</tr>
<tr>
<td><strong>SYSTEMS:</strong></td>
<td></td>
</tr>
<tr>
<td>DPS: &lt; 2 GNC GPCs</td>
<td>2 GNC GPCs reqd for Ti and PROX OPS within 250 ft. Loss of GNC GPC redundancy inside 250 ft requires backout to 250 ft and stationkeep until reconfiguration to a 2 GNC redundant set is complete</td>
</tr>
<tr>
<td>GNC: Loss of redundant +Z Trans or PRCS TRANS, any axis ↓ or PRCS ROT, any axis ↓ or AFT THC (-Z sense), &gt; 1 TX contact ↓, all TY contacts ↓, all TZ contacts ↓ or AFT RHC, all channels, any axis ↓ or &lt; 2 IMUs</td>
<td>PROX OPS within 250 ft not permitted. For loss of 2 TX contacts in the “out” (-) direction, PROX OPS permitted if forward THC is available for braking redundancy and manned within 75 ft. For loss of 2 TX contacts in the “in” (+) direction, PROX OPS permitted if DAP remains in Translation Pulse while aft Flight Control Power is ON</td>
</tr>
<tr>
<td>Both Left Aft firing jets ↓ or Both Right Aft firing jets ↓</td>
<td>Continue Approach, per DEGRADED +X TRANSLATION (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>Two Forward firing jets ↓</td>
<td>Continue Approach, per DEGRADED -X TRANSLATION (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>Both Forward Right firing jets ↓ or Both Forward Left firing jets ↓</td>
<td>PROX OPS within 250 ft not permitted. Approach or Backout to 250 ft per LOSS OF FORWARD SIDE FIRING JETS (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>One Forward Down firing jet ↓</td>
<td>Continue Approach per LOSS OF ONE FxD JET (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>Both Forward Down firing jets same side ↓</td>
<td>PROX OPS within 250 ft not permitted. Approach or Backout to 250 ft per LOSS OF BOTH FxD JETS (SAME SIDE) (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>Loss of VRCS</td>
<td>Use ALT in place of VERN during RNDZ, approach outside 2000 ft, and sep Use PRI in place of VERN during approach inside 2000 ft, and flyaround See LOSS OF VRCS (CONTINGENCY OPS)</td>
</tr>
<tr>
<td>MECH: 1 KU ANTENNA STOW MOTOR ↓</td>
<td>Normal ops</td>
</tr>
</tbody>
</table>
ISS AT CENTER OF ROTATING LVLH REFERENCE FRAME

PET EVENT
-3:00 START RNDZ T/L (not shown)
-2:22 NH BURN (not shown)
-1:32 NC BURN
-1:28 S TRK NAVIGATION
-0:58 NCC BURN
-0:44 RADAR NAVIGATION
-0:00 Ti BURN
ORBT POST Ti PROFILE

<table>
<thead>
<tr>
<th>PET</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>Ti BURN</td>
</tr>
<tr>
<td>0:05</td>
<td>RR NAV (OR S TRK NAV, IF REQD)</td>
</tr>
<tr>
<td>0:20</td>
<td>MC1 BURN</td>
</tr>
<tr>
<td>~0:31</td>
<td>OOP NULL BURN</td>
</tr>
<tr>
<td>0:36</td>
<td>SUNSET</td>
</tr>
<tr>
<td>~0:50</td>
<td>MC2 BURN</td>
</tr>
<tr>
<td>~1:07</td>
<td>MC3 BURN</td>
</tr>
<tr>
<td>~1:12</td>
<td>SUNRISE</td>
</tr>
<tr>
<td>~1:17</td>
<td>MC4 BURN, START MANUAL PHASE</td>
</tr>
</tbody>
</table>

ISS AT CENTER OF
ROTATING LVLH
REFERENCE FRAME

SUNRISE
MC3
MC4
MC2
SUNSET

Ti
NOON

Vbar
-50 kft
-40
-30
-20
-10

Rbar
15 kft
10
5

S TRK
NIGHT

SUNRISE
MC3
MC4
# TERMINAL PHASE, RPM, AND TORVA

<table>
<thead>
<tr>
<th>MC2 ET (h:mm)</th>
<th>Range (ft) CG-CG</th>
<th>Rdot (fps)</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0:27</td>
<td>2000</td>
<td>-3.0</td>
<td>MANUAL PHASE TAKEOVER (POST-MC4)</td>
</tr>
<tr>
<td>0:29</td>
<td>1700</td>
<td>-2.4</td>
<td></td>
</tr>
<tr>
<td>2 0:31</td>
<td>1500</td>
<td>-2.1</td>
<td></td>
</tr>
<tr>
<td>3 0:36</td>
<td>1000</td>
<td>-1.3</td>
<td>TRANSITION TO LOWZ</td>
</tr>
<tr>
<td>0:37</td>
<td>900</td>
<td>-1.1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>WHEN IN RBAR ATTITUDE: LOAD DAP A9/B9, MOD DAP A PRI/VERN ROT RATE TO 0.75 DEG/SEC AND YAW JET OPTION TO BOTH NOSE &amp; TAIL (ALL) LOAD UNIV PTG P=145 DEG</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>-0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>700</td>
<td>-0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>650</td>
<td>-0.3</td>
<td></td>
</tr>
<tr>
<td>5 0:46</td>
<td>620</td>
<td>0.0</td>
<td>STATIONKEEP TO AVOID SHADOWING IF REQUIRED</td>
</tr>
<tr>
<td>6 1:00</td>
<td>620</td>
<td>-0.35</td>
<td>INITIATE RPM, DAP A/PRI, ITEM 19</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>-0.25</td>
<td>WHEN -Z ADI PITCH &gt; 100 DEG: DAP A/VERN</td>
</tr>
<tr>
<td></td>
<td>580</td>
<td>-0.15</td>
<td>WHEN -Z ADI PITCH &gt; 170 DEG: DAP FREE, RESET</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td></td>
<td>UNIV PTG P=270 DEG, ITEM 19, DAP PRI</td>
</tr>
<tr>
<td></td>
<td>580</td>
<td></td>
<td>DIGITAL IMAGERY TAKEN FROM ISS SM</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td></td>
<td>WHEN -Z ADI PITCH &gt; 10 DEG: DAP AUTO</td>
</tr>
<tr>
<td></td>
<td>580</td>
<td></td>
<td>WHEN RPM COMPLETE: DAP VERN</td>
</tr>
<tr>
<td>7 1:11</td>
<td>600</td>
<td>-0.7</td>
<td>RELOAD DAP A9, LOAD UNIV PTG P=179 DEG, REESTABLISH RDOT PER TORVA ICs</td>
</tr>
<tr>
<td></td>
<td>550</td>
<td>-0.6</td>
<td>INITIATE TORVA: DAP A, ITEM 19 (+X PULSES AS REQ'D TO NULL TARGET MOTION IN CAMERA)</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>-0.4</td>
<td></td>
</tr>
</tbody>
</table>
**VBAR APPROACH**

<table>
<thead>
<tr>
<th>MC2 ET (h:mm)</th>
<th>Range (ft)</th>
<th>Rdot (fps)</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 1:25</td>
<td>320</td>
<td>-0.20</td>
<td>VBAR ARRIVAL (-X PULSES AS REQ'D TO NULL TARGET MOTION IN CAMERA)</td>
</tr>
<tr>
<td>1:42</td>
<td>110</td>
<td>-0.15</td>
<td></td>
</tr>
<tr>
<td>1:46</td>
<td>75</td>
<td>-0.10</td>
<td>TRANSITION TO NORMZ, LOAD DAP A10/B10, CONFIGURE FOR SINGLE -X JET (DESELECT F1F/F3F)</td>
</tr>
<tr>
<td>9 1:54</td>
<td>30</td>
<td>-0.07</td>
<td>STATIONKEEP FOR 5 MINUTES IF ANGULAR ALIGNMENT MANEUVER REQUIRED</td>
</tr>
<tr>
<td>10 2:05</td>
<td>0</td>
<td>-0.10</td>
<td>DOCKING</td>
</tr>
</tbody>
</table>
UNDOCKING, TORS/TORF, AND FINAL SEPARATION

<table>
<thead>
<tr>
<th>UNDOCK ET (h:mm)</th>
<th>Range (ft)</th>
<th>EVENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0:03</td>
<td>0</td>
<td>ORBITER AND ISS IN FREE DRIFT TO BEGIN UNHOOKING (ISS LVLH PYR 0, 0, 0, ATTITUDE)</td>
</tr>
<tr>
<td>1 0:00</td>
<td>0</td>
<td>UNDOCKING AT MIDNIGHT-2 MIN; DAP B/ALT MODE TO LVLH; MAINTAIN CORRIDOR</td>
</tr>
<tr>
<td>0:01</td>
<td>2</td>
<td>SELECT VERNS; PERFORM DAP B +Z NORMZ BURNS AT 10 SEC INTERVALS TO BUILD OPENING RATE TO 0.15 FPS</td>
</tr>
<tr>
<td>&gt;0:03</td>
<td>&gt;30</td>
<td>DAP B +Z NORMZ BURNS AT 10 SEC INTERVALS TO BUILD OPENING RATE TO 0.20 FPS</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>RESELECT -X JETS (F1F, F3F)</td>
</tr>
<tr>
<td>2 0:07</td>
<td>75</td>
<td>TRANSITION TO LOWZ</td>
</tr>
<tr>
<td>3 0:29 [1:15]*</td>
<td>&gt;400</td>
<td>SEP1: 1.5 FPS +X RADIAL BURN</td>
</tr>
<tr>
<td></td>
<td>(CG-CG)</td>
<td>[IF PROP AVAILABLE, PERFORM 1/4 LAP TORS BETWEEN 400 AND 600 FT (CG-CG); NULL OPENING RATE OUTSIDE 600 FT; PERFORM 3/4 LAP TORF BETWEEN 600 AND 700 FT; THEN PERFORM SEP 1]</td>
</tr>
<tr>
<td>4 0:57 [1:43]*</td>
<td>&gt;2000</td>
<td>SEP2: 3.0 FPS +X, NORMZ RETROGRADE BURN</td>
</tr>
<tr>
<td></td>
<td>(CG-CG)</td>
<td></td>
</tr>
</tbody>
</table>

* Alternate Times are for Flyaround Case
UNDOCKING/SEPARATION PAD 4A

Nominal Undocking Time: __/:__/:__
Orbiter Weight: ____/____/

Flyaround Terminate Criteria Post-Undocking:
When FRCS QTY < ___% or L or R RCS QTY < ___%:
Go to SHUTTLE NOSE IN-PLANE BREAKOUT (CONTINGENCY OPS). 5-16 >>
CONFIGURE FOR SEPARATION  5A

MCC UPDATE
ORB SV
TGT SV
Covar Matrix

MCC UPDATE
Undocking Time  4A

ENABLE RENDEZVOUS NAV  5B

PET

-00:45
A12

-00:40

-00:35

-00:30

-00:25

-00:20

-00:15

\DPS config for Undocking Ops - STRING 1233

CONFIGURE FOR SEPARATION  5A

\DPS config for Undocking Ops - STRING 1233

ENABLE RENDEZVOUS NAV  5B

On RPOP PGSCs:
Perform RPOP INITIALIZATION (RNDZ TOOLS), 7-8, then:
Perform RPOP OPS (RNDZ TOOLS), 7-9, then:
Perform TCS ACTIVATION, steps 1 thru 3 (RNDZ TOOLS), 7-18, then:
Perform TCS MANUAL ACQUISITION, step 1 (RNDZ TOOLS), 7-19
(Set RANGE = 4 ft, AZIMUTH = 0, ELEVATION = 0)
NOTE: TCS will not track until after undock

Perform HHL CHECKOUT (RNDZ TOOLS), 7-6

Perform DOCKING MECHANISM POWERUP  (APDS), 8-5
UNDOCKING PREP  (APDS), 8-7

Perform CCTV CONFIG FOR DOCKING/UNDOCKING (RNDZ TOOLS), 7-2

\MCC
DAP: FREE
O14:F RUDA 1A L2/R2 MANF DRIVER - OFF
O15:F RJD MANF L5/F5/R5 DRIVER - OFF
O16:F Pri RJD LOGIC (eight) - ON
\MCC FOR GO TO POWER UP Vern AND Pri DRIVERS (Pri in [6A])
RUD MANF L5/F5/R5 DRIVER - ON
Wait 5 sec,
DAP: AUTO

CONFIGURE FOR SEPARATION  5A

CRT \DAP config: A12
\DAP: L0 Z
\DAP: A/AUTO/VERN(ALT)

A6U ADI ATT - LVLH
ERR - MED
RATE - MED
SENSE - Z
\FLT CNTLR PWR - OFF

GNC 23 RCS

CRT RCS F – ITEM 1 EXEC (+)
JET DES F1L – ITEM 9 EXEC (no *)
F3L – ITEM 11 EXEC (no *)
F2R – ITEM 13 EXEC (no *)
F4R – ITEM 15 EXEC (no *)
F1U – ITEM 17 EXEC (no *)
F3U – ITEM 19 EXEC (no *)
F2U – ITEM 21 EXEC (no *)

GNC UNIV PTG
TGT ID \+2
BODY VECT \+5
P \+180
Y \+0
OM \+0
\TRK - ITEM 19 EXEC (CUR - *)
\ERR TOT - ITEM 23 EXEC (+)

OPS 202 PRO

GNC ORBIT MNVR EXEC
Set TIG to Undocking Time and update Orbiter weight per [4A]
Enter any non-zero \DV
LOAD – ITEM 22 EXEC
TIMER– ITEM 23 EXEC
OPS 201 PRO
Install –Z COAS
KU OPS Cue Card
CORRIDOR Overlay
RANGE RULER Overlay

ENABLE RENDEZVOUS NAV  5B

GNC 33 REL NAV
CRT RNDZ NAV ENA - ITEM 1 EXEC (+)
SV SEL, ITEM 4 - FLTR
UNDOCKING / SEPARATION TIMELINE

1. PREP FOR UNDOCKING
   When MCC-H and ISS issue GO for Undocking:
   CRT
   O14, All DDU cbs (six) – cls
   O15
   O16:E
   A6U
   FLT CNTLR PWR - ON

2. RECONFIGURE DAP
   CRT
   Config DAP A,B to A9,B9
   X Jets ROT ENA – ITEM 7 EXEC (no *)
   DAP: B/FREE/ALT
   DAP TRANS: NO LO Z
   √DAP TRANS: PULSE/PULSE/PULSE
   √SENSE: –Z

3. COMMAND UNDOCKING
   CRT
   If Hooks 1(2) fail to drive (HK1(2) DRV CMD - OFF):
   * OPEN HOOKS pb - push
   * If Hooks 1(2) appear to stop before reaching end of travel
   * [HK1(2) Pos > 4% + not decr]:
   * Allow for single motor drive time (~4:40) before performing
   * POWER OFF pb - push
   * ON pb - push

   A7L
   CRT
   √UNDOCKING pb - push
   √HOOKS 1, HOOKS 2 CLOSED lt (two) - It off [HK1,HK2 POS (two) < 92% + decr]

   -02:20 > A7L
   * If Hooks 1(2) fail to open (HK1, HK2 POS (two) approx 30%):
   * (confirmed by no physical separation):
   * Inform MCC: “Hooks failed to open”
   * POWER OFF pb - push
   * ON pb - push
   * CLOSE HOOKS pb - push
   * HK1,HK2 POS (two) - incr
   * HOOKS 1, HOOKS 2 CLOSED lt (two) - It on [HK1,HK2 POS=92-93%]
   * POWER OFF pb - push
   * Perform DOCKING MECHANISM POWERDOWN (APDS), 8-6
   * MCC for IFM capability
   * Prepare for 96 BOLT EVA TIMELINE (EVA FS, ORB CONT EVA), then,
   * Perform ODS HOOKS OPEN-CONTINGENCY (APDS),8-27 >>

   -03:00 >
   DAP: FREE
   O14:F, Pri RJD DRIVER (eight) - ON
   O15:F
   O16:F

   √DAP TRANS: PULSE/PULSE/PULSE
   √SENSE: –Z

4. POST UNDOCKING
   CRT
   If Hooks 1(2) OPEN lt failed on:
   * APDS POWER A OFF (√A and failed lts off)
   * APDS CIRC PROT OFF pb - push
   √CIRCUIT PROTECT OFF lt - It on
   √APDS POWER A OFF pb - push
   √APDS CIRC PROT OFF pb - push

   -02:20 > UNDOCKING pb  - push
   √HOOKS 1, HOOKS 2 CLOSED lt (two) - It off [HK1,HK2 POS (two) < 92% + decr]

   CRT
   √RCS FWD – ITEM 1 EXEC (+)
   √JET DES F1F – ITEM 31 EXEC (no +)
   √F3F – ITEM 33 EXEC (no +)

   5. POWER OFF
   A7L
   √ POWER OFF pb - push
   √ STATUS lt (eighteen) - It off
   GO TO SEP/FLYAROUND [BA]
UNDOCKING / SEPARATION TIMELINE

PET

-00:15
A12

-00:10

-00:05

00:00

00:05

00:10

00:15

\MCC: GO FOR UNDOCKING

\MCC UPDATE
GO for Undocking

UNDOCKING OPERATIONS

UNDOCK COMPLETE

A9(B9)

A9(B9)
UNDOCKING / SEPARATION TIMELINE

SEP/FLYAROUND [BA]

1. When RNG > 75 ft (DP-DP):
   DAP: LO Z
   THC: Maintain RDOT > 0.2 fps
   Maintain C/L tgt within 8 deg corridor on C/L camera
   NOTE: DAP A allowed for ± X and ± Z THC

   If TCS not tracking during corridor sep or flyaround, provide periodic HHL range updates to MCC

2. When RNG > 150 ft (DP-DP): If radar desired, INIT RADAR ACQ

3. When RNG > 250 ft: Set RPOP POR: ORB CG - TGT CG
   Set RPOP Overlay: Flyaround Zone [Shift]/[F7]
   Perform DOCKING MECHANISM POWERDOWN (APDS), 8-6

4. When RNG = 450 ± 50 FT (CG-CG)
   GNC UNIV PTG
   TGT ID ✓+2
   BODY VECT ✓+5
   P ✓+90 (-RBAR)
   Y ✓+0
   OM ✓+0
   ERR TOT – ITEM 23 (+)
   TRK – ITEM 19 EXEC (CUR - +)

   If no flyaround, Go to SEP BURN [BB]
   If flyaround, Go to FLYAROUND [9A]

SEP BURNS [BB]

1. RADIAL BURN
   DAP TRANS: NORM/PULSE/PULSE
   THC: +X (up) 6 sec (1.5 fps)

   DAP: A/AUTO/VERN(PRI)
   DAP TRANS: PULSE/PULSE/PULSE
   FLT CNTRL PWR – OFF

   Inform MCC when SEP complete
   Record Radial Burn TIG / __/__/__
   [GNC 2 TIME]

   Set GNC TIMER counting to final burn (Radial Burn TIG + 28 min)

2. CONFIG FOR FINAL BURN
   At final burn TIG – 1 minute:
   A6U ✓SENSE: –Z
   FLT CNTRL PWR – ON
   DAP TRANS: NORM/PULSE/PULSE
   DAP: NO LO Z

3. FINAL BURN
   MCC for final burn direction

   At final burn TIG:
   If posigrade final sep burn
   ✓ Aft THC: –X (down) 4 sec (1.0 fps)
   If retrograde final sep burn (no late inspection)
   ✓ Aft THC: +X (up) 12 sec (3.0 fps)

   DAP TRANS: PULSE/PULSE/PULSE
   FLT CNTRL PWR – OFF

   Inform MCC when SEP complete

   Go to TERMINATE SEP OPS [BC]

TERMINATE SEP OPS [BC]

If KU MODE – RDR PASSIVE
   Perform KU OPS, step 4 (Cue Card)

   GNC 33 REL NAV

   CRT RNDZ NAV ENA - ITEM 1 EXEC (no +)

   GNC 20 DAP CONFIG
   Config DAP A, B to A1, B1

   A6L LIGHTS TRUSS FWD, AFT (two) - OFF
   VESTIBULE PORT, STBD (two) - OFF

   Exit RPOP - [Shift]/[F10]
   Perform TCS DEACTIVATION (RNDZ TOOLS), 7-20
   Perform HHL STOW (RNDZ TOOLS), 7-6

   Go to FLIGHT PLAN
FLYAROUND

1. DAP: A/AUTO/VERN(PRI)
   THC: Maintain ISS CG inside ± 15 degree vertical and
   ± 20 degrees horizontal on C/L camera

2. Prior to –Rbar crossing (Aft ADI P = 270):
   [GNC UNIV PTG]
   P +270 (–VBAR)
   TRK - ITEM 19 EXEC (CUR - *)
   When RNG > 600 ft (CG–CG):
   THC: Maintain flyaround range of 650 ± 50 ft (CG-CG)

3. Prior to –Vbar crossing (Aft ADI P = 0):
   [GNC UNIV PTG]
   P +270 (+RBAR)
   TRK - ITEM 19 EXEC (CUR - *)

4. Prior to +Rbar crossing (Aft ADI P = 90):
   [GNC UNIV PTG]
   P +180 (+VBAR)
   TRK - ITEM 19 EXEC (CUR - *)

5. Prior to +Vbar crossing (Aft ADI P = 180):
   [GNC UNIV PTG]
   P +90 (–RBAR)
   TRK - ITEM 19 EXEC (CUR - *)

6. Repeat steps 2 thru 5 as reqd to continue flyaround

7. At flyaround completion – 10 minutes:
   If radar not tracking target:
   INITIAL RADAR ACQ [10A]

8. When flyaround complete (in +Vbar attitude),
   Go to SEP BURN [8B]

FLYAROUND RANGE REFERENCE

NOTE: Range conversion assumes ISS CG in center of centerline camera at a CG–
CG range of 650 ft, with HHL aim point directly between HHL and ISS CG

<table>
<thead>
<tr>
<th>HHL Aim Point</th>
<th>Raw HHL Range (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 2 - Fwd</td>
<td>579</td>
</tr>
<tr>
<td>Centerline Target</td>
<td>572</td>
</tr>
<tr>
<td>ISS Airlock</td>
<td>632</td>
</tr>
<tr>
<td>Progress - Aft</td>
<td>517</td>
</tr>
</tbody>
</table>

TCS Reflector Visibility During Flyaround

Notes
1. Refl #3 becomes less visible as Orbiter Y_LVLH position becomes more positive (into the page)
2. Refl #5 (on PMA 3) may be acquired before Refl #2
3. Flyaround between 600 - 700 ft
4. Some arrays and radiator are not shown for clarity of the TCS information
5. ISS is not to scale
### UNDOCKING / SEPARATION TIMELINE

**INITIAL RADAR AQQ [10A]**

- **GNC 33 REL NAV**
  - CRT √INH RNG, ITEM 18 - (*)
  - √RDOT, ITEM 21 - (*)
  - √Angles, ITEM 24 - (*)
  - KU ANT ENA - ITEM 2 EXEC (*)
  - GNC I/O RESET
  - √SV SEL, ITEM 4 - (FLTR)
  - RADAR - ITEM 13 EXEC (*)

- **SM ANTENNA**
  - CRT RDR RNG MIN - ITEM 17 EXEC (*)
  - A2 DIGI-DIS sel - R/RDOT
  - A1U KU PWR - STBY
    - MODE - RR PASSIVE
    - RADAR OUTPUT - LO
    - √sel - GPC
    - √CNTL - PNL (wait 3 seconds)
    - PWR - ON

**IF NO RADAR LOCK-ON WITHIN 2 MIN**

- KU sel - AUTO TRK
- SLEW EL, AZ to 0,0 deg
- KU SEARCH - SEARCH (tb – gray)

When lock on occurs:

- **GNC 33 REL NAV**
  - CRT AUT RNG - ITEM 17 EXEC (*)
    - RDOT - ITEM 20 EXEC (*)
    - Angles - ITEM 23 EXEC (*)
  - If RATIO > 1.0,
    - Force aff mark until RATIO < 1.0
  - When RESIDs small and stable,

- **SM ANTENNA**
  - RDR RNG AUTO - ITEM 16 EXEC (*)
MANEUVER PADS
FINAL ORBIT MANEUVER PAD FOR NH

OMS BOTH 1
L 2
R 3
RCS SEL 4
TV ROLL 5

TRIM LOAD
P 6
LY 7
RY 8
WT 9
TIG 10

TGT PEG 7
ΔVX 19
ΔVY 20
ΔVZ 21

OMS GMBL CK:

BURN ATT
R 24
P 25
Y 26

RCS I’CNCT:
L OMS → RCS
R OMS → RCS
NONE

DOWN MODE OPTIONS:
2 OMS → 1 OMS
1 OMS → RCS
NONE

ORBIT BURN MONITOR:

GPC FILL-INS  ( )
CRIT BURN
NON-CRIT BURN

MAX TIG SLIP ___ MIN
DO NOT UPDATE TIG
UPDATE TIG AFTER ___ MIN

NOTES
### FINAL ORBIT MANEUVER PAD FOR Ti

**BURN ATT**
- **R]** 24
- **P]** 25
- **Y]** 26

**ΔVTOT**
- **TGO**

**VGO**
- **X**
- **Y**
- **Z**

**TGT**

**ΔVTOT**
- **TGO**

**TGT PEG 7**
- **ΔVX** 19
- **ΔVY** 20
- **ΔVZ** 21

**TIDELAY**
- **ΔVX** 19
- **ΔVY** 20
- **ΔVZ** 21

**NEW Ti (BASETIME)**

**TV ROLL**

**TRIM LOAD**
- **P]** 6
- **LY** 7
- **RY** 8
- **WT** 9

**TIG**

**RCS SEL**

**OMS BOTH**

**OSM GMBL CK:**
- **PRE**
- **POST-BURN**

**RCS I'CNCT:**
- **L OMS → RCS**
- **R OMS → RCS**
- **NONE**

**DOWN MODE OPTIONS:**
- **2 OMS → 1 OMS**
- **1 OMS → RCS**
- **NONE**

**GPC**
- **L OP CL**
- **R OP CL**

**ORBIT BURN MONITOR**

**GPC FILL-INS**

**CRIT BURN**

**NON-CRIT BURN**

**OMS HE REG TEST:**

- **NONE**

**-X RCS BURNS:**

**-X RCS BURNS:**

**TIG SLIP:**
- If Ti not started by nominal TIG + ___ min, go to Ti DELAY, 5-27

**Max Ti DELAY TIG slip ___ min**

**DO NOT UPDATE TIG**

**UPDATE TIG AFTER ___ MIN**

**NOTES**
### ORBIT MANEUVER PAD FOR ________

<table>
<thead>
<tr>
<th>OMS BOTH</th>
<th>L</th>
<th>R</th>
<th>RCS SEL</th>
<th>TV ROLL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

- **MULTI-AXIS**

<table>
<thead>
<tr>
<th>TRIM LOAD</th>
<th>P</th>
<th>LY</th>
<th>RY</th>
<th>WT</th>
<th>TIG</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

- **TRIM LOAD**

<table>
<thead>
<tr>
<th>ΔVX</th>
<th>ΔVY</th>
<th>ΔVZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
</tbody>
</table>

- **ΔVX**

- **ΔVY**

- **ΔVZ**

<table>
<thead>
<tr>
<th>BURN ATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>R 24</td>
</tr>
</tbody>
</table>

- **BURN ATT**

<table>
<thead>
<tr>
<th>VGO X</th>
<th>VGO Y</th>
<th>VGO Z</th>
</tr>
</thead>
</table>

- **VGO**

<table>
<thead>
<tr>
<th>ΔVTOT</th>
<th>TGO</th>
</tr>
</thead>
</table>

- **ΔVTOT**

<table>
<thead>
<tr>
<th>OMS GMBL CK:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE</td>
</tr>
<tr>
<td>L PRI</td>
</tr>
<tr>
<td>L SEC</td>
</tr>
<tr>
<td>R PRI</td>
</tr>
<tr>
<td>R SEC</td>
</tr>
</tbody>
</table>

- **OMS GMBL CK:**

<table>
<thead>
<tr>
<th>RCS I’CNCT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>L OMS → RCS</td>
</tr>
<tr>
<td>R OMS → RCS</td>
</tr>
</tbody>
</table>

- **RCS I’CNCT:**

<table>
<thead>
<tr>
<th>DOWN MODE OPTIONS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 OMS → 1 OMS</td>
</tr>
<tr>
<td>1 OMS → RCS</td>
</tr>
</tbody>
</table>

- **DOWN MODE OPTIONS:**

<table>
<thead>
<tr>
<th>ORBIT BURN MONITOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPC FILL-INS</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

- **ORBIT BURN MONITOR**

<table>
<thead>
<tr>
<th>MAX TIG SLIP ___ MIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO NOT UPDATE TIG</td>
</tr>
<tr>
<td>UPDATE TIG AFTER ___ MIN</td>
</tr>
</tbody>
</table>

- **MAX TIG SLIP ___ MIN**

<table>
<thead>
<tr>
<th>GPC L OP CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A B A B</td>
</tr>
</tbody>
</table>

- **GPC L OP CL**

<table>
<thead>
<tr>
<th>-X RCS BURNS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>BURN ATT</td>
</tr>
<tr>
<td>P 15</td>
</tr>
<tr>
<td>Y 16</td>
</tr>
</tbody>
</table>

- **-X RCS BURNS:**

<table>
<thead>
<tr>
<th>ORBIT HE REG TEST:</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
</tbody>
</table>

- **ORBIT HE REG TEST:**

### NOTES

### OMS HE REG TEST:

### DO NOT UPDATE TIG

### UPDATE TIG AFTER ___ MIN

### MAX TIG SLIP ___ MIN

### ORBIT BURN MONITOR

### GPC FILL-INS | CRIT BURN | NON-CRIT BURN

### MAX TIG SLIP ___ MIN

### DO NOT UPDATE TIG

### UPDATE TIG AFTER ___ MIN

### NOTES
RENDZVOUS TIMELINE
RENDEZVOUS TIMELINE

AFT FLT STATION CONFIG FOR RNDZ

O14,16:E √cb MNA,C DDU AFT (two) - cl

A6U
ADI ATT - LVLH
ERR - MED
RATE - MED
SENSE - minus Z

R13 √KU ANT - GND
A1U
PWR - STBY
sel - MAN SLEW
MODE - RDR PASSIVE
RADAR OUTPUT - HI
CNTL - PNL (wait 3 seconds)
PWR - ON
SIG STRENGTH sel - KU
SLEW RATE - as reqd

A2
DIGI-DIS sel - R/RDOT
X-PNTR SCALE - X1

NOTE

SELF TEST runs about 3 min

CRT
SELF TEST - ITEM 7 EXEC (*)

A1U
KU SCAN WARN tb - gray
 TRACK tb - gray
 SEARCH tb - gray
A2
RANGE - 888.8
DIGI-DIS sel - EL/AZ

CRT
SELF TEST - ITEM 7 EXEC (no *)

A1U
KU MODE - COMM
sel - GPC
CNTL - CMD

Install:
−Z COAS
RCS BURN Cue Card
KU OPS Cue Card
APPROACH Cue Card
TARGET ALIGNMENT Cue Card
DOCKING SEQUENCE Cue Card
Velcro over Aft DAP PCT pbi (SPARE pbi)

VELCRO OVER AFT DAP PCT PBI (SPARE PBI)
PET

-03:00

CDR  AFT FLT STATION CONFIG FOR RNDZ  [4A]

PLT  RNDZ OPS INITIALIZATION  [5A]

-02:55

MCC UPDATE

Final NH Burn Pad, 3-5 (if reqd)

CDR  If OMS BURN, Perform RNDZ OMS BURN, steps 1-4 (CONTINGENCY OPS), 5-4

If +X RCS burn, Perform RCS BURN, steps 1-5 (Cue Card)

Postburn DAP: A/LVLH/VERN(ALT)

-02:50

MS  Perform 6.105 SSOR ACTIVATION, steps 1 and 2 (SODF: JOINT ONS, COMM/DATA)

-02:45

-02:40

-02:35

-02:30

RENDEZVOUS TIMELINE
**RENDEZVOUS TIMELINE**

- **PET**
  - 02:30
    - A7(B7)
    - TIG – 5 min
  - 02:25
    - If reqd.
    - NH TIG
      - Postburn DAP: A/LVLH/VERN(ALT)
  - 02:20
    - PLT ENABLE RENDEZVOUS NAV [7A]
      - MS PGSCs setup per PGSC Usage Chart (if available) or UTILITY OUTLET PLUG-IN
      - PLAN ORBIT CONFIGURATION (REF DATA FS, UTIL PWR)
      - PLT, On RPOP PGSCs:
        - MS Perform RPOP INITIALIZATION (RNDZ TOOLS), 7-8, then
        - Perform RPOP OPS (RNDZ TOOLS), 7-9, then
        - Perform TCS ACTIVATION, step 1 (RNDZ TOOLS), 7-18
      - MS Perform HHL CHECKOUT (RNDZ TOOLS), 7-6
  - 02:15
    - MCC UPDATE
      - Final NC Burn Pad, 3-3
    - ENABLE RENDEZVOUS NAV [7A]
      - 1. [GNC_33__REL_NAV]
        - CRT RNDZ NAV ENA - ITEM 1 EXEC (★)
        - ⇒ SV SEL, ITEM 4 - PROP
        - ⇒ S TRK, ITEM 12 - (★)
      - 2. [GNC_34__ORBIT_TGT]
        - TGT NO - ITEM 1 + 1 EXEC
        - Set BASE TIME to TIG, (Ti Burn Pad, 3-6)
        - LOAD - ITEM 26 EXEC
CDR If OMS BURN, Perform RNDZ OMS BURN, steps 1-4 (CONTINGENCY OPS), 5-4
If +X RCS burn, Perform RCS BURN, steps 1-5 (Cue Card)

MCC UPDATE
STAR TRK NAV
IMU DES [10A], 4-10

LOAD TARGET TRACK [9A]
√DAP: A/LVLH/VERN(ALT)

GNC UNIV PTG

CRT
CNCL - ITEM 21 EXEC
TGT ID + 1

DAP:  A/LVLH/VERN(ALT)

CRT
CNCL - ITEM 21 EXEC
TGT ID + 1

DAP:  A/AUTO/VERN(ALT)

When MNVR cmplt,
DAP:  A/AUTO/VERN(ALT)

NOTE
If NH performed, delay mnvr to NC burn attitude until NC TIG – 5 min to minimize attitude mnvr

Do not INITIATE TARGET TRACK [9B] until post NC

LOAD TARGET TRACK [9A]
√DAP: A/LVLH/VERN(ALT)

GNC UNIV PTG

CRT
CNCL - ITEM 21 EXEC
TGT ID + 1

DAP:  A/LVLH/VERN(ALT)

CRT
CNCL - ITEM 21 EXEC
TGT ID + 1

DAP:  A/AUTO/VERN(ALT)

When MNVR cmplt,
DAP:  A/AUTO/VERN(ALT)

Do not INITIATE TARGET TRACK [9B] until post NC

NOTE
If NH performed, delay mnvr to NC burn attitude until NC TIG – 5 min to minimize attitude mnvr

Do not INITIATE TARGET TRACK [9B] until post NC

NOTE
If NH performed, delay mnvr to NC burn attitude until NC TIG – 5 min to minimize attitude mnvr

Do not INITIATE TARGET TRACK [9B] until post NC

NOTE
If NH performed, delay mnvr to NC burn attitude until NC TIG – 5 min to minimize attitude mnvr

Do not INITIATE TARGET TRACK [9B] until post NC

NOTE
If NH performed, delay mnvr to NC burn attitude until NC TIG – 5 min to minimize attitude mnvr

Do not INITIATE TARGET TRACK [9B] until post NC
STAR TRACKER NAV 10A

1. CONFIG FOR STRK NAV

√DAP: A/AUTO/VERN(ALT)
  Turn down cabin lights to optimize target viewing through –Z COAS/overhead window
  IMU for Deselect _____ (If no comm, use IMU 1 for deselect)

GNC 21 IMU ALIGN

CRT IMU DES - ITEM 7(8,9) EXEC (*)
√MCC for NAV selected IMU _____

GNC 33 REL NAV
If first NAV pass,
√SV SEL, ITEM 4 - PROP
If previous NAV,
√SV SEL, ITEM 4 - FLTR
√INH Angles, ITEM 24 - (*)
√S TRK, ITEM 12 - (*)

GNC 22 S TRK/COAS_CNTL
–Y THOLD – ITEM 13 + 3 EXEC
–Z THOLD – ITEM 14 + 3 EXEC
–Z (–Y) TGT TRK - ITEM 6(5) EXEC (*)
√STATUS - blank
√SHUTTER - op

2. INITIAL MEASUREMENT EVALUATION

GNC 22 S TRK/COAS_CNTL
When S PRES - (*), continue

GNC 33 REL NAV
Monitor RESID V and H each NAV cycle for at least four consecutive cycles (~30 sec)
Record init RESID V = __________ __________ __________ __________
H = __________ __________ __________ __________

If RESID V or H changes by > 0.05 each cycle:
GNC 22 S TRK/COAS_CNTL
–Z(–Y) BREAK TRK - ITEM 8(7) EXEC
Repeat Step 2

If RESID V or H > 0.6:
GNC 22 S TRK/COAS_CNTL
–Z(–Y) BREAK TRK - ITEM 8(7) EXEC
When S PRES - (*), if RESID V or H still > 0.6 and stable:
  Perform S TRK NAV - HIGH INITIAL RESID (CONTINGENCY OPS), 5-8

3. INTEGRATE DATA INTO NAV

If SV SEL = PROP:
  AUTO Angles - ITEM 23 EXEC (*)
  Record 1st SV UPDATE POS = __________ __________ __________
  When SV UPDATE POS < 1.0 and Angle ACPT > 9: __________
  SV SEL - ITEM 4 EXEC (FLTR) >>
If SV = FLTR:
  FLTR TO PROP - ITEM 8 EXEC
  AUTO Angles - ITEM 23 EXEC (*)
  Record 1st SV UPDATE POS = __________ __________ __________ __________
  If FLTR MINUS PROP changes by more than 8 kft within a S TRK pass:
  ∗ Perform S TRK NAV - HIGH FLTR MINUS PROP
  ∗ (CONTINGENCY OPS), 5-9

END S TRK NAV 10B

GNC 33 REL NAV

CRT INH Angles - ITEM 24 EXEC (*)

GNC 21 IMU ALIGN

IMU DES - ITEM 7(8,9) EXEC (no *)
**RENDEZVOUS TIMELINE**

**PET**

- **01:30**
  - PLT STAR TRACKER NAV [10A]
  - MCC UPDATE
    - Nav Selected IMU

**01:25**

- CDR TARGET NCC BURN [11A] (Intermediate)
- When NAV converged (SV UPDATES small and stable):
  - CDR TARGET NCC BURN [11A]

**01:20**

- When NAV converged (SV UPDATES small and stable):
  - CDR TARGET NCC BURN [11A] (Final)

**01:15**

- TIG – 10 min \(\Delta M\)CC for burn type
  - If no comm
    - If \(\Delta VT\) > 6 fps:
      - END S TRK NAV [10B]
      - TARGET NCC BURN [11A] (Final)
      - Perform RNDZ OMS BURN (CONTINGENCY OPS), 5-4
  - If \(\Delta VM\) > 4 fps:
    - END S TRK NAV [10B]
    - TARGET NCC BURN [11A] (Final)
    - Perform +X Burn, RCS BURN (Cue Card)

**01:10**

- TIG – 5 MIN
  - PLT TARGET NCC BURN [11A] (Final)

**01:05**

- PLT END S TRK NAV [10B]

**01:00**

- CDR Perform RCS BURN (Cue Card)

---

**TARGET NCC BURN [11A]**

**FINAL SOLUTION**

- OPS 202 PRO
  - GNC ORBIT MNVR EXEC
  - Eng Sel CORRECT

- GNC 34 ORBIT TGT
  - TGT NO - ITEM 1 + 9 EXEC
  - TGT Set data:
    - T1 TIG = NCC BURN SOLUTION TIG
    - EL = + 0
    - AT = + 57.7
    - AX = + 48.6
    - AY = + 0.0
    - AZ = + 1.2
    - COMPUTE T1 - ITEM 28 EXEC
    - Record solution in PAD

**FINALE SOLUTION**

- FINAL SOLUTION
  - If > 40 marks in current sensor pass and
    - SV UPDATE POS < 0.5 for the last 4 marks:
      - Burn FLTR soln
    - FLTR within ground solution limits:
      - Burn FLTR soln
    - PROP within ground solution limits:
      - Burn PROP soln
    - None of the above:
      - Burn ground soln EXT \(\Delta V\)s

**NCC BURN SOLUTION**

<table>
<thead>
<tr>
<th>TIG</th>
<th>/</th>
<th>:</th>
<th>:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Delta VX)</td>
<td>( )</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(\Delta VY)</td>
<td>( )</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(\Delta VZ)</td>
<td>( )</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(\Delta VT)</td>
<td>( )</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>PRELIMINARY</td>
<td>INTERMEDIATE</td>
<td>FINAL</td>
<td></td>
</tr>
<tr>
<td>GROUND</td>
<td>FINAL - GROUND LIMITS</td>
<td>(0.5)</td>
<td></td>
</tr>
<tr>
<td>( )</td>
<td>*</td>
<td>(1.5)</td>
<td></td>
</tr>
<tr>
<td>( )</td>
<td>*</td>
<td>(1.6)</td>
<td></td>
</tr>
<tr>
<td>( )</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**RENDZVOUS TIMELINE**

4-11

RNDZ/123/FIN 1
**-Z AXIS TARGET TRACK**

<table>
<thead>
<tr>
<th>CRT</th>
<th>GNC UNIV PTG</th>
</tr>
</thead>
</table>
|  \( TGT \) ID | +1  
| BODY VECT   | +3 (-Z)  
| OM         | +0  

**C3**

DAP: B/AUTO/ALT

**CRT**

TRK - ITEM 19 EXEC (CUR - *)

When MNVR cmplt,

DAP: A/AUTO/VERN(ALT)
**RENDEZVOUS TIMELINE**

**PET**
-01:00
-00:55
-00:50
-00:45
-00:40
-00:35
-00:30

**A7(B7)**

**NCC TIG**

**PLT**

**TARGET TI BURN**

(Intermediate)

**MCC UPDATE**

RNDZ PRPLT PAD

**RNDZ PRPLT PAD**

**IF Y STRK TRACK**

**-2 AXIS TARGET TRACK**

**CDR**

**-Z AXIS TARGET TRACK**

**12A**

**CRT**

**√SV SEL correct**

**GNC 34 ORBIT TGT**

**TGT NO - ITEM 1 +1 0 EXEC**

**√TGT Set data:**

**T1 TIG = BASE TIME**

**EL**

+ 0

**ΔT**

+ 76.9

**ΔX**

- 0.9

**ΔY**

+ 0

**ΔZ**

+ 1.8

**COMPUTE T1 - ITEM 28 EXEC**

Record solution in PAD

**RR NAVIGATION**

**13B**

**CRT**

**RR - ITEM 13 EXEC (**)

**√Elev, Az approx 0**

Record Initial RESID RANGE = ______

RDOT = ______

**IF RESID RANGE > 5.0 or RDOT > 3.0**

SV SEL - ITEM 4 EXEC (PROP)

Proceed with taking data and contact MCC as soon as practical

**FLTR TO PROP - ITEM 8 EXEC**

**AUTO RNG - ITEM 17 EXEC (**)

**RDOT - ITEM 20 EXEC (**)

**Angles - ITEM 23 EXEC (**)

Record 1st SV UPDATE POS = ______

**IF SV SEL = PROP**

When SV UPDATE POS < 0.3 and MARK ACPT > 9:

SV SEL - ITEM 4 EXEC (FLTR)

**TARGET TI BURN**

**13A**

(Intermediate)

**When:**

**NAV RNG < 150 KFT:**

**MS KU OPS, step 1 (Cue Card)**

**PLT**

**TARGET TI BURN**

(Preliminary)

**13A**

**MCC UPDATE**

RNDZ PRPLT PAD

**RR NAVIGATION**

**13B**

**CRT**

**GNC 33 REL NAV**

**√**

**MS**

**- 150 KFT:**

**KU OPS, step 1 (Cue Card)**

**When:**

**NAV RNG < 150 KFT:**

**MS KU OPS, step 1 (Cue Card)**

**If no lock-on by 10 minutes after initial search:**

**MS KU OPS, step 2 (Cue Card)**

**When RR RNG < 135 KFT:**

**PLT**

**Perform RR NAVIGATION**

(Intermediate)

**When:**

**NAV converged (SV UPDATES small and stable):**

**PLT**

**TARGET TI BURN**

(Preliminary)
<table>
<thead>
<tr>
<th>PREL FLTR</th>
<th>INTER FLTR</th>
<th>FINAL FLTR</th>
<th>GND</th>
<th>FINAL - GROUND LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>ΔVX (0.6)</td>
</tr>
<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>ΔVY (1.2)</td>
</tr>
<tr>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
<td>ΔVZ (0.8)</td>
</tr>
</tbody>
</table>

- Ti  BURN SOLUTIONS
- FINAL Ti Burn Pad, 3-7

ΔVX (0.6) ΔVY (1.2) ΔVZ (0.8)
MCC for burn type. If no comm:

- If ΔVT > 6, at TIG–17:
  - Perform RNDZ OMS BURN (CONTINGENCY OPERATIONS), 5-4

- If 4 ≤ ΔVT ≤ 6, at TIG-17:
  - Perform +X RCS burn, RCS BURN (Cue Card)

- If ΔVT < 4, at TIG-5:
  - Perform multi-axis RCS burn, RCS BURN (Cue Card)

If GO for Ti not received by TIG – 5 min or RNDZ DELAY called by MCC

- CDR: Perform Ti DELAY BURN (CONTINGENCY OPS), 5-27

If Ti is +X RCS burn:

- CDR: Perform RCS BURN (Cue Card)

If Ti is OMS BURN:

- CDR: Perform RNDZ OMS BURN (CONTINGENCY OPERATIONS), 5-4

Ti Final Ground Soln, Ti DELAY Soln, 3-7

MCC UPDATE

Go for Ti

Ti TIG = BASE TIME

ΔT = 76.9

ΔX = -0.9

ΔY = 2

ΔZ = 1.8

In case of Ti final ground solution:

- MCC UPDATE

Final Solution:

- If > 40 marks in current sensor pass and SV UPDATE POS < 0.5 for the last 4 marks:
  - Burn FLTR soln

- If FLTR within ground solution limits:
  - Burn FLTR soln

- If PROP within ground solution limits:
  - Burn PROP soln

- If none of the above:
  - Burn ground soln EXT ΔVs
RENDEZVOUS TIMELINE

POST Ti NAV [16A]

A6U √DAP: A/AUTO/VERN(ALT)
A1U √KU sel - GPC

[16A]

[10A]

[574x99]4-16 RNDZ/123/FIN

RENDEZVOUS TIMELINE

POST Ti NAV [16A]

A6U √DAP: A/AUTO/VERN(ALT)
A1U √KU sel - GPC

[16A]

[10A]

[574x99]4-16 RNDZ/123/FIN

[16A]

[10A]

[574x99]4-16 RNDZ/123/FIN

[16A]

[10A]

[574x99]4-16 RNDZ/123/FIN

[16A]

[10A]

[574x99]4-16 RNDZ/123/FIN

[16A]

[10A]
RENEWING TIMELINE

MC 1 BURN SOLUTION

ΔVX  
ΔVY  
ΔVZ  
ΔVT  

MEAN ± (3σ VARIATION)

A7(B7)

PET
00:00
PLT  TARGET MC 1 BURN [17A] (Preliminary)

When MNVR to att cmplt:

CDR  POST TI NAV [16A]

00:05
MS  √Time of OOP null

00:10
PLT  TARGET MC 1 BURN [17A] (Intermediate)

When NAV converged, (SV UPDATES small and stable):

00:15
PLT  TARGET MC 1 BURN [17A] (Final)

Perform RCS BURN (Cue Card)

00:20
MC 1 TIG

00:25
PLT  TARGET MC 2 BURN [17B] (Preliminary)

When Y = 0:

00:30
PLT  MANUAL OUT-OF-PLANE NULL [19A]

TARGET MC 1 BURN [17A]

CRT  

GNC 34 ORBIT TGT

TGT NO - ITEM 1 +1 EXEC

TGT Set data:

T1 TIG = MC1 BURN SOLUTION TIG

EL  + 0
ΔT  + 0.9
ΔX  + 0
ΔY  + 0
ΔZ  + 1.8

COMPUTE T1 - ITEM 28 EXEC

Record solution in PAD

TARGET MC 2 [17B] (Preliminary)

CRT  

GNC 34 ORBIT TGT

TGT NO - ITEM 1 +2 EXEC

TGT Set data:

T1 TIG = MC2 BURN SOLUTION TIG

EL  + 29.07
ΔT  + 37.0
ΔX  + 0.9
ΔY  + 0
ΔZ  + 1.8

COMPUTE T1 - ITEM 28 EXEC

Record solution in PAD

NOTE

If TGT EL ANG Alarm,

ΔV still valid for current TIG,

TIG slip limits still apply
TARGET MC 2 BURN (Intermediate)

**CRT**

- SV SEL correct
- GNC 34 ORBIT TGT
  - TGT NO - ITEM 1 + 1 2 EXEC
  - COMPUTE T1 - ITEM 28 EXEC
  - Record solution in PAD

**TARGET MC 2 BURN (Final)**

**CRT**

- SV SEL correct
- GNC 34 ORBIT TGT
  - TGT NO - ITEM 1 + 1 2 EXEC
  - TIG change

  **IF TIG CHANGE < –3 OR > +7 MIN**
  
  Set BASE TIME to (Nominal MC 2 TIG –3 or +7 min as appropriate)
  
  LOAD - ITEM 26 EXEC
  
  TGT NO - ITEM 1 + 1 9 EXEC

- TIG Set data:
  
  - T1 TIG = BASE TIME
  - EL + 0
  - ∆T + 27.0
  - ∆X + 0.9
  - ∆Y + 0
  - ∆Z + 1.8

  COMPUTE T1 - ITEM 28 EXEC

  Set EVENT TIMER counting to MC 2 TIG
  
  Record solution in PAD

- GNC 33 REL NAV

- FLTR TO PROP - ITEM 8 EXEC

**END S TRK NAV**

**CRT**

- GNC 33 REL NAV

- INH Angles - ITEM 24 EXEC (*)

- GNC 21 IMU ALIGN

- IMU DES - ITEM 7(8,9) EXEC (no *)

**–Z AXIS TARGET TRACK**

**CRT**

- GNC UNIV PTG

- TGT ID

- BODY VECT +3 (~Z)

- OM +3

- C3 DAP: B/AUTO/ALT

- TRK - ITEM 19 EXEC (CUR - *)

  When MNVR cmlpt,
  
  DAP: A/AUTO/VERN(ALT)

**MC 2 BURN SOLUTION**

**Preliminary**

<table>
<thead>
<tr>
<th>VX</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VY</td>
<td></td>
</tr>
<tr>
<td>VZ</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td></td>
</tr>
</tbody>
</table>

**Intermediate**

<table>
<thead>
<tr>
<th>VX</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VY</td>
<td></td>
</tr>
<tr>
<td>VZ</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td></td>
</tr>
</tbody>
</table>

**Final**

<table>
<thead>
<tr>
<th>VX</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VY</td>
<td></td>
</tr>
<tr>
<td>VZ</td>
<td></td>
</tr>
<tr>
<td>VT</td>
<td></td>
</tr>
</tbody>
</table>

**TIG**

**TIG SLIP**

**PREL**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>

**INTER**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>

**FINAL**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>

**NOMINAL**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>

**RENDZVOUS TIMELINE**

**NIGHTTIME STRK OPS**

1. GNC 33 REL NAV

   INH Angles - ITEM 24 EXEC (*)

   At sunset,

2. GNC 22 S TRK/COAS_CNTL

   –Z(–Y) THOLD - ITEM 14(13) + 0 EXEC

3. Perform STAR TRACKER NAV [18A], steps 2 and 3
**RENDZVOUS TIMELINE**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:30</td>
<td><strong>MS</strong> Perform 6.105 SSOR ACTIVATION, step 3 (SODF: JOINT OPS, COMM/DATA)</td>
</tr>
<tr>
<td>00:35</td>
<td><strong>A7(B7)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>MC2 ET</strong></td>
</tr>
<tr>
<td>00:40</td>
<td><strong>PET</strong></td>
</tr>
<tr>
<td>00:45</td>
<td><strong>PLT</strong> When NAV converged (SV UPDATES small and stable):</td>
</tr>
<tr>
<td></td>
<td><strong>TARGET MC 2 BURN</strong> (Intermediate)</td>
</tr>
<tr>
<td>00:50</td>
<td><strong>MS</strong> Perform CCTV CONFIG FOR DOCKING/UNDOCKING (RNDZ TOOLS), 7-2</td>
</tr>
<tr>
<td>00:55</td>
<td><strong>MC 3 BURN SOLUTION</strong></td>
</tr>
<tr>
<td></td>
<td><strong>FINAL</strong></td>
</tr>
<tr>
<td>01:00</td>
<td><strong>PLT</strong> END STAR TRACKER NAV (18C)</td>
</tr>
</tbody>
</table>

**MANUAL OUT-OF-PLANE NULL**

**19A**

**CRT**

- When Y = 0:
- F7  FLT CNTLR PWR - ON
- DAP: A/AUTO/PRI
- DAP TRANS: as reqd
- THC: Null YDOT
- If –Z AXIS TRACK,
  - +YDOT = FWD THC left
  - AFT THC right
- If –Y S TRK TRACK,
  - +YDOT = FWD THC down
  - AFT THC out

**F7**  FLT CNTLR PWR - OFF
- DAP: A/AUTO/ALT
- When rates nulled:
  - DAP: VERN(ALT)

**TARGET MC 3**

**19B**

**CRT**

- SV SEL correct
- GNC 34 ORBIT TGT
- TGT NO. - ITEM 1 + 3 EXEC
- √TGT Set data:
  - T1 TIG = BASE TIME + 0:00:17:00
  - EL + 0
  - ΔT + 10.0
  - ΔX = –0.9
  - ΔY = +0
  - ΔZ = +1.8
- COMPUTE T1 - ITEM 28 EXEC
- Record solution in PAD

## MC 3 BURN SOLUTION

<table>
<thead>
<tr>
<th>TIG</th>
<th>PRELIMINARY</th>
<th>FINAL</th>
<th>MEAN ± (3σ VARIATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔVX</td>
<td>( ) *</td>
<td>( )</td>
<td>+0.8 ± (1.8)</td>
</tr>
<tr>
<td>ΔVY</td>
<td>( ) *</td>
<td>( )</td>
<td>+0.0 ± (0.4)</td>
</tr>
<tr>
<td>ΔVZ</td>
<td>( ) *</td>
<td>( )</td>
<td>+1.4 ± (3.1)</td>
</tr>
<tr>
<td>ΔVT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**RENDEZVOUS TIMELINE**

**TARGET MC 4 BURN SOLUTION**

<table>
<thead>
<tr>
<th>TIG</th>
<th>/</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRELIMINARY</td>
<td>FINAL</td>
</tr>
<tr>
<td>∆VX</td>
<td>+0.4 ± (1.7)</td>
</tr>
<tr>
<td>∆VY</td>
<td>+0.0 ± (0.4)</td>
</tr>
<tr>
<td>∆VZ</td>
<td>+0.2 ± (2.2)</td>
</tr>
<tr>
<td>∆VT</td>
<td></td>
</tr>
<tr>
<td>MEAN ± 3σ VARIATION</td>
<td></td>
</tr>
</tbody>
</table>

**TARGET MC 4 BURN**

- **CRT**
  - √ SV SEL correct
  - [GNC 34 ORBIT TGT]
  - TGT NO - ITEM 1 ± 1.4 EXEC
  - √ TGT Set data:
    - T1 TIG = BASE TIME + 0:00:27:00
    - EL + 0
    - ΔX + 0
    - ΔY + 0
    - ΔZ + 0.8
  - COMPUTE T1 - ITEM 28 EXEC
  - Record solution in PAD

**CONFIG FOR RBAR**

- [GNC UNIV PTG]
  - √ ERR TOT - ITEM 23 EXEC (+)
  - GNC 20 DAP CONFIG
  - Config DAP A,B to A8,B8

**ESTABLISH RBAR**

- A6U FLT CNTLR PWR - ON
  - √ SENSE - -Z
  - DAP: A/LVLH/PRI
  - √ COAS for TGT vertical position
    - THC: +X (or –X) per COAS LOGIC:
      - If TGT = N deg high in COAS, perform 2N +X (up) pulses
      - If TGT = N deg low in COAS, perform 1N –X (down) pulses
    - DAP: A/LVLH/VERN(PRI)
    - Inform MCC of TGT vertical position in COAS and number of pulses performed
    - Following radar fail X correction,
      - THC: As reqd to control out of plane motion and manage RDOT
      - Perform CONFIG FOR RBAR

**LATE RADAR NAV**

- [GNC 33 REL NAV]
  - CRT FLTR TO PROP - ITEM 8 EXEC
    - SV SEL, ITEM 4 - PROP
    - √ RR - ITEM 13 EXEC (+)
    - AUTO RNG - ITEM 17 EXEC (+)
    - RDOT - ITEM 20 EXEC (+)
    - Angles - ITEM 23 EXEC (+)
  - Go to RADAR FAIL PROCEDURE

**RADAR FAIL PROCEDURE**

- Note: When TGT visible, report TGT Tally-Ho to MCC
  - MS If TGT outside COAS reticle, config CCTV as reqd to measure vertical position
  - 1. At MC2 TIG+14:00 (MC3 TIG–3:00):
    - PLT TARGET MC3 (19B) (final)
    - CDR Perform RCS BURN (Cue Card)
    - [GNC 33__REL_NAV]
    - CRT FLTR TO PROP - ITEM 8 EXEC
      - √ SENSE - -Z
      - DAP: A/LVLH/PRI
      - √ COAS for TGT vertical position
      - THC: +X (or –X) per COAS LOGIC:
        - If TGT = N deg high in COAS, perform 2N +X (up) pulses
        - If TGT = N deg low in COAS, perform 1N –X (down) pulses
      - DAP: A/LVLH/VERN(PRI)
      - Inform MCC of TGT vertical position in COAS and number of pulses performed
      - Following radar fail X correction,
        - THC: As reqd to control out of plane motion and manage RDOT
        - Perform CONFIG FOR RBAR
  - 2. At MC2 TIG + 19:00:
    - A6U FLT CNTLR PWR - ON
      - √ SENSE - -Z
      - DAP: A/LVLH/PRI
      - √ COAS for TGT vertical position
      - THC: +X (or –X) per COAS LOGIC:
        - If TGT = N deg high in COAS, perform 2N +X (up) pulses
        - If TGT = N deg low in COAS, perform 1N –X (down) pulses
      - DAP: A/LVLH/VERN(PRI)
      - Inform MCC of TGT vertical position in COAS and number of pulses performed
      - Following radar fail X correction,
        - THC: As reqd to control out of plane motion and manage RDOT
        - Perform CONFIG FOR RBAR
  - 3. At MC2 TIG + 24:00 or 2000 ft, whichever comes first:
    - GNC UNIV PTG
    - CRT TRK - ITEM 19 EXEC (CUR - *)
    - A6U DAP: A/AUTO/VERN (PRI)
    - THC: as reqd to stabilize and maintain TGT docking port between 0 and 10 deg high in COAS
    - At 2000 ft:
      - Perform APPROACH (Cue Card)

- AT MC2+18 IF NO VISUAL ACQUISITION OR TARGET > 30 DEG FROM COAS HORIZONTAL
  - [GNC 34 REL NAV]
  - CRT FLTR TO PROP - ITEM 8 EXEC
    - √ SENSE - -Z
    - DAP: A/LVLH/PRI
    - √ COAS for TGT vertical position
    - THC: +X (or –X) per COAS LOGIC:
      - If TGT = N deg high in COAS, perform 2N +X (up) pulses
      - If TGT = N deg low in COAS, perform 1N –X (down) pulses
    - DAP: A/LVLH/VERN(PRI)
    - Inform MCC of TGT vertical position in COAS and number of pulses performed
    - Following radar fail X correction,
      - THC: As reqd to control out of plane motion and manage RDOT
      - Perform CONFIG FOR RBAR

**CONFIG FOR RBAR**

- For RBAR:
  - [GNC UNIV PTG]
  - √ ERR TOT - ITEM 23 EXEC (+)
    - GNC 20 DAP CONFIG
    - Config DAP A,B to A8,B8
  - Note: When TGT visible, report TGT Tally-Ho to MCC
  - MS If TGT outside COAS reticle, config CCTV as reqd to measure vertical position

**AT MC2 TIG+14:00 (MC3 TIG–3:00):**

- PLT TARGET MC3 (19B) (final)
- CDR Perform RCS BURN (Cue Card)

**AT MC2 TIG + 19:00:**

- A6U FLT CNTLR PWR - ON
  - √ SENSE - -Z
  - DAP: A/LVLH/PRI
  - √ COAS for TGT vertical position
  - THC: +X (or –X) per COAS LOGIC:
    - If TGT = N deg high in COAS, perform 2N +X (up) pulses
    - If TGT = N deg low in COAS, perform 1N –X (down) pulses
  - DAP: A/LVLH/VERN(PRI)
  - Inform MCC of TGT vertical position in COAS and number of pulses performed
  - Following radar fail X correction,
    - THC: As reqd to control out of plane motion and manage RDOT
    - Perform CONFIG FOR RBAR

**AT MC2 TIG + 24:00 or 2000 ft, whichever comes first:**

- GNC UNIV PTG
- CRT TRK - ITEM 19 EXEC (CUR - *)
- A6U DAP: A/AUTO/VERN (PRI)
- THC: as reqd to stabilize and maintain TGT docking port between 0 and 10 deg high in COAS

**Go to RADAR FAIL PROCEDURE**
**RENDEZVOUS TIMELINE**

**PET 01:00**
- A7(B7)
- TIG – 3 min
- Task: TARGET MC3 BURN [19B] (Final)
- Task: Perform RCS BURN (Cue Card)

**MC2 ET 00:10**
- Task: Go to RADAR FAIL PROCEDURES [20D]

**00:15**
- **MC 3 TIG**
- Task: PLT TARGET MC BURN [20A] (Final)
- Task: Perform RCS BURN (Cue Card)

**00:25**
- **MC 4 TIG**
- Task: CDR CONFIG FOR RBAR [20B]
- Task: MS Perform HHL OPS (RNDZ TOOLS), 7-7

**00:30**
- Task: HHL REPORT R and Rdot

**00:35**
- **MC 4 TIG**
- Task: CDR ESTABLISH RBAR [20C]
- Task: Perform APPROACH (Cue Card)

**Manual Trajectory Control**
TERMINATE RNDZ OPS [22A]

1. ORBITER CONFIG FOR MATED ATTITUDE CONTROL

   PLT
   IF VERNs available:
   O14:F, Pri RJD LOGIC, DRIVER (sixteen) – OFF
   O15:F, RJDA 1A L2/R2 MANF DRIVER – ON
   O16:F
   O14:E, All DDU cbs (six) – op
   O15:E, O16:E
   CDR A6U
   √ FLT CNTRL PWR - OFF
   PLT
   GNC 23 RCS
   CRT
   RCS F – ITEM 1 EXEC (+)
   JET DES F1L – ITEM 9 EXEC (+)
   F3L – ITEM 11 EXEC (+)
   F2R – ITEM 13 EXEC (+)
   F4R – ITEM 15 EXEC (+)
   F1U – ITEM 17 EXEC (+)
   F3U – ITEM 19 EXEC (+)
   F2U – ITEM 21 EXEC (+)

   GNC 20 DAP CONFIG
   Config DAP A,B to A12,B12
   X JET ROT ENA - ITEM 7 EXEC (+)
   EDIT A9 - ITEM 3 + 9 EXEC
   PRI RATE DB - ITEM 52 + 0.2 EXEC
   LOAD - ITEM 5 EXEC
   EDIT B9 - ITEM 4 + 9 EXEC
   PRI RATE DB - ITEM 52 + 0.2 EXEC
   LOAD - ITEM 5 EXEC

   SM 167 DOCKING STATUS
   √ 12 hooks closed

   CRT
   DAP: LO Z
   If Loss of Verns:
   DAP: A/ALT
   DAP: LVLH
   If VERN:
   DAP: LVLH
   * If ISS attitude control required,
   ∗ Perform 3.111 HANDOVER ATTITUDE CONTROL ORBITER TO
   ∗ CMG TA, (SODF: JOINT OPS, MATED OPERATIONS)

2. ORBITER CONFIG FOR MATED OPS

   MS
   Perform DOCKING MECHANISM POWERDOWN (APDS), 8-6
   A6L
   LTS TRUSS FWD, AFT (two) - OFF
   VEST PORT, STBD (two) - OFF
   Exit RPOP - [Shift][F10]
   Perform HHL STOW (RNDZ TOOLS), 7-6
   ∼ Z COAS - OFF

RETURN TO FLIGHT PLAN
CONTINGENCY OPS

RNDZ OMS BURN ............................................................................................................ 5-3
SENSOR FAIL ................................................................................................................ 5-7
  S TRK NAV – HIGH INITIAL RESID ........................................................................ 5-8
  FLTR MINUS PROP ................................................................................................... 5-9
COAS NAVIGATION .................................................................................................... 5-10
BACKOUT/BREAKOUTS .............................................................................................. 5-11
  VBAR CORRIDOR BACKOUT .................................................................................. 5-12
  BREAKOUT ............................................................................................................... 5-14
SHUTTLE NOSE IN-PLANE BREAKOUT (R < 700 ft) ................................................ 5-16
RNDZ BREAKOUT ...................................................................................................... 5-18
EXPEDITED SEPS ...................................................................................................... 5-19
  SHUTTLE EMERGENCY SEPARATION .................................................................. 5-21
  ANY ATTITUDE SEPARATION ................................................................................ 5-23
Ti DELAY BURN .......................................................................................................... 5-27
RNDZ NAV RECOVERY .............................................................................................. 5-29
TGT ITER ...................................................................................................................... 5-30
LOSS OF COMM ........................................................................................................... 5-31
DEGRADED CONTROL ................................................................................................. 5-33
  DEGRADED +X TRANSLATION ................................................................................ 5-35
  -X TRANSLATION .................................................................................................. 5-36
LOSS OF FORWARD SIDE-FIRING JETS ..................................................................... 5-37
  ONE FxD JET ........................................................................................................... 5-38
  BOTH FxD JETS (SAME SIDE) ................................................................................ 5-39
VRCS ........................................................................................................................... 5-41
RNDZ OMS BURN

1. OMS BURN PREP
   C2 Install OMS2/ORBIT OMS BURNS (Cue Cards) (two) and
   ORBIT BURN MONITOR (Cue Cards) (two) (F6,F8)
   Wedge
   CRT1
   1: GNC 20 DAP CONFIG
   √DAP config A7,B7
   GNC, OPS 202 PRO
   1: GNC ORBIT MNVR EXEC
   2: GNC SYS SUMM 2

2. LOAD TGT DATA
   If onboard-computed burn:
   √Eng sel, TV ROLL, TRIM LOAD, and WT per Burn Pad
   √TIG and TGT PEG 7 ΔVs per Final ORBIT TGT solution
   √Guidance option is LAMBERT
   If ground-computed burn:
   √TGT data per Burn Pad (reload WT as reqd)
   LOAD – ITEM 22 EXEC
   TIMER – ITEM 23 EXEC
   √Burn data
   C3 DAP: A/AUTO/ALT(B/ALT as reqd)
   CRT1 MNVR – ITEM 27 EXEC (*)
   If RR ops:
   A1U KU sel – AUTO TRK
   1: GNC 33 REL NAV
   CRT1 INH Angles – ITEM 24 EXEC (*)
   1: GNC ORBIT MNVR EXEC
   When mnvr to att complete:
   √DAP: A/AUTO/ALT

3. PERFORM RNDZ OMS BURN
   TIG-3 F6,F8 FLT CNTRL PWR (two) – ON
   Perform OMS2/ORBIT OMS BURNS (Cue Card)

4. OMS POST BURN RECONFIGURATION
   F6,F8 FLT CNTRL PWR (two) – OFF
   O8 L,R OMS He PRESS/VAP ISOL (four) – CL
   C3 DAP: B/INRTL/ALT
   DAP TRANS: PULSE/PULSE/PULSE
   CRT1 RCS SEL – ITEM 4 EXEC (*)
   Perform OMS TVC GMBL CK per Burn Pad
   * If down arrow(s) or M(s), *
   * select good GMBL *
   GNC, OPS 201 PRO

Cont next page
5. MNVR TO POST BURN ATTITUDE

1: GNC UNIV PTG

√Desired UNIV PTG load active

C3 DAP: B/AUTO/ALT

If RR ops, when ATT ERR < 30 deg:

A1U

KU sel – GPC

√KU TRACK tb – gray

1: GNC 33 REL NAV

CRT1

AUTO Angles – ITEM 23 EXEC (*)

1: GNC UNIV PTG

When in attitude and rates nulled:

C3 DAP: A/AUTO/VERN(ALT)
SENSOR FAIL
S TRK NAV – HIGH INITIAL RESID

1. NAV SAFING
   1: GNC 33 REL NAV
   CRT1 √INH Angles – ITEM 24 EXEC (*)

   On MCC GO (if no comm, continue):

2. CHECK FOR S TRK FALSE LOCK
   2: GNC 22 S TRK/COAS CNTL
   If -Z S TRK, perform COAS visual check:

   NOTE
   GNC 33 REL NAV: COAS X (+up) and COAS Y (+left)
   provide approx TGT position in COAS based on -Z
   S TRK measurement

   √For debris near TGT position
   If no debris near TGT position or TGT not visible:
   Go to step 3
   If debris near TGT position:
   CRT2 -Z BREAK TRK – ITEM 8 EXEC
   When S PRES – (*):
   CRT1  Monitor RESID V and H. Repeat BREAK TRK as reqd until
         stable lock-on
         Go to STAR TRACKER NAV, step 2 [10A]

   If -Y S TRK, perform visual check through W1:
   √For debris near TGT line-of-sight
   If no debris near TGT line-of-sight or TGT not visible:
   Go to step 3
   If debris near TGT line-of-sight:
   CRT2 -Y BREAK TRK – ITEM 7 EXEC
   When S PRES – (*):
   CRT1  Monitor RESID V and H. Repeat BREAK TRK as reqd until
         stable lock-on
         Go to STAR TRACKER NAV, step 2 [10A]

3. CHECK IMU MISALIGNMENT
   2: GNC 21 IMU ALIGN
   CRT2 Nav sel IMU – des,sel (If Nav sel IMU unknown, pick one of two remaining IMUs)
   CRT1 Record RESID V ______ and H ______
   If RESID V and H < 0.6:
       Go to STAR TRACKER NAV, step 3 [10A]
   CRT2 Other IMU – des,sel
   CRT1 Record RESID V ______ and H ______

4. RESUME PASS
   Continue with pass per STAR TRACKER NAV, step 3 [10A], then:
   After S TRK pass, on MCC GO:

   NOTE
   SELF-TEST may false fail. √MCC for S TRK status

   2: GNC 22 S TRK/COAS CNTL
   CRT2 -Z(-Y) SELF-TEST – ITEM 2(1) EXEC (*)
S TRK NAV – HIGH FLTR MINUS PROP

1. NAV SAFING
   
   1: GNC 33 REL NAV
   
   CRT1 INH Angles – ITEM 24 EXEC (*)

   On MCC GO (continue if no comm):

2. CHECK FOR S TRK FALSE LOCK

   2: GNC 22 S TRK/COAS CNTL
   
   If -Z S TRK, perform COAS visual check:
   
   NOTE
   GNC 33 REL NAV: COAS X (+up) and COAS Y (+left)
   provide approx TGT position in COAS based on -Z
   S TRK measurement

   √ For debris near TGT position
   If no debris near TGT position or TGT not visible:
     Go to step 3
   If debris near TGT position:
     SV SEL – ITEM 4 EXEC (PROP)
     PROP TO FLTR – ITEM 9 EXEC
   
   CRT2 -Z BREAK TRK – ITEM 8 EXEC
   
   When S PRES – (*):
   
   CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until stable
   lock-on
   
   Go to STAR TRACKER NAV, step 2 [10A]

   If -Y S TRK, perform visual check through W1:
   √ For debris near TGT line-of-sight
   If no debris near TGT line-of-sight or TGT not visible:
     Go to step 3
   If debris near TGT line-of-sight:
     SV SEL – ITEM 4 EXEC (PROP)
     PROP TO FLTR – ITEM 9 EXEC
   
   CRT2 -Y BREAK TRK – ITEM 7 EXEC
   
   When S PRES – (*):
   
   CRT1 Monitor RESID V and H. Repeat BREAK TRK as reqd until stable
   lock-on
   
   Perform STAR TRACKER NAV, step 2 [10A]

3. RESUME PASS
   
   AUTO Angles – ITEM 23 EXEC (*)
   
   Continue -Z S TRK pass
   After S TRK pass, on MCC GO:
   
   NOTE
   SELF-TEST may false fail. √MCC for S TRK status

   2: GNC 22 S TRK/COAS CNTL
   
   CRT2 -Z(-Y) SELF-TEST – ITEM 2(1) EXEC (*)
COAS NAVIGATION

NOTE
Do not execute MC1 or Out-Of-Plane null.
Prior COAS cal reqd to perform COAS NAV.
VERNs reqd to perform COAS NAV.
COAS Nav must be started within ~10 min of Ti to guarantee
adequate geometry for nav convergence.
Breakout – If tgt not visible at MC2+18, refer to 1-4 for
breakout criteria

1. COAS NAV CONFIG
A6U
\[\text{SENSE: } -Z\]
\[\text{DAP: } B7/AUTO/VERN(ALT)\]

CRT
\[\text{GNC 22 STRK/COAS CNTL}\]
\[\text{COAS: SIGHT MODE – ITEM 22 EXEC (*)}\]
\[\text{REQD ID – ITEM 21 } +1 \text{ EXEC}\]
\[\text{POS -Z: ITEM 27 (*)}\]

\[\text{GNC 33 REL NAV}\]
\[\text{INH Angles – ITEM 24 EXEC (*)}\]
\[\text{SV SEL, ITEM 4 – FLTR}\]
If TGT NOT in COAS FOV:
\[\text{MCC}\]
If TGT in COAS FOV:
\[\text{FLTR TO PROP – ITEM 8 EXEC}\]
\[\text{COAS – ITEM 14 EXEC (*)}\]
Upon MCC uplink of COVARIANCE MATRIX,
\[\text{COVAR REINIT – ITEM 16 EXEC}\]

2. COAS MARKS
A6U
\[\text{FLT CNTLR PWR – ON}\]
\[\text{DAP: B/FREE/PRI}\]
\[\text{RHC: As reqd to move TGT near COAS center and maintain BODY YAW}\]
\[\text{ERR < 10 deg}\]
\[\text{DAP: B/FREE/VERN}\]
\[\text{RHC: As reqd to maintain TGT at COAS center and maintain BODY YAW}\]
\[\text{ERR < 10 deg}\]

When TGT centered in COAS, ATT REF pb – push

\[\text{GNC 33 REL NAV}\]
If X and Y RESID magnitudes \(\geq 1.0\):
\[\text{MCC}\]
If X and Y RESID magnitudes < 1.0:
\[\text{FOR – ITEM 25 EXEC}\]
\[\text{SV UPDATE – non-zero (within 8 sec), then}\]
\[\text{– 0.0 (after 8 sec more)}\]
Repeat step 2 per schedule:
One mark every 10 to 20 sec until sunset Post-Ti

At sunset,

3. END COAS NAV
A6U
\[\text{DAP: A7/AUTO/VERN(ALT)}\]
\[\text{FLT CNTLR PWR – OFF}\]
\[\text{GNC 22 STRK/COAS CNTL}\]

CRT
\[\text{COAS: DES – ITEM 25 EXEC (*)}\]
Resume rendezvous timeline

5-10 RNDZ/123/FIN
BACKOUT/BREAKOUTS
VBAR CORRIDOR BACKOUT

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
</table>
| Constraints for use:  
Orbiter on + Vbar in approach corridor |

If RNG < 75 ft:
1. **INITIATE CORRIDOR BACKOUT**
   DAP: B/LVLH/VERN(PRI), no LO Z

   **NOTE:** DAP A allowed for ±X and -Z (in) THC

   THC: +Z (out) to establish a +0.1 ft/sec opening rate
   Maintain 8 deg corridor

   If PCT ARMED:
   F4
   DISARM PCT: SPDBRK/THROT pb – AUTO
   √lt – OFF

   If 30 ft STATIONKEEPING desired:
   Maintain tgt in 5 deg corridor
   When RNG = 30 ft:
   THC: -Z (in) as reqd establish 30 ± 5 ft stationkeeping >>

   When RNG > 50 ft:
   DAP config: A9/B9
   **[GNC 23 RCS]**
   RCS F – ITEM 1 EXEC (*)
   JET DES F1F – ITEM 31 EXEC (no *)
   F3F – ITEM 33 EXEC (no *)

   If(When) RNG > 75 ft:
2. **INITIATE(CONTINUE) CORRIDOR BACKOUT**
   DAP: A(B)/LVLH/VERN(PRI), LO Z

   **NOTE:** DAP A allowed for ±X and ±Z THC

   THC: +Z (out) to establish a +0.1 ft/sec opening rate
   Maintain 8 deg corridor

   DAP: B(A)

   When opening rate established and RNG > 150:
3. **PERFORM CORRIDOR BACKOUT OR BREAKOUT**
   If BREAKOUT desired:
   Go To VBAR BREAKOUT, 5-14 >>
   Else:
   Maintain 8 deg corridor

   When desired stationkeeping range reached:
   THC: -Z (in) as reqd to establish stationkeeping range

Cont next page
4. REAPPROACH  
DAP: AUTO  

Go to **VBAR APPROACH** (Cue Card) from current stationkeeping range
VAIBR BREAKOUT

CAUTION
Constraints for use:
Orbiter on ± Vbar in approach attitude
Range < 1000 ft cg to cg
Tgt stable on orbiter -Z axis
Orbiter X and Z axes are in-plane

If RNG < 75 ft:
1. INITIATE CORRIDOR BACKOUT
   DAP: B/LVLH/VERN(PRI), no LO Z

   NOTE: DAP A allowed for ±X and -Z (in) THC
   THC: +Z (out) to establish a +0.1 ft/sec opening rate
      Maintain 8 deg corridor

When RNG > 50 ft:
   DAP config: A9/B9
   [GNC 23 RCS]
   RCS F – ITEM 1 EXEC (*)
   JET DES F1F – ITEM 31 EXEC (no *)
   F3F – ITEM 33 EXEC (no *)

If(When) 75 < RNG < 150 ft:
2. INITIATE(CONTINUE) CORRIDOR BACKOUT
   DAP: A(B)/LVLH/VERN(PRI), LO Z

   NOTE: DAP A allowed for ±X and ±Z THC
   THC: +Z (out) to establish a +0.1 ft/sec opening rate
      Maintain 8 deg corridor

   DAP: B(A)

If(When) RNG > 150 ft:
3. PERFORM RADIAL BURN ON ±VBAR
   If Rdot negative (closing on the target):
      THC: +Z (out) to null closing rate (Rdot ≥ 0 fps)
      Config DAP A,B to A7,B7
      DAP: A/LVLH/VERN(PRI), LO Z

   DAP TRANS: NORM/PULSE/PULSE
   THC: +X (up) for 6 sec (1.5 fps)

   DAP TRANS: PULSE/PULSE/PULSE
   FLT CNTLR PWR – OFF
   DAP: A/INRTL/VERN(ALT)

   Record Radial Burn TIG ___/___:___:

   Inform MCC when SEP complete

Cont next page
4. PERFORM POSIGRADE/RETROGRADE BURN
√MCC for breakout direction

NOTE
Posigrade burn performed if second docking attempt desired

GNC, OPS 202 PRO
[GNC ORBIT MNVR EXEC]
√RCS SEL – ITEM 4 EXEC (*)

If radial burn from +Vbar:
TV ROLL – ITEM 5 +1 8 0 EXEC
If radial burn from -Vbar:
TV ROLL – ITEM 5 +0 EXEC

Set TIG to Radial Burn +28 min:
If Posigrade Sep:
   TGT PEG 7 ΔVX – ITEM 19 +3 EXEC
   ΔVY – ITEM 20 +0 EXEC
   ΔVZ – ITEM 21 +0 EXEC
If Retrograde Sep:
   TGT PEG 7 ΔVX – ITEM 19 –3 EXEC
   ΔVY – ITEM 20 +0 EXEC
   ΔVZ – ITEM 21 +0 EXEC

LOAD – ITEM 22 EXEC
TIMER – ITEM 23 EXEC

When RNG > 1000 ft:
DAP: NO LO Z

At TIG -8:00:
DAP: B/AUTO/ALT
MNVR – ITEM 27 EXEC

At TIG -0:30:
DAP: A/INRTL/PRI
FLT CNTLR PWR – ON

At TIG, THC: Trim VGOs ≤ 0.2 fps

FLT CNTLR PWR – OFF
DAP: A/INRTL/VERN(ALT)

Inform MCC when SEP complete

GNC, OPS 201 PRO
CAUTION

Constraints for use:
Orbiter X and Z axes in-plane
Range $\leq 700$ ft cg to cg*
Tgt stable on orbiter -Z axis

*On approach use RNDZ Breakout until TORVA init
(+X burns to start TORVA are complete)

If RNG < 75 ft:
1. INITIATE CORRIDOR BACKOUT
   DAP: B/LVLH/VERN(PRI), no LO Z

   NOTE
   DAP A allowed for $\pm X$ and -Z (in) THC

   THC: +Z (out) to establish a +0.1 ft/sec opening rate
       Maintain 8 deg corridor

When RNG > 50 ft:
   DAP: config: A9/B9
   [GNC 23 RCS]
   RCS F – ITEM 1 EXEC (*)
   JET DES F1F – ITEM 31 EXEC (no *)
   F3F – ITEM 33 EXEC (no *)

If(When) 75 < RNG < 150 ft:
2. INITIATE(CONTINUE) CORRIDOR BACKOUT
   DAP: A(B)/LVLH/VERN(PRI), LO Z

   NOTE
   DAP A allowed for $\pm X$ and $\pm Z$ THC

   THC: +Z (out) to establish a +0.1 ft/sec opening rate
       Maintain 8 deg corridor

   DAP: B(A)

If(When) RNG > 150 ft:
3. PERFORM +X OR -X BURN
   DAP TRANS: NORM/PULSE/PULSE

   If Nose-Forward (TGT ID = 2 and OM = 0):
   | THC: +X (up) for 6 sec (1.5 fps)
   If Tail-Forward (TGT ID = 2 and OM = 180):
   | THC: -X (down) for 6 sec (1.5 fps)

   DAP TRANS: PULSE/PULSE/PULSE

   DAP: A/INRTL/VERN(ALT)

   Record ($\pm X$) Burn TIG ___/___:___
   Report Tig to MCC

   A6U       FLT_CNTL PWR – OFF

Cont next page
4. PERFORM FINAL BURN (+X Burn, Posigrade/Retrograde and Out-of-Plane)

GNC, OPS 202 PRO

[**GNC ORBIT MNVR EXEC**]

√RCS SEL – ITEM 4 EXEC (*)

√MCC for breakout direction and TV ROLL

**NOTE**

Posigrade burn will be performed if second docking attempt desired

Set TIG to (±X) burn + 30 min

If Posigrade Sep:

| TGT PEG 7 ΔVX | ITEM 19 +4.3 EXEC |
| ΔVY | ITEM 20 +3.6 EXEC |
| ΔVZ | ITEM 21 +0 EXEC |

If Retrograde Sep:

| TGT PEG 7 ΔVX | ITEM 19 -4.3 EXEC |
| ΔVY | ITEM 20 +3.6 EXEC |
| ΔVZ | ITEM 21 +0 EXEC |

TV ROLL – ITEM 5 +_ _ _ EXEC
LOAD – ITEM 22 EXEC
TIMER – ITEM 23 EXEC
Config DAP A,B to A7,B7

At TIG -8 min:

DAP: B/ALT, NO LO Z
MNVR – ITEM 27 EXEC (*)
DAP: AUTO

At TIG -0:30:

DAP TRANS: as reqd
DAP: A/INRTL/PRI

F7 FLT CNTLR PWR – ON

At TIG, THC: Trim VGOs ≤ 0.2 fps

F7 FLT CNTLR PWR – OFF

DAP TRANS: PULSE/PULSE/PULSE
DAP: A/INRTL/VERN(ALT)

GNC, OPS 201 PRO

On MCC call:

Go to **TERMINATE SEP OPS [8C]**, 2-8
RNDZ BREAKOUT

NOTE
This procedure may be performed anytime between Ti and TORVA init (+X burns to start TORVA are complete)

1. BREAKOUT BURN PREP
   DAP: A/AUTO/PRI
   FLT CNTLR PWR – ON

2. 3 FPS RETROGRADE
   CRT
   OPS 202 PRO
   [GNC ORBIT MNVR EXEC]

   √RCS SEL – ITEM 4 (*)
   Set TIG to current time
   TGT PEG 7 ΔVX – ITEM 19 -3 EXEC
      ΔVY – ITEM 20 +0 EXEC
      ΔVZ – ITEM 21 +0 EXEC
   LOAD – ITEM 22 EXEC
   TIMER – ITEM 23 EXEC
   Do not maneuver to burn attitude
   DAP TRANS: as reqd
   Deflect THC to null VGOs
   FLT CNTLR PWR – OFF

   CRT
   OPS 201 PRO
   DAP: A/AUTO/VERN(ALT)
EXPEDITED SEPS
SHUTTLE EMERGENCY SEPARATION

NOTE

9.101 JOINT EMERGENCY UNDOCK AND SEPARATION (SODF: JOINT OPS, EMERGENCY RESPONSE) meets all constraints for use. Constraints for use:
- Maneuver mated stack to the ±Vbar attitude
- Attitude rates ≤ 0.12 deg/axis
- Initial separation includes APDS spring pushoff
- Nominal Undock Orbiter DAP and RCS config

1. INITIAL SEPARATION SEQUENCE

When petals clear:
- DAP: B9/LVLH/ALT
- DAP TRANS: PULSE/PULSE/PULSE, no LO Z
- THC: as reqd to maintain target within 8 degree corridor on C/L camera or COAS

NOTE: DAP A allowed for ±X and -Z (in) THC

At physical sep + 1:00:
- DAP: VERN(ALT)
- THC: +Z (out) pulses at 10 sec intervals to establish RDOT > 0.1 fps

At physical sep + 3:00 and when RNG > 30 ft (DP-DP):
- THC: +Z (out) as reqd at 10 sec intervals to establish and maintain RDOT > 0.2 fps

When RNG > 50 ft (DP-DP):

GNC 23 RCS
- RCS FWD – ITEM 1 EXEC (*)
- JET DES F1F – ITEM 31 EXEC (no *)
- JET DES F3F – ITEM 33 EXEC (no *)

When RNG > 75 ft (DP–DP):
- DAP: LO Z

NOTE: DAP A allowed for ±X and ±Z THC

When RNG > 100 ft (DP–DP):
- If radar desired, perform INIT RADAR ACQ 10A, 2-10
- Perform DOCKING MECHANISM POWERDOWN (APDS), 8-6

2. PERFORM RADIAL BURN ON ±VBAR

When RNG > 150 ft (DP–DP):
- DAP: A/LVLH/VERN(PRI), LO Z
- DAP TRANS: NORM/PULSE/PULSE
- THC: +X (up) for 12 sec (3.0 fps)
- DAP TRANS: PULSE/PULSE/PULSE

FLT CNTLR PWR – OFF
- DAP: A/INRTL/VERN(ALT)
- Record Radial Burn TIG ___ / ___ : ___ : ___

Inform MCC when burn complete

At radial burn TIG + 6 min or when RNG > 1000 ft confirmed:

GNC 20 DAP CONFIG
- Config DAP A,B to A7,B7
- DAP: no LO Z

Cont next page
3. PERFORM FINAL BURN

NOTE: OMS burns:
If initial sep from +Vbar attitude, Final burn TIG should be NET Radial Burn TIG + 13 min and NLT Radial Burn TIG + 60 min
If initial sep from -Vbar attitude, Final burn TIG should be NET Radial Burn TIG + 13 min and NLT Radial Burn TIG + 40 min
+ X burns:
Final Burn TIG is Radial Burn TIG + 13 min

If performing emergency deorbit:
\/^MCC/PGSC for deorbit burn TIG/PAD
TV ROLL – ITEM 5 +180 EXEC
Go to EMERGENCY DEORBIT PREP/ENTRY (CONT DEORBIT, EMERGENCY)
Use single OMS burn procedures >>

If prop leak:
Go to LEAKING OMS PRPLT/He BURN (ORB PKT, OMS) >>

If other OMS burn:
Go to RNDZ OMS BURN, 5-4, use single OMS burn procedures >>

If +X burn:
\/^MCC for +X burn TIG and direction
NOTE: Posigrade burn should be performed if second docking attempt desired or if deorbit same day

GNC, OPS 202 PRO
GNC ORBIT MNVR EXEC
^RCS SEL – ITEM 4 EXEC (*)

If posigrade sep desired:
\| TGT PEG 7 \( \Delta VX \) – ITEM 19 +3 EXEC
\| \( \Delta VY \) – ITEM 20 +0 EXEC
\| \( \Delta VZ \) – ITEM 21 +0 EXEC

If retrograde sep desired:
\| TGT PEG 7 \( \Delta VX \) – ITEM 19 –3 EXEC
\| \( \Delta VY \) – ITEM 20 +0 EXEC
\| \( \Delta VZ \) – ITEM 21 +0 EXEC

LOAD – ITEM 22 EXEC
TIMER – ITEM 23 EXEC
MNVR – ITEM 27 EXEC (*)
DAP: B/AUTO/PRI

At TIG -0:30:
\| FLT CNTLR PWR – ON
DAP: A/INRTL/PRI

At TIG:
\| THC: Trim VGOs \( \leq 0.2 \) fps
\| FLT CNTLR PWR – OFF
DAP: A/INRTL/VERN(ALT)

GNC, OPS 201 PRO

Go to TERMINATE SEP OPS [8C], 2-8
ANY ATTITUDE SEPARATION

CAUTION
For time-critical undocking procedures, go to 9.101 JOINT EXPEDITED UNDOCKING AND SEPARATION (SODF: JOINT OPS, EMERGENCY RESPONSE)
If not hard-mated, start in step 3
Constraints for use:
Stack angular rates ≤ 0.12 deg/sec per axis
APDS ring relative misalignment < 5º per axis (as read in C/L camr)

1. INSTALL RNDZ TOOLS
If rendezvous tools already installed, go to step 2
Perform C/L CAM INSTALL (PHOTO/TV, CENTERLINE (C/L) CAMR)
Perform CCTV CONFIG FOR DOCKING/UNDOCKING (RNDZ TOOLS), 7-2
If reqd, install -Z COAS
If RPOP setup reqd:

GNC 33 REL NAV
ORB TO TGT – ITEM 10 EXEC
RNDZ NAV ENA – ITEM 1 EXEC (*)

Perform RPOP INITIALIZATION (RNDZ TOOLS), 7-8, then:
Perform RPOP OPS (RNDZ TOOLS), 7-9, then:
Perform TCS ACTIVATION (RNDZ TOOLS), 7-18, steps 1 to 3, then:
Perform TCS MANUAL ACQUISITION (RNDZ TOOLS), 7-19, step 1
(Set RANGE = 4 ft, AZIMUTH = 0, ELEVATION = 0)
Note: TCS will not track until after undock
Perform HHL CHECKOUT (RNDZ TOOLS), 7-6

2. CONFIGURE FOR UNDOCKING
ISS: FREE
A6U
DAP: FREE
SENSE: -Z
AFT ADI ATT – LVLH
ERR – MED
RT – MED

GNC 20 DAP CONFIG
Config DAP A,B to A9/B9
X Jets ROT ENA – ITEM 7 EXEC (no *)

DAP: B/FREE/ALT, no LO Z
DAP TRANS: PULSE/PULSE/PULSE

GNC 23 RCS
Reselect manually deselected primary jets (no *) except F1F and F3F

O14:E, All DDU cbs (six) – cl
O15:E,
O16:E
O14:F, Pri RJD LOGIC, DRIVER (sixteen) – ON
O15:F,
O16:F

Perform DOCKING MECHANISM POWERUP (APDS), 8-5

Cont next page
3. **COMMAND SEPARATION**

Perform UNDOCKING PREP (APDS), 8-7

If APDS spring-assisted separation not expected (not hard-mated):

- On MCC GO, and when \(-0.12 \leq \text{ROLL}, \text{PITCH}, \text{YAW RATE} \leq 0.12\)
- APDS CIRC PROT OFF pb – push
- \(\sqrt{\text{CIRCUIT PROTECT OFF It – It on}}\)
- OPEN LATCHES pb – push
- \(\sqrt{\text{LATCHES CLOSED It – It off}}\)
- OPEN lt – lt on

If APDS spring-assist expected (hard-mated):

- On MCC Go, and when \(-0.12 \leq \text{ROLL}, \text{PITCH}, \text{YAW RATE} \leq 0.12\)
- Perform UNDOCKING OPERATIONS [6A], 2-6, step 3

4. **INITIAL SEPARATION SEQUENCE**

Perform UNDOCKING OPERATIONS

If no spring-assisted separation:
- THC: +Z (out) 4 pulses at 10 sec intervals
- Do not attempt to maintain 8 degree corridor

If spring-assisted separation:
- When petals clear:
  - DAP: B/LVLH/ALT, no LO Z
  - THC: \(\sqrt{\text{as reqd to maintain target within 8 deg corridor on C/L camera}}\)

At physical sep +1:00:
- DAP: LVLH/VERN(PRI)
- THC: \(\sqrt{\text{as reqd to maintain target within 8 degree corridor on C/L camera}}\)
- THC: +Z (out) pulses at 10 sec intervals to establish RDOT > 0.1 fps, then
- no +Z (out) pulses until 30 ft step
- Note: DAP A allowed for ±X and -Z (in) THC

If Rdot falls below 0.02 fps, establish opening rate \(\leq 0.05 \text{ fps using } +\text{Z (out) }}\) pulses at 10 second intervals, then wait > 2 min to perform 30 ft step

If reqd, perform TCS MANUAL ACQUISITION (RNDZ TOOLS), 7-19, step 2

At physical sep +3:00 and when RNG > 30 ft (DP to DP):
- THC: +Z (out) as reqd at 10 sec intervals to establish and maintain RDOT > 0.2 fps

When RNG > 50 ft (DP to DP):

- [GNC 23 RCS]
- \(\sqrt{\text{RCS FWD ITEM 1 EXEC (*)}}\)
- JET DES F1F – ITEM 31 EXEC (no *)
- F3F – ITEM 33 EXEC (no *)

When RNG > 75 ft (DP to DP):
- DAP: LO Z
- Note: DAP A allowed for ±X and ±Z THC

When RNG > 100 ft (DP to DP):
- If radar desired, perform INIT RADAR ACQ [10A], 2-10

- POWER OFF pb – push
- If reqd, perform DOCKING RING RETRACTION (NOT MATED) (APDS), 8-9
- Perform DOCKING MECHANISM POWERDOWN (APDS), 8-6
5. PERFORM +X BURN AT RNG > 150 FT  
When RNG > 150 ft (DP-DP):  
   DAP:  A/LVLH/VERN(PRI), LO Z  
   DAP TRANS:  NORM/PULSE/PULSE  
   THC:  +X (up) for 8 sec (2.0 fps)  
   DAP TRANS:  PULSE/PULSE/PULSE  
Record +X Burn TIG ___ / ___ : ___ : ___  
Stop maintaining 8 deg corridor  
Inform MCC when burn complete

6. ROTATE TO PLACE AND MAINTAIN ISS IN OVHD WINDOW  
DAP:  A/INRTL/PRI  
Perform manual pitch rotation as reqd:  
   DAP ROT:  DISC/PULSE/DISC  
   RHC:  ± PITCH as reqd to place and maintain ISS in OVHD Window  
When RNG > 1000 ft (CG–CG):  
   DAP:  no LO Z

7. PERFORM OUT-OF-PLANE BURN  
   GNC 20 DAP CONFIG  
Config DAP A,B to A7/B7  
   GNC, OPS 202 PRO  
   GNC ORBIT MNVR EXEC  
√ RCS SEL – ITEM 4 EXEC (*)  
   Set TIG to +X Burn TIG + 22 min  
   TGT PEG 7 ΔVX – ITEM 19 +0 EXEC  
   ΔVY – ITEM 20 +2.5 EXEC  
   ΔVZ – ITEM 21 +0 EXEC  
   LOAD – ITEM 22 EXEC  
   TIMER – ITEM 23 EXEC  
If VGO Z is negative:  
   TGT PEG 7 ΔVY – ITEM 20 -2.5 EXEC  
   LOAD – ITEM 22 EXEC  
   TIMER – ITEM 23 EXEC  
   √VGO Z ≥ 0  
Do not maneuver to burn attitude  
At TIG:  
   √ RNG > 1500 ft (CG–CG)  
   A6U  
   FLT CNTLR PWR – OFF  
   DAP ROT:  DISC/DISC/DISC  
   F6  
   FLT CNTLR PWR – ON  
   THC:  trim VGOs ≤ 0.2 fps  
   FLT CNTLR PWR – OFF  
Record Out-of-Plane Burn TIG ___/___:___:___

Cont next page
8. **PERFORM FINAL BURN**

- MCC for final burn engine selection and breakout direction

**NOTE:** Posigrade burn should be performed if second docking attempt desired or if deorbit same day

If single OMS burn:
- MCC for burn TIG
  - Perform RNDZ OMS BURN, 5-4

If + X burn:
  - If posigrade sep desired:
    - If $\Delta V_Y$ from Out-of-Plane burn (step 4) was positive:
      - TV ROLL – ITEM 5 +2 7 0 EXEC
    - If $\Delta V_Y$ from Out-of-Plane burn (step 4) was negative:
      - TV ROLL – ITEM 5 +9 0 EXEC
    - TGT PEG 7 $\Delta V_X$ – ITEM 19 +7.0 EXEC
      - $\Delta V_Y$ – ITEM 20 +0 EXEC
      - $\Delta V_Z$ – ITEM 21 +0 EXEC
  - If retrograde sep desired:
    - If $\Delta V_Y$ from Out-of-Plane burn (step 4) was positive:
      - TV ROLL – ITEM 5 +9 0 EXEC
    - If $\Delta V_Y$ from Out-of-Plane burn (step 4) was negative:
      - TV ROLL – ITEM 5 +2 7 0 EXEC
    - TGT PEG 7 $\Delta V_X$ – ITEM 19 -7.0 EXEC
      - $\Delta V_Y$ – ITEM 20 +0 EXEC
      - $\Delta V_Z$ – ITEM 21 +0 EXEC
  - Set TIG to Out-of-Plane Burn TIG + 22 min

- LOAD – ITEM 22 EXEC
- TIMER – ITEM 23 EXEC
- MNVR – ITEM 27 EXEC (*)
- DAP: B/AUTO/PRI

At TIG -0:30:
- F6 FLT CNTLR PWR – ON
  - DAP: A/INRTL/PRI

At TIG:
- THC: trim VGOs $\leq$ 0.2 fps
- F6 FLT CNTLR PWR – OFF
  - DAP: A/INRTL/VERN(ALT)
  - GNC, OPS 201 PRO

Go to **TERMINATE SEP OPS [8C]**, 2-8
Ti DELAY BURN

1. **OPS 202 PRO**

   **GNC ORBIT MNVR EXEC**

   Load Ti Delay Pad, 3-7

   If no Ti Delay targets available:
   - Add 3.0 fps to $\Delta V_x$ of last Ti burn solution
   - Burn $\Delta V_y$ and $\Delta V_z$ as computed in last Ti burn solution
   - Max TIG Slip is 4 minutes

   **NOTE**
   Guidance will downmode to EXT $\Delta V$

   If RCS:
   - Perform RCS BURN (Cue Card)

   If OMS:
   - Perform RNDZ OMS BURN (CONTINGENCY OPS), 5-4

2. **Reload new BASETIME per final Ti PAD, 3-7**

   **GNC 34 ORBIT TGT**

   TGT NO – ITEM 1 +1 EXEC

   Set BASETIME to new Ti TIG ___/___:___:___

   Load – ITEM 26 EXEC

   Reset ET, SM timers to new Ti TIG

   **NOTE**
   If Ti Delay executed because no comm:
   - Add 0/01:32:00 to BASE TIME for subsequent delay rev
   - See LOSS OF COMM (CONTINGENCY OPS), 5-31

   **NOTE**
   If no comm for 2 delay revs:
   - Ti Delay breakout is a 1.5 fps posigrade burn at the next Ti point

   Perform RNDZ BREAKOUT (CONTINGENCY OPS), 5-18, with the following deltas:

   - Set TIG to BASE TIME
   - TGT PEG 7 \( \Delta V_x \) – ITEM 19 +1.5 EXEC
   - \( \Delta V_y \) – ITEM 20 +0 EXEC
   - \( \Delta V_z \) – ITEM 21 +0 EXEC
   - Perform TERMINATE SEP OPS 8C, 2-8

3. **Perform Post Ti Nav 16A**, 4-16, then

   Return to RENDEZVOUS TIMELINE at PET: -01:25, 4-11

   **NOTE**
   Extra NCC Burn and Ti Onboard Solution pads, 5-28
### NCC BURN SOLUTION

**TIG**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

/ : : : :

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### PRELIMINARY

<table>
<thead>
<tr>
<th>( \Delta V_X )</th>
<th></th>
<th>.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta V_Y )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_Z )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_T )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### INTERMEDIATE

<table>
<thead>
<tr>
<th>( \Delta V_X )</th>
<th></th>
<th>.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta V_Y )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_Z )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_T )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### FINAL

<table>
<thead>
<tr>
<th>( \Delta V_X )</th>
<th></th>
<th>.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta V_Y )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_Z )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_T )</td>
<td></td>
<td>.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### GROUND

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### FINAL-GROUND LIMITS

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

### Ti ONBOARD SOLUTIONS

#### PREL FLTR

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### 1ST INTER FLTR

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### 2ND INTER FLTR (IF REQD)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### FINAL FLTR

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### PROP (IF REQD)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

#### FINAL-GROUND LIMITS

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

### FINAL Ti PAD (MNVR PADS)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
RNDZ NAV RECOVERY

1. If Recovery from OPS MODE RECALL:
   (add/delete GPC to/from redundant set)
   [GNC 33 REL NAV]
   RNDZ NAV ENA – ITEM 1 EXEC (*)
   [GNC UNIV PTG]
   TRK – ITEM 19 (CUR-*)
   Go to step 3

2. If Recovery from OPS TRANSITION (G8/G3 to G2):
   [GNC 34 ORBIT TGT]
   TGT NO – ITEM 1 +1 EXEC
   Set BASE TIME to Ti TIG (Ti Burn Pad, 3-6)
   LOAD – ITEM 26 EXEC
   [GNC 33 REL NAV]
   Upon MCC uplink of TGT SV,
   RNDZ NAV ENA – ITEM 1 EXEC (*)

   NOTE
   If RNDZ NAV not enabled (no *),
   DO NOT PROCEED. ✓MCC

   Select appropriate target track attitude
   [GNC UNIV PTG]

<table>
<thead>
<tr>
<th>-Z</th>
<th>-Y (STRK)</th>
<th>+Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGT ID</td>
<td>+1</td>
<td>+1</td>
</tr>
<tr>
<td>BODY VECT</td>
<td>+3</td>
<td>+4</td>
</tr>
<tr>
<td>P</td>
<td>✓+90</td>
<td>✓+0</td>
</tr>
<tr>
<td>Y</td>
<td>✓+90</td>
<td>✓+280.6</td>
</tr>
<tr>
<td>OM</td>
<td>+0</td>
<td>+90</td>
</tr>
</tbody>
</table>

   TRK – ITEM 19 (CUR-*)

3. DAP: ALT
   DAP: A/AUTO
   DAP ROT: DISC/DISC/DISC
   When in attitude, DAP: VERN

   If NAV sensor data available:
   If STRK NAV:
   Go to STAR TRACKER NAV 10A, 4-10 >>
   If RR NAV:
   [GNC 33 REL NAV]

   CRT
   KU ANT ENA – ITEM 2 (*)
   GNC I/O RESET
   Go to RR NAVIGATION 13B, 4-13
TGT ITER

When in Lambert Targeting and TGT ITER occurs:

If PRED MATCH other than 999999 (all 9s):
√MCC and read down PRED MATCH from SPEC 34 (MCC has delta Vs)

On MCC GO or if no comm:
    Recall TGT set and recompute

If TGT ITER recurs and PRED MATCH less than 400:
    Contact MCC and read down PRED MATCH from SPEC 34
    On MCC GO or if no comm:
        Load current delta Vs and execute as Lambert burn  >>

If TGT ITER recurs and PRED MATCH greater than 400:
    Contact MCC and read down PRED MATCH from SPEC 34
    On MCC GO or if no comm:
        Load ground solution and execute as EXT DV burn
            (If MC burn, uplink of ground solution reqd)  >>
            If ground solution not available:  No burn  >>

If PRED MATCH 999999 (all 9s):
    On MCC GO or if no comm:
        Load ground solution and execute as EXT DV burn
            (If MC burn, uplink of ground solution reqd)  >>
            If ground solution not available:  No burn  >>
LOSS OF COMM

If comm with MCC is lost during rendezvous ops, attempt to establish comm by performing 6.105 SSOR ACTIVATION (SODF: JOINT OPS, COMM/DATA), and COMM LOST (ORB PKT, COMM). Do not maneuver out of target track attitude unless all other means of acquiring comm are expended.

Ground-Targeted Burns
1. If NH or NC PADs not available, do not perform burn.
2. If a day of rendezvous NC or NH maneuver was not performed nominally, then discontinue rendezvous operations.
3. If the day of rendezvous NC maneuver is performed using preliminary pads, a large NCC burn can be expected.

Lambert-Targeted Burns
1. If “GO for Ti” not received from MCC by Ti TIG - 5 min, perform Ti DELAY BURN (CONTINGENCY OPS), 5-27. If comm is not recovered after two delay revs, perform modified RNDZ BREAKOUT per Ti DELAY BURN (CONTINGENCY OPS), 5-27.
2. If radar nav was stopped in an attempt to get Ku comm during the delay, do not perform second or third NCC burn unless radar nav is re-enabled and sufficient radar marks are taken to provide a converged solution.
3. If no comm for any midcourse correction (MC) burn, perform burn and continue to prox ops.

Prox Ops
1. If “GO for RPM” not received from MCC, do not perform Rbar Pitch Maneuver. Proceed directly to the TORVA and continue to the Vbar. On the Vbar, stationkeep for a maximum of 1 rev and attempt to re-establish comm. If no comm after 1 rev of stationkeeping, perform VBAR BREAKOUT (CONTINGENCY OPS), 5-14.
2. If “GO to proceed inside 600 ft” not received from MCC, do not approach inside 600 ft (CG-CG). Stationkeep on the Vbar outside of 600 ft for a maximum of 1 rev and attempt to re-establish comm. If no comm after 1 rev of stationkeeping, perform VBAR BREAKOUT (CONTINGENCY OPS), 5-14.
3. If “GO for docking” not received from MCC do not attempt docking. Back out (if required) and stationkeep outside of 250 ft for a maximum of 1 rev and attempt to re-establish comm. If no comm after 1 rev of stationkeeping, go to VBAR BREAKOUT (CONTINGENCY OPS), 5-14.
DEGRADED CONTROL
This Page Intentionally Blank
DEGRADED +X TRANSLATION

NOTE 1
Degraded +X occurs with loss of L1A and L3A or R1A and R3A.
Perform these procedures in addition to nominal approach or separation procedures.
√MCC for additional procedure updates

NOTE 2
NO-GO for RPM.
LO Z +Z translation is not effective, do not perform LO Z +Z translation (braking).
+X translation pulses must be doubled to attain desired ΔV.
+X translation couples into Y translation toward the failed jets
(selection of DAP P, Y – ALL minimizes coupling)

1. Between Ti and TORVA initiation, continue to Rbar and initiate TORVA:
   Perform APPROACH (Cue Card), with the following deltas:
   Bias Rdot 0.1 fps slower than Cue Card
   Do not perform LO Z +Z translation (braking)
   Perform DAPS A9, B9 PITCH AND YAW TO ALL
   Do not perform RPM
   Initiate TORVA with approx 0.1 fps slower Rdot
   Double +X pulses to initiate TORVA
   Null Ydot (approx 0.1 fps) immediately after TORVA initiation

2. Between TORVA initiation and RNG = 250, continue to Vbar:
   Perform APPROACH (Cue Card) with the following deltas:
   Do not perform LO Z +Z translation (braking)
   Perform DAPS A9, B9 PITCH AND YAW TO ALL
   When ready to ESTABLISH VBAR,
   DAP: No LO Z, stay No LO Z thru dock
   If Rdot exceeds cue card limit:
   DAP: B
   THC: Brake to cue card limit using 10 sec pulse spacing

3. Inside RNG = 250, continue approach to docking
   Perform VBAR APPROACH (Cue Card) with the following deltas:
   If RNG > 75 ft:
   DAP: No LO Z, stay No LO Z thru dock
   Perform DAPS A9, B9 PITCH AND YAW TO ALL
   If Rdot exceeds cue card limit:
   DAP: B
   THC: Brake to cue card limit using 10 sec pulse spacing
   If RNG < 75 ft,
   No changes to approach procedures

4. During docked operations, or undocking and separation:
   √MCC for updates to UNDOCKING/SEP TIMELINE

<table>
<thead>
<tr>
<th>DAPS A9, B9 PITCH AND YAW TO ALL</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNC 20 DAP CONFIG</td>
<td></td>
</tr>
<tr>
<td>DAP EDIT – ITEM 3 +9 EXEC</td>
<td></td>
</tr>
<tr>
<td>PRI P OPTION – ITEM 55 EXEC – (ALL)</td>
<td></td>
</tr>
<tr>
<td>PRI Y OPTION – ITEM 56 EXEC – (ALL)</td>
<td></td>
</tr>
<tr>
<td>LOAD – ITEM 5 EXEC</td>
<td></td>
</tr>
<tr>
<td>DAP EDIT – ITEM 4 +9 EXEC</td>
<td></td>
</tr>
<tr>
<td>PRI P OPTION – ITEM 55 EXEC – (ALL)</td>
<td></td>
</tr>
<tr>
<td>PRI Y OPTION – ITEM 56 EXEC – (ALL)</td>
<td></td>
</tr>
<tr>
<td>LOAD – ITEM 5 EXEC</td>
<td></td>
</tr>
</tbody>
</table>
DEGRADED -X TRANSLATION

NOTE 1
Degraded -X occurs with loss of any two forward-firing jets (F1F, F2F, F3F). Perform these procedures in addition to nominal approach or separation procedures.
\MCC for additional procedure updates

NOTE 2
LO Z +Z translation (braking) couples strongly into +X translation. Forward-firing jet deselect/reselect at 75 ft not required

During approach, backout, breakout, or separation:
If LO Z +Z translation (braking) is required, perform 4-6 -X pulses for every 1 LO Z +Z pulse
Double the number of degraded -X pulses to achieve desired -X translation
LOSS OF FORWARD SIDE-FIRING JETS

NOTE 1
This failure occurs with the loss of F1L and F3L or F2R and F4R. Perform these procedures in addition to the nominal approach, or separation procedures. √MCC for additional procedure updates

NOTE 2
DAP disables ±Y translation. NO-GO for RPM, approach within 250 ft, or docking

During approach:
If failure occurs post-Ti:
    Do not trim VGO Y on MC1-4
    If in -Z TGT TRK, do not perform MANUAL OUT-OF-PLANE NULL [19A], 4-19

Do not approach inside 250 ft (interface to interface)

If inside 250 ft, perform VBAR CORRIDOR BACKOUT (CONTINGENCY OPS), 5-12 to RNG > 250 ft, with the following deltas:
    Maintain 8 deg corridor in X-axis direction
If 8 deg corridor is violated in X or Y direction and 250 ft > RNG > 150 ft, go to VBAR BREAKOUT (CONTINGENCY OPS), 5-14
When RNG = 250 ft, √MCC for further actions
NOTE
Failure occurs with the loss of any one of the following jets: F1D, F2D, F3D, or F4D. Perform these procedures in addition to nominal approach or separation procedures.
NO-GO for RPM

If VERNs failed, perform APPROACH and VBAR APPROACH Cue Cards with following deltas:
   Do not perform braking (LO Z or NORM Z) between 600 ft and the Vbar (PITCH ERR < 2 deg)
   When in Vbar attitude (PITCH ERR < 2 deg):
      DAP: NO LO Z, maintain NORM Z until docking
      For braking, use DAP B +Z (out) pulses at 10-sec intervals

   When RNG = 75 ft:
      10-sec intervals for +Z (out) pulses no longer required

   When RNG = 30 ft:
      Stationkeep:
         THC: +Z (out) as reqd to null Rdot
      When ready to initiate final approach:
         THC: -Z (in) as reqd to establish Rdot = -0.07 fps
         Note: This verifies the health of the remaining FxD jet
LOSS OF BOTH FxD JETS (SAME SIDE)

* IMMEDIATE ACTIONS *
* Perform the IMMEDIATE ACTIONS for the 2FxD CASE on the RCS *
* FAILURE DURING PROX OPS Cue Card *

NOTE 1
Failure occurs with loss of F1D and F3D, or F2D and F4D.
Perform these procedures in addition to nominal approach or separation procedures.
\^MCC for additional procedure updates

NOTE 2
NO-GO for RPM, approach within 250 ft, or docking.
DAP disables \(\pm Y\) translation.
Reselecting failed forward down-firing jet overrides DAP lockout of \(\pm Y\) translation.
Do not perform LO Z \(+Z\) translation(braking) or PCT.
LO Z \(+Z\) translation(braking) will couple into -Z translation(closing) and Y translation toward failed jets.
Norm Z DAP B braking on Vbar (when RNG > 75 ft) is to be performed at 10-sec intervals (pulses at 10 sec intervals minimizes structural resonance).
-Z translation couples into Y translation toward failed jets.
-X translation couples into -Z translation (closing) in LO Z PRI control.
DAP PRI P OPTION – TAIL, Y OPTION – ALL minimizes Y translation effects resulting from attitude control firings

1. If failure occurs prior to Ti, delay RNDZ until failed jet(s) recovered:
   Perform CONFIG PITCH OPTION TO TAIL [A]
   If failed jet(s) not recovered, \^MCC for breakout procedure >>

2. If failure occurs between Ti and TORVA initiation, continue to Rbar:
   Perform CONFIG PITCH OPTION TO TAIL [A]
   Do not trim VGO Y on MC1-4
   If in -Z TGT TRK, do not perform MANUAL OUT-OF-PLANE NULL [19A] 4-19
   After CONFIG FOR RBAR [20B], 4-20 perform CONFIG PITCH OPTION TO TAIL [A]
   Perform APPROACH (cue card) with following deltas:
   Bias Rdot 0.1 ft/s slower than cue card
   Do not perform LO Z \(+Z\) (braking) translation
   Perform CONFIG YAW OPTION TO ALL [B]
   Do not perform RPM
   Do not initiate TORVA
   If failed jet(s) not recovered by RNG = 500 ft,
   Go to RNDZ BREAKOUT (CONTINGENCY OPS), 5-18 with following deltas:
   Do not trim VGO Y >>

Cont next page
3. If failure occurs between TORVA initiation and Vbar arrival, continue approach:
   Perform CONFIG YAW OPTION TO ALL \[B\]
   Do not perform LO Z +Z (braking) translations
   If RNG < 345 cg-cg (280 dp-dp) prior to Vbar arrival, or if 8 deg corridor violated in Y-axis direction:
      Go to SHUTTLE NOSE IN-PLANE BREAKOUT (R < 700 ft), 5-16 >>
   When ready to ESTABLISH VBAR (PITCH ERR \(\leq\) 2 deg):
      DAP: No LO Z
      Use DAP B +Z (out) pulses at 10 second intervals to maintain Interface RNG > 250 ft
      Perform REGAIN Y CONTROL \[C\]
      Establish and maintain 8 deg corridor
      If failed jet(s) not recovered, go to step 6

4. If failure occurs after Vbar arrival, backout to RNG > 250 ft:
   Perform VBAR CORRIDOR BACKOUT (CONTINGENCY OPS), 5-12 with following deltas:
   After establishing opening rate:
      Config DAP to A9, B9
      Perform REGAIN Y CONTROL \[C\]
      Perform CONFIG DAP YAW OPTION TO ALL \[B\]
   When RNG > 75 ft,
      \(\sqrt{DAP}:\) No LO Z
      Use DAP B +Z (out) pulses at 10-second intervals to maintain opening RDOT
      If 8 deg corridor violated and 250 ft > RNG > 150 ft, go to step 6
      When RNG > 250 ft, do not perform -Z translation (maintain opening RDOT)
      If failed jet(s) not recovered, go to step 6

5. If failure occurs while docked, or during undocking/separation:
   \(\sqrt{MCC}\) for updates to UNDOCKING/SEP TIMELINE >>

6. Perform VBAR BREAKOUT (CONTINGENCY OPS), 5-14 with following deltas:
   \(\sqrt{DAP}:\) No LO Z
   In steps 2 and 3, do not select DAP LO Z
   After step 3:
      Perform DESELECT FAILED FORWARD DOWN-FIRING JET \[D\]
      DAP: LO Z
   In step 4, do not trim VGO Y

---

**CONFIG PITCH OPTION TO TAIL** \[A\]
\[GNC 20 DAP CONFIG\]
A PRI P OPTION – ITEM 15 EXEC (twice)(TAIL)
B PRI P OPTION – ITEM 35 EXEC (twice)(TAIL)

**REGAIN Y CONTROL** \[C\]
\(\sqrt{MCC}\) for which jet to reselect
\[GNC 23 RCS\]
RCS FWD – ITEM 1 EXEC (*)
JET DES FxD – ITEM XX EXEC (no *)
NOTE: Do not perform any THC: -Z (in) commands

**CONFIG YAW OPTION TO ALL** \[B\]
\[GNC 20 DAP CONFIG\]
A PRI Y OPTION – ITEM 16 EXEC (ALL)
B PRI Y OPTION – ITEM 36 EXEC (ALL)

**DESELECT FAILED FORWARD DOWN-FIRING JET** \[D\]
Deselect manually reselected jet
\[GNC 23 RCS\]
RCS FWD – ITEM 1 EXEC (*)
JET DES FxD – ITEM XX EXEC (*)
NOTE
This procedure overrides LOSS OF VERNIERS (ORB OPS, RCS) during rendezvous ops

1. Utilize VERN fail downmodes (PRI/ALT) specified in parentheses and follow VERN fail starred blocks per timeline. If VERN fail downmode not specified, use PRI Nose and Tail control

2. COAS NAV should not be performed if VERN fail

3. Additional braking pulses (+Z) may be reqd due to LO Z PRI attitude control cross coupling

4. PCT modes to FREE/VERN. In the event of failed capture, mode DAP to PRI per FAILED CAPTURE block, step 2

5. Twelve hooks reqd for mated attitude control in ALT
This Page Intentionally Blank
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISS RNDZ OPS DAP CONFIGURATIONS</td>
<td>6-2</td>
</tr>
<tr>
<td>POST-CONTACT THRUST (PCT) REFERENCE DATA</td>
<td>6-3</td>
</tr>
<tr>
<td>TARGETING DATA</td>
<td>6-4</td>
</tr>
<tr>
<td>POST NC</td>
<td>6-6</td>
</tr>
<tr>
<td>Ti</td>
<td>6-7</td>
</tr>
<tr>
<td>MC3</td>
<td>6-8</td>
</tr>
<tr>
<td>TCS REFLECTOR VISIBILITY DURING APPROACH</td>
<td>6-9</td>
</tr>
<tr>
<td>HHL AIMING LOCATIONS</td>
<td>6-10</td>
</tr>
<tr>
<td>SHUTTLE CENTERLINE TARGET</td>
<td>6-11</td>
</tr>
<tr>
<td>ISS ATTITUDE CONTROL SYSTEM MODING INDICATORS</td>
<td>6-12</td>
</tr>
<tr>
<td>RANGING CHARTS</td>
<td>6-13</td>
</tr>
<tr>
<td>COAS SUBTENDED ANGLES (DEG) VS RANGE (FT)</td>
<td>6-14</td>
</tr>
</tbody>
</table>
# ISS RNDZ OPS DAP CONFIGURATIONS

<table>
<thead>
<tr>
<th></th>
<th>RNDZ</th>
<th>TERMINAL PHASE</th>
<th>PROX OPS</th>
<th>DOCKING</th>
<th>SPEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROT RATE</td>
<td>0.200</td>
<td>0.500</td>
<td>0.050</td>
<td>0.050</td>
<td>0.130</td>
</tr>
<tr>
<td>ATT DB</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>RATE DB</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>0.20</td>
<td>0.10</td>
</tr>
<tr>
<td>ROT PLS</td>
<td>0.10</td>
<td>0.04</td>
<td>0.10</td>
<td>0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>COMP</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>P OPTION</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>TAIL</td>
</tr>
<tr>
<td>Y OPTION</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>TAIL</td>
</tr>
<tr>
<td>TRANS PLS</td>
<td>0.10</td>
<td>0.05</td>
<td>0.10</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>ALT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RATE DB</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>JET OPT</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>ALL</td>
<td>TAIL</td>
</tr>
<tr>
<td># JETS</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ON TIME</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>DELAY</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>VERN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROT RATE</td>
<td>0.016</td>
<td>0.200</td>
<td>0.050</td>
<td>0.050</td>
<td>0.130</td>
</tr>
<tr>
<td>ATT DB</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>RATE DB</td>
<td>0.020</td>
<td>0.020</td>
<td>0.020</td>
<td>0.020</td>
<td>0.020</td>
</tr>
<tr>
<td>ROT PLS</td>
<td>0.010</td>
<td>0.002</td>
<td>0.05</td>
<td>0.020</td>
<td>0.050</td>
</tr>
<tr>
<td>COMP</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>CNTL ACC</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## POST-CONTACT THRUST (PCT) REFERENCE DATA

### PBI FUNCTION WHENEVER IN OPS 2:

<table>
<thead>
<tr>
<th>PBI</th>
<th>When PCT is disarmed...</th>
<th>When PCT is armed...</th>
<th>When PCT is active...</th>
</tr>
</thead>
<tbody>
<tr>
<td>L or R AUTO SB PBI (PBI lit when PCT armed/active)</td>
<td>Arms PCT</td>
<td>Disarms PCT</td>
<td>Disarms and Terminates PCT ¹</td>
</tr>
<tr>
<td>L AUTO/MAN BF PBI or DAP: Spare PBI (PBI lit when PCT active)</td>
<td>No Effect</td>
<td>Modes to DAP: FREE/PRI and activates PCT ²</td>
<td>Terminates PCT ¹</td>
</tr>
<tr>
<td>DAP: FREE PBI</td>
<td>Normal Function</td>
<td>Normal Function</td>
<td>Terminates PCT ¹</td>
</tr>
</tbody>
</table>

¹ The following actions occur when PCT terminated by either automatic timeout or manual abort via above PBIs:
- PCT firing sequence terminated
- DAP moded to A/VERN
- DAP A,B configured to A9,B9 (Prox Ops DAP)

² Once PBI is depressed, PCT sequence will be initiated within maximum of 0.28 sec. The PCT sequence for ISS docking missions consists of 0.56 sec jet firing sequence, followed by 0.96 delay, completed with 0.88 sec jet firing sequence, giving total PCT sequence duration of 2.4 sec. Two nose jets and two tail jets fire during sequence

- PCT firing sequence can also be aborted by taking RHC/THC out of detent
### TARGETING DATA

<table>
<thead>
<tr>
<th>ALTITUDE</th>
<th>SPEC 34</th>
<th>ITEM NO</th>
<th>TGT NO</th>
<th>DESCRIPTION</th>
<th>T1 REL TO BASETIME</th>
<th>EL (DEG)</th>
<th>DT (MIN)</th>
<th>DX (KFT)</th>
<th>DY (KFT)</th>
<th>DZ (KFT)</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>9</td>
<td>NCC</td>
<td>-0/00:55:48</td>
<td>0</td>
<td>55.8</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>74.4</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>54.4</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>MC2</td>
<td>0/00:47:24</td>
<td>28.45</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BASETIME = TI TIG</td>
</tr>
</tbody>
</table>

| 150      | 9       | NCC     | -0/00:56:18 | 0 | 56.3 | -48.6 | 0 | +1.2 |
|          | 10      | Ti      | 0/00:00:00   | 0 | 75.1 | -0.9 | 0 | +1.8 |
|          | 11      | MC1     | 0/00:20:00   | 0 | 55.1 | -0.9 | 0 | +1.8 |
|          | 12      | MC2     | 0/00:48:06   | 28.46 | 27.0 | -0.9 | 0 | +1.8 |
|          | 13      | MC3     | 0/00:17:00   | 0 | 10.0 | -0.9 | 0 | +1.8 |
|          | 14      | MC4     | 0/00:27:00   | 0 | 13.0 | 0 | 0 | +0.6 |
|          | 19      | MC2 ON TIME | 0/00:00:00   | 0 | 27.0 | -0.9 | 0 | +1.8 |
|          |         |         |         |         |         |         |         |         |         |         | BASETIME = MC2 TIG |

| 170      | 9       | NCC     | -0/00:56:48 | 0 | 56.8 | -48.6 | 0 | +1.2 |
|          | 10      | Ti      | 0/00:00:00   | 0 | 75.7 | -0.9 | 0 | +1.8 |
|          | 11      | MC1     | 0/00:20:00   | 0 | 55.7 | -0.9 | 0 | +1.8 |
|          | 12      | MC2     | 0/00:48:42   | 28.66 | 27.0 | -0.9 | 0 | +1.8 |
|          | 13      | MC3     | 0/00:17:00   | 0 | 10.0 | -0.9 | 0 | +1.8 |
|          | 14      | MC4     | 0/00:27:00   | 0 | 13.0 | 0 | 0 | +0.6 |
|          | 19      | MC2 ON TIME | 0/00:00:00   | 0 | 27.0 | -0.9 | 0 | +1.8 |
|          |         |         |         |         |         |         |         |         |         |         | BASETIME = MC2 TIG |

| 190      | 9       | NCC     | -0/00:57:12 | 0 | 57.2 | -48.6 | 0 | +1.2 |
|          | 10      | Ti      | 0/00:00:00   | 0 | 76.3 | -0.9 | 0 | +1.8 |
|          | 11      | MC1     | 0/00:20:00   | 0 | 56.3 | -0.9 | 0 | +1.8 |
|          | 12      | MC2     | 0/00:49:18   | 28.85 | 27.0 | -0.9 | 0 | +1.8 |
|          | 13      | MC3     | 0/00:17:00   | 0 | 10.0 | -0.9 | 0 | +1.8 |
|          | 14      | MC4     | 0/00:27:00   | 0 | 13.0 | 0 | 0 | +0.6 |
|          | 19      | MC2 ON TIME | 0/00:00:00   | 0 | 27.0 | -0.9 | 0 | +1.8 |
|          |         |         |         |         |         |         |         |         |         |         | BASETIME = MC2 TIG |

<p>| 210      | 9       | NCC     | -0/00:57:42 | 0 | 57.7 | -48.6 | 0 | +1.2 |
|          | 10      | Ti      | 0/00:00:00   | 0 | 76.9 | -0.9 | 0 | +1.8 |
|          | 11      | MC1     | 0/00:20:00   | 0 | 56.9 | -0.9 | 0 | +1.8 |
|          | 12      | MC2     | 0/00:49:54   | 29.07 | 27.0 | -0.9 | 0 | +1.8 |
|          | 13      | MC3     | 0/00:17:00   | 0 | 10.0 | -0.9 | 0 | +1.8 |
|          | 14      | MC4     | 0/00:27:00   | 0 | 13.0 | 0 | 0 | +0.6 |
|          | 19      | MC2 ON TIME | 0/00:00:00   | 0 | 27.0 | -0.9 | 0 | +1.8 |</p>
<table>
<thead>
<tr>
<th>SPEC 34 ITEM NO</th>
<th>1</th>
<th>6</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGT ALTITUDE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCC</td>
<td>-0/00:58:12</td>
<td>0</td>
<td>58.2</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
</tr>
<tr>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>77.6</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>57.6</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>12</td>
<td>MC2</td>
<td>0/00:50:36</td>
<td>29.32</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
</tr>
<tr>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCC</td>
<td>-0/00:58:42</td>
<td>0</td>
<td>58.7</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
</tr>
<tr>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>78.2</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>58.2</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>12</td>
<td>MC2</td>
<td>0/00:51:12</td>
<td>29.55</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
</tr>
<tr>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCC</td>
<td>-0/00:59:06</td>
<td>0</td>
<td>59.1</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
</tr>
<tr>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>78.9</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>58.9</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>12</td>
<td>MC2</td>
<td>0/00:51:54</td>
<td>29.80</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
</tr>
<tr>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>290</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCC</td>
<td>-0/00:59:36</td>
<td>0</td>
<td>59.6</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
</tr>
<tr>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>79.5</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>59.5</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>12</td>
<td>MC2</td>
<td>0/00:52:30</td>
<td>30.03</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
</tr>
<tr>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>310</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>NCC</td>
<td>-0/00:60:06</td>
<td>0</td>
<td>60.1</td>
<td>-48.6</td>
<td>0</td>
<td>+1.2</td>
</tr>
<tr>
<td>10</td>
<td>Ti</td>
<td>0/00:00:00</td>
<td>0</td>
<td>80.1</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>11</td>
<td>MC1</td>
<td>0/00:20:00</td>
<td>0</td>
<td>60.1</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>12</td>
<td>MC2</td>
<td>0/00:53:06</td>
<td>30.25</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>13</td>
<td>MC3</td>
<td>0/00:17:00</td>
<td>0</td>
<td>10.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
<tr>
<td>14</td>
<td>MC4</td>
<td>0/00:27:00</td>
<td>0</td>
<td>13.0</td>
<td>0</td>
<td>0</td>
<td>+0.6</td>
</tr>
<tr>
<td>19</td>
<td>MC2 ON TIME</td>
<td>0/00:00:00</td>
<td>0</td>
<td>27.0</td>
<td>-0.9</td>
<td>0</td>
<td>+1.8</td>
</tr>
</tbody>
</table>
TCS REFLECTOR VISIBILITY DURING APPROACH

Some arrays and radiators are not shown for clarity of the TCS reflector information.

Expected TCS/Ref! Acquisition Range
Ref! #2 at TCS max range limit of 5000-6000 ft
NOTE: Refl #5 might be acquired before Ref = #2 (based on planar reflector performance flight history).

Refl #3 becomes less visible as Orbiter Y-LVLH position becomes more positive (into the page).
HHL AIMING LOCATIONS

NOTE: Array & Radiator Feathering Not Shown
Roll indicators are to be used with the vertical and horizontal lines on the CTVC monitor overlays. All six sets of roll indicators are sized to give roll misalignments in increments of 2 degrees. At least two sets of roll indicators on opposite sides of the target backplate are required during roll misalignment determination (see roll misalignment example). The outer roll indicators (extra set on horizontal axis) may not be used with the inner roll indicator.

Pitch and yaw indicators are to be used with the pointers on the stand-off cross (see pitch misalignment example). Both sets of pitch indicator and yaw indicators are sized to give misalignments in increments of 2, 3, 4, 5, and 6 degrees.
ISS ATTITUDE CONTROL SYSTEM MODING INDICATORS

- INDICATOR LIGHTS STEADY — ISS ACS ACTIVE
- INDICATOR LIGHTS FLASHING — ISS IN FREE DRIFT
- INDICATOR LIGHTS OFF — LIGHTS FAILED OR SOFTWARE OFF

<table>
<thead>
<tr>
<th>Unit/LEDs</th>
<th>MDM</th>
<th>Card/Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starboard LEDs 1 &amp; 2</td>
<td>LA-1</td>
<td>DIO Card Slot 4 Channel 13</td>
</tr>
<tr>
<td>Starboard LEDs 3 &amp; 4</td>
<td>LA-1</td>
<td>DIO Card Slot 4 Channel 14</td>
</tr>
</tbody>
</table>

Bottom View

LED Numbers

Starboard

Port

Non-functional

4 red LEDs on each plug-type connector

1.5 in.

1 3

2 4

Side View

PMA2

Orbiter overhead windows

Location wrt Orbiter Structure: X=572, Y=0, Z=548.6
<table>
<thead>
<tr>
<th>Deg</th>
<th>Full Truss*</th>
<th>Half Truss**</th>
<th>SM SA</th>
<th>Node2 Dia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>31739</td>
<td>18407</td>
<td>11178</td>
<td>1682</td>
</tr>
<tr>
<td>1</td>
<td>15869</td>
<td>9203</td>
<td>5589</td>
<td>841</td>
</tr>
<tr>
<td>1.5</td>
<td>10579</td>
<td>6135</td>
<td>3726</td>
<td>561</td>
</tr>
<tr>
<td>2</td>
<td>7934</td>
<td>4601</td>
<td>2794</td>
<td>421</td>
</tr>
<tr>
<td>2.5</td>
<td>6347</td>
<td>3681</td>
<td>2235</td>
<td>336</td>
</tr>
<tr>
<td>3</td>
<td>5289</td>
<td>3067</td>
<td>1863</td>
<td>280</td>
</tr>
<tr>
<td>3.5</td>
<td>4533</td>
<td>2629</td>
<td>1596</td>
<td>237</td>
</tr>
<tr>
<td>4</td>
<td>3966</td>
<td>2300</td>
<td>1397</td>
<td>210</td>
</tr>
<tr>
<td>4.5</td>
<td>3525</td>
<td>2044</td>
<td>1241</td>
<td>187</td>
</tr>
<tr>
<td>5</td>
<td>3172</td>
<td>1840</td>
<td>1117</td>
<td>168</td>
</tr>
<tr>
<td>5.5</td>
<td>2883</td>
<td>1672</td>
<td>1015</td>
<td>152</td>
</tr>
<tr>
<td>6</td>
<td>2643</td>
<td>1533</td>
<td>931</td>
<td>140</td>
</tr>
<tr>
<td>6.5</td>
<td>2439</td>
<td>1414</td>
<td>859</td>
<td>129</td>
</tr>
<tr>
<td>7</td>
<td>2264</td>
<td>1313</td>
<td>797</td>
<td>120</td>
</tr>
<tr>
<td>7.5</td>
<td>2113</td>
<td>1225</td>
<td>744</td>
<td>112</td>
</tr>
<tr>
<td>8</td>
<td>1980</td>
<td>1149</td>
<td>698</td>
<td>105</td>
</tr>
<tr>
<td>8.5</td>
<td>1864</td>
<td>1081</td>
<td>656</td>
<td>98</td>
</tr>
<tr>
<td>9</td>
<td>1760</td>
<td>1020</td>
<td>620</td>
<td>93</td>
</tr>
<tr>
<td>9.5</td>
<td>1667</td>
<td>967</td>
<td>587</td>
<td>88</td>
</tr>
<tr>
<td>10</td>
<td>1583</td>
<td>918</td>
<td>558</td>
<td>84</td>
</tr>
<tr>
<td>10.5</td>
<td>1507</td>
<td>874</td>
<td>531</td>
<td>80</td>
</tr>
<tr>
<td>11</td>
<td>1438</td>
<td>834</td>
<td>507</td>
<td>76</td>
</tr>
<tr>
<td>11.5</td>
<td>1375</td>
<td>798</td>
<td>484</td>
<td>73</td>
</tr>
<tr>
<td>12</td>
<td>1318</td>
<td>764</td>
<td>464</td>
<td>70</td>
</tr>
</tbody>
</table>

* Full Truss from S5 to P6
**Half Truss is the Port side of ISS from P6 to center of ISS
RENDEZVOUS TOOLS

CCTV CONFIG FOR DOCKING/UNDOCKING ................................................................. 7-2
RNDZ TOOLS CHECKOUT ......................................................................................... 7-4
TROUBLESHOOTING ............................................................................................... 7-5
HAND-HELD LIDAR CHECKOUT .............................................................................. 7-6
STOW ......................................................................................................................... 7-6
OPS ............................................................................................................................. 7-7
RPOP INITIALIZATION .............................................................................................. 7-8
OPS ............................................................................................................................. 7-9
FUNCTION KEY SUMMARY ...................................................................................... 7-11
KEYSTROKE SUMMARY ......................................................................................... 7-15
TRAJECTORY DATA SOURCE OPTIONS .................................................................. 7-16
TCS ACTIVATION ....................................................................................................... 7-18
MANUAL ACQUISITION ............................................................................................ 7-19
DEACTIVATION ......................................................................................................... 7-20
LIMITS ....................................................................................................................... 7-21
TRAD FAIL RANGE AND RANGE RATE DETERMINATION ..................................... 7-21
NOMINAL OPS .......................................................................................................... 7-21
RADAR FAIL ............................................................................................................. 7-22
TCS FAIL .................................................................................................................. 7-22
HHL FAIL .................................................................................................................. 7-22
PCMMU/WINDECOM FAIL ..................................................................................... 7-23
PGSC FAIL (NO PROP, NO TCS) .............................................................................. 7-23
CCTV CONFIG FOR DOCKING/UNDOCKING

1. **ACTIVATION**
   Perform ACTIVATION (Cue Card, TV)
   √ Monitors set to USCAN – ON
   √ MCC: VSU Sync/Async configuration

   Pwr up Cameras for Docking/Undocking:
   CENTERLINE
   Camrs A,C,D
   Camr B
   Install Monitor Sunshades

2. **SET CCTV CAMERA FUNCTIONS**
   2.1 For Centerline Camera:
      ALC pb – press
      AVG pb – press
      √ GAM BLK STR – ON
      √ COLOR BAL – SUN
   2.2 For Cameras A,C,D:
      ALC pb – press
      AVG pb – press
      GAM BLK STR – ON
      √ COLOR BAL – SUN
      SHUTTER – ON pb press as reqd
   2.3 For Camera B:
      ALC pb – press
      AVG pb – press
      LT LEVEL pb – press
      NIGHT pb – press
      GAM BLK STR – ON

3. **SET CAMERA ZOOM SETTINGS**

<table>
<thead>
<tr>
<th>CAMERA</th>
<th>ZOOM</th>
<th>OVERLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centerline</td>
<td>40.0° (Corridor)</td>
<td>Corridor</td>
</tr>
<tr>
<td></td>
<td>10.1° (full zoom)</td>
<td>Grid</td>
</tr>
</tbody>
</table>

4. **MONITOR SETUP**
   MON 1,2 L-DATA – on
   C-DATA – grn
   XHAIR – grn

5. **CAMERA SETUP – CAMERA A,D**
   A7
   MON 2 – Camr A (Range Ruler), D (Backup Range Ruler)
   Zoom = 74.4° FOV (full unzoom), Focus = 12 ft
   Pan: as reqd to center ODS in monitor (see figure next page)
   Tilt: as reqd until bottom of ODS Interface Ring touches bottom of screen (see figure next page)

6. **FINAL CONFIG FOR APPROACH AND UNDOCKING/SEP**
   MON 1 – CENTERLINE
   MON 2 – RANGE RULER

   Install CORRIDOR overlay:
   Use green XHair to center overlay

   Install RANGE RULER overlay:
   Place contact ring tangent line on top of ODS Contact Ring (see figure next page)
Use Top/Front Of ISS Ring

Use Bottom/Back Of ISS Ring

Contact ring tangent line

Camera FOV

Camr A,D Range Ruler Vew
Approach Config
RNDZ TOOLS CHECKOUT

1. **MCC uplink to TGT SV**
   - **GNC 33 REL NAV**
   - RNDZ NAV ENA – ITEM 1 EXEC (*)

2. **RNDZ TOOLS** connected per PGSC Usage Chart (if available) or UTILITY OUTLET PLUG-IN PLAN ORBIT CONFIGURATION (REF DATA FS, UTIL PWR)

3. Perform WINDECOM OPS – ACT (ORB OPS, PGSC)

4. Perform RPOP INITIALIZATION, 7-8
   - On MCC GO:

5. Perform TCS ACTIVATION, steps 1 and 2, 7-18

6. Perform HAND-HELD LIDAR CHECKOUT, 7-6

7. When checkout complete, perform TCS DEACTIVATION, 7-20, then:
   - Exit RPOP – [SHIFT]/[F10], then:
   - HHL PWR SW – OFF, then:
   - Temp stow Rndz Tools as reqd

8. **GNC 33 REL NAV**
   - RNDZ NAV ENA – ITEM 1 EXEC (no *)
RNDZ TOOLS TROUBLESHOOTING

Notify MCC of problem; then perform each step from appropriate procedure, one at a time, until functionality restored. Troubleshooting steps assume RPOP is configured to receive PCMMU data via the RS-422 data cable.

TCS CADS NOT RECEIVING TCS DATA
1. \Windows system tray for PC card icon to verify good connection to MCIU/Quatech card
2. \TX/RX end of TCS data cable connected to MCIU/Quatech card COM2
3. \Correct port config in TCS CADS s/w
4. Quit and restart TCS CADS
5. Change out TCS data cable and MCIU/Quatech card
6. Reboot PGSC and restart TCS CADS
7. On MCC GO, perform TCS DEACTIVATION, 7-20, followed by TCS ACTIVATION, 7-18
8. MCC

RPOP NOT RECEIVING PCMMU DATA
1. Windows system tray for PC card icon to verify good connection to MCIU/Quatech card
2. \Correct end of RS-422 Y data cable connected to MCIU/Quatech card COM4
3. \Correct port config in RPOP s/w
4. Quit and restart RPOP
5. Change out RS-422 Y data cable and MCIU/Quatech card
6. Reboot PGSC and restart RPOP
7. MCC

RPOP NOT RECEIVING HHL DATA
1. \HHL cable securely connected to HHL unit and COM1
2. \RPOP port config set to COM1 for HHL
3. Quit and restart RPOP
4. Reboot RPOP PGSC and restart RPOP
5. Connect HHL cable to backup RPOP PGSC COM1 to check data flow. Swap to backup HHL data cable or backup HHL as reqd
6. MCC

RPOP NOT RECEIVING TCS DATA (TCS CADS IS RECEIVING DATA ON SAME PGSC)
1. \RPOP configured to receive TCS data via DLL
2. Quit and restart RPOP
3. Reboot RPOP PGSC and restart RPOP and TCS CADS
4. MCC
HAND-HELD LIDAR CHECKOUT

1. Unstow HHL, Battery Pack(s), and RS-232 cable
   - Connect RS-232 cable from HHL to PGSC
   - Plug Battery Pack into HHL
   - Verify RPOP program enabled per RPOP INITIALIZATION, 7-8

2. Perform HAND-HELD LIDAR OPS, 7-7

3. Take multiple (~10) Range and Velocity measurements using top center of aft PLB bulkhead or S0 Truss Segment as TGT
   - HHL data received by RPOP (HHL trajectory source must be selected)
     - Range check:
       - √ Range from aft port window to bulkhead = 60 ft
       - or
       - √ Range from overhead window to S0 Truss Segment = ~44 ft
     - Velocity check:
       - Depress trigger for 5 sec
       - √ Velocity = 0.0 fps
     - Report range and velocity discrepancies to MCC
     - Self-Test: Press and hold Test Mode button, √8.8.8.8. Select range

HAND-HELD LIDAR STOW

- Power sw – OFF
- Remove RS-232 cable
- Unplug Battery Pack
- Stow HHL, Battery Pack(s), and RS-232 cable
HAND-HELD LIDAR OPS

Power sw – ON

NOTE
If msg ‘LoB’ or flashing [8888] on display or irregular tone emitted, replace battery

Display Intensity knob – Adjust intensity to minimum acceptable level

Select Range or Velocity decimal place by toggling RANGE/VELOCITY buttons
  Range pb – 1 ft or 0.1 ft
  Velocity pb – 0.1 fps or 0.01 fps

Center red dot on TGT

Depress trigger for each measurement
Hold trigger for velocity measurements

Velocity accuracy increases with trigger hold duration:

<table>
<thead>
<tr>
<th>Duration</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.15</td>
</tr>
<tr>
<td>1.0</td>
<td>0.06</td>
</tr>
<tr>
<td>2.0</td>
<td>0.03</td>
</tr>
<tr>
<td>5.0</td>
<td>0.01</td>
</tr>
</tbody>
</table>

To verify lock-on (if desired):
  1. Push Test Mode button
  2. Center red dot on TGT
  3. Depress and hold trigger. Pitch on tone proportional to received signal strength
  4. Press Range or Velocity button to return to Operational Mode

Error Codes:
  E01 Never acquired target because target out of range or target too close
  E02 Excessive percentage of total laser pulses in measurement sample unsatisfactory
  E03 Excessive number of consecutive laser pulses in measurement sample unsatisfactory
RPOP INITIALIZATION

1. Power on RPOP/TCS PGSCs
   √Data, power cables installed per PGSC Usage Chart (if available) or UTILITY OUTLET PLUG-IN PLAN, ON-ORBIT CONFIG (REF DATA FS, UTIL PWR)

2. Select Shuttle Apps Icon
   Select RPOP folder
   Select appropriate RPOP icon
   [RPOP logo display]
   Initialization

3. Enter current MET:
   Days>___/Hrs>___:Min>___:Sec>___
   Click [OK] to continue

   NOTE
   Time synchronized on [OK]

4. √RPOP window title bar – verify mission specific scenario
   √MET correct (upper right corner of trajectory display)

5. √PCM selected – status displayed above F6 in Function Key Menu
   If “No PCM” displayed, select PCM mode with [CNTL]/[F6]
   √RPOP is receiving PCMMU data
   Verify no “RPOP is not receiving PCMMU data” message on display
   If RPOP not receiving PCMMU data, √MCC and refer to RNDZ TOOLS TROUBLESHOOTING, 7-5

   NOTE
   If no target state vector on board, expect error message
   If RNDZ NAV not enabled, expect bad relative state
1. Select desired trajectory/sensor data as needed (F1 thru F4 keys)  
Reference TRAD FAIL RANGE AND RANGE RATE DETERMINATION, 7-21,  
for recommended RPOP and TRAD configuration

2. Configure HHL settings  
   [CNTL]/[F4] HHL  
   √Appropriate aimpoint configuration per table

<table>
<thead>
<tr>
<th>HHL Aim Point</th>
<th>Angle Source</th>
<th>Angle Aim Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual phase</td>
<td>Tgt CG</td>
<td>Dock Cam</td>
</tr>
<tr>
<td>+Vbar</td>
<td>Node2-Fwd/Top</td>
<td>Dock Cam</td>
</tr>
<tr>
<td>Flyaround</td>
<td></td>
<td>As appropriate</td>
</tr>
</tbody>
</table>

Configure Vert(deg) and Horiz(deg) angles to 0 deg  
Lock Vert(deg) and Horiz(deg) angles (click box below input field)  
   NOTE: user may unlock angles and input angle data if desired  
   Click [Update Settings] button to close HHL window

3. Use [F5] to display/hide Rdot window  
   Click [sources] button to select/deselect additional data sources  
   NOTE: nominal configuration is to display “HHL/dt” and “HHLRaw”

4. Adjust configuration as required  
   Use [SHIFT]/[F1] thru [SHIFT]/[F4] to show/hide trajectory plots  
   NOTE: cannot hide currently selected trajectory/sensor  
   Use [CNTL]/[F8] to cycle through Points of Reference (POR)  
   Use [F11] to cycle thru declutter levels  
   Use [F12] to snap a range ruler mark; [SHIFT]/[F12] to delete it  
   Use [SPACEBAR] to toggle on-screen Function Key Menu ON/OFF  
   Move axes or zoom in/out per RPOP KEYSTROKE SUMMARY, 7-15  
   For other options, reference RPOP FUNCTION KEY SUMMARY, 7-11

   NOTE  
   Display of some data input windows (such as [CNTL]/[F4] HHL)  
   prevents background sensor processing (e.g., TCS NAV).  
   Minimize the time that these data input windows are displayed as  
   much as practical.

   Sensor processing is NOT affected by display of the Rdot or  
   THC-to-Go windows or associated sub-windows

5. To exit RPOP program – [SHIFT]/[F10]
* Configure TCS reflectors
  * [CNTL]/[F10]  [RPOP Configuration]
  * Select [TCS/Refl...] button  [Select TCS/Reflector Set]
  * Select appropriate Reflector No.
  * NOTE: for a single TCS unit, TCS No. selection is irrelevant

* Configure RPOP Guidance, if desired for approach
  * [CNTL]/[F5]  [Select Guidance Type]
  * Select desired flight phase to start prox ops guidance sequence
  * If +Rbar Acquisition,
    * If no RPM, uncheck “with RPM” option
  * If RPM stationkeeping (SK) required,
    * Select “with SK until MET”
    * Enter RPM start window open time (per APPROACH cue card)

* Update target attitude
  * √MCC for target attitude data
  * [SHIFT]/[F6]  [Enter Target Vehicle Attitude Info]
  * Input appropriate reference frame and attitude (PYR Seq)
    * Pitch>_____  Yaw>_____  Roll>_____
  * Input appropriate attitude rate mode and rates
  * NOTE: nominal dock and undock settings are “LVLH to Tgt Body”,
    * 0 / 0 / 0 deg attitude, and “LVLH Hold” rate

* Input subtended angle data
  * [F5]  [Rdot]
  * Click [sources] button, then select “SubAng” option
  * Click [SubAng] button or [F6] to open data input window
  * NOTE: timetag is recorded when [SubAng] or [F6] button is clicked
  * Input appropriate structural element and angle (measured via COAS or
    * CCTV with SUB ANG RULER overlay)
  * Click [OK] to incorporate mark, or [Back 1] to delete previous mark

* Configure comm ports
  * [CNTL]/[F10]  [RPOP Configuration]
  * Select [Comm Ports...] button  [RPOP Communications Setup]
  * Configure com ports and DLL
    * NOTE: TCS source must be set to DLL
    * HHL source must be set to COM1
    * PCMMU source if TLMServer (network or serial) is DLL
    * PCMMU source if no TLMServer (serial) is COM4

* For assistance with other options, √MCC, [F10]  [Help], or RPOP FUNCTION
* KEY SUMMARY, 7-11
## RPOP FUNCTION KEY SUMMARY

### TRAJECTORY DATA KEYS (Columns F1 → F4)

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Description</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>[F1→F4]</td>
<td>PRIME KEY</td>
<td>Make this Trajectory Prime Trajectory</td>
</tr>
<tr>
<td>(SV, RR, HHL, CCTV or TCS)</td>
<td></td>
<td>- Only one trajectory can be Prime at a time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Prime Trajectory has orbiter graphics, predictors, and color-coordinated digital data</td>
</tr>
<tr>
<td>[SHIFT]/[F1→F4]</td>
<td>SHOW/HIDE KEY</td>
<td>Show or Hide this Trajectory (toggle)</td>
</tr>
<tr>
<td>(Show/Hide)</td>
<td></td>
<td>- Prime Trajectory cannot be hidden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Background processing of trajectory continues even when hidden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Exception: HHL trajectory data will not prompt for user input when hidden)</td>
</tr>
<tr>
<td>[CTRL]/[F1→F4]</td>
<td>DATA KEY</td>
<td>Configure/input data for trajectory</td>
</tr>
<tr>
<td>(Data)</td>
<td></td>
<td>- Allows user to configure specific Trajectory Data Source Options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Allows user to input manual data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Allows user to reconfigure function key to another Trajectory Data Source</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Duplicate Trajectory Data Source configurations are permitted (e.g., HHL could be configured for both F3 and F4, if desired)</td>
</tr>
</tbody>
</table>

**NOTE**

Although duplicate data source configurations are permitted, duplicate automatic data modes (namely, State Vector, RR Auto, TCS Auto and TCS Nav) are not permitted. In such a situation, duplicated auto mode option grayed out in Trajectory Data Source Options dialog box.
## GENERAL FUNCTION KEYS (Columns F5 → F12)

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>[F5]</strong></td>
<td>RDOT WINDOW</td>
</tr>
<tr>
<td>(Rdot)</td>
<td>Toggles display of Rdot Window</td>
</tr>
<tr>
<td><strong>[SHIFT][F5]</strong></td>
<td>ORBITER ATTITUDE</td>
</tr>
<tr>
<td>(Orb Att)</td>
<td>Update orbiter attitude and attitude rate</td>
</tr>
<tr>
<td><strong>[CTRL][F5]</strong></td>
<td>GUIDANCE</td>
</tr>
<tr>
<td>(Guid)</td>
<td>Select guidance cues on demand</td>
</tr>
<tr>
<td>Available options are:</td>
<td></td>
</tr>
<tr>
<td>+Rbar acquisition – provides THC recommendations for acquiring the +Rbar. Includes options for targeting pre-TORVA conditions, pre-RPM conditions, or a pre-RPM stationkeep</td>
<td></td>
</tr>
<tr>
<td>TORVA – provides THC recommendations for performing the +Rbar to +Vbar transfer</td>
<td></td>
</tr>
<tr>
<td>+Vbar Acquisition – provides THC recommendations for acquiring the +Vbar in preparation for final approach</td>
<td></td>
</tr>
<tr>
<td>Glideslope Approach – provides THC recommendations for flying the final approach along a glideslope</td>
<td></td>
</tr>
<tr>
<td>CW Targeting – given a burn time, transfer time, and desired LVLH position, CW Targeting will provide required THC inputs</td>
<td></td>
</tr>
<tr>
<td>LVLH Velocity Null – provides THC recommendations for nulling LVLH velocities in each direction</td>
<td></td>
</tr>
<tr>
<td>Average Rdot – information for timed approach</td>
<td></td>
</tr>
<tr>
<td><strong>[F6]</strong></td>
<td>SUBTENDED ANGLE</td>
</tr>
<tr>
<td>(Sub Ang)</td>
<td>Enter subtended angle in Rdot Window to get range and range rate. Only active when SubAng source active on Rdot Window</td>
</tr>
<tr>
<td><strong>[SHIFT][F6]</strong></td>
<td>TARGET ATTITUDE</td>
</tr>
<tr>
<td>(Tgt Att)</td>
<td>Update Target attitude and attitude rate</td>
</tr>
<tr>
<td><strong>[CTRL][F6]</strong></td>
<td>PCMMU MODE</td>
</tr>
<tr>
<td>(PCMMU)</td>
<td>No PCM mode (displays No PCM)</td>
</tr>
<tr>
<td>Requires orbiter attitude data to be entered manually with each sensor mark</td>
<td></td>
</tr>
<tr>
<td>PCM MODE (displays PCM)</td>
<td></td>
</tr>
<tr>
<td>Orbiter attitude is automatically computed using PCMMU data</td>
<td></td>
</tr>
<tr>
<td><strong>[F7]</strong></td>
<td>VIEW</td>
</tr>
<tr>
<td>(View)</td>
<td>If Tgt-Centered LVLH, cycle through views: XZ, XY, YZ</td>
</tr>
<tr>
<td>If Orb-Centered LVLH, cycle through views: XZ, XY, YZ, CAM</td>
<td></td>
</tr>
<tr>
<td>View identification displayed upper left-hand corner of Trajectory Display</td>
<td></td>
</tr>
<tr>
<td><strong>[SHIFT][F7]</strong></td>
<td>OVERLAY</td>
</tr>
<tr>
<td>(Ovrlay)</td>
<td>Cycle through displays of overlays</td>
</tr>
<tr>
<td><strong>[F8]</strong></td>
<td>REFERENCE FRAME</td>
</tr>
<tr>
<td>(Tgt/Orb)</td>
<td>Toggle display between Tgt-Centered LVLH plot and Orb-Centered LVLH plot</td>
</tr>
<tr>
<td><strong>[SHIFT][F8]</strong></td>
<td>LO Z</td>
</tr>
<tr>
<td>(Low Z)</td>
<td>Toggle jet-select between No Low Z and Low Z for making THC “What If” inputs. Displays Low Z</td>
</tr>
<tr>
<td><strong>[CTRL][F8]</strong></td>
<td>POINT OF REFERENCE</td>
</tr>
<tr>
<td>(POR)</td>
<td>Cycle through preselected orbiter Point-Of-Reference to Target Point-Of-Reference sets (e.g., CG to CG, Dock Port to Dock Port)</td>
</tr>
</tbody>
</table>
GENERAL FUNCTION KEYS (Columns F5 → F12) (Cont)

[F9] THC CLEAR
    (THC Clr) Clear THC “What if” inputs from the Prime Trajectory

[SHIFT]/[F9] TRAJECTORY CLEAR
    (TrajClr) Clear Prime Trajectory history of all but 2 most recent data inputs

[CTRL]/[F9] BACK 1
    (Back 1) Delete last data input from the Prime Trajectory

[F10] HELP
    (Help) Access on-line help information

[SHIFT]/[F10] EXIT
    (Exit) Save output files and exit RPOP program

[CTRL]/[F10] RPOP CONFIGURATION
    (Config) Configure following RPOP options:

    Debug
    Enable serial port I/O debug text to be displayed. Displays Debug

    Data Freq...
    Change frequency of automatic acceptance (plotting) of PCM data (SV or RR Auto) or TCS data (TCS Auto)

    Predictors...
    Change number and/or time increment of displayed predictors

    Update MET...
    Change the mission elapsed time

    Altitude...
    Change altitude of target vehicle

    Comm Ports...
    Reconfigure serial ports and/or the DLL

    TCS/Refl...
    Select TCS ID number (1-2) and reflector ID number (1-6)

    Views...
    Enable/disable Tgt- and Orb-Centered views

NOTE
Currently displayed view (both Tgt- and Orb-Centered) cannot be disabled

THC “What if”...
Select DAP setting (trans pulse size) to be used for THC “What if” inputs
Options include: Rndz DAP, Prox Ops DAP, and a User-Configurable DAP
GENERAL FUNCTION KEYS (Columns F5 → F12) (Cont)

[F11] DECLUTTER
Cycle RPOP displays through three different levels of declutter

[F12] RANGE RULER SNAP
Computes range rate based on time between snaps and assumed delta range interval. Feature available only if I-loaded delta range interval has non zero value

[SHIFT]/[F12] RANGE RULER CLEAR
Clears range ruler display from screen. Feature available only if I-loaded delta range interval has non zero value
RPOP KEYSTROKE SUMMARY

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[CTRL]/[←] or l</td>
<td>Move Vertical axis left</td>
</tr>
<tr>
<td>[CTRL]/[→] or r</td>
<td>Move Vertical axis right</td>
</tr>
<tr>
<td>[CTRL]/[↑] or u</td>
<td>Move Horizontal axis up</td>
</tr>
<tr>
<td>[CTRL]/[↓] or d</td>
<td>Move Horizontal axis down</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[CTRL]/[PGUP]</td>
<td>Zoom IN on Trajectory Display</td>
</tr>
<tr>
<td>[CTRL]/[X]/[PGUP]</td>
<td>Zoom IN on X axis only</td>
</tr>
<tr>
<td>[CTRL]/[Y]/[PGUP]</td>
<td>Zoom IN on Y axis only</td>
</tr>
<tr>
<td>[CTRL]/[Z]/[PGUP]</td>
<td>Zoom IN on Z axis only</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[CTRL]/[PGDN]</td>
<td>Zoom OUT on Trajectory Display</td>
</tr>
<tr>
<td>[CTRL]/[X]/[PGDN]</td>
<td>Zoom OUT on X axis only</td>
</tr>
<tr>
<td>[CTRL]/[Y]/[PGDN]</td>
<td>Zoom OUT on Y axis only</td>
</tr>
<tr>
<td>[CTRL]/[Z]/[PGDN]</td>
<td>Zoom OUT on Z axis only</td>
</tr>
</tbody>
</table>

**NOTE**
Use [SHIFT] in combination with any of above keystrokes in order to scale/move axes in finer increments. Each view may be independently scaled and/or autoscaled.

<table>
<thead>
<tr>
<th>Key Combination</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>[CTRL]/[HOME]</td>
<td>Resume autoscaling and reset scale</td>
</tr>
<tr>
<td>[SPACEBAR]</td>
<td>Toggle on-screen Function Key Menu ON/OFF</td>
</tr>
</tbody>
</table>

THC “What if” (-Z sense) Keystrokes (Prime Trajectory only)

<table>
<thead>
<tr>
<th>Function</th>
<th>DAP A8</th>
<th>DAP B8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z IN</td>
<td>[SHIFT]/[→]</td>
<td>→</td>
</tr>
<tr>
<td>Z OUT</td>
<td>[SHIFT]/[←]</td>
<td>←</td>
</tr>
<tr>
<td>X UP</td>
<td>[SHIFT]/[↑]</td>
<td>↑</td>
</tr>
<tr>
<td>X DOWN</td>
<td>[SHIFT]/[↓]</td>
<td>↓</td>
</tr>
</tbody>
</table>
TRAJECTORY DATA SOURCE OPTIONS

SV  STATE VECTOR
   Options include:
   State Vector – Enable automatic acceptance of the Onboard Nav states
   None – Turn State Vector processing off
   Config... – Reconfigure Trajectory Data Source for this function key

RR  RENDEZVOUS RADAR
   Options include:
   Manual – Manually enter Radar RNG, EL and AZ
   Auto – Enable automatic acceptance of Radar RNG, EL and AZ
   None – Turn Radar processing off
   Config... – Reconfigure the Trajectory Data Source for this function key

HHL  HANDHELD LASER
Manually select HHL Aim Point, Angle Source, and Angle Source Aim Point
Manually enter HHL RNG and two Angle Source angles (an in-plane and out-of-plane)

   Options include:
   Lock – Hold the in-plane angle constant (locked) for each HHL mark
   Lock – Hold the out-of-plane angle constant (locked) for each HHL mark
   Update Settings – Accept configuration changes to Aim Points, Angle Source, and Lock option without incorporating a trajectory mark
   Config... – Reconfigure the Trajectory Data Source for this function key

   Angle Source options include:
   Fwd CCTV, Aft CCTV, Dock Cam, COAS, Radar, TCS, Other

   NOTE
   Manual inputs reqd for all angle sources except Radar and TCS. If Radar or TCS selected, angles will be automatically snapped (if available). Other camera is optional, and may be completely specified via I-load

   Aim Point options include:
   HHL Aim Pt, Tgt CG, Point of Interest #1, Point of Interest #2, Point of Interest #3

   NOTE
   HHL Aim Pt is always available and may be completely specified via I-load. Tgt CG is always available Points of Interest 1-3 are optional, and may be completely specified via I-load. For Angle Source Radar, angle aim point is Tgt CG. For Angle Source TCS, angle aim point is current reflector number

CCTV  CLOSED CIRCUIT TELEVISION CAMERAS
Manually enter FWD and AFT CCTV tilt angles
Options include:
Config... – Reconfigure Trajectory Data Source for this function key
TRAJECTORY CONTROL SENSOR

Options include:

- Manual – Manually enter TCS RNG, EL and AZ
- Auto – Enable automatic acceptance of TCS RNG, EL and AZ
- Nav – Enable TCS NAV (Kalman Filtering)
  - Display Resids and Ratios
  - Force Measurements
  - Re-Initialize on [OK]
- None – Turn TCS processing off
- Config – Reconfigure the Trajectory Data Source for this function key
TCS ACTIVATION

1. CADS BOOTUP
   √ RPOP/TCS PGSC powered ON
   PGSC  √ Data cables installed per PGSC Usage Chart (if available) or UTILITY OUTLET
         PLUG-IN PLAN ORBIT CONFIGURATION (REF DATA FS, UTIL PWR)

   SHUTTLE APPS
   > TCS

2. TCS PWRUP/INITIALIZATION
   L12  TCS PWR – ON (tb-gray)
        * If tb – bp, cycle sw  *
        * If no joy, notify MCC *

   PGCS  TCS Self Test

<table>
<thead>
<tr>
<th>Status</th>
<th>Override</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutter:</td>
<td>Passed</td>
</tr>
<tr>
<td>Z Latch:</td>
<td>Passed</td>
</tr>
<tr>
<td>CW Laser:</td>
<td>Passed</td>
</tr>
<tr>
<td>Pulse Laser:</td>
<td>Passed</td>
</tr>
</tbody>
</table>

   √ MSG:  INITIALIZATION COMPLETE
        * If error msg received during initialization, *
        * ∇MCC                              *

   TCS OPS

   | Mode:       | Stby     |
   | Z Latch:    | Unlocked |
   | Pulse:      | Avail    |
   | CW:         | Active   |
        * If not in config, *
        * ∇MCC            *

3. TIME REFERENCE SELECT
   TCS C&D1
   Commands > Send TCS Time

   CAD Clock
   Enter MET
   > Send
   √ Messages – ‘TCS Clock has been set’

4. ENABLE AUTO ACQUISITION
   TCS C&D1
   > Config > Automatic > Acquisition
   Update ‘Maximum Range’ for auto acquisition to begin as desired
   > OK
   Inform MCC of range entered
TCS MANUAL ACQUISITION

1. ACQUIRE

PGSC

√Pulse: Avail
√CW: Active

TCS C&DI
> Macros > ACQUISITION

Target Acquisition Data
Input current estimate of range to Target and zero for Azimuth and Elevation:
RANGE > ________________
AZIMUTH > ________________
ELEVATION > ________________

√95% RANGE GATE – (no X)
> SEND

TCS OPS
If first acquisition:
√Shutter – Open (after ~22 sec)

* If shutter fails to open: *
* > Commands > Standby *
* > Commands > Open Shutter *
* > Commands > Acquire *

√Data – Good (and active tracking data)

* If TCS not tracking and no RPOP or Auto Seed *
* Update disabled, *
* TCS C&DI *
* > Commands > Acquire *
* Update Range estimate and zero AZ & EL *
* > Send *

2. ENABLE AUTO ACQUISITION

√Data – Good (and active tracking data)

TCS C&DI
> Config > Automatic
If Seed Update – (no √)
> Seed Update
√Maximum Range (ft): 5000
>OK
> Config > Automatic
If Acquisition – (no √)
> Acquisition
√Maximum Range (ft): 5000
> OK
> Config > Automatic
√Initialization – (√)
√Seed Update – (√)
√Acquisition – (√)
TCS DEACTIVATION

1. **SHUTDOWN TCS**
   - **PGSC**
     - [TCS C&DI]
     - > Macros > SHUTDOWN

     * If error msg received during SHUTDOWN, *
     * \textendash \textendash \textendash \textendash MCC

   **TCS OPS**
   \textendash \textendash \textendash \textendash Shutter: Closed (takes ~22 sec)

   * If shutter fails to close: *
   * \textendash \textendash \textendash \textendash > Commands > Close shutter

If Final TCS deactivation for mission:

2. **SECURE Z AXIS**
   - **PGSC**
     - [TCS C&DI]
     - > Commands > Lock Z Axis Latch

   **TCS OPS**
   \textendash \textendash \textendash \textendash Z Latch: Locked

   * If Z Latch fails to lock: *
   * \textendash \textendash \textendash \textendash If Z Latch: Transit
   * \textendash \textendash \textendash \textendash > Commands > Lock Z Axis
   * \textendash \textendash \textendash \textendash Latch
   * \textendash \textendash \textendash \textendash Otherwise
   * \textendash \textendash \textendash \textendash \textendash \textendash \textendash \textendash \textendash \textendash \textendash MCC

3. **POWERDOWN TCS**
   - **L12**
     - TCS PWR – OFF (tb-bp)

     * If tb – gray, cycle sw *
     * If no joy, notify MCC

4. **SHUTDOWN CADS**
   - **PGSC**
     - [TCS C&DI]
     - > File > Exit TCS CAD
TCS LIMITS

<table>
<thead>
<tr>
<th>TEMPERATURE (degC)</th>
<th>LOW ALERT</th>
<th>HIGH ALERT</th>
<th>AUTOSAFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW Laser</td>
<td>-40.0</td>
<td>45.0</td>
<td>50.0</td>
</tr>
<tr>
<td>APD</td>
<td>-40.0</td>
<td>65.0</td>
<td>70.0</td>
</tr>
<tr>
<td>CPU</td>
<td>-40.0</td>
<td>80.0</td>
<td>85.0</td>
</tr>
<tr>
<td>DC Power</td>
<td>-40.0</td>
<td>80.0</td>
<td>85.0</td>
</tr>
<tr>
<td>Galvos</td>
<td>-40.0</td>
<td>80.0</td>
<td>85.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VOLTAGES</th>
<th>LOW ALERT</th>
<th>HIGH ALERT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>4.75</td>
<td>5.25</td>
</tr>
<tr>
<td>5.5V</td>
<td>5.00</td>
<td>6.00</td>
</tr>
<tr>
<td>12V</td>
<td>11.00</td>
<td>12.75</td>
</tr>
<tr>
<td>15V</td>
<td>14.25</td>
<td>15.50</td>
</tr>
</tbody>
</table>

TRAD FAIL RANGE AND RANGE RATE DETERMINATION

1. Maintain a prime and a backup range and rdot estimate
2. Prime and backup range and rdot estimates shall have independent sensor sources
3. Maintain prime and backup RPOP PGSCs
4. Refer to tables below for the recommended prime and backup source/configuration for NOMINAL OPS, RADAR FAIL, TCS FAIL, HHL FAIL, PCMMU/WINDECOM FAIL, and PGSC FAIL (No RPOP, No TCS) scenarios

NOMINAL OPS

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source: Configuration</th>
<th>Backup Source: Configuration</th>
</tr>
</thead>
</table>
| 1. Manual Takeover thru TCS lock-on (R > 3000 ft assumed for TCS nominal lock-on*) | State data: SV | Rdot window: HHL/Dt
NOTE: Configure HHL angle source to Dock Cam and lock angles to 0 |
| 2. TCS lock-on thru 15 ft | State data: TCS NAV | Rdot window: HHL/Dt
NOTE: Configure HHL angle source to Dock Cam and lock angles to 0 |
| 3. 15 ft thru dock | Raw data: TCS Raw | Rdot Window: Range Ruler (F12) |

*If no joy on TCS lock-on by 1200 ft, start subtended angle operations so that subtended angle estimates can back up the HHL/Dt inside of 1000 ft
RADAR FAIL

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source:</th>
<th>Backup Source:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Takeover thru TCS lock-on*</td>
<td>Rdot window: HHL/Dt</td>
<td>Rdot window: HHL/Dt</td>
</tr>
<tr>
<td>NOTE: RPOP State data: (HHL/SV) can be suspect</td>
<td>NOTE: Configure HHL angle source to Dock Cam and lock angles to 0</td>
<td></td>
</tr>
<tr>
<td>2. TCS lock-on thru 15 ft</td>
<td>State data: TCS NAV</td>
<td>Rdot window: Subtended angles</td>
</tr>
<tr>
<td>NOTE: Configure HHL angle source to Dock Cam and lock angles to 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. 15 ft thru dock</td>
<td>Raw data: TCS Raw</td>
<td>Rdot Window: Range Ruler (F12)</td>
</tr>
</tbody>
</table>

*Start Subtended angle ops after the radar fail correction if no joy on TCS lock-on

TCS FAIL

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source:</th>
<th>Backup Source:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Takeover thru ~1200 ft</td>
<td>State data: SV</td>
<td>Rdot window: HHL/Dt</td>
</tr>
<tr>
<td>NOTE: Transition from phase 1 to phase 2 should be gradual. Start transition at ~1500 ft and complete it prior to 1000 ft braking gate</td>
<td>NOTE: Configure HHL angle source to Dock Cam and lock angles to 0</td>
<td></td>
</tr>
<tr>
<td>2. ~1200 ft thru 15 ft</td>
<td>Rdot window: HHL Dt</td>
<td>Rdot window: Subtended angles</td>
</tr>
<tr>
<td>NOTE: Spec 33: FLTR, and State data: HHL can be suspect</td>
<td>NOTE: Configure HHL angle source to Dock Cam and lock angles to 0</td>
<td>Spec 33: Raw Radar*</td>
</tr>
<tr>
<td>3. 15 ft thru dock</td>
<td>Rdot Window: Range Ruler (F12)</td>
<td>Rdot window: HHL/Dt**</td>
</tr>
</tbody>
</table>

*Radar data will be unusable at close ranges. The range at which the data becomes unusable is dependent on the target size, geometry, and physical characteristics, but can not be accurately predicted. For ISS the RR can become too noisy to use at ranges as great as 1000 ft

**HHL will not work if the aimpoint surface is closer than 12 feet (5 ft DP-DP)

HHL FAIL

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source:</th>
<th>Backup Source:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Takeover thru TCS lock-on</td>
<td>State data: SV</td>
<td>Rdot window: Subtended Angle</td>
</tr>
<tr>
<td>2. TCS lock-on thru 15 ft</td>
<td>State data: TCS NAV</td>
<td>Spec 33: Raw RR*</td>
</tr>
<tr>
<td>3. 15 ft thru dock</td>
<td>Raw data: TCS Raw</td>
<td>Rdot Window: Range Ruler (F12)</td>
</tr>
</tbody>
</table>

*Radar data will be unusable at close ranges. The range at which the data becomes unusable is dependent on the target size, geometry, and physical characteristics, but cannot be accurately predicted. For ISS the RR can become too noisy to use at ranges as great as 1000 ft
### PCMMU/WINDECOM FAIL

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source: Configuration</th>
<th>Backup Source: Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Takeover thru ~1200 ft</td>
<td>Spec 33: FLTR</td>
<td>Rdot window: HHL/Dt&lt;br&gt;Note: RPOP prompts user for Orb attitude after 1st HHL mark. Enter P/Y/R= (90/0/0)* and check “Do not prompt for attitude”&lt;br&gt;TCS CADS: Raw TCS (pulse active)&lt;br&gt;Note: Range data good, rdot can be quite noisy&lt;br&gt;Note: Resize and reposition the RPOP window so that the TCS mode (pulse/CW) is visible</td>
</tr>
<tr>
<td>NOTE: Transition from phase 1 to 2 should be gradual. Start transition at ~1500 ft and complete it prior to 1000 ft braking gate&lt;br&gt;Note: RPOP state data is bad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ~1200 ft thru TCS CW lock-on (~800 ft)</td>
<td>Rdot window: HHL/Dt&lt;br&gt;Note: RPOP uses the last two marks with Dt &gt; 30 sec to calculate the Rdot estimate</td>
<td>TCS CADS: Raw TCS (pulse active)&lt;br&gt;Note: Range data good, rdot can be quite noisy&lt;br&gt;Note: Rdot window: Generic&lt;br&gt;Note: Manually enter raw TCS range marks. RPOP uses the last two marks with Dt &gt; 30 sec to calculate the Rdot estimate</td>
</tr>
<tr>
<td>NOTE: RPOP State data is bad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. TCS CW lock-on (~800 ft) thru Vbar arrival</td>
<td>TCS CADS: Raw TCS (cw active)</td>
<td>Rdot window: HHL/Dt</td>
</tr>
<tr>
<td>NOTE: RPOP State data is bad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Vbar arrival thru 15 ft</td>
<td>TCS CADS: Raw TCS (cw active) and/or&lt;br&gt;State Data: TCS AUTO&lt;br&gt;Note: Check Orb Att = (90/0/0), and set TCS frequency to 30 sec[CNTRL F10]</td>
<td>Rdot window: HHL/Dt</td>
</tr>
<tr>
<td>5. 15 ft thru dock</td>
<td>TCS CADS: TCS Raw (cw active)</td>
<td>Rdot window: Range Ruler(F12)</td>
</tr>
</tbody>
</table>

*Orbiter attitude displayed on RPOP will not be correct until maneuver to Vbar attitude is complete. Until Vbar arrival, do not use the RPOP trajectory data other than the data in the Rdot Window

### PGSC FAIL (NO RPOP, NO TCS)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Prime Source: Configuration</th>
<th>Backup Source: Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manual Takeover thru ~1200 ft (noisy RR angles)</td>
<td>Spec 33: SV, Raw RR</td>
<td>For range – HHL (back of unit): Raw HHL&lt;br&gt;For Rdot – Rdot vs. ΔRng/Δt Cue Card: Record Raw HHL range and times on cue card</td>
</tr>
<tr>
<td>2. ~1200 ft thru 15 ft</td>
<td>For Range: HHL (back of unit): Raw HHL(short pulls)&lt;br&gt;For Rdot: HHL (back of unit): Raw HHL(long pulls)&lt;br&gt;Note: HHL will not work if the aimpoint surface is closer than 12 feet (5 ft DP-DP)</td>
<td>For range – Subtended Angle table(6-13): COAS or Centerline Cam subtended angle&lt;br&gt;For Rdot – Rdot vs. ΔRng/Δt Cue Card: Record subtended angle range and times on cue card</td>
</tr>
<tr>
<td>3. 15 ft thru dock</td>
<td>For Range: HHL Ruler Overlay: Camera A/D&lt;br&gt;For Rdot: HHL (back of unit): Raw HHL* (long trigger pulls)&lt;br&gt;Rdot table on Range Ruler Overlay: Dt between 1 ft DRange</td>
<td></td>
</tr>
</tbody>
</table>

*RPOP trajectory data other than the data in the Rdot Window

For Range – HHL (back of unit): Raw HHL
For Rdot – Rdot vs. ΔRng/Δt Cue Card: Record Raw HHL range and times on cue card

For range – Subtended Angle table(6-13): COAS or Centerline Cam subtended angle
For Rdot – Rdot vs. ΔRng/Δt Cue Card: Record subtended angle range and times on cue card

*HHL will not work if the aimpoint surface is closer than 12 feet (5 ft DP-DP)
This Page Intentionally Blank
APDS
APDS NOMINAL

DOCKING MECHANISM INITIALIZATION ........................................................................  8-4
POWERUP ...............................................................................................................  8-5
POWERDOWN ....................................................................................................  8-6
PREP .....................................................................................................................  8-7
UNDOCKING PREP ...............................................................................................  8-7
DOCKING RING EXTENSION ..................................................................................  8-8
RETRACTION (NOT MATED) ...................................................................................  8-9
AIRLOCK FAN ACT AND ODS VOLUME PREP ....................................................  8-10
POST DOCKING HATCH LEAK CHECK ..................................................................  8-11
AIRLOCK PREP FOR INGRESS – BYPASS CONFIG .............................................  8-12
– BOOSTER FAN ACTIVE ....................................................................................  8-12a
DOCKING MECHANISM INITIALIZATION

A6L  1.  cb ESS 1BC SYS PWR CNTL SYS 1 – cl
       2CA SYS PWR CNTL SYS 2 – cl
       1BC DEP SYS 1 VENT ISOL – cl
       2CA DEP SYS 2 VENT ISOL – cl
       MN A DEP SYS 1 VENT – cl
       B DEP SYS 2 VENT – cl
       MN A,MN B DOCK LT (four) – cl
       MN A,MN B,MN C LOGIC (six) – cl
       √PMA 2/3 GRP 1,GRP 2 HOOKS (eight) – op
       √SYS PWR MN A,MN B (two) – ctr
       √SYS 1(SYS 2 tb (two) – OFF
       √PYRO PWR MN A,MN C (two) – OFF
       √PMA 2/3 HOOKS SYS A,SYS B (two) – ctr
       √GRP 1,2 tb (two) – bp
       √PSU PWR MN A,MN B (two) – OFF
       √LT TRUSS,VEST (four) – OFF

A7L  2.  √CONTROL PANEL POWER A,B,C (three) – OFF
       √HEATERS/DCU POWER (three) – OFF
       √APDS POWER A_DS,B_DS,C_DS (three) – OFF
       √A_DS,B_DS,C_DS lt (three) – lt off
       √STATUS lt (eighteen) – lt off
       √PYROS A_p,B_p,C_p (three) – OFF
       √A_p,B_p,C_p lt (three) – lt off
       √PYRO CIRCUIT PROTECT OFF lt – lt off

A6L  3.  SYS PWR MN A,MN B (two) – ON (hold 5 sec)
       √SYS 1(SYS 2 tb (two) – ON
       √VEST DEP VLV SYS 1,SYS 2 VENT (two) – ctr (tb-CL)
       √VEST DEP VLV SYS 1,SYS 2 VENT ISOL (two) – ctr (tb-CL)
       cb ESS 1BC DEP SYS 1 VENT ISOL – op
       2CA DEP SYS 2 VENT ISOL – op
       MN A DEP SYS 1 VENT – op
       B DEP SYS 2 VENT – op
       √VEST DEP VLV SYS 1,SYS 2 VENT tb (two) – bp
       √VEST DEP VLV SYS 1,SYS 2 VENT ISOL (two) – bp

ML86B:C  cb MNA EXT ARLK HTR VEST Z1/2/3 – cl
DOCKING MECHANISM POWERUP

A6L 1. √SYS PWR SYS 1, SYS 2 tb (two) – ON
    PSU PWR MN A, MN B (two) – ON
    If in Undocking timeline and ODS VEST/PMA HATCH LEAK CHECK complete:
    √VEST DEP VLV SYS 1(SYS 2) VENT – ctr (tb-OP)

A7L 2. HEATERS/DCU POWER (three) – ON
    √HTR/DCU PWR – A/B/C
    √RNG DR BUS – 1/2
    √HKS DR BUS – 1/2
    √DAMPER BUS – 1/2
    √FIXER BUS – 1/2

A7L 3. CONTROL PANEL POWER A, B, C (three) – ON
    √CNTL PNL PWR – A/B/C

A7L 4. APDS POWER A_dS, B_dS, C_dS (three) – ON
    √A_dS, B_dS, C_dS lt (three) – lt on

A7L 5. LAMP TEST pb – push
    √STATUS lt (eighteen) – lt on
    √PYRO CIRCUIT PROTECT OFF lt – lt on

CRT,A7L * If CNTL PNL PWR A(C) tlm blank, and STATUS lts nominal, *
    * tlm failure only >>

CRT * If CNTL PNL PWR B tlm blank:
A7L * CONTROL PANEL POWER A(C) – OFF
    * POWER ON pb – push (√ and report STATUS lts to MCC)*
    * If any STATUS lt on, tlm failure only
    * CONTROL PANEL POWER A(C) – ON
DOCKING MECHANISM POWERDOWN

**SM 167 DOCKING STATUS**

A7L 1. √STATUS lt (eighteen) – It off

2. APDS POWER A_DS, B_DS, C_DS (three) – OFF
   √A_DS, B_DS, C_DS lt (three) – It off

CRT √PWR (three) – blank

A7L 3. CONTROL PANEL POWER A, B, C (three) – OFF

CRT √CNTL PNL PWR A, B, C (three) – blank

A7L 4. HEATERS/DCU POWER (three) – OFF

CRT √HTR/DCU PWR (three) – blank

A6L 5. PSU PWR MN A, MN B (two) – OFF

6. If post-undocking:
   VEST DEP VLV SYS 1(SYS 2) VENT – CL (tb-CL)
   ISOL – CL (tb-CL)
   cb MNA DEP SYS 1 VENT – op
   √MNB DEP SYS 2 VENT – op
   ESS 1BC DEP SYS 1 VENT ISOL – op
   √2CA DEP SYS 2 VENT ISOL – op

ML86B:C

MNA EXT ARLK HTR VEST Z1/2/3 – op
MNB EXT ARLK HTR VEST Z1/2/3 – cl
DOCKING PREP

SM 167 DOCKING STATUS

A6L 1. LTS TRUSS AFT,FWD (two) – ON
VEST PORT,STBD (two) – ON (if reqd)

A7L 2. POWER ON pb – push
   √ON lt – lt on
   √RING ALIGNED lt – lt on
   √INITIAL POSITION lt – lt on
   √HOOKS 1,HOOKS 2 OPEN lt (two) – lt on
   √LATCHES CLOSED lt – lt on

CRT √CLUTCH – blank/SLIP

UNDOCKING PREP

A6L 1. LTS TRUSS FWD,AFT (two) – ON (as reqd)
VEST PORT,STBD (two) – ON (if reqd)

A7L 2. POWER ON pb – push
   √ON lt – lt on
   √RING ALIGNED lt – lt on
   √READY TO HOOK lt – lt on
   √INTERF SEALED lt – lt on
   √HOOKS 1,HOOKS 2 CLOSED lt (two) – lt on
   √LATCHES OPEN lt – lt on
   √RING FINAL POSITION lt – lt on
DOCKING RING EXTENSION

SM 167 DOCKING STATUS

A7L 1. POWER ON pb – push
    √ON lt – lt on
    √RING ALIGNED lt – lt on
    √HOOKS 1,HOOKS 2 OPEN lt (two) – lt on
    √LATCHES CLOSED lt – lt on
    √RING FINAL POSITION lt – lt on

CRT √CLUTCH – LOCK/blank

A7L 2. APDS CIRC PROT OFF pb – push
    √CIRCUIT PROTECT OFF lt – lt on

0:00 3. RING OUT pb – push
0:10    √FINAL POSITION lt – lt off

CRT √DRV CMD – ON
    √FIXERS – ON
    √PETAL POS BASE (three) – incr

A7L * If RING INITIAL POSITION lt failed on (ring stops after 1 sec, *
    CRT * and CLUTCH – blank/SLIP): *
A7L *    FIXER OFF pb – push *
    *    √FIXERS OFF lt – lt on *
    *    RING OUT pb – push *

CRT *    When PETAL POS BASE (three) = 76 ± 3%: *
A7L *    POWER OFF pb – push *
    *    ON pb – push *
    *    √FIXERS OFF lt – lt off *
    *    APDS CIRC PROT OFF pb – push *
    *    CIRCUIT PROTECT OFF lt – lt on *
    *    RING OUT pb – push *
    *    After 1 sec: *

CRT *    √RING DRV CMD – OFF *
    * *

A7L *    If RING FORWARD POSITION lt failed on (ring stops after *
    *    10 sec): *

A7L *    RING OUT pb – push *
    *    Within 10 sec: *
    *    APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF *
    *    APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON *
    *    CIRC PROT OFF pb – push *
    *    √CIRCUIT PROTECT OFF lt – lt on *
    *    When RING INITIAL POSITION lt – lt on: *
    *    RING OUT pb – push *
3:40 A7L 4. √RING INITIAL POSITION lt – lt on
CRT  √PETAL POS BASE (three): 76 ± 3%
3:50 √CLUTCH – blank/SLIP

* If CLUTCH – blank/blank:
  * √APDS CIRCUIT PROTECT OFF lt – lt on
  * √RING OUT pb – push (expect 1 sec of drive), wait
    * 10 sec
 CRT  * √RING DRV CMD – OFF

* If CLUTCH – LOCK/blank:
  * √RING INITIAL POSITION lt – lt on
  * √FIXERS OFF lt – lt off
  * √APDS CIRCUIT PROTECT OFF lt – lt on
  * √RING OUT pb – push (expect 1 sec of drive), wait
    * 10 sec
 CRT  * √RING DRV CMD – OFF

* If not CLUTCH – blank/SLIP:
  * √MCC

A7L 5. POWER OFF pb – push
  √STATUS lt (eighteen) – lt off

DOCKING RING RETRACTION (NOT MATED)

SM 167 DOCKING STATUS
A7L 1. POWER ON pb – push
  √ON lt – lt on
  √RING ALIGNED lt – lt on
  √INITIAL POSITION lt – lt on
  √HOOKS 1,HOOKS 2 OPEN lt (two) – lt on
  √LATCHES CLOSED lt – lt on
 CRT  √CLUTCH – blank/SLIP

0:00 A7L 2. RING IN pb – push
  √INITIAL POSITION lt – lt off
 CRT  √CLUTCH – LOCK/blank

A7L
  * If RING FINAL POSITION lt failed on (ring stops after
    * 10 sec):
    * RING IN pb – push

3:40 CRT
  * When PETAL POS BASE = 5 ± 3% and not decr:
    * Wait 10 sec, then:
      * A7L
        * POWER OFF pb – push
          * √STATUS lt (eighteen) – lt off >>

3:40 A7L 3. √RING FINAL POSITION lt – lt on
3:50 √DRV CMD – OFF

A7L 4. POWER OFF pb – push
  √STATUS lt (eighteen) – lt off
AIRLOCK FAN ACT AND ODS VOLUME PREP

MIDDK  1. Disconnect bypass duct from middeck floor fitting. Remove cap from Airlock Fan outlet and temp stow. Unstow, install diffuser on middeck floor fitting

TNL EXT  2. Attach bypass duct to Airlock Fan outlet

MA73C:G  3. √cb AC1,2 ARLK TNL FAN A,B (six) – cl

MO13Q  4. AIRLK FAN A(B) – ON

EXT A/L  5. √Airflow at top of external airlock halo and muffler

If in Approach CC perform the following:
6. Unstrap centerline camera diffuser flex duct from EXT A/L wall
   Attach flex duct to camera bracket to direct air flow to window
   If required, tape diffuser open

AW18A  7. LTG FLOOD 1(3,4) – OFF

MO13Q  8. AIRLK 2 – OFF/ON

MIDDK  9. Close Inner Hatch:
   Position handle to preclosing posn per decal
   Hatch – rotate about hinge and push
   Handle – CCW to LATCH
   Lock lever to LOCKED

10. Equal vlv (two) – OFF, install caps

MO10W  11. √14.7 CAB REG INLET SYS 1, SYS 2 (two) vlv – CL
POST DOCKING HATCH LEAK CHECK

NOTE
ISS will concurrently perform a leak check of the PMA2 volume

1. Notify MCC and ISS, “Beginning initial Hatch leak checks”

MO10W 2. √14.7 CAB REG INLET SYS 1, SYS 2 (two) vlv – CL

SM 177 EXTERNAL AIRLOCK

3. Record EXT A/L PRESS: _____ psia
   Record A/L-VEST ΔP: _____ psid

4. Wait 20 min
   * If EXT A/L Press ≤ previously recorded – 0.16 psia
   * Notify MCC-H (possible leakage from EXT A/L)
   * If A/L-VEST ΔP ≤ previously recorded – 0.16 psid
   * Notify MCC-H (possible leakage through Hatches)

AIRLOCK PREP FOR INGRESS – BYPASS CONFIG

Inner Hatch

1. Equal vlv caps (two) – remove

2. Equal vlv (two) – NORM

3. √Hatch ΔP < 0.2 psid

4. Open Hatch per decal

5. Equal vlv (two) – OFF, reinstall caps

6. ARLK 2 – ON/OFF

7. ARLK FAN A(B) – OFF

TNL EXT MIDDK

8. Disconnect bypass duct from Airlock Fan outlet
   - Remove diffuser from middeck floor fitting and temp stow
   - Connect bypass duct to middeck floor fitting. Unstow, install cap on Airlock Fan outlet

AW18A

9. As required, LTG FLOOD 1(3,4) – ON

EXT A/L

10. Unstrap centerline camera diffuser flex duct from camera bracket
    - Stow duct along Stbd top of EXT A/L wall (in straps)

11. √Airflow at top of external airlock halo

12. Go to P/TV02 DOCK, DEACTIVATION, step 2 (PHOTO/TV, SCENES)
1. Equal vlv caps (two) – remove
2. Equal vlv (two) – NORM
3. √ Hatch, ΔP < 0.2 psid
4. Open Hatch per decal
5. Equal vlv (two) – OFF, reinstall caps

6. AIRLK 2 – ON/OFF
7. ARLK FAN A(B) – OFF

8. Remove diffuser cap from Aft Middeck Floor Fitting. Unstow fwd flex duct from Tunnel extension wall. Attach one end to airlock booster fan muffler inlet. Attach free end to Aft Middeck Floor Fitting.
9. Remove mylar sleeve/tape from outer screen of Fwd Middeck Floor Fitting and temp stow

10. AIRLK FAN A(B) – ON
11. As required, LTG FLOOD 1(3,4) – ON

12. Unstrap Centerline Camera diffuser flex duct from camera bracket Stow duct along stbd top of EXT A/L wall (in straps)

13. √ Airflow at top of external airlock halo

14. Go to P/TV02 DOCK, DEACTIVATION, step 2 (PHOTO/TV, SCENES)
APDS OFF-NOMINAL

POWER FAILED OFF (STATUS LTS OFF) ............................................................... 8-14
DAMPING FAILED ON ................................................................................. 8-15
CAPTURE LT FAILED ON .......................................................................... 8-15
FIXERS FAILED ON ..................................................................................... 8-16
    OFF LT FAILED ON ............................................................................... 8-18
    OFF ......................................................................................................... 8-18
RING FAILS TO DRIVE .............................................................................. 8-19
    DRV CMD OFF ...................................................................................... 8-19
    FINAL POSITION LT FAILED ON ........................................................... 8-20
FORCE RING ALIGNMENT ......................................................................... 8-20
CLUTCH NOT 'LOCK' ................................................................................. 8-21
APDS CIRCUIT PROTECT OFF LT FAILED OFF ........................................... 8-21
HOOKS 1(2) OPEN LT FAILED ON ................................................................. 8-21
    NOT CLOSED WITHIN SINGLE MTR TIME ......................................... 8-22
READY TO HOOK LT FAILED ON ................................................................. 8-23
HOOKS 1(2) CLOSED LT FAILED ON ............................................................ 8-23
LATCHES OPEN LT FAILED OFF ................................................................. 8-24
APDS POWER FAILED OFF ......................................................................... 8-24
DOCKING MECHANISM DEMATE/REMTAE ............................................... 8-25
ODS HOOKS OPEN – CONTINGENCY ............................................................ 8-27
PMA 2/3 HOOKS OPEN – CONTINGENCY ..................................................... 8-30
APDS FAILED CAPTURE RECONFIG ............................................................ 8-33
PMA 2/3 HOOKS CLOSE ............................................................................... 8-35
    OPEN ....................................................................................................... 8-37
POWER FAILED OFF (STATUS LTS OFF)

CAUTION
Pre-Contact, if all STATUS Its off, NO-GO for docking until power recovered. Initiate VBAR CORRIDOR BACKOUT (CONTINGENCY OPS) while attempting power recovery steps.

A7L

1. CONTROL PANEL POWER A – OFF
   POWER ON pb – push
   If expected STATUS Its on:
   Continue in DOCKING SEQUENCE (Cue Card), as reqd >>

2. CONTROL PANEL POWER A – ON
   APDS POWER A_DS – OFF
   POWER ON pb – push
   If expected STATUS Its on:
   If Undocking:
   Continue in UNDOCKING OPERATIONS, as reqd >>
   If Docking:
   Continue in DOCKING SEQUENCE (Cue Card) through step 16, then:
   Go to POWER FAILED OFF (STATUS LTS OFF), step 4

3. APDS POWER A_DS – ON
   B_DS – OFF
   POWER ON pb – push
   If STATUS lt (eighteen) – lt off:
   \MCC >>
   If expected STATUS Its on:
   If Undocking:
   Continue in UNDOCKING OPERATIONS, as reqd >>
   If Docking:
   Continue in DOCKING SEQUENCE (Cue Card) through step 16, then:
   Go to POWER FAILED OFF (STATUS LTS OFF), step 4

4. APDS CIRC PROT OFF pb – push
   \CIRCUIT PROTECT OFF lt – lt on
   OPEN LATCHES pb – push
   \LATCHES CLOSED lt – lt off
   APDS POWER C_DS – OFF
   A_DS,B_DS (two) – ON
   POWER ON pb – push
   If STATUS lt (eighteen) – lt off:
   APDS POWER B_DS – OFF
   C_DS – ON
   POWER ON pb – push
   APDS CIRC PROT OFF pb – push
   \CIRCUIT PROTECT OFF lt – lt on
   Go to DOCKING SEQUENCE (Cue Card), step 17
DAMPING FAILED ON

CAUTION
Pre-Contact, NO-GO for docking if DAMPING – ON. Initiate VBAR CORRIDOR BACKOUT (CONTINGENCY OPS) while attempting to power off dampers

SM 167 DOCKING STATUS

A6L 1. PSU PWR MN A,MN B (two) – OFF
CRT If DAMPING – ON (TLM failure only):
A6L PSU PWR MN A,MN B (two) – ON
Continue approach or DOCKING SEQUENCE (Cue Card), as reqd >>

2. PSU PWR MN A – ON
CRT If DAMPING – ON:
A6L PSU PWR MN A – OFF
MN B – ON
CRT If DAMPING – OFF:
Pre-Contact:
Continue Approach
Post-Capture, wait 5 sec then:
A6L PSU PWR MN A (MN B) – ON
Continue in DOCKING SEQUENCE (Cue Card), with the following change:
After step 3:
PSU PWR MN A (MN B) – OFF >>

3. PSU PWR MN A,MN B (two) – OFF
Pre-Contact:
Continue Approach
Post-Capture, wait 5 sec then:
PSU PWR MN A,MN B (two) – ON
Continue in DOCKING SEQUENCE (Cue Card), starting in step 8

CAPTURE LT FAILED ON

CAUTION
Pre-Contact, NO-GO for docking if DAMPING – ON. Initiate VBAR CORRIDOR BACKOUT (CONTINGENCY OPS) while attempting to power off dampers

SM 167 DOCKING STATUS
If Pre-Contact:

CRT If DAMPING – OFF:
Continue Approach >>
If DAMPING – ON:
A6L PSU PWR MN A,MN B (two) – OFF
Continue Approach
Post-Capture (no physical separation):
PSU PWR MN A,MN B (two) – ON
Continue in DOCKING SEQUENCE (Cue Card), as reqd
FIXERS FAILED ON

**CAUTION**
Pre-Contact, **NO-GO** for docking if RING FIXERS – ON.
Initiate VBAR CORRIDOR BACKOUT (CONTINGENCY OPS) while attempting to power off fixers

**SM 167 DOCKING STATUS**

<table>
<thead>
<tr>
<th>A7L</th>
<th>1. POWER OFF pb – push</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CRT</td>
</tr>
<tr>
<td></td>
<td>If RING FIXERS – ON:</td>
</tr>
<tr>
<td></td>
<td>A7L</td>
</tr>
<tr>
<td></td>
<td>POWER ON pb – push</td>
</tr>
<tr>
<td></td>
<td>Continue Approach or</td>
</tr>
<tr>
<td></td>
<td>DOCKING SEQUENCE (Cue Card), as reqd</td>
</tr>
<tr>
<td></td>
<td>&gt;&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A7L</th>
<th>2. POWER ON pb – push</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CRT</td>
</tr>
<tr>
<td></td>
<td>If RING FIXERS – ON:</td>
</tr>
<tr>
<td></td>
<td>A7L</td>
</tr>
<tr>
<td></td>
<td>APDS POWER A_{DS} – ON</td>
</tr>
<tr>
<td></td>
<td>B_{DS} – OFF</td>
</tr>
<tr>
<td></td>
<td>CRT</td>
</tr>
<tr>
<td></td>
<td>If RING FIXERS – OFF:</td>
</tr>
<tr>
<td></td>
<td>Pre-Contact:</td>
</tr>
<tr>
<td></td>
<td>Continue Approach</td>
</tr>
<tr>
<td></td>
<td>Post-Capture, continue in DOCKING SEQUENCE (Cue Card), as reqd, with the following change:</td>
</tr>
<tr>
<td></td>
<td>After DOCKING SEQUENCE (Cue Card), step 16:</td>
</tr>
<tr>
<td></td>
<td>A7L</td>
</tr>
<tr>
<td></td>
<td>APDS POWER A_{DS} (B_{DS}) – ON &gt;&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A6L</th>
<th>3. APDS POWER B_{DS} – ON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PSU PWR MN A,MN B (two) – OFF</td>
</tr>
<tr>
<td></td>
<td>If post-contact:</td>
</tr>
<tr>
<td></td>
<td>√MCC for subsequent steps</td>
</tr>
<tr>
<td></td>
<td>Continue Approach</td>
</tr>
<tr>
<td></td>
<td>Post-capture wait 7 seconds, then:</td>
</tr>
<tr>
<td></td>
<td>A7L</td>
</tr>
<tr>
<td></td>
<td>APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF</td>
</tr>
<tr>
<td></td>
<td>A6L</td>
</tr>
<tr>
<td></td>
<td>PSU PWR MN A,MN B (two) – ON</td>
</tr>
<tr>
<td></td>
<td>CRT</td>
</tr>
<tr>
<td></td>
<td>√DAMPING – ON</td>
</tr>
</tbody>
</table>

**DISABLE DAMPING**

<table>
<thead>
<tr>
<th>A6L</th>
<th>4. When no relative motion [PETAL POS BASE (three) not changing for 60 sec]:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A6L</td>
</tr>
<tr>
<td></td>
<td>PSU PWR MN A,MN B (two) – OFF</td>
</tr>
<tr>
<td></td>
<td>A7L</td>
</tr>
<tr>
<td></td>
<td>APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON</td>
</tr>
<tr>
<td></td>
<td>POWER ON pb – push</td>
</tr>
</tbody>
</table>

Cont next page
COMMAND CLUTCH TO LOCK

CRT 5. When no relative motion [PETAL POS BASE (three) not changing for 30 sec]:
   If PETAL POS BASE (three) not within 5% of each other:
      √MCC
A7L  RING IN pb – push
      POWER ON pb – push
A6L  PSU PWR MN A,MN B (two) – ON
CRT  √DAMPING – OFF
      √CLUTCH – LOCK/blank
A6L  PSU PWR MN A,MN B (two) – OFF

RETRACT RING

A7L 6. RING IN pb – push
CRT
   APDS POWER A<sub>DS</sub>,B<sub>DS</sub>,C<sub>DS</sub> (three) – OFF
0:00 A6L  PSU PWR MN A,MN B (two) – ON
CRT  √RNG DRV CMD – ON [PETAL POS BASE (three) – decr]
0:05 A6L  PSU PWR MN A,MN B (two) – OFF
A7L  APDS POWER A<sub>DS</sub>,B<sub>DS</sub>,C<sub>DS</sub> (three) – ON
       POWER ON pb – push

EXTEND RING

CRT 7. When no relative motion [PETAL POS BASE (three) not changing for 30 sec]:
A7L  APDS CIRC PROT OFF pb – push
      √CIRCUIT PROTECT OFF lt – lt on
      RING OUT pb – push
A6L  APDS POWER A<sub>DS</sub>,B<sub>DS</sub>,C<sub>DS</sub> (three) – OFF
CRT
0:00 A6L  PSU PWR MN A,MN B (two) – ON
CRT  √RNG DRV CMD – ON [PETAL POS BASE (three) – incr]
0:05 A6L  PSU PWR MN A,MN B (two) – OFF
A7L  APDS POWER A<sub>DS</sub>,B<sub>DS</sub>,C<sub>DS</sub> (three) – ON
       POWER ON pb – push

8. If RING ALIGNED lt – lt off:
   √MCC
A6L  PSU PWR MN A,MN B (two) – ON
Go to DOCKING SEQUENCE (Cue Card), step 8
FIXERS OFF LT FAILED ON

**SM 167 DOCKING STATUS**

If performing DOCKING RING EXTENSION, 8-8:

**CRT** 1. If RING FIXERS – ON during ring drive:
   
   Continue in DOCKING RING EXTENSION, 8-8 >>

**A7L** 2. FIXER OFF pb – push
   
   POWER OFF pb – push
   
   ON pb – push
   
   If FIXERS OFF lt – lt off:
   
   Continue in DOCKING RING EXTENSION, 8-8 >>

3. APDS CIRC PROT OFF pb – push
   
   CIRCUIT PROTECT OFF lt – lt on
   
   RING OUT pb – push

**CRT** When PETAL POS BASE (three) = 76 ± 3%:

**A7L** POWER OFF pb – push

Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F) to drive slip clutch to SLIP

**FIXERS OFF LT FAILED OFF**

**SM 167 DOCKING STATUS**

**A7L** 1. POWER OFF pb – push
   
   ON pb – push
   
   FIXER OFF pb – push
   
   If FIXERS OFF lt – lt on:
   
   Continue in DOCKING SEQUENCE (Cue Card), as reqd >>

**CRT** 2. If not CLUTCH – LOCK/blank

**A6L** PSU PWR MN A,MN B (two) – OFF

**A7L** RING IN pb – push

**A7L** POWER ON pb – push

**0:00 CRT** 3. PSU PWR MN A,MN B (two) – ON

**A6L** CLUTCH – LOCK/blank

**0:05 CRT** 3. PSU PWR MN A,MN B (two) – OFF

**A7L** RING IN pb – push

**A7L** APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF

**0:00 A6L** APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON

**CRT** PETAL POS BASE (three) – decr

**0:05 A7L** POWER ON pb – push

**CRT** PETAL POS BASE (three) – incr

**A6L** 4. PSU PWR MN A,MN B (two) – OFF

**CRT** PETAL POS BASE (three) – decr

**0:05 A7L** PETAL POS BASE (three) – incr

**A7L** RING DRV CMD – OFF

**A6L** 4. PSU PWR MN A,MN B (two) – OFF

**CRT** RING DRV CMD – OFF

**0:00 A6L** PSU PWR MN A,MN B (two) – ON (ring will begin to drive in this step)

**CRT** PETAL POS BASE (three) – decr

**0:05 A7L** PSU PWR MN A,MN B (two) – OFF (ring will begin to drive in this step)

5. Go to DOCKING SEQUENCE (Cue Card), step 8
RING FAILS TO DRIVE

**SM 167 DOCKING STATUS**

A7L 1. **POWER ON pb – push**
   - APDS CIRC PROT OFF pb – push
     - √ CIRCUIT PROTECT OFF lt – lt on
   - FIXER OFF pb – push
     - √ FIXERS OFF lt – lt on

2. **RING OUT pb – push**
   - CRT If PETAL POS BASE (three) incr:
     - A7L POWER ON pb – push
     - √ MCC
   - CRT 3. If PETAL POS BASE (three) not incr:
     - If RING DRV CMD – ON:
       - If not CLUTCH – LOCK/blank:
         - A7L POWER OFF pb – push
         - ON pb – push
         - Go to CLUTCH NOT ‘LOCK’ >>
     - CRT If RING DRV CMD – OFF:
       - Go to RING DRV CMD OFF

RING DRV CMD OFF

**SM 167 DOCKING STATUS**

A7L 1. **POWER OFF pb – push**
   - ON pb – push
   - If STATUS lt (eighteen) – lt off:
     - CONTROL PANEL POWER A – OFF
     - POWER ON pb – push
   - If STATUS lt (eighteen) – lt off:
     - Go to step 3
     - Continue in **DOCKING SEQUENCE** (Cue Card), as reqd >>

2. **APDS POWER A_DS – OFF**
   - RING IN pb – push
   - CRT If RING DRV CMD – OFF:
     - A7L APDS POWER A_DS – ON
     - C_DS – OFF
     - RING IN pb – push
   - CRT If RING DRV CMD – OFF:
     - Go to step 3

   A7L POWER ON pb – push
   - Continue in **DOCKING SEQUENCE** (Cue Card) through step 16, then:
     - APDS POWER A_DS (C_DS) – ON
     - OPEN LATCHES pb – push
     - After 5 sec:
       - √ LATCHES OPEN lt – lt on
     - APDS POWER A_DS (C_DS) – OFF
     - Go to **DOCKING SEQUENCE** (Cue Card), step 18 >>

3. **If free drift, comm, and power level constraints permit (√MCC):**
   - Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F)
     to complete docking >>

4. Go to **FAILED CAPTURE (VBAR APPROACH, Cue Card)** to undock
RING FINAL POSITION LT FAILED ON

SM 167 DOCKING STATUS
Continue in DOCKING SEQUENCE (Cue Card), as reqd, with the following changes:
In step 8, after the ring stops (10 sec after having previously pushed the RING IN pb):
A7L      RING IN pb – push
In step 11, to stop ring drive
       POWER ON pb – push
CRT      In step 18, when PETAL POS BASE (three) = 5 ± 3% and not changing for
       10 sec:
A7L      POWER OFF pb – push

FORCE RING ALIGNMENT

A7L  1.  APDS CIRC PROT OFF pb – push
    √CIRCUIT PROTECT OFF lt – lt on
2.  FIXER OFF pb – push
    √FIXERS OFF lt – lt on
0:00  3.  RING OUT pb – push
CRT    √DRV CMD – ON [PETAL POS BASE (three) – incr]
       √FIXERS – OFF
0:05  √CLUTCH – LOCK/blank
A7L    √RING INITIAL POSITION lt – lt on (√off at ~0:30)
* If RING FORWARD POSITION lt failed on (ring stops after 10 sec):
*       RING OUT pb – push
*       Within 10 sec:
*       APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF
*       APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON
*       CIRC PROT OFF pb – push
*       √CIRCUIT PROTECT OFF lt – lt on
CRT    * When PETAL POS BASE (any) = 92%:
A6L    *   PSU PWR MN A,MN B (two) – OFF
CRT    * When PETAL POS BASE (three) not changing for 30 sec:
A6L    *   PSU PWR MN A,MN B (two) – ON
CRT    * When PETAL POS BASE (three) = 98%:
A7L    *   RING OUT pb – push
*       Go to step 7
CRT    4. When PETAL POS BASE (any) = 92%:
A7L    POWER ON pb – push
CRT    5. When PETAL POS BASE (three) not changing for 30 sec:
A7L    RING OUT pb – push
0:00  6. √RING FORWARD POSITION lt – lt on [PETAL POS BASE (three) = 98%]
0:10  √RING DRV CMD – OFF
A7L    √FIXERS OFF lt – lt off
       √RING ALIGNED lt – lt on [PETAL POS RING (three) 50 ± 1%] and
       [PETAL POS BASE (three) within 1%]
8. Return to DOCKING SEQUENCE (Cue Card), step 8
CLUTCH NOT ‘LOCK’

<table>
<thead>
<tr>
<th>SM 167 DOCKING STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT</td>
</tr>
<tr>
<td>If no ring motion when RING DRV CMD – ON</td>
</tr>
</tbody>
</table>

A7L 1. APDS CIRC PROT OFF pb – push

\[\sqrt{\text{CIRCUIT PROTECT OFF lt – lt on}}\]

FIXER OFF pb – push

\[\sqrt{\text{FIXERS OFF lt – lt on}}\]

RING OUT pb – push

After 10 sec:

POWER OFF pb – push

ON pb – push

CRT

If CLUTCH – LOCK/blank:

Continue in DOCKING SEQUENCE (Cue Card), as reqd >>

A7L 2. RING IN pb – push

After 10 sec:

POWER ON pb – push

CRT

If CLUTCH – LOCK/blank:

Continue in DOCKING SEQUENCE (Cue Card), as reqd >>

3. If free drift, comm, and power level constraints permit (\[\sqrt{\text{MCC}}\]):

Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F) to complete docking

APDS CIRCUIT PROTECT OFF LT FAILED OFF

<table>
<thead>
<tr>
<th>SM 167 DOCKING STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT</td>
</tr>
<tr>
<td>If APDS CIRC PROT – ON:</td>
</tr>
</tbody>
</table>

A7L

POWER OFF pb – push

ON pb – push

APDS CIRC PROT OFF pb – push

A7L

If APDS CIRCUIT PROTECT OFF lt – lt on or

CRT

APDS CIRC PROT – OFF:

Continue sequence as required >>

Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F)
for RING OUT, OPEN HOOKS, OPEN LATCHES, and UNDOCKING pb commands

HOOKS 1(2) OPEN LT FAILED ON

NOTE
The following procedure should be performed immediately after DOCKING SEQUENCE (Cue Card) completed or prior to undocking as applicable

A7L 1. POWER ON pb – push

APDS POWER ADS – OFF

If HOOKS 1(2) OPEN lt – lt off:

Go to nominal UNDOCKING OPERATIONS per nominal mission timeline with APDS POWER ADS – OFF >>

2. Prior to nominal undocking:

Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F) to open affected hooks
HOOKS 1(2) NOT CLOSED WITHIN SINGLE MTR TIME

<table>
<thead>
<tr>
<th>SM 167 DOCKING STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRT 1. If no hook motion when commanded:</td>
</tr>
<tr>
<td>A7L APDS POWER A\textsubscript{DS} – OFF</td>
</tr>
<tr>
<td>CLOSE HOOKS pb – push</td>
</tr>
<tr>
<td>CRT If no hook motion after 10 sec:</td>
</tr>
<tr>
<td>A7L APDS POWER A\textsubscript{DS} – ON</td>
</tr>
<tr>
<td>B\textsubscript{DS} – OFF</td>
</tr>
<tr>
<td>CLOSE HOOKS pb – push</td>
</tr>
<tr>
<td>CRT If Hook Pos increasing after 10 sec:</td>
</tr>
<tr>
<td>Continue in DOCKING SEQUENCE (Cue Card) with the following change:</td>
</tr>
<tr>
<td>After step 16:</td>
</tr>
<tr>
<td>A7L APDS POWER A\textsubscript{DS} (B\textsubscript{DS}) – ON &gt;&gt;</td>
</tr>
</tbody>
</table>

2. APDS POWER A\textsubscript{DS} (B\textsubscript{DS}) – ON |
POWER OFF pb – push |
ON pb – push

3. If other hook gang closed: |
Continue in DOCKING SEQUENCE (Cue Card), as reqd |
After DOCKING SEQUENCE (Cue Card) complete, go to PMA 2/3 |
HOOKS CLOSE, 8-35, to secure interface with 12 hooks >>

4. If neither hook gang closed: |
\sqrt{MCC for IFM capability} |
Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES A THRU F) and PMA 2/3 |
HOOKS CLOSE, 8-35, as reqd, to secure interface with 12 hooks >>

5. If no IFM capability or time does not permit IFM: |
APDS CIRC PROT OFF pb – push |
\sqrt{CIRCUIT PROTECT OFF lt – lt on} |
OPEN HOOKS pb – push |
CRT \sqrt{HK1,HK2 POS (two) – decr} |
A7L \sqrt{HOOKS 1,HOOKS 2 OPEN lt (two) – lt on} |
0:00 RING OUT pb – push |
3:40 A7L RING INITIAL POSITION lt – lt on |
Go to FAILED CAPTURE (VBAR APPROACH, Cue Card) to undock
READY TO HOOK LT FAILED ON

1. Immediately prior to step 4 in DOCKING SEQUENCE (Cue Card):
   A7L APDS POWER A DS – OFF
   If READY TO HOOK lt – lt off:
   · If HOOKS 1(2) OPEN lt – lt off:
   ·   · APDS CIRC PROT OFF pb – push
   ·   · √CIRCUIT PROTECT OFF lt – lt on
   ·   · OPEN HOOKS pb – push
   ·   L √HOOKS 1,HOOKS 2 OPEN lt (two) – lt on
   · Continue in DOCKING SEQUENCE (Cue Card), as reqd, with the
   ·   following change:
   · After hooks begin to drive closed in step 10:
   ·   APDS POWER A DS – ON >>

2. APDS POWER A DS – ON
   Continue in DOCKING SEQUENCE (Cue Card), as reqd, with the following
   changes:
   Immediately after RING IN pb – push in step 4:
   · APDS CIRC PROT OFF pb – push
   · √CIRCUIT PROTECT OFF lt – lt on
   · OPEN HOOKS pb – push
   CRT √HK1(2) POS decreasing to 5%
   Immediately after RING IN pb – push in step 8:
   A7L APDS CIRC PROT OFF pb – push
   · √CIRCUIT PROTECT OFF lt – lt on
   · OPEN HOOKS pb – push
   CRT √HK1(2) POS decreasing to 5%
   When PETAL POS BASE (three) ≤ 7%:
   A7L CLOSE HOOKS pb – push

HOOKS 1(2) CLOSED LT FAILED ON

A7L 1. APDS POWER A DS – OFF

2. If HOOKS 1(2) CLOSED lt – lt off:
   3. If Pre-Contact:
      APDS POWER A DS – ON
      Continue Approach
   4. Post-Capture, continue in DOCKING SEQUENCE (Cue Card). If affected
      hooks do not close in step 10:
      APDS POWER A DS – OFF
      CLOSE HOOKS pb – push
   5. Continue in DOCKING SEQUENCE (Cue Card) with the following
      change:
      After step 13:
      APDS POWER A DS – ON >>

6. If HOOKS 1(2) CLOSED lt – lt on:
   APDS POWER A DS – ON
   Continue in DOCKING SEQUENCE (Cue Card). If affected hooks do
   not close in step 10:
   After DOCKING SEQUENCE (Cue Card) complete:
   Go to APDS DIRECT DRIVE USING BOB (IFM, PROCEDURES
   A THRU F), to secure the interface with 12 hooks
LATCHES OPEN LT FAILED OFF

CRT  1. If CAP LAT IND – OP/blank:
     Continue in DOCKING SEQUENCE (Cue Card) >>

A7L  2. √APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON
     √A_{DS},B_{DS},C_{DS} lt (three) – lt on
     CIRC PROT OFF pb – push
     √CIRCUIT PROTECT OFF lt – lt on
     OPEN LATCHES pb – push

A7L, CRT  If LATCHES OPEN lt – lt on or CAP LAT IND – OP/blank:
         Continue in DOCKING SEQUENCE (Cue Card) >>

3. Continue in DOCKING SEQUENCE (Cue Card), deleting step 18, then:
   On MCC GO:
   Go to 2.109 CAPTURE LATCH MANUAL RELEASE, HATCH OPENING
   AND DUCT INSTALL (JOINT OPS, INGRESS STATION)

APDS POWER FAILED OFF

A7L  If any APDS POWER A_{DS},B_{DS},C_{DS} lt off:

CAUTION
Associated capture latch cannot be driven open,
resulting in inability to separate interfaces once the
structural interfaces are within 3 inches of each other

Post-Capture:
Continue in DOCKING SEQUENCE (Cue Card), deleting steps 17 and 18

On MCC GO:
Go to 2.109 CAPTURE LATCH MANUAL RELEASE, HATCH
OPENING AND DUCT INSTALL (JOINT OPS, INGRESS STATION)
NOTE
This procedure assumes vestibule leak check failed, or both ODS hook gangs jammed simultaneously. Docking ring will recapture PMA petals, hooks will be driven open, interface will be separated, and second mating attempt will be performed. Procedure assumes DOCKING SEQUENCE (Cue Card) completed.

Successful completion of this procedure ends with Shuttle resuming attitude control.

1. Perform steps 1 and 2 of ANY ATTITUDE SEPARATION, (CONTINGENCY OPS), 5-23

SM 167 DOCKING STATUS

RECAPTURE PMA PETALS

A7L

2. POWER ON pb – push
0:00
CLOSE LATCHES pb – push
√LATCHES OPEN lt – lt off
0:05
√CLOSED lt – lt on

3. APDS CIRC PROT OFF pb – push
√CIRCUIT PROTECT OFF lt – lt on
FIXER OFF pb – push
√FIXERS OFF lt – lt on
0:00
RING OUT pb – push
√FINAL POSITION lt – lt off
0:20

4. When CAPTURE lt – lt on:
POWER OFF pb – push
ON pb – push
√CAPTURE lt – lt off
0:00

5. RING IN pb – push
0:10
POWER ON pb – push
√RING FINAL POSITION lt – lt off
CRT
√DRV CMD – OFF
A7L
√LATCHES CLOSED lt – lt on

WARNING
Vehicle separation may occur when ODS hooks opened if RING FINAL POSITION lt is ON or LATCHES CLOSED lt is OFF. Be prepared to pick up in ANY ATTITUDE SEPARATION (CONTINGENCY OPS), step 4.

OPEN ODS HOOKS

6. APDS CIRC PROT OFF pb – push
√CIRCUIT PROTECT OFF lt – lt on
0:00
OPEN HOOKS pb – push
√HOOKS 1,HOOKS 2 CLOSED lt (two) – lt off
2:20
√OPEN lt (two) – lt on

Cont next page
EXTEND RING TO INITIAL POSITION FOR INTERFACE SEPARATION:

0:00  7. RING OUT pb – push
       CRT  √DRV CMD – ON
       A7L  √INTERF SEALED lt – lt off

3:40  8. RING INITIAL POSITION lt – lt on
       CRT  √DRV CMD – OFF
       √PETAL POS BASE = 76 ± 3%

RETRACT RING FOR SECOND MATING ATTEMPT:

0:00 A7L 9. RING IN pb – push
       CRT  √DRV CMD – ON [PETAL POS BASE (three) - decr]
       √CLUTCH – LOCK/blank

3:15 A7L  √READY TO HOOK lt – lt on
0:00       √HOOKS 1,HOOKS 2 OPEN lt (two) – lt off
≤1:30      √INTERF SEALED lt – lt on
2:20       √HOOKS 1,HOOKS 2 CLOSED lt (two) – lt on

10. √APDS CIRCUIT PROTECT OFF lt – lt on

0:00 A7L 11. OPEN LATCHES pb – push
       CRT  √LATCHES CLOSED lt – lt off

0:05       √OPEN lt – lt on

0:00  12. RING IN pb – push
0:10 A7L  √FINAL POSITION lt – lt on
0:20 CRT  √DRV CMD – OFF

A7L 13. POWER OFF pb – push
       √STATUS lt (eighteen) – lt off

14. Perform DOCKING MECHANISM POWERDOWN, 8-6, if reqd, then:

A6U 15. Perform TERMINATE RNDZ OPS 22A  4-22, step 1

16. Return to FLIGHT PLAN
ODS HOOKS OPEN – CONTINGENCY

NOTE
Procedure assumes PMA 2/3 hooks have not been closed at any time during the mission, and either ODS hooks could not be opened nominally or ODS hooks were driven full open and physical separation did not occur. If PMA 2/3 hooks have been closed at any point during the mission, go to PMA 2/3 HOOKS OPEN – CONTINGENCY, 8-30.

To undock, the crew will start in the ANY ATTITUDE SEPARATION (AAS), 5-23, to prep for undocking, then transition to this procedure. Once in this procedure, steps 3-6 will recapture the PMA petals in preparation for firing the ODS hook pyros. Steps 7-8 re-open the ODS hooks. The capture latches maintain the connection between the two vehicles. Steps 9-11 will discharge the active hook pyros. When the active docking ring is extended in step 12, separation is expected at the interface between the fixed shuttle APDS structural ring and the fixed PMA structural ring. Vehicles maintain a physical connection via the active docking ring until the capture latches are opened after returning to the AAS procedure in step 20. If there is no separation in step 12, the passive hook pyros are discharged in steps 14-16. Interface separation is attempted again in step 17. As in step 12, the vehicles will maintain a physical connection via the active docking ring capture latches. In step 20, the crew will transition back to the AAS procedure where the capture latches will be opened and the actual vehicle separation performed.

Procedure also assumes that an EVA crew is prepared to immediately perform the 96 BOLT EVA if ODS pyros are discharged and physical separation does not occur.

1. Perform steps 1 and 2 of ANY ATTITUDE SEPARATION (CONTINGENCY OPS), 5-23

A7L

2. POWER ON pb – push

SM 167 DOCKING STATUS

RECAPTURE PMA PETALS
3. CLOSE LATCHES pb – push
   √LATCHES OPEN lt – lt off
   √CLOSED lt – lt on

4. APDS CIRC PROT OFF pb – push
   √CIRCUIT PROTECT OFF lt – lt on
   FIXER OFF pb – push
   √FIXERS OFF lt – lt on
   RING OUT pb – push
   √FINAL POSITION lt – lt off

5. When CAPTURE lt – lt on:
   POWER OFF pb – push
   ON pb – push
   √CAPTURE lt – lt off

Cont next page
0:00  6. RING IN pb – push
0:10  POWER ON pb – push
    √RING FINAL POSITION lt – lt off
    √DRV CMD – OFF
CRT  √LATCHES CLOSED lt – lt on
A7L

WARNING
Vehicle separation may occur when ODS hooks opened or pyros discharged if RING FINAL POSITION lt is ON or LATCHES CLOSED lt is OFF. Be prepared to pick up in ANY ATTITUDE SEPARATION, (CONTINGENCY OPS) step 4, 5-23

RE-OPEN CLOSED HOOKS
A7L  7. APDS CIRC PROT OFF pb – push
    √CIRCUIT PROTECT OFF lt – lt on
OPEN HOOKS pb – push

A7L  8. When good HOOKS 1(2) OPEN lt on
    and jammed HK2(1) POS not decr:
    POWER OFF pb – push
    ON pb – push

DISCHARGE ACTIVE HOOK PYROS
A6L  9. PYRO PWR MN A,MN C (two) – ON
A7L  PYROS A_p,B_p,C_p (three) – ON
    √A_p,B_p,C_p lt (three) – lt on
PYRO CIRC PROT OFF pb – push
    √CIRCUIT PROTECT OFF lt – lt on

10. ACT HOOKS FIRING pb – push
11. PYRO CIRC PROT ON pb – push
    √CIRCUIT PROTECT OFF lt – lt off
    PYROS A_p,B_p,C_p (three) – OFF
    √A_p,B_p,C_p lt (three) – lt off
A6L  PYRO PWR MN A,MN C (two) – OFF

EXTEND RING TO INITIAL POSITION FOR INTERFACE SEPARATION
A7L  12. APDS CIRC PROT OFF pb – push
0:00  RING OUT pb – push
    √CIRCUIT PROTECT OFF lt – lt off
    √INTERF SEALED lt – lt off
CRT  If interface separates [PETAL POS BASE (three) incr after 20 sec]:
    Go to step 19

RECONFIGURE AND DISCHARGE PASSIVE HOOK PYROS
A7L  13. POWER ON pb – push
A6L  PSU PWR MN A,MN B (two) – OFF
A7L  RING IN pb – push
    APDS POWER A_ds,B_ds,C_ds (three) – OFF
    – ON
A6L  PSU PWR MN A,MN B (two) – ON
CRT  When PETAL POS BASE (three) = ~6% and not decr:
A7L  POWER ON pb – push

Cont next page
A6L  14.  PYRO PWR MN A,MN C (two) – ON
A7L  PYROS $A_p,B_p,C_p$ (three) – ON
    $\sqrt[ ]{A_p,B_p,C_p}$ lt (three) – It on
    PYRO CIRC PROT OFF pb – push
    $\sqrt[ ]{\text{CIRCUIT PROTECT OFF lt – lt on}}$

15.  PAS HOOKS FIRING pb – push

16.  PYRO CIRC PROT ON pb – push
    $\sqrt[ ]{\text{CIRCUIT PROTECT OFF lt – lt off}}$
    PYROS $A_p,B_p,C_p$ (three) – OFF
    $\sqrt[ ]{A_p,B_p,C_p}$ lt (three) – lt off
A6L  PYRO PWR MN A,MN C (two) – OFF

REALTEMPT EXTENDING RING TO INITIAL POSITION FOR INTERFACE
SEPARATION
A7L  17.  $\sqrt[ ]{\text{APDS CIRCUIT PROTECT OFF lt – lt on}}$
0:00  RING OUT pb – push
      $\sqrt[ ]{\text{INTERF SEALED lt – lt off}}$
CRT  If interface separates [PETAL POS BASE (three) incr after 20 sec]:
      Go to step 19

RECONFIGURE AND PREPARE FOR 96 BOLT EVA
A7L  18.  POWER ON pb – push
    RING IN pb – push
CRT  When PETAL POS BASE (three) = ~6% and not decr:
A7L  POWER OFF pb – push
    Perform DOCKING MECHANISM POWERDOWN, 8-6, then:
    Go to 96 BOLT EVA TIMELINE (EVA, ORB CONT EVA) >>

FINAL PREPARATION FOR VEHICLE SEPARATION
~3:20  19.  $\sqrt[ ]{\text{RING INITIAL POSITION lt – lt on}}$
CRT  $\sqrt[ ]{\text{DRV CMD – OFF}}$
    $\sqrt[ ]{\text{PETAL POS BASE (three) = 76 \pm 3\%}}$

20.  Go to step 3 of ANY ATTITUDE SEPARATION (CONTINGENCY OPS),
     5-23.  Expect no spring assisted separation
PMA 2/3 HOOKS OPEN – CONTINGENCY

NOTE
Procedure assumes PMA 2/3 hooks could not be opened nominally or ODS hooks were driven fully open and physical separation did not occur and PMA 2/3 were closed at some point during the mission.

To undock, the crew will start in the ANY ATTITUDE SEPARATION (AAS), 5-23, to prep for undocking, then transition to this procedure. Once in this procedure, steps 3-6 will recapture the PMA petals in preparation for firing the ODS hook pyros. Steps 7-9 re-open the ODS hooks. The capture latches maintain the connection between the two vehicles. Step 10 commands the ring out to verify that the initial problem still exists before firing the pyros. When the active docking ring is extended in step 10, separation is expected at the interface between the fixed shuttle APDS structural ring and the fixed PMA structural ring. Vehicles maintain a physical connection via the active docking ring until the capture latches are opened after returning to the AAS procedure in step 23. Steps 12-14 will discharge the passive hook pyros. Interface separation is attempted again in step 15. As in step 10, the vehicles will maintain a physical connection via the active docking ring capture latches. If there is no separation in step 15, the active hook pyros are discharged in steps 17-19. Interface separation is attempted again in step 20. As in step 10, the vehicles will maintain a physical connection via the active docking ring capture latches. In step 23, the crew will transition back to the AAS procedure where the capture latches will be opened and the actual vehicle separation performed.

Procedure also assumes that an EVA crew is prepared to immediately perform the 96 BOLT EVA if ODS pyros are discharged, and physical separation does not occur

1. Perform steps 1 and 2 of ANY ATTITUDE SEPARATION (CONTINGENCY OPS), 5-23

2. POWER ON pb – push

A7L

SM 167 DOCKING STATUS

RECAPTURE PMA PETALS
3. CLOSE LATCHES pb – push
   \sqrt{LATCHES OPEN} lt – lt off
   \sqrt{CLOSED} lt – lt on

4. APDS CIRC PROT OFF pb – push
   \sqrt{CIRCUIT PROTECT OFF} lt – lt on
   FIXER OFF pb – push
   \sqrt{FIXERS OFF} lt – lt on
   RING OUT pb – push
   \sqrt{FINAL POSITION} lt – lt off

5. When CAPTURE lt – lt on:
   POWER OFF pb – push
   ON pb – push
   \sqrt{CAPTURE} lt – lt off

6. RING IN pb – push
0:10
   POWER ON pb – push
   \sqrt{RING FINAL POSITION} lt – lt off
   CRT

A7L
\sqrt{LATCHES CLOSED} lt – lt on
WARNING
Vehicle separation may occur when ODS hooks opened or pyros discharged if RING FINAL POSITION it is ON or LATCHES CLOSED it is OFF. Be prepared to pick up in ANY ATTITUDE SEPARATION (CONTINGENCY OPS), step 4, 5-23

OPEN ODS HOOKS
7. APDS CIRC PROT OFF pb – push
   √CIRCUIT PROTECT OFF lt – lt on
0:00
8. OPEN HOOKS pb – push
   √HOOKS 1,HOOKS 2 CLOSED lt (two) – lt off
   CRT √HK1,HK2 POS (two) < 92% and decr
2:20
9. √HOOKS 1,HOOKS 2 OPEN lt (two) – lt on

ATTEMPT TO EXTEND RING TO INITIAL POSITION FOR INTERFACE SEPARATION
0:00
10. RING OUT pb – push
    √INTERF SEALED lt – lt off
    CRT If interface separates [PETAL POS BASE (three) incr after 20 sec]:
        Go to step 22

RECONFIGURE AND DISCHARGE PASSIVE HOOK PYROS
A7L
11. POWER ON pb – push
A6L
   PSU PWR MN A,MN B (two) – OFF
A7L
   RING IN pb – push
   APDS POWER A_{DS,B_{DS,C_{DS}} (three) – OFF
               – ON
A6L
   PSU PWR MN A,MN B (two) – ON
CRT When PETAL POS BASE (three) = ~6% and not decr:
A7L
   POWER ON pb – push
A6L
12. PYRO PWR MN A,MN C (two) – ON
A7L
   PYROS A_p,B_p,C_p (three) – ON
   √A_p,B_p,C_p lt (three) – lt on
   PYRO CIRC PROT OFF pb – push
   √CIRCUIT PROTECT OFF lt – lt on
13. PAS HOOKS FIRING pb – push
14. PYRO CIRC PROT ON pb – push
   √CIRCUIT PROTECT OFF lt – lt off
   PYROS A_p,B_p,C_p (three) – OFF
   √A_p,B_p,C_p lt (three) – lt off
A6L
   PYRO PWR MN A,MN C (two) – OFF

REATTEMPT EXTENDING RING TO INITIAL POSITION FOR INTERFACE SEPARATION
A7L
15. √APDS CIRCUIT PROTECT OFF lt – lt on
0:00
   RING OUT pb – push
   √INTERF SEALED lt – lt off
   CRT If interface separates [PETAL POS BASE (three) incr after 20 sec]:
       Go to step 22

Cont next page
RECONFIGURE AND DISCHARGE ACTIVE HOOK PYROS

A7L  16. POWER ON pb – push
A6L  PSU PWR MN A,MN B (two) – OFF
A7L  RING IN pb – push
     APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF
     – ON
A6L  PSU PWR MN A,MN B (two) – ON
CRT  When PETAL POS BASE (three) = ~6% and not decr:
A7L  POWER ON pb – push

A6L  17. PYRO PWR MN A,MN C (two) – ON
A7L  PYROS A_{P},B_{P},C_{P} (three) – ON
     \sqrt{A_{P},B_{P},C_{P}} lt (three) – lt on
     PYRO CIRC PROT OFF pb – push
     \sqrt{CIRCUIT PROTECT OFF} It – lt on

18. ACT HOOKS FIRING pb – push

19. PYRO CIRC PROT ON pb – push
     \sqrt{CIRCUIT PROTECT OFF} It – It off
     PYROS A_{P},B_{P},C_{P} (three) – OFF
     \sqrt{A_{P},B_{P},C_{P}} lt (three) – lt off
A6L  PYRO PWR MN A,MN C (two) – OFF

REATTEMPT EXTENDING RING TO INITIAL POSITION FOR INTERFACE SEPARATION

A7L  20. \sqrt{APDS CIRCUIT PROTECT OFF} It – lt on
     RING OUT pb – push
     \sqrt{INTERF SEALED} lt – lt off
CRT  If interface separates [PETAL POS BASE (three) incr after 20 sec]:
     Go to step 22

RECONFIGURE AND PREPARE FOR 96 BOLT EVA

A7L  21. POWER ON pb – push
     RING IN pb – push
CRT  When PETAL POS BASE (three) = ~6% and not decr:
A7L  POWER ON pb – push
     Perform DOCKING MECHANISM POWERDOWN, 8-6, then:
     Go to 96 BOLT EVA TIMELINE (EVA, ORB CONT EVA) >>

FINAL PREPARATION FOR VEHICLE SEPARATION

~3:20  A7L  22. \sqrt{RING INITIAL POSITION} It – It on
CRT  \sqrt{DRV CMD} – OFF
     \sqrt{PETAL POS BASE (three)} = 76 \pm 3%

23. Go to step 3 of ANY ATTITUDE SEPARATION (CONTINGENCY OPS),
    5-23. Expect no spring assisted separation
APDS FAILED CAPTURE RECONFIG

SM 167 DOCKING STATUS

A7L 1. If LATCHES OPEN Lt – Lt on:
   0:00 CLOSE LATCHES pb – push
   √ LATCHES OPEN Lt – Lt off
   0:05 √ CLOSED Lt – Lt on

2. √ APDS CIRCUIT PROTECT OFF Lt – Lt on

3. FIXER OFF pb – push
   √ FIXERS OFF Lt – Lt on
   0:00 RING OUT pb – push
   CRT √ PETAL POS BASE (three) – incr
   0:05 √ CLUTCH – LOCK/blank
   A7L √ RING INITIAL POSITION Lt – Lt on (for ~16 sec), then Lt off

   * If RING FORWARD POSITION Lt failed on (ring stops *
   * after 10 sec):
   * RING OUT pb – push
   * Within 10 sec:
   * APDS POWER A_D, B_D, C_D (three) – OFF
   * APDS POWER A_D, B_D, C_D (three) – ON
   * CIRC PROT OFF pb – push
   * √ CIRCUIT PROTECT OFF Lt – Lt on
   * √ RING INITIAL POSITION Lt – Lt on (for ~16 sec), *
   * then Lt off
   CRT ∗ When PETAL POS BASE (three) = 98 ± 2%: ∗
   A7L ∗ RING OUT pb – push ∗
   ∗ After 10 sec: ∗
   CRT ∗ √ RING DRV CMD – OFF ∗

1:15 A7L 4. √ RING FORWARD POSITION Lt – Lt on
   √ ALIGNED Lt – Lt on
   √ FIXERS OFF Lt – Lt off
   CRT √ PETAL POS BASE (three): 98 ± 2%

0:00 A7L 5. RING IN pb – push
   CRT √ CLUTCH – LOCK/blank
   A7L √ RING FORWARD POSITION Lt – Lt off
   1:15 √ INITIAL POSITION Lt – Lt on (for ~16 sec), then Lt off

   * If RING FINAL POSITION Lt failed on (ring stops after 10 sec): *
   * RING IN pb – push *
   * √ FORWARD POSITION Lt – Lt off *
   1:15 *
   * √ INITIAL POSITION Lt – Lt on (for ~16 sec), then Lt off *
   4:50 CRT *
   A7L *
   * When PETAL POS BASE (three) = 5 ± 3% and not decr: *
   * POWER ON pb – push *

6. √ RING FINAL POSITION Lt – Lt on

5:00 CRT √ DRV CMD – OFF

0:00 A7L 7. APDS CIRCUIT PROT OFF pb – push
   √ CIRCUIT PROTECT OFF Lt – Lt on
   RING OUT pb – push
   CRT √ CLUTCH – LOCK/blank

0:10 A7L √ RING FINAL POSITION Lt – Lt off

Cont next page
* If RING INITIAL POSITION lt failed on (ring stops after 1 sec, and Clutch drives to SLIP):
  * FIXER OFF pb – push
  * \sqrt{\text{FIXERS OFF lt – lt on}}
  * RING OUT pb – push
  CRT
  * When PETAL POS BASE (three) = 76 ± 3%:
    * POWER OFF pb – push
    * POWER ON pb – push
    * FIXERS OFF lt – lt off
    * APDS CIRC PROT OFF pb – push
    * \sqrt{\text{CIRCUIT PROTECT OFF lt – lt on}}
    * RING OUT pb – push
    * After 1 sec:
      * \sqrt{\text{RING DRV CMD – OFF}}

A7L
* If RING FORWARD POSITION lt failed on (ring stops after 10 sec):
  * RING OUT pb – push
  * Within 10 sec:
    * \sqrt{\text{APDS POWER A_{DS},B_{DS},C_{DS} (three) – OFF}}
    * \sqrt{\text{APDS POWER A_{DS},B_{DS},C_{DS} (three) – ON}}
    * CIRC PROT OFF pb – push
    * \sqrt{\text{CIRCUIT PROTECT OFF lt – lt on}}
    * When RING INITIAL POSITION lt on:
      * RING OUT pb – push

3:40
8. \sqrt{\text{RING INITIAL POSITION lt – lt on}}
CRT
  * PETAL POS BASE (three) – 76 ± 3%
  * CLUTCH – blank/SLIP
  * If CLUTCH – blank/blank:
    * \sqrt{\text{APDS CIRCUIT PROTECT OFF lt – lt on}}
    * RING OUT pb – push (expect 1 sec of drive),
    * wait 10 sec

A7L
* If CLUTCH – LOCK/blank:
  * \sqrt{\text{RING INITIAL POSITION lt – lt on}}
  * \sqrt{\text{FIXERS OFF lt – lt off}}
  * \sqrt{\text{APDS CIRCUIT PROTECT OFF lt – lt on}}
  * RING OUT pb – push (expect 1 sec of drive),
  * wait 10 sec
  * \sqrt{\text{RING DRV CMD – OFF}}

CRT
* If not CLUTCH – blank/SLIP:
  * MCC

A7L
9. POWER OFF pb – push
  * \sqrt{\text{STATUS lt (eighteen) – lt off}}
CAUTION
Procedure assumes one ODS Hook Gang has failed and one PMA 2/3 Hook Gang can be used to recover a total of 12 hooks. ODS to PMA 2/3 interface must be hard mated, as verified by the ODS X3/X4 connector mate indications, in order to provide PMA 2/3 active hook control and tlm through the interface X-connectors

NOTE
PMA2/3 Active Hooks 1(2) engage ODS Passive Hooks 2(1). Therefore, if ODS Active Hooks 1(2) is failed, it is preferrable to close PMA Active Hooks 2(1)

SM 167 DOCKING STATUS

CRT
1. √ODS CONN X3,X4 (two) – ON

A6L
2. √cb PMA 2/3 GRP 1,2 HOOKS (eight) – op
   √PMA 2/3 HOOKS SYS A,SYS B (two) – ctr
      √GRP 1 tb – bp
      √GRP 2 tb – bp

TO CLOSE HOOKS 1, PERFORM STEPS 3 THRU 6
3. cb PMA 2/3 GRP 1 HOOKS SYS A OP,CL (two) – cl
   B OP,CL (two) – cl
   √PMA 2/3 HOOKS GRP 1 tb – OP

CRT
   √HK1 IND OP – 1,2
   √IND CL – blank
   √HK CLS 1/3/5, 7/9/11 (two) – blank

   * If either IND CL present, hooks may operate single motor. If both IND CL present, hooks may not drive:
   * √MCC

0:00 A6L
4. PMA 2/3 HOOKS SYS A,SYS B (two) – CL
   √GRP 1 tb – bp

CRT
   √HK1 CMD CL – 1,2
   √IND OP – blank

2:20 A6L
5. √PMA 2/3 HOOKS GRP 1 tb – CL
   √HK1 IND CL – 1,2
   √CMD CL – blank
   √HK CLS 1/3/5, 7/9/11 (two) – CL

A6L
6. PMA 2/3 HOOKS SYS A,SYS B (two) – ctr
   cb PMA 2/3 GRP 1 HOOKS SYS A OP,CL (two) – op
   B OP,CL (two) – op

Cont next page
TO CLOSE HOOKS 2, PERFORM STEPS 7 THRU 10

7. cb PMA 2/3 GRP 2 HOOKS SYS A OP, CL (two) – cl
   B OP, CL (two) – cl
   √PMA 2/3 HOOKS GRP 2 tb – OP
   CRT √HK2 IND OP – 1,2
       √CL – blank
       √HK CLS 2/4/6, 8/10/12 (two) – blank
   * If either IND CL present, hooks may operate single
   * motor. If both IND CL present, hooks may not drive:
   * √MCC

0:00 A6L 8. PMA 2/3 HOOKS SYS A, SYS B (two) – CL
   √GRP 2 tb – bp
   CRT √HK2 CMD CL – 1,2
       √IND OP – blank

2:20 A6L 9. √PMA 2/3 HOOKS GRP 2 tb – CL
   CRT √HK2 IND CL – 1,2
       √CMD CL – blank
       √HK CLS 2/4/6, 8/10/12 (two) – CL

A6L 10. PMA 2/3 HOOKS SYS A, SYS B (two) – ctr
   cb PMA 2/3 GRP 2 HOOKS SYS A OP, CL (two) – op
   B OP, CL (two) – op
CAUTION

ODS to PMA 2/3 interface must remain hard mated by at least one gang of ODS hooks through entire procedure in order to provide PMA 2/3 active hook control and tlm through the interface X-connectors.

SM 167 DOCKING STATUS

A6L  1. √ cb PMA 2/3 GRP 1,2 HOOKS (eight) – op
    √ PMA 2/3 HOOKS SYS A,SYS B (two) – ctr (tb-bp)
    √ GRP 1 tb – bp
    √ GRP 2 tb – bp

TO OPEN HOOKS 1, PERFORM STEPS 2 THRU 5

2. cb PMA 2/3 GRP 1 HOOKS SYS A OP,CL (two) – cl
    B OP,CL (two) – cl
    √ PMA 2/3 HOOKS GRP 1 tb – CL

CRT
    √ HK1 IND CL – 1,2
    √ OP – blank
    √ HK CLS 1/3/5, 7/9/11 (two) – CL

* If either IND OP present, hooks may operate single motor. If both IND OP present, hooks may not drive. *

0:00 A6L  3. PMA 2/3 HOOKS SYS A,SYS B (two) – OP
    √ GRP 1 tb – bp

CRT
    √ HK1 CMD OP – 1,2
    √ IND CL – blank
    √ HK CLS 1/3/5, 7/9/11 (two) – blank

2:20 A6L  4. PMA 2/3 HOOKS GRP 1 tb – OP

CRT
    √ HK1 IND OP – 1,2
    √ CMD OP – blank

* If PMA 2/3 HOOKS fail to drive, or do not reach end-of-travel after single motor drive time (~4:40): *

A6L
* PMA 2/3 HOOKS SYS A,SYS B (two) – ctr *
* cb PMA 2/3 GRP 1 HOOKS SYS A OP,CL (two) – op *
* cb PMA 2/3 GRP 1 HOOKS SYS B OP,CL (two) – op *
* Perform PMA 2/3 HOOKS OPEN – CONTINGENCY, *
* 8-30 *

5. PMA 2/3 HOOKS SYS A,SYS B (two) – ctr
    cb PMA 2/3 GRP 1 HOOKS SYS A OP,CL (two) – op
    B OP,CL (two) – op

Cont next page
TO OPEN HOOKS 2, PERFORM STEPS 6 THRU 9

6. cb PMA 2/3 GRP 2 HOOKS SYS A OP, CL (two) – cl
   B OP, CL (two) – cl
   √PMA 2/3 HOOKS GRP 2 tb – CL
   CRT √HK2 IND CL – 1,2
   √IND OP – blank
   √HK CLS 2/4/6, 8/10/12 (two) – CL

   * If either IND OP present, hooks may operate single motor. If both IND OP present, hooks may not drive *

0:00 A6L 7. PMA 2/3 HOOKS SYS A, SYS B (two) – OP
   √GRP 2 tb – bp
   CRT √HK2 CMD OP – 1,2
   √IND CL – blank
   √HK CLS 2/4/6, 8/10/12 (two) – blank

2:20 A6L 8. √PMA 2/3 HOOKS GRP 2 tb – OP
   CRT √HK2 IND OP – 1,2
   √CMD OP – blank

   * If PMA 2/3 HOOKS fail to drive, or do not reach end-of-travel after single motor drive time (~4:40): *

A6L * √PMA 2/3 HOOKS SYS A, SYS B (two) – ctr
   * cb PMA 2/3 GRP 2 HOOKS SYS A OP, CL (two) – op *
   * cb PMA 2/3 GRP 2 HOOKS SYS B OP, CL (two) – op *
   * Perform PMA 2/3 HOOKS OPEN – CONTINGENCY *
   * 8-30 *

9. PMA 2/3 HOOKS SYS A, SYS B (two) – ctr
   cb PMA 2/3 GRP 2 HOOKS SYS A OP, CL (two) – op
   B OP, CL (two) – op
<table>
<thead>
<tr>
<th>APDS Status It</th>
<th>APDS FAILURE s = potential single failure m = multiple failures reqd</th>
<th>IMPACT</th>
<th>OFF NOMINAL PROCEDURE (IF APPLICABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER ON pb</td>
<td>Failed ON (m)</td>
<td>Continuous PWR ON will inhibit ring, damping, and fixer commands. Relays may overheat preventing future powerup. [Detectable only during powerup or ring drive operations]</td>
<td>RING DRV CMD OFF</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>If all STATUS lts are off, loss of all logic power to APDS. Docking system cannot be operated</td>
<td>POWER FAILED OFF (STATUS LTS OFF)</td>
</tr>
<tr>
<td>APDS CIRCUIT PROTECT OFF</td>
<td>Failed ON (m)</td>
<td>RING OUT, OPEN LATCHES, OPEN HOOKS, and UNDOCKING pb commands are enabled</td>
<td>APDS CIRCUIT PROTECT OFF LT FAILED OFF</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>No RING OUT, OPEN LATCHES, OPEN HOOKS, or UNDOCKING pb capability</td>
<td></td>
</tr>
<tr>
<td>RING ALIGNED</td>
<td>Failed ON (m)</td>
<td>Prime alignment cue lost. Use CRT RING ALIGN and PETAL POS BASE 1,2,3 indications as backup. Erroneous ind possible with significant pitch motion (sensors rotated 360°)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed OFF (s)</td>
<td>Prime alignment cue lost. Use CRT RING ALIGN and PETAL POS BASE 1,2,3 indications as backup</td>
<td></td>
</tr>
<tr>
<td>RING INITIAL POSITION</td>
<td>Failed ON (s)</td>
<td>Ring will only drive for 1 sec with RING OUT pb commands. Slip clutch will drive alternately between the SLIP and LOCK positions</td>
<td>Starred blocks in the DOCKING RING EXTENSION and DOCKING MECHANISM DEMATE/REMATE</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>INITIAL CONTACT lt disabled. Slip clutch will not drive to SLIP</td>
<td>APDS DIRECT DRIVE USING BOB required to drive slip clutch</td>
</tr>
<tr>
<td>FIXERS OFF</td>
<td>Failed ON (m)</td>
<td>IFM may be required to drive clutch to SLIP if failure occurs during ring extension. During docking, only centering springs maintain alignment during ring retraction</td>
<td>FIXERS OFF LT FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Unable to inhibit fixer operation during manual ring drive</td>
<td>FIXERS OFF LT FAILED OFF</td>
</tr>
<tr>
<td>HOOKS 1(2) OPEN</td>
<td>Failed ON (s)</td>
<td>Logic prevents hooks from driving open</td>
<td>HOOKS 1(2) OPEN LT FAILED ON [UNDOCKING]</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Hooks will not stop driving at Open position</td>
<td></td>
</tr>
<tr>
<td>LATCHES CLOSED</td>
<td>Failed ON (s)</td>
<td>If ring retraction to Final Position is attempted, ring will stall against capture latches if latches are failed closed. No impact if latches open on SPEC 167</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>No impact to nominal sequence. [May not be able to recapture, if reqd, if capture latches are not closed. Multiple failures reqd to inadvertently drive a latch motor open]</td>
<td></td>
</tr>
<tr>
<td>APDS Status</td>
<td>APDS FAILURE</td>
<td>IMPACT</td>
<td>OFF NOMINAL PROCEDURE (IF APPLICABLE)</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
</tr>
<tr>
<td>UNDOCK COMPLET</td>
<td>Failed ON (s)</td>
<td>If light comes on when APDS CIRC PROT OFF pb is pressed, hooks may be continuously commanded open.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>No impact. Indication is not used by any logic</td>
<td></td>
</tr>
<tr>
<td>INITIAL CONTACT</td>
<td>Failed ON (s)</td>
<td>One contact cue disabled. RING ALIGNED It, and CRT RING ALIGN and PETAL POS BASE 1,2,3 indications, may be used as contact indications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>One contact cue disabled. [Not detectable prior to contact]</td>
<td></td>
</tr>
<tr>
<td>CAPTURE</td>
<td>Failed ON (m)</td>
<td>Auto sequence may be active (dampers, fixers, ring/hook drive). May be unable to reset dampers. Potential Shuttle/PMA 2/3 mechanism damage if no damping or damping failed on</td>
<td>CAPTURE LT FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Auto Sequence may be inactive; no active damping resulting in excessive relative motion Must use visual cues (no sep) and DAMPING indication to verify capture</td>
<td></td>
</tr>
<tr>
<td>RING FORWARD POSITION</td>
<td>Failed ON (s)</td>
<td>Ring will only drive out for 10 sec at a time</td>
<td>Starrered blocks in affected procedures</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Ring will continue to drive at Forward Position until terminated by a PWR On/Off reset</td>
<td></td>
</tr>
<tr>
<td>READY TO HOOK</td>
<td>Failed ON (s)</td>
<td>Hooks will begin driving closed with RING IN pb command</td>
<td>READY TO HOOK LT FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Auto hook drive disabled. Ring will not stop driving at In-Between Hooks position Manual CLOSE HOOKS pb command required to drive hooks closed per starred block on DOCKING SEQUENCE (Cue Card)</td>
<td></td>
</tr>
<tr>
<td>INTERF SEALED</td>
<td>Failed ON (s)</td>
<td>No impact to APDS operations. Indication is not used by any logic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>No impact to APDS operations. Indication is not used by any logic</td>
<td></td>
</tr>
<tr>
<td>HOOKS 1(2) CLOSED</td>
<td>Failed ON (s)</td>
<td>Logic prevents associated hooks from driving closed</td>
<td>HOOKS 1(2) CLOSED LT FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>Hooks will not stop driving when closed position reached</td>
<td>HOOKS 1(2) NOT CLOSED WITHIN SINGLE MTR TIME if hooks not verified closed via CRT</td>
</tr>
<tr>
<td>LATCHES OPEN</td>
<td>Failed ON (s)</td>
<td>Ring will drive in once CAPTURE is achieved, or immediately if CAPTURE already present</td>
<td>LATCHES OPEN LT FAILED OFF</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>If Latches failed closed, ring will stall against Latches if Ring commanded to Final Position</td>
<td></td>
</tr>
<tr>
<td>RING FINAL POSITION</td>
<td>Failed ON (s)</td>
<td>During ring retraction, ring will only drive 10 sec 1st time. After 2nd Ring In command, ring will not stop driving at In-Between Hooks position and/or Final Position</td>
<td>RING FINAL POSITION LT FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (m)</td>
<td>During Ring retraction to Final Position, ring will not stop driving at Final Position</td>
<td></td>
</tr>
</tbody>
</table>
# APDS FAILURE/IMPACT MATRIX (Cont)

<table>
<thead>
<tr>
<th>APDS Status It</th>
<th>APDS FAILURE</th>
<th>IMPACT</th>
<th>OFF NOMINAL PROCEDURE (IF APPLICABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>APDS POWER</strong></td>
<td>Failed ON (s)</td>
<td>One logic bus remains powered. Still at least two failures from any inadvertent ops</td>
<td></td>
</tr>
<tr>
<td>$A_{DS}$, $B_{DS}$, $C_{DS}$</td>
<td>Failed OFF (s)</td>
<td>Loss of one capture latch motor. Next failure results in loss of all APDS avionics logic</td>
<td>APDS POWER FAILED OFF</td>
</tr>
<tr>
<td><strong>A6L SYSTEM POWER</strong></td>
<td>Failed OFF (s)</td>
<td>Loss of redundancy to APDS logic busses, Control Panel Power busses, and PMA hook power. Loss of some docking lights and vestibule depress valves capability</td>
<td></td>
</tr>
<tr>
<td>$A(B)$ $tb$</td>
<td>Failed ON (s)</td>
<td>One Pyro logic bus powered. Still more than two failures from charging pyros</td>
<td></td>
</tr>
<tr>
<td><strong>PYROS</strong></td>
<td>Failed OFF (s)</td>
<td>Loss of Pyro logic redundancy</td>
<td></td>
</tr>
<tr>
<td>$A_p$, $B_p$, $C_p$</td>
<td>Failed ON (s)</td>
<td>Possible loss of Pyro charge/fire inhibits</td>
<td></td>
</tr>
<tr>
<td><strong>PYRO CIRCUIT</strong></td>
<td>Failed OFF (m)</td>
<td>Loss of capability to arm/fire Pyros</td>
<td></td>
</tr>
<tr>
<td>PROTECT OFF</td>
<td>Failed OFF (m)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# APDS FAILURE/IMPACT MATRIX (TLM)

<table>
<thead>
<tr>
<th>APDS TLM</th>
<th>APDS FAILURE</th>
<th>IMPACT</th>
<th>OFF NOMINAL PROCEDURE (IF APPLICABLE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>s = potential single failure m = multiple failures reqd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAMPING</td>
<td>Failed ON (s)</td>
<td>Mechanism may not have compliance on contact; load capability may be exceeded. Failed-on dampers slow ring drive to about single motor drive time</td>
<td>DAMPING FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (s)</td>
<td>No impact for single failure. If all dampers failed, large rates/ misalignments may cause mechanism to hit hard stops, exceeding its load capability</td>
<td></td>
</tr>
<tr>
<td>RING FIXERS</td>
<td>Failed ON (s)</td>
<td>Mechanism may not have compliance on contact; load capability may be exceeded</td>
<td>FIXERS FAILED ON</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (s)</td>
<td>No impact for single fixer failure. For multiple failure case, alignment may be lost during ring retraction. [Detectable only during ring drive operations]</td>
<td></td>
</tr>
<tr>
<td>CLUTCH – SLIP</td>
<td>Failed ON (s)</td>
<td>If slip clutch locking mechanism failed in SLIP, resistance created by dampers and/or pusher springs will load actuator sufficiently to prevent ring motion</td>
<td>APDS DIRECT DRIVE USING BOB required to drive slip clutch to LOCK</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (s)</td>
<td>Must verify clutch in SLIP prior to contact</td>
<td></td>
</tr>
<tr>
<td>CLUTCH – LOCK</td>
<td>Failed ON (s)</td>
<td>Must verify clutch in SLIP prior to contact, otherwise mechanism may not have compliance on contact; load capability may be exceeded</td>
<td>APDS DIRECT DRIVE USING BOB required to drive slip clutch to SLIP</td>
</tr>
<tr>
<td></td>
<td>Failed OFF (s)</td>
<td>If slip clutch locking mechanism failed in SLIP, resistance created by dampers and/or pusher springs will load ring actuator sufficiently to prevent ring motion</td>
<td></td>
</tr>
<tr>
<td>CAP MAN REL</td>
<td>Failed OP (s)</td>
<td>If latch is released, may be unable to draw interfaces together</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failed ON (s)</td>
<td>One logic bus remains powered. Still at least two failures from any inadvertent ops</td>
<td>Next failure may require APDS Direct Drive IFM to complete docking or separate, or require manual capture latch release</td>
</tr>
<tr>
<td>CNTL PNL PWR</td>
<td>Failed OFF (s)</td>
<td>Loss of pb command redundancy. CNTL PNL PWR A will remove power from columns 1 &amp; 3 of the STATUS light matrix. CNTL PNL PWR C will remove power from columns 2 and 4 of the STATUS lights matrix. (Pyro pbs are not affected)</td>
<td></td>
</tr>
<tr>
<td>RNG DR BUS 1(2)</td>
<td>Failed OFF (s)</td>
<td>Loss of ring drive motor 1(2)</td>
<td></td>
</tr>
<tr>
<td>HKS DR BUS 1(2)</td>
<td>Failed OFF (s)</td>
<td>Loss of hook drive motor 1(2) [Affects both Hooks 1 &amp; 2]</td>
<td></td>
</tr>
<tr>
<td>DAMPER BUS 1(2)</td>
<td>Failed OFF (s)</td>
<td>BUS 1 (MN A): Dampers 1, 2 failed. BUS 2 (MN B): Damper 3 failed</td>
<td></td>
</tr>
<tr>
<td>FIXER BUS 1(2)</td>
<td>Failed OFF (s)</td>
<td>BUS 1 (MN A): Fixers 1, 2 failed. BUS 2 (MN B): Fixers 3, 4, 5 failed</td>
<td></td>
</tr>
<tr>
<td>Configuration</td>
<td>Page</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCS BURN (+X, -X, Multi-axis) (Front)</td>
<td>CC 9-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RENDEZVOUS PRPLT PAD (Back)</td>
<td>CC 9-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KU OPS (Front)</td>
<td>CC 9-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Back)</td>
<td>CC 9-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPROACH (Front)</td>
<td>CC 9-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VBAR APPROACH (Back)</td>
<td>CC 9-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/L CAMERA TARGET ALIGNMENT (+VBAR) (Front)</td>
<td>CC 9-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Back)</td>
<td>CC 9-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOCKING SEQUENCE (Front)</td>
<td>CC 9-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Back)</td>
<td>CC 9-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STOPWATCH RDOT CONVERSION (Front)</td>
<td>CC 9-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Back)</td>
<td>CC 9-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPC/MDM FAILURE RESPONSE DURING RNDZ (Front)</td>
<td>CC 9-15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RNDZ REF DATA (Back)</td>
<td>CC 9-16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/L CAMERA CORRIDOR AND ALIGNMENT</td>
<td>CC 9-17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAMERA A/D RANGE RULER</td>
<td>CC 9-18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/L CAMERA ZOOM CALIBRATION (RING READY FOR DOCK)</td>
<td>CC 9-19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLIGHT SUB ANG RULER</td>
<td>CC 9-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V10 MONITOR CORRIDOR</td>
<td>CC 9-21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A31P PGSC DISPLAY OF C/L CAMERA CORRIDOR AND ALIGNMENT</td>
<td>CC 9-22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A31P PGSC CAMERA A/D RANGE RULER</td>
<td>CC 9-23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCS FAILURE RESPONSE DURING PROX OPS</td>
<td>CC 9-25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCS/DPS/EPS FAILURE IMPACTS</td>
<td>CC 9-26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RCS BURN (+X, -X, Multi-axis)

1. GNC, OPS 202 PRO
   GNC ORBIT MNVR EXEC
   √RCS SEL, ITEM 4 – (*)

2. If onboard computed burn:
   √TIG and TGT PEG 7 ΔVs per Final solution
   √Guidance option is LAMBERT
   If ground computed burn:
   √TGT data per Burn Pad (reload WT as reqd)
   LOAD – ITEM 22 EXEC
   TIMER – ITEM 23 EXEC

3. If +X burn:
   DAP: A/AUTO/ALT(B/ALT as reqd)
   MNVR – ITEM 27 EXEC (*)
   If RR ops:
   KU – AUTO TRK
   GNC 33 REL NAV
   INH Angles – ITEM 24 EXEC (*)

TIG-0:30

4. FLT CNTLR PWR – ON
   DAP TRANS: as reqd
   If Multi-axis:
   √DAP: A/AUTO/PRI
   √If +X or -X:
   DAP: A/INRTL/PRI

TIG

5. If VGO Z is neg, Z,X,Y seq;
   otherwise, X,Y,Z
   THC: Trim VGOs < 0.2 fps
   FLT CNTLR PWR – OFF
   DAP: ALT
   DAP TRANS: PULSE/PULSE/PULSE
   GNC, OPS 201 PRO

6. If +X burn:
   DAP: A/AUTO(B/AUTO/ALT as reqd)
   If RR ops, when ATT ERR < 30 deg:
   KU – GPC
   √KU TRACK tb – gray
   GNC 33 REL NAV
   AUTO Angles – ITEM 23 EXEC (*)

7. When in attitude:
   DAP: A/AUTO/VERN(ALT)
When L or R RCS QTY < 1:
I’CNCT: 2 OMS to RCS (ORB PKT, RCS)

When G23 OMS/RCS QTY > 4:
I’CNCT TK SWITCH: (ORB PKT, RCS)

When G23 OMS/RCS QTY > 6:
I’CNCT RETURN (ORB PKT, RCS)

When L or R RCS QTY < 7:
or when FRCS QTY < 8:

DAP: NO LO Z

When L or R RCS QTY < 9:
or when FRCS QTY < 10:

If prior to Ti:
Do not perform Ti
If after Ti, but prior to TORVA init (+X burns to start TORVA are complete):
Go to RNDZ BREAKOUT (CONTINGENCY OPS), 5-18
If during TORVA:
Go to SHUTTLE NOSE IN-PLANE BREAKOUT (CONTINGENCY OPS), 5-16
If stable on +VBAR:
Go to VBAR BREAKOUT (CONTINGENCY OPS), 5-14
KU OPS

1. **CONFIGURE KU FOR RR TGT ACQ**
   - **GNC 33 REL NAV**
     - SV SEL, ITEM 4 – FLTR
     - INH RNG, ITEM 18 – (*)
     - RDOT, ITEM 21 – (*)
     - Angles, ITEM 24 – (*)
   - KU ANT ENA – ITEM 2 EXEC (*)
   - GNC I/O RESET
   - √
   - A2 DIGI-DIS sel – R/RDOT
   - A1U KU PWR – STBY
   - MODE – RDR PASSIVE
   - √ RDR OUTPUT – HI
   - CNTL – PNL (wait 3 sec)
   - PWR – ON
   - KU SEL – GPC >>

2. **AUTO TRK ACQ**
   - KU SEL – AUTO TRK
   - SLEW – as reqd (as seen in COAS)
   - EL, AZ angles < 30 deg
   - KU SEARCH – SEARCH (tb–gray)
   - Repeat slew and search as reqd
   - If acquisition not successful, √MCC >>

3. **RR NAVIGATION**
   - **GNC 33 REL NAV**
     - RADAR, ITEM 13 – (*)
   - √ If RATIO > 1.0: *
   - √ MCC *
   - FLTR TO PROP – ITEM 8 EXEC (*)
   - AUT RNG – ITEM 17 EXEC (*)
   - RDOT – ITEM 20 EXEC (*)
   - Angles – ITEM 23 EXEC (*) >>

4. **CONFIGURE KU FOR COMM**
   - **GNC 33 REL NAV**
     - INH RNG – ITEM 18 (*)
     - RDOT – ITEM 21 (*)
     - Angles – ITEM 24 (*)
     - KU ANT ENA – ITEM 2 (no *)
   - A1U KU PWR – STBY
     - MODE – COMM
     - √ sel – GPC
     - CNTL – CMD
   - A2 DIGI-DIS sel – EL/AZ

(reduced copy)
## APPROACH

### CC to CG RNG (ft) RPM & CONT TORVA RDOT (ft/s) MCC Z TYP w/RPM (h:mm:ss) DAP EVENT NO- RPM RDOT (ft/s) HHL RNG (ft) to ISS CG Raw TCS RNG* (ft) (Ref #2)

| 2000 | -3.0 | 02:00 | A/B/B | AUTO/ VERN (PRI) | If ROOT falls below value for next gate, THC: -Z (in) as reqd to maintain ROOT | -3.0 | 1990 | HHL Report | 2015 |
| 1700 | -2.4 | 02:00 | | | | | -2.8 | 1690 | 1698 |
| 1500 | -2.1 | 03:00 | | | | | -2.3 | 1490 | 1498 |
| 1000 | -1.3 | 03:00 | LO Z | MCC UPDATE: Go for RPM, Go to proceed inside 600 ft | | | -1.5 | 950 | 985 |
| 900 | -1.1 | 03:00 | | If Go for RPM, report to ISS: 10 min to RPM start F6, A6 ADI ATT -√LVLH | | | -1.3 | 800 | 885 |
| 800 | 0.9 | 03:00 | A/B/B | ATU KU BD VOR OUTPUT – LOW When in Rbar attitude, config DAP to A/B/B | | | | 750 | 796 |
| 700 | 0.6 | 04:00 | Null ISS rates in C/L camr | If Go for RPM, perform RPM SETUP A | | | 690 | 686 |
| 650 | 0.4 | 04:30 | Report to ISS: Range 650 ft | | | | 640 | 636 |

### 620
-0.4 < Rdot < -0.3

### 600
-0.3 < Rdot < -0.2

### 580
-0.2 < Rdot < -0.1

- Null KU B/D VOR OUTPUT – LOW
- Throttle: +X (up) as reqd to null tgt motion in C/L camr, and initiate flyaround
- Maintain ISS within C/L camr FOV

### 415-315

#### 350-250

- Perform CONFIGURE FOR DOCKING D
- Perform VBAR APPROACH (Cue Card)

### RPM SETUP A

<table>
<thead>
<tr>
<th>RPM START WINDOW (MET) OPEN:</th>
<th>Close:</th>
</tr>
</thead>
</table>

### CONTINGENCY 600 FT TORVA A

- If no-go to proceed inside 800 ft, perform CONTINGENCY 600 FT TORVA C

### RBAR PITCH MNVR B

- If Go for RPM, perform nominal RPM actions per APPROACH cue card
- Continue APPROACH cue card with the following deltas:
  - Initiate TORVA at range 700 ft, Rdot -0.3 ft/s
  - Maintain RNG > 600 ft (C/G-C/G) until VBAR arrival
  - Maintain ISS in C/L camr FOV
- On MCC GO, perform CONFIGURE FOR DOCKING B and VBAR APPROACH (Cue Card)

### CONFIGURE FOR DOCKING B

- Perform AIRLOCK FAN ACT AND ODS VOLUME PREP (APDS), 6-10
- Perform DOCKING MECHANISM POWERUP (APDS), 8-5
- Perform DOCKING PREP (APDS), 8-7

### RPM START WINDOW (MET)

- OPEN: / /
- CLOSE: / /
### VBAR APPROACH

**Interface RNG (ft)** | **RDOT (ft/s)** | **MC2 ET h:mm:ss (doc.–PET)** | **DAP** | **EVENT** | **HHL RNG (to Node 2) (ft)** | **Raw TCS RNG* (Ref #1)**
--- | --- | --- | --- | --- | --- | ---
250 | -0.20 ±0.05 | 1:15.00 (-34.00) | \(\triangle LO Z\) | MCC UPDATE: Go for docking Maintain ISS docking target within 8 deg Corridor | 257 | 255 |
(170 ± 10) 170 | -0.20 ±0.05 | 1:21.30 (-27.30) | DAP: B | Note: DAP A allowed for \(\pm X\) and \(\pm Z\) THC If reqd, THC: as reqd to null Rdot and perform VBAR stationkeeping | 177 | 175 |
110 | -0.15 ±0.05 | 1:26.30 (-22.30) | | Perform CONFIGURE KU FOR COMM (Cue Card, KU OPS) | 117 | 115 |
75 | -0.10 ±0.05 | 1:30.30 (-18.30) | No LO Z A10,B10 \(\triangle DAP: B\) | Note: DAP A allowed for \(\pm X\) and \(\pm Z\) THC (in GNC 23 RCS (Maintain through contact) \(\triangle RCS FWD – ITEM 1 EXEC (*)\) \(\triangle JET DES F1F – ITEM 31 EXEC (*)\) \(\triangle F3F – ITEM 33 EXEC (**\)) | 82 | 80 |
30 ± 5 | 0.0 | 1:38.00 (-11.00) | \(\triangle A10,B10 \triangle DAP: B\) | 5° Corridor If Flyout Req'd: THC: +Z (out) as reqd to null RDOT Perform AUTO ANGULAR FLYOUT (Cue Card) outside 25 ft Review FAILED CAPTURE, steps 1 thru 3, CAUTION (Cue Card, DOCKING SEQUENCE) \(\triangle A7L Panel Config\) Set EVENT TIMER for CAPTURE (counting up from 00:00) | 32-42 | 30-40 |
30 | -0.07 ±0.02 | 1:43.00 (-06.00) | \(\triangle 5° Corridor\) THC: as reqd to establish RDOT = -0.07 ± 0.02 fps Report to MCC and ISS: Initiating final approach | 37 | 35 |
25 | | 1:44.00 (-05.00) | | Maintain GNC 23 RCS through contact | 32 | 30 |
10 | -0.10 ±0.03 | 1:47.20 (-01.40) | No LO Z | ARM PCT | 17 | 15 |
3 | -0.10 ±0.03 | 1:48.30 (-00.30) | | Maintain 3 inch lateral alignment cylinder | N/A | 8 |
CONTACT or ~2 in | -0.10 ±0.03 | 1:49.00 (00.00) | PCT (SPARE pb) | CAPTURE | N/A | 5 |

* Raw TCS Range assumes ISS in docking attitude

### CAPTURE

**MS START EVENT TIMER = 00:00:00**

**A7L**

\(\triangle\) CAPTURE it – It on Notify ISS and MCC-H: “Capture Confirmed” DISARM PCT

**F4**

SPDBK/THROT pb – push (It off)

\(\triangle\) ISS in FREE DRIFT (ISS indicator lights flashing)

\(\triangle\) IF NO INDICATION of ISS FREE

\(\triangle\) DRIFT AT CAPTURE + 65 SEC.

\(\triangle\) Go to FAILED CAPTURE

**A8U**

When capture confirmed and ISS in FREE FLT CNTL RWR – OFF Perform TCS DEACTIVATION (RNDZ TOOLS) 7-20 Go to DOCKING SEQUENCE (Cue Card)

### FAILED CAPTURE

1. APDS CIRC PROT OFF pb – push \(\triangle\) CIRCUIT PROTECT OFF it – It on OPEN LATCHES pb – push \(\triangle\) LATCHES CLOSED it – It off \(\triangle\) OPEN it – It off

2. \(\triangle\) DAP: NO LO Z

\(\triangle\) IF VERN FAIL: 

\(\triangle\) DAP: PRI

If petals clear:

**DAP**: A(B)/LVLH

3. THC: +Z (out) to establish 0.1 fps opening rate

**DAP**: B/LVLH

If ISS in FREE DRIFT:

Use ISS CG as corridor reference Maintain 8 degree corridor Inform MCC-H and ISS: Failed Capture Maintain opening rate of at least 0.1 fps

4. Go to VBAR CORRIDOR BACKOUT, CONTINGENCY OPS 5-12

(reduced copy)
C/L CAMERA TARGET ALIGNMENT (+VBAR)

**PITCH (P)**

ITEM 15

Target Displaced DOWN  
(Cross Displaced UP)

3. $P = 179 - P = (A)$
5. $P = PITCH - P = (D)$

-target displaced down (cross displaced up)

Target Displaced UP  
(Cross Displaced DOWN)

3. $P = 179 + P = (A)$
5. $P = PITCH + P = (D)$

-target displaced up (cross displaced down)

**ROLL (R)**

ITEM 16

Rotated CW

3. $YAW = 360 - R = (B)$
5. $YAW = YAW - R = (E)$

-target displaced right (cross displaced left)

Rotated CCW

3. $YAW = 0 + R = (B)$
5. $YAW = YAW + R = (E)$

-target displaced left (cross displaced right)

**YAW (Y)**

ITEM 17

-target displaced right (cross displaced left)

3. $OM = 0 + Y = (C)$
5. $OM = OM + Y = (F)$

-target displaced left (cross displaced right)

3. $OM = 360 - Y = (C)$
5. $OM = OM - Y = (F)$

(reduced copy)
AUTO ANGULAR FLYOUT

CAUTION
AUTO ANGULAR FLYOUT must be completed by RNG = 10 ft

1. RECORD ANGULAR MISALIGNMENT
   √DAP: A10, B10
   Read error from ISS centerline target
   PITCH ________ (P)
   YAW ________ (Y)
   ROLL ________ (R)
   Report misalignment to MCC
   If all axes within 1.0 deg of zero, no mnvr reqd >>

2. CALCULATE UNIV PTG INPUTS
   Use diagrams in TARGET ALIGNMENT (Cue Card) to determine
   UNIV PTG inputs for step 3

3. EXECUTE ALIGNMENT MNVR
   GNC UNIV PTG
   √TGT ID +2
   √BODY VECT +5
   PITCH +(A)
   YAW +(B)
   OM +(C)
   TRK – ITEM 19 EXEC (CUR-*)

   When mnvr cplt,
   4. RECORD REMAINING ANGULAR MISALIGNMENT
      Record error from ISS centerline target:
      PITCH ________ (P)
      YAW ________ (Y)
      ROLL ________ (R)
      If all axes within 1.0 deg of zero, no additional mnvr reqd >>

   Otherwise,
   5. REPEAT ALIGNMENT
      a. Calculate UNIV PTG inputs:
         Use diagrams in TARGET ALIGNMENT (Cue Card) to determine UNIV PTG inputs for step 5b
      b. Execute alignment MNVR
         GNC UNIV PTG
         √TGT ID +2
         √BODY VECT +5
         PITCH +(D)
         YAW +(E)
         OM +(F)
         TRK – ITEM 19 EXEC (CUR-*)

(reduced copy)
DOCKING SEQUENCE

**CAUTION**
If following failures occur during final approach (< 30 ft), **NO-GO** for docking. Initiate Corridor Backout. Then proceed with APDS OFF-NOMINAL procedures (APDS).

<table>
<thead>
<tr>
<th>POWER Failed OFF (All STATUS lts OFF)</th>
<th>DAMPING tlm Failed ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPTURE lt Failed ON</td>
<td>FIXERS tlm Failed ON</td>
</tr>
</tbody>
</table>

**CAUTION**
If any Docking Sequence command occurs out of order or if any STATUS lt functions erroneously:
- A7L POWER OFF pb – push
- ON pb – push

Proceed with APDS OFF-NOMINAL procedures (APDS).

---

**Event Time**

### Contact/Capture/Damping

<table>
<thead>
<tr>
<th>SM 167 DOCKING STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00 A7L</td>
</tr>
<tr>
<td>0:05 CRT</td>
</tr>
</tbody>
</table>

### Disable and Release Dampers

3. When no relative motion [PETAL POS BASE (three) not changing for 60 sec]:
- A7L POWER ON pb – push
- CRT \(\checkmark\) DAMPING – OFF

4. When no relative motion [PETAL POS BASE (three) not changing for 30 sec]:
- A7L FIXER OFF pb – push
- CRT \(\checkmark\) FIXERS Off lt – lt on
- 0:00 CRT \(\checkmark\) DRV CMD – ON [PETAL POS BASE (three) – decr]
- \(\checkmark\) CLUTCH – LOCK/blank

5. On MCC GO [PETAL POS BASE (three) not changing for 30 sec]:
- A7L APDS CIRC PROT OFF pb – push
- CRT \(\checkmark\) CIRCUIT PROTECT OFF lt – It on
- 0:00 CRT \(\checkmark\) DRV CMD – ON [PETAL POS BASE (three) – incr]

6. On MCC GO [PETAL POS BASE (three) not changing for 30 sec]:
- A7L POWER OFF pb – push
- CRT \(\checkmark\) RING DRV CMD – OFF

7. On MCC GO [PETAL POS BASE (three) not changing for 30 sec]:
- A7L POWER OFF pb – push
- CRT \(\checkmark\) RING DRV CMD – OFF
### Retract Ring

**A7L,CRT**

8. On MCC GO (RING ALIGNED lt on and [PETAL POS BASE (three) not changing] for 30 sec):

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L RING IN pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT DRV CMD – ON [PETAL POS BASE (three) – decr]</td>
</tr>
<tr>
<td></td>
<td>CRT FIXERS – ON</td>
</tr>
<tr>
<td></td>
<td>CRT CLUTCH – LOCK/blank</td>
</tr>
</tbody>
</table>

* If PETAL POS BASE (three) > 20 % and RING ALIGNED lt off:
  * A7L POWER ON pb – push
  * A7L Wait for ring alignment (up to 30 min)
  * A7L When RING ALIGNED lt on and [PETAL POS BASE (three) not changing] for 30 sec:

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:15</td>
<td>A7L RING IN pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT PETAL POS BASE (three) ≤ 7%</td>
</tr>
</tbody>
</table>

### Close Hooks

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L HOOKS 1,HOOKS 2 OPEN lt (two) – lt off</td>
</tr>
<tr>
<td></td>
<td>CRT HK1,HK2 DRV CMD (two) – ON</td>
</tr>
<tr>
<td></td>
<td>CRT POS (two) ≥ 5% &amp; incr</td>
</tr>
<tr>
<td></td>
<td>CRT A7L CLOSE HOOKS pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT A7L CLOSE HOOKS 1(2) CLOSED lt failed ON:</td>
</tr>
<tr>
<td></td>
<td>CRT A7L Perform HOOKS 1(2) CLOSED LT FAILED ON, 8-23</td>
</tr>
<tr>
<td>0:20</td>
<td>CRT RING DRV CMD – OFF</td>
</tr>
<tr>
<td></td>
<td>CRT A7L POWER ON pb – push</td>
</tr>
</tbody>
</table>

### Load Relieve Capture Latches (Extend Ring)

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L APDS CIRC PROT OFF pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT CIRCUIT PROTECT OFF lt – lt on</td>
</tr>
<tr>
<td>0:10</td>
<td>A7L POWER ON pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT RING DRV CMD – OFF</td>
</tr>
</tbody>
</table>

### Open Capture Latches

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L OPEN LATCHES pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT LATCHES CLOSED lt – lt off</td>
</tr>
<tr>
<td>0:05</td>
<td>A7L OPEN lt – lt on</td>
</tr>
</tbody>
</table>

### Retract Ring to FNL POS

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L RING IN pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT DRV CMD – ON [PETAL POS BASE (three) – decr]</td>
</tr>
<tr>
<td></td>
<td>CRT FIXERS – ON</td>
</tr>
<tr>
<td>0:10</td>
<td>A7L FINAL POSITION lt – lt on</td>
</tr>
<tr>
<td></td>
<td>CRT PETAL POS BASE (three) = 5 ± 3%</td>
</tr>
<tr>
<td>0:20</td>
<td>A7L RING DRV CMD – OFF</td>
</tr>
</tbody>
</table>

### Power Off

<table>
<thead>
<tr>
<th>Time</th>
<th>Action 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>A7L POWER OFF pb – push</td>
</tr>
<tr>
<td></td>
<td>CRT STATUS lt (eighteen) – lt off</td>
</tr>
<tr>
<td>20.</td>
<td>Go to TERMINATE RNDZ OPS 22A 4-22 &gt;&gt;</td>
</tr>
</tbody>
</table>
### STOPWATCH RDOT CONVERSION

<table>
<thead>
<tr>
<th>TIME BETWEEN 1 FT MARKS (SEC)</th>
<th>RANGE RATE (FT/SEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>3</td>
<td>0.33</td>
</tr>
<tr>
<td>4</td>
<td>0.25</td>
</tr>
<tr>
<td>5</td>
<td>0.20</td>
</tr>
<tr>
<td>5.5</td>
<td>0.18</td>
</tr>
<tr>
<td>6</td>
<td>0.17</td>
</tr>
<tr>
<td>6.5</td>
<td>0.15</td>
</tr>
<tr>
<td>7</td>
<td>0.14</td>
</tr>
<tr>
<td>7.5</td>
<td>0.13</td>
</tr>
<tr>
<td>8</td>
<td>0.125</td>
</tr>
<tr>
<td>8.5</td>
<td>0.12</td>
</tr>
<tr>
<td>9</td>
<td>0.11</td>
</tr>
<tr>
<td>10</td>
<td>0.10</td>
</tr>
<tr>
<td>11</td>
<td>0.09</td>
</tr>
<tr>
<td>12</td>
<td>0.08</td>
</tr>
<tr>
<td>13</td>
<td>0.075</td>
</tr>
<tr>
<td>14</td>
<td>0.07</td>
</tr>
<tr>
<td>15</td>
<td>0.067</td>
</tr>
<tr>
<td>16</td>
<td>0.063</td>
</tr>
<tr>
<td>18</td>
<td>0.056</td>
</tr>
<tr>
<td>20</td>
<td>0.050</td>
</tr>
</tbody>
</table>

**NOTE**

HHL SPECS state that the HHL will not work if the aimpoint surface is closer than 12 ft from the HHL unit; therefore, no HHL use should be expected at an HHL range less than 12 ft (5 ft interface-to-interface)
### Rdot vs DELTA RNG/DELTA TIME

<table>
<thead>
<tr>
<th>Time (m:ss)</th>
<th>ΔRng (m)</th>
<th>1000</th>
<th>800</th>
<th>600</th>
<th>500</th>
<th>400</th>
<th>300</th>
<th>250</th>
<th>200</th>
<th>150</th>
<th>100</th>
<th>50</th>
<th>25</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:45</td>
<td></td>
<td>8.9</td>
<td>6.7</td>
<td>5.6</td>
<td>4.4</td>
<td>3.3</td>
<td>2.2</td>
<td>1.1</td>
<td>0.56</td>
<td>0.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:50</td>
<td></td>
<td>10.0</td>
<td>8.0</td>
<td>6.0</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.0</td>
<td>1.0</td>
<td>0.50</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:55</td>
<td></td>
<td>9.1</td>
<td>7.3</td>
<td>5.5</td>
<td>4.5</td>
<td>3.6</td>
<td>2.7</td>
<td>1.8</td>
<td>0.91</td>
<td>0.45</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:00</td>
<td></td>
<td>10.0</td>
<td>8.3</td>
<td>6.7</td>
<td>5.0</td>
<td>4.2</td>
<td>3.3</td>
<td>2.5</td>
<td>1.7</td>
<td>0.83</td>
<td>0.42</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:10</td>
<td></td>
<td>10.0</td>
<td>8.6</td>
<td>7.1</td>
<td>5.7</td>
<td>4.3</td>
<td>3.6</td>
<td>2.9</td>
<td>2.1</td>
<td>1.4</td>
<td>0.71</td>
<td>0.36</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>1:20</td>
<td></td>
<td>10.0</td>
<td>8.5</td>
<td>7.5</td>
<td>6.3</td>
<td>5.0</td>
<td>3.8</td>
<td>3.1</td>
<td>2.5</td>
<td>1.9</td>
<td>1.3</td>
<td>0.63</td>
<td>0.31</td>
<td>0.13</td>
</tr>
<tr>
<td>1:30</td>
<td></td>
<td>8.9</td>
<td>7.8</td>
<td>6.7</td>
<td>5.6</td>
<td>4.4</td>
<td>3.3</td>
<td>2.8</td>
<td>2.2</td>
<td>1.7</td>
<td>1.1</td>
<td>0.56</td>
<td>0.28</td>
<td>0.11</td>
</tr>
<tr>
<td>1:40</td>
<td></td>
<td>10.0</td>
<td>8.0</td>
<td>7.0</td>
<td>6.0</td>
<td>5.0</td>
<td>4.0</td>
<td>3.0</td>
<td>2.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.0</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>1:50</td>
<td></td>
<td>9.1</td>
<td>7.3</td>
<td>6.4</td>
<td>5.5</td>
<td>4.5</td>
<td>3.6</td>
<td>2.7</td>
<td>2.3</td>
<td>1.8</td>
<td>1.4</td>
<td>0.91</td>
<td>0.45</td>
<td>0.23</td>
</tr>
<tr>
<td>2:00</td>
<td></td>
<td>8.3</td>
<td>6.7</td>
<td>5.6</td>
<td>5.0</td>
<td>4.2</td>
<td>3.3</td>
<td>2.5</td>
<td>2.1</td>
<td>1.7</td>
<td>1.3</td>
<td>0.83</td>
<td>0.42</td>
<td>0.21</td>
</tr>
<tr>
<td>2:10</td>
<td></td>
<td>7.1</td>
<td>5.7</td>
<td>5.0</td>
<td>4.3</td>
<td>3.6</td>
<td>2.9</td>
<td>2.1</td>
<td>1.8</td>
<td>1.4</td>
<td>1.1</td>
<td>0.71</td>
<td>0.36</td>
<td>0.18</td>
</tr>
<tr>
<td>2:20</td>
<td></td>
<td>6.3</td>
<td>5.0</td>
<td>4.4</td>
<td>3.8</td>
<td>3.1</td>
<td>2.5</td>
<td>1.9</td>
<td>1.6</td>
<td>1.3</td>
<td>0.9</td>
<td>0.63</td>
<td>0.31</td>
<td>0.16</td>
</tr>
<tr>
<td>2:30</td>
<td></td>
<td>5.6</td>
<td>4.4</td>
<td>3.9</td>
<td>3.3</td>
<td>2.8</td>
<td>2.2</td>
<td>1.7</td>
<td>1.4</td>
<td>1.1</td>
<td>0.8</td>
<td>0.56</td>
<td>0.28</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**NOTE:**
If RPOP is available, use RPOP subtended angle function.
## GPC/MDM Failure Response During RNDZ

### Notes
1. Perform appropriate ORB PKT procedure in parallel with IMMEDIATE ACTIONS on card as soon as practical.
2. Use this card during Rndz T/L thru MC4 burn (if RR FAIL PROCEDURES, thru RR fail correction burn).
3. GPC assignments assume 1233 NBAT.
4. Do NOT restring for Non-Universal I/O Errors. Otherwise, a restring for GPC 1, 2, 3 fails will recover everything (see expected restring below).
5. If any GNC GPC fails, VERNs ↓
6. If IMUs not commfaulted, THC's are normally GO.
7. Loss of FF2, FF4, FA3, and FA4 do not impact Rndz (unless other failures).

<table>
<thead>
<tr>
<th>GPC</th>
<th>MDM</th>
<th>Immediate Action</th>
<th>Major Impact</th>
</tr>
</thead>
</table>
| **GPC1** *(3232*) | **FF1** | 1. IF -Z ST NAV, INH ST to NAV  
2. IF -Z ST not recovered: Use -Y ST, if reqd | 1. C3 DAP lights latched (go out with MDM pwrs fail)  
2. -Z ST ↓ |
| **FA1** | DAP: ALT/AUTO | VERNs ↓ |
| **GPC2** *(1313*) | **FA2** | DAP: ALT/AUTO | VERNs ↓ |
| **Man OMS Shutdown**  
**GPC3** *(1212*) | **FF3** | 1. DAP: ALT/AUTO  
2. IF RR NAV, INH RR to NAV  
3. IF -Y ST NAV, INH ST to NAV  
4. IF RR not recovered: Work RR FAIL procedures | 1. VERNs ↓  
2. RR → NAV/RPOP ↓ (Panel A2 OK)  
3. A6 DAP lights latched (go out with MDM pwrs fail)  
4. -Y ST ↓  
5. Also for loss of GPC3: R OMS GMBL PRI/SEC ↓ |
| **Loss of Aft DAP**  
**GPC4** *(1212*) | **PL** | If Ku breaks lock: Ku sel – AUTO TRK | 1. GPC Ku ptg ↓, slew in AUTO TRK if Ku breaks lock  
2. No Ku self-test |

* Expect this NBAT if GPC fail

*| MALFUNCTION | >> |
|-------------|-----|
**TOP**

BACK OF 'GPC/MDM FAILURE RESPONSE DURING RNDZ'

### RNDZ REF DATA

<table>
<thead>
<tr>
<th>FF1</th>
<th>FF3</th>
<th>FA1</th>
<th>DSC OF2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F MANF 1 JETS</strong></td>
<td><strong>VERNS</strong></td>
<td><strong>L/R MANF 1 JETS</strong></td>
<td><strong>VERNS &amp; F MANF 3,4 RM</strong></td>
</tr>
<tr>
<td><strong>C3 DAP LTS</strong></td>
<td><strong>VERNS</strong></td>
<td><strong>VERNS</strong></td>
<td><strong>F RCS OX, FU QTY</strong></td>
</tr>
<tr>
<td><strong>IMU 1</strong></td>
<td><strong>F MANF 4 JETS</strong></td>
<td><strong>L OMS GBML PRI</strong></td>
<td><strong>DSC OF4</strong></td>
</tr>
<tr>
<td><strong>-Z STRK</strong></td>
<td><strong>A6 DAP LTS</strong></td>
<td><strong>L OMS GBML PRI</strong></td>
<td><strong>F MANF 1,2 RM</strong></td>
</tr>
<tr>
<td><strong>L OMS GBML PRI ENA</strong></td>
<td><strong>IMU 3</strong></td>
<td><strong>L OMS GBML PRI</strong></td>
<td><strong>DSC OL1</strong></td>
</tr>
<tr>
<td><strong>L ADI sw, ATT REF</strong></td>
<td><strong>RR → NAV/RPOP</strong></td>
<td><strong>VERN &amp; L MANF 1,2 RM</strong></td>
<td><strong>VERN &amp; L MANF 1.2 RM</strong></td>
</tr>
<tr>
<td><strong>F.A THC contact 1</strong></td>
<td><strong>-Y STRK</strong></td>
<td><strong>L OMS GBML ONLY</strong></td>
<td><strong>L OMS DEORB ONLY</strong></td>
</tr>
<tr>
<td><strong>L RHC channel 1</strong></td>
<td><strong>R OMS GBML SEC ENA</strong></td>
<td><strong>L RCS OX QTY</strong></td>
<td><strong>L RCS OX QTY</strong></td>
</tr>
<tr>
<td><strong>PNL O3 F,L RCS OX QTY</strong></td>
<td><strong>A ADI sw, ATT REF</strong></td>
<td><strong>VNLMAN 3,4 RM</strong></td>
<td><strong>DSC OR2</strong></td>
</tr>
<tr>
<td><strong>PNL O3 F,L RCS LOW QTY</strong></td>
<td><strong>F.A THC contact 3</strong></td>
<td><strong>L RCS FU QTY</strong></td>
<td><strong>R MANF 3,4 RM</strong></td>
</tr>
<tr>
<td>**FF2</td>
<td>FF4</td>
<td>FA2</td>
<td>DSC OA2</td>
</tr>
<tr>
<td><strong>F MANF 2 JETS</strong></td>
<td><strong>F MANF 3 JETS</strong></td>
<td><strong>L/R MANF 2 JETS</strong></td>
<td><strong>VERN &amp; R MANF 1,2 RM</strong></td>
</tr>
<tr>
<td><strong>IMU 2</strong></td>
<td><strong>R OMS GBML SEC ENA</strong></td>
<td><strong>R OMS GBML SEC</strong></td>
<td><strong>R OMS DEORB ONLY</strong></td>
</tr>
<tr>
<td><strong>L OMS GBML SEC ENA</strong></td>
<td><strong>R AHC Roll channel 2</strong></td>
<td><strong>L OMS GBML SEC</strong></td>
<td><strong>R RCS OX QTY</strong></td>
</tr>
<tr>
<td><strong>R ADI sw, ATT REF</strong></td>
<td><strong>R RHC channel 3</strong></td>
<td><strong>VERNS &amp; R MANF 1,2 RM</strong></td>
<td><strong>DSC OA2</strong></td>
</tr>
<tr>
<td><strong>F.A THC contact 2</strong></td>
<td><strong>PL1</strong></td>
<td><strong>R OMS GBML PRI</strong></td>
<td><strong>VERN &amp; R MANF 3,4 RM</strong></td>
</tr>
<tr>
<td><strong>A RHC P,Y channel 2</strong></td>
<td><strong>GPC KU PTG</strong></td>
<td><strong>R OMS GBML SEC</strong></td>
<td><strong>L RCS FU QTY</strong></td>
</tr>
<tr>
<td><strong>L RHC channel 2</strong></td>
<td><strong>KU self-test</strong></td>
<td><strong>L(R) OMS DEORB ONLY</strong></td>
<td><strong>DSC OA2</strong></td>
</tr>
<tr>
<td><strong>R RHC channel 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CNTL AB1

- PLB LTS (Fwd-P, Aft-S, Bulkhead)
- L ADI ATT REF
- CCTV CONTR UNIT PRI

### CNTL AB2

- F MANF 1 JETS
- L ADI switches, ATT REF

### CNTL AB3

- C3 DAP ROT,TRANS pbs

### MAIN A

- FPC1: MCIU
- FLC1: F MANF 1 JETS
- AC1B: PNL O3 RCS/OMS QTY
- FWD EVENT TIMER
- A6 DAP LTS, TRANS pbs (PCT)
- R ADI switches, ATT REF
- L ADI sw, ATT REF
- F.A THC contact 1
- L OMS GBML PRI
- R OMS GBML SEC
- ALC1: VERNS
- O14: -Y STRK
- AFT EVENT TIMER
- O14/A8: RMS PRI PWR
- R14: CCTV CAM-C,D
- CCTV MON-1
- CCTV CONTR UNIT PRI
- MDC: APDS RING DAMP 1
- APDS HK, RING MTR 1
- RBC PRI PWR
- OVDH DOCK, RMS LTS
- PLB LTS (Fwd-P, Aft-S)

### MAIN B

- FPC2: MCIU
- FLC2: F MANF 2 JETS
- AC2C: PNL A2 DIGITALS
- A6 DAP LTS, TRANS pbs (PCT)
- R ADI switches, ATT REF
- L ADI sw, ATT REF
- F.A THC contact 1
- L OMS GBML PRI
- R OMS GBML SEC
- ALC2: VERNS
- O15: -Y STRK
- FWD EVENT TIMER
- O15/A8: RMS B/JU PWR
- R14: KU COMM & RR
- CCTV CAM-A, A2, CCTV MON-2
- CCTV CONTR UNIT SEC
- VPU (C/L CAM CMD)

### MAIN C

- FPC3: MCIU
- FLC3: VERNS
- AC3A: COAS PWR
- A6 DAP LTS, TRANS pbs (PCT)
- R ADI switches, ATT REF
- L ADI sw, ATT REF
- F.A THC contact 1
- L OMS GBML PRI
- ALC3: VERNS
- O16: PNL O3 RCS/OMS QTY
- R14: KU SIG PROC (RR OK)
- CCTV CAM-B
- CABIN TV UTIL PORT
- MDC: PLB LTS (Aft-P, Mid-S)

### ESS 2CA

- TCS

### CABIN PL (Flt Specific)

- CCTV C/L CAM

---

CC 9-16

RNDZ-7b/123/O/A
Note: Fabricate As Transparency

C/L CAMERA

CORRIDOR AND ALIGNMENT

CTVC 40.0 DEG HFOV - CORRIDOR
CTVC FULL ZOOM - ALIGNMENT
Note: Fabricate As Transparency

CTVC FULL NO ZOOM

RNDZ-9a/123/O/A
Note: Fabricate As Transparency

C/L CAMERA

ZOOM CALIBRATION (RING READY FOR DOCK)

CTVC AT HFOV = 40.0 DEG

RNDZ-10a/123/O/A
Note: Fabricate As Transparency

V10 MONITOR

CORRIDOR

CTVC 40.0 DEG HFOV - CORRIDOR
CTVC FULL ZOOM - ALIGNMENT

RNDZ-14a/123/O/A
Note: Fabricate As Transparency
**TOP**

**BACK OF ‘RCS FAILURE RESPONSE DURING PROX OPS’**

**RCS/DPS/EPS FAILURE IMPACTS**

<table>
<thead>
<tr>
<th>DPS</th>
<th>FRCS JET GROUPS</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPC</td>
<td>MDM 1 2 3 4 5 6</td>
<td>DC SUBBUS</td>
</tr>
<tr>
<td>FF1</td>
<td>F1F F1L F1U F1D</td>
<td>FLC1 FPC1 MN A DA1</td>
</tr>
<tr>
<td>FF2</td>
<td>F2F F2R F2U F2D</td>
<td>FLC2 FPC2 MN B DA2</td>
</tr>
<tr>
<td>FF3</td>
<td>F3F F3L F3U F3D</td>
<td>FLC3 FPC3 MN C DA3</td>
</tr>
</tbody>
</table>

**CASE**

1 JET ↓ 1Fx D 1Fx D

2 JETS ↓ -X Y Y

2Fx D 2Fx D

---

<table>
<thead>
<tr>
<th>DPS</th>
<th>ARCS JET GROUPS</th>
<th>EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPC</td>
<td>MDM 7 8 9 10 11 12 13 14</td>
<td>DC SUBBUS</td>
</tr>
<tr>
<td>FA1</td>
<td>R1A L1A L1L R1R L1U R1U</td>
<td>L5L L5D</td>
</tr>
<tr>
<td>FA2</td>
<td>R3A L3A L3L R3R L3D R3D</td>
<td>R5R R5D</td>
</tr>
<tr>
<td>FA3</td>
<td>L2L R2R L2U R2U L2D R2D</td>
<td>N/A REDUNDANT POWER</td>
</tr>
<tr>
<td>FA4</td>
<td>L4L R4R L4U R4U L4D R4D</td>
<td></td>
</tr>
</tbody>
</table>

**CASE**

1 JET ↓ 1 JET ↓

2 JETS ↓ +X +X

---

1. For RCS failures, strike aff jet(s). For DPS/EPS failures, strike all jets in same row(s) as aff GPC/MDM/bus
2. For each group with failed jet(s), read down to 1 JET ↓ or 2 JETS ↓ as appropriate to determine applicable case
3. Refer to reverse side for appropriate procedures and flight rule impacts for each applicable case
4. If 1 JET ↓, read down to 2 JETS ↓ to determine case for next worse failure, then read back up to determine which RCS/DPS/EPS failures can result in next worse failure. Review IMMEDIATE ACTIONS for next worse failure