

CAUTION

Constraints for undocking of unmanned Orbiter:

ISS capable of controlling -Rbar attitude (ISS 90,0,0 LVLH PYR) with 1° deadbands

ISS RWS powerup required to monitor ODS

TCS REPOWER previously performed

SHUTTLE EGRESS, steps 1 - 6, previously performed prior to APDS REMOTE COMMAND

APDS REMOTE COMMAND, steps 1 - 29, previously performed

PMA2 DEPRESSURIZATION AND LEAK CHECK, steps 1 - 4, previously performed

IFM to provide TCS power via MAIN A or MAIN C previously performed

At least 2 GNC GPCs available

At least 2 IMUs available

2 PGSCs available for WinDecom and RPOP/CADS

S-band comm optimized for 7.5 hours

DAP B9 previously configured to include 10 second ALT DAP DELAY

Docking target previously installed on ISS hatch

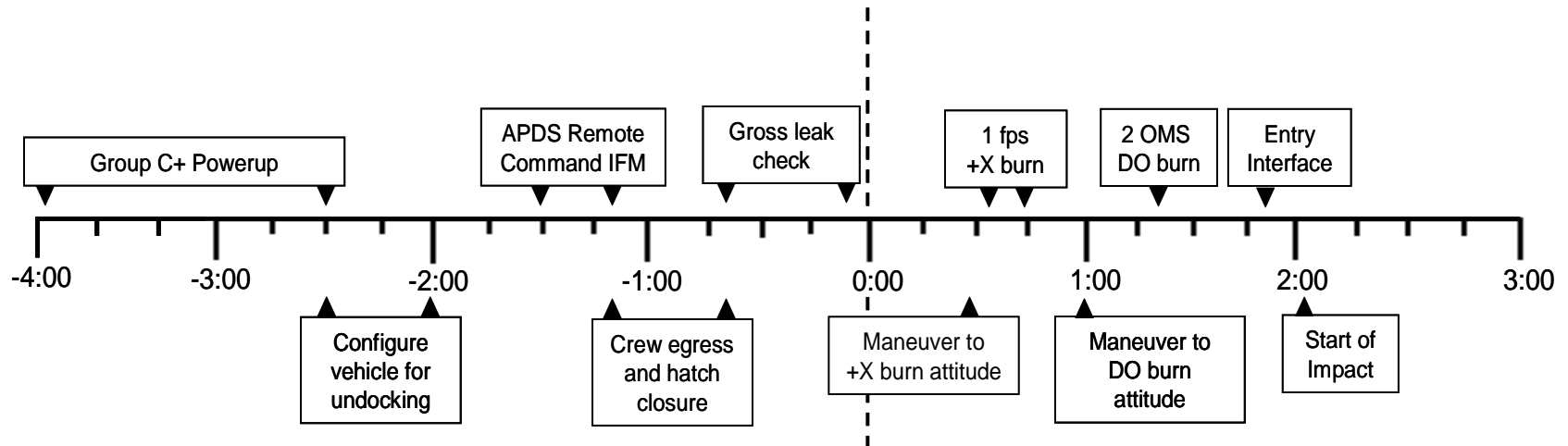
SUMMARY TIMELINE

PET

-4:00 to -2:30 Group C+ powerup
 -2:30 to -2:00 Configure Orbiter for undocking (DAP configs, rendezvous nav, TCS, radar, jet configs, etc.)
 -1:45 to -1:35 Orbiter maneuvers stack to undock attitude, then hands over control to ISS
 -1:30 to -1:10 APDS Remote Command IFM
 -1:10 to -0:40 Crew egress and closure of hatches from ISS side
 -0:40 to -0:05 Gross leak check
 -0:05 ISS goes free drift, Orbiter in simulated free drift
 -0:04:40 MCC repowers MAIN B to issue undocking command

Event

0:00 Physical separation
 0:30 to 0:35 MCC maneuvers Orbiter to +X burn attitude
 0:35 to 0:45 1 fps config 2 +X reboost burn
 1:00 to 1:10 MCC maneuvers Orbiter to deorbit burn attitude
 1:20 2 OMS deorbit burn
 1:50 Entry interface
 2:02 Begin impact



PET

-04:00

SET UNDOCKING TIMER [3A]

-03:55

Perform CONTINGENCY SHUTTLE CREW SUPPORT GROUP C+ PWRUP

-03:50

-03:45

-03:40

-03:35

-03:30

MCC UPDATE

Undocking Time [3A]

SET UNDOCKING TIMER [3A]

Nominal:

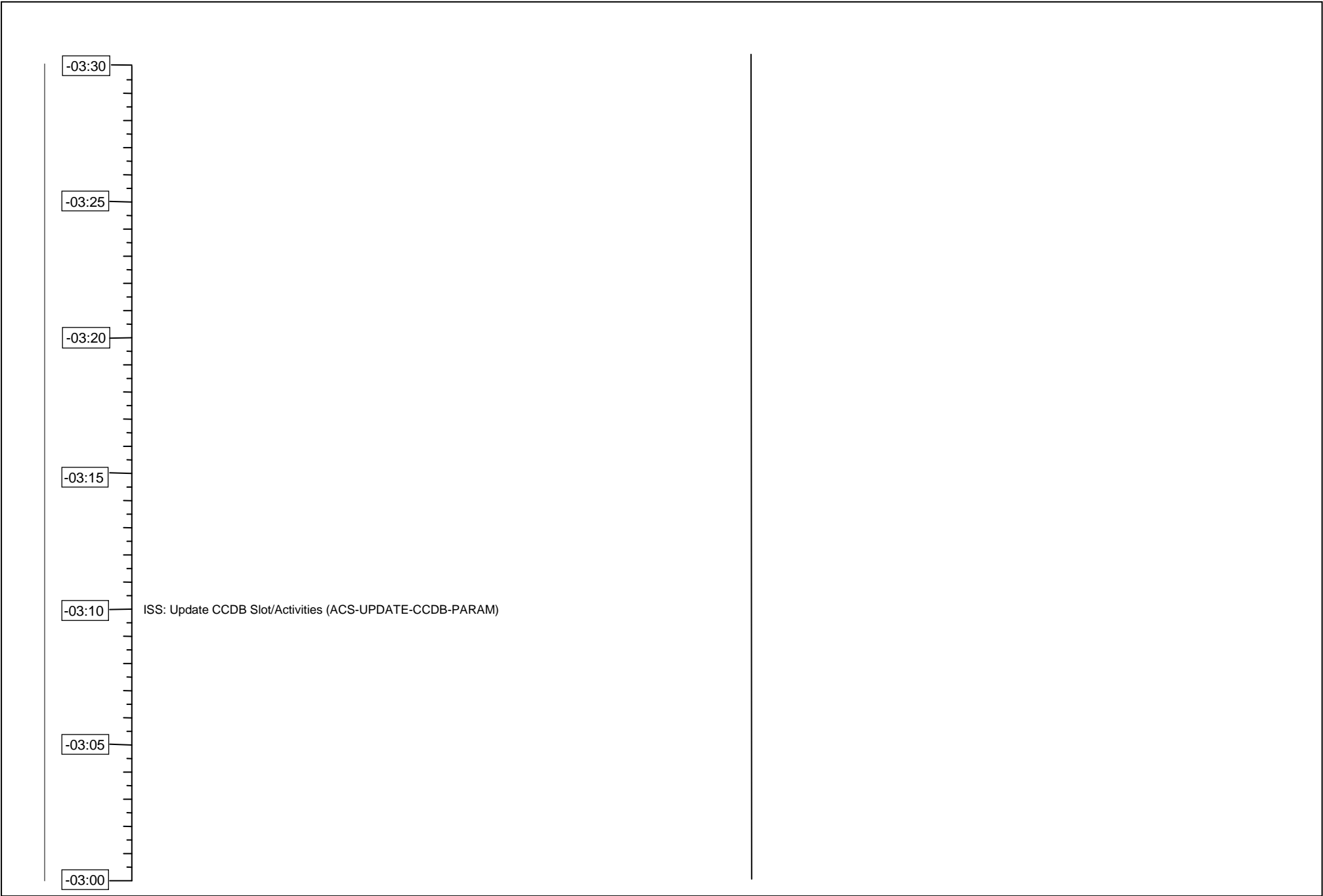
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Backup:

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Set SM and GNC timers counting down to undocking time

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-03:00

-02:55

-02:50

-02:45

-02:40

-02:35

-02:30

ISS: US to RS handover (ACS-H/O US-RS)

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PET

-02:30 CONFIGURE RCS JETS FOR SEPARATION 9A

When 1233 set expansion complete: ENABLE RENDEZVOUS NAV 9B

-02:25

CONFIGURE Ku FOR RADAR 9C

-02:20

CONFIGURE FREE DRIFT DAP 10A

-02:15

CONFIGURE +X BURN 10B

-02:10

CONFIGURE GPS FOR SEPARATION 10C

ISS: RS to Orbiter H/O (ACS-H/O RS to Orbiter)

-02:05

UPDATE ORBITER WEIGHT 10D

-02:00

CONFIGURE TCS FOR SEPARATION 10E

MCC UPDATE
ORB SV
TGT SV

MCC UPLINK
Configure TFL for
TCS operations

CONFIGURE RCS JETS FOR SEPARATION 9A

GNC 23 RCS

RCS F – ITEM 1 EXEC (*)

JET DES F1U – ITEM 17 EXEC (no *)

F3U – ITEM 19 EXEC (no *)

F2U – ITEM 21 EXEC (no *)

F3F – ITEM 33 EXEC (no *)

ENABLE RENDEZVOUS NAV 9B

GNC 33 REL NAV

RNDZ NAV ENA - ITEM 1 EXEC (*)

SV SEL FLTR - ITEM 4 EXEC

√RR - ITEM 13 (*)

√INH RNG - ITEM 18 (*)

RDOT - ITEM 21 (*)

Angles - ITEM 24 (*)

CONFIGURE Ku FOR RADAR 9C

A1U √PWR - ON

KU MODE - RDR PASSIVE

RDR OUTPUT - LO

CNTL - PNL

KU sel - GPC

GNC 33 REL NAV

KU ANT ENA - ITEM 2 EXEC (*)

CONFIGURE FREE DRIFT DAP 10A

GNC 20 DAP CONFIG

ITEM 4 + 8 EXEC
ITEM 51 + 4 0 EXEC
ITEM 58 + 5 EXEC
ITEM 62 + 1 0 EXEC
ITEM 5 EXEC

CONFIGURE +X BURN 10B

GNC 20 DAP CONFIG

REBOOST CFG – ITEM 8 + 2 EXEC
INTVL – ITEM 9 + 2 4 EXEC

GNC UNIV PTG

DURATION – ITEM 27 + 0 0 + 1 0 + 0 0.0 0 EXEC

CONFIGURE GPS FOR SEPARATION 10C

Perform GPS PWRUP (ORBIT OPS, GNC)

GNC 55 GPS STATUS

DES RCVR - ITEM 27 EXEC (no *)
√INH GPS to G&C - ITEM 33 EXEC (*)
NAV - ITEM 36 EXEC (*)

UPDATE ORBITER WEIGHT 10D

√MCC: Current Orbiter weight _____

GNC, OPS 202 PRO

GNC ORBIT MNVR EXEC

Update Orbiter weight

Change ΔVx to 1 fps

ITEM 19 + 1 EXEC

√ITEM 20 + 0 EXEC

√ITEM 21 + 0 EXEC

Change TIG to 1 hour in the future

ITEM 22 - LOAD

OPS 201 PRO

CONFIGURE TCS FOR SEPARATION 10E

√PGSCs setup per PGSC Usage Chart (if available) or UTILITY OUTLET PLUG-IN PLAN ORBIT CONFIGURATION (REF DATA FS, UTIL PWR)

NOTE: power PGSCs via source not on MAIN B (example: A15 connector)

On RPOP PGSCs:

Perform RPOP INITIALIZATION (RENDEZVOUS, RNDZ TOOLS), then:

Perform RPOP OPS (RENDEZVOUS, RNDZ TOOLS), 7-9, then:

In RPOP, set POR - ORB DP to TGT DP, then:

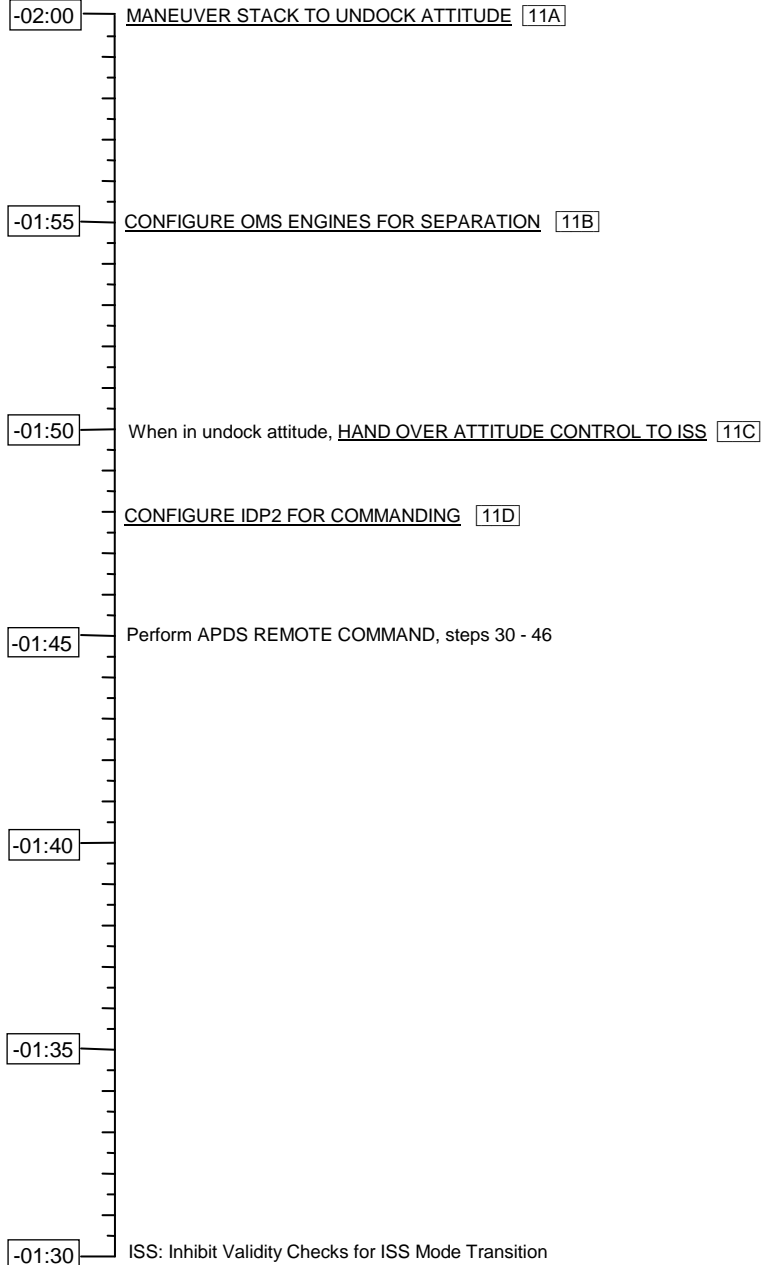
set ISS attitude to LVLH TO TGT BODY 90,0,0 PYR, then:

Perform TCS ACTIVATION, steps 1 thru 3 (RENDEZVOUS, RNDZ TOOLS), then:

Perform TCS MANUAL ACQUISITION (RENDEZVOUS, RNDZ TOOLS)

set RANGE = 4 ft, AZIMUTH = 0, ELEVATION = 0

PET



MANEUVER STACK TO UNDOCK ATTITUDE [11A]

Load mated attitude DAP:
 [GNC 20 DAP CONFIG]
 √ITEM 1 + 1 2 EXEC

Configure Universal Pointing for undock attitude:
 [GNC UNIV PTG]
 ITEM 15 + 9 0 EXEC
 ITEM 16 + 0 EXEC
 ITEM 17 + 0 EXEC

ISS: On MCC go, go to FREE DRIFT

On MCC go, establish Orbiter attitude control and begin maneuver to undock attitude:
 √DAP: LOW Z
 ITEM 19 EXEC
 DAP: A/AUTO/VERN

CONFIGURE OMS ENGINES FOR SEPARATION [11B]

L,R OMS HE PRESS/VAP ISOL (two) A - OP
 L,R OMS HE PRESS/VAP ISOL (two) B - GPC
 OMS ENG (two) - ARM/PRESS

HAND OVER ATTITUDE CONTROL TO ISS [11C]

Simulate Orbiter free drift:
 [GNC 20 DAP CONFIG]
 ITEM 2 + 8 EXEC
 X JETS ROT – ITEM 7 EXEC (no *)
 DAP: B/AUTO/ALT
 DAP: NO LOW Z

ISS: on MCC go, establish attitude control

CONFIGURE IDP2 FOR COMMANDING [11D]

[GNC 20 DAP CONFIG] on IDP 2
 Do not reconfigure IDP 2

C2 √IDP/CRT 1,2 (two) PWR - ON, major function to GNC
 R11 IDP/CRT 4 PWR - ON, major function to GNC

√[GNC UNIV PTG] on IDP 1

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PET

-01:30

Perform SHUTTLE EGRESS, steps 7 - 12

-01:25

-01:20

ISS: Mode to prox ops

-01:15

-01:10

Perform PMA2 DEPRESSURIZATION AND LEAK CHECK (ECLSS, NOMINAL), steps 5 - 8

-01:05

ISS: PMA2 Pre-Departure Configuration (Thrusters) (ACS-PRE-DEPART-CNFG-THRUSTERS)

-01:00

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PET

-01:00 ISS MCC: Feather ISS solar arrays per SEPARATION SOLAR ARRAY CONFIG (RENDEZVOUS, REFERENCE DATA)

-00:55

-00:50

-00:45 ISS MCC: Confirm ISS solar arrays feathered

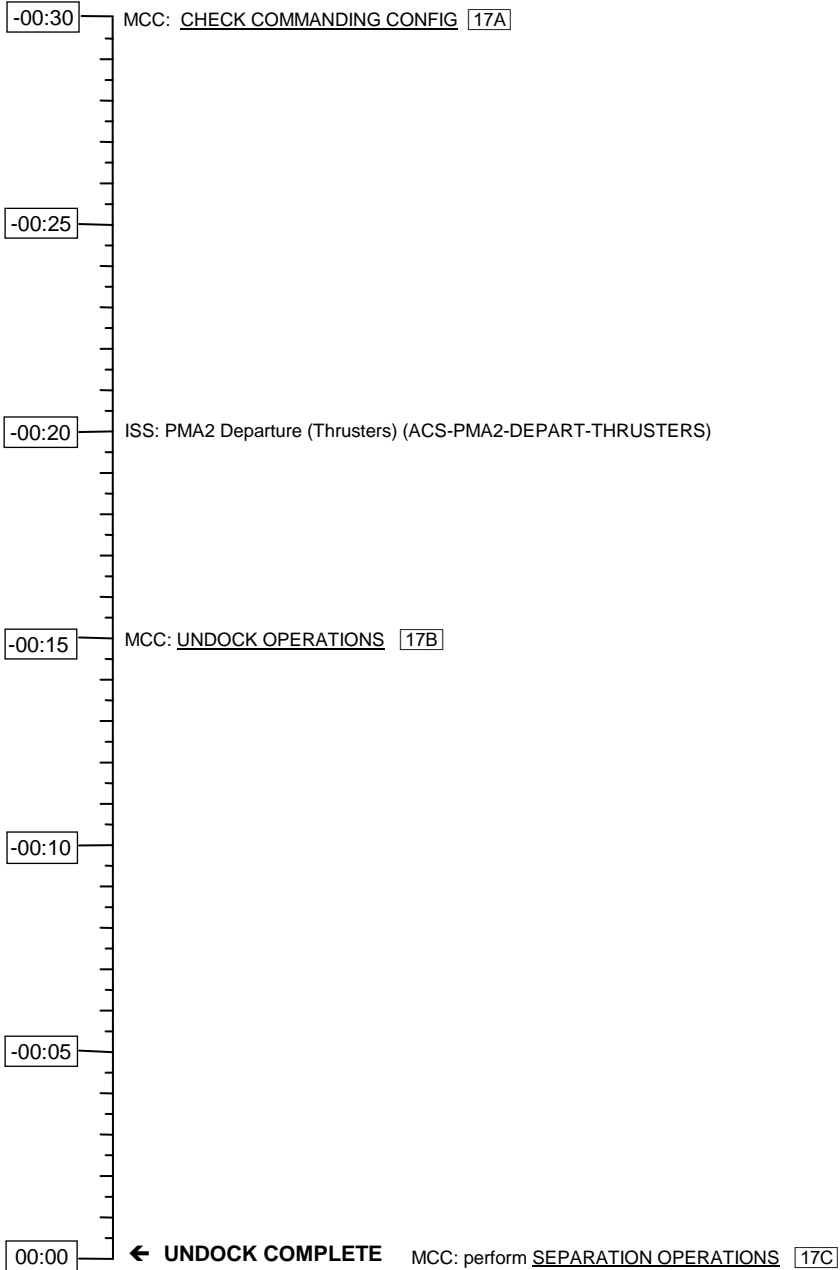
-00:40

-00:35

-00:30

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PET



CHECK COMMANDING CONFIG (17A)

Configure the following displays for undocking:

- √ GNC UNIV PTG on IDP1 (DSM 20102 to the GNC if reqd)
- √ GNC 20 DAP CONFIG on IDP2 (DSM 20103 to the GNC if reqd)
- GNC 33 REL NAV on IDP4 (DSM 20104 to the GNC if reqd)

UNDOCK OPERATIONS (17B)

- 15:00 > MCC uplink:
GNC 33 REL NAV
ORB TO TGT - ITEM 10 EXEC (DSM 20105 to the GNC, IDP4)
- 10:00 > NOTE: Undocking command unsafed
- 5:00 > ISS: command attitude control to FREE
- 4:40 > MCC: repower MAIN B to issue UNDOCK command (DSM _____)
Note MET: __/__:__
- 0:20 > MCC: When APDS hooks 10%
MCC Uplink: snap Orbiter inertial hold with CNCL:
GNC UNIV PTG
ITEM 21 EXEC (DSM 20106 to the GNC, IDP1)

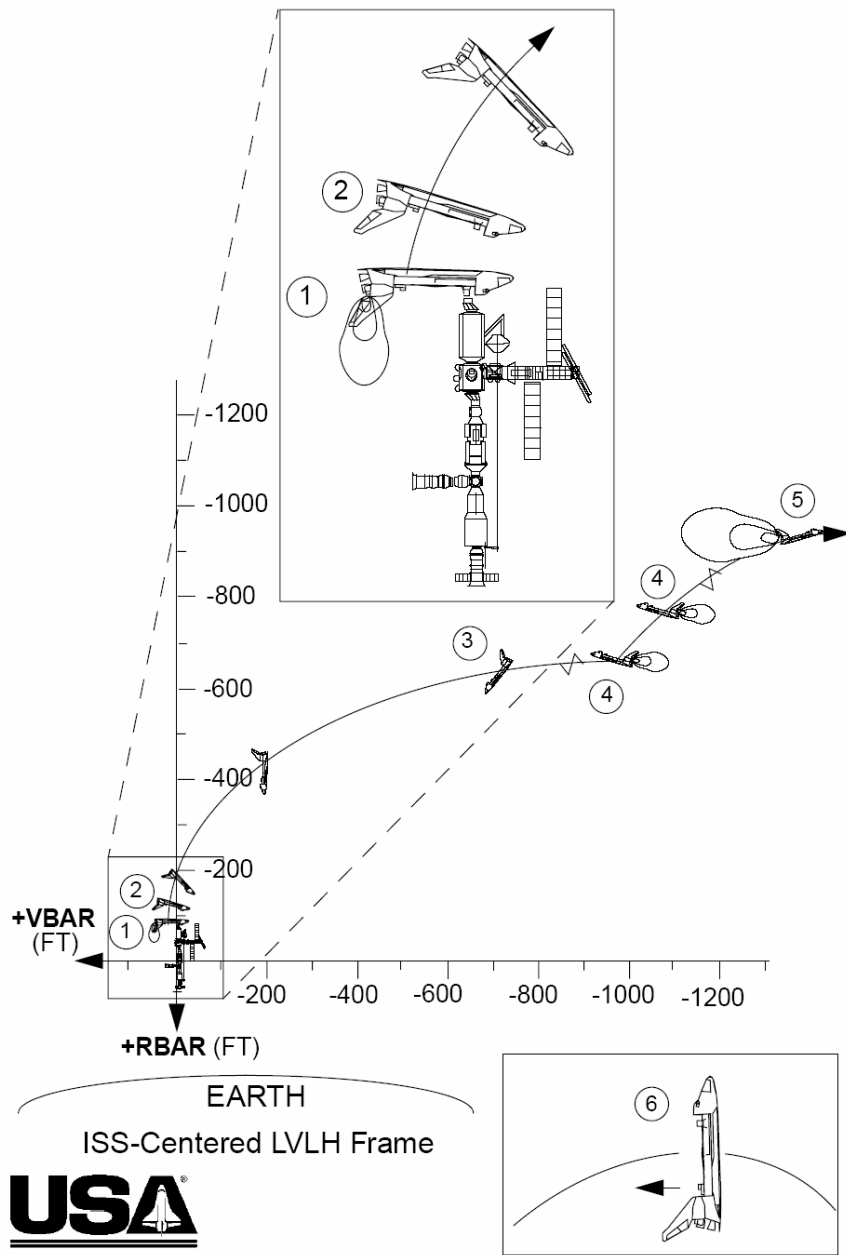
NOTE:
TIME CRITICAL
COMMANDING!

SEPARATION OPERATIONS (17C)

- 0:00 ISS: Using truss camera, at physical separation, report to MCC: "Physical separation complete"
Note MET: __/__:__
- ISS: Using truss camera, when ODS petals clear, report to MCC: "ODS petals clear"
- When ODS petals clear:
MCC uplink: Load DAP B9 to collapse deadbands:
GNC 20 DAP CONFIG
ITEM 2 + 9 EXEC (DSM 20107 to the GNC, IDP2)
- 1:40 > ISS: Snap and hold attitude at undock + 100 seconds
- 2:00 > MCC: Open deadbands to simulate free drift
GNC 20 DAP CONFIG
ITEM 2 + 8 EXEC (DSM 20108 to the GNC, IDP2)
- MCC: If attitude error in any axis nears 40 deg deadband:
GNC UNIV PTG
ITEM 20 EXEC (DSM 20109 to the GNC, IDP1)

NOTE:
TIME CRITICAL
COMMANDING!

UNMANNED ORBITER SEPARATION AND DISPOSAL



	APPROX PET (h:mm)	EVENT
	-0:05	ORBITER AND ISS IN "FREE DRIFT" TO BEGIN SINGLE MOTOR UNHOOKING PROCESS COMMANDED FROM GROUND; ISS LVLH 90,0,0 PYR ATTITUDE; ORBITER DAP IN DAP B8/AUTO/ALT NO LOW Z WITH 40 DEG ALT ATTITUDE DEADBAND, 5 DPS ALT RATE DEADBAND, AND ALT 10 SEC DELAY; OMS IN ARM/PRESS
	-0:01	WHEN APDS HOOKS 10% REMAINING, MODE TO INERTIAL HOLD WITH ITEM 21 (CNCL) ON UNIVERSAL POINTING FROM GROUND
1	0:00	UNDOCKING; AT 2 FT, LOAD DAP B9 TO REDUCE ALT DEADBANDS TO 2 DEG AND 0.1 DEG/SEC AND ALT 10 SEC DELAY; AFT PITCH JETS PROVIDE TOTAL OPENING RATE OF APPROXIMATELY 0.2 FT/SEC
2	0:02	OPEN ALT DEADBANDS BACK UP TO SIMULATE FREE DRIFT; IF ATTITUDE NEARS 40 DEG DEADBAND, PERFORM ITEM 20 (ROT) ON UNIV PTG TO RECENTER DEADBAND
3	0:32	AT >1000 FT CG-CG, LOAD DAP B7 AND MANEUVER AT 0.5 DEG/SEC TO REBOOST BURN ATTITUDE (ORB LVLH 10,-5,0 DEG PYR)
4	0:35	WHEN IN ATTITUDE, PERFORM 10 MIN DURATION, 1 FT/SEC POSIGRADE CONFIG 2 +X AUTO-REBOOST BURN
	0:45	BEGIN MNVR TO DEORBIT BURN ATTITUDE
5	>1:20	AT >6562 FT CG-CG EXECUTE RETROGRADE 2 OMS DEORBIT BURN
6		MANEUVER TO DISPOSAL ATTITUDE (ORB LVLH 90,0,180 DEG PYR)

PET

00:00

00:05

ISS: PMA2 Post Departure Configuration (ACS-POST-DEPART)

00:10

MCC: When R > 100 ft: INCORPORATE RADAR DATA 19A

00:15

00:20

MCC UPDATE
Orbiter vent (DSM 42601)

00:25

ISS: When Orbiter RNG > 400 ft, maneuver to LVLH TEA attitude

00:30

INCORPORATE RADAR DATA 19A

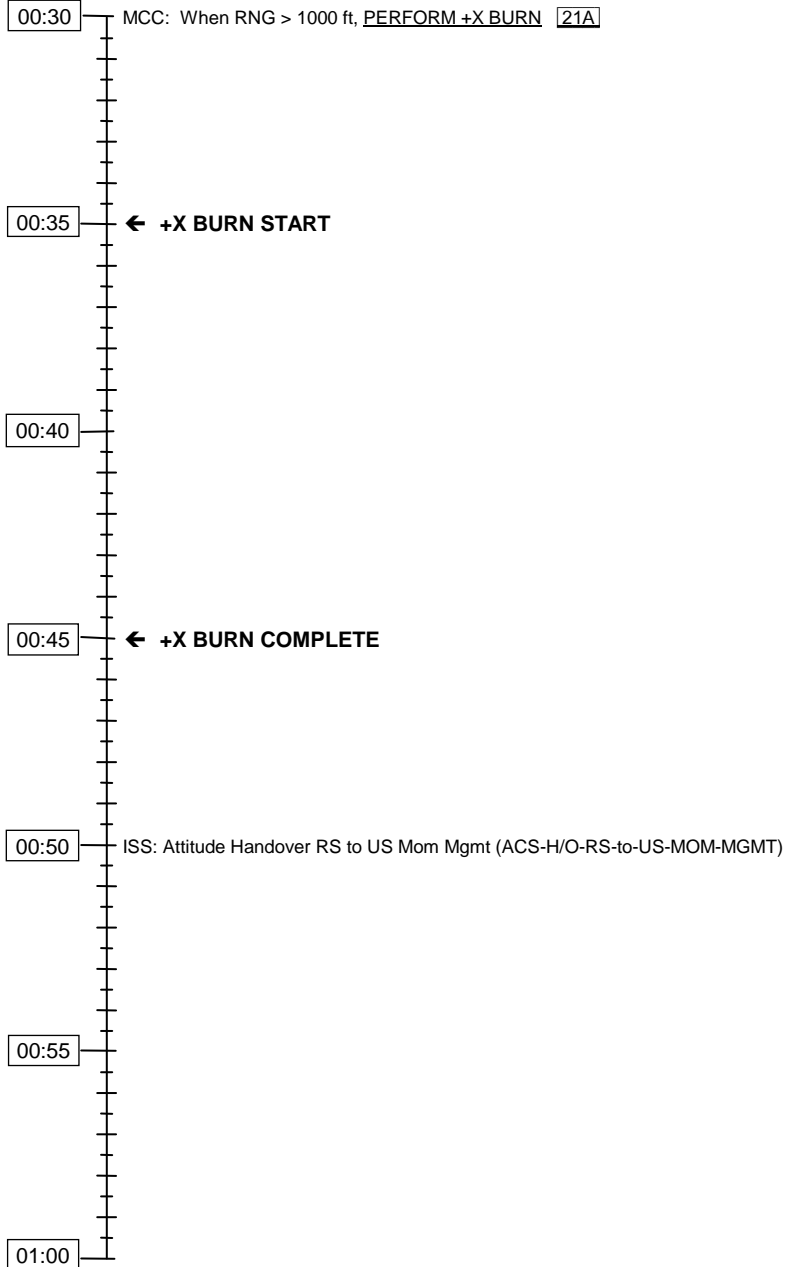
MCC uplink:
Updated Orbiter SV, if reqd (DSM 40101 to the GNC, IDP1)
Ku Serial I/O Enable (DSM 14007)
GNC I/O RESET (DSM 20110 to the GNC, IDP1)

MCC: when radar lock-on occurs:
GNC 33 REL NAV
AUT RNG - ITEM 17 EXEC (*) (DSM 20111 to the GNC, IDP4)
RDOT - ITEM 20 EXEC (*) (DSM 20112 to the GNC, IDP4)
Angles - ITEM 23 EXEC (*) (DSM 20113 to the GNC, IDP4)

MCC: If RATIO > 1.0, force aff mark until RATIO < 1.0
GNC 33 REL NAV
FOR RNG - ITEM 19 EXEC (*) as reqd (DSM 20114 to the GNC, IDP4)
RDOT - ITEM 22 EXEC (*) as reqd (DSM 20115 to the GNC, IDP4)
Angles - ITEM 25 EXEC (*) as reqd (DSM 20116 to the GNC, IDP4)

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PET



PERFORM +X BURN 21A

MCC: when R > 1000 (CG to CG):
GNC UNIV PTG
ITEM 21 EXEC (DSM 20106 to the GNC, IDP1)

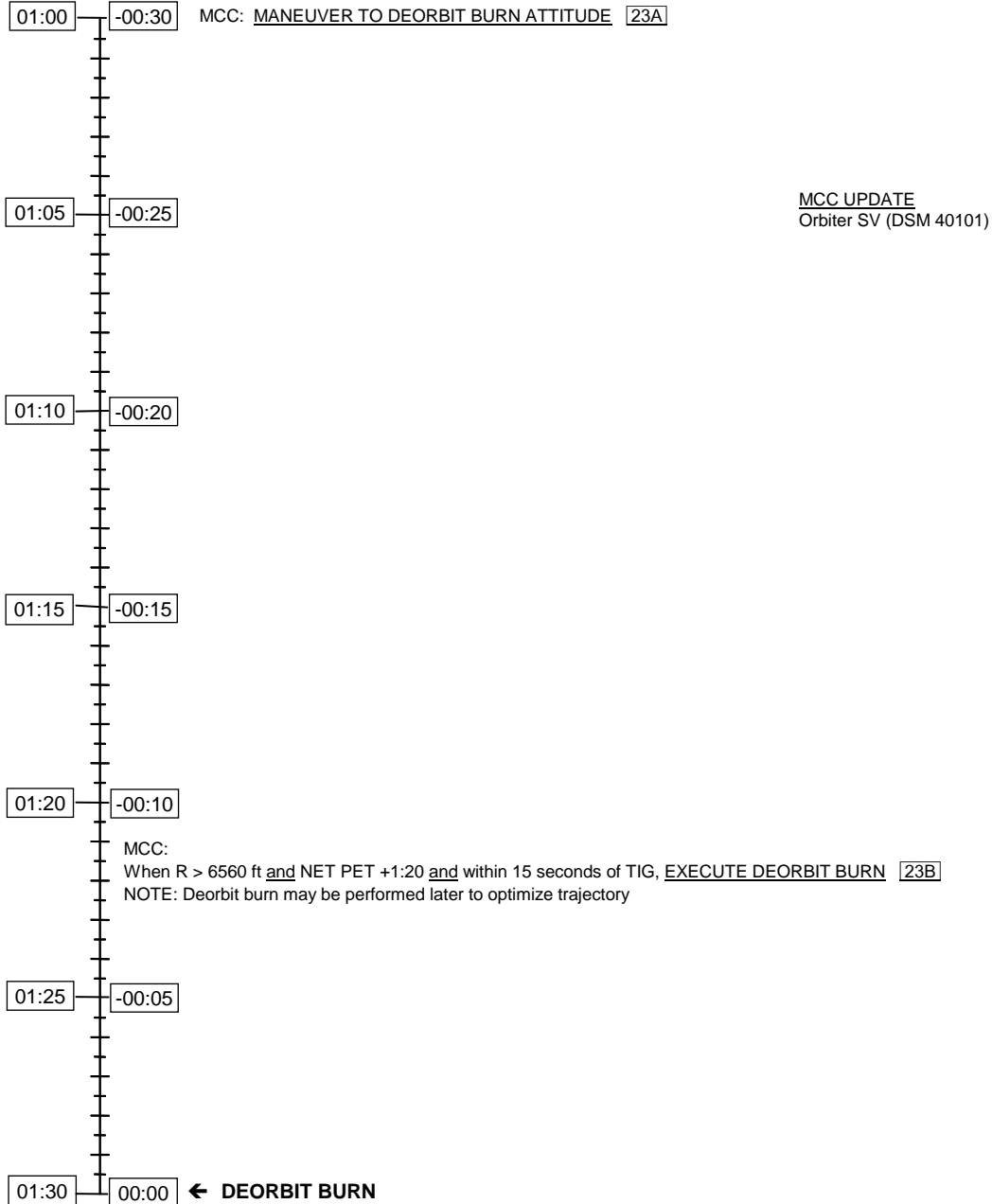
Load DAP B7:
GNC 20 DAP CONFIG
ITEM 2 + 7 EXEC (DSM 20117 to the GNC, IDP2)

Maneuver to burn attitude:
GNC UNIV PTG
ITEM 15 + 2 6 0 EXEC (DSM 20118 to the GNC, IDP1)
ITEM 16 + 0 EXEC
ITEM 17 + 3 5 5 EXEC (DSM 20119 to the GNC, IDP1)
ITEM 19 EXEC

When in attitude, enable reboost:
GNC UNIV PTG
RBST – ITEM 25 EXEC (CUR – *) (DSM 20120 to the GNC, IDP1)

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PET D/O BURN



MANEUVER TO DEORBIT BURN ATTITUDE [23A]

NOTE: Deorbit burn must occur > 1:20 after physical separation to ensure R > 6560 ft

MCC uplink: OPS 202 PRO (DSM 20121 to the GNC, IDP1)

MCC uplink: disposal burn/deorbit targets

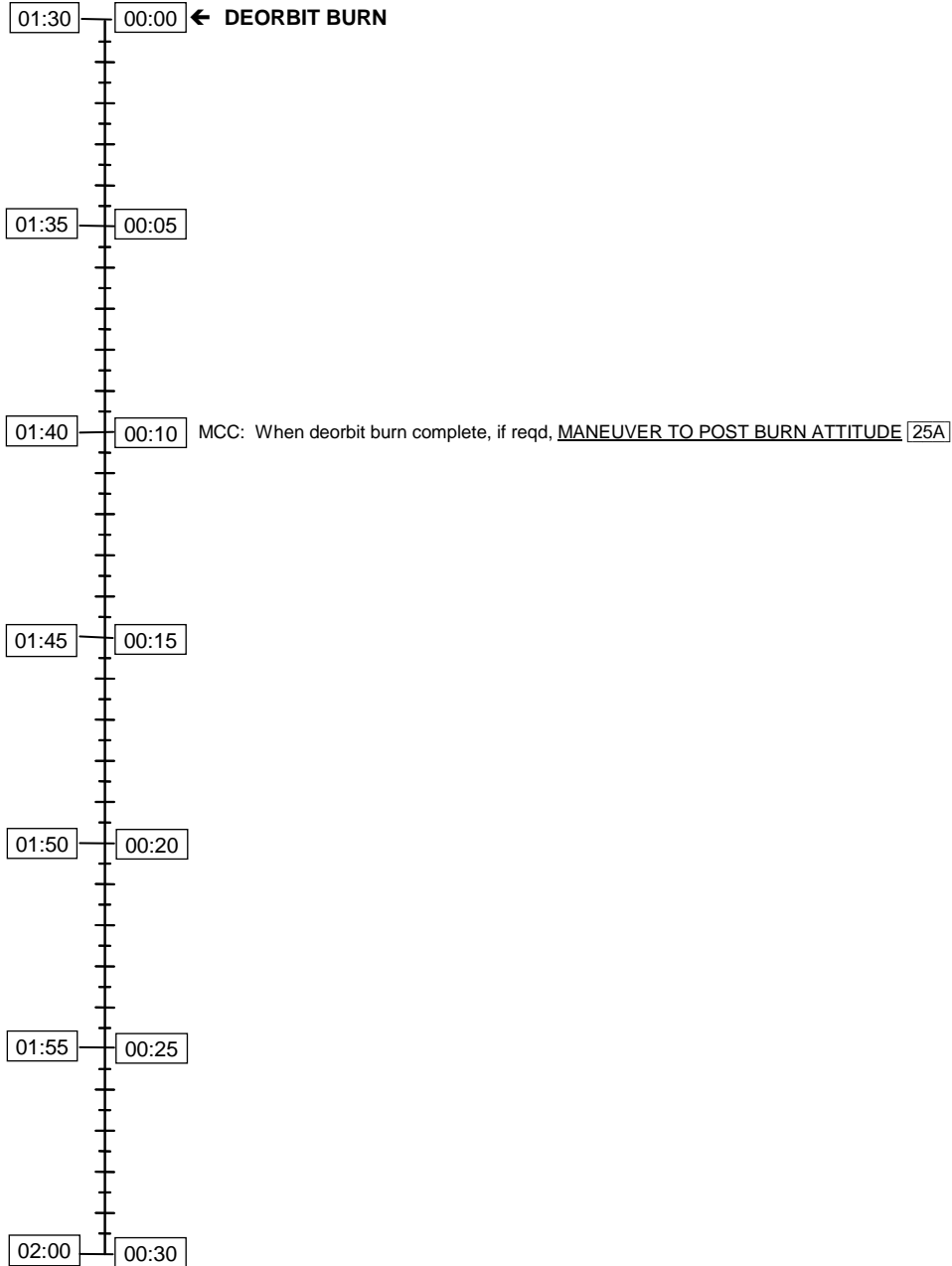
MCC uplink: load target and maneuver to burn attitude:
MNVR EXEC
 LOAD - ITEM 22 EXEC (DSM 20122 to the GNC, IDP1)
 MNVR - ITEM 27 EXEC (DSM 20123 to the GNC, IDP1)

EXECUTE DEORBIT BURN [23B]

When R > 6560 ft and PET > 1:20 and within 15 seconds before deorbit TIG, MCC uplink:
MNVR EXEC
 EXEC (DSM 20124 to the GNC, IDP1)

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PET D/O BURN



MANEUVER TO POST BURN ATTITUDE 25A

If maneuver required after disposal burn:
MCC: OPS 201 PRO (DSM 20125 to the GNC, IDP1)

Configure disposal attitude (-XLV -ZVV):
GNC UNIV PTG
ITEM 8 + 2 EXEC (DSM 20126 to the GNC, IDP1)
ITEM 14 + 2 EXEC (DSM 20127 to the GNC, IDP1)
ITEM 17 + 1 8 0 EXEC (DSM 20128 to the GNC, IDP1)
ITEM 19 EXEC (DSM 20119 to the GNC, IDP1)

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