

CAP**CHANDRA**

Command Action Procedure

CAP # 1548**Date:** 9/28/20**Participants** OC**Required for** CC, HRC**Execution:****Originator:** Dan Patnaude**Commands Checked By:** Ken Gage/HRC Team**Time of CAP execution:****Title:**

Controlled ramp-up of the HRC-I microchannel plate high voltage

Description/Rationale:

Following the successful swap to the B-side electronics on the redundant bus, and subsequent ramp-up and continued usage of the PMT#2 for radiation monitoring aboard Chandra, the HRC is currently in a state where both the HRC-I and HRC-S are powered off and set to 0 voltage steps. As part of checkout to determine the functionality of the controlling electronics for the HRC-I as well as the performance of the side B preamps in the frontend electronics assembly (FEA-B), the HRC team will perform a controlled voltage ramp-up, from 0 steps on both plates, to nominal operating voltage steps of 89 for the bottom plate and 77 for the top plate, and optionally, for two additional step increases beyond the nominal settings. The HRC-I will observe the calibration source AR Lac for 30 minutes at nominal settings, and optionally, for 30 minutes each at the additional settings above the nominal ones.

Restrictions/Warnings/Notes:

- RADENTRY commanding in the daily loads (including activation of SCS 87 verified during the CAP) will result in an entry in the OBC error log due to Disabling the already disabled SCS 89

Yes ☐ No ☒ CAP requires enabling of a disabled command? If yes, provide a list of Disabled Commands

CARD Items:

HRC-C-003 – HRC High Voltage Power Sequence

HRC-C-004 – HRC High Voltage Limit

HRC-C-006 – HRC High Voltage and Detector Selection

Schedule Requirements/Load Interaction:

CAP execution window: __2020:273:01:40UT__ to 2020:273:04:30UT

CAP duration: 2hr40m

CAP verified against __SEP2820C__ daily loads if applicable: N/A ☐Yes ☒ No ☐ Daily load commands exist during execution window of CAPYes ☒ No ☐ CAP requires specific DSN comm. or timing requirementsYes ☐ No ☒ CAP will be run concurrently with another CAP

Yes ☒ No ☐ CAP requires commanding in the load to be executed to ensure success
 Yes ☐ No ☒ Daily load requires the CAP to be completed to ensure success
 Yes ☒ No ☐ CAP uses SCS slots. If yes, performs SCS cleanup

Comments

- The CAP loads a 20 minute deadman timer into SCS 135. The deadman timer will turn off the HRC-I and set both plates to 0 steps in the event of loss of COMM before reaching half voltage. The SCS is cleared after HRC-I reaches half voltage
- The CAP requires that SCS 87 be activated as part of the daily loads (near the end of the scheduled comm)
- The CAP will be executed during the COMM pass with BOT 273:01:40 and EOT 273:04:30

Initial Conditions/Spacecraft Configuration:

As part of the daily loads, the spacecraft will set up for obsid 24644 (HRC-I/ AR Lac). This involves slewing to the target, positioning the SIM at the HRC-I aimpoint, setting HRC dither parameters, and switching to FMT1. No additional HRC commanding is required, as the HRC-I is already the active detector and HRC-I defaults were loaded as part of execution of CAP 1543. Additionally, SCS 89 needs to be disabled and SCS 91 needs to be inactive. As part of the activity, the CAP disables and subsequently re-enables SCS 87.

CAP depends upon or changes the state of:

<input checked="" type="checkbox"/> Telemetry Format	<input checked="" type="checkbox"/> SIM Table Position
<input checked="" type="checkbox"/> Safing Monitor En\Dis State (inc. RadMon)	<input type="checkbox"/> Grating Positions
<input checked="" type="checkbox"/> OBSID	<input type="checkbox"/> SI Mode
<input type="checkbox"/> Momentum State	<input type="checkbox"/> ACIS Parameter Blocks
<input checked="" type="checkbox"/> Attitude	<input checked="" type="checkbox"/> HRC Configuration
<input checked="" type="checkbox"/> PCAD Mode	<input checked="" type="checkbox"/> SCS States or Contents
<input type="checkbox"/> S/C Unit Configuration (H/W or S/W)	<input checked="" type="checkbox"/> Dither State
<input type="checkbox"/> Ground System Configuration/Settings	<input type="checkbox"/> FSW Element
<input type="checkbox"/> S/C Clock (VCDU)	

Comments:

- The CAP requires FMT1
- The CAP requires that radmon be enabled
- The CAP requires an obsid change to 24644
- The CAP makes an obsid change to 62650
- The CAP requires normal pointing mode
- The CAP requires the SIM position be at the HRC-I aimpoint and focus
- The CAP requires that dither be enabled, with HRC dither parameters
- The CAP requires that the HRC-I be the active detector
- The CAP requires that SCS 89 be disabled and SCS 91 be inactive. Additionally, the CAP disables and subsequently re-enables SCS 87, and requires that SCS 87 be activated as part of the daily loads. Finally, the CAP activates SCS 92
- The CAP loads a 20 minute deadman timer into SCS 135.

Risk/Comm. Loss/Worst Case Scenario:**What happens if comm. is lost during CAP execution?**

If comm is lost during execution of the CAP there are two scenarios which could occur, both of which will leave the HRC-I in a safe state. In the event that COMM is lost before reaching half voltage, a deadman timer, loaded into SCS 135, will turn off the HRC-I and set both plates to 0 steps. If COMM is lost after SCS 135 is disabled and cleared, activation of SCS 87 has been included in the daily loads 10 minutes before the scheduled end of track. This will leave the HRC at half voltage, which is safe for radzone entry.

What is the worst case scenario for CAP execution? (Assuming the CAP is executed correctly)

The worst case scenario is that, during successful execution of the CAP steps, the HRC-I does not come up in the expected state. In the event of this scenario, the script will be halted, and the HRC will be either turned off or automatically set to half voltage by commanding from the daily loads.

Required Products (Scripts, Displays, SOPs, etc.):

Product Name	Version	On-Console
2 HV I UP VERY SLOW.ssc	3.2	<input checked="" type="checkbox"/>
O PROT SCSCCTRL.ssc	3.2	<input checked="" type="checkbox"/>
O SCSCCTRL.ssc	3.4	<input checked="" type="checkbox"/>
O SETOBSID.ssc	3.2	<input checked="" type="checkbox"/>
F MAIN.dec (GRETA display)	2.74	<input checked="" type="checkbox"/>
I HRC SOH.dsp (EHS display)	3.10	<input checked="" type="checkbox"/>
F HRC ALL.dec (GRETA display)	2.1	<input checked="" type="checkbox"/>

Command Load Name	Checksum (if applicable)	In ODB
2A IHV DM20 135.CLD	3C5947B	<input checked="" type="checkbox"/>

Instructions:

1. Verify **SCS 89** is **Disabled** and **SCS 91** is **Inactive**.
2. Ensure that the SIM is at HRC-I 3TSCPOS = -50504 +/- 1 step
3. Verify FMT1
4. Use Script **O_PROT_SCSCCTRL** to disable **SCS 87**
5. Verify Dither is enabled

Verify AODITHEN = ENAB

6. Uplink Command load **2A_IHV_DM20_135.CLD** Checksum = 3C5947B

18 Commands

7. Use script **O_SETOBSID** with input 62650 to change OBSID

Verify COBSRQID = 62650

TURN ON HRC-I MCP HV AND BRING TO HALF POWER SETTINGS

8. On HRC Go, Use Script **O_SCSCTRL** to enable and activate **SCS 135**

Note Deadman activation time: _____

(Duration is **20** minutes)

Note Deadman execution time: _____

9. **(OPTIONAL) Contingency commanding**

At any time, at HRC direction turn off the HRC-I MCP HV:

Send command **2IMHVOF**

HRC verify 2IMONST = OFF

Allow the Deadman to expire or SCS 87 to be activated

10. On HRC Go, Use Script **O_PROT_SCSCTRL** to activate **SCS 92**

SCS 92 will set Top and Bottom steps to zero and turn on the HRC-I MCP HV

HRC verify 2IMONST = ON

11. Start Script **2_HV_I_UP_VERY_SLOW** and hold at the INITIAL WAIT

12. On HRC Go, **Resume** script

Script will buffer commands (commands are separated by NOOPS for timing)

6418000 2IMCLDS - Disable current limiting

6416260 2IMTBHV - Set Bottom Plate Voltage step to 19

6414100 2IMTTHV - Set Top Plate Voltage step to 8

6418020 2IMCLEN - Enable current limiting

13. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 19

Top Plate Voltage step level: 2IMTPAST = 8

14. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
64164C0	2IMTBHV - Set Bottom Plate Voltage step to 38
6414360	2IMTTHV - Set Top Plate Voltage step to 27
6418020	2IMCLEN - Enable current limiting

15. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 38

Top Plate Voltage step level: 2IMTPAST = 27

16. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
64166A0	2IMTBHV - Set Bottom Plate Voltage step to 53
6414540	2IMTTHV - Set Top Plate Voltage step to 42
6418020	2IMCLEN - Enable current limiting

17. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 53

Top Plate Voltage step level: 2IMTPAST = 42

HRC monitor at “half voltage” for a few minutes to confirm nominal operation

CLEAR DEADMAN LOAD AND ENABLE SCS 87

18. On HRC Go, Use Script **O_SCSCTRL** to disable and clear **SCS 135**

19. On HRC Go, Use Script **O_PROT_SCSCTRL** to enable **SCS 87**

CONTINUE INCREASING VOLTAGE TO OPERATIONAL SETTINGS

20. On HRC Go, **Resume** script **2_HV_I_UP_VERY_SLOW**

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
64167A0	2IMTBHV - Set Bottom Plate Voltage step to 61
6414640	2IMTTHV - Set Top Plate Voltage step to 50
6418020	2IMCLEN - Enable current limiting

21. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 61
Top Plate Voltage step level: 2IMTPAST = 50

22. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416880	2IMTBHV - Set Bottom Plate Voltage step to 68
6414720	2IMTTHV - Set Top Plate Voltage step to 57
6418020	2IMCLEN - Enable current limiting

23. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 68
Top Plate Voltage step level: 2IMTPAST = 57

24. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416980	2IMTBHV - Set Bottom Plate Voltage step to 76
6414820	2IMTTHV - Set Top Plate Voltage step to 65
6418020	2IMCLEN - Enable current limiting

25. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 76
Top Plate Voltage step level: 2IMTPAST = 65

26. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
64169C0	2IMTBHV - Set Bottom Plate Voltage step to 78
6414860	2IMTTHV - Set Top Plate Voltage step to 67
6418020	2IMCLEN - Enable current limiting

27. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 78
Top Plate Voltage step level: 2IMTPAST = 67

28. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416A00	2IMTBHV - Set Bottom Plate Voltage step to 80
64148A0	2IMTTHV - Set Top Plate Voltage step to 69
6418020	2IMCLEN - Enable current limiting

29. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 80
Top Plate Voltage step level: 2IMTPAST = 69

30. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416A40	2IMTBHV - Set Bottom Plate Voltage step to 82
64148E0	2IMTTHV - Set Top Plate Voltage step to 71
6418020	2IMCLEN - Enable current limiting

31. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 82
Top Plate Voltage step level: 2IMTPAST = 71

32. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416A80	2IMTBHV - Set Bottom Plate Voltage step to 84
6414920	2IMTTHV - Set Top Plate Voltage step to 73
6418020	2IMCLEN - Enable current limiting

33. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 84
Top Plate Voltage step level: 2IMTPAST = 73

34. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416AC0	2IMTBHV - Set Bottom Plate Voltage step to 86
6414960	2IMTTHV - Set Top Plate Voltage step to 75
6418020	2IMCLEN - Enable current limiting

35. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 86
Top Plate Voltage step level: 2IMTPAST = 75

36. On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416B20	2IMTBHV - Set Bottom Plate Voltage step to 89
64149A0	2IMTTHV - Set Top Plate Voltage step to 77
6418020	2IMCLEN - Enable current limiting

37. Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 89
Top Plate Voltage step level: 2IMTPAST = 77

HRC will collect data at operational settings for at least 30 minutes

(OPTIONAL) INCREASE VOLTAGE TO DETERMINE OPERATIONAL SETTINGS

If any optional steps are not to be run:

Stop script **2_HV_I_UP_VERY_SLOW** and exit

38. **(OPTIONAL)** On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416B40	2IMTBHV - Set Bottom Plate Voltage step to 90
64149C0	2IMTTHV - Set Top Plate Voltage step to 78
6418020	2IMCLEN - Enable current limiting

39. **(OPTIONAL)** Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 90
Top Plate Voltage step level: 2IMTPAST = 78

HRC will collect data at these settings for approximately 30 minutes

40. **(OPTIONAL)** On HRC Go, **Resume** script

Script will buffer commands

6418000	2IMCLDS - Disable current limiting
6416B60	2IMTBHV - Set Bottom Plate Voltage step to 91
64149E0	2IMTTHV - Set Top Plate Voltage step to 79
6418020	2IMCLEN - Enable current limiting

41. **(OPTIONAL)** Verify Buffer and **Resume** script to uplink

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 91
Top Plate Voltage step level: 2IMTPAST = 79

HRC will collect data at these settings for approximately 30 minutes

42. On HRC Go, **Resume** to end script **2_HV_I_UP_VERY_SLOW** and exit

43. 10 minutes before EOT, verify SCS 87 has been activated and the HRC-I plate voltages are set to half.

HRC verify Bottom Plate Voltage step level: 2IMBPAST = 53
Top Plate Voltage step level: 2IMTPAST = 42

SOT Manager/Lead:	JV (Verbal)		Mission Planning Manager:	JS3 - Verbal	
OC or Ops Manager:	WR-Verbal		FOM:	SH - Verbal	
Sys. Engineer:	PV - Verbal		Flight Director:	<i>Scott J Wolk</i>	