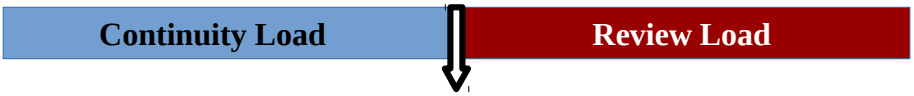
Previous Capabilities of Backstop-History:

1) Normal Weekly loads – no events processed

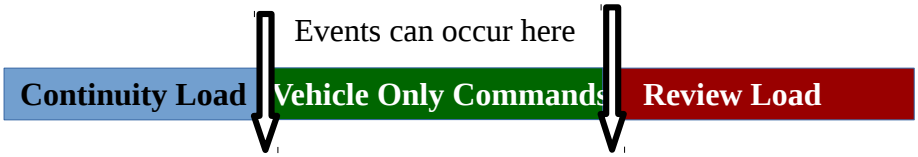


Referred to as a "cut point" though no commands are lost
Just transition from one load to the next

2) TOO loads - no events processed

Continuity load cut here
- sci and vehicle commands lost;
Review load starts here

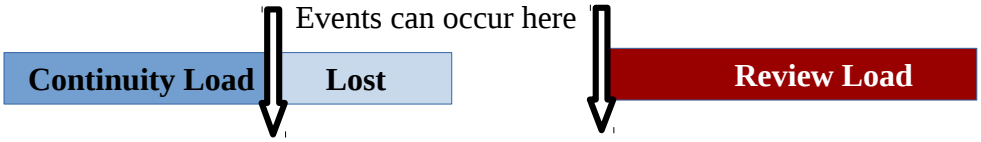
3) SCS-107 loads - Maneuvers and LTECS events processed



Continuity load cut here; sci. cmds lost

Review load starts here

4) Full Stop loads - Maneuvers and LTECS events processed



Continuity Load cut here
sci. and vehicle cmds lost

Review load starts here

For SCS-107 and Full Stop load, only the gap between shutdown and the first command of the review load was searched for events.

Continuity loads never had events.

The only events processed were LTECS and Maneuver Events.

New Modes of Operation Require New Capabilities:

1) Recently began using Maneuver-Only loads. (e.g MAY2620)
   - No science observation commands
   - Always able to use, just not done in ~ over a decade.

2) Science loads with a "pause" in which Maneuvers, LTECS and Power Commands might be executed (e.g. JUL2720 IRU Swap)

These modes bring new capabilities to mission planning

Ramifications:

1) **ANY** load can be Maneuver-only (Normal, TOO, 107, Full Stop)
2) **ANY** Science load can have a "science pause" anywhere in the load
3) Therefore, Continuity loads can have events prior to cut point
4) LTECS events can straddle loads.
   - Review load may, or may not, have 2 stop science commands
   - Review load must be searched for Stop Science commands in order to assemble correct history
4) Normal and TOO loads must also be searched for events
5) Software must search for events starting from the beginning of the continuity load to the end of the "review" load.
6) Load endpoints reset as you backchain loads to assemble a history that takes you back before the last telemetry entry in db.
   - New search start point at the beginning of the new Continuity load; New search end point is the start of already assembled history

Backstop-History now handles events (LTECS, Maneuvers, and Power Commands) within any load type, including maneuver-only loads and "pause" loads, correctly.

Load Types and Possible Events:

Remember: That all Review loads become Continuity loads as you add new weekly loads. Review loads can be either Science or Maneuver-only.

1) Normal loads

- LTECS measurement may occur during pause via CAP
  e.g. July2720 “IRU Swap” normal load with pause
  LTECS event during pause via CAP 1535

- Power command via CAP

- Pauses, and therefore events, can occur anywhere in the load

- Events can occur anywhere in a Maneuver-Only load

- Ground-commanded maneuvers unlikely but would be handled.

2) TOO loads

- LTECS measurement may occur during pause via CAP
  e.g. APR3020 hand built TOO test load

- Power command via CAP

- Pauses, and therefore events, can occur anywhere in the load

- Events can occur anywhere in a Maneuver-Only load

- Ground-commanded maneuvers unlikely but would be handled.

- Has not occurred but the software can handle it if it does.

“Shutdown” Return to Science Load Types

Events can occur during shutdown as well as within the load

3) SCS-107 Loads – Return to science load after SCS-107

- During shutdown, Science load was stopped; Vehicle load running

- Pauses, and therefore events, can occur anywhere in the Science load

- Events can occur anywhere in a Maneuver-Only load
  - (e.g. AUG3120 SCS-107, Maneuver-only load)

4) Full Stop Loads – Return to Science load after Full stop.

- Both Science and Vehicle commands stopped during shutdown

- Pauses, and therefore events, can occur anywhere in the Science load

- Events may occur anywhere in Maneuver-Only load.

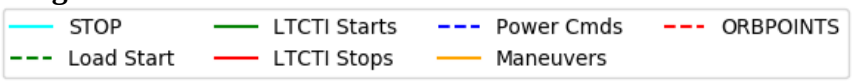
Tests Loads:

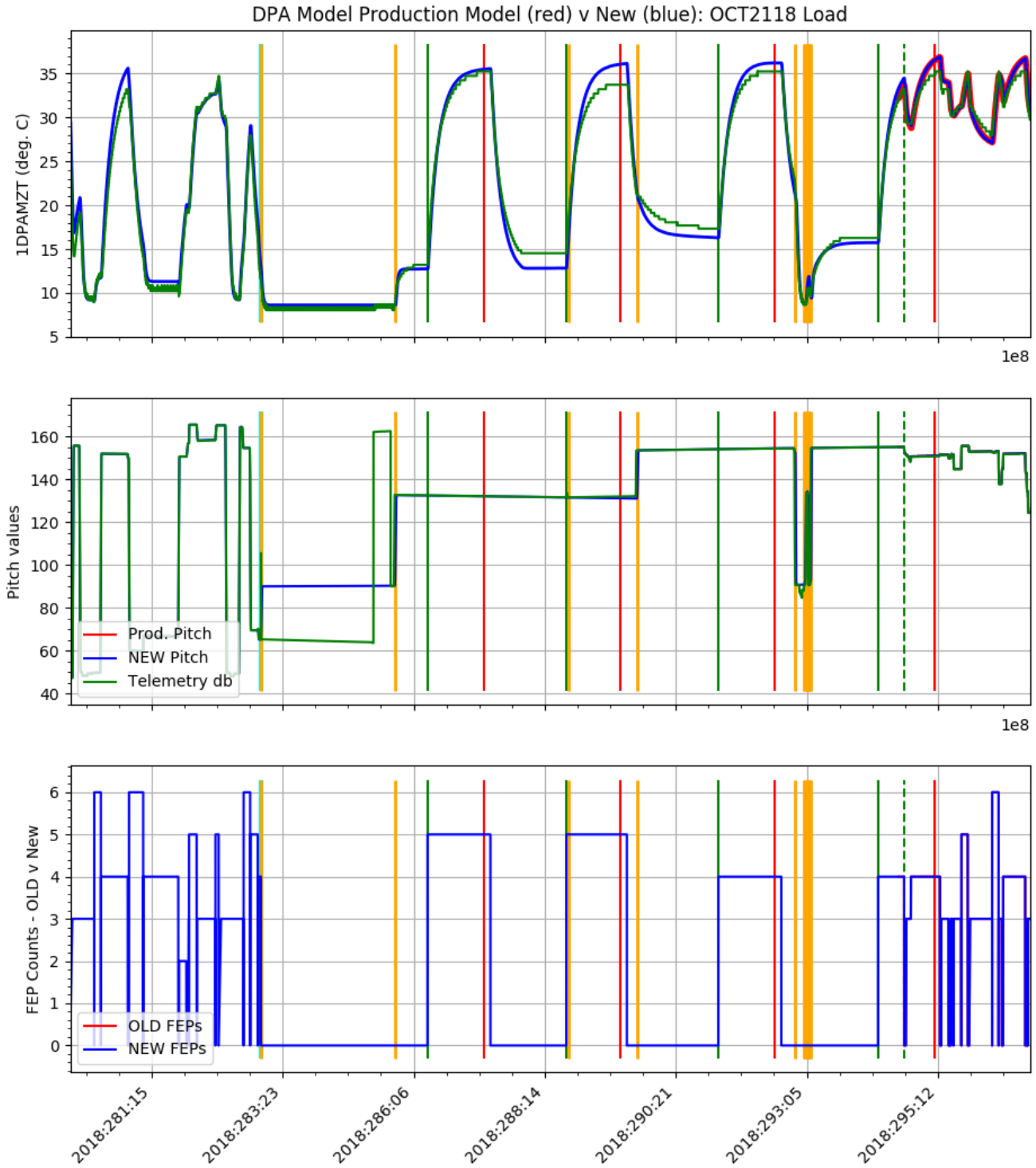
OCT2118 Load: Normal - complicated load stresses the system

OCT0818: TOO 2018:280:05:55:00.00 2018:283:13:54:39.00 STOP to 2018:288:04:13:59.32
2018:283:13:54:39.00 STOP
2018:283:13:54:52.00 MAN 89.98 293.72
2018:285:22:38:00 MAN 132.59 1.91
2018:286:12:30:00 LTCTI 1449 1_5_CTI 001:00:00:00
2018:288:23:21:00 LTCTI 1462 1_5_CTI 000:23:00:00
2018:289:00:05:00 MAN 131.46 358.12
2018:290:05:17:00 MAN 153.49 176.62
2018:291:15:50:00.00 LTCTI 1467 1_4_CTI 001:00:00:00
2018:293:00:30:00.00 MAN 90.75 0.19
2018:293:04:14:00.00 MAN 90.80 0.34
2018:293:04:41:00.00 MAN 133.81 180.41
2018:293:05:15:00.00 MAN 128.47 226.63
2018:293:05:25:00.00 MAN 133.82 180.44
2018:293:05:54:00.00 MAN 90.83 0.40
2018:293:06:07:00.00 MAN 90.83 0.41
2018:293:06:22:00.00 MAN 90.84 0.42
2018:293:07:05:00.00 MAN 154.61 183.11
2018:294:11:30:00 2018:294:22:30:00.00 LTCTI 1468 1_4_CTI 001:00:00:00
GO

OCT2118B: Return to Science STOP – 2018:294:22:30:00.00 to 2018:297:02:14:37.48
Continuity Load: OCT0818B

Legend for Vertical Bars:





First Problem load – MAY2620 Maneuver-Only load

ECS measurement AFTER the load start at 2020:148:01:00:00.00 was missed
– old code did not search for events throughout the review load

MAY2420A - TOO_2020:145:13:55:00.00_2020:145:14:17:30.00 STOP_to_2020:153:05:14:00.00

2020:145:14:17:30.00 STOP (BSH-NSM)
2020:147:01:55:00.00 MAN 90.02 210.64
2020:147:02:08:00.00 LTCTI 1527 1_4_CTI 000:16:00:00
Stop: 2020:147:18:08:00.000

ECS CLD files require an upgrade:

4 chip ECS CLD file excerpt:

```
……...
!============================================================
! 10.    Stop Science
!============================================================
ACIS,AA00000000,DELTA=02:38:20.000
……..
!============================================================
! 12.    Video Board Power Down
!============================================================
ACIS,WSPOW00000,DELTA=00:00:04.000
```

Therefore 4 chips on for 2:38 but no data was taken

2020:147:11:21:00.00 MAN 155.93 272.06

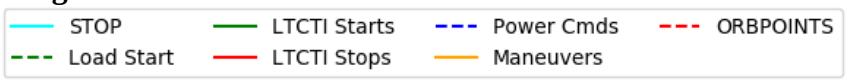
MAY2620B - MANEUVER-ONLY STOP_2020:148:01:00:00.00_to_2020:149:01:00:00.000
- No ACIS commands (i.e. No stop science commands at the start of the lead

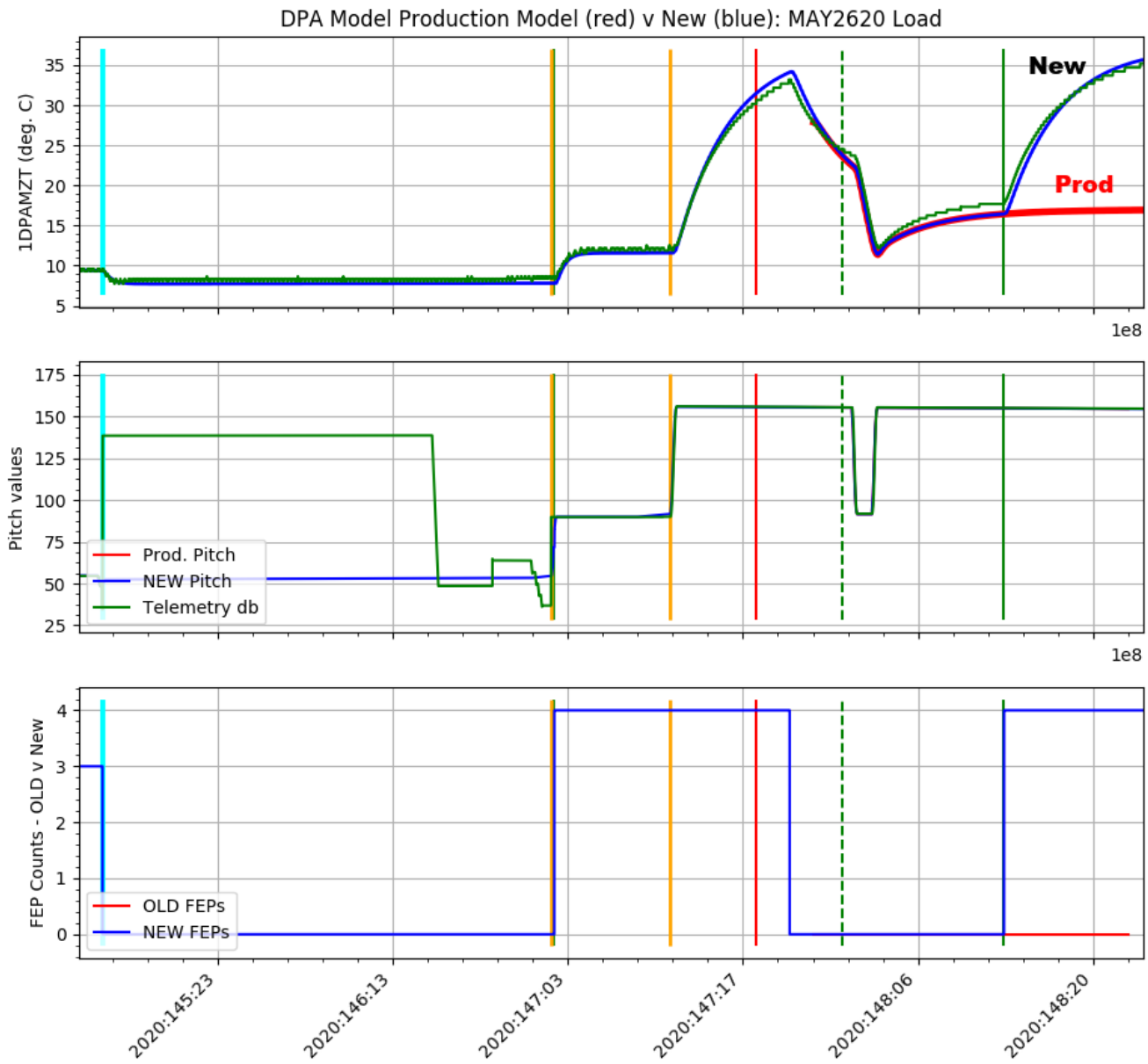
2020:148:13:48:00 LTCTI 1528 1_4_CTI 001:15:00:00
- 39 hours nominal length ending at 2020:150:04:48:00.00

MAY2820A - Normal - Return to Science 2020:149:01:00:00.00_to_2020:153:05:14:00.00
Begins with 2 Stop science commands
2020:149:00:57:00.000 793248 ACISPKT AA00000000 – Stops LTCTI
2020:149:00:57:03.000 793260 ACISPKT AA00000000

LTCTI started in MAY2620 Maneuver-only load bleeds into this load but stopped
CUT COMMAND: 2020:149:00:57:00.00

Legend for Vertical Bars:





JUL2720B - Normal – 2020:208:18:41:00.00 2020: 213:05:22:00 to 2020:223:11:49:42.28

IRU Swap with In Situ ECS during a "pause" at 2020: 213:05:22:00

No observations or ACIS commands between 2020:213:00:44:38.466 and 2020:213:10:15:00.798

- This was the time period for the Gyro Swap operations which begins with:

2020:213:00:44:38.466 5592064 SIMTRANS -99616 (HRC-S)

2020:213:05:22:00 LTCTI 1535 1_CTI06 000:06:00:00

Nominal end of ECS measurement: 2020:213:11:22:00 + 2:38

…..and ends with two Stop Science at:

```
2020:213:10:07:00.000    5723738  ACISPKT     AA00000000
2020:213:10:07:03.000    5723750  ACISPKT     AA00000000
```

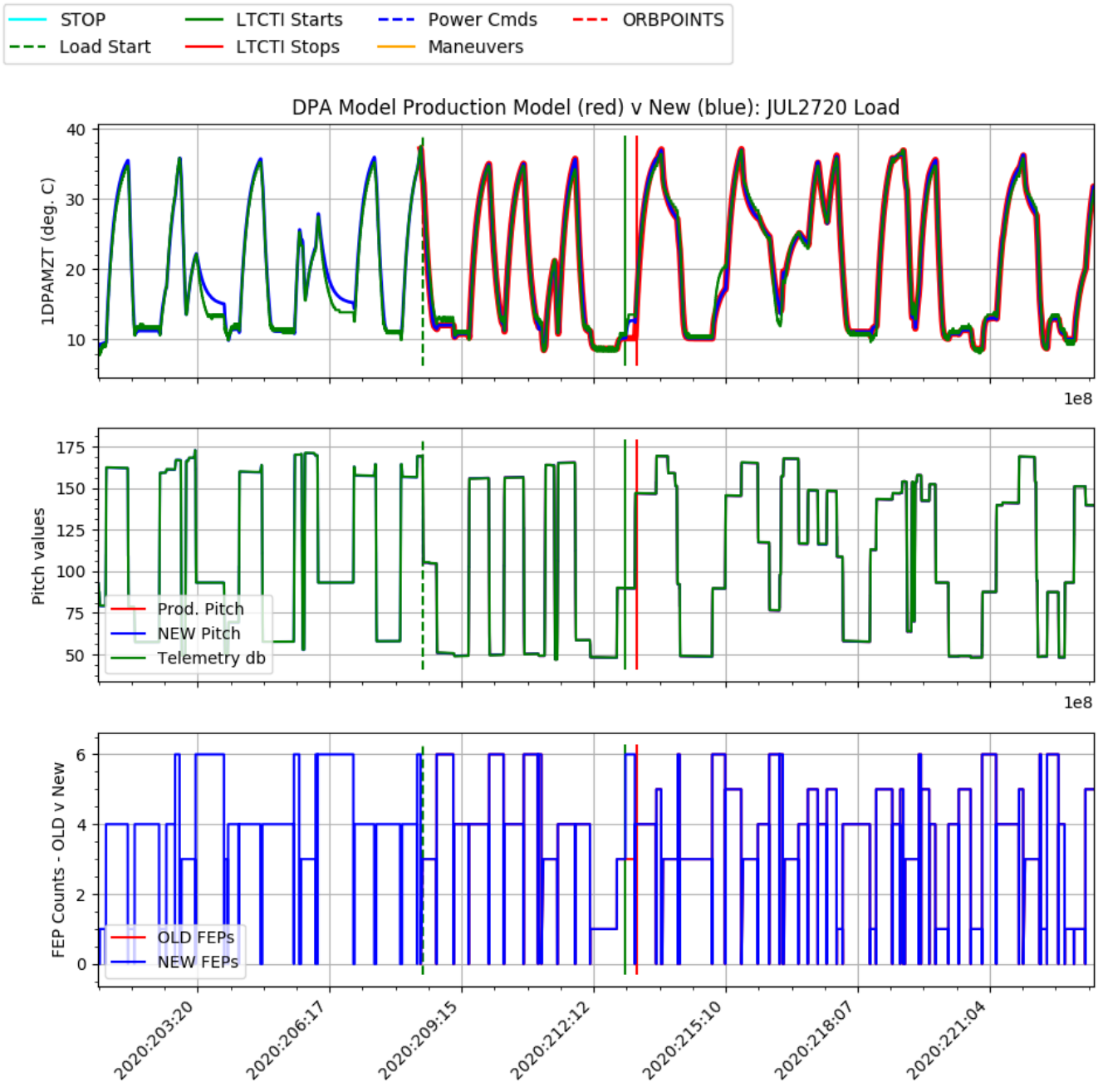
LTCTI cmds trimmed to: 2020:213:05:23:39.00 RH_0000001

- NO CAP 1535 commands after that. ECS measurement halted by 2 Stop Science commands.

- followed by 4 CHIP ACIS observation 22991 with SIMTRANS at 2020:213:10:15:00.798

Therefore the new software must look for the first stop science commands after the beginning of the LTECS CLD command execution and trim off any CLD commands that occur after the Stop Sciences.

Legend for Vertical Bars:



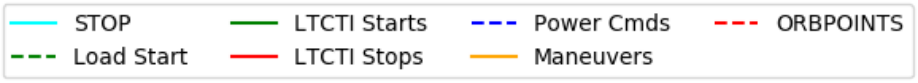
AUG3120 - Maneuver-Only load – Power Command CAP

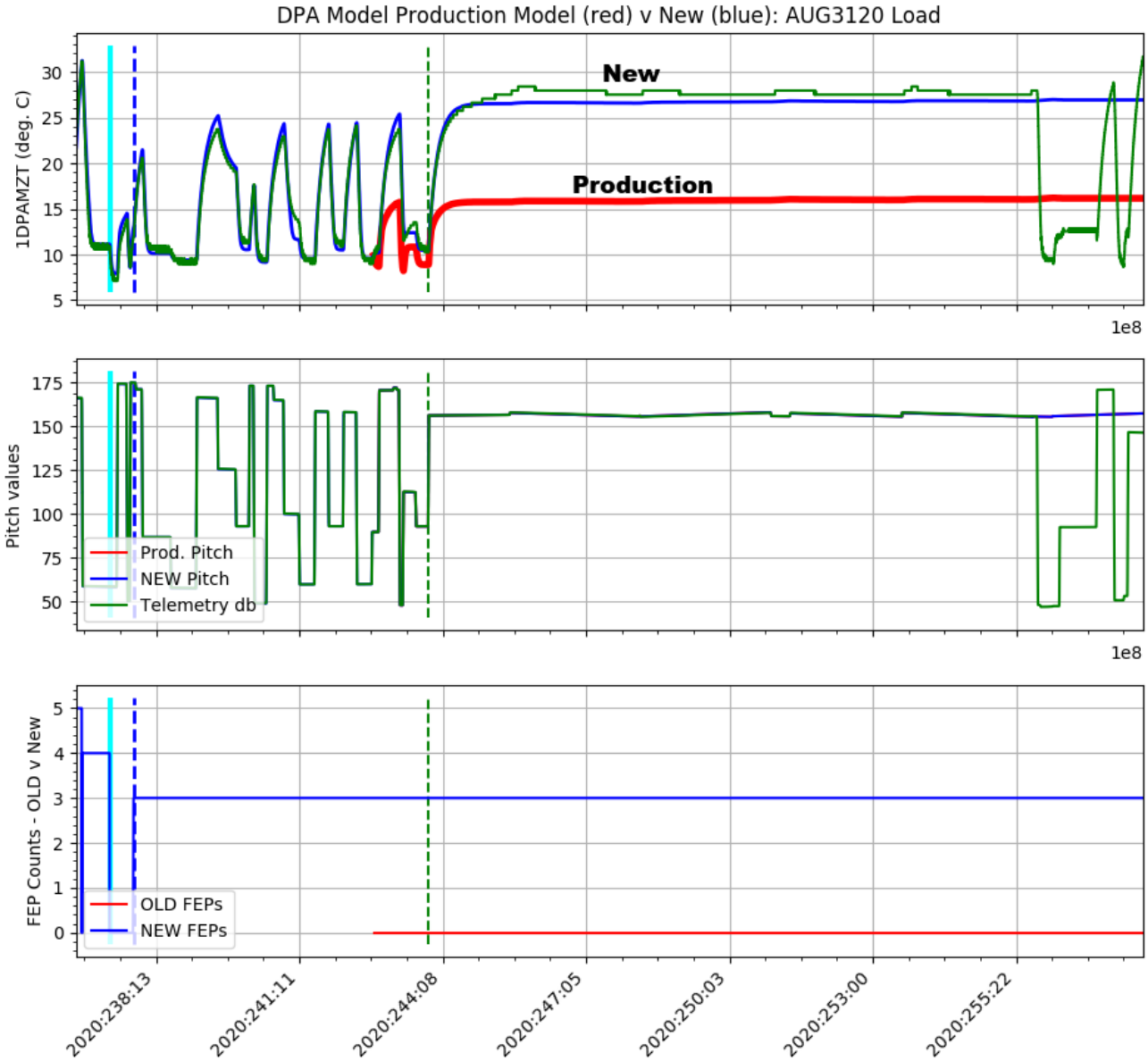
AUG2420: Normal 2020:237:01:35:07.79 2020:237:15:11:00 S107 to 2020:244:01:26:48.013

2020:237:15:11:00 S107
2020:238:02:48:00 WSPOW0002A 1540

AUG3120: MO/SCS-107 – 2020:244:01:23:48.013 to 2020:258:12:00:00.000

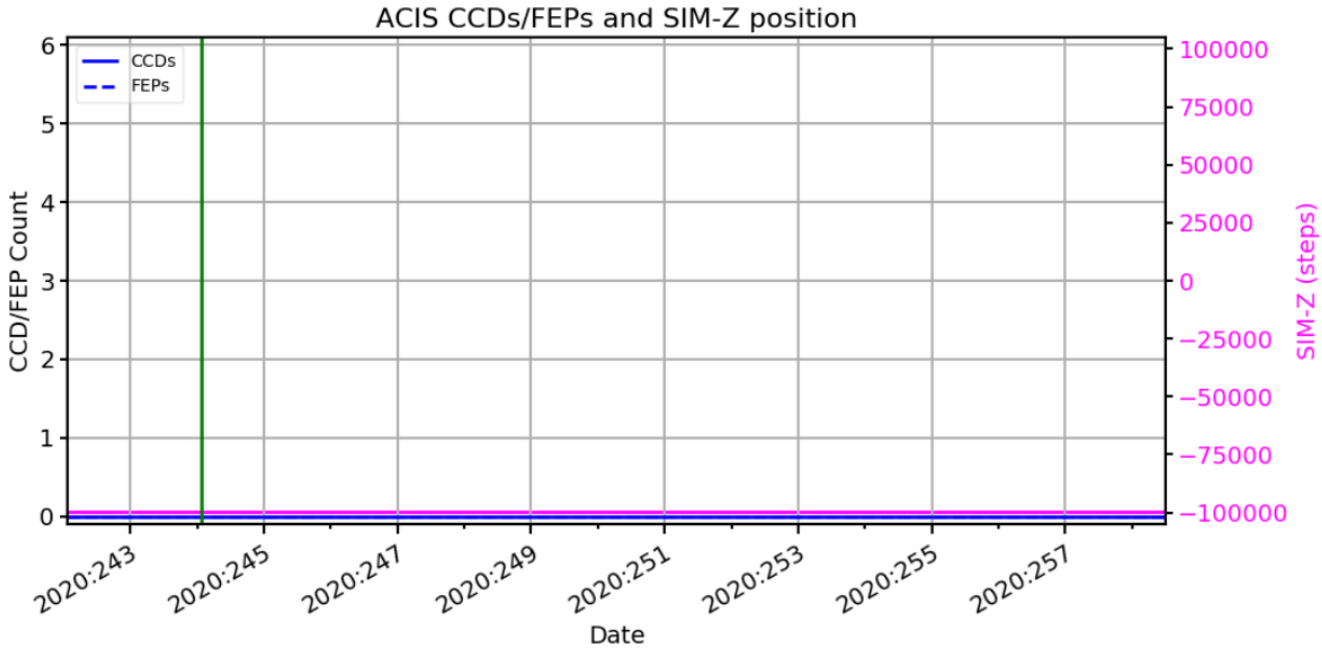
Legend for Vertical bars:



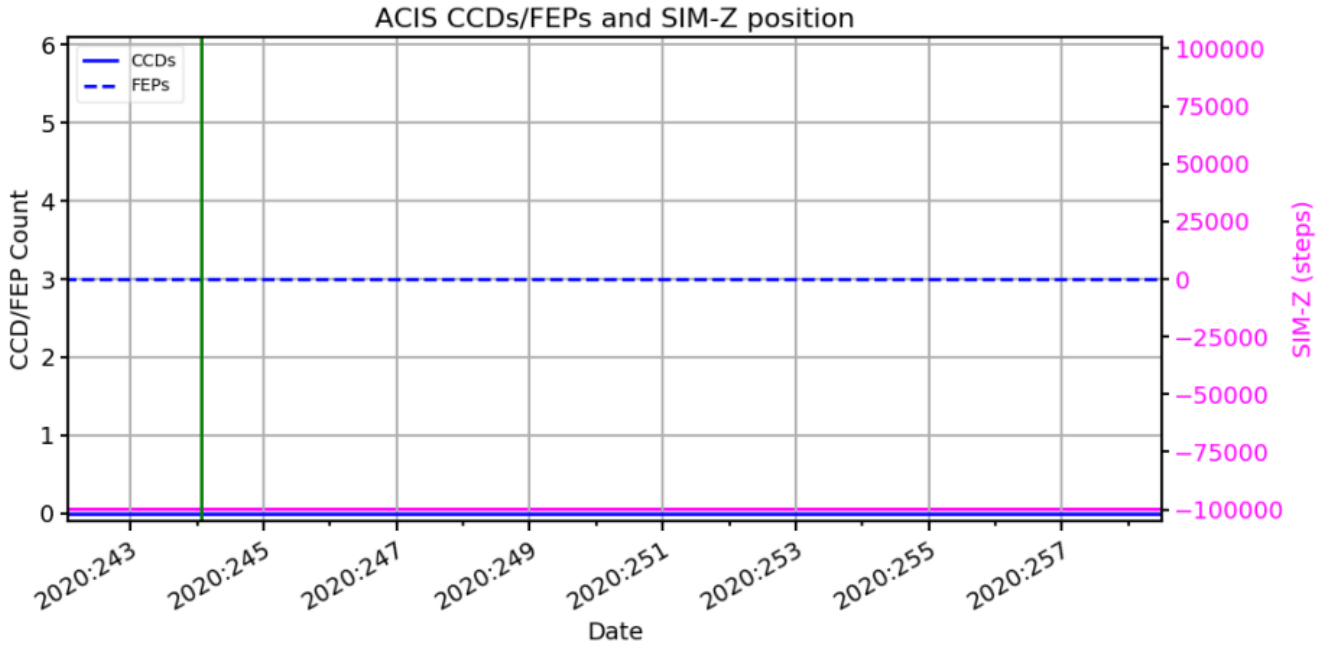


States generated by model runs do not always extend back as far for these plots so...

Production model FEP plot:



New Backstop-History:



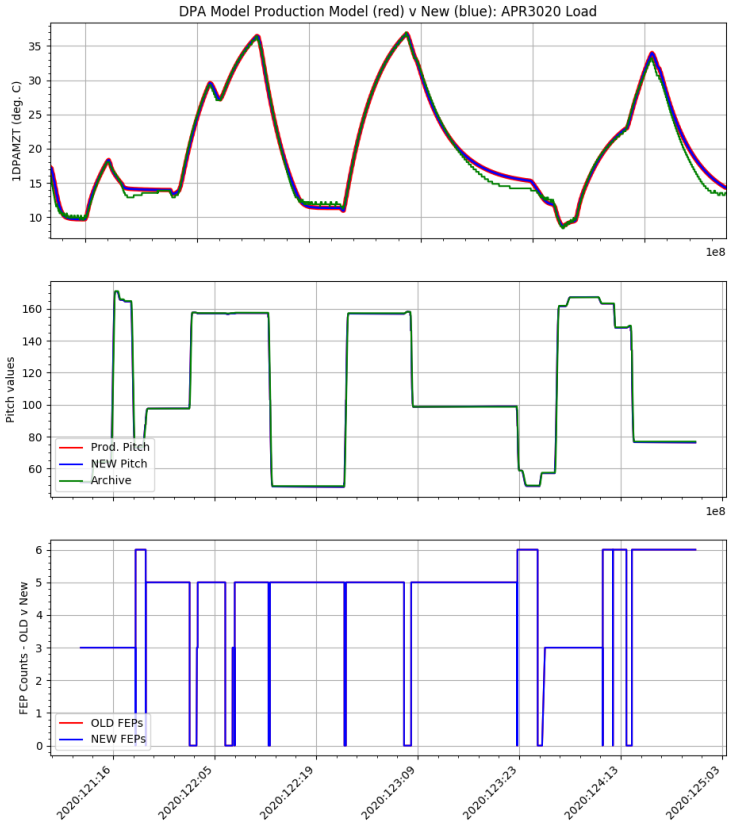
TOO Test – Hand Modified APR3020 Load

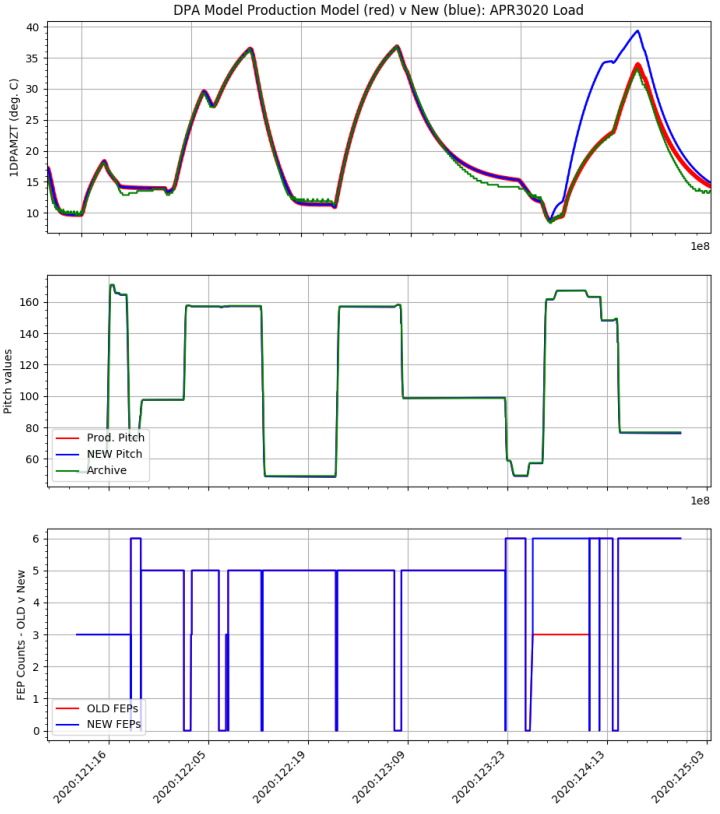
APR0320 Load: Very Fast TOO - 2020:121:15:45:00.00 to 2020:124:23:46:08.591

6 chip LTCTI run inserted during perigee passage

2020:124:04:57:05.830 7185854 ORBPOINT EPERIGEE
2020:124:04:57:05.830 LTCTI 9991 1_CTI06 000:04:00:00
2020:124:11:04:48.003 7277858 ACISPKT AA00000000
2020:124:11:04:48.003 7277858 ORBPOINT XEF1000

Production **Test Load**





Also notice that the number of FEPS stay at 6 even though we are supposed to be done.

This is due to the 2 hour 38 minute delay in the RTS. Also the 6 chip ECS CLD file does a VIDALLDN where the 4 and 5 Chip CLD's execute a WSPOW00000.

```
!====================================================================
! 6.      Start Science
!====================================================================
ACIS,XTZ0000005,DELTA=00:00:04.000

!====================================================================
! 10.     Stop Science
!====================================================================
ACIS,AA00000000,DELTA=02:38:20.000

!====================================================================
! 11.     Stop Science
!====================================================================
ACIS,AA00000000,DELTA=00:00:10.000

!====================================================================
! 12.     Video Board Power Down
!====================================================================
ACIS,WSVIDALLDN,DELTA=00:00:04.000
```