Aktivitetstitel: Start NICMOS Cooling System (NCS)

Applicable SMOV Requirement:
J.10.4.4.5.1, J.10.4.4.5.2, J.10.4.4.5.3, J.10.4.4.6.1, and J.10.4.4.6.2

Beskrivelse:

Purpose:
Configure the NCS to re-cool the NICMOS detectors, determine the optimal science operating temperature for the NICMOS detectors, and verify stable operation.

Goals:
1) Cool the NICMOS to the coldest possible temperature with HST at a hot attitude and the NCC compressor operating near its maximum allowable speed.
2) Measure NICMOS detector performance during the cool-down and steady state operation of the NCS.
3) Demonstrate stability (+/-0.1K) of the NICMOS detector temperature at the optimal science operating temperature.
4) Demonstrate repeatability (+/-0.1 K) of NICMOS detector temperature following changes from the optimal science operating temperature.

Methodology:

Execute step 1 of VDT (at least 1 full orbit at +V3 sunpoint prior to NCC operation while moving the ACS Filter Wheel).

Execute step 2 of VDT (at least 1 full orbit at +V3 sunpoint prior to NCC operation with no filter wheel motion).

As early as possible in the BEA period:
1) Start the NCS CPL.

Execute step 3 of VDT (at least 1 full orbit at +V3 sunpoint during NCC startup).

2) Start the NCC circulator.
3) Start the NCC compressor.
4) With the NCC compressor max speed at its default value (7300 rps.), set the NCC PID control set point to 60 K, controlling off of the weighted average of the neon temperatures. This will result in the fastest cool-down.
5) 24 hours after the NCC cool-down is begun, begin taking NICMOS detector internal temperature monitoring observations (30-minute dark, 0-sec bias exposures, FPA temperature, mounting cup temperature) once per orbit until the conclusion of the test [148 hr after start of cooldown (TBR)].
6) 76 hours (TBR) after the NCC cool-down is begun, slew HST to the sun angle and roll (consistent with the BEA constraints) that produce the warmest mean NCS radiator temperature. Maintain this attitude for 72 hours (TBR).
7) 90 hours after the NCC cool-down is begun, set the NCC compressor max speed to 7250 rps (normal max speed is 7300 rps) and keep the NCC PID control set point at 60 K. This will cause the compressor to run at a fixed speed of 7250 rps. and will result in an asymptotic cool-down to the lowest temperature that can be reached at this speed and under these thermal conditions.

No HST attitude requirements pertain to steps 8-15.
8) 148 hours (TBR) after the NCC cool-down is begun, set the NCC PID control set point to 3.0 K warmer than the temperature reached and the NCC compressor max speed to 7300 rps. This will put the NCC under active PID control at a controlled operating temperature. Maintain this set point for 48 hours (TBR). (Note: This configuration is a normal operational configuration and can be maintained indefinitely.)

Steps 9-11 verify the repeatability of the NICMOS detector temperature:
9) Increase NCC PID control set point by an amount that corresponds to 0.5 K at the NICMOS detector and maintain this temperature for 48 hours (TBR).
10) Decrease NCC PID control set point by an amount that corresponds to 1.0 K at the NICMOS detector and maintain this temperature for 48 hours (TBR).
11) Increase NCC PID control set point by an amount that corresponds to 0.5 K at the NICMOS detector and maintain this temperature for 48 hours (TBR).

Execute step 4 of VDT (at least 5 full orbits at +V3 sunpoint while NCC is operating at steady state).

Execute step 5 of VDT (at least 5 full orbits at -V1 sunpoint while NCC is operating at steady-state).

Two weeks after the end of the BEA period:
12) Set the NCC PID control set point to the temperature that corresponds to the NICMOS detector optimal science operating temperature as determined from analysis of the data taken in step 7. This temperature will depend on NCS and NICMOS detector performance. Maintain this set point for 48 hours (TBR).

13) Concurrent with steps 8-12, take NICMOS detector internal temperature monitoring observations once per orbit.
14) At the end of the 48-hr stabilization interval, take continuous NICMOS detector internal temperature monitoring observations for 1 orbit to demonstrate +/-0.1K stability at the science operating temperature (known as rapid monitor data takes).
15) Continue NICMOS detector internal temperature monitoring observations once every three orbits for 1 month (150 samples) to demonstrate +/-0.5K stability at the science operating temperature.

IMPLEMENTATION METHOD:
Real-time commanding for NCS operations.
Proposal for NICMOS measurements.

DEPENDENCIES:
1) Fill NCS circulator neon loop (done in servicing mission command plan)
2) Perform STIS baseline measurements.
3) A Vehicle Disturbance Test (VDT) is planned in regards to NCC startup. The following are the requirements in conjunction with NCC startup:
   1) at least 1 full orbit at +V3 sunpoint prior to NCC operation while moving the ACS Filter Wheel
   2) at least 5 full orbits at +V3 sunpoint prior to NCC operation with no filter wheel motion
   3) at least 1 full orbit at +V3 sunpoint during NCC startup
   4) at least 5 full orbits at +V3 sunpoint while NCC is operating at steady-state
   5) at least 5 full orbits at -V1 sunpoint while NCC is operating at steady-state

4) ACS CCD functional

5) FGS jitter baseline

DURATION:

Starting the NCS CPL requires approximately 3 hours of sparse real-time commanding.
Starting the NCC circulator and compressor requires approximately 1 hour of real-time commanding.
The NCC cool-down during the BEA requires approximately 148 hours. The final 76 hours of this is at a specified attitude.

The NCS stability and repeatability steps require approximately 15 days. There are no related HST attitude requirements and these steps can be done in parallel with other activities.

DATA REQUIREMENTS:

Several NCS history buffer dumps for NCS start-up (8 Kbytes/dump)

NICMOS detector data:
Once-per-orbit internal temperature monitor: DARK = 30-min dark, 3 detectors = 12.5 MB. BIAS = 2 x 100 0-sec exposures, 1 detector = 32 MB. There is no additional data volume for FPA and mounting cup temperature.
Daily data volume = 15 orbits of 3-detector DARK + 15 orbits of 1-detector BIAS + 1 orbit of 2-detector BIAS = 15*12.5 + 15*32 + 2*32 = 731.5 MB.
One orbit rapid monitor: 88 MB

ANALYSES & RESULTS:

The CHAMP Thermal group will analyze NCS thermal performance. The BEA NCS cool-down and steady state data will be used to determine the coldest NCC Cold Load Interface temperature that the NCS can maintain under active PID control in all expected thermal environments. Analysis is expected to require two weeks. Results of this analysis are required for the stability and repeatability parts of this activity, which begin after the BEA period.

The STScI NICMOS team will analyze NICMOS detector performance. NICMOS detector data from the BEA cool-down period will be used to determine the detector temperature that will provide the optimal science data by trading detector quantum efficiency and dark current and considering the minimum sustainable NICMOS temperature. Analysis is expected to require two weeks. Results of this analysis are required for the stability and repeatability parts of this activity, which begin after the BEA period.

NICMOS detector data from the post-BEA period will be used to determine detector temperature stability and repeatability. Analysis is expected to require one week. Results of this analysis are required prior to beginning NICMOS calibration and science observations.
COMMENTS:

The TBRs associated with the various event times in the “Methodology” section will be resolved by 5/31/01 when the MOSES Thermal Group has finished their analysis.

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