



WFC3 Side Switch Re-Commissioning

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WFC3 Side Switch SMOV



- This is the contingency plan for WFC3 re-commissioning on Side 1 following a side switch.
- Key Assumptions and Constraints
 - Must obtain maximum confidence in Side 1 prior to cooling detectors to avoid multiple cooldown cycles.
 - Real-Time *vs.* SMS controlled cooldown to be decided during contingency – ability to monitor and abort during cooldown is critical
 - Retain option to perform SMOV on only one channel
 - CSM Resolver recalibration is not required on Side 1
 - Consistent with ground testing experience
 - Science can start fairly quickly with some degree of risk
 - Only “Engineering Activities” absolutely required to start some science
 - Re-use of 2009 SMOV Proposals (subset at visit level) rather than writing new proposals
 - ERO science is not included in this plan



Fallback Plans



- WFC3 SMOV design is primarily channel based
 - Either UVIS or IR commissioning can proceed without the other
- Major risk areas within each channel
 - Detector cooling: science margin exists to operate warmer at cost of considerable re-calibration (e.g. darks and flats)
 - Detector noise: most of SMOV can proceed during analysis of cause
- Phased start to GO science observations
 - EASY = programs not pushing on risk areas (can overlap sci cal part of SMOV)
 - HARD = programs dependent upon performance in “risk areas”
 - Defer until SMOV determines if these programs require modification



Preliminary Proposal Validation



- SMS OAT work completed
 - 11454 – WFC3 SMS based FT
 - 11358 – Image Memory load and dump (subset)
 - RAM tested via RT commanding
 - 11431 – ANNEAL (full version)
 - 11434 and 11435 – UVIS and IR File Alignments (visit 1 only)
- STScI proceeding to create and validate (PIT) all SS-SMOV proposals



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Engineering Activities (1)



- 11454/WF01 – Activation Test
 - Re-run of SM4 FT to confirm basic function and stability of instrument.
 - Provide global check of basic SI functionality
- 11358/WF03 – Science Data Buffer Check
 - Validates memory in Side 1 MEB (untested since 2008)
- **NOTE: The proceeding steps:**
 - Must be done prior to detector cool-downs
 - May all proceed regardless of results of each step
- 11419/WF06 – UVIS Detector Functional test
 - Verify detector readout operation, noise level, and gain.
 - Obtain series of darks and internal flat fields.
- 11420/WF07 – IR Detector Functional test
 - Verify detector readout operation, noise level, and gain.
 - Obtain series of darks and internal flat fields.



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Engineering Activities (2)



- 11421/WF08 – Channel Select Mechanism Test
 - Verify proper positioning of CSM IR fold mirror and IR diffuser
 - Verify unobstructed UVIS beam
- 11422/WF09 – SOFA and Tungsten Lamp test
 - Verify operation of all SOFA filter wheels.
 - Verify operation of at least 2 Tungsten lamps.
 - Establishes an initial baseline over a broad wavelength range.
- WF10 – IR FSM and Tungsten Lamp Test
 - Verify operation of FSM.
 - Verify operation of at least 2 Tungsten lamps.
 - Establishes an initial baseline for all IR filter elements.
- 11426/WF13 – UVIS SMOV Contamination Monitor
 - Standard star and bias/dark/internal flat observations in F218W, F225W, F275W, F606W
 - Execute weekly for 4 weeks until transition to Cal Contam Monitor (CY21=13088) – 2 orbits per visit



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Engineering Activities (3)



- 11427/WF14 – UVIS Shutter test
 - Verify operation and timing of the UVIS shutter mechanism.
 - Obtain internal flat fields over a range of exposure times to verify shutter shading is unchanged from ground testing.
 - Obtain observations of a standard star at 0.5, 0.7, 1.0, 1.5, and 2.0 seconds at four locations within the FOV using subarrays.
- 11428/WF15 – D2 Calibration lamp test
 - Verify operation of D2 lamp via UV filter internal flat fields.
 - Establishes an initial baseline for UV filter elements.
 - Determine on-orbit range of D2 lamp “turn-on” times.
 - De-scoped from 2009 SMOV by factor of 2 (Visits 2,5,6,9,11,12 only)
- 13071/WF18 – UVIS Hot Pixel Anneal
 - Demonstrate ability to performance UVIS anneal
 - Maintain strategy of limiting hot pixel growth with CCDs cold
 - Must be performed within 30 days of cool-down of UVIS detector.
 - Uses current (March 2013) Anneal strategy
 - Execution with “UVIS only” or “Full Anneal” to be decided at time of SMS build



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Contingency Alignment Activities



- Assumptions:
 - No credible failure modes should degrade the alignment outside of the range of the fine alignment proposals.
 - Activating the internal WFC3 tip-tilt/focus mechanisms should not be done solely to verify their operation for a potential future (“out years”) use.
- Conditions for execution of WFC3 Fine Alignment Proposals:
 - Observed degradation of PSF by >20 percent in EE and/or central pixel flux fraction
 - Change in optical bench temperature by >2 degrees C.
- Note: These proposals will require near real-time availability of unique staff

- 11434/WF21 – UVIS Fine Alignment
 - Observe a sparse star field (NGC 188) over a 7 step internal focus sweep.
 - Update optimal focus (real-time uplink)
 - Observe a sparse star field (NGC 188) over a 3x3 internal tip-tilt sweep.
 - Update optimal tip-tilt alignment position (real-time uplink)
- 11435WF22 – IR Fine Alignment
 - Observe a sparse star field (NGC 188) over a 7 step internal focus sweep.
 - Update optimal focus (real-time uplink)
 - Observe a sparse star field (NGC 188) over a 3x3 internal tip-tilt sweep.
 - Update optimal tip-tilt alignment position (real-time uplink)



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Science Calibration Activities (1)



- 11432/WF19 – UVIS Internal Flats
 - Obtain internal flat fields using the Tungsten lamps
 - D2 flat obtained in activity WF15
 - Limited subset of heavily used filters to verify stability of contamination and instrument flat field (Visits 90-96 only)
- 11433/WF20 – IR Internal Flats
 - Obtain internal flat fields using the Tungsten lamps.
 - Limited subset of heavily used filters to verify stability of instrument flat field (Visits 1,2,3 only)
- 11442/WF29 – FGS-UVIS Alignment
 - Observations of NGC 188 at three positions separated to at least 10 arc seconds and moving in orthogonal directions will be obtained.
- 11443/WF30 – FGS-IR Alignment
 - Observations of NGC 188 at three positions separated to at least 10 arc seconds and moving in orthogonal directions will be obtained.



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Science Calibration Activities (2)



- 11436/WF23– UVIS Image Quality
 - Detailed characterization of the achieved image quality using the NGC 188 sparse star field.
 - Four observations in F275W and F621M using a 2x2 dither pattern with 0.5 pixel steps will be obtained at two pointings offset by 10 arc seconds.
- 11437/WF24 – IR Image Quality
 - Detailed characterization of the achieved image quality using the NGC 188 sparse star field.
 - Four observations in the F098M, F105W, F127M, F160W, and F164N using a 2x2 dither pattern with 0.5 pixel steps will be obtained at two pointings offset by 10 arc seconds.
- 11438/WF25 – UVIS PSF Wings
 - Observations of a moderately bright star in F275W and F621M to measure the wings of the PSF over a large dynamic range
 - De-scoped from 2009 SMOV to include only one field point.
- 11439/WF26 – IR PSF Wings
 - IR PSF Wings in F098M and F160W will be measured at 5 field points over a large dynamic range.



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Science Calibration Activities (3)



- 11450/WF37 – UVIS Photometric Zero Points
 - Photometric standard star will be observed in high priority filters using sub-arrays.
- 11451/WF38 – IR Photometric Zero Points
 - Two photometric standard stars (red and blue) will be observed in each filter.
- 11452/WF39 – UVIS Flat Field uniformity
 - Omega Cen star field will be observed to assess quality of low frequency flat fields and to check astrometric calibration.
- 11453/WF40 – IR Flat Field uniformity
 - The 47 Tuc star field will be observed to assess quality of low frequency flat fields and to check the astrometric calibration.



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Calibration Activities (4)



- 11798/WF43 – UVIS PSF Core Modulation
 - Measure impact of UVIS Shutter induced jitter on observations
- 13069/NEW – WFC3 UVIS Post-Flash Calibration
 - Confirm operation and level of UVIS Post-Flash on redundant lamp
 - Initial Calibration of Post-Flash
 - Include Visits B0,B1,B2,B3, D0,D1,D2,D3 from CY19 CAL 13069



Timeline



- Week 1:
 - Activation Test (i.e. FT), Memory Tests, go for detector cooldown
- Week 2:
 - Engineering Tests; then start “Easy Science”
- Week 3:
 - Science Calibration Pages 1 & 2
 - Decision on Image Quality/Optical Alignment
- Week 4:
 - Complete Science Calibration; Start “Hard Science”
 - OR
 - Stop Science & Perform Fine Alignment (might take 2 weeks)
- Week 5 or 6:
 - Complete Science Calibration; Start “Hard Science”



WFC3 SS-SMOV Program (1)



Activity	PropID	Title	Visits #1	Visits #2	Comments	Ext Orbits	Int Orbits	Notes
WF01	11454	Activation Test	7	7	Prerequisite for cooldown		12	includes cooldown
WF02	11357	Memory Test	1	1	Prerequisite for cooldown			OMIT -- in EEPROM I
WF03	11358	Sci Data Buffer Test	14	14	Prerequisite for cooldown		14	
WF04	n/a	UVIS CCD Cooldown			R/T Monitoring Required			
WF05	n/a	IR Detector Cooldown			R/T Monitoring Required			
WF06	11419	UVIS Det Functional	14	14			16	
WF07	11420	IR Det Functional	13	13			13	
WF08	11421	CSM Test	2	2		1	1	
WF09a	11422	UVIS SOFA Test	3	3			2	
WF09b	11529	UVIS Spare Tungsten La	2	2	Special Commanding		2	
WF10a	11423	IR FSM Test	4	4			4	
WF10b	11543	IR Spare Tungsten Lamp	4	4	Special Commanding		4	
WF11	11424	UVIS Initial Alignment	3	0	Assume stable			
WF12	11425	IR Initial Alignment	3	0	Assume stable			
WF13	11426	UVIS Contam Monitor	21	12		8	8	
WF14	11427	UVIS Shutter Test	3	3		2	1	
WF15	11428	D2 Cal Lamp Test	12	6	Visits 2,5,6,9,11,12 only		6	
WF16	n/a	UVIS TEC Performance	N/A		Engineering Support			
WF17	n/a	IR TEC Performance	N/A		Engineering Support			
WF18	11431	UVIS Hot Pixel Anneal	6	0	Use Current Proposal		0	
WF19	11432	UVIS Int Flats	63	7	Visits 90-96 only		4	
WF20	11433	IR Int Flats	50	3	Visits 1,2,3 only		3	

Activities in Blue are UVIS proposals

Activities in Red are IR proposals

Yellow Highlight indication omission from SMOV



WFC3 SS-SMOV Program (2)



WF21	11434	UVIS Fine Alignment	4	4	Contingent on Bench Temp			16 EXT/1 INT
WF22	11435	IR Fine Alignment	4	4	Contingent on Bench Temp			7 Ext/1 INT
WF23	11436	UVIS Image Quality	1	1		3		
WF24	11437	IR Image Quality	1	1		2		
WF25	11438	UVIS PSF Wings	4	1	De-scoped from 13 orbits	4		
WF26	11439	IR PSF Wings	1	1		5		
WF27/28	11549	UVIS & IR Pointing Stab	12	1	Omit			
WF29	11442	FGS-UVIS Update	1	1		1		
WF30	11443	FGS-IR Update	1	1		1		
WF31	11444	UVIS Plate Scale	2	0	Omit (Use normal monitor)			
WF32	11445	IR Plate Scale	2	0	Omit (Use normal monitor)			
WF33	11446	UVIS Dark, Noise, Backg	22	0	Omit (Use normal monitor)			
WF34	11447	IR Dark, Noise, Backgnd	22	0	Omit (Use normal monitor)			
WF35	11448	UVIS SAA Passage	3	0	Omit			
WF36	11449	IR SAA Passage	3	0	Omit			
WF37	11450	UVIS Phot Zero Points	4	1	De-scoped from 8 orbits	5		
WF38	11451	IR Phot Zero Points	8	2	De-scoped from 4 orbits	2		
WF39	11452	UVIS Flat Field Uniformit	2	1	De-scoped from 11 orbits	6		
WF40	11453	IR Flat Field Uniformity	3	1	De-scoped from 9 orbits	3		
WF42	11552	IR Grisms	4	0	Omit (Use normal monitor)			include if bench tem
WF43	11798	UVIS PSF Core Modulat	2	2		5		
WF44	11808	UVIS Bowtie Monitor	100	0	Omit (Use normal cal)			
NEW	13069	Post Flash Check		8			8	



Notes



- External orbits = 48 (compared to 132 for SM4 SMOV)
- Internal orbits = 98
 - Anneal & Bowtie from CyXX calibration program
 - Additional 23 External and 2 Internal contingency on optical alignment
- **SMOV Activities De-scoped or Omitted for Re-commissioning**
 - UVIS Contamination Monitor: one month only; then resume Cal plan
 - Anneal: use current Anneal procedure (probably w/ two channel Anneal)
 - Internal Flats (UVIS and IR): spot checks only
 - Alignment: Initial (coarse) not required; Fine kept as contingency
 - UVIS PSF Wings: only central field point observed
 - Line of Sight Pointing Stability: omitted
 - Plate Scale Calibrations: checked inside Flat Field test
 - UVIS&IR Darks, Bowtie: covered by calibration monitor programs
 - SAA operation and contour tests: omitted