

## MESO-SAILS (Multiple Elevation Scan Option for SAILS) Initial Description Document

Background: SAILS (Supplemental Adaptive Intra-Volume Low-Level Scan) inserts one supplemental (lowest elevation defined in the VCP definition, normally  $0.5^\circ$ ) split cut scan into the existing severe weather VCPs 12 and 212. This new split cut scan is inserted into the “middle” of the volume scan to evenly space, as close as possible, the time intervals between low-level data updates. The “middle” of the volume scan is adaptive and determined on a volume scan-to-volume scan basis based on the termination angle determined by the Automated Volume Scan Evaluation and Termination (AVSET) function. SAILS was deployed with Build 14 in the Spring of 2014.

MESO-SAILS: Building on SAILS, MESO-SAILS (Multiple Elevation Scan Option for SAILS) allows the operator to select either one, two or three supplemental low-level elevation scans (verses only one supplemental scan allowed in the initial SAILS implementation) per VCP (for VCP 12 and 212). These additional supplemental low-level elevation scans are evenly spaced, in time (as close as possible given the defined VCP rotation rates), throughout the volume scan. The new MESO-SAILS options will result in two, three or four low-level elevation scan updates per volume scan, at the operator’s discretion.

Initial Testing: To facilitate “proof of concept” testing, two test VCPs, based on VCP 12, were defined that included hardcoded additional low-level split-cut scans. These test VCPs, identified as SAILSx2 and SAILSx3 in Table 1, were loaded onto the KOUN RPG on Jun 26, 2013 and Jun 28, 2013, respectively.

For the first test event (Jun 26, 2013), the SAILSx2 VCP was executed for approximately 4 1/2 hours on KOUN. During this period, the ROC Electronics Maintenance Technician Lead spent a considerable amount of time in the radome observing the behavior of the antenna/pedestal assembly.

During the second test event (Jun 28, 2013), the SAILSx3 VCP was executed for approximately 1 1/2 hours on KOUN. For this demonstration, a ROC Radar Hardware Engineer reviewed the SAILSx3 VCP definition and accompanied the ROC Electronics Maintenance Technician Lead into the radome to observe and inspect the antenna/pedestal assembly.

Calculated antenna elevation and acceleration/deceleration rates required to execute the additional SAILS elevations within VCP 12 and 212 are all well within the design and performance specifications of the antenna/pedestal assembly and pose no increased risk to the operational fleet (For additional information, please refer to the test report: Initial\_MESO-SAILS\_Test\_Report\_July\_2013.docx).

**Table 1: SAILS Test VCP Definitions**

Elevation Angles (VCP 12)	VCP 12 Elevation Duration	SAILS	SAILSx2	SAILSx3
0.5°	31 Sec	31 Sec	31 Sec	31 Sec
0.9°	31 Sec	31 Sec	31 Sec	31 Sec
1.3°	31 Sec	31 Sec	31 Sec	31 Sec
0.5°				31 Sec
1.8°	15 Sec	15 Sec	15 Sec	15 Sec
0.5°			31 Sec	
2.4°	14 Sec	14 Sec	14 Sec	14 Sec
3.1°	14 Sec	14 Sec	14 Sec	14 Sec
0.5°		31 Sec		
4.0°	14 Sec	14 Sec	14 Sec	14 Sec
0.5°				31 Sec
5.1°	14 Sec	14 Sec	14 Sec	14 Sec
6.4°	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec	
8.0°	13 Sec	13 Sec	13 Sec	13 Sec
0.5°				31 Sec
10.0°	13 Sec	13 Sec	13 Sec	13 Sec
12.5°	13 Sec	13 Sec	13 Sec	13 Sec
15.6°	13 Sec	13 Sec	13 Sec	13 Sec
19.5°	13 Sec	13 Sec	13 Sec	13 Sec
Duration	243 Sec	274 Sec	305 Sec	336 Sec
0.5 Elevation Update Times	253 Sec*	136 Sec, and 148 Sec*	108 Sec, 101 Sec and 106 Sec*	93 Sec, 88 Sec, 72 Sec and 93 Sec*
		Avg 147** Sec	Avg 108** Sec	Avg 89** Sec
* 10 seconds were added to account for Retrace Time    ** The Avg estimate includes 20 seconds to account for Retrace and Elevation Transition times				

Implementation: The MESO-SAILS function adds the Multiple Elevation option to the original SAILS design enabling the operator to choose the number of low-level scans (1,2,3 or 4) available for each volume scan. The tables below show the insertion points for SAILSx2 and SAILSx3 for each of the available AVSET termination angles for VCP 12. (NOTE: The SAILS

elevation scans are **RED** in the table.) Additionally, the low-level product update times are also provided for each AVSET termination angle.

### MESO-SAILS x2 with AVSET

Elevation Angles (VCP 12)	VCP 12 Elevation Duration	Term Angle 19.5	AVSET Term Angle 15.6	AVSET Term Angle 12.5	AVSET Term Angle 10.0	AVSET Term Angle 8.0	AVSET Term Angle 6.4
0.5°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.9°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°							31 Sec
1.3°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°		31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	
1.8°	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec
2.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°							31 Sec
3.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°						31 Sec	
4.0°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°				31 Sec	31 Sec		
5.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec				
6.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°		31 Sec					
8.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	
10.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec		
12.5°	13 Sec	13 Sec	13 Sec	13 Sec			
15.6°	13 Sec	13 Sec	13 Sec				
19.5°	13 Sec	13 Sec					
Duration	245 Sec	305 Sec	292 Sec	279 Sec	266 Sec	253 Sec	240 Sec
0.5 Elevation Update Times	243 Sec	93 Sec, 116 Sec, and 106 Sec*	93 Sec, 102 Sec and 107 Sec*	93 Sec, 88 and 108 Sec*	93 Sec, 88 Sec and 95 Sec*	93 Sec, 74 Sec and 96 Sec*	62 Sec, 91 Sec and 97 Sec*
		Avg 108 Sec	Avg 104 Sec	Avg 100 Sec	Avg 96 Sec	Avg 90 Sec	Avg 84 Sec
* ~10 Seconds Added to Account for Retrace Time. Avg estimate includes 10 additional seconds to account for elevation transition time							

Table 2: SAILSx2 with AVSET

### MESO-SAILS x3 with AVSET

Elevation Angles (VCP 12)	VCP 12 Elevation Duration	Term Angle 19.5	AVSET Term Angle 15.6	AVSET Term Angle 12.5	AVSET Term Angle 10.0	AVSET Term Angle 8.0	AVSET Term Angle 6.4
0.5°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.9°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°				31 Sec	31 Sec	31 Sec	31 Sec
1.3°	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec	31 Sec
0.5°		31 Sec	31 Sec				31 Sec
1.8°	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec	15 Sec
0.5°						31 Sec	
2.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec	31 Sec	31 Sec		
3.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°		31 Sec					31 Sec
4.0°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°						31 Sec	
5.1°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°				31 Sec	31 Sec		
6.4°	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec	14 Sec
0.5°			31 Sec				
8.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec	
0.5°		31 Sec					
10.0°	13 Sec	13 Sec	13 Sec	13 Sec	13 Sec		
12.5°	13 Sec	13 Sec	13 Sec	13 Sec			
15.6°	13 Sec	13 Sec	13 Sec				
19.5°	13 Sec	13 Sec					
Duration	243 Sec	336 Sec	323 Sec	310 Sec	297 Sec	284 Sec	271 Sec
0.5 Elevation Update Times	243 Sec	93 Sec, 74 Sec, 86 Sec and 93 Sec*	93 Sec, 60 Sec, 87 Sec and 93 Sec*	62 Sec, 91 Sec, 73 Sec and 94 Sec*	62 Sec, 91 Sec, 73 Sec and 81 Sec*	62 Sec, 77 Sec, 73 Sec and 82 Sec*	62 Sec, 62 Sec, 74 Sec and 83 Sec*
		Avg 89 Sec	Avg 86 Sec	Avg 83 Sec	Avg 79 Sec	Avg 76 Sec	Avg 73 Sec
* 10 Seconds Added to Account for Retrace Time. Avg estimate includes 10 additional seconds to account for elevation transition time							

Table 3: SAILSx3 with AVSET

The number of supplemental elevations will be controlled via GUI by selecting the corresponding radio button. Changes to the number of SAILS elevations will take effect at the beginning of the next volume scan.

**Benefits:** The Multiple Elevation Scan Option for SAILS provides the operator with the flexibility to select either 1 (SAILS off), 2, 3 or 4 low-level data updates per volume scan. This flexibility combined with the option to enable AVSET results in significant improvement in low-level data availability. The table below provides the expected frequency of low-level scan updates per hour when AVSET, SAILS, MESO-SAILS, or a combination of those techniques are employed. (NOTE: As the frequency of low-level scans increases, the number of full volume updates per hour decreases.)

VCP 12	Number of 0.5° Base Product Updates per Hour	Volume Product Updates per Hour
Standard Operation	14	14
AVSET	14 - 19	14 - 19
SAILS	24	12
AVSET and SAILS	24 - 32	12 - 16
AVSET and MESO-SAILS	40 - 50	10 - 13