SLC Production and Final Products Distribution Functional Requirements Document for the Modified Antarctic Mapping Mission

April 20, 2001

ASF-00-REQ001-2.12, SLC Production and Final Products Distribution Functional Requirements Document

RHM

Signature Page

SLC Production and Final Products Distribution Functional Requirements Document

Approved by:

_____ _____

Dr. Verne Kaupp **Date**
ASF Project Director / Chief Scientist

Concurrence:

Alaska SAR Facility

_____

Dr. Nettie LaBelle-Hamer
Science Center Manager

_____

Carel W. Lane Jr.
Operations Center Manager

_____

Jamie Marschner
Engineering Center Manager

_____

Larry Ledlow
Project Systems Engineer

Byrd Polar Research Center

_____

Dr. Ken Jezek
Professor, Byrd Polar Research Center

Vexcel Corporation

_____

Richard Carande
RAMS Program Manager

Prepared by:
Richard Marlin
Principal Systems Engineer

1.0 INTRODUCTION

1.1 Identification of Document

This document defines the ASF requirements to support the RADARSAT Antarctic Mapping Project (RAMP), specifically, ASF requirements for the Modified Antarctic Mapping Mission (MAMM) Single Look Complex (SLC) product production and distribution.

1.2 Scope of Document

This document does not include requirements for MAMM data acquisition or processing/testing during acquisition. It does include updated processor calibration, Level-zero processing, and SLC processing requirements. Also included are requirements regarding data distribution and archiving.

This document reflects requirements for a custom processing system engineered exclusively for generating custom products acquired for the MAMM mission.

1.3 Purpose and Objectives of Document

This document is to provide the MAMM project with a requirement specification for the processing of MAMM SLC products. OSU will use the SLC products created by ASF, as specified by this document to produce maps of Antarctica. Also in this specification are the requirements for ASF's distribution of final products to authorized users.

1.4 Document Statuses and Schedule

ASF shall update this document as science and operational requirements change. It is the responsibility of the ASF to maintain this document. This document will be under configuration control from the date of initial approval. ASF shall coordinate all revisions and releases of this document. The signature page includes a list of signatories with approval authority.

Document Log

Date	Status	Version
02/20/2000	Initial Draft	0.1
03/15/2000	Draft Release	0.5
05/05/2000	Rewrite and update	0.9
06/22/2000	Release version	1.0

2.0 RELATED DOCUMENTATION

The following documents contain policies, standards, procedures, and formats that are requirements for all project activities. The most recent version of the documents referenced below shall be governing unless specific issue dates are noted.

2.1 Parent Documents

[01.] ASF-00-REQ001-0.9 Modified Antarctic Mapping Mission, ASF Functional Requirements Document, June 22, 2000
[02.] Antarctic Mapping Mission – 2, RADARSAT-1 Antarctic Mapping Project, Science Requirements Document, Byrd Polar Research Center

2.2 Applicable Documents

[03.] RADARSAT Antarctic Mapping System 2 (RAMS-2), Functional Requirements Document, Vexcel Corporation
[04.] ASF-00-CAL120-1.0 Alaska SAR Facility, RADARSAT Modified Antarctic Mapping Mission Calibration Plan
[05.] CDRL No. IS-3 RADARSAT Canadian Data Processing Facility (CDPF) Product Specification, MacDonald Dettwiler
[06.] NASA NPG 2810.1 NASA Procedures and Guide lines
[07.] IEEE-STD-610.12 *IEEE Standard Glossary of Software Engineering Terminology*

2.3 Information Documents

The following documents provide guidance that will assist all participants in complying with Project requirements identified by this Functional Requirements Document.

- NASA-STD-2201-93 *Software Assurance Standard*, November 10, 1992

- ANSI-EIA-632-1999 *Processes for Engineering a System, 1999*
- NASA-STD-2100-91 *Software Documentation Standard*, July 29, 1991.

3.0 REQUIREMENTS APPROACH AND TRADEOFFS

3.1 Requirements Approach

The parent of this document is ASF's MAMM ASF Functional Requirements Document Version 1.0. Vexcel's RADARSAT Antarctica Mapping System 2, Functional Requirements Document is a peer document. The requirements are also the result of discussion, meetings and Telecons held at ASF during MAMM data acquisition and shortly thereafter.

This document contains ASF requirements for the period after MAMM data acquisition namely validation and calibration of Vexcel's FOCUS processor, production of all MAMM products and their distribution.

4.0 EXTERNAL INTERFACE REQUIREMENTS

4.1 ASF to OSU Interface

4.1.1 ASF shall provide OSU with a list of MAMM datatakes.

4.1.1.1 ASF shall provide OSU a Job Identifier for each datatake.

4.1.1.2 ASF shall provide OSU the Satellite Revolution Number for each datatake.

4.1.1.3 ASF shall provide OSU the Beam Mode for each datatake.

4.1.1.4 ASF shall provide OSU the Sequence Number of each datatake.

4.1.1.5 ASF shall provide OSU the ASF Frame Numbers for each datatake.

4.1.2 ASF shall accept MAMM datatake orders starting March 1, 2001.

4.1.3 ASF shall provide preliminary ancillary files to OSU for each MAMM datatake. [1]

4.1.3.1 ASF shall provide Vexcel Level-zero STF granule parameter ("par") files for each datatake ordered by OSU by FTP.

4.1.3.2 ASF shall provide Vexcel Level-zero STF tagged image file format (“tif”) files for each datatake ordered by OSU by FTP.

4.1.3.3 ASF shall provide Vexcel a “par” file for each “tif” file

4.1.4 ASF shall receive ancillary files for each datatake ordered by OSU.

4.1.4.1 ASF shall receive updated ancillary files from OSU via FTP.

4.1.4.1.1 ASF shall receive modified Vexcel Level-zero STF granule parameter (“par”) files for each datatake ordered by OSU.

4.1.4.1.2 ASF shall receive MAMM-specific Level-zero STF “chop” files for each datatake ordered by OSU.

4.1.5 ASF shall ship completed SLC products to OSU on DLT tapes.

4.1.5.1 ASF shall label the SLC data tapes with the order number.

4.1.5.2 ASF shall label the SLC data tapes with the SLC basenames as included in the “chop” file.

5.0 REQUIRMENTS SPECIFICATION

5.1 Processing and Data Requirements

5.1.1 ASF shall scan telemetry tapes from all mission downlink sites to produce Scan Results Files. [2]

5.1.1.1 ASF shall provide OSU a list of datatakes from all mission dowlink sites based on the Scan Results files.

5.1.1.1.1 The list shall include the datatake Revolution.

5.1.1.1.2 The list shall include the datatake Sequence number.

5.1.1.1.3 The list shall include the datatake Beam Mode.

5.1.1.1.4 The list shall include the number of the first ASF frame covered by the datatake.

5.1.1.1.5 The list shall include the number of the last ASF frame covered by the datatake.

5.1.1.1.6 The list shall include Job Identification numbers set by ASF.

5.1.1.2 ASF shall enter into the catalog all MAMM metadata.

5.1.2 ASF shall process, at the request of OSU, MAMM datatakes to produce a Vexcel format Level-zero STF granule.

5.1.2.1 A data granule shall include a binary data file.

5.1.2.2 A data granule shall include a “tif” quicklook image.

5.1.2.3 A data granule shall include metadata files.

5.1.2.3.1 ASF shall include a “par” file for the “tif” (quicklook) image in the data granules.

5.1.2.3.2 ASF shall include a “par” file for the binary data file in the data granules.

5.1.2.4 ASF shall provide Level-zero metadata files to OSU starting on or before May 16, 2001.

5.1.2.5 ASF shall complete sending Level-zero metadata files to OSU on or before February 1, 2002.

5.1.3 ASF shall process MAMM data to Vexcel’s Level-one SLC products per specification defined in Vexcel’s RAMS-2 FRD [3].

5.1.3.1 ASF SAR granules shall have, meet or exceed the following image characteristics:

Image Quality Metric	**SLC**
Radiometric Error*	0.1 dB
Radiometric Linearity*	0.97
Absolute Location Accuracy*	40 m
Geometric Distortion*	30 m
Phase Error (relative)	10 deg.

(*) Excluding ephemeris and terrain effects

5.1.3.2 ASF shall produce SAR imagery with a SLC Doppler bandwidth specified in the chop file provided by OSU.

5.1.3.3 ASF shall be capable of producing SLC products using a Doppler bandwidth up to 1200hz.

5.1.3.4 ASF shall use the most current version of “chop” files modified by OSU in the SLC processing of MAMM swaths.

5.1.3.5 ASF shall use the most current version of “par” files modified by OSU in the SLC processing of MAMM swaths.

5.1.3.6 ASF shall process SLC images at an average rate of 30 datatakes per day.

5.1.3.7 ASF shall produce SAR imagery using the elevation correction specified in the “chop” file.

5.1.3.8 ASF shall produce SAR imagery using the scene size specified in the “chop” file.

5.1.3.9 ASF shall name SAR imagery using the name specified in the “chop” file.

5.1.3.10 ASF shall complete processing of RADARSAT F1 beam data by November 15, 2001.

5.1.3.11 ASF shall complete all SLC processing by March 1, 2002.

5.1.4 ASF shall provide SLC products to OSU.

5.1.4.1 ASF shall provide SLC products to OSU on DLT media.

5.1.4.2 ASF shall TAR data files onto media

5.1.4.3 ASF shall provide SLC data files in a CEOS format, as per CDPF Product specification No. IS-3. [5]

5.1.4.4 ASF shall provide complex data that is in the “natural” SAR order of increasing fast time (range); i.e. not flipped in range.

5.1.4.5 ASF shall provide Complex data that is in order of increasing slow time (azimuth); i.e., not flipped in azimuth.

5.1.4.6 ASF shall ship SLC scenes to OSU starting May 23,2001

5.2 Data Archiving and Distribution Requirements

5.2.1 ASF shall provide an interface to allow OSU to order MAMM SLC products.

5.2.2 ASF shall maintain a MAMM data archive.

5.2.2.1 ASF shall maintain an archive of MAMM Level-zero data including its metadata.

5.2.2.2 ASF shall maintain the MAMM Level-zero data archive for at least 5 years from the last day of MAMM production.

5.2.2.3 ASF shall maintain an archive of MAMM Level-one data including its metadata.

5.2.2.4 ASF shall maintain an archive of MAMM Level-one data for five years from the last day of MAMM production.

5.2.2.5 ASF shall archive data processing files received from OSU until ASF has completed all MAMM SLC processing.

5.2.2.5.1 ASF shall archive the “par” files sent to OSU by ASF.

5.2.2.5.2 ASF shall archive modified “par” files received by ASF from OSU.

5.2.2.5.3 ASF shall archive “chop” files received by ASF from OSU.

5.2.2.5.4 ASF shall archive the “tif” files received by ASF from OSU.

5.2.2.6 ASF shall archive MAMM Level 2 products for at least five years.

5.2.3 ASF shall provide an archive of MAMM software and its associated documentation.

5.2.3.1 ASF shall archive all ASF produced software to support MAMM calibration for at least 5 years after responsible parties sign the controlling documents.

5.2.3.2 ASF shall archive all ASF produced software to support MAMM data acquisition for at least 5 years after responsible parties sign the controlling documents.

5.2.3.3 ASF shall archive all software produced to support MAMM production for at least 5 years after responsible parties sign the controlling documents.

5.2.3.4 ASF shall archive all documentation produced to support MAMM for at least 5 years after signing by responsible parties.

5.3 Performance and Quality Engineering Requirements

5.3.1 ASF shall supply Vexcel suitable test data that meets the specifications described in this document and the ASF MAMM-Mission Calibration plan [4].

5.3.1.1 ASF shall supply Vexcel un-calibrated IFSAR pairs of all primary SAR modes to Vexcel by March 1, 2001.

5.3.1.1.1 ASF shall supply Vexcel un-calibrated IFSAR pairs on DLT media in TAR format.

5.3.1.1.2 ASF shall provide Vexcel un-calibrated IFSAR pairs of RADARSAT data taken over the ice-covered regions of Antarctica.

5.3.1.1.3 ASF shall provide Vexcel un-calibrated IFSAR pairs of RADARSAT data in ASF standard frame sizes.

5.3.1.1.4 ASF shall supply Vexcel one IFSAR pair of RADARSAT Extended Low beam one (EL1) data.

5.3.1.1.5 ASF shall supply Vexcel one IFSAR pair of RADARSAT Standard beam one (ST1) data.

5.3.1.1.6 ASF shall supply Vexcel one IFSAR pair of RADARSAT Standard beam two (ST2) data.

5.3.1.1.7 ASF shall supply Vexcel three overlapping IFSAR pairs of RADARSAT Standard beam six (ST6) data.

5.3.1.1.8 ASF shall supply Vexcel one IFSAR pair of RADARSAT Fine beam one (FN1) data.

5.3.1.1.9 ASF shall supply Vexcel one SLC image of RADARSAT Standard beam three (ST3) data.

5.3.1.1.10 ASF shall supply Vexcel one SLC image of RADARSAT Standard beam four (ST4) data.

5.3.1.1.11 ASF shall supply Vexcel one SLC image of RADARSAT Standard beam six (ST6) data.

5.3.1.1.12 ASF shall supply Vexcel one SLC image of RADARSAT Standard beam seven (ST7) data.

5.3.2 ASF shall provide Vexcel SLC images of the Delta Junction Calibration sites in each of the MAMM Beam modes. [3]

5.3.3 ASF shall produce MAMM SLC images that meet or exceeds RSI specifications for data quality [3]

5.3.3.1 ASF shall complete the initial calibration (for the data quality review) March 23, 2001.

5.3.3.2 ASF shall provide Vexcel calibrated test data, as per Calibration Plan. [4]

5.3.3.3 ASF shall provide OSU calibrated test data, as per Calibration Plan. [4]

5.3.3.4 ASF shall calibrate processors used for MAMM production by September 25, 2001.

5.3.3.5 ASF shall produce calibrated SLC products with the following characteristics [3]:

IR PARAMETER	ST1	ST2	ST6	EL	F1
Slant Range Resolution (m)	11.9	11.9	17.7	11.9	6.8
Azimuth Resolution (m)	11.0	11.0	11.0	11.0	11.0
PSLR (dB)	-18	-18	-18	-18	-18
ISLR (dB)	-13	-13	-13	-13	-13

5.3.3.6 MAMM SAR imagery shall be radiometrically calibrated to +/- 1 dB relative.

5.3.3.7 MAMM SAR imagery shall be radiometrically calibrated to +/- 2 db absolute.

5.3.4 ASF shall write an updated calibration plan for MAMM [4] by April 20, 2001.

5.3.4.1 ASF shall update the calibration specifications.

5.3.4.2 ASF shall update the calibration data acquisition plans.

5.3.4.3 ASF shall update the calibration algorithms.

5.3.4.4 ASF shall update the calibration schedule.

5.3.5 ASF shall conduct an internal Data Quality Review before starting SLC production.

5.3.6 ASF shall write MAMM Calibration Lessons Learned document by 60 days after calibrations are complete.

5.3.7 ASF shall archive MAMM calibration documentation for at least 5 years.

5.3.8 ASF shall process all MAMM data one time through before attempting to recover datatakes that have data errors.

5.4 Safety Requirements

5.4.1 ASF shall physically insolate the MAMM production system from all but authorized

operators.

5.4.2 ASF shall implement polices and procedures to deter unauthorized users from accessing the MAMM production system.

5.4.3 MAMM production systems shall not pose environmental, electrical or physical hazards to ASF systems or personnel.

5.5 Security and Privacy Requirements

5.5.1 ASF shall provide system security as spelled out in NASA NPG 2810.1 [6].

5.5.2 ASF shall adhere to ASF security policy in the development and documentation of the MAMM production and distribution system.

5.6 Implementation Constraints

5.6.1 ASF shall not interrupt or constrain normal data acquisition activities to perform MAMM data processing.

5.6.2 ASF shall not interrupt or constrain normal processing activities to perform MAMM data production.

5.6.2 ASF shall use existing operational personnel to operate systems pertaining to MAMM processing.

5.6.3 ASF shall process all MAMM data using only one version of the SLC processing software.

5.6.4 ASF shall process all MAMM data using only one version of the Level-zero processing software.

5.7 Site Adaptation

5.7.1 ASF shall provide a MAMM production environment.

5.7.1.1 ASF shall provide space for MAMM production equipment and system.

5.7.1.2 ASF shall provide space for a MAMM production operator.

5.7.1.3 ASF shall provide electrical power for MAMM processors.

5.7.1.4 ASF shall provide environmental conditioning for the MAMM production system.

5.7.1.5 ASF shall provide noise suppression for the MAMM production system.

5.7.2 ASF shall update its storage silo for use in MAMM production.

5.7.2.1 ASF shall update the AMASS software to the most current version as of April 1, 2001.

5.7.2.2 ASF shall update the silo-associated computer operating systems to the most current version as of April 1, 2001.

5.7.2.3 ASF shall verify that there is sufficient silo media to support MAMM data production.

5.8 Design Goals

5.8.1 ASF will design a MAMM production system that uses existing hardware and software components, to the maximum extent practicable.

5.8.2 ASF will develop software for MAMM in such a way that ASF can reuse it for other projects.

5.8.2 ASF will take advantage of this opportunity to develop new capabilities for its production system.

6.0 ABBREVIATIONS AND ACRONYMS

ASF – Alaska SAR Facility

MAMM – Modified Antarctic Mapping Mission

N/A - Not Applicable

NASA - National Aeronautics and Space Administration

OSU - Ohio State University

QA - Quality Assurance

SAR – Synthetic Aperture RADAR

SRF – Scan Results File

STD - Standard

TBD - To Be Determined (at a later date)

7.0 GLOSSARY

For terms not appearing in this glossary, refer to the *IEEE Standard Glossary of Software Engineering Terminology* [7]

8.0 NOTES

None

8.0 APPENDICES

TBD