

**NOAA NESDIS**

**CENTER for SATELLITE APPLICATIONS and RESEARCH**

**The NetCDF4 Reformatting Toolkit**

**REQUIREMENTS ALLOCATION DOCUMENT**

**Version 1.3**

Title: The NetCDF4 Reformatting Toolkit (N4RT)

Requirements allocation document

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NETCDF4 reformatting toolkit PROJECT

REQUIREMENTS ALLOCATION DOCUMENT

Version History SUMMARY

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# INTRODUCTION

NOAA’s National Environmental Satellite Data Information System (NESDIS) will provide Joint Polar Satellite System (JPSS) data to the civil user community. The JPSS Interface Data Processing Segment (IDPS) will provide NESDIS with satellite data records in Hierarchical Data Format v 5 (HDF5). Only a few satellite users have experience with HDF data and no one has transitioned to HDF5. The National Polar Orbiting Satellite System (NPOESS) Data Exploitation (NDE) project will develop a tool that takes HDF5 data and reformats it into Network Common Data Form version 4 (NetCDF4) format. NDE and NESDIS/STAR will develop reformatting tools that will take NetCDF4 data without manipulation of the data and reformat it into data that will make it easier for users to ingest and exploit the JPSS data. NESDIS will also develop reformatting tools that will take NOAA-unique products (NUP) data in NetCDF4 without manipulation of the data and reformat it into data that will make it easier for the users to ingest and exploit the NUP data.

This document describes the requirements for a NetCDF4 reformatting toolkit. These requirements define the capabilities to be delivered by the project, the basis for assessments during the development period, and the baseline for determining whether the project achieves its ultimate operational goals.

## Objective

The RAD defines the basic and derived requirements for the work products and the allocation of the requirements to system components and product components. The intended target users are customers, product users, requirements reviewers, design reviewers and project managers.

## Background

This is the second version of the NetCdF4 Reformatting Toolkit (N4RT) RAD. This version is labeled v2.0. It was updated from version 1.0 for Critical Design Review (CDR).

The responsible entity for storage, accessibility and distribution of this document is the Operational Products Development Branch (OPDB) of the NESDIS Center for Satellite Applications and Research (STAR) Satellite Meteorology and Climatology Division (SMCD).

## Overview

This document contains the following sections:

Section 1.0 - Introduction

Section 2.0 - Requirements Identification

Section 3.0 - Requirements Allocation

Section 4.0 - Requirements Quality Assurance

Section 5.0 - List of References

# REQUIREMENTS IDENTIFICATION

This section presents the formal set of requirements for the N4RT project.

## 2.1 Requirements Identification Overview

* Basic requirements were identified from the SPSRB Requirements which were given to the N4RT developers in a document entitled: “Level 1 Requirements for a NetCDF4 Reformatting Tool”. The additional requirements were obtained in a series of meetings between the N4RT developers, EMC (the customer) and the heritage product teams.

Requirements are presented by paragraphs of text, including a requirements header and text paragraphs. Requirements are classified by following categories:

* **Process Requirements**: Requirements on the process to be followed by the project.
* **Product Requirements**: Requirements on product content, performance, operational production, and end use.
* **System Requirements**: System component characteristics, interfaces and dependencies (e.g., code, test data, production environments and platforms).
  + - **Operational requirements** – state “under what conditions” a function must be available or performable and address how the product will serve the users.
    - **Functional requirements** – address what the product must do to satisfy the operational requirements and define the necessary tasks, actions, or activities that must be accomplished.

The format for Requirements identification is as follows:

|  |
| --- |
| Requirements ID  Text paragraph |

The requirement ID is in the form:

<N4RT>-<a.b.c>-<number>, followed by text paragraph(s), where

<a.b.c> corresponds to the subsection number in which the requirement is contained.

<number> is a sequential number for the requirement.

## 2.2 Stakeholders

The NOAA Environmental Modeling Center (EMC) will be the primary United States user of the tailored products.

The Department of Defense Naval Research Lab (NRL) will be a United States user of these products.

The Department of Defense Fleet Numerical Meteorology and Oceanographic Center (FNMOC) is a United States user.

The NASA Global Modeling and Assimilation Office (GMAO) will be a United States user of these tailored products.

The European Organization for the Exploitation of Satellites (EUMETSAT) will be an international user of these tailored products.

The United Kingdom Meteorological Office (UK Met) will be an international user of these tailored products.

The NDE project will build the system in which the N4RT software operates.

The NOAA Offices of Operational Satellite Data Processing and Distribution (OSDPD) will run the system NDE builds operationally.

The NOAA Office of Systems Development (OSD) is funding this project.

## 2.3 Requirements

2.3.1 Basic Requirement 1.0 (System Functional)

N4RT-2.3.1-1.0

*STAR shall deliver to NDE a reformatting toolkit capable of translating NESDIS NetCDF4 data products into NCEP-accepted data formats (i.e., BUFR and/or GRIB2).*

2.3.1.1 Derived Requirement 1.1

N4RT-2.3.1.1-1.1

*The toolkit shall be capable of reformatting the NPP tailoring prioritized phase 1 product list.*

2.3.1.2 Derived Requirement 1.2

N4RT-2.3.1.2-1.2

*The toolkit shall provide its capabilities such that it may be run automatically within an operational system, especially within the NDE environment.*

2.3.1.2.1 Derived Requirement 1.2.1

N4RT-2.3.1.2.1-1.2.1

*The Toolkit shall compile and run on the NDE IBM AIX P5, P6, and P7 series hardware.*

2.3.1.2.2 Derived Requirement 1.2.2

N4RT-2.3.1.2.2-1.2.2

*The Tool shall interact with the NDE Data Handling System (DHS).*

* + - * 1. Derived Requirement 1.2.2.1

N4RT-2.3.1.2.2.1-1.2.2.1

*The Toolkit shall be able to read a Production Control File (PCF).*

2.3.1.2.4 Derived Requirement 1.2.2.2

N4RT-2.3.1.2.2.2-1.2.2.2

*The Toolkit shall handle and return errors according to NDE/STAR standard codes.*

* + - * 1. Derived Requirement 1.2.2.3

N4RT-2.3.1.2.2.3-1.2.2.3

*The Toolkit shall be able to write a PSF.*

2.3.1.3 Derived Requirement 1.3

N4RT -2.3.1.3-1.3

*The toolkit shall consist of modular components that can be tested independently.*

2.3.1.3.1 Derived Requirement 1.3.1

N4RT-2.3.1.3.1-1.3.1

*The code shall consist of a single compiled program that parses arguments and logically assigns tasks to a family of hierarchically structured tailoring subroutines.*

* + - * 1. Derived Requirement 1.3.2

N4RT-2.3.1.3.2-1.3.2

*Data shall be stored in allocatable data structures.*

* + - 1. Derived Requirement 1.4

N4RT-2.3.1.4-1.4

*STAR shall include one update to the reformatting toolkit within its initial project plan****.***

* + - 1. Derived Requirement 1.5

N4RT-2.3.1.5-1.5

*STAR shall propose additional updates to the reformatting toolkit at a future Annual Review for Satellite Product Development that will address the NDE Phase 2 products.*

* + - 1. Derived Requirement 1.6

N4RT-2.3.1.6-1.6

*STAR shall use the standard set of NCEP software libraries for BUFR and GRIB2 in the reformatting toolkit.*

* + - 1. Derived Requirement 1.7

N4RT-2.3.1.7-1.7

*STAR shall update the reformatting toolkit when NCEP updates its BUFR and GRIB2 libraries.*

* + - * 1. Derived Requirement 1.7.1

N4RT-2.3.1.7.1-1.7.1

*Updates shall be made when there are updates to the versions of the netCDF4 library being used by NDE.*

* + - 1. Derived Requirement 1.8

N4RT-2.3.1.8-1.8

*STAR shall coordinate with the NDE Project before proposing any enhancements to add other standard format translations to the toolkit at the Annual Review for Satellite Product Development.*

* + - 1. Derived Requirement 1.9

N4RT-2.3.1.9-1.9

*The output from the toolkit shall be compared with the input to verify that the conversion was performed correctly.*

* + - 1. Derived Requirement 1.10

N4RT-2.3.1.10-1.10

*The translation toolkit shall convert from the new format back into NetCDF4.*

* + - 1. Derived Requirement 1.11

N4RT-2.3.1.11-1.11

*The reformatting software shall log each transaction’s control information, including: the calling application, the type of transaction requested, the start and end times, and completion status codes*

* + - * 1. Derived Requirement 1.11*.*1

N4RT-2.3.1.11.1-1.11.1

*The Reformatting Toolkit software shall generate run logs and return NDE/STAR standard (agreed upon) error codes to the DHS.*

* + - 1. Derived Requirement 1.12

N4RT-2.3.1.12-1.12

*Applications running under either Linux or AIX Operating Systems shall be able to provide the reformatting toolkit data and be able to accept the data from the toolkit for further processing (e.g., dissemination).*

* + - 1. Derived Requirement 1.13

N4RT-2.3.1.13-1.13

*The toolkit parameters (e.g., how to use the service) shall be well documented.*

* + - * 1. Derived Requirement 1.13.1

N4RT-2.3.1.13.1-1.13.1

*Reformatting Toolkit Developers shall provide documentation in the form of a tailored Delivered Algorithm Package (DAP) whose name and contents are defined in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + - * 1. Derived Requirement 1.13.2

N4RT-2.3.1.13.2-1.13.2

*The DAP shall contain the following two SPSRB documents: the SMM (System Maintenance Manual) and the EUM (External Users Manual).*

* + - 1. Derived Requirement 1.14

N4RT-2.3.1.14-1.14

*The messages provided by the toolkit in the event of failure to perform a requested service shall be comprehensible by untrained operators.*

* + - * 1. Derived Requirement 1.14.1

N4RT-2.3.1.14.1-1.14.1

*Reformatting Toolkit shall use the standard set of error return codes developed by NDE for code running with the DHS.*

* + - 1. Derived Requirement 1.15

N4RT-2.3.1.15-1.15

*The messages provided by the toolkit in the event of failure to perform a requested service shall include diagnostic details needed for troubleshooting.*

* + - * 1. Derived Requirement 1.15.1

N4RT-2.3.1.15.1-1.15.1

*All messages shall be directed to a run log file. These messages shall be documented in the N4RT tailored DAP.*

* + - 1. Derived Requirement 1.16

N4RT-2.3.1.16-1.16

*STAR shall coordinate development of the reformatting toolkit Application Program Interface with the NDE contractors and assist the NDE contractors with the integration of the toolkit within each of the environments of the NDE processing system.*

* + - 1. Derived Requirement 1.17

N4RT-2.3.1.17-1.17

*Toolkit code shall adhere to the SPSRB coding standards.*

* + - 1. Derived Requirement 1.18

N4RT-2.3.1.18-1.18

*Performance shall be measured on a product level.*

* + - 1. Derived Requirement 1.19

N4RT-2.3.1.19-1.19

*The Toolkit shall output BUFR files whose names adhere to the NDE file naming convention in “Algorithm Delivery Standards, Integration, and Test”.*

2.3.2 Basic requirement 2.0 (Program Requirement).

N4RT-2.3.2-2.0

*STAR shall provide monthly project status reports to OSPO and OSD.*

2.3.3 Basic Requirement 3.0 (Program Requirement).

N4RT-2.3.3-3.0

*Earned Value Management shall be performed on the project.*

2.3.4 Basic Requirement 4.0 (Program Requirement)

N4RT-2.3.4-4.0

*STAR shall update the project plan on an annual basis and submit it to the Annual Review of Satellite Product Development for funding consideration.*

2.3.5 Basic Requirement 5.0 (Program Requirement)

N4RT-2.3.5-5.0

*The toolkit shall be implemented and tested six months before the NPP launch to ensure NDE readiness.*

* + 1. Basic Requirement 6.0 (Product Requirement)

N4RT-2.3.6-6.0

*The Reformatting Toolkit shall tailor the NUCAPS thinned CrIS Radiances from netCDF4 into BUFR for EMC and EUMETSAT.*

2.3.6.1 Derived Requirement 6.1

*N4RT-2.3.6.1-6.1*

*The Reformatting Toolkit developers shall work with EMC and the rest of the NWP community to create a BUFR table for the NUCAPS thinned and full resolution radiances based on AIRS and IASI.*

* + - 1. Derived Requirement 6.2

N4RT-2.3.6.2-6.2

*The table shall use delayed replication for storing the radiances.*

* + - 1. Derived Requirement 6.3

N4RT-2.3.6.3-6.3

*BUFR messages shall be smaller than 50KB. (Removed: this is no longer a limitation of the BUFRLIB)*

* + - 1. Derived Requirement 6.4

N4RT-2.3.6.4-6.4

*The BUFR format shall allow for the storage of negative radiances.*

* + - 1. Derived Requirement 6.5

N4RT-2.3.6.5-6.5

*The file shall contain the following data fields:*

*Satellite ID*

*ID of Originating Center*

*Satellite Instrument*

*Satellite Classification*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Location of Platform*

*Latitude*

*Longitude*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*Ascending/Descending flag*

*Scan Line Number*

*Field of Regard*

*Field of View*

*Orbit Number*

*Height of Land Surface*

*Satellite Height*

*Land Fraction*

*Land/Sea Qualifier*

*Cloud Cover*

*Height of Cloud Top*

*Radiance Type Flags*

*Scan-Level Quality Flags*

*Type of Band*

*Starting Wavenumber (per band)*

*Ending Wavenumber (per band)*

*Start Channel (per band)*

*End Channel (per band)*

*Calibration Quality Flags*

*Field of View Quality Flags*

*Geolocation Quality*

*NUCAPS Quality*

*Channel Radiance*

*In dir. of North Pole, distance from the Earth's center*

*In direction of 0 deg E, distance from Earth's center*

*In direction of 90 deg E, distance from Earth's center*

* + - 1. Derived Requirement 6.6

N4RT-2.3.6.6-6.6

*The reformatting Toolkit shall use the thinned CrIS radiances (399 channels) files from NUCAPS as an input for generating the CrIS radiance BUFR files for EMC.*

* + - 1. Derived Requirement 6.7

N4RT-2.3.6.7-6.7

*The reformatting Toolkit shall use the full spatial and spectral resolution CrIS radiances (1305 channels and all FOVs on all FORs) files from NUCAPS as an input for generating the CrIS radiance BUFR files for EUMETSAT.*

* + - 1. Derived Requirement 6.8

N4RT-2.3.6.8-6.8

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 7.0 (Product Requirement).

N4RT-2.3.7-7.0

*The Reformatting Toolkit shall tailor the JPSS ATMS SDR and TDR data from netCDF4 into BUFR for EMC.*

2.3.7.1 Derived Requirement 7.1

N4RT-2.3.7.1-7.1

*The ATMS BUFR file shall contain, from all channels, the antenna and brightness temperatures, associated Quality Flags, and Geolocation data at native resolution (not resampled) data.*

* + - 1. Derived Requirement 7.2

N4RT-2.3.7.2-7.2

*The Reformatting Toolkit developers shall work with EMC and the MIRS team to create an ATMS BUFR table. The ATMS BUFR file shall be based on what is currently provided for AMSU and MHS.*

* + - 1. Derived Requirement 7.3

N4RT-2.3.7.3-7.3

*BUFR messages shall be smaller than 50KB. (Removed: this is no longer a limitation of the BUFRLIB)*

* + - 1. Derived Requirement 7.4

N4RT-2.3.7.4-7.4

*The file shall contain the following data fields:*

*Satellite ID*

*ID of Originating Center*

*ID of Originating Sub-Center*

*Satellite Instrument*

*Satellite Classification*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Scan Line Number*

*FOV Number*

*Orbit Number*

*Granule-Level Quality Flags*

*Scan-Level Quality Flags*

*Geolocation Quality*

*Latitude*

*Longitude*

*Satellite Height*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*ATMS Channel Number*

*ATMS Central Frequencies*

*Antenna Polarization*

*Antenna Temperatures*

*Brightness Temperatures*

*Channel-Level Quality Flags*

*NeDT cold target*

*NeDT warm target*

*Sattellite Antenna Correction Version Number*

* + - 1. Derived Requirement 7.5

N4RT-2.3.7.5-7.5

*The Reformatting Toolkit shall use the JPSS ATMS TDR and SDR files and associated Geolocation files tailored into NetCDF4 as an input for generating the ATMS radiance BUFR files.*

* + - 1. Derived Requirement 7.6

N4RT-2.3.7.6-7.6

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 8.0

N4RT-2.3.8-8.0

*The Reformatting Toolkit shall tailor JPSS OMPS Ozone products from netCDF4 into BUFR for EMC.*

* + - 1. Derived Requirement 8.1

N4RT-2.3.8.1-8.1

*The product shall contain OMPS Nadir Profile and Total Column (this would be the version 8 ozone algorithm for both products) in separate files.*

* + - 1. Derived Requirement 8.2

N4RT-2.3.8.2-8.2

*The Reformatting Toolkit developers shall work with EMC to develop an OMPS BUFR table based on that currently used for GOME and SBUV.*

* + - 1. Derived Requirement 8.3

N4RT-2.3.8.3-8.3

*BUFR messages shall be smaller than 50KB. (Removed: this is no longer a limitation of the BUFRLIB)*

* + - 1. Derived Requirement 8.4

N4RT-2.3.8.4-8.4

*The file shall contain the following data fields:*

*Satellite ID*

*ID of Originating Center*

*ID of Originating Sub-Center*

*Satellite Instrument*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Orbit Number*

*Asc/Desc Flag*

*Latitude*

*Longitude*

*Satellite Height*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*Vertical Significance*

*Pressure*

*Number of Retrieved Layers*

*Total Ozone*

*Ozone p (Dobson Units)*

*Significance and Volumetric Mixing Ratio*

*SO2 Index*

*Volcanic Contamination Index*

*SBUV Total Ozone Quality*

*SBUV Profile Ozone Quality*

*Geolocation Quality*

*Ozone Quality Flag*

* + - 1. Derived Requirement 8.5

N4RT-2.3.8.5-8.5

*The Reformatting Toolkit shall use the JPSS OMPS Total Column Ozone EDR files and OMPS Nadir Profile IP files tailored into NetCDF4 as an input for generating the OMPS Ozone BUFR files.*

* + - 1. Derived Requirement 8.6

N4RT-2.3.8.6-8.6

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 9.0

N4RT-2.3.9-9.0

*The Reformatting Toolkit shall tailor JPSS VIIRS SST products from netCDF4 into BUFR for EMC.*

* + - 1. Derived Requirement 9.1

N4RT-2.3.9.1-9.1

*Product shall contain Skin SST, Bulk SST, Quality Flags, Cloud Mask, and geolocation data.*

* + - 1. Derived Requirement 9.2

N4RT-2.3.9.2-9.2

*Reformatting Tool developers shall work with EMC to create a BUFR table for the VIIRS SST product.*

* + - 1. Derived Requirement 9.3

N4RT-2.3.9.3-9.3

*The VIIRS SST BUFR table shall be derived from that currently being used for the AVHRR derived SST (from ACSPO - Advanced Clear-Sky Processor for Oceans).*

* + - 1. Derived Requirement 9.4

N4RT-2.3.9.4-9.4

*BUFR messages shall be smaller than 50KB. (Removed: this is no longer a limitation of the BUFRLIB)*

* + - 1. Derived Requirement 9.5

N4RT-2.3.9.5-9.5

*The file shall contain the following data fields:*

*Satellite ID*

*ID of Originating Center*

*ID of Originating Sub-Center*

*Satellite Instrument*

*Satellite Classification*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Latitude*

*Longitude*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*Satellite Height*

*Scan Line Number*

*FOV Number*

*Orbit Number*

*Day/Night Flag*

*Pixel Type*

*Asc/Desc Flag*

*Geolocation Quality*

*VIIRS Geolocation Quality*

*Retrieval Data Quality*

*Adjacency Cloud Mask*

*SST Pixel-Level Quality flag*

*SST*

*SST bulk*

* + - 1. Derived Requirement 9.6

N4RT-2.3.9.6-9.6

*The Reformatting Toolkit shall use the JPSS VIIRS radiance SDR files and associated Geolocation files tailored into NetCDF4 as an input for generating the VIIRS radiance BUFR files.*

* + - 1. Derived Requirement 9.7

N4RT-2.3.9.7-9.7

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 10.0 (Product Requirement)

N4RT-2.3.10-10.0

*The Reformatting Toolkit shall tailor JPSS VIIRS radiances and brightness temperatures, reflectances from netCDF4 into BUFR for EMC.*

* + - 1. Derived Requirement 10.1

N4RT-2.3.10.1-10.1

*Each BUFR file shall contain the VIIRS data for a single band (Imagery band, Moderate band, or Day/Night band resolution).*

* + - 1. Derived Requirement 10.2

N4RT-2.3.10.2-10.2

*Coverage shall be global.*

*Removed as per Andrew Collards update requirements for the VIIRS TIM.*

* + - 1. Derived Requirement 10.3

N4RT-2.3.10.3-10.3

*Each of the 3 bands will use the same VIIRS BUFR table.*

* + - 1. Derived Requirement 10.4

N4RT-2.3.10.4-10.4

*The product shall contain the land and cloud mask if it doesn’t take too long for the IDPS to generate those EDRs.*

*Removed as per Andrew Collards update requirements for the VIIRS TIM.*

* + - 1. Derived Requirement 10.5

N4RT-2.3.10.5-10.5

*Reformatting Toolkit developers shall work with EMC and the rest of the NWP user community to create a BUFR table derived from that used earlier for the GAC AVHRR.*

* + - 1. Derived Requirement 10.6

N4RT-2.3.10.6-10.6

*BUFR messages shall be smaller than 50KB. (Removed: this is no longer a limitation of the BUFRLIB)*

* + - 1. Derived Requirement 10.7

N4RT-2.3.10.7-10.7

*The file shall contain the following data fields:*

*Satellite ID*

*ID of Originating Center*

*ID of Originating Sub-Center*

*Satellite Instrument*

*Satellite Classification*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Latitude*

*Longitude*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*Satellite Height*

*Type of Band*

*Scan line*

*FOV number*

*Orbit number*

*Geolocation Quality*

*VIIRS Geolocation Quality*

*Radiance Quality*

*Cloud Mask*

*Surface Type*

*Channel Number*

*Channel Wavelength*

*Channel Radiance*

*Channel Reflectance*

* + - 1. Derived Requirement 10.8

N4RT-2.3.10.8-10.8

*The BUFR shall contain the following Moderate and Imagery resolution channels as requested by EMC:*

*Channel M12 (3.70 microns)*

*Channel M13 (4.05 microns)*

*Channel M15 (10.763 microns)*

*Channel M16 (12.013 microns)*

*Channel I5 (11.450 microns)*

* + - 1. Derived Requirement 10.9

N4RT-2.3.10.9-10.9 Requirement Removed

*The toolkit shall set data missing for obviously cloudy FOVs. This will improve compression and reduce the total data volumes. Obviously cloudy FOVs are those with brightness temperatures in one of the longwave SST channels (M15 or M16) less than 270K. To preserve sea ice FOVs, this test shall only be applied for latitudes equatorward of 50 degrees.*

*Note: An important concern is that more CPU time required to encode the BUFR than what NDE can supply. A recommended solution was to reduce the number of VIIRS channels to only a required subset, reject obviously cloudy data, and reject land-only granules. Very few granules, if any, will be entirely land-only. This would also require comparing the lat/lons of all points to a land mask which means more processing and we'd still have to read all the data anyway.*

*Andrew Collard in an email on 6/8/2011 says "We don't NEED data thinning, we can ACCEPT data thinning." Therefore, we have decided to supply all the granules, but reduce the channels and employ the obviously-cloudy check.*

*Removed: Bob Grumbine wants to keep frozen inland lakes, to do this we decided to not thin. This is documented in an email from Andrew on 11/9/2011. CC’d were Bob Grumbine, John Derber, Tom Schott, and Walter Wolf.*

* + - 1. Derived Requirement 10.10

N4RT-2.3.10.10-10.10

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 11.0 (Product Requirement)

N4RT-2.3.11-11.0

*The Reformatting Toolkit shall tailor JPSS Aerosol Optical Thickness (AOT) from netCDF4 into BUFR for EMC.*

* + - 1. Derived Requirement 11.1

N4RT-2.3.11.1-11.1

*The product shall contain the AOT, wavelength of AOT, and Aerosol Size.*

* + - 1. Derived Requirement 11.2

N4RT-2.3.11.2-11.2

*Reformatting Toolkit developers shall work with EMC to develop the AOT BUFR table based on what has already been done for MODIS.*

* + - 1. Derived Requirement 11.3

N4RT-2.3.11.3-11.3

*BUFR messages shall be smaller than 50KB*. (Removed: this is no longer a limitation of the BUFRLIB)

* + - 1. Derived Requirement 11.4

N4RT-2.3.11.4-11.4

*The file shall contain the following data fields*:

*Satellite ID*

*ID of Originating Center*

*ID of Originating Sub-Center*

*Satellite Instrument*

*Satellite Classification*

*Year*

*Month*

*Day*

*Hour*

*Minute*

*Second*

*Latitude*

*Longitude*

*Satellite Zenith Angle*

*Satellite Azimuth*

*Solar Zenith*

*Solar Azimuth*

*Satellite Height*

*Orbit Number*

*Scan Line Number*

*FOV Number*

*Remotely Sensed Surface Type*

*Asc/Desc Flag*

*Geolocation Quality*

*VIIRS Geolocation Quality*

*Retrieval Quality*

*Aerosol Type (land)*

*AOT Quality Flag*

*Aerosol Wavelength Angstrom Exponent*

*Channel Wavelength*

*Optical Depth*

* + - 1. Derived Requirement 11.5

N4RT-2.3.11.5-11.5

*The Reformatting Toolkit shall use the JPSS Aerosol Optical Thickness EDR files and associated Geolocation files tailored into netCDF4 as an input for generating the Aerosol Optical Thickness EDR BUFR files.*

* + - 1. Derived Requirement 11.6

N4RT-2.3.11.6-11.6

*BUFR files produced by the reformatting toolkit shall have names that adhere to the NDE naming convention described in the NDE document entitled “Algorithm Delivery Standards, Integration, and Test”.*

* + 1. Basic Requirement 12.0

N4RT-2.3.12-12.0

*The Reformatting Toolkit shall tailor NDE-generated Polar Winds product from netCDF4 to BUFR format for EMC.*

Additional requirements for this product will be forthcoming.

* + 1. Basic Requirement 13.0 (Product Requirement)

N4RT-2.3.13-13.0

*The Reformatting Toolkit shall tailor NDE-generated Green Vegetation Fraction products from netCDF4 to GRIB2 format for EMC.*

Additional requirements for this product will be forthcoming.

* + 1. Basic Requirement 14.0 (Product Requirement)

N4RT-2.3.14-14.0

*The Reformatting toolkit shall comply with OSPO coding standards and security standards identified in the OSPO security checklist.*

# 3.0 REQUIREMENTS ALLOCATION

This section describes the allocation of requirements to system and product components.

* This section of RAD is waved for the current phase of this project.

# 4.0 REQUIREMENTS QUALITY ASSURANCE

## 4.1 Requirements Traceability

Requirements Traceability includes vertical traceability from the basic requirement to its lower level derived requirements and from the lower level requirements back to their source. This is automatically accomplished by the requirements numbering convention. Using this convention, a requirement numbered N.x.y.z can immediately be traced to requirement N.x.y, then N.x, and finally back to basic requirement N.

## 4.2 Requirements Tracking

Requirements tracking involve the monitoring of the status of the requirements and their allocation to ensure that the integrity of the requirements allocation is preserved as the solutions, design and implementation matures.

The RAD will be updated as necessary to document changes to requirements and/or their allocations.

Requirements and their allocations will be reviewed at each Technical Review. This will include review and approval of any RAD revisions.

Because this is the second version of the RAD, there are no requirements tracking to report.

RAD v3r0 will include a report on the status of requirements tracking.

## 4.3 Requirements Validation

Requirements validation is concerned with ensuring that the requirements and requirements allocation provide a satisfactory balance between customer/user needs and expectations, NESDIS mission goals, technical feasibility, available resources and external constraints. The requirements documented in this version of the RAD have been developed to achieve this balance.

# 5.0 LIST OF REFERENCES

Jensen, K. A. (2006). DG-9.5: Requirements Allocation Document Guideline, Version 1.0.

Jensen, K. A. (2007). DG-9.1: Project Requirements Training Document, Version 2.0.

“Level 1 Requirements for a NetCDF4 Reformatting Tool”.

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