



# Geostationary Operational Environmental Satellite (GOES)

## GOES-R Series Level I Requirements (LIRD)


August 2009

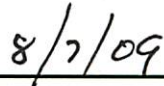



U.S. Department of Commerce (DOC)  
National Oceanic and Atmospheric Administration (NOAA)  
NOAA Satellite and Information Service (NESDIS)  
National Aeronautics and Space Administration (NASA)

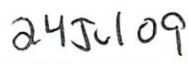
LEVEL 1 REQUIREMENTS DOCUMENT (LIRD)  
SIGNATURE PAGE

Approvals:

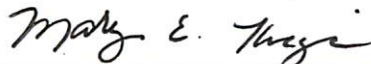
  
\_\_\_\_\_  
Mary M. Glackin  
Deputy Undersecretary of Commerce for  
Oceans and Atmosphere


  
\_\_\_\_\_  
Date

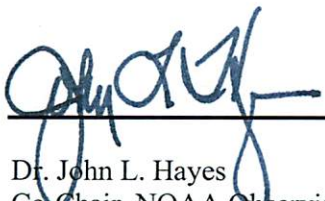
  
\_\_\_\_\_  
Gregory A. Mandt  
System Program Director, GOES-R


  
\_\_\_\_\_  
Date

Concurrences:

  
\_\_\_\_\_  
Mary E. Kicza  
Co-Chair, NOAA Observing System Council

  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Dr. John L. Hayes  
Co-Chair, NOAA Observing System Council

  
\_\_\_\_\_  
Date

**LEVEL 1 REQUIREMENTS DOCUMENT (L1RD)  
 DOCUMENT CHANGE RECORD**

VERSION	DATE	CCR #	SECTIONS AFFECTED	DESCRIPTION
Baseline	08/06/07	1066	All	Baseline the Level 1 Requirements Document
1.1	12/12/08	1259	TOC, LIRD83, LIRD84, LIRD244, LIRD245; LIRD246; Deleted LIRD 71- LIRD78; deleted LIRD 85-87; LIRD79 - LIRD84; LIRD245 – 246	CCR 1259 partially approved by DUS/ implemented. * Updates TOC * Adds new LIRD244 " Operational Capability Status" *Adds new LIRD245 and LIRD246 "Level I Budget and Schedule Requirements" *Deletes LIRD71- LIRD78 and LIRD85 - LIRD87 *Modifies LIRD83 and LIRD84 to reflect "System Operational Lifetime" *Re-numbers sections 5 & 6.
1.1	12/12/08	1275	LIRD246	Revises LIRD246 "Level I Budget and Schedule Requirements"
2.0	08/18/09	1296	LIRD109, TOC	*Delete Cloud Imagery: Coastal *DOORS automatically renumbers sections following a deletion
2.0	08/18/09	1314	LIRD159	Add CONUS & Mesoscale Coverages for Total Precipitable Water (TPW)
2.0	08/18/09	1318	LIRD161, TOC	*Delete Entire Product: Total Water Content (TWC) *DOORS automatically renumbers sections following a deletion
2.0	08/18/09	1346	LIRD131, LIRD153, LIRD155, LIRD157, LIRD166, LIRD187, LIRD223	* Add CONUS & Mesoscale (meso) to Refresh Rate/Coverage Rate (RR/CR) (LIRD131) * Add FD, CONUS, meso to RR/CR (LIRD153, LIRD155) * Add Full Disk coverage (LIRD157) * Updates Geo coverage/condition and RR/CR (LIRD166) * Updates FD RR/CR (LIRD187) * Delete CONUS & Mesoscale coverages (LIRD223)
2.0	08/18/09	1378	LIRD32, LIRD222, LIRD223, TOC	Change the name from Sea Surface Temperature to Sea Surface Temperature (skin)

2.0	08/18/09	1383	LIRD192	Change the accuracy
2.0	08/18/09	1384	LIRD211	Change the accuracy
2.0	08/18/09	1385	LIRD32, LIRD169, LIRD172, LIRD173, LIRD174, LIRD175, LIRD177, TOC	Radiation Budget: Updates * Downward Solar Insolation: Surface to Downward Shortwave Radiation: Surface (LIRD32, 172, 173) * Reflected Solar Insolation: TOA to Reflected Shortwave Radiation: TOA (LIRD32, 174, 175) * change measurement accuracy (LIRD169, 175, 177)
2.0	08/18/09	1386A	LIRD187	Updates Derived Motion Winds measurement accuracy & RR/CR
2.0	08/18/09	1417	LIRD153, LIRD155, LIRD157, LIRD159 LIRD204	Soundings: Product Parameter Updates * Legacy Vertical Moisture Profile – threshold for geo coverage/ conditions (LIRD153) * Legacy Vertical Temperature Profile - threshold for geo coverage/ conditions ; measurement accuracy (LIRD155) * measurement acc., removes ± (LIRD157) * TPW - threshold for geo coverage/ conditions ; measurement accuracy (LIRD159) * Surface Emissivity – measurement accuracy (LIRD204)
2.0	08/18/09	1418	TOC, LIRD32, LIRD193, LIRD194, LIRD198, LIRD200, LIRD215, LIRD218, LIRD219 LIRD221	Cryosphere: Prod Parameter Updates * deletes “Landlocked” (TOC, LIRD32, LIRD193, LIRD194) * deletes Sea & Lake Ice: Extent (TOC, LIRD32 LIRD219) * measurement accuracy and RR/CR (LIRD194, LIRD198) * measurement accuracy (LIRD200, LIRD215, LIRD221)
2.0	08/18/09	1419B	TOC, LIRD27, LIRD32, LIRD90, LIRD91, LIRD98, LIRD102, LIRD107, LIRD108, LIRD110, LIRD111, LIRD113, LIRD117, LIRD121, LIRD123, LIRD125, LIRD127, LIRD129, LIRD137, LIRD141, LIRD159, LIRD160, LIRD164, LIRD204, LIRD225	Clouds: Product Parameter Updates * update figure (LIRD27) * remove “Thickness” (LIRD32, LIRD110, LIRD111) * add “Appendix”(LIRD90) * update AA (LIRD91) * correct typographical errors/ omissions (LIRD98, LIRD102, LIRD107, LIRD108, LIRD137, LIRD141, LIRD159, LIRD160, LIRD204, LIRD225) * Measurement accuracy (LIRD107, LIRD111, LIRD113, LIRD117, LIRD121, LIRD123, LIRD125, LIRD127, LIRD129. LIRD164)

2.0	08/18/09	1425	TOC, LIRD32, LIRD105, LIRD131, LIRD133, LIRD139, LIRD140, LIRD141, LIRD143, LIRD184	Aviation: Product Parameter Updates * Turbulence to Tropopause Folding Turbulence Prediction (TOC, LIRD32, LIRD140, LIRD141) * Measurement accuracy (LIRD105, LIRD131, LIRD133, LIRD139, LIRD141, LIRD143, LIRD184) * typographical error (LIRD133)
2.0	08/18/09	1426A	LIRD148, LIRD150	Hydrology: Product Parameter Updates *Measurement accuracy (LIRD148, LIRD150)
2.0	08/18/09	1437	LIRD66, LIRD137	Revises Description of Geostationary Lightning Mapper (GLM) and lightning detection
2.0	08/18/09	1469	TOC, LIRD32, LIRD96, LIRD99, LIRD100, LIRD182	Aerosols: Product Parameter Updates * change Suspended Matter/Optical Depth to Aerosol Optical Depth (TOC, LIRD32, LIRD99, LIRD100) * typographical error (LIRD96, LIRD100) * Measurement accuracy (LIRD96, LIRD100, LIRD182)

**/LIRD**

**LIRD**

P417-R-LIRD-0137, RM Version, Level I Requirements Document

Version: 2.0 (9-01-09)

Printed by: belizaire

Printed on: Monday, August 31, 2009

No filter applied.

No sort applied.

## Contents

<b>1</b>	<b>Document Purpose and Scope</b>	<b>1</b>
1.1	References	1
1.2	GOES-R Purpose	1
1.3	Scope	1
<b>2</b>	<b>GOES-R Series Satellite System Background</b>	<b>3</b>
2.1	System Need	3
2.1.1	NOAA Programs and Performance Measures Supported	3
2.1.2	NOAA Observational Gap Addressed	3
2.1.3	Program Definition and Oversight	4
2.1.4	Requirements Ownership and Oversight	4
<b>3</b>	<b>Level I Performance Requirements</b>	<b>6</b>
3.1	System Concept	6
3.1.1	Observational Requirements	7
3.1.2	Auxiliary Communication Services Requirements	11
3.1.3	Satellite Operations/Mission Management Requirements	11
3.1.4	Product Generation Requirements	12
3.1.5	Product Distribution/Archiving Requirements	12
3.1.6	Enterprise Management	12
<b>4</b>	<b>Baseline Instrumentation</b>	<b>13</b>
4.1	Advanced Baseline Imager (ABI)	13
4.2	Reserved	13
4.3	EUVS XRS Irradiance Sensors (EXIS)	13
4.4	Solar UltraViolet Imager (SUVI)	13
4.5	Space Environment In-Situ Suite (SEISS)	13
4.6	Geostationary Lightning Mapper (GLM)	13
4.7	Magnetometer	13
4.8	Instrument Performance Specifications	13
<b>5</b>	<b>Operational Capability Status (CCR 1259)</b>	<b>15</b>
5.1	System Initial Operational Capability (IOC)	15
5.2	System Full Operational Capability (FOC)	15
5.3	System Operational Lifetime (CCR 1259)	15
<b>6</b>	<b>Level I Budget and Schedule Requirements (CCR 1259)</b>	<b>16</b>
<b>7</b>	<b>MINIMUM PERFORMANCE SUCCESS CRITERIA</b>	<b>17</b>

<b>8</b>	<b>Acronyms Appendix (CCR 1419B)</b>	<b>18</b>
<b>9</b>	<b>Observational Requirements Appendix</b>	<b>20</b>
9.1	Observational Requirements: Atmosphere	20
9.1.1	Aerosols	20
9.1.1.1	Aerosol Detection (including Smoke and Dust)	20
9.1.1.2	Aerosol Particle Size	20
9.1.1.3	Aerosol Optical Depth (CCR 1469)	20
9.1.1.4	Volcanic Ash: Detection and Height	21
9.1.2	Clouds	21
9.1.2.1	Aircraft Icing Threat	21
9.1.2.2	Cloud Ice Water Path	22
9.1.2.3	Cloud Layers/Heights (CCR 1419B)	22
9.1.2.4	Cloud Liquid Water	23
9.1.2.5	Cloud and Moisture Imagery	23
9.1.2.6	Cloud Optical Depth	24
9.1.2.7	Cloud Particle Size Distribution	24
9.1.2.8	Cloud Top Phase	25
9.1.2.9	Cloud Top Height	25
9.1.2.10	Cloud Top Pressure	26
9.1.2.11	Cloud Top Temperature	26
9.1.2.12	Cloud Type	27
9.1.2.13	Convective Initiation	27
9.1.2.14	Enhanced "V"/Overshooting Top Detection	28
9.1.2.15	Hurricane Intensity	28
9.1.2.16	Lightning Detection	29
9.1.2.17	Low Cloud and Fog	29
9.1.2.18	Tropopause Folding Turbulence Prediction (CCR 1425)	29
9.1.2.19	Visibility	30
9.1.3	Precipitation	30
9.1.3.1	Probability of Rainfall	30
9.1.3.2	Rainfall Potential	30
9.1.3.3	Rainfall Rate/QPE	31
9.1.4	Profiles, Indices, Total Water	31
9.1.4.1	Legacy Vertical Moisture Profile	31
9.1.4.2	Legacy Vertical Temperature Profile	32
9.1.4.3	Derived Stability Indices	32
9.1.4.4	Total Precipitable Water	33
9.1.5	Radiances	33
9.1.5.1	Clear Sky Masks	33
9.1.5.2	Radiances	34

9.1.6	Radiation	34
9.1.6.1	Absorbed Shortwave Radiation: Surface	34
9.1.6.2	Downward Longwave Radiation: Surface	35
9.1.6.3	Downward Shortwave Radiation: Surface (CCR 1385)	35
9.1.6.4	Reflected Shortwave Radiation: TOA (CCR 1385)	36
9.1.6.5	Upward Longwave Radiation: Surface	36
9.1.6.6	Upward Longwave Radiation: TOA	37
9.1.7	Trace Gases	37
9.1.7.1	Ozone Total	37
9.1.7.2	SO <sub>2</sub> Detection	37
9.1.8	Winds	38
9.1.8.1	Derived Motion Winds	38
9.2	Observational Requirements: Land	38
9.2.1	Fire/Hot Spot Characterization	38
9.2.2	Flood/Standing Water	39
9.2.3	Ice Cover (CCR 1418)	39
9.2.4	Land Surface (Skin) Temperature	39
9.2.5	Snow Cover	40
9.2.6	Snow Depth (over Plains)	40
9.2.7	Surface Albedo	41
9.2.8	Surface Emissivity	41
9.2.9	Vegetation Fraction: Green	41
9.2.10	Vegetation Index	42
9.3	Observational Requirements: Ocean	42
9.3.1	Currents	42
9.3.2	Currents: Offshore	42
9.3.3	Sea and Lake Ice: Age	43
9.3.4	Sea and Lake Ice: Concentration	43
9.3.5	Sea and Lake Ice: Motion	44
9.3.6	Sea Surface Temperature (skin) (CCR 1378)	44
9.4	Observational Requirements: Space and Solar	45
9.4.1	Energetic Particles (CCR 1419B)	45
9.4.1.1	Energetic Heavy Ions	45
9.4.1.2	Magnetospheric Electrons and Protons: Low Energy	45
9.4.1.3	Magnetospheric Electrons and Protons: Medium and High Energy	46
9.4.1.4	Solar and Galactic Protons	46
9.4.2	Magnetic Field	46
9.4.2.1	Geomagnetic Field	46
9.4.3	Solar	47
9.4.3.1	Solar Flux: EUV	47
9.4.3.2	Solar Flux: X-Ray	47

9.4.3.3 Solar Imagery: X-Ray

<b>ID</b>	<b>Object Number</b>	<b>P417-R-LIRD-0137, RM Version, Level I Requirements Document</b>
LIRD1	1	<b>1 Document Purpose and Scope</b>
LIRD2	1.1	<b>1.1 References</b>
LIRD3	1.1.0-1	<ol style="list-style-type: none"><li>1. GOES-N, O, P, Q Performance Specification, Attachment B, S-415-22, August 1997</li><li>2. 1999 National Weather Service Operational Requirements Document</li><li>3. NOAA's Updated Strategic Plan, April 2005</li><li>4. Approval of NOAA Major Projects - Memorandum, September 2005</li><li>5. NOAA Administrative Order (NAO) 216-108, October 2005</li></ol>
LIRD4	1.2	<b>1.2 GOES-R Purpose</b>
LIRD5	1.2.0-1	<p>This document provides the Level I performance, budget and schedule requirements for developing the next Geostationary Operational Environmental Satellite System. The purposes of this document are to:</p> <ol style="list-style-type: none"><li>a) Provide a brief summary of background, mission need, and fundamental objectives of the GOES-R Series System</li><li>b) Provide the top-level performance, budget and schedule requirements of the program for policy-level review, management control and generation of lower level requirements documents</li></ol>
LIRD6	1.3	<b>1.3 Scope</b>

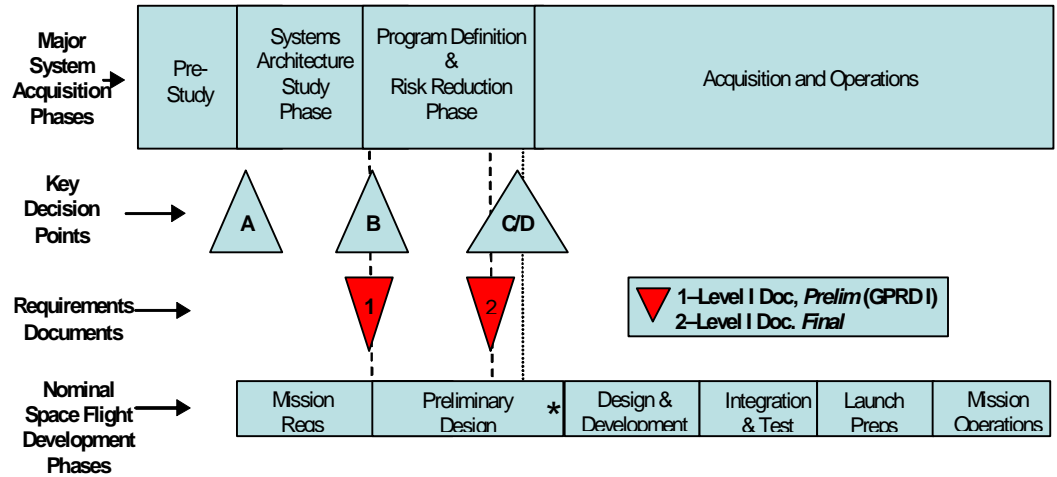
**ID Object Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD7 1.3.0-1

These Level I requirements, finalized at the end of the Program Definition and Risk Reduction Phase, reflect results obtained from system capabilities studies and document the final set of system requirements for the Acquisition and Operations Phase. They also serve as the basis for generation of lower-level, system-component requirements documents (e.g., Level II requirements documents).

The GOES-R Series Satellites Acquisition and Development figure below depicts the relationship between the overall GOES-R Series System Acquisition Phases, the major system Key Decision Points, and this Level I Requirements Document.



**GOES-R Series Satellites Acquisition and Development Figure**

The GOES-R Series System Level I, *Preliminary* document was the GOES-R Series Program Requirements Document I (GPRD I) approved on June 14, 2004. Differences between the GPRD I and this GOES-R Series System Level I, *Final* document are summarized in the GPO Technical Report, GPRD and LIRD product differences, dated March 26, 2007.

ID	Object Number	P417-R-LIRD-0137, RM Version, Level I Requirements Document
LIRD8	2	<b>2 GOES-R Series Satellite System Background</b>
LIRD9	2.1	<b>2.1 System Need</b>
LIRD10	2.1.0-1	<p>The primary missions of NOAA are to understand and predict changes in the Earth's environment, and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs. Specifically NOAA is to:</p> <ul style="list-style-type: none"> <li>a) Serve society's needs for weather and water information.</li> <li>b) Protect, restore, and manage the use of coastal and ocean resources through an ecosystem approach to management.</li> <li>c) Understand climate variability and change to enhance society's ability to plan and respond.</li> <li>d) Support the Nation's commerce with information for safe, efficient and environmentally sound transportation.</li> </ul>
LIRD11	2.1.0-2	<p>In accordance with the Geostationary Satellite Program Charter, GOES satellites meet current and near-term national operational environmental sensing requirements for continuous observation of weather, Earth's environment, and solar and space environment. To meet requirements and accomplish its mission, the geostationary satellites program performs three major functions:</p> <ul style="list-style-type: none"> <li>a) Provide continuous Geostationary Environmental Sensing to support NOAA Goal Teams.</li> <li>b) Provide Data Collection Service capability to support NOAA Goal Teams.</li> <li>c) Provide continuous relay of environmental data to distributed users and relay of distress signals from aircraft or marine vessels to search and rescue ground stations.</li> </ul>
LIRD12	2.1.1	<b>2.1.1 NOAA Programs and Performance Measures Supported</b>
LIRD13	2.1.1.0-1	<p>NOAA's strategic plan and mission are implemented through four primary Goal Areas: Weather and Water, Climate, Commerce and Transportation, and Ecosystems. Each NOAA Goal is further divided into application Programs and is accountable to address several Government Performance Results Act (GPRA) performance measures. GOES-R will contribute to meeting the following GPRA measures:</p> <ul style="list-style-type: none"> <li>a) Lead time, accuracy, and false alarm rate for tornado warnings</li> <li>b) Lead time and accuracy for flash flood warnings</li> <li>c) Hurricane forecast track error</li> <li>d) Accuracy of day 1 precipitation forecasts</li> <li>e) Lead time and accuracy for winter storm warnings</li> <li>f) Accuracy and false alarm rate of forecasts of ceiling and visibility in aviation forecasts</li> <li>g) Accuracy of forecasts for wind speed and wave height in marine forecasts</li> <li>h) US seasonal temperature forecasts</li> </ul>
LIRD14	2.1.2	<b>2.1.2 NOAA Observational Gap Addressed</b>
LIRD15	2.1.2.0-1	<p>There is no single environmental observing system that can meet the geographic coverage, vertical and horizontal resolution, measurement accuracy and timeliness requirements of the hundreds of environmental parameters needing to be sensed throughout our atmosphere, oceans, land and ice masses, and space and solar regimes to accomplish NOAA's mission. While NOAA's complementary polar-orbiting system of satellites provides data across the entire globe, its lower temporal coverage of four or more hours does not allow detection and monitoring of rapidly developing storms threatening US life and property. Similarly, nationwide radar systems, while able to continually detect precipitation areas, are unable to image the cloud systems and provide the 3-D fields of atmospheric temperature and moisture needed to predict the onset, intensity, duration and direction of these storms.</p>

<b>ID</b>	<b>Object Number</b>	<b>P417-R-LIRD-0137, RM Version, Level I Requirements Document</b>
LIRD16	2.1.3	<b>2.1.3 Program Definition and Oversight</b>
LIRD17	2.1.3.0-1	The GOES-R Series System meets the criteria of a major NOAA system in accordance with criteria set out in NOAA's Administrative Order (NAO) 216-108. NOAA major programs are those exceeding a \$250M life cycle cost or as deemed of high importance to the agency's mission; having high development costs, and/or having a significant role in the administration of the agency's programs. Each major NOAA program is assigned oversight by a NOAA Council.
LIRD18	2.1.4	<b>2.1.4 Requirements Ownership and Oversight</b>
LIRD19	2.1.4.0-1	As a major NOAA program, the GOES-R Series System has been assigned to the NOAA Executive Panel (NEP) for oversight. The NEP has delegated this oversight authority to the NOAA Program Management Council (PMC) chaired by the Deputy Undersecretary of Commerce for Oceans and Atmosphere. The NEP has delegated authority of the design, development, acquisition and implementation of the GOES-R Series System to the GOES-R Series System Program Director (SPD), within NOAA's NESDIS. The GOES-R SPD is charged with responsibility for successful execution of the GOES-R Series Satellite program and reports the status and areas of risk/concern monthly to the NOAA PMC.

**ID            Object  
                 Number**
**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD20    2.1.4.0-2

The requirements hierarchy for the GOES-R Series System, along with the reviewing and approving authorities, is listed in the GOES-R Requirements Documents Reviews and Approvals Table below.

**GOES-R Requirements Documents Reviews and Approvals**

<b>Requirement Level</b>	<b>Baseline Document</b>	<b>Document Custodian and Control Process</b>	<b>Reviewing Body</b>	<b>Approving Body</b>
<b>NOAA Observing Systems Architecture (NOSA)</b>	Consolidated Observational Requirements List (CORL)	NOAA Observing Systems Council (NOSC)	NOSC	NOAA Executive Council (NEC)
<b>Level I</b>	GOES-R Level I Requirements Document	Final: GOES-R Program Office (GPO)	NOSC, GOES-R System Program Director (SPD) NESDIS AA/DAA	NOAA DUS
<b>Level II</b>	GOES-R Management Control Plan	GPO	NESDIS AA/DAA NASA/GSFC PMC	NESDIS AA, NASA/GSFC Center Director
<b>Level IIa</b>	Mission Requirements Document  CONOPS	GPO	GPO GORWG	GOES-R SPD
<b>Level III</b>	GOES-R Project Plans	GOES-R Projects	GPO	GOES-R SPD
<b>Level IIIa</b>	Project Level Interface Documents and Functional Specifications	GOES-R Projects	GPO	GOES-R Project Managers

**ID**      **Object Number**      **P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD21    3      **3 Level I Performance Requirements**

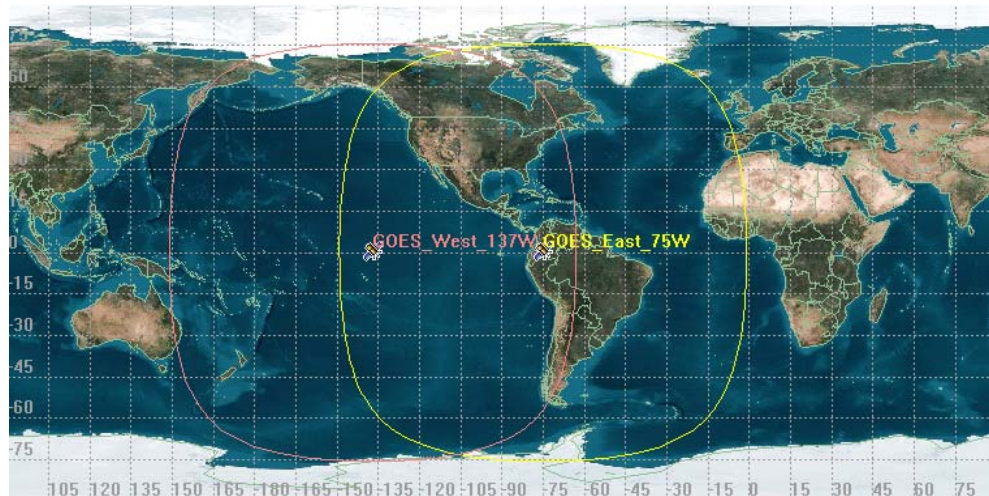
LIRD22    3.0-1      To accomplish the overall system performance requirements the GOES-R Series System has specific requirements in the following functional areas: Observational, Auxiliary Communication Services, Satellite Operations/Mission Management, Product Generation, Product Distribution/Archiving, and Enterprise Management.

LIRD23    3.1      **3.1 System Concept**

LIRD24    3.1.0-1      The GOES-R Series System Architecture consists of the following space and ground components:

- a) Spacecrafts
- b) Instruments
- c) Launch support
- d) Communications and distribution systems
- e) Satellite system command and control systems
- f) Product development, production, access and archiving systems
- g) Ground system enterprise management system

LIRD25    3.1.0-2      The GOES-R Series Imagery Coverage Figure below depicts the current GOES-R Series geographic coverage for imagery capabilities. The GOES-R Series System **shall** provide this imagery coverage, at a minimum, to maintain program continuity.



**GOES-R Series Imagery Coverage Figure**

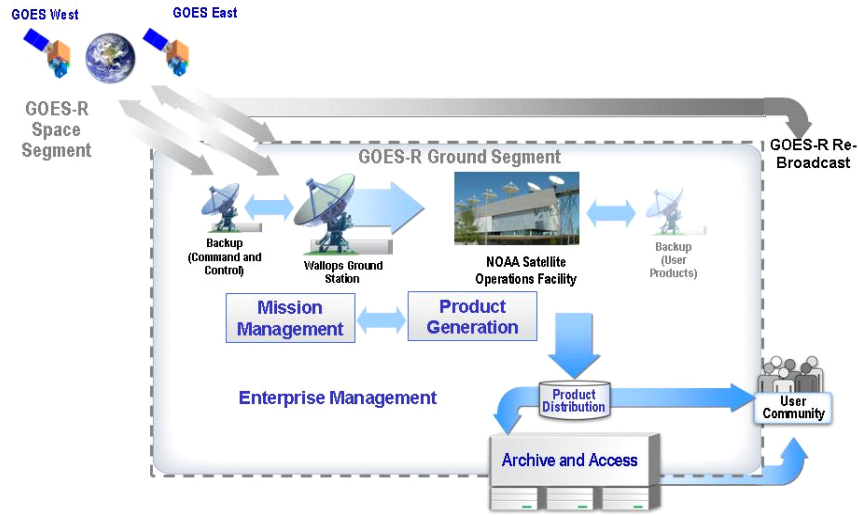
LIRD26    3.1.0-3      The GOES-R Series System **shall** provide nearly continuous (with outages less than 6 hours per year) sensor data for ground product generation while meeting performance specifications.

LIRD27    3.1.0-4      The GOES-R Series System **shall** provide functional components to maintain, at a minimum, the continuity of the GOES-NOP Series “end-to-end” capabilities. These functional capabilities will be located in three primary locations: the NOAA Satellite Operations Facility (NSOF) in Suitland, MD; the Wallops Command and Data Acquisition Station (WCDAS) in Wallops, VA; and a Backup location (TBR). The GOES-R Series Minimum “End-to-End” System Configuration Figure below depicts the minimum GOES-R configuration.

**ID Object Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD27 3.1.0-4



**GOES-R Minimum "End-to-End" System Configuration Figure**

(CCR 1419B)

LIRD28 3.1.0-5

Mission availability, which is the probability that the entire GOES-R and -S system can be successfully used for its specified mission (collection, generation, and distribution of the KPPs) over the operational lifetime, **shall** be 0.80 over the east, west, and central coverage zones as defined in the Coverage Zone Definitions Table below. When coverage is supplied by another GOES series such as a GOES-N or the next GOES series, the availability contribution from this coverage area is considered to be 100% over its lifetime for this calculation.

**Coverage Zone Definitions Table**

	<b>Imaging</b>
West	Latitude: From 68° to -68° Longitude: From -215° to -60°
Central	Latitude: From 68° to -68° Longitude: From -182° to -28°
Central Subset	Latitude: From 45° to -45° Longitude: From -182° to -28°
East	Latitude: From 68° to -68° Longitude: From -153° to 2°

LIRD29 3.1.0-6

The GOES-R Series satellites **shall** be capable of being configured to accommodate additional instrumentation with minimal redesign of the spacecraft bus.

LIRD30 3.1.1

**3.1.1 Observational Requirements**

LIRD31 3.1.1.0-1

GOES-R Series System Observational Requirements are prioritized as follows:

- a) **Tier IA:** Key Performance Parameters (KPPs): Inability to meet Threshold level requirement is cause for system reevaluation or termination
- b) **Tier IB:** NOAA Program Priority-1 and High GOES-R Series Satellite Contribution
- c) **Tier II:** NOAA Program Priority-1 and Moderate GOES-R Series Satellite Contribution
- d) **Tier III:** NOAA Program Priority-2/3 and Moderate GOES-R Series Satellite Contribution

**ID                      Object    P417-R-LIRD-0137, RM Version, Level I Requirements Document**  
**Number**

LIRD32    3.1.1.0-2

The high-level GOES-R Series System observational requirements, detailed in the Observational Requirements Appendix [LIRD92], form the basis for the GOES-R Level II Requirements Documents (The GOES-R Mission Requirements Document).

The Observational Requirements Appendix provides a listing of each GOES-R Series Satellite Observational product in relation to Primary Payload Instrument, Tier Prioritization, Geographic Coverage, Vertical Resolution, Horizontal Resolution, Measurement Accuracy, and Refresh Rate requirements.

A summary of the Observational Requirements is provided in the GOES-R Series Observational Requirements Summary Tables below.

**Observational Requirements Summary Tables**

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
<b>AEROSOLS</b>			
Aerosol Detection (including Smoke and Dust)	ABI	IB	C, FD, M
Aerosol Particle Size	ABI	III	FD
Aerosol Optical Depth	ABI	IB	C, FD
Volcanic Ash: Detection and Height	ABI	IB	FD

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
<b>CLOUDS</b>			
Aircraft Icing Threat	ABI	III	FD
Cloud Ice Water Path	ABI	III	C, FD, M
Cloud Layers/Heights	ABI	III	C, FD, M
Cloud Liquid Water	ABI	II	C, FD, M
Cloud and Moisture Imagery	ABI	IA	C, FD, M
Cloud Optical Depth	ABI	III	C, FD
Cloud Particle Size Distribution	ABI	III	C, FD, M
Cloud Top Phase	ABI	III	C, FD, M
Cloud Top Height	ABI	IB	C, FD, M
Cloud Top Pressure	ABI	IB	C, FD
Cloud Top Temperature	ABI	IB	FD, M
Cloud Type	ABI	III	C, FD, M
Convective Initiation	ABI	III	C, M
Enhanced "V"/Overshooting Top Detection	ABI	II	C, M
Hurricane Intensity	ABI	II	FD
Lightning Detection	GLM	IB	C, FD, M
Low Cloud and Fog	ABI	II	FD
Tropopause Folding Turbulence Prediction	ABI	III	FD, M
Visibility	ABI	III	FD

**ID            Object  
              Number**
**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD32 3.1.1.0-2

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
PRECIPITATION			
Probability of Rainfall	ABI	III	FD
Rainfall Potential	ABI	III	FD
Rainfall Rate/QPE	ABI	II	FD

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
PROFILES, INDICES, TOTAL WATER			
Legacy Vertical Moisture Profile	ABI	IB	C, FD, M
Legacy Vertical Temperature Profile	ABI	IB	C, FD, M
Derived Stability Indices	ABI	IB	C, FD, M
Total Precipitable Water	ABI	IB	C, FD, M

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
RADIANCES			
Clear Sky Masks	ABI	II	C, FD, M
Radiances	ABI	IB	C, FD, M

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
RADIATION			
Absorbed Shortwave Radiation: Surface	ABI	II	M
Downward Longwave Radiation: Surface	ABI	II	C, FD
Downward Shortwave Radiation: Surface	ABI	II	C, FD, M
Reflected Shortwave Radiation: TOA	ABI	II	C, FD
Upward Longwave Radiation: Surface	ABI	II	C, FD
Upward Longwave Radiation: TOA	ABI	II	C, FD

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
TRACE GASES			
Ozone Total	ABI	III	C, FD
SO <sub>2</sub> Detection	ABI	III	FD

<b>ATMOSPHERE</b>	Primary Instrument	Priority Tier	Coverage
WINDS			
Derived Motion Winds	ABI	II	C, FD, M

**ID            Object  
                 Number**
**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD32    3.1.1.0-2

<b>LAND</b>	Primary Instrument	Priority Tier	Coverage
Fire/Hot Spot Characterization	ABI	II	C, FD
Flood/Standing Water	ABI	III	FD, M
Ice Cover	ABI	III	FD
Land Surface (Skin) Temperature	ABI	III	C, FD, M
Snow Cover	ABI	II	C, FD, M
Snow Depth (over Plains)	ABI	III	C, FD, M
Surface Albedo	ABI	III	FD
Surface Emissivity	ABI	III	C
Vegetation Fraction: Green	ABI	III	C
Vegetation Index	ABI	III	C

<b>OCEAN</b>	Primary Instrument	Priority Tier	Coverage
Currents	ABI	III	FD, M
Currents: Offshore	ABI	III	C, FD
Sea and Lake Ice: Age	ABI	III	FD
Sea and Lake Ice: Concentration	ABI	III	C, FD
Sea and Lake Ice: Motion	ABI	III	Lakes, FD
Sea Surface Temperature (skin)	ABI	IB	FD

<b>SPACE AND SOLAR</b>	Primary Instrument	Priority Tier	Coverage
<b>ENERGETIC PARTICLES</b>			
Energetic Heavy Ions	SEISS	II	1 dir.
Magnetospheric Electrons and Protons: Low Energy	SEISS	II	5 dir.
Magnetospheric Electrons and Protons: Medium and High Energy	SEISS	II	5 dir.
Solar and Galactic Protons	SEISS	IB	2 dir.

<b>SPACE AND SOLAR</b>	Primary Instrument	Priority Tier	Coverage
<b>MAGNETIC FIELD</b>			
Geomagnetic Field	Mag.	II	3-axis

**ID                      Object Number                      P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD32    3.1.1.0-2

<b>SPACE AND SOLAR</b>	Primary Instrument	Priority Tier	Coverage
SOLAR			
Solar Flux: EUV	EXIS	II	Solar Disk
Solar Flux: X-Ray	EXIS	IB	Solar Disk
Solar Imagery: X-Ray	SUVI	IB	0.0-1.3 Solar Radii

(CCR 1385)(CCR 1419B)(CCR 1425)(CCR 1469)(CCR 1378)(CCR 1418)

Notes:

1. FD = Full Disk, C = CONUS, M = Mesoscale
2. Full Disk: Full Disk is defined as the portion of the earth's full disk observed from geostationary orbit that can be used for the computation of each product, which:
  - a) Varies on a product by product basis (typically 62 to 84 degree local zenith angle)
  - b) Is often less than the full disk observed in imagery
  - c) Provides continuity with GOES-N series data which experience the same limitations

LIRD33    3.1.1.0-3

GOES-R product latency will provide data to the users before the product regeneration is required by the product refresh time requirement.

LIRD34    3.1.1.0-4

For GOES-R, ABI will provide data with finer spatial resolution, faster refresh rate, and comparable to improved product performance relative to the GOES-N series. The GLM will provide new lightning detection capability that was not available on the GOES-N series. The SUVI, EXIS, and SEISS will provide data comparable to improved product performance relative to the GOES-N series.

LIRD35    3.1.1.0-5

GOES-R Series System continuity, above and beyond GOES-NOP, **shall** be consistent with the performance levels required to support the observational requirements outlined in Observational Requirements Appendix [LRID92].

LIRD36    3.1.2

### **3.1.2 Auxiliary Communication Services Requirements**

LIRD37    3.1.2.0-1

The GOES-R Series System **shall** meet or exceed the level of capability of the current GOES-NOP series in the relay of emergency beacon signals to Local User Terminals (LUTs) in the Search and Rescue Satellite Aided Tracking (SARSAT) system.

LIRD38    3.1.2.0-2

The GOES-R Series System **shall** meet or exceed the level of capability of the current GOES-NOP series for the rebroadcast of Emergency Managers Weather Information Network (EMWIN) data.

LIRD39    3.1.2.0-3

The GOES-R Series System **shall** meet or exceed the level of capability of the current GOES-NOP series for the rebroadcast of Low rate Image Transmission (LRIT) data.

LIRD40    3.1.2.0-4

The GOES-R Series System **shall** meet or exceed the level of capability of the current GOES-NOP series for the collection of data from in-situ Data Collection Platforms (DCP).

LIRD41    3.1.2.0-5

The GOES-R Series System **shall** have the capability of distributing calibrated and navigated (Level 1b equivalent, as applicable) GOES-R data via satellite rebroadcast.

LIRD42    3.1.3

### **3.1.3 Satellite Operations/Mission Management Requirements**

ID	Object Number	P417-R-LIRD-0137, RM Version, Level I Requirements Document
LIRD43	3.1.3.0-1	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for the acquisition and transmission of the raw environmental data, and associated ancillary data, to ground stations to allow for the timely and accurate processing of data.
LIRD44	3.1.3.0-2	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for rapid collection, processing and analysis of platform and instrument data for the monitoring of the satellite constellations health, safety and performance.
LIRD45	3.1.3.0-3	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for scheduling and executing satellite operations and data acquisition functions while continuing to meet user observational requirements.
LIRD46	3.1.4	<b>3.1.4 Product Generation Requirements</b>
LIRD47	3.1.4.0-1	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for the ingest of environmental and ancillary data from GOES-R, and other auxiliary datasets (other remotely sensed or in-situ datasets, model output etc.) required for the processing of data to meet users needs.
LIRD48	3.1.4.0-2	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series in the processing of environmental and ancillary data from GOES-R, and other auxiliary datasets (other remotely sensed or in-situ datasets, model output etc.) required to meet both direct and derived product generation in terms of users geographic coverage and resolution, accuracy, refresh and data latency specifications.
LIRD49	3.1.4.0-3	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for monitoring and analysis of all data processing components health, safety and performance.
LIRD50	3.1.5	<b>3.1.5 Product Distribution/Archiving Requirements</b>
LIRD51	3.1.5.0-1	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series in the dissemination and access of environmental data and products.
LIRD52	3.1.5.0-2	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series in the storage (archive) and retrieval of environmental data and products.
LIRD53	3.1.6	<b>3.1.6 Enterprise Management</b>
LIRD54	3.1.6.0-1	The GOES-R Series System <b>shall</b> meet or exceed the level of capability of the current GOES-NOP series for monitoring, assessing, and regulating the elements that comprise the operational systems, networks, and communication for the GOES-R ground system.

ID	Object Number	P417-R-LIRD-0137, RM Version, Level I Requirements Document
LIRD55	4	<b>4 Baseline Instrumentation</b>
LIRD56	4.1	<b>4.1 Advanced Baseline Imager (ABI)</b>
LIRD57	4.1.0-1	The ABI is a multi-spectral channel, two-axis scanning radiometer designed to provide variable area imagery and radiometric information of the Earth's surface as well as the capability for star sensing. The ABI measures emitted and solar reflected radiance simultaneously in all spectral channels. Data availability, radiometric quality, simultaneous data collection, coverage rates, scan flexibility, and minimizing data loss due to the sun, are prime capability requirements of the ABI system.
LIRD58	4.2	<b>4.2 Reserved</b>
LIRD59	4.3	<b>4.3 EUVS XRS Irradiance Sensors (EXIS)</b>
LIRD60	4.3.0-1	The Solar X Ray Sensor (XRS) is designed to detect the beginning, duration, and magnitude of solar X-ray flares. It also provides input to models predicting severe impacts on satellites, astronauts, and airline passengers on polar routes, and provides input on possible impacts to power grid performance. The Extreme Ultraviolet Sensor (EUVS) is designed to provide information on the full EUV spectrum that is critical to understanding and modeling the thermosphere and ionosphere.
LIRD61	4.4	<b>4.4 Solar UltraViolet Imager (SUVI)</b>
LIRD62	4.4.0-1	The Solar extreme UltraViolet Imager (SUVI) is a coronal imager that provides full-disk solar images, designed to provide information to aid in forecasting geomagnetic storms and Solar Energetic Particle (SEP) events.
LIRD63	4.5	<b>4.5 Space Environment In-Situ Suite (SEISS)</b>
LIRD64	4.5.0-1	The Space Environment In-Situ Suite (SEISS) consists of energetic particle sensors. The particle sensors will monitor the proton, electron and alpha particle fluxes. Knowledge of the near-Earth energetic particle environment is important in establishing the natural radiation hazard to humans at high altitudes and in space, as well as risk assessment and warning of radiation hazards to satellite systems. In addition, warnings of high flux episodes can mitigate damage to radio communications and navigation systems.
LIRD65	4.6	<b>4.6 Geostationary Lightning Mapper (GLM)</b>
LIRD66	4.6.0-1	The Geostationary Lightning Mapper is designed to continuously map all forms of lightning with a high spatial resolution and detection efficiency over the Western Hemisphere. GLM will deliver, on a real-time basis, lightning measurements that are of sufficient quality and quantity for operational thunderstorm intensity monitoring in support of tornado, severe thunderstorm, and flash flood warnings. GLM information will support operational Aviation Weather applications allowing for avoidance of thunderstorm related convective weather hazards. (CCR 1437)
LIRD67	4.7	<b>4.7 Magnetometer</b>
LIRD68	4.7.0-1	The magnetometer will measure the magnitude and direction of the Earth's ambient magnetic field. The magnetometer will provide a map of the space environment that controls charged particle dynamics in the outer region of the magnetosphere. Magnetic field measurements provide information on the general level of geomagnetic activity, monitor current systems in space, and permit detection of magnetopause crossings, sudden storm commencements, and substorms.
LIRD69	4.8	<b>4.8 Instrument Performance Specifications</b>

**ID**      **Object  
Number****P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD70    4.8.0-1

The Observational Requirements Appendix [LIRD92] aligns the instrumentation baselined for the GOES-R Series with the system high level (threshold) observation requirements listed in the appendix. Threshold performance levels are those required to ensure continuity of capabilities with the current GOES-NOP Series. Threshold and objective (goal) performance levels will be listed in Level II requirements documentation.

ID	Object Number	P417-R-LIRD-0137, RM Version, Level I Requirements Document
LIRD244	5	<b>5 Operational Capability Status (CCR 1259)</b>
LIRD79	5.1	<b>5.1 System Initial Operational Capability (IOC)</b>
LIRD80	5.1.0-1	An Initial Operating Capability will be achieved when quality Cloud and Water Vapor imagery are available, with either west or east coverage, exclusively from GOES-R Series satellite(s) and associated Ground Segment capabilities.
LIRD81	5.2	<b>5.2 System Full Operational Capability (FOC)</b>
LIRD82	5.2.0-1	Full Operational Capability (FOC) will provide the full coverage of the east and west positions and associated Ground Segment capabilities.
LIRD83	5.3	<b>5.3 System Operational Lifetime (CCR 1259)</b>
LIRD84	5.3.0-1	System lifetime <b>shall</b> extend from IOC, beginning immediately after instrument check-out, to the End of Operational Lifetime. (see Program Management Directive) (CCR 1259)

**ID**            **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD245    6

**6 Level I Budget and Schedule Requirements (CCR 1259)**

LIRD246    6.0-1

GOES-R Level I Budget and Schedule Requirements will be updated yearly and documented in the GOES-R Program Management Directive, which will be approved by the Deputy Under Secretary for Oceans and Atmosphere and accepted by the GOES-R System Program Director and the NESDIS Assistant Administrator.

The Program Management Directive will include:

1. Program Overview
2. Schedule Commitment
3. Cost Commitment

If the GPO projects that the total development cost of the program will exceed the estimate provided at KDP I by more than 10 percent, written notification shall be provided to the NOAA DUS and the program will be subject to a NOAA program assessment. This assessment should address, as a minimum:

- a) Rescope options
- b) Realism of new estimates of the development cost
- c) Adequacy of management structure and processes to manage and control program

The Program Director **shall** notify the NOAA Under Secretary and the NESDIS Assistant Administrator if there is reasonable cause to believe that the development cost of the program will exceed the estimate provided in the Baseline Report of the program by 20 percent or more, and provide the Under Secretary a written notification explaining the reasons for the change within 30 days.

In the event that any key milestone defined in the Program Management Directive is projected to delay greater than three months, the GPO shall notify the NOAA DUS and NESDIS AA.

As specified in the Memorandum for the Delegation of Key Decision Point Authority for the GOES-R Program, as part of the regular reporting on GOES-R, NOAA and the GOES-R program will highlight for the Chief Financial Officer and Assistant Secretary for Administration actual or expected deviation from GOES-R cost or schedule variances in all program elements -including ground systems, spacecraft, instruments, and systems engineering - exceeding 5% of the dollar amount or schedule currently established for that element. Schedule variance shall be defined as a projected 3 month delay of key, critical, or program milestones as defined in the Management Control Plan. (CCR 1259)(CCR 1275)

<b>ID</b>	<b>Object Number</b>
-----------	--------------------------

## **P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD88	7
--------	---

### **7 MINIMUM PERFORMANCE SUCCESS CRITERIA**

LIRD89	7.0-1
--------	-------

Mission availability, which is the probability that the entire GOES-R series system can be successfully used for its specified mission (collection, generation, and distribution of the KPPs) over the operational lifetime, **shall** be 0.97 over the central subset coverage zone defined in the Coverage Zone Definitions Table (LIRD28 [3.1.0-5]). When coverage is supplied by another GOES series such as a GOES-N or the next GOES series, the availability contribution from this coverage area is considered to be 100% over its lifetime for this calculation.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD90    8

**8 Acronyms Appendix (CCR 1419B)**

LIRD91    8.0-1

AA	Assistant Administrator
ABI	Advanced Baseline Imager
B	Billion
C	CONUS
CLASS	Comprehensive Large Array - Data Stewardship System
CMD	Command
CONUS	Contiguous United States
CORL	Consolidated Observational Requirements List
DAA	Deputy Associate Administrator
DCP	Data Collection Platform
DCPI	Data Collection Platform Interrogate
DCPR	Data Collection Platform Report
DCS	Data Collection System
dir	Direction
DOC	Department of Commerce
DUS	Deputy Under Secretary
EEZ	Exclusive Economic Zone
EMWIN	Emergency Managers Weather Information Network
EUV	Extreme UltraViolet
EUVS	Extreme UltraViolet Sensor
EXIS	EUVS XRS Irradiance Sensors
FOC	Full Operating Capability
FD	Full Disk
GLM	Geostationary Lightning Mapper
GOES	Geostationary Operational Environmental Satellite
GORWG	GOES-R Operational Requirements Working Group
GPO	Government Program Office
GPRA	Government Performance Results Act
GRB	GOES Rebroadcast
GSFC	Goddard Space Flight Center
hr	Hour
IOC	Initial Operating Capability
J/kg	Joules/Kilogram
K	Kelvin
KDP	Key Decision Point
km	Kilometer
KPP	Key Performance Parameter
LRIT	Low Rate Information Transmission
LUT	Local User Terminal
m/s	Meter/Second
m	Meter
M	Mesoscale
M	Million
mb	Millibars
mm	Millimeter
MAG	Magnetometer
min	Minute
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NEC	NOAA Executive Council
NEP	NOAA Executive Panel
NESDIS	National Environmental Satellite, Data Information Service
NOAA	National Oceanic and Atmospheric Administration
NOSC	NOAA Observing Systems Council

**ID            Object                                    P417-R-LIRD-0137, RM Version, Level I Requirements Document**  
**Number**

LIRD91	8.0-1	NSOF	NOAA Satellite Operations Facility
		nT	Nanotesla
		PMC	Program Management Council
		QPE	Quantitative Precipitation Estimation
		RBU	Remote Backup facility
		SARSAT	Search and Rescue Satellite Aided Tracking
		SEC	Space Environment Center
		SEISS	Space Environment In-Situ Suite
		SEP	Solar Energetic Particles
		SPD	System Program Director
		SUVI	Solar UltraViolet Imager
		TBD	To Be Determined
		TBR	To Be Resolved
		TOA	Top of Atmosphere
		W	Watt
		WCDAS	Wallops Command and Data Acquisition Station
		XRS	Solar X-Ray Sensor

*(CCR 1419B)*

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD92    9

**9 Observational Requirements Appendix**

LIRD93    9.1

**9.1 Observational Requirements: Atmosphere**

LIRD94    9.1.1

**9.1.1 Aerosols**

LIRD95    9.1.1.1

**9.1.1.1 Aerosol Detection (including Smoke and Dust)**

LIRD96    9.1.1.1.0-1

The GOES-R System **shall** produce Aerosol Detection (including Smoke and Dust) observational products in accordance with the table below.

<b>Aerosol Detection (including Smoke and Dust)</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Total column
Horizontal Resolution	2 km
Measurement Accuracy	Dust: 80% correct detection over land and ocean Smoke: 80% correct detection over land; 70% correct detection over ocean
Refresh Rate/Coverage Time	15 min

(CCR 1469)

LIRD97    9.1.1.2

**9.1.1.2 Aerosol Particle Size**

LIRD98    9.1.1.2.0-1

The GOES-R System **shall** produce an Aerosol Particle Size observational product in accordance with the table below.

<b>Aerosol Particle Size</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	Total column
Horizontal Resolution	2 km
Measurement Accuracy	0.03 $\mu\text{m}$ radius
Refresh Rate/Coverage Time	15 min

(CCR 1419B)

LIRD99    9.1.1.3

**9.1.1.3 Aerosol Optical Depth (CCR 1469)**

LIRD100    9.1.1.3.0-1

The GOES-R System **shall** produce an Aerosol Optical Depth observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD100 9.1.1.3.0-1

<b>Aerosol Optical Depth</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	Total column
Horizontal Resolution	2 km
Measurement Accuracy	Based on Aerosol Optical Depth ranges: Over land: < 0.04: 0.06 0.04 – 0.80: 0.04 > 0.80: 0.12 Over water: < 0.40: 0.02 > 0.40: 0.10
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min

(CCR 1469)

LIRD101 9.1.1.4

**9.1.1.4 Volcanic Ash: Detection and Height**

LIRD102 9.1.1.4.0-1

The GOES-R System **shall** produce a Volcanic Ash: Detection and Height observational product in accordance with the table below.

<b>Volcanic Ash: Detection and Height</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	3 km (top height)
Horizontal Resolution	2 km
Measurement Accuracy	2 ton/km <sup>2</sup>
Refresh Rate/Coverage Time	15 min

(CCR 1419B)

LIRD103 9.1.2

**9.1.2 Clouds**

LIRD104 9.1.2.1

**9.1.2.1 Aircraft Icing Threat**

LIRD105 9.1.2.1.0-1

The GOES-R System **shall** produce an Aircraft Icing Threat observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD105    9.1.2.1.0-1

<b>Aircraft Icing Threat</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	Cloud top
Horizontal Resolution	10 km
Measurement Accuracy	50% correct classification
Refresh Rate/Coverage Time	60 min

(CCR 1425)

LIRD106    9.1.2.2

**9.1.2.2 Cloud Ice Water Path**

LIRD107    9.1.2.2.0-1

The GOES-R System **shall** produce a Cloud Ice Water Path observational product in accordance with the table below.

<b>Cloud Ice Water Path</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS – for limited cloudiness Full Disk – for limited cloudiness Mesoscale – for limited cloudiness
Vertical Resolution	Surface – 20 km
Horizontal Resolution	2 km
Measurement Accuracy	Greater of 25 g/m <sup>2</sup> or 30%
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min Mesoscale: 5 min

(CCR 1419B)

LIRD110    9.1.2.3

**9.1.2.3 Cloud Layers/Heights (CCR 1419B)**

LIRD111    9.1.2.3.0-1

The GOES-R System **shall** produce a Cloud Layers/Heights observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD111    9.1.2.3.0-1

<b>Cloud Layers/Heights</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	1 cloud layer
Horizontal Resolution	CONUS: 10 km Full Disk: 10 km Mesoscale: 4 km
Measurement Accuracy	80% correct classification
Refresh Rate/Coverage Time	CONUS: 60 min Full Disk: 60 min Mesoscale: 5 min

(CCR 1419B)

LIRD112    9.1.2.4

**9.1.2.4 Cloud Liquid Water**

LIRD113    9.1.2.4.0-1

The GOES-R System **shall** produce a Cloud Liquid Water observational product in accordance with the table below.

<b>Cloud Liquid Water</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Total column
Horizontal Resolution	2 km
Measurement Accuracy	Greater of 25 g/m <sup>2</sup> or 15%
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 30 min Mesoscale: 5 min

(CCR 1419B)

LIRD114    9.1.2.5

**9.1.2.5 Cloud and Moisture Imagery**

LIRD115    9.1.2.5.0-1

The GOES-R System **shall** produce a Cloud and Moisture Imagery observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD115    9.1.2.5.0-1

<b>Cloud and Moisture Imagery</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IA
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	2 km, with finer daytime observations
Measurement Accuracy	N/A
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min Mesoscale: 30 sec

LIRD116    9.1.2.6

**9.1.2.6 Cloud Optical Depth**

LIRD117    9.1.2.6.0-1

The GOES-R System **shall** produce a Cloud Optical Depth observational product in accordance with the table below.

<b>Cloud Optical Depth</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS: optical depth > 1 Full Disk: optical depth > 1
Vertical Resolution	Total column
Horizontal Resolution	CONUS: 2 km Full Disk: 4 km
Measurement Accuracy	Liquid phase: 20% (Day), 20% (Night); Ice phase: 20% (Day), 30% (Night)
Refresh Rate/Coverage Time	CONUS: 30 min Full Disk: 15 min

(CCR 1419B)

LIRD118    9.1.2.7

**9.1.2.7 Cloud Particle Size Distribution**

LIRD119    9.1.2.7.0-1

The GOES-R System **shall** produce a Cloud Particle Size Distribution observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD119    9.1.2.7.0-1

<b>Cloud Particle Size Distribution</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Cloud Top
Horizontal Resolution	2 km
Measurement Accuracy	4 $\mu$ m
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min Mesoscale: 5 min

LIRD120    9.1.2.8

**9.1.2.8 Cloud Top Phase**

LIRD121    9.1.2.8.0-1

The GOES-R System **shall** produce a Cloud Top Phase observational product in accordance with the table below.

<b>Cloud Top Phase</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Cloud Top
Horizontal Resolution	2 km
Measurement Accuracy	80% correct classification
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min Mesoscale: 5 min

*(CCR 1419B)*

LIRD122    9.1.2.9

**9.1.2.9 Cloud Top Height**

LIRD123    9.1.2.9.0-1

The GOES-R System **shall** produce a Cloud Top Height observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD123    9.1.2.9.0-1

<b>Cloud Top Height</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Cloud top
Horizontal Resolution	CONUS: 10 km Full Disk: 10 km Mesoscale: 4 km
Measurement Accuracy	500 m for clouds with emissivity > 0.8
Refresh Rate/Coverage Time	CONUS: 60 min Full Disk: 60 min Mesoscale: 5 min

(CCR 1419B)

LIRD124    9.1.2.10

**9.1.2.10 Cloud Top Pressure**

LIRD125    9.1.2.10.0-1

The GOES-R System **shall** produce a Cloud Top Pressure observational product in accordance with the table below.

<b>Cloud Top Pressure</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	Cloud top
Horizontal Resolution	10 km
Measurement Accuracy	50 mb for clouds with emissivity > 0.8
Refresh Rate/Coverage Time	CONUS: 60 min Full Disk: 60 min

(CCR 1419B)

LIRD126    9.1.2.11

**9.1.2.11 Cloud Top Temperature**

LIRD127    9.1.2.11.0-1

The GOES-R System **shall** produce a Cloud Top Temperature observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD127    9.1.2.11.0-1

<b>Cloud Top Temperature</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk Mesoscale
Vertical Resolution	At cloud tops
Horizontal Resolution	2 km
Measurement Accuracy	3 K for clouds with emissivity > 0.8
Refresh Rate/Coverage Time	Full Disk: 15 min Mesoscale: 5 min

(CCR 1419B)

LIRD128    9.1.2.12

**9.1.2.12 Cloud Type**

LIRD129    9.1.2.12.0-1

The GOES-R System **shall** produce a Cloud Type observational product in accordance with the table below.

<b>Cloud Type</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 10km Full Disk: 2km Mesoscale: 2 km
Measurement Accuracy	60% correct classification
Refresh Rate/Coverage Time	CONUS: 30 min Full Disk: 15 min Mesoscale: 15 min

(CCR 1419B)

LIRD130    9.1.2.13

**9.1.2.13 Convective Initiation**

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD131 9.1.2.13.0-1 The GOES-R System **shall** produce a Convective Initiation observational product in accordance with the table below.

<b>Convective Initiation</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	70% correct detection
Refresh Rate/Coverage Time	CONUS: 5 min Mesoscale: 5 min

(CCR 1346)(CCR 1425)

LIRD132 9.1.2.14

**9.1.2.14 Enhanced "V"/Overshooting Top Detection**

LIRD133 9.1.2.14.0-1 The GOES-R System **shall** produce an Enhanced "V"/Overshooting Top Detection observational product in accordance with the table below.

<b>Enhanced "V"/Overshooting Top Detection</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	75% correct detection (in terms of 1 – False Alarm Rate) for known emissivity and known atmosphere
Refresh Rate/Coverage Time	5 min

(CCR 1425)

LIRD134 9.1.2.15

**9.1.2.15 Hurricane Intensity**

LIRD135 9.1.2.15.0-1 The GOES-R System **shall** produce a Hurricane Intensity observational product in accordance with the table below.

<b>Hurricane Intensity</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	5 m/s over ocean
Refresh Rate/Coverage Time	30 min

**ID                      Object Number                      P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD136    9.1.2.16                      **9.1.2.16 Lightning Detection**

LIRD137    9.1.2.16.0-1                      The Product will include the collection of Lightning Events, identification of contiguous Events as “Lightning Groups” and events having discrete time and space continuity as “Lightning Flashes.”

The GOES-R System **shall** produce a Lightning Detection observational product in accordance with the table below.

<b>Lightning Detection</b>	<b>Threshold</b>
Primary Instrument	GLM
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	Surface to cloud top
Horizontal Resolution	10 km
Measurement Accuracy	70% total flashes detection
Refresh Rate/Coverage Time	20 sec

(CCR 1419B)(CCR 1437)

LIRD138    9.1.2.17                      **9.1.2.17 Low Cloud and Fog**

LIRD139    9.1.2.17.0-1                      The GOES-R System **shall** produce a Low Cloud and Fog observational product in accordance with the table below.

<b>Low Cloud and Fog</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	0.5 km (depth)
Horizontal Resolution	2 km
Measurement Accuracy	70% correct detection
Refresh Rate/Coverage Time	15 min

(CCR 1425)

LIRD140    9.1.2.18                      **9.1.2.18 Tropopause Folding Turbulence Prediction (CCR 1425)**

LIRD141    9.1.2.18.0-1                      The GOES-R System **shall** produce a Tropopause Folding Turbulence Prediction observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD141 9.1.2.18.0-1

<b>Tropopause Folding Turbulence Prediction</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk Mesoscale
Vertical Resolution	Surface – 100mb
Horizontal Resolution	2 km
Measurement Accuracy	50% correct detection of Moderate or Greater turbulence
Refresh Rate/Coverage Time	Full Disk: 15 min Mesoscale: 5 min

(CCR 1419B)(CCR 1425)

LIRD142 9.1.2.19

**9.1.2.19 Visibility**

LIRD143 9.1.2.19.0-1

The GOES-R System **shall** produce a Visibility observational product in accordance with the table below.

<b>Visibility</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	10 km
Measurement Accuracy	80% correct classification
Refresh Rate/Coverage Time	60 min

(CCR 1425)

LIRD144 9.1.3

**9.1.3 Precipitation**

LIRD145 9.1.3.1

**9.1.3.1 Probability of Rainfall**

LIRD146 9.1.3.1.0-1

The GOES-R System **shall** produce a Probability of Rainfall observational product in accordance with the table below.

<b>Probability of Rainfall</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	25%
Refresh Rate/Coverage Time	15 min

LIRD147 9.1.3.2

**9.1.3.2 Rainfall Potential**

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD148 9.1.3.2.0-1 The GOES-R System **shall** produce a Rainfall Potential observational product in accordance with the table below.

<b>Rainfall Potential</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	5 mm for pixels designated as raining
Refresh Rate/Coverage Time	15 min

(CCR 1426A)

LIRD149 9.1.3.3 **9.1.3.3 Rainfall Rate/QPE**

LIRD150 9.1.3.3.0-1 The GOES-R System **shall** produce a Rainfall Rate/QPE observational product in accordance with the table below.

<b>Rainfall Rate/QPE</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	6 mm/hr at 10 mm/hr rate with higher values at higher rates
Refresh Rate/Coverage Time	15 min

(CCR 1426A)

LIRD151 9.1.4 **9.1.4 Profiles, Indices, Total Water**

LIRD152 9.1.4.1 **9.1.4.1 Legacy Vertical Moisture Profile**

LIRD153 9.1.4.1.0-1 The GOES-R System **shall** produce a Legacy Vertical Moisture Profile observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD153    9.1.4.1.0-1

<b>Legacy Vertical Moisture Profile</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Reflects layering of numerical weather prediction models; Inherent vertical resolution is only 3 to 5 km
Horizontal Resolution	10 km
Measurement Accuracy	20% relative humidity
Refresh Rate/Coverage Time	Full Disk: 60 min CONUS: 30min Mesoscale: 5 min

(CCR 1346)(CCR 1417)

LIRD154    9.1.4.2

**9.1.4.2 Legacy Vertical Temperature Profile**

LIRD155    9.1.4.2.0-1

The GOES-R System **shall** produce a Legacy Vertical Temperature Profile observational product in accordance with the table below.

<b>Legacy Vertical Temperature Profile</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Reflects layering of numerical weather prediction models; Inherent vertical resolution is only 3 to 5 km
Horizontal Resolution	10 km
Measurement Accuracy	1 K below 400 hPa and above boundary layer
Refresh Rate/Coverage Time	Full Disk: 60 min CONUS: 30 min Mesoscale: 5 min

(CCR 1346)(CCR 1417)

LIRD156    9.1.4.3

**9.1.4.3 Derived Stability Indices**

LIRD157    9.1.4.3.0-1

The GOES-R System **shall** produce a Derived Stability Indices observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD157 9.1.4.3.0-1

<b>Derived Stability Indices</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk CONUS Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	Full Disk: 10km CONUS: 4 km Mesoscale: 4 km
Measurement Accuracy	Lifted Index: 2.0K CAPE: 1000 J/kg Shower index: 2 Total totals Index: 1 K-index: 2
Refresh Rate/Coverage Time	Full Disk: 60 min CONUS: 30 min Mesoscale: 5 min

(CCR 1346)(CCR 1417)

LIRD158 9.1.4.4

**9.1.4.4 Total Precipitable Water**

LIRD159 9.1.4.4.0-1

The GOES-R System **shall** produce a Total Precipitable Water observational product in accordance with the table below.

<b>Total Precipitable Water</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk CONUS Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	Full Disk = 10 km CONUS = 10 km Mesoscale = 10 km
Measurement Accuracy	1 mm
Refresh Rate/Coverage Time	Full Disk = 60 min CONUS = 30 min Mesoscale = 5 min

(CCR 1314)(CCR 1419B)(CCR 1417)

LIRD162 9.1.5

**9.1.5 Radiances**

LIRD163 9.1.5.1

**9.1.5.1 Clear Sky Masks**

LIRD164 9.1.5.1.0-1

The GOES-R System **shall** produce a Clear Sky Masks observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD164    9.1.5.1.0-1

<b>Clear Sky Masks</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	87% correct detection
Refresh Rate/Coverage Time	CONUS: 15 min Full Disk: 15 min Mesoscale: 5 min

(CCR 1419B)

LIRD165    9.1.5.2

**9.1.5.2 Radiances**

LIRD166    9.1.5.2.0-1

The GOES-R System **shall** produce a Radiances observational product in accordance with the table below.

<b>Radiances</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	Individual channel resolutions (0.5 km, 1.0 km, and 2.0 km)
Measurement Accuracy	1.0 K equivalent when converted into brightness temperature units for known emissivity
Refresh Rate/Coverage Time	Full Disk: 15 min CONUS: 15 min Mesoscale: 5 min

(CCR 1346)

LIRD167    9.1.6

**9.1.6 Radiation**

LIRD168    9.1.6.1

**9.1.6.1 Absorbed Shortwave Radiation: Surface**

LIRD169    9.1.6.1.0-1

The GOES-R System **shall** produce an Absorbed Shortwave Radiation: Surface observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD169    9.1.6.1.0-1

<b>Absorbed Shortwave Radiation: Surface</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	5 km
Measurement Accuracy	90 W/m <sup>2</sup> at low value (100 W/m <sup>2</sup> ); 45 W/m <sup>2</sup> at mid value (400 W/m <sup>2</sup> ); 55 W/m <sup>2</sup> at high value (800 W/m <sup>2</sup> )'
Refresh Rate/Coverage Time	60 min

(CCR 1385)

LIRD170    9.1.6.2

**9.1.6.2 Downward Longwave Radiation: Surface**

LIRD171    9.1.6.2.0-1

The GOES-R System **shall** produce a Downward Longwave Radiation: Surface observational product in accordance with the table below.

<b>Downward Longwave Radiation: Surface</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 25 km Full Disk: 100 km
Measurement Accuracy	25 W/m <sup>2</sup>
Refresh Rate/Coverage Time	60 min

LIRD172    9.1.6.3

**9.1.6.3 Downward Shortwave Radiation: Surface (CCR 1385)**

LIRD173    9.1.6.3.0-1

The GOES-R System **shall** produce a Downward Shortwave Radiation: Surface observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD173 9.1.6.3.0-1

<b>Downward Shortwave Radiation: Surface</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 25 km Full Disk: 50 km Mesoscale: 5 km
Measurement Accuracy	85 W/m <sup>2</sup> at high end of range (1000 W/m <sup>2</sup> ); 65 W/m <sup>2</sup> at typical value/midpoint (350 W/m <sup>2</sup> ); 110 W/m <sup>2</sup> at low end of range (100 W/m <sup>2</sup> )
Refresh Rate/Coverage Time	60 min

(CCR 1385)

LIRD174 9.1.6.4

**9.1.6.4 Reflected Shortwave Radiation: TOA (CCR 1385)**

LIRD175 9.1.6.4.0-1

The GOES-R System **shall** produce a Reflected Shortwave Radiation: TOA observational product in accordance with the table below.

<b>Reflected Shortwave Radiation: TOA</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 25 km Full Disk: 100 km
Measurement Accuracy	85 W/m <sup>2</sup> at high end of range (1000 W/m <sup>2</sup> ); 65 W/m <sup>2</sup> at typical value/midpoint (350 W/m <sup>2</sup> ); 110 W/m <sup>2</sup> at low end of range (100 W/m <sup>2</sup> )
Refresh Rate/Coverage Time	60 min

(CCR 1385)

LIRD176 9.1.6.5

**9.1.6.5 Upward Longwave Radiation: Surface**

LIRD177 9.1.6.5.0-1

The GOES-R System **shall** produce an Upward Longwave Radiation: Surface observational product in accordance with the table below.

**ID            Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD177    9.1.6.5.0-1

<b>Upward Longwave Radiation: Surface</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS, Full Disk
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 25 km Full Disk: 100 km
Measurement Accuracy	30 W/m <sup>2</sup>
Refresh Rate/Coverage Time	60 min

(CCR 1385)

LIRD178    9.1.6.6

**9.1.6.6 Upward Longwave Radiation: TOA**

LIRD179    9.1.6.6.0-1

The GOES-R System **shall** produce an Upward Longwave Radiation: TOA observational product in accordance with the table below.

<b>Upward Longwave Radiation: TOA</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	N/A
Horizontal Resolution	25 km
Measurement Accuracy	20 W/m <sup>2</sup>
Refresh Rate/Coverage Time	60 min

LIRD180    9.1.7

**9.1.7 Trace Gases**

LIRD181    9.1.7.1

**9.1.7.1 Ozone Total**

LIRD182    9.1.7.1.0-1

The GOES-R System **shall** produce an Ozone Total observational product in accordance with the table below.

<b>Ozone Total</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	Total column
Horizontal Resolution	10 km
Measurement Accuracy	15 Dobson Units
Refresh Rate/Coverage Time	60 min

(CCR 1469)

LIRD183    9.1.7.2

**9.1.7.2 SO<sub>2</sub> Detection**

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD184    9.1.7.2.0-1    The GOES-R System **shall** produce an SO<sub>2</sub> Detection observational product in accordance with the table below.

<b>SO<sub>2</sub> Detection</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	Total column
Horizontal Resolution	5 km
Measurement Accuracy	70% correct detection
Refresh Rate/Coverage Time	60 min

(CCR 1425)

LIRD185    9.1.8            **9.1.8 Winds**

LIRD186    9.1.8.1        **9.1.8.1 Derived Motion Winds**

LIRD187    9.1.8.1.0-1    The GOES-R System **shall** produce a Derived Motion Winds observational product in accordance with the table below.

<b>Derived Motion Winds</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	Cloud motion vector winds: At cloud tops; Clear-Sky water vapor winds: 200mb
Horizontal Resolution	CONUS: 10 km Full Disk: 30 km Mesoscale: 10km
Measurement Accuracy	Mean Vector Difference: 7.5 m/s
Refresh Rate/Coverage Time	CONUS: 15 min Full Disk: 60 min (based on a single set of 3 sequential images 5 or more minutes apart) Mesoscale: 5 min

(CCR 1346)(CCR 1386A)

LIRD188    9.2              **9.2 Observational Requirements: Land**

LIRD189    9.2.1          **9.2.1 Fire/Hot Spot Characterization**

LIRD190    9.2.1.0-1    The GOES-R System **shall** produce a Fire/Hot Spot Characterization observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD190    9.2.1.0-1

<b>Fire/Hot Spot Characterization</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	2.0 K within dynamic range
Refresh Rate/Coverage Time	CONUS: 5 min Full Disk: 15 min

LIRD191    9.2.2

**9.2.2 Flood/Standing Water**

LIRD192    9.2.2.0-1

The GOES-R System **shall** produce a Flood/Standing Water observational product in accordance with the table below.

<b>Flood/Standing Water</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	10 km
Measurement Accuracy	60% correct classification
Refresh Rate/Coverage Time	60 min

(CCR 1383)

LIRD193    9.2.3

**9.2.3 Ice Cover (CCR 1418)**

LIRD194    9.2.3.0-1

The GOES-R System **shall** produce an Ice Cover observational product in accordance with the table below.

<b>Ice Cover</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	85% correct detection
Refresh Rate/Coverage Time	180 min

(CCR 1418)

LIRD195    9.2.4

**9.2.4 Land Surface (Skin) Temperature**

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD196    9.2.4.0-1

The GOES-R System **shall** produce a Land Surface (Skin) Temperature observational product in accordance with the table below.

<b>Land Surface (Skin) Temperature</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 2 km Full Disk: 10 km Mesoscale: 2 km
Measurement Accuracy	2.5 K with known emissivity, known atmospheric correction, and 80% channel correlation; 5 K otherwise
Refresh Rate/Coverage Time	60 min

LIRD197    9.2.5

**9.2.5 Snow Cover**

LIRD198    9.2.5.0-1

The GOES-R System **shall** produce a Snow Cover observational product in accordance with the table below.

<b>Snow Cover</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	II
Geographic Coverage/Conditions	CONUS Full Disk Mesoscale
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	0.30
Refresh Rate/Coverage Time	60 min

(CCR 1418)

LIRD199    9.2.6

**9.2.6 Snow Depth (over Plains)**

LIRD200    9.2.6.0-1

The GOES-R System **shall** produce a Snow Depth (over Plains) observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD200 9.2.6.0-1

<b>Snow Depth (over Plains)</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS - tall grassy plains only Full Disk - tall grassy plains only Mesoscale - tall grassy plains only
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	9 cm
Refresh Rate/Coverage Time	60 min

(CCR 1418)

LIRD201 9.2.7

**9.2.7 Surface Albedo**

LIRD202 9.2.7.0-1

The GOES-R System **shall** produce a Surface Albedo observational product in accordance with the table below.

<b>Surface Albedo</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	0.08 (albedo units)
Refresh Rate/Coverage Time	60 min

LIRD203 9.2.8

**9.2.8 Surface Emissivity**

LIRD204 9.2.8.0-1

The GOES-R System **shall** produce a Surface Emissivity observational product in accordance with the table below.

<b>Surface Emissivity</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage Conditions	CONUS
Vertical Resolution	N/A
Horizontal Resolution	10 km
Measurement Accuracy	0.05
Refresh Rate/Coverage Time	60 min

(CCR 1419B)(CCR 1417)

LIRD205 9.2.9

**9.2.9 Vegetation Fraction: Green**

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD206    9.2.9.0-1

The GOES-R System **shall** produce a Vegetation Fraction: Green observational product in accordance with the table below.

<b>Vegetation Fraction: Green</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	0.05
Refresh Rate/Coverage Time	60 min

LIRD207    9.2.10

**9.2.10 Vegetation Index**

LIRD208    9.2.10.0-1

The GOES-R System **shall** produce a Vegetation Index observational product in accordance with the table below.

<b>Vegetation Index</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	0.04 NDVI Units
Refresh Rate/Coverage Time	60 min

LIRD209    9.3

**9.3 Observational Requirements: Ocean**

LIRD210    9.3.1

**9.3.1 Currents**

LIRD211    9.3.1.0-1

The GOES-R System **shall** produce a Currents observational product in accordance with the table below.

<b>Currents</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk Mesoscale
Vertical Resolution	Surface
Horizontal Resolution	2 km
Measurement Accuracy	Speed: 1.0 km/hr; Direction: 45°
Refresh Rate/Coverage Time	6 hr

(CCR 1384)

LIRD212    9.3.2

**9.3.2 Currents: Offshore**

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD213    9.3.2.0-1

The GOES-R System **shall** produce a Currents: Offshore observational product in accordance with the table below.

<b>Currents: Offshore</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS and US navigable waters through EEZ Full Disk
Vertical Resolution	Surface
Horizontal Resolution	2 km
Measurement Accuracy	1.0 km/hr
Refresh Rate/Coverage Time	180 min

LIRD214    9.3.3

**9.3.3 Sea and Lake Ice: Age**

LIRD215    9.3.3.0-1

The GOES-R System **shall** produce a Sea and Lake Ice: Age observational product in accordance with the table below.

<b>Sea and Lake Ice: Age</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	Ice surface
Horizontal Resolution	1 km
Measurement Accuracy	80% correct detection
Refresh Rate/Coverage Time	6 hr

(CCR 1418)

LIRD216    9.3.4

**9.3.4 Sea and Lake Ice: Concentration**

LIRD217    9.3.4.0-1

The GOES-R System **shall** produce a Sea and Lake Ice: Concentration observational product in accordance with the table below.

**ID            Object  
                 Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD217    9.3.4.0-1

<b>Sea and Lake Ice: Concentration</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	CONUS/Regional – Great Lakes and US coastal waters containing sea ice hazards to navigation Full Disk – Sea ice covered waters in Northern and Southern Hemispheres
Vertical Resolution	Ice surface
Horizontal Resolution	CONUS: 3 km Full Disk: 10 km
Measurement Accuracy	Ice concentration – 10%
Refresh Rate/Coverage Time	CONUS: 180 min Full Disk: 6 hr

LIRD220    9.3.5

**9.3.5 Sea and Lake Ice: Motion**

LIRD221    9.3.5.0-1

The GOES-R System **shall** produce a Sea and Lake Ice: Motion observational product in accordance with the table below.

<b>Sea and Lake Ice: Motion</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	III
Geographic Coverage/Conditions	Great Lakes and Chesapeake and Delaware Bays Full Disk – Sea ice covered waters in northern and southern hemispheres
Vertical Resolution	N/A
Horizontal Resolution	CONUS: 5 km Full Disk: 15 km
Measurement Accuracy	Direction: 22.5°; Speed: 3 km/day
Refresh Rate/Coverage Time	CONUS: 3 hr Full Disk: 6 hr

(CCR 1418)

LIRD222    9.3.6

**9.3.6 Sea Surface Temperature (skin) (CCR 1378)**

LIRD223    9.3.6.0-1

The GOES-R System **shall** produce a Sea Surface Temperature (skin) observational product in accordance with the table below.

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD223    9.3.6.0-1

<b>Sea Surface Temperature (skin)</b>	<b>Threshold</b>
Primary Instrument	ABI
Prioritization Tier	IB
Geographic Coverage/Conditions	Full Disk
Vertical Resolution	N/A
Horizontal Resolution	2 km
Measurement Accuracy	2.1 K with known emissivity, known atmospheric correction, and 80% channel correlation; 3.1 K otherwise
Refresh Rate/Coverage Time	Full Disk: 60 min

(CCR 1346)(CCR 1378)

LIRD224    9.4

**9.4 Observational Requirements: Space and Solar**

LIRD225    9.4.1

**9.4.1 Energetic Particles (CCR 1419B)**

LIRD226    9.4.1.1

**9.4.1.1 Energetic Heavy Ions**

LIRD227    9.4.1.1.0-1

The GOES-R System **shall** produce an Energetic Heavy Ions observational product in accordance with the table below.

<b>Energetic Heavy Ions</b>	<b>Threshold</b>
Primary Instrument	SEISS
Prioritization Tier	II
Orthogonality/Coverage	1 direction
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	25%
Refresh Rate/Coverage Time	5 min

LIRD228    9.4.1.2

**9.4.1.2 Magnetospheric Electrons and Protons: Low Energy**

**ID                      Object Number                      P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD229    9.4.1.2.0-1    The GOES-R System **shall** produce a Magnetospheric Electrons and Protons: Low Energy observational product in accordance with the table below.

<b>Magnetospheric Electrons and Protons: Low Energy</b>	<b>Threshold</b>
Primary Instrument	SEISS
Prioritization Tier	II
Orthogonality/Coverage	5 directions
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	25%
Refresh Rate/Coverage Time	30 sec

LIRD230    9.4.1.3

**9.4.1.3 Magnetospheric Electrons and Protons: Medium and High Energy**

LIRD231    9.4.1.3.0-1    The GOES-R System **shall** produce a Magnetospheric Electrons and Protons: Medium and High Energy observational product in accordance with the table below.

<b>Magnetospheric Electrons and Protons: Medium and High Energy</b>	<b>Threshold</b>
Primary Instrument	SEISS
Prioritization Tier	II
Orthogonality/Coverage	5 directions
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	25%
Refresh Rate/Coverage Time	30 sec

LIRD232    9.4.1.4

**9.4.1.4 Solar and Galactic Protons**

LIRD233    9.4.1.4.0-1    The GOES-R System **shall** produce a Solar and Galactic Protons observational product in accordance with the table below.

<b>Solar and Galactic Protons</b>	<b>Threshold</b>
Primary Instrument	SEISS
Prioritization Tier	IB
Orthogonality/Coverage	2 directions
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	25%
Refresh Rate/Coverage Time	1 min

LIRD234    9.4.2

**9.4.2 Magnetic Field**

LIRD235    9.4.2.1

**9.4.2.1 Geomagnetic Field**

**ID**      **Object  
Number**

**P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD236 9.4.2.1.0-1

The GOES-R System **shall** produce a Geomagnetic Field observational product in accordance with the table below.

<b>Geomagnetic Field</b>	<b>Threshold</b>
Primary Instrument	Magnetometer
Prioritization Tier	II
Orthogonality/Coverage	3-axis 0.5°
Vertical Resolution	N/A
Horizontal/Angular Resolution	± 0.25°
Measurement Accuracy	1.0 nT (per axis)
Refresh Rate/Coverage Time	2 samples/sec

LIRD237 9.4.3

**9.4.3 Solar**

LIRD238 9.4.3.1

**9.4.3.1 Solar Flux: EUV**

LIRD239 9.4.3.1.0-1

The GOES-R System **shall** produce a Solar Flux: EUV observational product in accordance with the table below.

<b>Solar Flux: EUV</b>	<b>Threshold</b>
Primary Instrument	EXIS
Prioritization Tier	II
Orthogonality/Coverage	Solar Disk (40 arcmin)
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	± 20%
Refresh Rate/Coverage Time	30 sec

LIRD240 9.4.3.2

**9.4.3.2 Solar Flux: X-Ray**

LIRD241 9.4.3.2.0-1

The GOES-R System **shall** produce a Solar Flux: X-Ray observational product in accordance with the table below.

<b>Solar Flux: X-Ray</b>	<b>Threshold</b>
Primary Instrument	EXIS
Prioritization Tier	IB
Orthogonality/Coverage	Solar Disk (40 arcmin)
Vertical Resolution	N/A
Horizontal/Angular Resolution	N/A
Measurement Accuracy	± 20%
Refresh Rate/Coverage Time	10 sec

LIRD242 9.4.3.3

**9.4.3.3 Solar Imagery: X-Ray**

**ID            Object  
              Number****P417-R-LIRD-0137, RM Version, Level I Requirements Document**

LIRD243    9.4.3.3.0-1

The GOES-R System **shall** produce a Solar Imagery: X-Ray observational product in accordance with the table below.

<b>Solar Imagery: X-Ray</b>	<b>Threshold</b>
Primary Instrument	SUVI
Prioritization Tier	IB
Orthogonality/Coverage	0.0 - 1.3 Solar Radii
Vertical Resolution	N/A
Horizontal/Angular Resolution	7.0 arcsec
Measurement Accuracy	± 40% in radiance
Refresh Rate/Coverage Time	Image: < 2 min Temp: < 6 min