NASA Procedural Requirements

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COMPLIANCE IS MANDATORY

NASA Radio Frequency (RF) Spectrum Management Manual

Responsible Office: Human Exploration and Operations Mission Directorate

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Preface

P.1 Purpose

a. These NASA Procedural Requirements (NPR) set forth the requirements for establishing and governing the use of radio frequencies by the National Aeronautics and Space Administration (NASA).

b. NASA Policy Directive (NPD) 1000.3 assigns the authority for the management of radio frequencies for NASA to the Associate Administrator (AA) for the Human Exploration and Operations Mission Directorate (HEOMD) at NASA Headquarters.

c. Comments, suggestions, or questions concerning this NPR should be addressed to the Director, Spectrum Policy and Planning, Space Communications and Navigation Office, Human Exploration and Operations Mission Directorate, NASA Headquarters, Washington DC 20546.

P.2 Applicability

a. This NPR applies to NASA Headquarters, NASA Centers, including Component Facilities and Technical and Service Support Centers.

b. This language applies to Jet Propulsion Laboratory (JPL), a Federally Funded Research and Development Center (FFRDC), other contractors, grant recipients, or parties to agreements only to the extent specified or referenced in the appropriate contracts, grants, or agreements.

P.3 Authority

a. National Aeronautics and Space Act, as amended, 51 U.S.C. 20113 (a).

b. NPD 1000.3, The NASA Organization.

P.4 Applicable Documents and Forms

a. Communications Act of 1934, as amended, 47 U.S.C. § 151 et seq.

b. Communications Satellite Act of 1962, as amended, 47 U.S.C. § 701 et seq.

c. National Telecommunications and Information Administration Organization Act of 1992, 47 U.S.C. § 901 et seq.

d. President's Memorandum: Unleashing the Wireless Broadband Revolution, Daily Comp. Pres. Doc. 2010 DCPD No. 0556, (June 28, 2010) (2010 Executive Memorandum).

e. President's Memorandum â?" Expanding America's Leadership in Wireless Innovation, Daily Comp. Pres. Doc. 2013 DCPD No. 00421, (June 14, 2013) (2013 Executive Memorandum).

f. EO 12046, Relating to the Transfer of Telecommunications Functions, 3 C.F.R. 158 (1978 Comp.), reprinted in 47 U.S.C. § 305 note.

g. Satellite Communications, 47 C.F.R. pt. 25.

h. Manual of Regulations and Procedures for Federal Radio Frequency Management, (National Telecommunications and Information Administration Manual), 47 C.F.R. pt. 300.

i. Radio Regulations, International Telecommunication Union (ITU), published in Geneva, Switzerland.

j. Office of Management and Budget (OMB) Circular No. A-11 (2012), Section 31.12.

k. NPD 1000.3, The NASA Organization.

l. NPD 2570.5, NASA Electromagnetic Spectrum Management.

m. NPR 7123.1, NASA Systems Engineering Processes and Requirements

n. NPR 1800.1C, NASA Occupational Health Program Procedures.

o. NASA-ESA Procedures for Coordination of Frequency Use, May 2006.

p. NASA-JAXA Procedures for Coordination of Frequency Use, May 2006.

q. SSP 50423, International Space Station Radio Frequency Coordination Manual.

r. Space Frequency Coordination Group Resolutions and Recommendations

(https://www.sfcgonline.org/resources/default.aspx).

s. IEEE C 95.1-2005, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

t. ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz).

P.5 Measurement/Verification

a. In order to determine if the Centers, Mission Directorates, and Agency programs and projects are following the content and process requirements of this NPR that are applicable to their activities, compliance will be evaluated through the following:

(1) All RF-related procurements (radio-based communications systems, wireless systems, which include: LAN, WAP, WiFi, Bluetooth, walkie-talkies, wireless microphones; active or passive remote-sensing systems; all systems employing satellite (space) communication or transmission/receiving systems; and any associated Earth-station sites and facilities) should be made with the approval of the applicable Center/Facility Spectrum Manager (SM) and are in compliance with NASA and Federal regulatory policies.

(2) NASA does not cause EM interference at NASA Centers and JPL (an FFRDC) or in the environment surrounding NASA Centers and JPL (an FFRDC).

(3) All NASA frequency assignment actions are accurate and completed in time to meet mission requirements.

(4) All Government frequency assignment actions are reviewed for their impact on NASA's ability to carry out its missions.

(5) Complete required five and ten-year frequency assignment reviews in a timely manner.

(6) All NASA system certification requests are accurate and processed through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC) Spectrum Planning Subcommittee in time to meet mission requirements.

(7) All non-NASA Government systems certification requests by the IRAC Spectrum Planning Subcommittee are reviewed for their impact on NASA's ability to carry out its missions.

(8) All NASA systems international registrations are accurate and processed through the IRAC Space Systems Subcommittee in time to meet mission requirements.

(9) All non-NASA international systems considered by the IRAC Space Systems Subcommittee are reviewed for their impact on NASA's ability to carry out its missions.

(10) All NASA RF assignments have been reviewed by their respective Center/Facility Spectrum Manager and the Director of Spectrum Policy and Planning (or his designate) to determine if they should be exempt from the Freedom of Information Act (FOIA) due to their sensitivity or mission essential nature and, so marked, if necessary.

(11) All Center/Facility long-term spectrum requirements are reported to the NASA Headquarters Spectrum Management Office.

P.6 Cancellation

NPR 2570.1B, NASA Radio Frequency (RF) Spectrum Management Manual, dated December 5, 2008.â??

Chapter 1: General

1.1 Purpose

This NPR provides guidance in the identification and use of radio frequency (RF) electromagnetic (EM) spectrum for Agency communications links and remote-sensing purposes. The NPR addresses radio frequency interference procedures and defines requirements for the support of future NASA programs with long-lead-time spectrum management initiatives. NASA personnel responsibilities are defined in Chapter 2. [1]

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[1] For the purpose of this NPR, the RF EM spectrum is defined as the set of radio frequencies below 3000 GHz. Also several terms have specific, technical connotations. A glossary of these terms is provided in Appendix A.

1.2 Spectrum Management Policy Guidance

1.2.1 The U.S. policy, with regard to the use of properly authorized frequency bands, is stated in the Communications Act of 1934, as amended and National Telecommunications and Information Administration Organization Act of 1992. In addition to these Acts, the Communications Satellite Act of 1962, as amended, is applicable for satellite systems. NASA has derived policies from the U.S. policy which is to be adhered to by all Agency spectrum users as given in NASA Policy Directive (NPD) 2570.5, and the document hierarchy is outlined in Appendix C.

1.2.2 All RF spectrum usage by NASA programs and projects shall be pursuant to specific assignments approved by the NASA Spectrum Manager and the Associate Administrator for HEOMD, under the conditions specified in this NPR Chapter 3, Section 3.7.

1.2.3 All missions, programs, projects, and other activities, requiring use of the EM spectrum, need to consider their spectrum requirements at each review in a project's life cycle and to submit requests for spectrum certification as early in the acquisition and procurement cycles as possible to ensure that missions receive the necessary authorizations and certifications to operate.

1.2.4 Funds cannot be obligated for formal engineering (as determined by the Center Director), development and testing, or procurement of operational EM-radiating or receiving devices until spectrum certifications have been approved by the NTIA and the approval is provided to the appropriate program, project office, and the Center/Facility SM.

1.2.5 Requests for spectrum certification for the development or procurement of major communications-electronics systems need to include cost estimates and economic alternatives when submitted to NTIA in accordance with national policy (Office of Management and Budget (OMB) Circular A-11) (see Appendix D).

1.2.6 NASA mission requirements shall be met by using the EM spectrum as efficiently as practical, which may be by the design, the use of advanced spectrum-efficient technologies (e.g., software-defined radios, cognitive radios, smart antennas) or advanced modulation and coding techniques.

1.2.7 All missions, programs, projects, and other activities will use frequency bands that are properly allocated for their intended use. Use of other frequencies will only be granted on a case by case basis.

1.2.8 All spacecraft must be able to remotely or directly cease EM emissions. A spacecraft that has an automatic capability to cease transmissions may be granted a waiver of this requirement.

1.2.9 No NASA space missions will be allowed to transmit in exclusive passive radio frequency (RF) bands allocated, either nationally or internationally, to the radio astronomy service, the Earth exploration- satellite service (passive), or the space research service (passive).

l.2.10 The Goddard Space Flight Center (GSFC) SM, working with the respective mission Center's SM, is responsible for frequency selection for NASA missions requiring use of 2025-2110 MHz or 2200-2290 MHz.

1.2.11 The Jet Propulsion Laboratory (JPL), a Federally Funded Research and Development Center, SM, in working with the respective mission Center's SM, is responsible for the frequency selection for NASA and Space Frequency Coordination Group members' deep space missions.

1.2.12 The Johnson Space Center SM, working with the applicable Center's SM for NASA network support, is responsible for the frequency selection and protection

requirements for all NASA human spaceflight activities.

1.3 Regulatory Structure

1.3.1 Within the United States and its Possessions, the RF EM spectrum is further allocated to non-Federal and Federal users. The FCC is responsible for the allocation and assignment of frequencies to non-Federal users (see http://www.fcc.gov), and the NTIA is responsible for the allocation and assignment of frequencies to departments and agencies of the U.S. Government (see http://www.ntia.doc.gov). The NTIA performs its functions through the assistance of the Interdepartment Radio Advisory Committee (IRAC) [2] that is also responsible for maintaining the National Table of Frequency Allocations (see Figure 1-1). [3] Coordination between non-Federal and Federal users of the RF EM spectrum is accomplished through correspondence and, if necessary, joint meetings of the FCC and the NTIA.

[2] The IRAC has been in session continuously since 1922; NASA has been an active member since 1958.

[3] See Chapter 4 of Manual of Regulations and Procedures for Federal Radio Frequency Management. (NTIA Manual).

1.3.2 The Department of State is responsible for coordinating United States participation in international fora where spectrum management issues are addressed.

1.3.3 Internationally, the RF EM spectrum is allocated by the International Telecommunication Union (ITU) (see http://www.itu.int/) to various classes of service according to different regions of the world (see Figure 1-2).

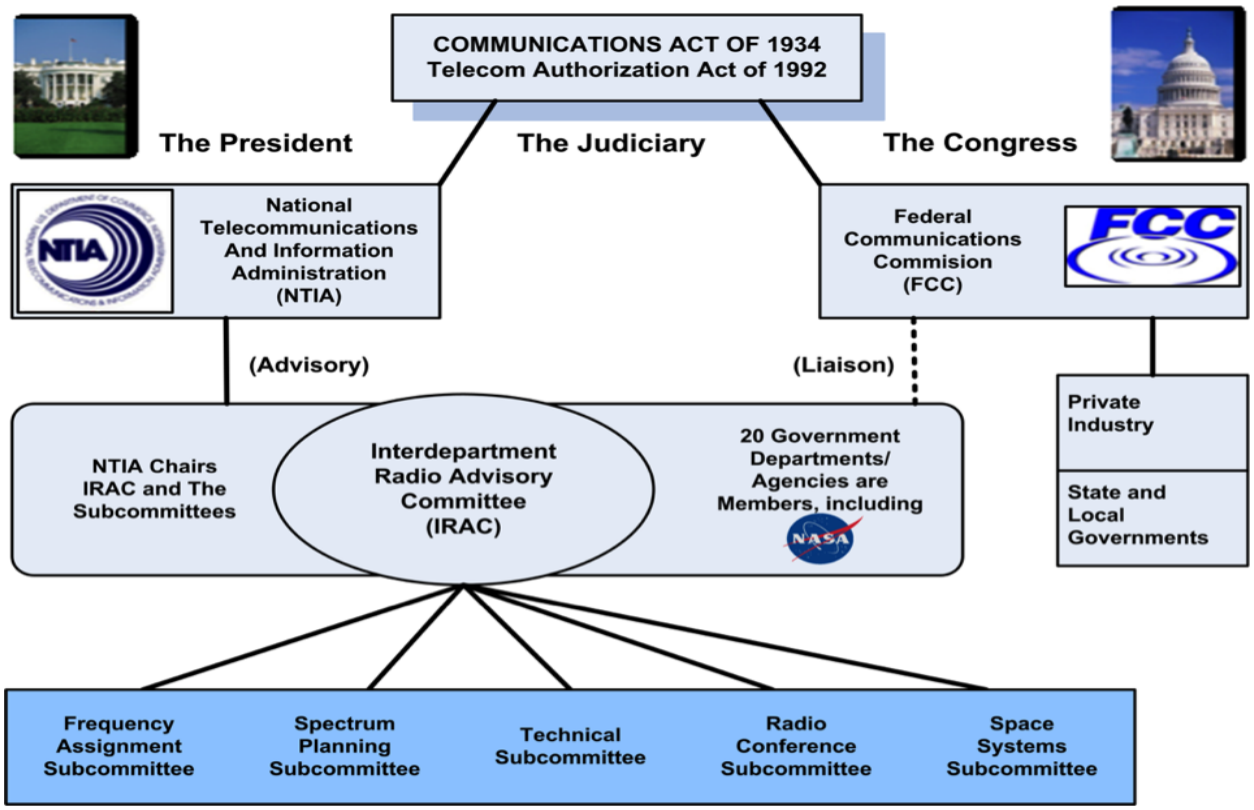

Figure 1-1 United States (US) National Spectrum Management Structure [4]

[4] The IRAC member agencies are: Department of Agriculture, Department of the Air Force. Department of the Army, Broadcasting Board of Governors, U.S. Coast Guard, Department of Commerce, Department of Energy, Federal Aviation Administration, Department of Homeland Security, Department of Justice, National Aeronautics and Space Administration, National Science Foundation, Department of the Navy, Department of State, Department of Transportation, Department of the Treasury, U.S. Postal Service, Department of Veterans Affairs, FCC Liaison.

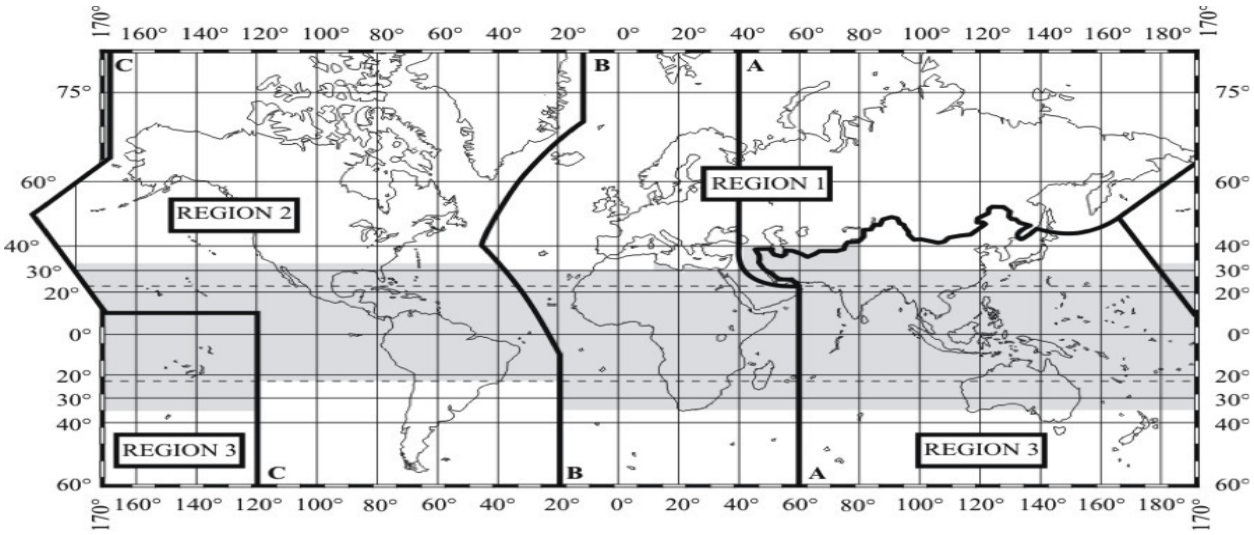

Figure 1-2 Geographic Regions for Frequency Allocation of the Spectrum

1.4 NASA Spectrum Management Program Overview

The mission of the NASA Spectrum Management Program, as directed by NASA Policy Directive (NPD) 2570.5, is to ensure that sufficient high-quality radio frequency EM spectrum is available in a timely manner to enable the success of NASA's missions. The Spectrum Management Program ensures that all NASA activities comply with national and international rules and regulations applicable to the use of the electromagnetic spectrum and facilitates securing spectrum and orbital resources (both domestically and internationally) needed to enable aeronautical and space mission requirements. The Spectrum Management Program supports the vital work of all NASA Mission Directorates.

Chapter 2: NASA Spectrum Management Program Roles and Responsibilities

2.1 Agency-Level Responsibilities

2.1.1 The Associate Administrator (AA) for Human Exploration and Operations Mission Directorate (HEOMD) is designated as the NASA Spectrum Manager and shall:

a. Publish the NASA Procedural Requirements (NPR) 2570.1, NASA Radio Frequency Spectrum Management Manual.

b. Ensure that all NASA activities comply with national and international rules and regulations applicable to the use of the EM spectrum as stated in the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management and the ITU Radio Regulations.

c. Ensure adequate NASA representation in international and national organizations and forums concerned with EM spectrum regulation and utilization.

d. Ensure adequate EM spectrum is available to support all Agency programs including NASA-sponsored commercial space programs.

2.1.2 The Deputy Associate Administrator (DAA) for Space Communications and Navigation (SCaN) shall be responsible for:

a. The overall planning, policy, and administration of the NASA Spectrum Management Program.

b. Chairing the SCaN Board of Directors (BoD) meetings which will be used as a forum for addressing program and policy-level spectrum issues. The NASA Headquarters offices and responsibilities in support of the BoD are identified in Section 2.2.

c. Appointing a Director of Spectrum Policy and Planning.

2.1.3 The Director of Spectrum Policy and Planning will be responsible for the Agency's programmatic implementation of policies and applicable procedures authorized by this NPR and the overall efficacy of the program. The Director has overall national and international spectrum policy and planning responsibility, as well as responsibility for planning of long-term national and international spectrum management initiatives aimed at improving the spectrum management environment within which NASA must operate. The Director of Spectrum Policy and Planning shall:

a. Designate a Deputy Director to act in his/her absence and assist in normal duties as required.

b. Designate an International Spectrum Program Manager and a National Spectrum Program Manager to fulfill the Agency's spectrum management responsibilities in accordance with this NPR.

c. Designate a NASA representative to the Interdepartment Radio Advisory Committee (IRAC) and representatives to the various IRAC subcommittees. When necessary; will also provide a nomination to the State Department for the chair of U.S. ITU-R Study Group 7 (Science Services).

2.1.4 The International Spectrum Program Manager shall carry out, under the direction of the Director of Spectrum Policy and Planning, the international spectrum management responsibilities assigned to the DAA SCaN, which are the EM spectrum activities involving entities external to the U.S., including the ITU, other non-NASA civilian space agencies (e.g., European Space Agency, Japanese Aerospace Exploration Agency, the Space Frequency Coordination Group (SFCG), and other entities external to the U.S. involved in the management of the EM spectrum.

2.1.5 The National Spectrum Program Manager shall:

a. Carry out, under the direction of the Director of Spectrum Policy and Planning, the domestic spectrum management responsibilities assigned to the DAA SCaN, which are the EM spectrum activities involving entities internal to the U.S., including the NTIA, the Federal Communications Commission, and other national entities involved in the management or regulation of the EM spectrum.

b. Ensure, in consultation with the applicable Center/Facility Spectrum Management Offices, that all frequency assignments are carefully reviewed as directed by the Director of Spectrum Policy and Planning or his/her designee, to determine if they should fall under the Sensitive But Unclassified (SBU) Category and/or should be Freedom of Information Act (FOIA) exempt in accordance with NPR 1600.1.

c. Ensure, in consultation with the International Spectrum Program Manager, that the Spectrum Management Implementation Plan, five-year Plan, and Long-Range Plan are reviewed and updated annually, if necessary, and cooperate in assisting the NTIA in its Federal Spectrum Strategic Plan effort.

d. Identify any programs at risk due to possible lack of spectrum allocations or the non-sustainability of these allocations because of commercial encroachment and/or possible electromagnetic interference (EMI) conflicts.

e. Chair the NASA Spectrum Managers Group (see Appendix E).

Note: Descriptions of the spectrum management structures for the ITU and interfaces between the U.S. national spectrum management structure and the ITU are contained in Appendices C and D.

2.1.6 The Director of the Spectrum Analysis Center shall oversee and manage activities within the Spectrum Analysis Center for the purpose of providing a centralized review process of Agency spectrum analyses and to perform selected technical analyses in consultation with the Director of Spectrum Policy and Planning and the NASA National and International Spectrum Managers. He or she will also coordinate with NASA Centers, as well as international and national organizations external to the Agency (e.g. NTIA, FCC, DoD, ITU, SFCG), in conducting both U.S. domestic and international spectrum analyses to advance the spectrum objectives of the Agency. The specific roles and responsibilities of the Spectrum Analysis Center are contained in the charter in Appendix F. Note: The structure of the NASA Spectrum Management Program is shown in Figure 2-1. NASA and its relationship to the national spectrum management structure are presented in Figure 2-2.

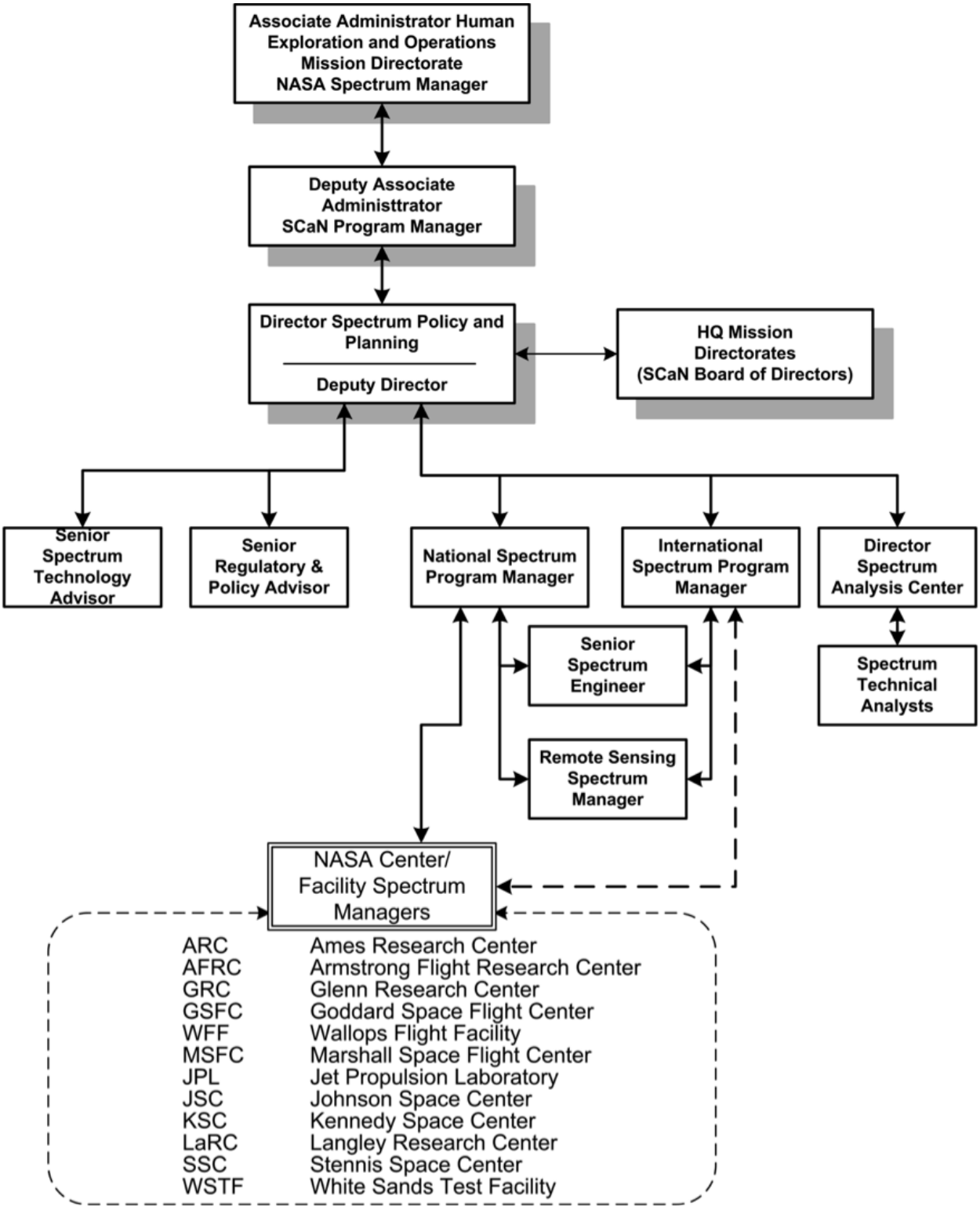

Figure 2-1 NASA Spectrum Management Program

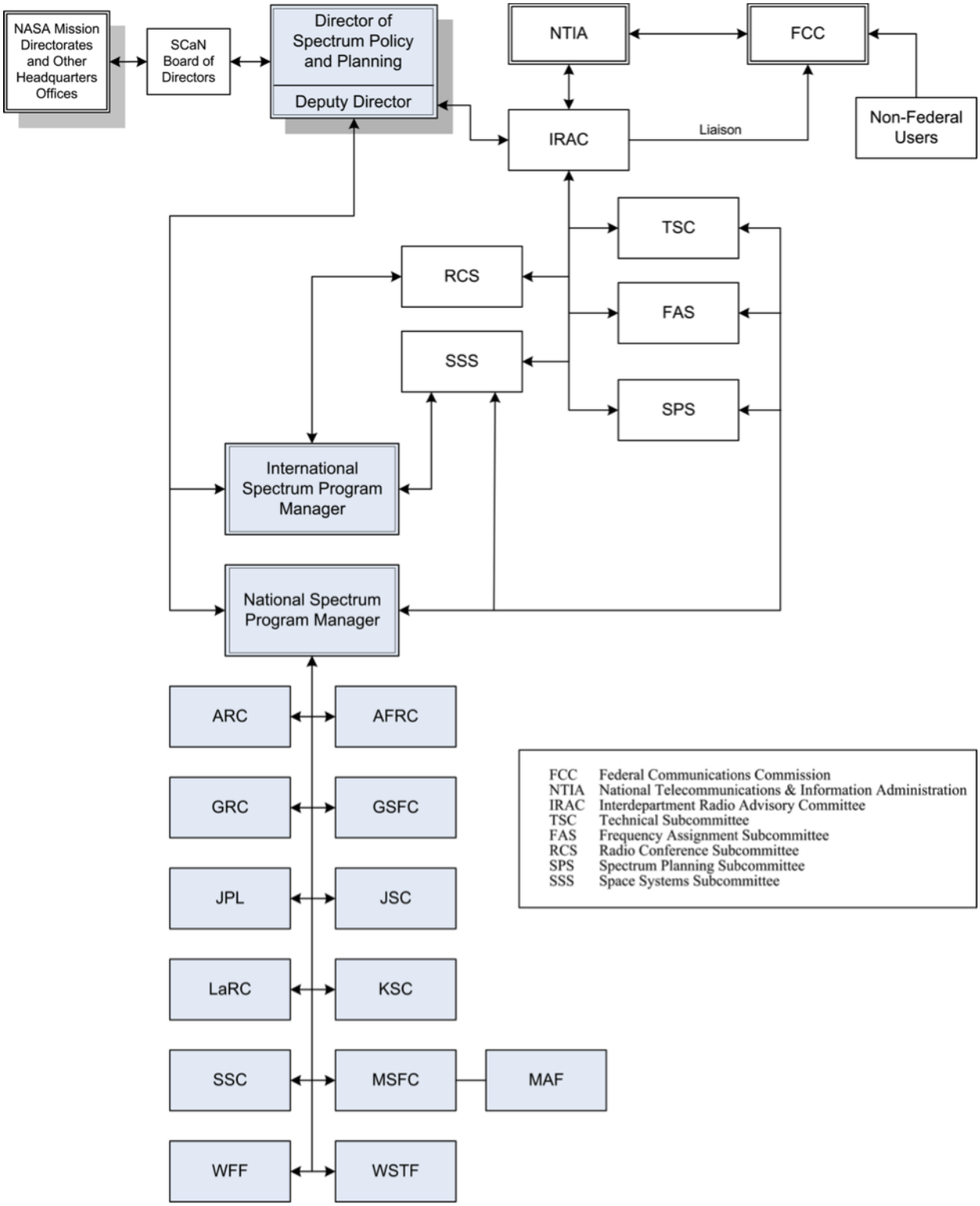

Figure 2-2 NASA/National Spectrum Management Structure

2.2 NASA Mission Directorates and Other Headquarters Offices Responsibilities

2.2.1 NASA Mission Directorates and other relevant Headquarters Offices shall each appoint a spectrum liaison who will coordinate the spectrum-related activities and requirements within their Directorate or office; provide those spectrum requirements to the Director of Spectrum Policy and Planning or designee; and provide support and representation to the SCaN Board of Directors meetings, as necessary, for addressing senior spectrum issues.

2.2.2 For future Agency missions, each NASA Mission Directorate, through the SCaN Board of Directors, shall provide the latest conceptual spectrum requirements (communications, remote sensing, and any others) and an economic analysis [5] justifying the need for the specific frequency and bandwidth, as required by OMB Circular A-11,

Section 31.12, to the Director of Spectrum Policy and Planning with respect to programs and future missions. This economic analysis will be completed and each system certified by the NTIA before funding can be provided. NTIA may also review these analyses during the certification process.

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[5] Subject to revision by the NTIA, an economic analysis for purposes of spectrum system certification is a statement that the value of the relevant spectrum was considered. It should indicate whether the system procured was the most spectrum "efficient" solution among the solutions considered in meeting specified mission/operational requirements.

2.2.3 Under 51 U.S.C. 20113(a), NASA has the responsibility to seek and encourage, to the maximum extent possible, the fullest commercial use of space. To the extent NASA technology programs are involved in supporting the U.S. commercial communications satellite industry and to the extent necessary to ensure adequate spectrum support for these programs, the National Spectrum Program Manager provides adequate coordination and representation to work with the FCC.

2.3 NASA Center Responsibilities

2.3.1 The Center Directors and the JPL (an FFRDC) Director shall:

a. Ensure that all Center/Facility long-term spectrum requirements are reported annually to the Director of Spectrum Policy and Planning.

b. Ensure that all missions, projects, and other activities requiring use of the EM spectrum submit to the Center/Facility SM a request for spectrum certification, which will be submitted to the NTIA, through NASA Headquarters, as early in the procurement cycle as possible.

c. Ensure the EM integrity of the property on which the Center or JPL (an FFRDC) and its Component Facilities are located, including protecting the property from EM interference.

d. Implement the policies, applicable procedures, and spectrum management functions at the Center or JPL (an FFRDC) and Component Facilities in accordance with this NPR and NASA Headquarters Procurement policies. The policies will ensure that spectrum-dependent missions, programs, or activities will not receive funding without approval from the Center SM. A waiver of this requirement may be granted by the DAA SCaN through the applicable Center SM and Director of Spectrum Policy and Planning.

e. Ensure that all RF-related contracts, grants, or agreements (radio-based communications systems, wireless systems, which include: LAN, WAP, WiFi, Bluetooth, walkie-talkies, wireless microphones; active or passive remote-sensing systems; all systems employing satellite (space) techniques; and any associated Earth-station sites and facilities) are made with the approval of the applicable Center/Facility SM and are in compliance with NASA and Federal regulations and policies.

f. Designate a civil servant or JPL (an FFRDC) employee as Center/Facility SM to perform the spectrum management function.

g. Designate a civil servant or JPL (an FFRDC) employee as alternate Center/Facility SM to assist and provide backup to the primary Center SM.

h. Ensure continuity of Center/Facility Spectrum Management by developing and maintaining a plan for Center/Facility SM succession. This succession plan will be submitted annually to the Director of Spectrum Policy and Planning.

i. Provide the funding required to fulfill the Center/Facility's spectrum management responsibilities in accordance with this policy.

j. Ensure that communication outside of NASA on spectrum-related matters has been coordinated and approved by the Director of Spectrum Policy and Planning or designee.

2.3.2 The GSFC SM shall assist other Center/Facility SMs in investigating incidences of RF interference that may occur in the 2025-2110 MHz and 2200-2290 MHz bands. GSFC will consult with JSC and JPL (an FFRDC) for protection requirements of human spaceflight and the Deep Space network (DSN), respectively.

2.3.3 All Center/Facility Spectrum Managers, JPL (an FFRDC) Spectrum Manager, and their alternates shall:

a. Coordinate frequency use for NASA missions, programs, and projects at their respective Center/Facility.

b. Function as the interface between its Center/Facility missions and the other Center/Facility SMs.

c. Ensure that all missions, projects, and other activities, requiring use of the EM spectrum, submit a request for spectrum certification, which is submitted to the NTIA, through NASA Headquarters, as early in the acquisition and procurement cycles as possible, as well as ensuring that any required economic cost/benefit analysis is completed and submitted with requests for frequency certification.

d. Ensure that these submissions are compliant with domestic (NTIA Manual) and international (ITU Radio Regulations) regulations, as well as SFCG recommendations, and provide guidance on the selection of properly allocated frequency bands to fulfill mission requirements. A waiver of this requirement may be granted by the Director of Spectrum Policy and Planning, through the applicable Center SM.

e. Obtain Radio Frequency Authorizations (RFAs) in the Government Master File (GMF) for all transmitters (including active remote sensing or communications use whether spaceborne or otherwise).

f. Obtain RFAs in the GMF for all receivers or radiometers for passive sensing or communications use whether spaceborne or otherwise. Such authorization will also take place for individual NASA-owned and/or operated instruments located in or on platforms owned by other U.S. Government agencies or foreign entities.

g. Ensure that all RF equipment belonging to other Government agencies and operating at NASA facilities or onboard NASA vehicles operated by the Center/Facility has received proper authorization to operate. The responsibility for obtaining that authorization is not necessarily the responsibility of the Center/Facility Spectrum Manager.

h. Review any non-NASA systems which are identified within domestic or international system filing and coordination processes for potentially causing interference to the Center operations and provide comments as required.

i. Ensure Centers/facilities adhere to the NTIA channel plan for the Very High and Ultra High Frequency land mobile radio bands.

j. Ensure that all NASA Center/Facility spacecraft requirements for use of the S-Band (2025 - 2110 MHz and 2200 - 2290 MHz) are provided to the National Spectrum Program Manager and the GSFC SM for their review and approval.

k. Ensure that permanent assignments are promptly renewed or deleted from the GMF at the time of their RFA 5-year review.

l. Maintain accurate records [6] of all frequency assignments in use by the Center and JPL (an FFRDC).

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[6] The Manual in NPR 1441.1, NASA Records Retention Schedules, should be followed to maintain and safeguard these records. Records such as documents and reports can only be disposed of based on the retention periods in NPR 1441.1. If an item is not described in NPR 1441.1, contact your Center Records Manager for assistance.

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m. Maintain the electromagnetic integrity of the site and its flight missions through proper selection of RF equipment frequencies and electromagnetic compatibility (EMC) testing.

n. Ensure day-to-day interference-free operations at the site and by its flight missions.

o. Identify communication and other RF EM spectrum requirements such as active and passive remote sensing requirements or future missions proposed by the site and report as early as possible to the National Spectrum Program Manager for inclusion in NASA long-range spectrum forecasts.

p. Prepare technical analyses required to support spectrum applications for site projects.

q. Participate in local, national, and international spectrum management coordination groups to provide representation and cognizance of the Center/Facility's project requirements.

r. Coordinate the development and maintenance of Center/JPL (an FFRDC) instructions for spectrum management with the National Spectrum Program Manager to ensure wide program consistency.

s. Serve as the representative for the Director of Spectrum Policy and Planning to the NASA programs/projects at their Centers and JPL (an FFRDC) and participate as a member of the NASA Spectrum Managers Group.

t. Coordinate with the local Center/Facility Radiation Safety Officer (RSO) and/or Non-Ionizing Radiation Safety Officer to ensure that RF and electromagnetic field emissions conform to the latest requirements of IEEE C95.1, Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields 3 kHz to 300 GHz and the ICNIRP Electromagnetic Field Standard, 1 Hz to 300 GHz.

u. Coordinate RF EM spectrum requirements with the NASA Center Safety and Mission Assurance Office or NASA Center Office with responsibility for RF safety. Based on the particular Center mission responsibilities, RF emissions will be coordinated with other operations such as range safety, flight operations, operation safety, explosive safety, and propellant handlers.

v. Represent respective Center or JPL (an FFRDC) at the NASA Spectrum Managers Group (NSMG) meeting, which meets at least annually to review issues pertinent to all Centers and JPL (an FFRDC) (see Appendix E).

w. Coordinate FOIA-related matters with the National Spectrum Program Manager to ensure consistency with Agency-level positions.

2.4 Mission/Program/Project Responsibilities

2.4.1 Each mission, program, project, and other activity with RF EM spectrum requirements at a NASA Center [7] has the following responsibilities:

[7] For purposes of this and subsequent sections within the document, Center also applies to JPL (an FFRDC).

a. to discuss spectrum considerations at each review in the project life cycle.

b. to receive approval from the responsible Center Spectrum Manager that program/project spectrum goals and progress are being achieved and all applicable spectrum regulatory requirements are satisfied at the entrance and success criteria in all life-cycle and technical reviews.

2.4.2 The specific spectrum criteria for the life-cycle reviews (as provided in NPR 7123.1, NASA Systems Engineering Processes and Requirements) are defined in Table 2.1 and illustrated in Figure 2-3.

Table 2.1: Spectrum Requirements for Program/Project Reviews

Phase/Review	Entrance Criteria	Success Criteria
Pre-Phase A	Notify Center Spectrum Manager of EM spectrum use concept	
Mission Concept Review (MCR)	Preliminary assessment of EM spectrum (radio frequency) requirements	Concurrence by the responsible Center Spectrum Manager that EM spectrum needs have been properly identified and addressed
System Requirements Review (SRR)	EM spectrum needs have been addressed including preparing requisite data for the responsible Center Spectrum Manager for possible Stage 1 Certification.	Concurrence by the responsible Center Spectrum Manager that the program/project has provided requisite EM spectrum system data.
System/Mission Definition Review (SDR)	EM spectrum considerations addressed	Concurrence by the responsible Center Spectrum Manager that spectrum considerations have been addressed
Preliminary Design Review (PDR)	Design details and requisite data have been submitted to Center/Facility Spectrum Manager for preparation of request for certification of Stage 2 spectrum support by at least 60 days prior to PDR	Concurrence by the responsible Center Spectrum Manager that the program/project has provided requisite EM spectrum system data
Critical Design Review (CDR)	- Received Stage 2 (Experimental) system certification signed by NTIA - Provide measured/as designed parameter updates to Center/Facility Spectrum Manager for request for certification of Stage 4 (Operational) spectrum support no later than 60 days prior to CDR	Concurrence by the responsible Center Spectrum Manager that the program/project has provided requisite EM spectrum system data
Production Readiness Review (PRR)	EM spectrum considerations have been addressed	Concurrence by the responsible Center Spectrum Manager that program complies with spectrum policy and regulation

System Integration Review (SIR)	NA	NA
Test Readiness Review (TRR)	EM spectrum considerations have been addressed	Concurrence by the responsible Center Spectrum Manager that all tests are performed in accordance with spectrum policy and regulation
System Acceptance Review (SAR)	Received Stage 4 (Operational) system certification signed by NTIA	Concurrence by the responsible Center Spectrum Manager that the Stage 4 (Operational) system certification has been obtained and the system is compliant with spectrum policy and regulation
Operational Readiness Review (ORR)	- Received Stage 4 (Operational) system certification signed by NTIA - All requisite radio frequency authorizations are in place	Concurrence by the responsible Center Spectrum Manager that all necessary spectrum certification(s) and authorization(s) have been obtained
Flight Readiness Review (FRR)	- Received Stage 4 (Operational) system certification signed by NTIA - All requisite radio frequency authorizations are in place	Concurrence by the responsible Center Spectrum Manager that all necessary spectrum certification(s) and authorization(s) have been obtained
Post-Launch Assessment Review (PLAR)		Concurrence by the responsible Center Spectrum Manager that the system is compliant with spectrum policy and regulation
Critical Event Readiness Review (CERR)	Critical event/activity requirements and constraints have been identified, including spectrum considerations	Concurrence by the responsible Center Spectrum Manager that the system is compliant with spectrum policy and regulation
Post-Flight Assessment Review (PFAR)	Problem reports, corrective action requests, and post-flight anomaly records are completed. Include Spectrum (radio frequency) interference or other related factors during assessment	Notify the responsible Center Spectrum Manager
Decommissioning Review (DR)		Notify the responsible Center Spectrum Manager
Disposal Readiness Review (DRR)		Notify the responsible Center Spectrum Manager

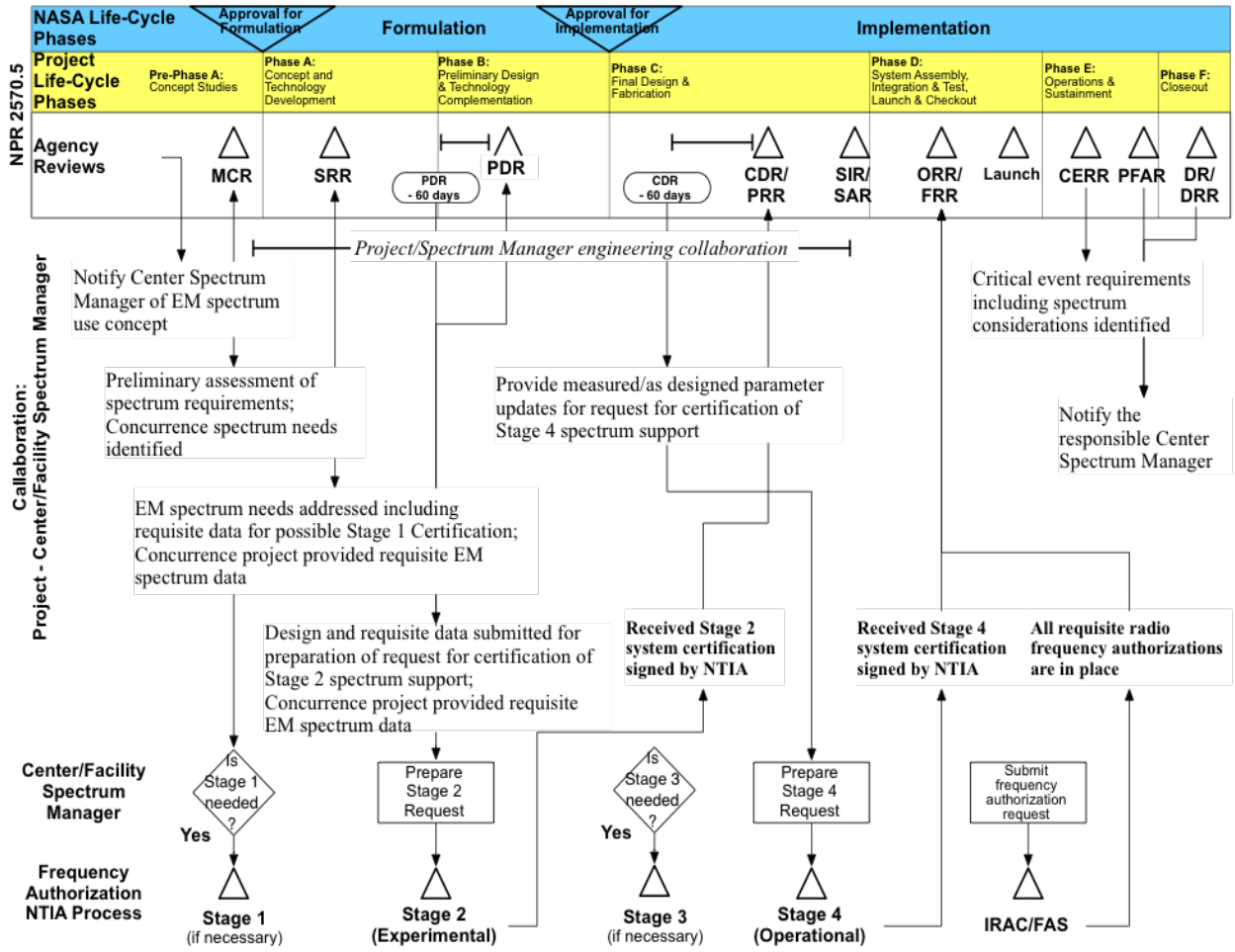

Figure 2-3: Spectrum Requirements Overlay on NASA Program/Project Life-Cycle Process

2.5 Host Responsibilities

2.5.1 Each program or project hosting equipment, experiments, and/or payloads with RF requirements at a NASA Center (i.e., NASA provides the platform, but does not control/own the RF equipment -- transmitters/receivers) has the following responsibilities:

a. Feasibility/Conceptual phase

(1) Inform the RF equipment/experiment/payload owner (i.e. customer) that spectrum certification and RF authorization/license to operate the equipment is their responsibility. An approved RF license (experimental or operational, depending on the use and scenarios) is a prerequisite for flight manifest.

(2) Notify Center Spectrum Manager of the new RF equipment use concept.

(3) Request, from customer, a copy of RF license for each RF transmitter and submit to Center Spectrum Manager for review and approval for flight use.

(a) Aircraft platforms: no later than eight weeks prior to first flight

(b) Space platforms: no later than System Requirements Review (SRR)

b. Prior to First Flight

(1) Customer will provide approved RF license(s) to program for final validation by the Center Spectrum Manager.

(2) Failure to provide approved RF license(s) will result in delay of first flight.

Chapter 3 RF Allocation and Assignment Process and Procedures

3.1 General

3.1.1 All RF EM spectrum usage by NASA programs, projects, and infrastructure will be pursuant to specific assignments approved by the NASA Spectrum Manager, the AA for HEOMD, or his/her designee under the conditions specified in Section 1.2.

3.1.2 NASA has adopted procedures for requesting frequency assignments and obtaining new frequency allocations in order to effectively implement national and international spectrum management policy. These procedures allow for a thorough coordinated process from identification of Agency program/project needs to national and international recognition of actual frequency band usage.

3.1.3 For the purpose of this NPR, the terms frequency allotment, frequency allocation, and frequency assignment use the definitions adopted from the ITU Radio Regulations (RR) (See Appendix A.)

3.1.4 The frequency assignment process outlined in Figure 3-1 is initiated at the user NASA Center/Facility and results in the issuance by NTIA of a Radio Frequency Authorization (RFA) or Special Temporary Authorization (STA).

3.1.5 If the use is not for a major terrestrial program nor for frequencies to be used for transmissions to and from space, the frequency assignment process is fairly simple as described in paragraph 3.3.b (2).

3.1.6 However, for major new programs or for programs involving spacecraft, NTIA has established a systems review process, for the purpose of certification of spectrum support, by which that use is coordinated within the United States and internationally. This process is described in Appendix G.

3.1.7 The Center/Facility SM shall apprise the contractor(s)/grantee(s) of the need for ensuring that radio frequency support appears feasible for NASA-funded studies or Federal-funded equipment procurements by non-Federal interests, where the use of radio frequencies is foreseen as a result of the study or procurement, Section 3.5 provides additional information.

3.2 Frequency Allocations

3.2.1 In almost all cases, identification of RF EM spectrum support for NASA needs is focused on frequency bands currently allocated nationally and internationally for the particular radio service for which the Agency requires support. This includes both terrestrial use (e.g. fixed, mobile, radiolocation, radionavigation and other terrestrial radio service allocations) and space use (e.g., space research service allocations that support the U.S. space programs). However, in some cases, it may be necessary to move Agency operations elsewhere in the RF EM spectrum where appropriate allocations do not currently exist, particularly as new scientific, technological, and commercial requirements emerge and bands in the existing RF allocations become congested. As shown in Figure 3-1, the identification of the need for a new allocation may be made by reference to the Table of Frequency Allocations or as a result of the systems review process, which includes a study of current frequency band occupancy.

3.2.2 In cases where new frequency allocations are deemed necessary, it is imperative that very long-lead-times (i.e., ten years or longer) be allowed for the national and international processes which are required for new allocations. World Radio Conferences (WRCs) review, and if necessary, revise the Radio Regulations. WRCs meet on a periodic basis (i.e., normally every three-four years). It is essential that NASA is prepared to identify new requirements well in advance of these conferences so that supporting technical and regulatory information can be prepared and presented.

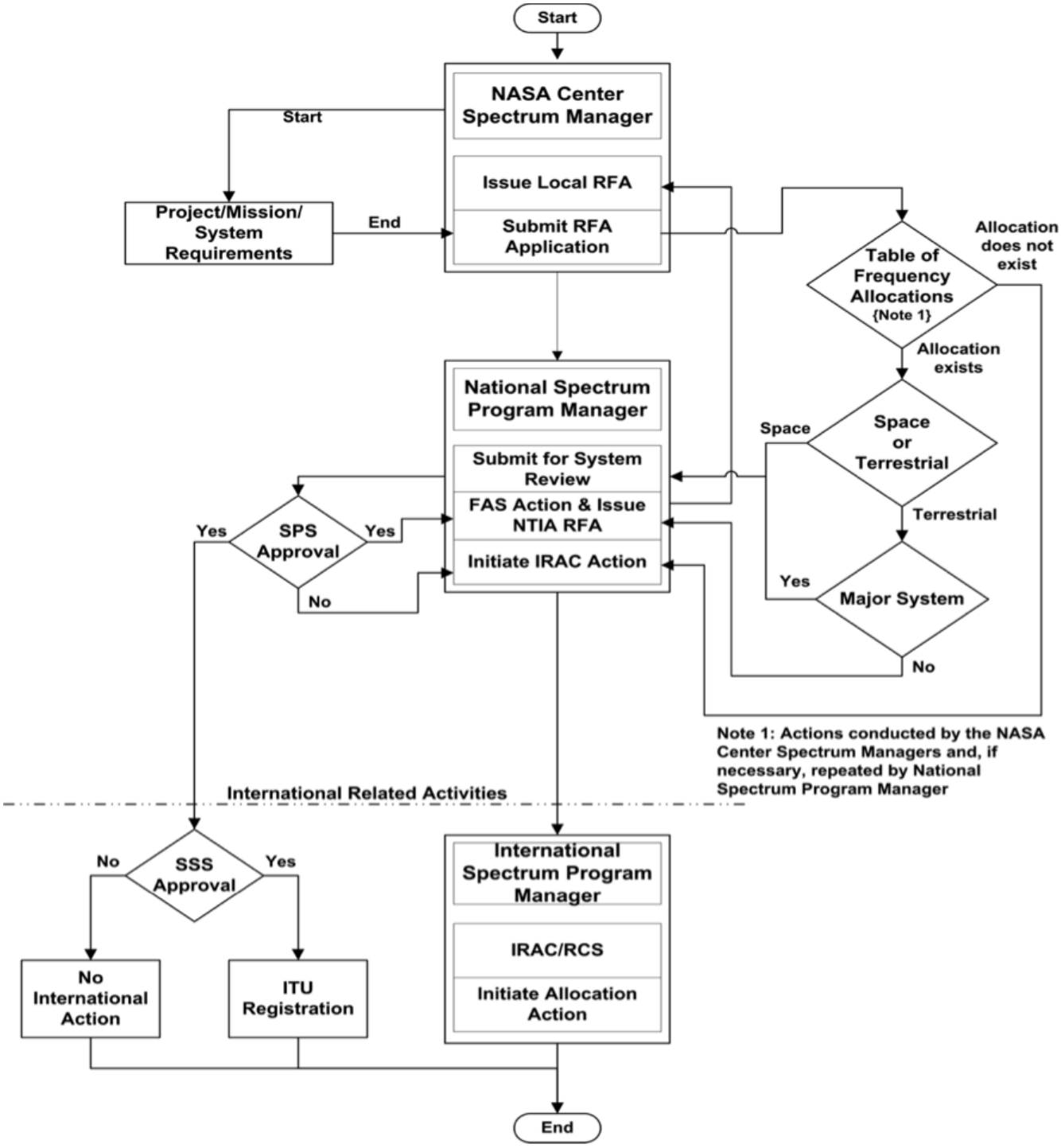

Figure 3-1 Frequency Authorization Process

3.3 Frequency Assignment Process

3.3.1 General

a. Specific procedures by which Agency users may be authorized to operate on a particular frequency depend upon the following factors:

(1) Availability of frequency allocation.

(2) System is terrestrial or spaceborne.

(3) System is considered a major telecommunications system, e.g., high investment.

(4) Duration of the system's operation.

Note: Using OMB regulations, the Center/Facility Spectrum Manager is responsible to ensure that the project completes and submits an economic cost/benefit analysis for each new frequency required. This analysis is done once for NTIA Spectrum Planning Subcommittee (SPS) Stage 2 certification (or at Stage 3 certification, if applicable).

3.3.2 Process for Frequency Selection

a. The process for frequency selection prior to design commitment is outlined below and in Figure 3.2.

(1) Project Commitment (Funding Approved) - Providing project commitment information is key to the successful coordination of design decisions involving the selection of frequencies for systems. An economic analysis justifying the need for the specific frequency and bandwidth is required by OMB Circular A-11. The project/program office has the responsibility to submit this analysis to NTIA SPS during system certification.

(2) Initial Frequency Coordination Guidance - Due to the increasing complexity and usage of the RF spectrum, the availability/cost [8] of spectrum may actually drive the design requirements for future NASA missions. Each Center has a designated Radio Frequency Spectrum Manager who is responsible for obtaining, maintaining, and retiring the RFA for programs, projects, and infrastructure at the Center; and for preventing or mitigating radio frequency interference at the Center or to the Center's programs, projects, and infrastructure. The Center Radio Frequency Spectrum Manager provides guidance on the selection of properly allocated frequency bands to fulfill mission requirements. Once candidate frequency bands and Center frequencies are selected, the dissemination of the information is necessary to ensure that appropriate feedback is obtained to ensure timely resolution of problems from within NASA, as well as with other users of the spectrum.

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[8] Spectrum fees are being considered but, as of the publication date, have not been established.

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(3) Dissemination of Candidate Frequencies - Parties who should receive information about candidate frequencies include the relevant NASA Spectrum Managers at the Center/Facility level and the candidate Government or commercial launch sites that NASA may use in the future. The Center/Facility Spectrum Manager shall send the SPS submissions to the National Spectrum Program Manager, NASA's SPS representative, and alternate SPS representatives. This ensures that the NTIA's SPS concerns are addressed before the submission of a request for certification of spectrum support. Spectrum Managers may also provide additional insight into scheduling issues for frequencies in highly congested bands requiring ground station support.

(4) Comments and Analysis of Frequencies - Projects should employ an approach similar to the RF analysis of the candidate frequencies. Therefore, projects should be prepared to fund an RF analysis that may need to be conducted to ensure electromagnetic compatibility with other users of the proposed frequency band(s) of operation. The results of such an analysis should provide additional

information for the selection of the best frequency for a particular mission and should be included in a submission to the NTIA for a request for certification of spectrum support.

(5) Initiate Spectrum Planning Subcommittee Process - The conceptual phase of a mission ends when the necessary analysis has determined the best frequency candidate(s) for a particular mission. The planning phase then begins with an initial submission of a request for certification of spectrum support (Stage 1 or 2) to the NTIA. The NTIA may provide further guidance or raise concerns regarding existing systems that may be incompatible with the particular mission. (See Appendix G of this NPR and Chapter 10 of the NTIA's "Manual of Regulations & Procedures for Federal Radio Frequency Management" -- referred to as the NTIA Manual).

b. NASA's SPS representative or alternate SPS representatives shall submit to NTIA all Center/Facilities responses to questions from NTIA during the systems review process in order to ensure that items are tracked.

c. It is mandatory that all Centers/Facilities use NTIA's Equipment Location -- Certification Identification Database (EL-CID) or current successor software program for the generation of the request for certification of spectrum support. The Center/Facility is also responsible for any additional required data to support a request for certification as described in Chapter 10 of the NTIA Manual. [9]

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[9] Spaceborne systems transmitting in the 2200 MHz to 2290 MHz band are limited to bandwidths of no more than 5 MHz (or approximately 6.16 MHz for spread spectrum use for multiple users on the same frequency through TDRS), in accordance with Section 8.2.41 of the NTIA Manual. Justification for a waiver of this policy is required by the NTIA before any system exceeding this constraint can be certified

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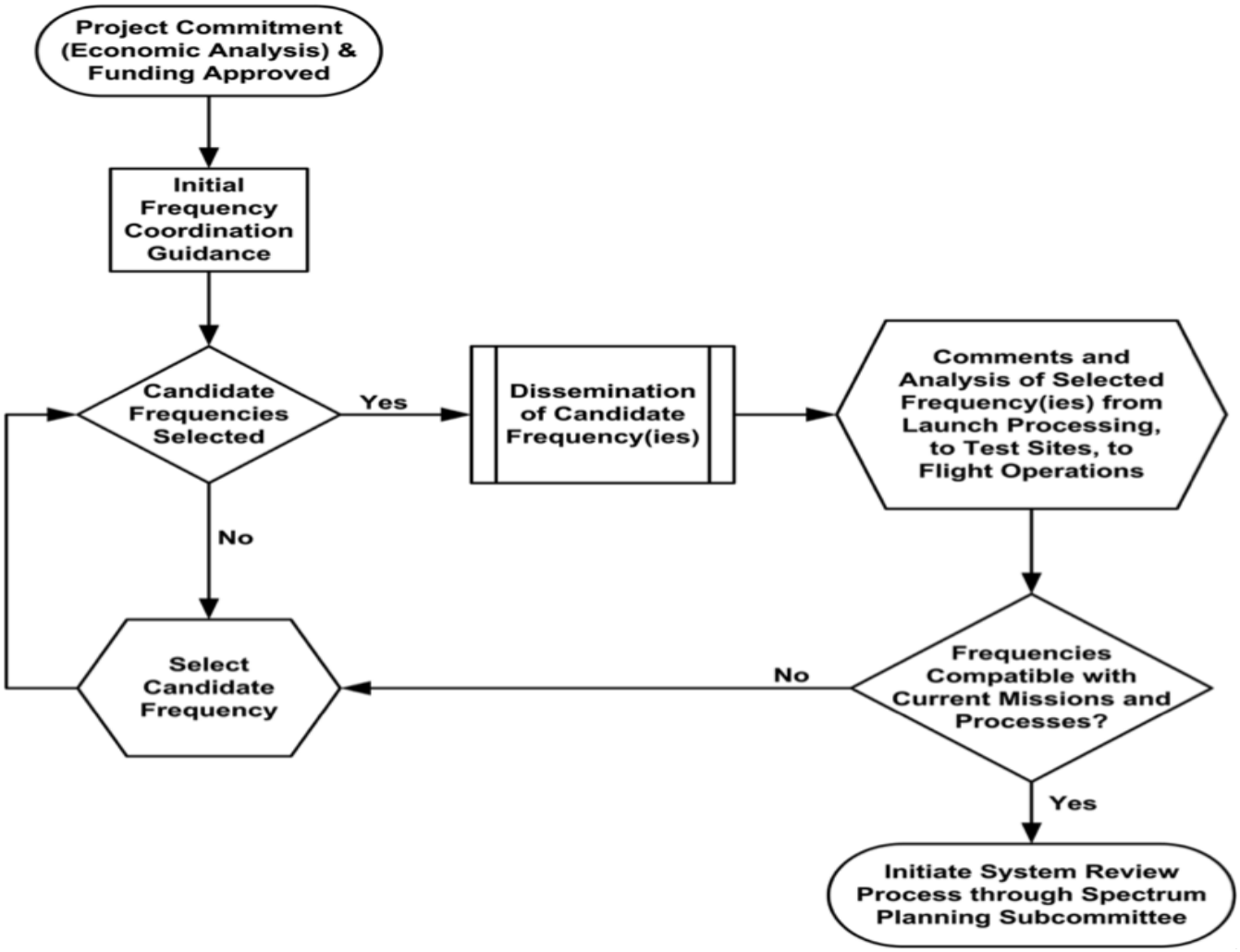

Figure 3-2 Frequency Selection Process

3.3.3 Terrestrial Assignments

a. Some terrestrial systems may be classified as major telecommunications systems. These are systems which, even though spectrum allocations currently exist, are required to be submitted to NTIA for certification of spectrum support because they have large bandwidth requirements, new modulation techniques, novel applications, or are considered to have a significant impact on the existing electromagnetic environment. (See Appendix G.).

b. NASA users requiring assignments for radio frequencies for non-major terrestrial use will provide the specific technical information to the Center/Facility Spectrum Manager. This information is submitted for all frequency assignment actions by the appropriate NASA Center/Facility Spectrum Manager to the NASA FAS representative utilizing the NTIA automated processing system to request and receive radio-frequency assignments.

c. The following procedures and notes will aid NASA spectrum applicants, from missions/programs/projects, in the preparation of their applications for frequency assignments and facilitate the processing of the applications:

(1) Step 1: From the operational requirements, determine the specific frequency or band of frequencies, together with alternate frequencies that would be acceptable if the desired frequencies are not available. Allow a lead-time of at least 60 work days for processing of typical land mobile radio operations and up to 180 work days for complex systems requiring pre-coordination with other Federal agencies. The process time commences when the application appears on the FAS electronic

agenda.

(2) Step 2: The Center/Facility Spectrum Manager will ensure that the frequencies are available and are in accordance with the National Table of Frequency Allocations. (Do not request "out-of-band" frequency assignments or allocations unless absolutely necessary and with written justification). In cases where out-of-band frequencies must be used, allow the maximum lead-time possible (240 days).

(3) Step 3: Refer to Section 3.4 of this NPR to determine if coordination with other users of the spectrum is required. The type and amount of coordination that might be required varies with the specific frequencies and applications involved. When such coordination is extensive, the user (applicant) provides funds for such coordination, including the preparation of coordination contour charts.

(4) Step 4: For each frequency assignment action required, submit the information to the NASA Center/Facility Spectrum Manager together with any other information that will aid in expediting the application.

d. NASA Center/Facility Spectrum Managers and/or JPL, a Federally Funded Research and Development Center (FFRDC), Spectrum Manager are responsible for processing the information into the proper NTIA computer mnemonic format. For short term uses of RF equipment (i.e., 30 days or less), the Center/Facility Spectrum Manager may determine that only a Special Temporary Authority (STA) is required. Submit this data via the NTIA automated processing system to the NASA FAS representative. Short-term use of greater than 30 days may be granted through a temporary RF authorization. Additionally, for short or intermittent experimental activities conducted within the immediate vicinity of a station, the Center/Facility may provide, on a case-by-case basis, local authorization for certain transmissions in accordance with Section 7.11 of the NTIA Manual.

e. Submission of data or acknowledged receipt does not constitute a frequency assignment or authorization regardless of any verbal agreements or understandings between the applicant and NASA spectrum management personnel. Do not attempt to operate on the frequency requested or to purchase equipment requiring such frequency support until authorized by formal RFA or STA issued through the Center/Facility Spectrum Manager.

3.3.4 Space Assignments

a. Chapter 10 of the NTIA Manual entitled, "Procedures for the Review of Telecommunication Systems for Frequency Availability and Electromagnetic Compatibility (EMC) and Telecommunications Service Priority for Radio communications (TSP-R)" states that, for Government agencies, the SPS review process is applicable to certain systems and subsystems. Furthermore, space systems are governed by both the U.S. interagency process (SPS review) and ITU requirements (notification/coordination through the SSS). The systems review is a procedure used by the SPS to develop recommendations, on behalf of the IRAC, for the Deputy Associate Administrator, Office of Spectrum Management of NTIA, regarding certification of spectrum support for telecommunication systems or subsystems. This review provides an early awareness in the regulatory community and allows for either early support or early identification of potential problems in the future. A system can be reviewed at four stages as it matures into an operational status. These are:

(1) Stage 1. Conceptual

(2) Stage 2. Experimental

(3) Stage 3. Developmental

(4) Stage 4. Operational

c. The SPS Systems Review is intended for:

(1) New telecommunication systems or subsystems and major modifications to existing systems or subsystems, involving the use of satellites or spacecraft.

(2) New major terrestrial systems or subsystems and major modifications to existing systems or subsystems.

(3) Other systems or facilities as may be referred to the SPS on a case-by-case basis. [10]

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[10] Telemetry, tracking, and control for spaceborne systems require a Stage 4 (Operational) certification of spectrum support (from NTIA) before any spaceborne system is launched (even if the spaceborne system is experimental).

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d. This review process is mandatory for space systems except those that operate under Appendix K of the NTIA Manual regarding low-power non-licensed devices. For those systems which require review by the SPS and certification by the NTIA, the Center/Facility Spectrum Manager shall be required to coordinate with the NASA SPS representative throughout the review process.

e. Systems that are intended to operate in space will be submitted to the ITU in order to meet the requirements for Advance Publication, Coordination, and Notification as necessary under Articles 9 and 11 of the ITU Radio Regulations. The SSS representative shall use the information provided for certification by NTIA to generate the submission(s) to the ITU and will work closely with the Center/Facility Spectrum Manager to collect any additional information that may be required. The Center/Facility Spectrum Manager may request a waiver from the NTIA's SSS of the requirement to file the ITU notification, provided that the space system operates for less than one year. [11]

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[11] Area coordinators are found in the NTIA Manual.

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f. Details of the Systems Review procedure can be found in Appendix G.

3.4 U.S. Coordination Requirements

3.4.1 NASA Components as Tenants at Other Government Agencies

NASA Centers/Facilities having joint tenant status at other Government agencies will coordinate frequency requirements with the host Government agency as required. Applications are then forwarded to the NASA FAS Representative reflecting the recommendations of the host Agency under whose jurisdiction the operation is proposed.

3.4.2 Joint Radio Frequency Coordination for National Test Ranges

a. The Department of Defense (DoD) has established a system of military interservice frequency coordination to minimize interference and to avoid conflict with or among radio and electronic operations at the DoD National Test Ranges. This system requires that certain frequencies be coordinated with DoD Area Frequency Coordinators (AFC) prior to the issuance of assignments. In the interest of economy and compatibility of operations, this system of coordination is used by NASA, in accordance with the joint DoD-NASA Agreement. [12]

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[12] The areas in which Military Interservice Frequency Coordination is required are shown in Table 8.3.26 of the NTIA Manual. Table 8.3.26 also lists the DoD AFC responsible for coordination within each area.

b. DoD AFC maintain current records of frequencies that have been coordinated for use in their area of cognizance. Upon request for frequency coordination, they supply technical comments on the probability of harmful interference being caused or received by the proposed operations.

c. All frequencies intended for use within the National Test Ranges (or within those areas delineated in Table 8.3.26 of the NTIA Manual) which are considered capable of causing harmful interference to operations at the specified test ranges, including any extended established "down-range" areas, are coordinated with the responsible DoD AFC. Area frequency coordination is accomplished by the Spectrum Manager of the NASA Center in accordance with the following procedures:

(1) Step 1: When NASA operations require DoD range support and are to be conducted at sites under military cognizance, select the use of the frequencies required in coordination with the AFC of the range concerned. In the case of those military test facilities where there is no resident AFC, coordinate NASA frequency usage with the local Military Frequency Manager who will, in turn, effect the necessary coordination with the cognizant AFC.

(2) Step 2: If the frequencies required are already assigned for use at the range concerned, the AFC (or local Military Frequency Manager) will effect local authorization and interference protection as necessary. When the frequencies required are not assigned to the range, the AFC will request assignment from the military department having cognizance of that range.

(3) Step 3: Where NASA operations are to be conducted at sites not under military cognizance, but within the area defined in Table 8.3.26 of the NTIA Manual, coordinate the use with the AFC of the range concerned by providing system/emission characteristics for this purpose. The AFC will comment with due regard to all military frequency usage within the area involved.

(4) Step 4: Forward system/emission characteristics in accordance with Chapter 9 of the NTIA Manual to the NASA FAS representative for coordination with other users and IRAC. Include a memorandum stating that coordination has been effected with the AFC involved. The NASA FAS representative will apply for the assignments to cover these operations.

(5) Step 5: Should a frequency conflict arise between the DoD AFC and NASA Center/Facility Spectrum Managers and/or JPL (an FFRDC), Spectrum Manager that cannot be resolved satisfactorily through measures acceptable to the Center involved, forward a complete and detailed report to the National Spectrum Program Manager and the NASA FAS representative who will attempt to resolve the conflict at the Agency level.

3.4.3 Coordination Procedures for the National Radio Quiet Zone (NRQZ)

a. The NRQZ is an area approximately 13,000 square miles set aside for radio astronomy observations. This area is bounded by 39°15'N on the North, 78°30'W on the East, 37°30'N on the South and 80°30'W on the West.

b. To protect the NRQZ from interference, the following criteria have been established:

(1) Based on a 20 kHz measurement bandwidth, the calculated power density of the transmitter at the reference point should be less than:

(a) 1 x 10-8 W/m2 for frequencies below 54 MHz.

(b) 1 x 10-12 W/m2 for frequencies from 54 MHz to 108 MHz.

(c) 1 x 10-14 W/m2 for frequencies from 108 MHz to 470 MHz.

(d) 1 x 10-17 W/m2 for frequencies from 470 MHz to 1000 MHz.

(e) freq2 (in GHz) x 10-17 W/m2 for frequencies above 1000 MHz.

(f) Except for frequencies that reside in the radio astronomy observing bands, in which case the power densities listed in Recommendation ITU-R RA.769-2 will apply. The reference point is located at 38°25' 59.2" N, 79°50' 23.4" W at 2,644 feet (806 meters) above mean sea level at a height of 458 feet above ground level. [13]

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[13] For detailed information on the NRQZ, please see http://www.gb.nrao.edu/nrqz/nrqz.shtml For coordination questions, contact the NRAO Interference Office at 304-456-2107.

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c. All proposed frequency assignments to NASA radio stations within the NRQZ are coordinated by the NASA FAS representative per the NTIA Manual Part 8.3.9, prior to authorization.

3.4.4 Coordination Procedures with the Aerospace and Flight Test Radio Coordinating Council (AFTRCC)

a. Coordination procedures are applicable for all frequency assignment actions for use of frequencies in the bands 1435-1525 MHz, 2310-2320 MHz, and 2345-2390 MHz by U.S. Government radio stations within the conterminous United States and are implemented to minimize, through local selection of frequencies and effective coordination, the possibility of interference.

b. All proposed and renewal frequency applications for NASA radio stations shall include an AFTRCC concurrence number obtained in accordance with the NTIA Manual Chapter 8.3.17 and Annex D of the NTIA Manual.

3.5 NASA Contractors and Grantees

3.5.1 Applications Required for Contractors and Grantees

If a NASA contractor or grantee requires the use of radio frequencies under the terms of a NASA contract/grant and the contract/grant does not explicitly address control of the transmitting equipment, a determination will be made by the Center SM in consultation with the National Spectrum Program Manager as to whether NASA should apply to the NTIA for the frequency authorization or whether the contractor/grantee should apply to the FCC. The determination is based upon whether the radio station "belongs to and is operated by" the Federal agency or the contractor. The NTIA and FCC provide guidance for such determinations, and all NASA contractors and grantees should work with the appropriate Center Spectrum Manager in making that determination.

3.5.2 Non-NASA Owned and Operated

For NASA-funded but non-Federal designated systems, NASA requires that the contractor or grantee obtain spectrum licensing through the appropriate FCC processes. Appropriate language should be included in the contract, grant, or agreement documents (e.g., contracts, cooperative research and development agreements (CRADAs), etc.).

3.5.3 NASA Owned and Operated

a. The Center/Facility Spectrum Manager shall provide to the contracting officer such technical assistance as may be required to enable the issuance of a radio frequency assignment.

b. Contractors, providing or operating RF equipment for NASA use, will obtain RF EM spectrum

authorization in accordance with the terms of the contract through the NASA contracting officer. Contractors desiring to use Federal spectrum, as specified in the NTIA table of allocations (Chapter 4), are required to submit their needs to the Center/Facility Spectrum Manager. (The radio frequencies so approved do not belong to the contractor and are only for NASA use. Additionally, NASA will ensure it maintains operational control of the radio equipment, should the need to cease transmissions arise.)

3.6 Foreign Frequency Assignments

Requests for foreign frequency assignments will be provided by the Center/Facility Spectrum Manager responsible for the project to the NASA International Spectrum Program Manager. In the case of frequency assignments to be used in aircraft over foreign territories, the International Spectrum Program Manager works with the Office of International and Interagency Relations (OIIR). In some circumstances, NASA may request cooperating space agencies to obtain frequency assignments.

3.7 Conditions of Assignment

3.7.1 All Center activities will be assigned frequencies by NTIA through the NASA FAS representative. Documentation of approved assignments is available to the Center/Facility Spectrum Managers via the NTIA automated processing system. Based on this authorization, Center/Facility Spectrum Managers may issue Center RFAs.

3.7.2 Additionally, a copy of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management will also be supplied to all Spectrum Managers. Supplements to this manual will be furnished by the National Spectrum Program Manager when published by the NTIA.

3.7.3 All NASA frequency assignments are issued subject to the following conditions:

a. All frequencies assigned to NASA are issued subject to the conditions stated on the authorization. It is the responsibility of the Center/Facility Spectrum Manager to ensure that expiration dates are valid for their assignments and that, by September of each year, they perform updates via the NTIA automated processing system to any radio frequency assignment due for its five year review.

b. Radio transmitters are operated by adequately trained and designated personnel and in a manner conforming to established and accepted procedures.

c. Transmitter operations are conducted by personnel only on authorized frequencies after an assignment has been granted by the NTIA Frequency Assignment Subcommittee and entered into the Government Master File (GMF) or a Special Temporary Authorization has been granted by NTIA.

d. Approved power, emissions, and conditions of assignments shall be adhered to at all times.

e. All land mobile radio transmissions are identified by the use of the authorized radio call signs pursuant to Appendix H of this NPR.

f. Transmitter operations are held within the prescribed tolerances outlined in Chapter 5 of the NTIA Manual unless otherwise authorized.

g. A copy of the current RFA for each fixed radio station should be posted or retained in some manner at the principal control point of each radio transmitter or station.

h. An RF evaluation should be conducted in accordance with NPR 1800.1C requirements to determine the effects on human health, including interference with personnel operations such as maintenance procedures. Evaluations should be handled at a local level with the Center Radiation Safety Officer and/or Non-Ionizing Radiation Safety Officer and in collaboration with the Center/Facility Spectrum Manager. Local procedures will vary at each site and, as a minimum, follow IEEE C95.1, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields."

3.7.4 Section 7.11 of the NTIA Manual outlines conditions under which specific frequency usage may be authorized without prior coordination with other Government agencies. The Center/Facility Spectrum Managers may issue local RFAs without referral to the NASA FAS Representative to cover those operations that meet the criteria established in this chapter of the NTIA Manual for the particular frequency usage involved.

3.7.5 All Ground Penetrating radar and Global Positioning Satellite (GPS) re-radiators shall receive NASA and NTIA approval prior to use (see NTIA Manual, Annex K for Ground Penetrating radars and Sections 8.3.28-8.3.30 for GPS re-radiators).

3.8 Emergency and Wartime Procedures

3.8.1 Emergency Procedures

a. Under a declared emergency condition, Center/Facility Spectrum Managers may use or assign to an operation under their direction, frequencies not otherwise authorized, provided that:

(1) The nature and duration of the requirement are such that the normal frequency assignment procedures are impractical.

(2) All reasonable measures are taken before such frequencies are used to ensure that harmful interference will not be caused to other users.

3.8.2 Wartime Procedures

a. In wartime, all radio frequencies, both Federal and non-Federal, may be under the centralized authority of NTIA. Normally, under such conditions, military operations will take precedence over nonmilitary operations. However, all priorities established by the NTIA take into account all aspects of the President's communications requirements for the national defense in time of war.

b. NASA's role in providing support for these wartime procedures is established through the NTIA by the NASA Director of Spectrum Policy and Planning and will be implemented as required. The specific procedures are beyond the scope or intent of this NPR.

Chapter 4: RF Interference Procedures

4.1 Radio Frequency Interference Reporting Procedures

4.1.1 The probability of harmful RFI increases as more demands for frequency assignments are placed in the RF spectrum. In an attempt to meet these demands and to optimize the use of the spectrum, the space between channels is minimized within the limitations imposed by the state-of-the-art development of electronic equipment. The same frequencies are often shared by users separated geographically, or the same frequencies may be assigned to two or more users on a time-share basis. Because of this frequency sharing, some interference can be expected (and even tolerated) since clear channels are not ordinarily available within the overcrowded RF spectrum.

4.1.2 Occurrences of interference should be investigated initially by the Center/Facility Spectrum Manager. Reports of harmful interference or jamming of NASA emitters should normally be distributed by the Center/Facility Spectrum Manager as follows:

a. At the impacted Center:

(1) Security Office

(2) Office of Safety and Mission Assurance

(3) Occupational Health Office

b. At the Agency level:

(1) National Spectrum Program Manager

(2) HQ Office of Security and Program Protection

(3) HQ Office of Inspector General

(4) HQ Office of the Chief Health and Medical Officer

4.1.3 Consideration should also be given to including intentional interference as an information technology security incident, which needs to be reported to the NASA Incident Response Center (NASIRC) and the Office of Inspector General Computer Crimes unit. Requests for the assignment of replacement frequencies are made only if the interference is prolonged and disruptive and cannot be cleared through normal procedures.

4.1.4 The Center/Facility Spectrum Manager shall not be responsible for any interference caused to Wi-Fi or IEEE 802.11 devices or other unlicensed devices (i.e., FCC Part 15 or NTIA Annex K devices).

4.2 RFI Control Procedures

4.2.1 Radio Frequency Users

a. Normally, the NASA frequency user will be the first to become aware of RFI, and a judgment is made of how the observed RFI affects their operation.

b. If the interference is such that it cannot be tolerated, radio frequency users should proceed in the following manner:

(1) Step 1: Thoroughly check the affected equipment to ensure that the equipment is operating properly and the RFI is not being generated internally or on the site.

(2) Step 2: If possible, identify by call sign (or other identification) the station causing the interference.

(3) Step 3: Measure the frequency or band of frequencies causing the interference.

(4) Step 4: If possible, determine the type of emission and the type of traffic being transmitted.

(5) Step 5: If possible, measure the bandwidth of the interfering signal (highest and lowest frequencies) using calibrated test equipment (i.e., spectrum analyzer/receiver with current metrology date affixed to test equipment) and note the type of equipment used for measurement.

(6) Step 6: If possible, determine the frequency of occurrence, duration of the interfering signal (i.e., continuous, intermittent, etc.), time of day of occurrence, and other circumstances to support the investigation.

(7) Step 7: Measure the interference signal strength.

(8) Step 8: Determine the nature or severity of the interference. Indicate the impact to operations including the severity of data loss or data degradation due to the interference.

(9) Step 9: After the information in Steps 2 through 8 have been obtained, report this data to the Center/Facility Spectrum Manager together with a formal request to clear the interference.

(10) Step 10: Supply the Center/Facility Spectrum Manager with any additional information that is necessary or may be useful in identifying and clearing the RFI (e.g., audio recordings or spectrum analyzer screen captures).

(11) Step 11: Contact the Center Security Office to determine if there are any other ramifications due to national security or law enforcement activity.

4.2.2 Center/Facility Spectrum Managers

a. The Center/Facility Spectrum Manager will make every effort to clear the interference at the Center before requesting assistance from the National Spectrum Program Manager.

b. Center/Facility Spectrum Managers should follow the appropriate procedures listed below to clear cases of interference to Agency operations:

(1) Step 1: Check the information supplied by the frequency user to ensure that it is as complete as possible. Request additional information from the user as required for filing the standard RFI report (See Step 6).

(2) Step 2: If the station can be identified, contact the interfering station directly and attempt to clear the interference through coordination with the station manager. If the interference originates from a foreign (non-U.S.) source, contact the National Spectrum Program Manager for further assistance (see paragraph 4.2 e (2) and (3)).

(3) Step 3: If direct contact with the interfering station is unsuccessful, and the interference appears to be from a non-Federal station, request assistance from the nearest FCC monitoring station as required to coordinate efforts to clear the interference. If the interference appears to be in the vicinity of an airport, contact the nearest FAA representative for assistance.

(4) Step 4: If the interference is encountered on or from a DoD Test Range, report the RFI to the local DoD Test Range Spectrum Manager for resolution. If there is no satisfactory resolution, then elevate the RFI to the DoD Area Frequency Coordinator (AFC) (see NTIA Manual, Table 8.3.26) in accordance with appropriate range communications instructions.

(5) Step 5: If all attempts to clear the interference through local coordination fail, report the RFI to the National Spectrum Program Manager in accordance with Steps 6 and 7 below.

(6) Step 6: Forward a message directly to the National Spectrum Program Manager. Use the standard RFI reporting format shown in Figure 4-1 for listing the particulars of the interference.

(7) Step 7: When practicable, forward a follow-up letter to the National Spectrum Program Manager. Reference the message by number, date, and time, and include the same information as the message together with a detailed report of local action taken to eliminate the interference.

c. The Center/Facility Spectrum Manager should cooperate fully with non-NASA spectrum users in resolving RFI that may be caused by emissions from within the local Center. â??

REPORT OF HARMFUL INTERFERENCE

- Particulars Concerning the Station Causing the Interference:

  A. Name or call sign and category of station
  B. Frequency measured
  C. Class of emission
  D. Bandwidth
  E. Field strength
  F. Nature of interference

- Particulars Concerning the Transmitting Station Interfered with:

  G. Name or call sign and category of station
  H. Frequency assigned
  I. Frequency measured
  J. Class of emission
  K. Bandwidth
  L. Field strength

- Particulars Furnished by the Receiving Station Experiencing the Interference:

  M. Name of station
  N. Geographic location of station
  O. Dates and times of occurrence of harmful interference
  P. Other particulars
  Q. Requested action

NOTE: For convenience and brevity, prepare reports in the format above, using the letters in the order listed in place of the explanatory titles, and place an "X" after any such letter if no information on that particular item is reported.

Figure 4-1

Standard RFI Reporting Format

4.2.3 National Spectrum Program Manager

a. When an RFI problem cannot be resolved at the Center, the National Spectrum Program Manager shall attempt to clear the interference through direct coordination with other Agencies if the problem is a national one, or indirectly with the assistance of the FCC or the NTIA if the problem is either international or the result of a non-Government system.

b. The National Spectrum Program Manager should follow the steps below as they apply to the particular situation: (1) Step 1: If the RFI is caused by a non-Federal station (or an unknown station) operating in the United States and its Possessions, notify the FCC directly, and provide such information and assistance required to enable the FCC to clear the interference.

(2) Step 2: If the RFI is caused by a station operated by another agency or department of the U.S. Government, refer the matter to the IRAC, including a full report of the interference and a request for action or assistance, as required.

(3) Step 3: If the RFI is caused by a station of another nation operating outside the United States and its Possessions, refer the matter to IRAC or to NTIA. NTIA or the FCC will assume the coordination necessary to resolve the problem at the International level through the ITU, if required.

c. The National Spectrum Program Manager should cooperate fully with non-NASA spectrum users in resolving RFI that may be caused by emissions from within the local Center.

4.2.4 Interference From Foreign (Non-U.S.) Sources

a. All NASA flight projects should follow the procedures for the management of RFI situations, outlined earlier in this chapter, except when the interference is believed to originate from a foreign (non-U.S.) source.

b. In the case of interference from a foreign (non-U.S.) source, the National Spectrum Program Manager, in

consultation with the International Spectrum Program Manager, shall use the information supplied in the standard RFI report to apprise appropriate spectrum administration offices (e.g., NTIA, FCC, U.S. Department of State) of the interference, its nature, source, and the need for cessation.

c. In the case where interference from a foreign (non-U.S.) source is jeopardizing the return of unique scientific data or the survival of a spacecraft (e.g., spacecraft emergency), the International Spectrum Program Manager shall contact appropriate Space Frequency Coordination Group (SFCG) members to try to secure cessation of the interfering transmission. This action is to be followed up with a formal report to the appropriate spectrum administration office (e.g., NTIA, FCC or U.S. Department of State).

4.2.5 NASA/ESA/JAXA RFI Coordination Procedures

Coordination of spectrum use between NASA, the European Space Agency (ESA), and the Japanese Aerospace and Exploration Administration (JAXA) will conform to the procedures outlined in the appropriate coordination manual. Such coordination shall be the responsibility of the International Spectrum Program Manager in consultation with affected Center/Facility Spectrum Managers and the National Spectrum Program Manager.

4.2.6 Space Frequency Coordination Group (SFCG)

a. The SFCG was established to provide a less formal and more flexible environment than the International Telecommunication Union for the solution of frequency management problems encountered by member space agencies. The Terms of Reference for SFCG are given in Appendix I.

b. The SFCG is concerned with the effective use and management of those radio frequency bands as allocated in the ITU RR for radio services within the scope of Radiocommunication Sector Study Group 7 (see Appendix J). In particular, the services of interest to the SFCG include space research, Earth-exploration satellites, meteorological satellites, space operations, data relay satellites, radio-navigation satellites, and radio astronomy (including radar astronomy) to the extent that they are relevant to spacecraft missions. Within the formal framework of the Radio Regulations, there is the need and opportunity for international informal agreement among participating space agencies concerning assignment of specific frequencies and related technical issues. The International Spectrum Program Manager, in consultation with the affected Center/Facility Spectrum Managers, shall facilitate this coordination. The Goddard Space Flight Center is responsible for the maintenance of the SFCG radio frequency database. Each Center/Facility Spectrum Manager is responsible for the analysis of NASA programs under their cognizance with the SFCG data.

c. The principal result of SFCG meetings is the adoption of resolutions and recommendations that express technical and administrative agreements. These agreements may be used by space agencies to make best use of allocated bands and to avoid interference.

4.2.7 International Space Station (ISS) Radio-Frequency Coordination Procedures for radio-frequency coordination for the International Space Station (ISS) are defined in NASA publication SSP 50423, ISS Radio Frequency Coordination Manual.

Chapter 5 NASA Long-Range Spectrum Planning

5.1 Background

5.1.1 The NASA Director of Spectrum Policy and Planning is responsible for the planning of long-term national and international spectrum management initiatives aimed at improving the spectrum management environment within which NASA operates. The National and International Spectrum Program Managers are responsible for implementation of these initiatives. For instance, in cases where new frequency allocations or changes to the national and international radio regulations are required, lead times of more than a decade may be necessary since periodic ITU conferences that are competent to make such changes are usually limited in scope. For this reason, and to permit NASA to continue to operate in compliance with section 1.2 of this NPR, the National and International Spectrum Program Managers must be made aware of new concepts, which may require spectrum support with sufficient time available to accomplish such changes.

5.1.2 Considering typical design and construction periods, it is essential that appropriate spectrum be allocated a minimum of five years prior to the anticipated launch dates for all Agency missions. Since new allocations may take as many as ten years to realize, it is essential that the National and International Spectrum Program Managers be informed of new mission concepts as early as possible so that appropriate allocation initiatives may be identified.

5.2 Long-Range Planning

5.2.1 General

a. The Director of Spectrum Policy and Planning maintains a long-range spectrum forecast in order to identify needed spectrum management initiatives in a timely manner. All dates are driven by the projected launch dates of particular missions and the need for any radio spectrum (national or international). The information is used by the NTIA as well as NASA to determine if additions/changes are required to agendas of World Radiocommunication Conferences (WRCs).

b. NASA expects that most mission RF EM spectrum needs will be satisfied by existing allocations. However, for some missions, changes in international agreements and national regulations may be required to support new and entirely unique operations in the future (such as operations on or in the vicinity of the far side of the Moon or for disruption tolerant radio protocols for use on terrestrial or space applications). To this end, the long-range spectrum forecast attempts to identify dates at which consideration of these matters needs to be completed if NASA is to operate in an interference-free environment.

5.2.2 Mission Directorate Responsibilities

a. For future Agency missions, it is the responsibility of each NASA Mission Directorate, through the SCaN Board of Directors, to provide the latest conceptual communications requirements to the Director of Spectrum Policy and Planning in respect to programs and future mission concepts for which they may have cognizance. This information should be provided from the inception of the conceptual mission and updated as the program evolves. The Director of Spectrum Policy and Planning will provide an assessment of the spectrum requirements in consultation with the concerned program office and the National and International Spectrum Program Managers and cognizant Center Spectrum Managers with sufficient lead-time to allow appropriate regulatory action.

b. Each Headquarters Mission Directorate should provide updated mission concepts and new anticipated launch dates to the Director of Spectrum Policy and Planning via direct consultation or via the SCaN Board of Directors.

5.2.3 Center Responsibilities

a. For future Agency missions, it is the responsibility of each Center/Facility Spectrum Manager to provide the latest conceptual communications requirements to the National and International Spectrum Program Managers, with respect to projects and future mission concepts for which the Center may have cognizance. This information should be provided from the inception of the conceptual mission and updated as the project evolves. It is the responsibility of each Center/Facility spectrum manager to provide semiannual updates.

b. The National Spectrum Program Manager will provide an assessment of the spectrum requirements in consultation with the Center and the International Spectrum Program Manager with sufficient lead time to permit appropriate regulatory action.

c. The Center/Facility Spectrum Manager of the originating project is responsible for obtaining the RFA and has the overall spectrum responsibility and coordination at the execution site. Any alteration or changes to the RFA that might be necessary will be coordinated between the RFA owner and the execution site Center/Facility Spectrum Manager.

d. Each Center should provide updated mission concepts and new anticipated launch dates to the National Spectrum Program Manager via direct consultation or via the NASA Spectrum Managers Group annual meeting.

Appendix A: Glossary of Commonly Used Terms from the International Telecommunication Union (ITU) Radio Regulations (RR) Applicable to NASA RF EM Spectrum Management

A.1 General Terms

A.1.1 Experimental Station: A station utilizing radio waves in experiments with a view to the development of science or technique.

A.1.2 Frequency Allocation: Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more (terrestrial or space) radiocommunication services or the radio astronomy service under specified conditions. This term should also be applied to the frequency band concerned.

A.1.3 Frequency Allotment: Entry of a designated frequency channel in an agreed-upon plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specific conditions.

A.1.4 Frequency Assignment: Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.

A.1.5 Frequency Coordination: Procedures established to provide portions of the RF spectrum or specific frequencies to two or more users that best accommodate the services required by each.

A.1.6 Harmful Interference: RF interference that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio communications service.

A.1.7 Non-Interference Basis: Use of radio frequencies, not in accordance with all applicable Radio Regulations (RR), must not cause harmful interference to, or claim protection from stations of, other services operating in accordance with the RR.

A.1.8 Radio Astronomy: Astronomy based on the reception of RF waves of a cosmic origin.

A.1.9 Radio Frequency Spectrum Management: The control of radio frequency interference through the processes of frequency allocation and assignment, monitoring of equipment research and development, frequency records administration, engineering analysis, and international negotiations.

A.1.10 Radio Frequency Spectrum Support: The availability of authorized frequencies or portions of the RF spectrum to accommodate the operational requirements of particular electronic equipment.

A.1.11 Radio Waves: Electromagnetic waves of frequencies lower than 3000 GHz, propagated in space without artificial guides.

A.1.12 Radiocommunication: Telecommunication by means of radio signals.

A.1.13 Radiosonde: An automatic radio transmitter in the meteorological aids service usually carried on an aircraft, free balloon, kite or parachute, and which transmits meteorological data.

A.1.14 Telecommunication: Any transmission, emission or reception of signs, signals, writing, images and sound or intelligence of any nature by wire, radio, optical or other systems.

A.1.15 Terrestrial Service: Any radio service other than a space service or the radio astronomy service.

A.1.16 Tropospheric Scatter: The propagation of radio waves by scattering as a result of irregularities or discontinuities in the physical properties of the troposphere.

A.2 Space Systems, Services, And Stations

A.2.1 Active Satellite: An Earth satellite carrying a station intended to transmit or retransmit radio signals either for communications or remote-sensing purposes.

A.2.2 Active Sensing: The measurement on board a spacecraft of signals transmitted by the sensor and then reflected, refracted, or scattered by the Earth's or another planet's surface or its atmosphere.

A.2.3 Broadcasting-Satellite Service: A space service in which signals transmitted or retransmitted by space stations, or transmitted by reflection from objects in orbit around the Earth, are intended for direct reception by the general public.

A.2.4 Earth Exploration-Satellite Service: A radiocommunication service between Earth stations and one or more space stations, which may include links between space stations, in which:

a. Information relating to the characteristics of the Earth and its natural phenomena including data relating to the state of the environment is obtained from active sensors or passive sensors on Earth stations.

b. Similar information is collected from airborne or Earth-based platforms.

c. Such information may be distributed to Earth stations within the system concerned.

d. Platform interrogation may be included. Note: This service may also include feeder links necessary for its operations.

A.2.5 Earth Station: A station in the space service located either on the Earth's surface, including on board a ship, or on board an aircraft.

A.2.6 Fixed-Satellite Service: A radiocommunication service between Earth stations at specified fixed points when one or more satellites are used; in some cases this service includes satellite-to-satellite links, which may also be effected in the intersatellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.

A.2.7 Geostationary Satellite: A satellite, the circular orbit of which lies in the plane of the Earth's equator and which turns about the polar axis of the Earth in the same direction and with the same period as those of the Earth's rotation.

A.2.8 Mobile Satellite-Service: A radio communication service between mobile Earth stations and one or more space stations, or between space stations used by this service; or between mobile Earth stations by means of one or more space stations.

A.2.9 Passive Sensing: The measurement on board a spacecraft of the natural electromagnetic energy emitted and scattered by the Earth or another planet and constituents of its atmosphere.

A.2.10 Remote Sensing: The observation of the Earth and its atmosphere using active or passive sensing.

A.2.11 Satellite System: A space system using one or more artificial Earth satellites.

A.2.12 Space Research Service: A space service in which spacecraft or other objects in space are used for scientific or technological research purposes.

A.2.13 Space Service: A radiocommunication service (1) between Earth stations and space stations or (2) between space stations or (3) between Earth stations when the signals are retransmitted by space stations, or transmitted by reflection from objects in space, excluding reflection or scattering by the ionosphere or within the Earth's atmosphere.

A.2.14 Space Station: A station in the space service located on an object, which is beyond, is intended to go beyond, or has been beyond, the major portion of the Earth's atmosphere.

A.2.15 Space System: Any group of cooperating Earth and space stations providing a given space service and which, in certain cases, may use objects in space for the reflection of the radiocommunication signals.

A.2.16 Space Telecommand: The use of radiocommunication for the transmission of signals to a space station to initiate, modify, or terminate functions of the equipment on a space object, including the space station.

A.2.17 Space Telemetering: The use of telemetering for the transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft.

A.2.18 Space Tracking: Determination of the orbit, velocity, or instantaneous position of an object in space by means of radiodetermination, excluding primary radar, for the purpose of following the movement of the object.

A.2.19 Spacecraft: Any type of space vehicle, including an Earth satellite or a deep-space probe, whether human-tended or robotic.

A.3 Space And Orbits Of Spacecraft

A.3.1 Apogee: Altitude above the surface of the Earth of the point on a closed orbit where a satellite is at its maximum distance from the center of the Earth.

A.3.2 Deep Space: Space at distances from the Earth equal to or greater than 2 x 106 km.

A.3.3 Geosynchronous: A location in space where a satellite's period of revolution is equal to the period of rotation of the Earth about its axis.

A.3.4 Geostationary: A location in space where a satellite's circular and direct orbit lies in the plane of the Earth's equator and which thus remains fixed relative to the Earth. This is a special case of geosynchronous where the orbit inclination is 0Â°.

A.3.5 Inclination: The acute angle between the plane containing an orbit and the plane of the Earth's equator.

A.3.6 Non-geostationary: A location in space where a satellite's orbit is not necessarily in the plane of the Earth's equator and has a period of revolution other than 24 hours.

A.3.7 Orbit: The path in space described by the center of mass of a satellite or other object in space.

A.3.8 Perigee: Altitude above the surface of the Earth of the point on a closed orbit where a satellite is at its minimum distance from the center of the Earth.

A.3.9 Period: The time elapsing between two consecutive passages of an object in space through the same point on its closed orbit.

A.3.10 Sun-Synchronous: An orbit in which the angle between the Sun-Earth vector and the intersection of the plane of a satellite's orbit and the Earth's equator is a constant and does not change with the season.

A.4 Technical Characteristics

A.4.1 Assigned Frequency: The center of the frequency band assigned to a station.

A.4.2 Assigned Frequency Band: The frequency band, the center of which coincides with the frequency assigned to the station and the width of which equals the necessary bandwidths plus twice the absolute value of the frequency tolerance.

A.4.3 Carrier Power of a Radio Transmitter: The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle under conditions of no modulation. This definition does not apply to pulse-modulated emissions.

A.4.4 Equivalent Isotropically Radiated Power: The product of the emitted power supplied to the antenna and the antenna gain relative to an isotropic antenna.

A.4.5 Frequency Tolerance: The maximum permissible departure by the center frequency of the frequency band occupied by an emission from the assigned frequency or, by the characteristic frequency of an emission from the reference frequency. The frequency tolerance is expressed in parts per million (ppm), or in percentage, or in Hz, kHz, or MHz.

A.4.6 Gain of an Antenna: The ratio of the power required at the input of a reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field at the same distance. When not specified otherwise, the figure expressing the gain of an antenna refers to the gain in the direction of the radiation main lobe.

A.4.7 Harmful Interference: Any emission, radiation, or induction which endangers the functioning of a radionavigation service or other safety service or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with ITU RR.

A.4.8 Isotropic or Absolute Gain of an Antenna: The gain of an antenna in a given direction when the reference antenna is an isotropic antenna isolated in space.

A.4.9 Mean Power of a Radio Transmitter: The power supplied to the antenna transmission line by a transmitter during normal operation, averaged over a time sufficiently long compared with the period of the lowest frequency encountered in the modulation. A time of 1/10 second during which the mean power is greatest will be selected normally.

A.4.10 Necessary Bandwidth: For a given class of emission, the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specific conditions. Emissions useful for the good functioning of the receiving equipment as, for example, the emission corresponding to the carrier of reduced carrier systems, are included in the necessary bandwidth. The necessary bandwidth for an emission is determined as prescribed in Annex J of the NTIA Manual.

A.4.11 Peak Envelope Power of a Radio Transmitter: The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the highest crest of the modulation envelope, taken under conditions of normal operation.

A.4.12 Relative Gain of an Antenna: The gain of an antenna in a given direction with reference to an antenna which is a half-wave, loss-free dipole isolated in space, and in the equatorial plane which contains the given direction.

Appendix B: Acronyms

AA	Associate Administrator
AFC	Area Frequency Coordinators
AFRC	Armstrong Flight Research Center
AFTRCC	Aerospace & Flight Test Radio Coordinating Council
ANSI	American National Standards Institute
ARC	Ames Research Center
BR	Radiocommunication Bureau
CSMAC	Commerce Spectrum Management Advisory Committee
DAA	Deputy Associate Administrator
DoD	Department of Defense
EL-CID	Equipment Location â?" Certification Information Database
EMC	Electromagnetic Compatibility
ESA	European Space Agency
FAR	Federal Acquisition Regulation
FAS	Frequency Assignment Subcommittee (of the IRAC)
FCC	Federal Communications Commission
GHz	gigahertz
GMF	Government Master File
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HEOMD	Human Exploration and Operations Mission Directorate
HF	High Frequency
HQ	Headquarters
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers Inc.
IFRB	International Frequency Registration Board
IRAC	Interdepartment Radio Advisory Committee
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union - Radiocommunication Sector
JAXA	Japanese Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory (an FFRDC)
JSC	Johnson Space Center
kHz	kilohertz
KSC	Kennedy Space Center
LaRC	Langley Research Center
MAF	Michoud Assembly Facility
MHz	megahertz
MSFC	Marshall Space Flight Center

NIST	National Institute of Standards and Technology
NMI	NASA Management Instruction
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NRQZ	National Radio Quiet Zone
NSF	National Science Foundation
NSMG	NASA Spectrum Managers' Group
NTIA	National Telecommunications and Information Administration
NTIA Manual	NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management
OMB	Office of Management and Budget
OSMA	Office of Safety and Mission Assurance
PPSG	Policy and Plans Steering Group
RCS	Radio Conference Subcommittee (of the IRAC)
RF	Radio Frequency
RFA	Radio Frequency Authorization
RFI	Radio Frequency Interference
RR	Radio Regulations
SCaN	Space Communications and Navigation
SFCG	Space Frequency Coordination Group
SM	Spectrum Manager
SPS	Spectrum Planning Subcommittee (of the IRAC)
SSC	Stennis Space Center
SSS	Space Systems Subcommittee (of the IRAC)
STA	Special Temporary Authorization
TDRS	Tracking and Data Relay Satellite
TSC	Technical Subcommittee (of the IRAC)
UHF	Ultra High Frequency
VHF	Very High Frequency
WFF	Wallops Flight Facility
WRC	World Radiocommunication Conference
WSTF	White Sands Test Facility

Appendix C: Spectrum Document Tree

The Spectrum Management Program Documentation Tree is shown in Figure C-3. The tree shows the linkages between NASA spectrum management documentation and U.S. national rules and regulations.

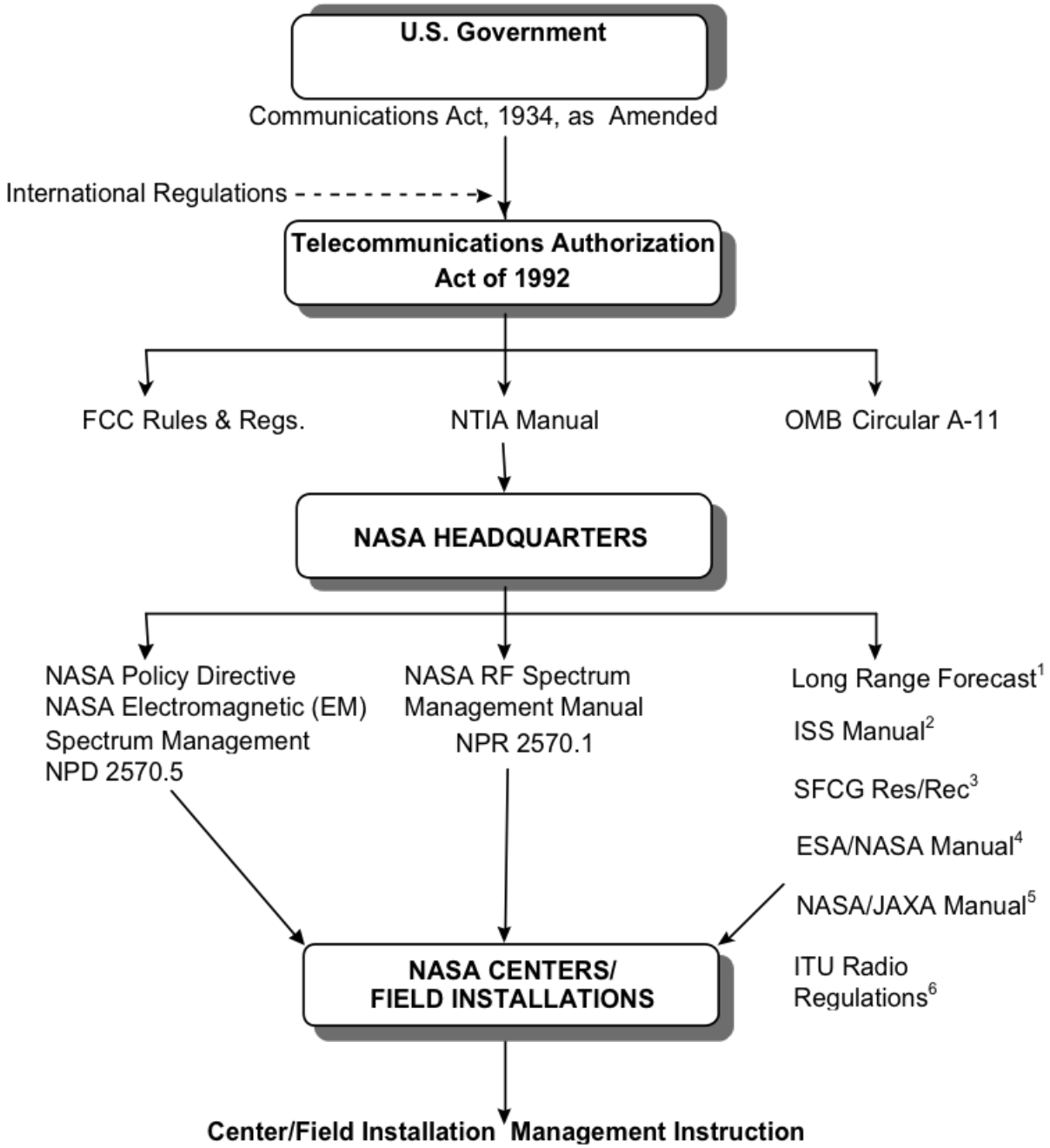

Figure C-3 NASA Spectrum Management Program Documentation Tree

[1] NASA Long Range Electromagnetic (EM) Forecast (https://www.spacecommunications.nasa.gov/spacecomm/spectrum/default.cfm) [2] SSP 50423, International Space Station Radio Frequency Coordination Manual [3] Space Frequency Coordination Group Resolutions and Recommendations (https://www.sfcgonline.org/resources/default.aspx) [4] NASA-ESA Procedures for Coordination of Frequency Use [5] NASA-JAXA Procedures for Coordination of Frequency Use [6] International Telecommunication Union Radio Regulations (http://www.itu.int)

Appendix D: Spectrum Certification and Value of Spectrum

D.1 *Spectrum certification.* NASA will obtain a certification by the NTIA, Department of Commerce, which is responsible for assigning spectrum to Federal users, that the radio frequency required can be made available before NASA submits estimates for the development or procurement of major radio spectrum-dependent communication-electronics systems (including all systems employing space satellite techniques). The NTIA may also review the Agency's economic analyses during the certification process.

D.2 OMB Circular A-11, Section 31.12, provides an example of a methodology to evaluate spectrum efficiency when considering alternatives for procuring systems, or when evaluating spectrum usage generally. In order to ensure compliance with the provisions of the Communications Act, and consistent with section 6411 of the Middle Class Tax Relief and Job Creation Act of 2012, OMB Circular No. A-11 (2012), Section 31.12, states that:

D.3 The value of radio spectrum required for telecommunications, radars, and related systems should be considered, to the extent practical, in economic analyses of alternative systems/solutions. In some cases, greater investments in systems could enhance Federal spectrum efficiency (e.g., purchase of more expensive radios that use less bandwidth); in other cases, the desired service could be met through other forms of supply (e.g., private wireless services or, use of land lines, or optical communications systems). Therefore, to identify solutions that have the highest net benefits, agencies should consider greater investment to increase spectrum efficiency along with cost-minimizing strategies.

D.4 To demonstrate consideration of the value of the relevant spectrum, agencies should indicate whether the system procured was the most spectrum "efficient" solution among those qualified bids (i.e., that met specified mission/operational requirements); if an agency is unable to so indicate, then the agency should indicate the investment difference between the solution chosen and the more spectrum "efficient" qualified solution. To further advance Federal stewardship of the spectrum resource, agencies should also include the following in their budget justifications for procurement of major spectrum-dependent communications systems:

a. In a Request for Proposal (RFP) to procure the system, the requirement that respondents address spectrum "efficiency" factors (e.g., greater adjacent band compatibility, less use of bandwidth, etc.) and assess trade-offs between investment in equipment and spectrum requirements.

b. Whether the system will share spectrum with other Federal or non-Federal existing systems/operations and, if so, the nature and extent of the sharing relationship.

c. When proposing a new system, whether sharing an existing Federal system to meet the capability requirement is possible, or whether sharing capabilities of similar Federal users has been considered.

d. When replacing systems, what improvements in spectrum "efficiency" and "effectiveness" exist compared to the prior system.

e. Certification of consideration of non-spectrum dependent or commercial alternatives to meet mission/operational requirements.

D.5 The methodology does not attempt to measure or judge the overall benefits of a Federal activity nor does it attempt to establish a dollar value or auction price. Instead, the method outlined provides agencies a way to evaluate improvements in spectrum efficiency in implementing their required and essential activities. A sample of the questions to be considered is provided below. OMB also allows agencies to develop alternative methods for measuring spectrum efficiency and submit them to OMB for approval.

Economic Value Analysis Sample Questions

Agencies should consider the economic value analysis of this proposed radio spectrum:

1. Were alternative systems considered?
2. Did this include consideration of more expensive hardware which would use less spectrum?
3. Were commercial/private capabilities examined?
4. Were landlines considered?
5. What was the cost benefit for choosing this system?

   Other mitigating factors, e.g., Physics of the spectrum required?

Appendix E: NASA Spectrum Managers Group (NSMG)

E.1 Purpose

The NSMG is organized to provide a forum for the exchange of information on radio-frequency spectrum management requirements, actions, and issues among all Center/Facility Spectrum Managers. The group provides the assurance to NASA Headquarters of the Centers' compliance with NASA policy.

E.2 Objectives

E.2.1 The group provides a medium for each Center to input the communications requirements of all current and future projects undertaken by that Center to NASA HEOMD, in a timely manner, to ensure that spectrum support is available as and when required by each project.

E.2.2 The group also provides a means for Center/Facility Spectrum Managers to be kept informed on the status and progress of frequency spectrum support issues in the national and international frequency spectrum arenas.

E.2.3 Additionally, the group's meetings provide the opportunity for Centers to comment on proposed Agency and interagency frequency management issues.

E.3 Organization

E.3.1 The group is chaired by the National Spectrum Program Manager on behalf of the AA for HEOMD. The chairperson convenes meetings of the group annually. Meeting locations vary to provide each Center/Facility Spectrum Manager an opportunity to host.

E.3.2 Each Center/Facility Spectrum Manager provides to the group at least one representative knowledgeable in the communications requirements of all current and future project activities in which the Center is involved. Additionally, the host Center/Facility Spectrum Manager will invite a local representative of the Office of Safety and Mission Assurance (OSMA) or the NASA Center Office with responsibility for RF safety to the annual meeting at their host NASA Center.

E.3.3 In addition, the International Spectrum Program Manager (or representative) will brief the attendees on current activities in the international arena applicable to NASA interests and concerns.

E.3.4 The work of the group is recorded by means of these documents:

a. Meeting Minutes [14], published after each meeting.

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[14] The Manual in NPR 1441.1, NASA Records Retention Schedules, should be followed to maintain and safeguard these records. Records, documents, reports, etc. can only be disposed of based on the retention periods in NPR 1441.1, If an item is not described in NPR 1441.1, an entry needs to be developed and added to the NPR. In this instance, contact your Center Records Manager for the procedures.

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b. Action Item List, reviewed quarterly by the National Spectrum Program Manager with Center/Facility SMs and updated at each meeting.

E.3.5 These documents are distributed electronically to participants and are located on the SCaN internal Web site after the meetings.

Appendix F: NASA Spectrum Analysis Center Charter

Roles and Responsibilities

F.1 The Director of the Spectrum Policy and Planning Division, NASA HQ, has directed the NASA Spectrum Office at NASA GRC to establish a Spectrum Analysis Center (SAC) with the following overall objectives:

a. To provide a centralized review process for all NASA spectrum-related analyses leaving the Agency.

b. To perform selected spectrum analyses as directed by the NASA HQ Spectrum Office and International/National Spectrum Managers.

c. To provide consistency in methodology and assumptions in spectrum analyses conducted across the Agency.

d. To ensure spectrum analyses are consistent with NASA spectrum policies and guidelines

F.2 NASA Centers will coordinate with SAC at GRC in conducting technical spectrum analyses intended for international and national organizations outside the Agency (e.g. NTIA, FCC, DoD, ITU, SFCG). The roles and responsibilities of the SAC as they relate to various spectrum-related task areas are outlined below:

F.2.1 US Domestic Spectrum Analyses

a. This includes analyses related to NTIA/FCC proceedings and regulatory actions (e.g. commercial wireless broadband studies within the PPSG and CSMAC; wireless broadband/GPS adjacent band compatibility studies; and spectrum coordination analyses with other government/non-government entities) along with NTIA IRAC Subcommittee activities (Spectrum Planning Subcommittee (SPS); Frequency Assignment Subcommittee (FAS); Technical Subcommittee (TSC); and Space Systems Subcommittee (SSS)) and NASA projects/missions.

b. The SAC will conduct these analyses with contract support.

c. To the extent that the analyses involve spectrum bands important to NASA's Space Network, Deep Space Network, Near Earth Network, or Manned Space Missions, the SAC will also request support from the spectrum analysis groups at GSFC, JPL, a Federally Funded Research and Development Center, and JSC.

d. SAC will support the National Spectrum Manager as necessary in the NTIA SPS, FAS, TSC, and SSS.

e. NASA Space Flight Projects:

(1) The SAC will perform technical analyses and reviews as directed by the National Spectrum Manager.

(2) SAC support for NASA projects and missions should be coordinated through the National Spectrum Manager.

F.2.2 International Spectrum Analyses

a. ITU-R Studies

(1) At the beginning of a WRC cycle, SAC will, in consultation with International Spectrum Manager, identify WRC Agenda Items of key importance to NASA and develop a matrix of responsibilities to assign WRC Agenda Item studies to appropriate NASA Centers.

(2) SAC will, as necessary, coordinate and review NASA generated ITU-R US Working Party input documents/analyses as they progress through the US Working Party cycle.

(3) To avoid imposing more schedule constraints on the NASA Centers performing the studies, the appropriate NASA Center will continue to submit their documents directly to the US WPs as they currently do and not be required to first funnel them through the SAC.

(4) At the direction of the International Spectrum Manager, the SAC itself may perform ITU-R sharing studies (e.g. WiBB studies in JTG 4-5-6-7 related to AI 1.1), in which case it will directly submit input documents into the appropriate US WPs.

b. Space Frequency Coordination Group Studies

(1) The SAC will perform analyses and technical reviews as directed by the International Spectrum Manager.

c. ESA/NASA/JAXA Studies

(1) The SAC will perform analyses and technical reviews as directed by the International Spectrum Manager. Most of these studies involve mission coordination and it is anticipated that the SAC will have limited involvement.

(2) Specific Tasks

(a) Specific tasks to be performed by the SAC will be developed in consultation with the NASA HQ Director of

Spectrum Policy and the National and International Spectrum Managers.

(b) Progress on SAC tasks will be reported at weekly and monthly Spectrum Office staff meetings as well as HQ Program Status Reviews (PSRs).

Appendix G: NTIA IRAC Spectrum Planning Subcommittee (SPS) and Space Systems Subcommittee (SSS) Procedures

G.1 IRAC Spectrum Planning Subcommittee

G.1.1 The procedure consists of a four-stage review performed by NTIA's Systems Review Branch in the IRAC SPS. All four stages of review are not required. Normally, NASA space systems undergo review at Stages 2, 3, and 4 or Stages 2 and 4. This review process is mandatory for space systems except those that operate under Annex K of the NTIA Manual regarding low power non-licensed devices. Details of the NTIA Systems Review process can be found in the NTIA Manual Chapter 10. (Note also Section 1.2 of this NPR.)

G.1.2 All data will be submitted by the responsible Center/Facility Spectrum Manager to the NASA SPS Representative (in either EI-CID or the current successor) in accordance with Sections 10.7 and 10.8 of the NTIA Manual.

G.1.3 Stage 1 Conceptual

a. In Stage 1, the initial planning effort has been completed, including proposed frequency bands and other available characteristics.

b. The Stage 1 Systems Review addresses the certification of spectrum support for telecommunication systems or subsystems and provides guidance on the feasibility of obtaining certification of spectrum support at subsequent stages. Those systems or subsystems that have a major impact on spectrum usage as defined by user agencies, IRAC, or NTIA, should be submitted especially those that use new technological concepts or use existing technology in significantly new ways.. The guidance provided by NTIA will indicate any modification, including more suitable frequency bands necessary to ensure conformance with the Tables of Frequency Allocations and the provisions of Chapter 5, Spectrum Standards of the NTIA Manual.

c. In analyses performed by the Systems Review Branch leading to certification of spectrum support, only gross calculations may be achievable for a general evaluation of spectrum impact (as much system data will be estimated) and will be subject to adjustment during later stages. The system will be reviewed for conformance to International and National Allocation Tables. In addition, checks will be made against existing standards and sharing criteria, comparison will be made with known similar systems, and spectrum efficiency will be considered.

d. With Stage 1 approval, the Agency may not apply for a frequency assignment. Frequency assignments are only available after Stage 2 certification of spectrum support and above.

G.1.4 Stage 2 Experimental

a. The preliminary design has been completed, and radiation, using test equipment or preliminary models, may be required.

b. Information identified in the Stage 1 Systems Review should be enhanced to make it current. Additionally, information required by Appendix 4 of the ITU RR will be furnished to the SSS in accordance with the instructions in the current NTIA Manual for the purposes of ITU-R Advance Publication. The Appendix 4 data should be provided to the SSS at the same time as the request for Stage 2 Systems Review.

c. The Advance Publication Information should be submitted not earlier than seven years and, preferably, not later than two years before bringing the frequency assignments into use. There is no minimum time period but, as a practical matter, if coordination and/or agreement are required, the information should be submitted at least two years before bringing the frequency assignments into use. Advanced publication may be waived by the NTIA on a case-by-case basis if the system will be operational for less than one year and the Agency requests a waiver from the SSS of the IRAC.

d. Certification of spectrum support for telecommunication systems or subsystems at Stage 2 is a prerequisite for NTIA authorization of radiation in support of experimentation for space systems. It also provides guidance for ensuring certification of spectrum support at subsequent stages. Certification, at Stage 2, may be requested for test equipment modified operational equipment or initial design models that can be used to determine which of several frequency bands or which of several proposed equipment configurations should be selected for continued investigation.

e. In the review leading to certification of spectrum support at Stage 2, an evaluation of the system conformance to NTIA Manual Chapter 5, Spectrum Standards, is performed along with an assessment of the system usage for war emergencies and verification that Appendix 4 of the ITU RR is satisfied. A general analysis will be applied by the Systems Review Branch, where appropriate, with more specific Electromagnetic Compatibility (EMC) analysis, against a typical environment, being added where experimental testing of technically defined equipment is involved. Recommendations for changes to equipment characteristics and contemplated operational employment and deployment will be provided when appropriate. Calculations required in connection with national and international

space coordination procedures in accordance with the methods of Appendices 28 and 29 of the ITU RR will be performed to the extent practicable.

f. After the SPS Stage 2 review is approved, the Agency may forward a request to the FAS to obtain the necessary frequency assignment. (see Section 3.3 of this NPR.) At this stage, the frequency assignment request should be for a trial assignment for the location at which the system will be tested. A planning assignment may also be requested in anticipation of the operational (Stage 4) approval.

G.1.5 Stage 3 Developmental

a. Major design has been completed, and radiation may be required during testing. For the Stage 3 Systems Review, the Agency will update the information already provided and include as a minimum:

(1) For each Earth station transmitter and receiver site:

(a) Frequencies or frequency bands and satellites to be accessed.

(b) Coordinates.

(c) Emission designator for each frequency or frequency band.

(d) Maximum spectral power density and output power for each frequency or frequency band.

(e) Lowest equivalent satellite link noise temperature and associated value of transmission gain for each frequency or frequency band (geostationary satellites with simple frequency changing transponders only).

(f) Antenna gain and beamwidth.

(g) Minimum elevation angle of antenna main beam.

(h) Range of azimuth angles.

(i) Lowest total receiver noise temperature (when (e) is not appropriate).

(2) For each Space Station transmitter and receiver:

(a) Frequency or frequency bands and cooperating Earth stations.

(b) Satellite orbital information.

(c) Emission designator for each frequency or frequency band.

(d) Peak power and spectral power density for each frequency or frequency band for transmitters.

(e) Receiver noise temperature.

(f) Transmitter antenna patterns (only if power flux density limits are exceeded).

b. Following receipt of these data, the SPS will initiate the Stage 3 Systems Review. Certification of spectrum support for telecommunication systems or subsystems at Stage 3 is a prerequisite for NTIA authorization of radiation in support of developmental testing for systems that are subject to these procedures. It also provides guidelines for assuring certification of spectrum support at Stage 4. At this point, the intended transmission frequencies will normally have been determined and certification at Stage 3 will be required for testing of proposed operational hardware and potential equipment configurations.

c. Detailed EMC analyses will be performed using test data and considering specific sites of equipment. A radiation hazard evaluation will be performed using IEEE C95.1 maximum permissible exposure limits as the standard by or with the Center/Facility Radiation Safety Officer and/or Non-Ionizing Radiation Safety Officer. Appropriate recommendations as to equipment characteristics or operational deployment will be developed. Calculations, in connection with national and international space system coordination procedures, will be performed or updated as appropriate.

d. After the Stage 3 approval, the Agency, through the FAS representative, should apply for or upgrade a temporary frequency assignment. This also applies to any planning assignments extant. G.1.6 Stage 4 Operational

a. Development has been essentially completed, and final operating constraints or restrictions required ensuring compatibility needs to be identified. All telemetry, tracking, and control equipment is required to have NTIA Stage 4 System Certification before their use.

b. When submitting a Stage 4 request for certification of spectrum support, NASA will update all previous information provided.

c. Certification of spectrum support for telecommunication systems or subsystems at Stage 4 is a prerequisite for an NTIA RFA for a station with an operational station class (i.e., other than experimental) for systems that are subject to

these procedures. Both the Stage 4 Certification of Spectrum Support and the RFA may provide restrictions on the operation of the system or subsystems as may be necessary to prevent harmful interference. In analyses leading to certification of spectrum support at Stage 4, detailed EMC analyses will be updated by the submitting Center, as required, to include consideration of frequency assignments for specific system deployment. Appropriate recommendations as to equipment characteristics and/or operational limitations will be provided. Having completed the SPS review process, application may be made by the Agency, through the FAS Representative, for an operational frequency assignment.

G.2 IRAC Space Systems Subcommittee

G.2.1 The SSS of the IRAC will review the information provided by the Agency prior to initiating the international Advance Publication, Coordination, and/or Notification process through the ITU-R. The SSS also provides a mechanism for NASA to provide comments at a national level back to foreign governments with respect to their planned operations.

G.2.2 For unclassified space systems that have not been waived from the requirements of international registration, information will be prepared in specific formats and submitted by the NASA SSS representative to the SSS in accordance with Articles 9 and 11 as well as Appendix 4 of the ITU Radio Regulations and according to the provisions of Chapter 10 of the NTIA Manual. The data usually used for developing the filing information submitted to the SSS are:

a. Stage 2 SPS request for Certification for the ITU-R Advance Publication.

b. Stage 4 SPS request for Certification for the ITU-R Coordination Request, if required, and Notification. When data from an existing Certification for a particular mission are insufficient for international filing requirements, the NASA SSS representative and/or alternate NASA SSS representative will work closely with Center/Facility Spectrum Managers to ensure any outstanding details may be provided, via the SSS, to the ITU-R in a timely and accurate manner.

G.2.3 It is recognized that the submission of information to the BR concerning Earth stations located outside the jurisdiction of the United States may be the responsibility of the country on whose territory the Earth station is located.

G.2.4 As a matter of policy, advance publication information and notices of frequency assignments relating to space systems will be submitted to the BR. Exceptions to this policy will be made only by the NTIA on a case-by-case basis.

Appendix H: Call Signs

H.1 Call Signs Allocated To NASA Centers And Jet Propulsion Laboratory (JPL) a Federally Funded Research and Development Center (FFRDC), Blocks of call signs are allotted to NASA Centers and JPL (an FFRDC) for assignment by the FCC through the NASA National Spectrum Program Manager who, in turn, allots them in groups to the Center or JPL (an FFRDC) Spectrum Manager. The Center/Facility Spectrum Manager assigns these call signs, as required, to all frequency users at the Center or JPL (an FFRDC), including commercial contractors. The call signs allocated to each NASA Center and JPL (FFRDC) are shown in Tables H-1 through H-3. For the assignment of additional call signs, contact the National Spectrum Program Manager.

Table H-1 Allocation of Experimental Call Signs

Glenn Research Center	NA2XAA through NA2XGZ
Armstrong Flight Research Center	NA2XHA through NA2XOZ
Langley Research Center	NA2XPA through NA2XZZ
Ames Research Center	NA3XAA through NA3XGZ
Goddard Space Flight Center	NA3XHA through NA3X0Z
NASA Headquarters	NA3XPA through NA3XRZ
Jet Propulsion Laboratory	NA3XSA through NA3XZZ
Marshall Space Flight Center	NA4XAA through NA4XEZ
Stennis Space Center	NA4XFA through NA4XJZ
Wallops Flight Facility	NA4XKA through NA4XUZ
Kennedy Space Center	NA4XVA through NA4XZZ
Johnson Space Center	NA5XAA through NA5XGZ

Table H-2 Allocation of HF Call Signs

Glenn Research Center	KHA940 through KHA944
Armstrong Flight Research Center	KHA910 through KHA914
Langley Research Center	KHA935 through KHA939
Ames Research Center	KHA905 through KHA909
Goddard Space Flight Center	KHA915 through KHA919
NASA Headquarters	KHA900 through KHA904
Jet Propulsion Laboratory	KHA920 through KHA924
Marshall Space Flight Center	KHA945 through KHA949
Stennis Space Center	KHA950 through KHA954
Wallops Flight Facility	KHA955 through KHA959
Kennedy Space Center	KHA930 through KHA934
Johnson Space Center	KHA925 through KHA929

Spare Call Signs	KHA960 through KHA969
Applicable only to fixed operations	

Table H-3 Allocation of VHF-UHF Call Signs

Glenn Research Center	PBA320 through WPBA335
Armstrong Flight Research Center	WPBA230 through WPBA244
Langley Research Center	WPBA305 through WPBA319
Ames Research Center	WPBA215 through WPBA229
Goddard Space Flight Center	WPBA245 through WPBA259
NASA Headquarters	WPBA200 through WPBA214
Jet Propulsion Laboratory	WPBA260 through WPBA274
Marshall Space Flight Center	WPBA336 through WPBA350
Stennis Space Center	WPBA351 through WPBA365
Wallops Flight Facility	WPBA366 through WPBA380
Kennedy Space Center	WPBA290 through WPBA304
Johnson Space Center	WPBA281 through WPBA289 and WPBA390 through WPBA395
White Sands Test Facility	WPBA275 through WPBA280 and WPBA381 through WPBA389
Spare Call Signs	WPBA396 through WPBA399
Applicable only to land mobile radio repeater systems	

H.2 Responsibility For Assignment

The NASA Center/Facility Spectrum Manager is responsible for the assignment of one or more of the call signs allocated to the Center to each specific operation requiring such an identifier.

H.3 Assignment Procedure

H.3.1 The Center or JPL (an FFRDC) Spectrum Manager exercises complete control of the assigned block of call signs and reserves the right to cancel or make changes. The Center/Facility Spectrum Manager maintains a complete and accurate record of all call sign assignments. Additional call signs may be made available by the National Spectrum Program Manager upon receipt of a request supplemented by documentary proof that the call sign allocation cannot satisfy existing call sign requirements.

H.3.2 One or more call signs may be assigned by the Center or JPL (an FFRDC) Spectrum Manager to any operation remotely located from the Center where the spectrum manager exercises responsibility for the Radio Frequency Assignment specifically issued to NASA representatives of commercial contractors, research institutes, colleges, and universities under contractual jurisdiction of the activity.

H.3.3 The Center or JPL (an FFRDC) Spectrum Manager will make all call sign assignments required by operations on such radio frequencies from the call sign block allocated to the Center or JPL (an FFRDC), regardless of the organization or commercial activity conducting the operation.

H.3.4 Prior to the assignment of an initial radio call sign, the Center or JPL (an FFRDC) Spectrum Manager will first determine that a valid requirement exists and that no previous assignment of an experimental call sign has been made to this operation.

H.3.5 Upon receipt of a request for an additional call sign, the Center or JPL (an FFRDC) Spectrum Manager will review the requirement to determine the feasibility of expanding the initial call sign assignment in lieu of the assignment of an additional identifier.

H.3.6 Duplicate assignment of the same call sign to different operations is not authorized.

H.4 Expansion of NASA Call Signs

In consideration of special requirements or the shortage of basic call signs, any assigned basic call sign may be expanded by suffixing any letter (A through Z) or any number (including zero) and may consist of more than one digit.

Appendix I: Terms of Reference of the Space Frequency Coordination Group (SFCG) (November 2000)

I.1 The SFCG provides a forum for multilateral discussion and coordination of spectrum matters of mutual interest concerning, in particular, the following space radiocommunication services as defined in the ITU RR:

a. Space Research

b. Space Operations

c. Earth Exploration Satellite

d. Meteorological Satellite

e. Intersatellite

f. Radionavigation Satellite

g. Radio Astronomy and Radar Astronomy to the extent that they are relevant to spacecraft missions

I.2 The agreed-upon results of the SFCG work will be expressed in the form of resolutions, recommendations, or whatever form may be appropriate for the case. SFCG members will attempt to ensure that findings of the SFCG are taken into account by their agencies.

I.3 The SFCG will:

a. Facilitate early understanding of present and future plans for space systems and services and of other systems affecting these.

b. Identify problem areas and coordination needs and study potential solutions associated therewith.

c. Identify issues and policy matters relating to the future orderly use of the frequency bands allocated to respective space radiocommunication services.

d. Suggest courses of action to be taken by SFCG member agencies with regard to current and future frequency needs of the space radiocommunications services identified above.

e. Identify those matters for which member agencies should facilitate contributions to regional bodies (e.g. APT [Asia Pacific Telecommunity], CEPT [Conference of European and Postal Telecommunications Administrations], CITEL), ITU-R Study Groups; or to encourage their administrations to make proposals to ITU WRCs.

f. Closely cooperate in the area of frequency management with other space agencies, as well as with commercial or research users of frequency bands allocated to the services identified above.

g. Consider any other items of technical, operational, or administrative nature which affect the interests of the group.

h. Maintain strong ties with other international bodies with related objectives.

I.4 Current list of SFCG Member Agencies:

ARGENTINA: Comision Nacional de Actividades Espaciales (CONAE)
AUSTRALIA: Commonwealth Scientific and Industrial Research Organization (CSIRO)
AUSTRIA: Austrian Space Agency (ASA)
BRAZIL: Instituto de Pesquisas Espaciais (INPE)
CANADA: Canadian Space Agency (CSA)
CHINA: China Meteorological Administration (CMA)
European Meteorological Satellite Organization (EUMETSAT)
EUROPEAN SPACE AGENCY (ESA)
FRANCE: Centre National d'Etudes Spatiales (CNES)
GERMANY: Deutsche Forschungs - und Versuchanstalt fur Luft - und Raumfahrt e.V. (DLR)
INDIA: Indian Space Research Organization (ISRO)
ITALY: AGENZIA SPAZIALE ITALIANA (ASI)
JAPAN: Japan Aerospace Exploration Agency (JAXA)
MALAYSIA: National Space Agency
NIGERIA: National Space Research and Development Agency (NSRDA)
REPUBLIC OF KOREA: Korea Aerospace Research Institute (KARI)
RUSSIAN FEDERATION: Russian Federal Space Agency (RFSA)
SOUTH AFRICA: South African National Space Agency
SPAIN: INTA/ Ingeniera y Servicios Aeroespaciales (INSA)
SWEDEN: Swedish Board for Space Activities/Swedish Space Corporation (SBSA/SSC)

TAIWAN: National Space Program Office (NSPO)
THE NETHERLANDS
UKRAINE: National Space Agency of Ukraine
UNITED ARAB EMIRATES: Emirates Institution for Advanced Science and Technology (EIAST)
UNITED KINGDOM: British National Space Center (BNSC)
UNITED STATES: NASA
UNITED STATES: National Oceanic and Atmospheric Administration (NOAA)

Appendix J: International Telecommunication Union (ITU) Structure

J.1 Structure

J.1.1 The ITU, a United Nations (UN) Specialized Agency, is the leading UN agency for information and communication technologies and is recognized by the United States as the international organization for telecommunications policy and regulations (agreements). Figure J-1 presents the ITU structure with its components.

J.1.2 The structure of the ITU comprises:

a. The Plenipotentiary Conference, which is the supreme policy-making body of the Union.

b. The Council, which acts on behalf of the Plenipotentiary Conference.

c. World conferences on international telecommunications.

J.1.3 The ITU is further divided into the General Secretariat and three major Sectors:

a. The Radiocommunication Sector, including world and regional radiocommunication conferences, radiocommunication assemblies, and the Radio Regulations Board;

b. The Telecommunication Standardization Sector, including World Telecommunication Standardization Conferences;

c. The Telecommunication Development Sector, including world and regional telecommunication development conferences.

J.1.4 The authority of the ITU is derived from its member nations and is contained in the Constitution and Convention of the ITU. The authority is further complemented by the Administrative Regulations, which are the International Telecommunication Regulations, and the Radio Regulations, each of which are treaties.

J.2 Plenipotentiary Conference

J.2.1 The Plenipotentiary Conference meets every four years to determine the operational framework of the Union including:

a. Elect the Secretary-General and the Deputy Secretary-General.

b. Elect the ITU Council members (a maximum of 25 percent of the total number of Member States).

c. Elect the Directors of the Bureaus of the Sectors and the Radio Regulations Board Members.

d. Authorize any World or Regional Radiocommunication Conferences.

e. Approve any changes to the ITU Constitution or ITU Convention.

f. Determine the budget for the Union.

J.3 Council

J.3.1 The Council meets annually and is presently comprised of 46 members elected by the Plenipotentiary to serve until the next Plenipotentiary. The functions served by the ITU Council include:

a. Establish agenda and actual dates for upcoming conferences.

b. Manage Union resources between Plenipotentiary meetings.

J.4 Radiocommunication Sector

J.4.1 The functions of the Radiocommunication Sector are to fulfill the purposes of the Union relating to radiocommunications:

a. By ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services.

b. By carrying out studies without limit of frequency range and adopting recommendations on radiocommunication matters.

J.4.2 The Radiocommunication Sector works through:

a. World and regional radiocommunication conferences.

b. The Radio Regulations Board.

c. Radiocommunication assemblies, which are associated with world radiocommunication conferences held once every three to four years.

d. Radiocommunication study groups and their associated working parties and task groups.

e. The Radiocommunication Bureau, headed by the elected Director.

J.5 Telecommunication Standardization Sector

J.5.1 The functions of the Telecommunication Standardization Sector are to fulfill the purposes of the Union relating to telecommunication standardization:

a. By studying technical, operating, and tariff questions; and adopting recommendations with a view to standardizing telecommunications on a worldwide basis.

J.5.2 The Telecommunication Standardization Sector works through:

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b. Telecommunication standardization study groups.

c. The Telecommunication Standardization Bureau headed by the elected Director.

J.6 Telecommunication Development Sector

J.6.1 The functions of the Telecommunication Development Sector are to fulfill the purposes of the Union relating to telecommunication development:

a. By promoting and offering technical assistance to countries in the field of telecommunications.

b. By promoting the mobilization of the material and financial resources needed for implementation.

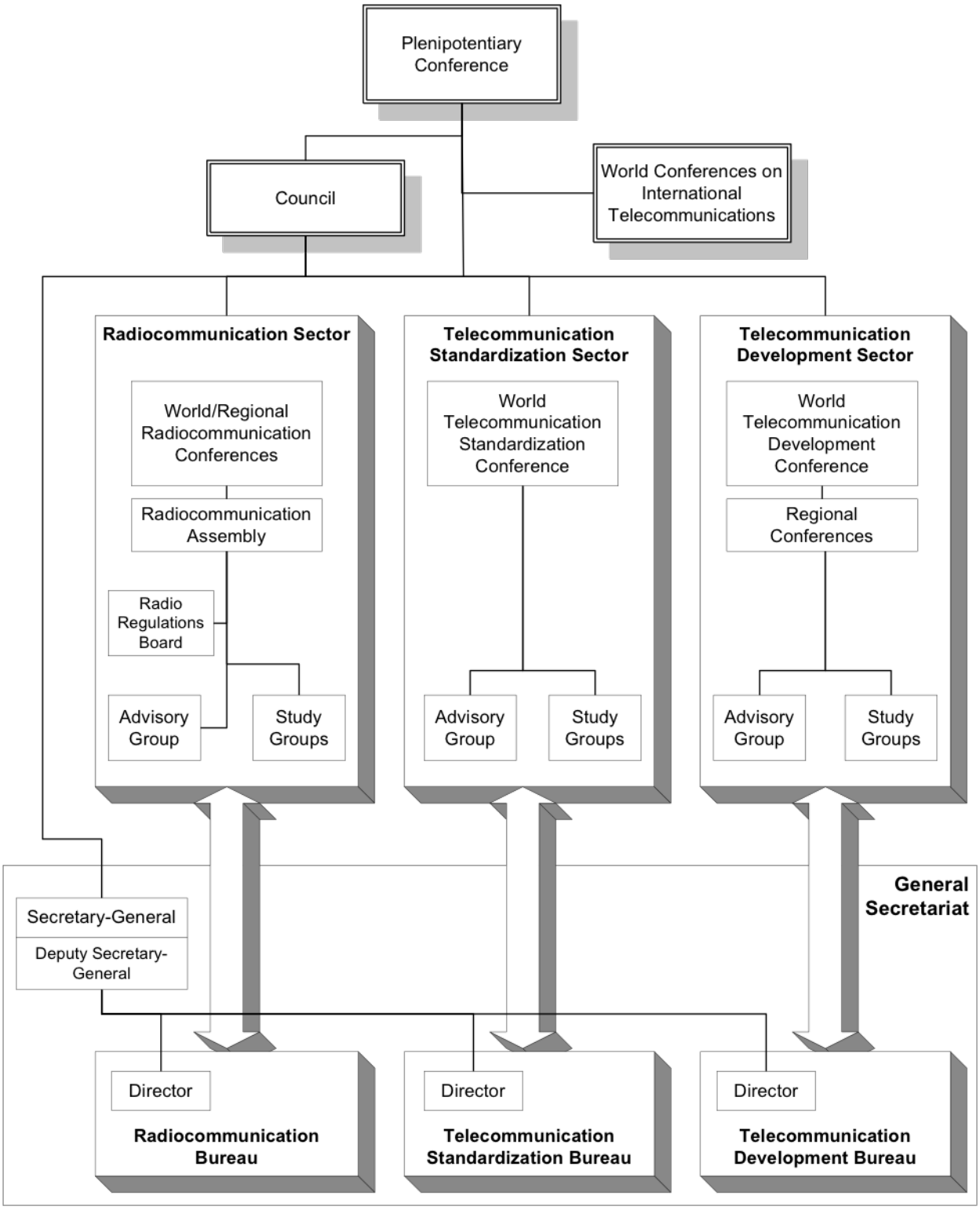
c. By promoting the extension of the benefits of the new telecommunication technologies to all the world's inhabitants.

J.7 Radiocommunication Study Groups

J.7.1 The study groups of the Radiocommunication Sector are responsible for specific areas of technical interest as follows:

Study Group	Name of Group
1	Spectrum Management
3	Radiowave Propagation
4	Satellite Services
5	Terrestrial Services
6	Broadcasting Service
7	Science Services

J.7.2 The United States uses a similar structure for its National Radiocommunication Study Groups (see Appendix K, Figure K-1, and Figure K-2).



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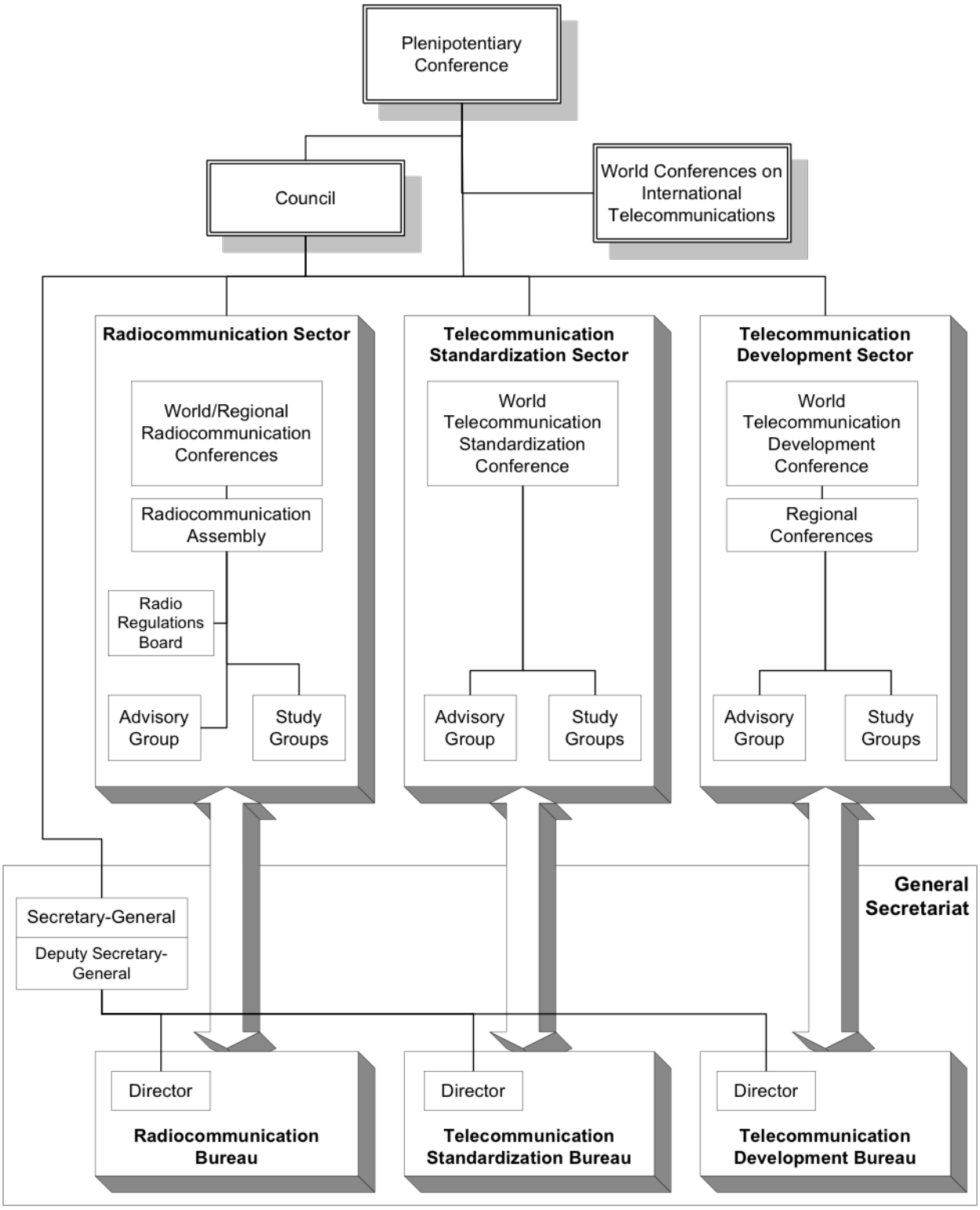

Figure J-1 The ITU Structure

Appendix L: References

L.1 NASA FAR Supplement, Frequency Authorization, 48 CFR 1823.71 and Section 1852.223-71.

L.2 NPD 1440.6, NASA Records Management.

L.3 NPR 1441.1, NASA Records Retention Schedules.