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NASA Procedural Requirements

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COMPLIANCE IS MANDATORY

NASA Radio Frequency (RF) Spectrum Management Manual

Responsible Office: Space Operations Mission Directorate

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Table of Contents

Preface

- P.1 Purpose
- P.2 Applicability
- P.3 Authority
- P.4 Applicable Documents
- P.5 Cancellation

Chapter 1 General

- 1.1 Purpose
- 1.2 Spectrum Management Policy Guidance
- 1.3 Regulatory Structure
- 1.4 NASA Spectrum Management Program Documentation Tree

Chapter 2 NASA Spectrum Management Roles and Responsibilities

- 2.1 Agency-Level Responsibilities
- 2.2 NASA Enterprises and Other Headquarters Offices' Responsibilities
- 2.3 NASA Centers' Responsibilities

Chapter 3 RF Allocations and Assignments

- 3.2 Frequency Allocations
- 3.3 Frequency Assignments
- 3.4 U.S. Coordination Requirements
- 3.5 NASA Contractors

- 3.6 Foreign Frequency Assignments
- 3.7 Conditions of Assignment
- 3.8 Emergency and Wartime Procedures

Chapter 4 Radio Frequency Interference Procedures

- 4.1 Radio Frequency Interference (RFI) Reporting Procedures
- 4.2 RFI Control Procedures

Chapter 5 NASA Long-Range Spectrum Planning

- 5.1 Background
- 5.2 Long-Range Planning

Appendix A. Glossary of Commonly Used Terms Applicable to NASA RF Spectrum Management

Appendix B. Acronyms

Appendix C. Headquarters Spectrum Management Forum (HSMF)

Appendix D. International Telecommunication Union (ITU) Structure

Appendix E. U.S. and ITU Spectrum Interfaces

Appendix F. NASA Spectrum Managers Group (NSMG)

Appendix G. National Telecommunications and Information Administration (NTIA) Spectrum Planning Subcommittee (SPS) and Space Systems Subcommittee (SSS)

Appendix H. Call Signs

Appendix I. Terms of Reference of the Space Frequency Coordination Group (SFCG)

Appendix J. Sample "Economic Value Form"

Preface

P.1 Purpose

This NPR sets forth the procedures for the management requirements for establishing and governing the use of radio frequencies by the National Aeronautics and Space Administration (NASA).

NPR 1000.3C assigns the authority for the management of radio frequencies for NASA to the Associate Administrator (AA) for the Space Operations Mission Directorate (SOMD) at NASA Headquarters.

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

P.2 Applicability

This NPR applies to NASA Headquarters, all NASA Centers, including Component Facilities, and to the Jet Propulsion Laboratory (JPL) and other contractors to the extent specified in their contracts.

P.3 Authority

- a. 42 U.S.C. 2473 (c)(1), Section 203 (c)(1) of the National Aeronautics and Space Act of 1958, as amended.
- b. NPD 1000.3C § 4.3.2.2 (e), The NASA Organization.

P.4 Applicable Documents

- a. 47 U.S.C. § 151 et seq., Communications Act of 1934, as amended.
- b. 47 U.S.C. § 901 et seq., National Telecommunications and Information Administration Organization Act of 1992.
- c. 47 U.S.C. § 701 et seq., Communications Satellite Act of 1962, as amended.
- d. Exec. Order No. 12,046, Relating to the Transfer of Telecommunications Functions, 3 C.F.R. 158 (1978 Comp.), reprinted in 47 U.S.C. § 305 note.
- e. President's Memorandum on Improving Spectrum Management for the 21st Century, 49 Weekly Comp.Pres.Doc.2875, § 3(c) (Nov. 29, 2004) (2004 Executive Memorandum).
- f. Radio Regulations, International Telecommunication Union (ITU), published in Geneva, Switzerland.
- g. 47 C.F.R. pt. 300, Manual of Regulations and Procedures for Federal Radio Frequency Management, (National Telecommunications and Information Administration Manual).
- h. 47 C.F.R. pt. 25, Satellite Communications.

- i. Office of Management and Budget (OMB) Circular No. A-11 (2008), Section 33.4.
- j. NPD 1000.3, The NASA Organization.
- k. NPD 2570.5, NASA Electromagnetic Spectrum Management.
- l. NPD 1440.6, NASA Records Management.
- m. NPR 1441.1, NASA Records Retention Schedules.
- n. NASA FAR Supplement, Subpart 1823.71 and Section 1852.223-71, Frequency Authorization.
- 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. ANSI/IEEE C 95.1-1992, 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).
- u. NASA Publication Space Shuttle Program (SSP) Radio Frequency Interference Management Manual (RFIMM), NSTS 37372 dated October 12, 2006.

P.5 Cancellation

This NPR updates NPR 2570.1, NASA Radio Frequency (RF) Spectrum Management Manual, dated April 24, 2003. /S/ William H. Gerstenmaier Associate Administrator for Space Operations

Chapter 1: General

1.1 Purpose

This NPR provides guidance in the identification and use of the RF spectrum for Agency communications links and remote-sensing purposes. Procedures relating to RFI are also presented, and requirements are defined for the support of future NASA programs that may require long-lead-time spectrum management initiatives. Responsibilities of concerned NASA personnel are defined in Chapter 2.

For the purpose of this NPR, the RF spectrum is defined as the set of radio frequencies below 3000 GHz. Also several terms used frequently have very specific, technical connotations for those familiar with the RF spectrum management discipline. A glossary of these terms is provided in Appendix A.

1.2 Spectrum Management Policy Guidance

The U.S. policy, with regard to the use of properly authorized frequency bands, is stated in the Communications Act of 1934, as amended. In order to ensure compliance with the provisions of the Communications Act, OMB Circular No. A-11 (2008), Section 33.4, states that:

Consistent with the Executive Memorandum issued by the President on November 30, 2004, agencies should consider the economic value of radio spectrum used in major telecommunication, broadcast, radar, and similar systems when developing economic and budget justifications for procurement of these systems, starting with the FY 2007 requests. The extent of economic and budget analysis required will depend upon the nature and value of the systems and spectrum involved, and agencies should work with their OMB contacts to ensure a proper level of analysis is conducted.

Spectrum should generally not be considered a free resource, but rather should be considered to have value and be included, to the extent practical, in economic analyses of alternative systems. In some cases greater investments in systems would reduce spectrum needs (e.g., purchase of radios that use less bandwidth than less expensive models); in other cases the desired service can be met with other forms of supply (e.g., private wireless services or use of land lines). In addition to considering cost minimizing strategies, agencies are encouraged to consider whether the investment would provide net benefits.

Spectrum valuations may be estimated based on recent prices of similar bands in spectrum auctions, or through other estimation methods.¹ The Commerce Department's NTIA, which is responsible for allocating spectrum across Federal users, may also review these analyses in making spectrum assignments.

Spectrum certification. You must obtain a certification by the NTIA, Department of Commerce, that the radio frequency required can be made available before you submit estimates for the development or procurement of major radio spectrum-dependent

communication-electronics systems (including all systems employing space satellite techniques).

1 Sensitivity analysis?showing the costs of choosing an alternative that requires less (or more) spectrum?may also provide useful information. For example, a sensitivity analysis might indicate that one option costs \$10 million more, but uses 5 MHz less bandwidth, nationwide, in the 900 MHz range. Even with "conservative" estimated values, the 5 MHz in spectrum savings would likely be worth an additional \$10 million in investment, as it conserves spectrum

The aspect of economic value of radio spectrum is a relatively new requirement being levied on Federal agency programs by Circular A-11, and the specific text is highlighted here to emphasize this new requirement. See sample form for "Economic Value Analysis" in Appendix J.

NASA policies to be adhered to by all Agency spectrum users are given in NASA Policy Directive (NPD) 2570.5D, (see <http://nodis-dms.gsfc.nasa.gov/dms/dms.cfm>).

All RF spectrum usage by NASA programs and projects shall be pursuant to specific assignments approved by the NASA Spectrum Manager, the AA for SOMD, under the conditions specified in this NPR Chapter 3, Section 3.7(c).

1.3 Regulatory Structure

Internationally, the RF 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 1-1). Within the United States and its Possessions, the RF spectrum is further allocated to non-Federal and Federal users. The U.S. national spectrum management activities are conducted by NTIA, the Federal Communications Commission (FCC), and the Department of State. The NTIA manages the spectrum used by Federal Government agencies, the FCC manages the spectrum used by non-Federal entities, and the Department of State is responsible for coordinating United States participation in international fora where spectrum management issues are addressed. The Federal Communications Commission (FCC) is responsible for the allocation and assignment of frequencies to non-Federal users (see <http://www.fcc.gov>). 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) that is also responsible for maintaining the National Table of Frequency Allocations (see Figure 1-2). Coordination between non-Federal and Federal users of the RF spectrum is accomplished through joint meetings of the FCC and the NTIA.

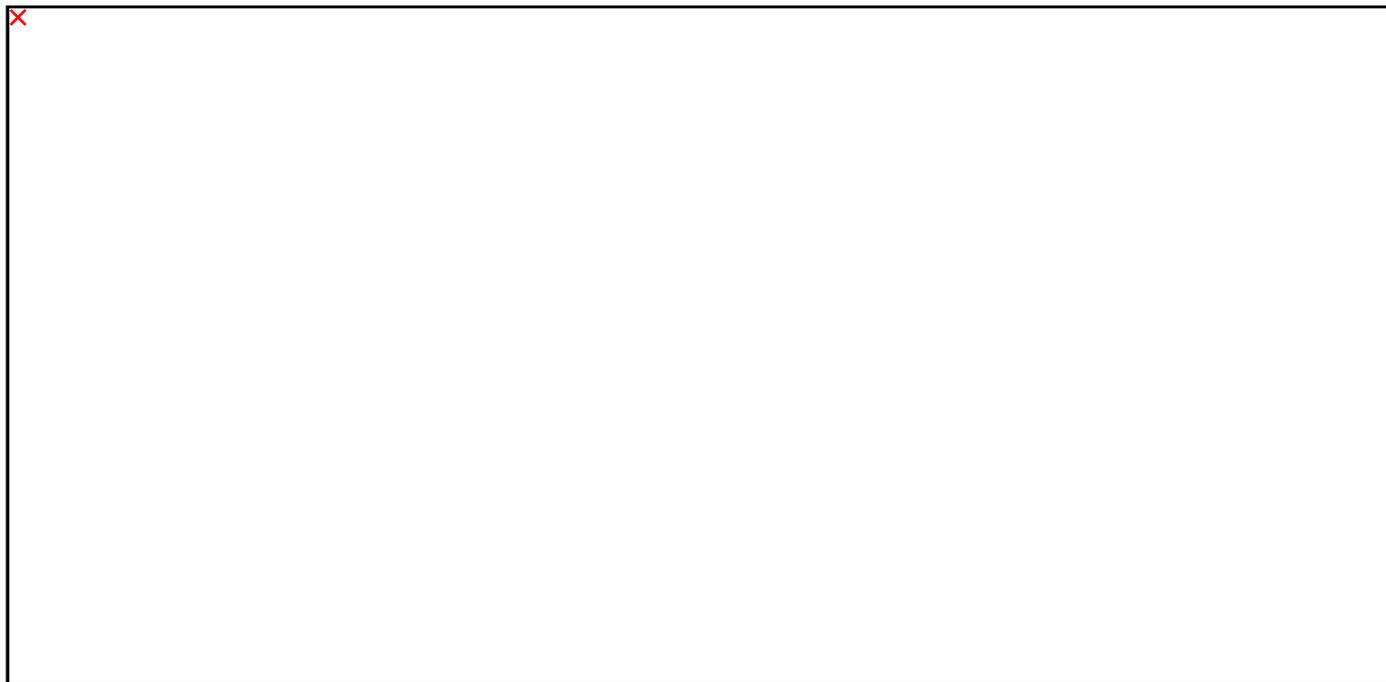


Figure 1-1 Geographic Regions for Frequency Allocation of the Spectrum



Figure 1-2 United States (US) National Spectrum Management Structure

The 20 Federal agencies are:

1. Agriculture
2. Air Force

3. Army
4. Broadcasting Board of Governors
5. Coast Guard
6. Commerce
7. Energy
8. Federal Aviation Administration
9. Homeland Security
10. Interior
11. Justice
12. National Aeronautics and Space Administration
13. National Science Foundation
14. Navy
15. State
16. Transportation
17. Treasury
18. U.S. Postal Service
19. Veterans Affairs
20. FCC Liaison

1.4 NASA Spectrum Management Program Overview

NASA responsibility for acquiring frequency allocations and providing assignment of frequencies for NASA programs is delegated to the AA for SOMD. All frequency assignments are made through the AA for SOMD and are issued to NASA RF spectrum users through NASA Center/Facility Spectrum Managers and/or JPL Spectrum Manager (for NASA spectrum management points of contact, see <https://www.spacecomm.nasa.gov/>). Headquarters RF spectrum assignments are obtained through the NASA National Spectrum Program Manager at HQ. Recognizing the global nature of NASA operations and missions, new frequency allocations require international agreement. New frequency allocations are obtained through the NASA International Spectrum Program Manager at HQ in consultation with the National Spectrum Program Manager (note that there is a multiyear lead time required for obtaining new frequency allocations).

The Spectrum Management Program Documentation Tree is shown in Figure 1-3. The tree shows the linkages between NASA spectrum management documentation and U.S. national

rules and regulations.

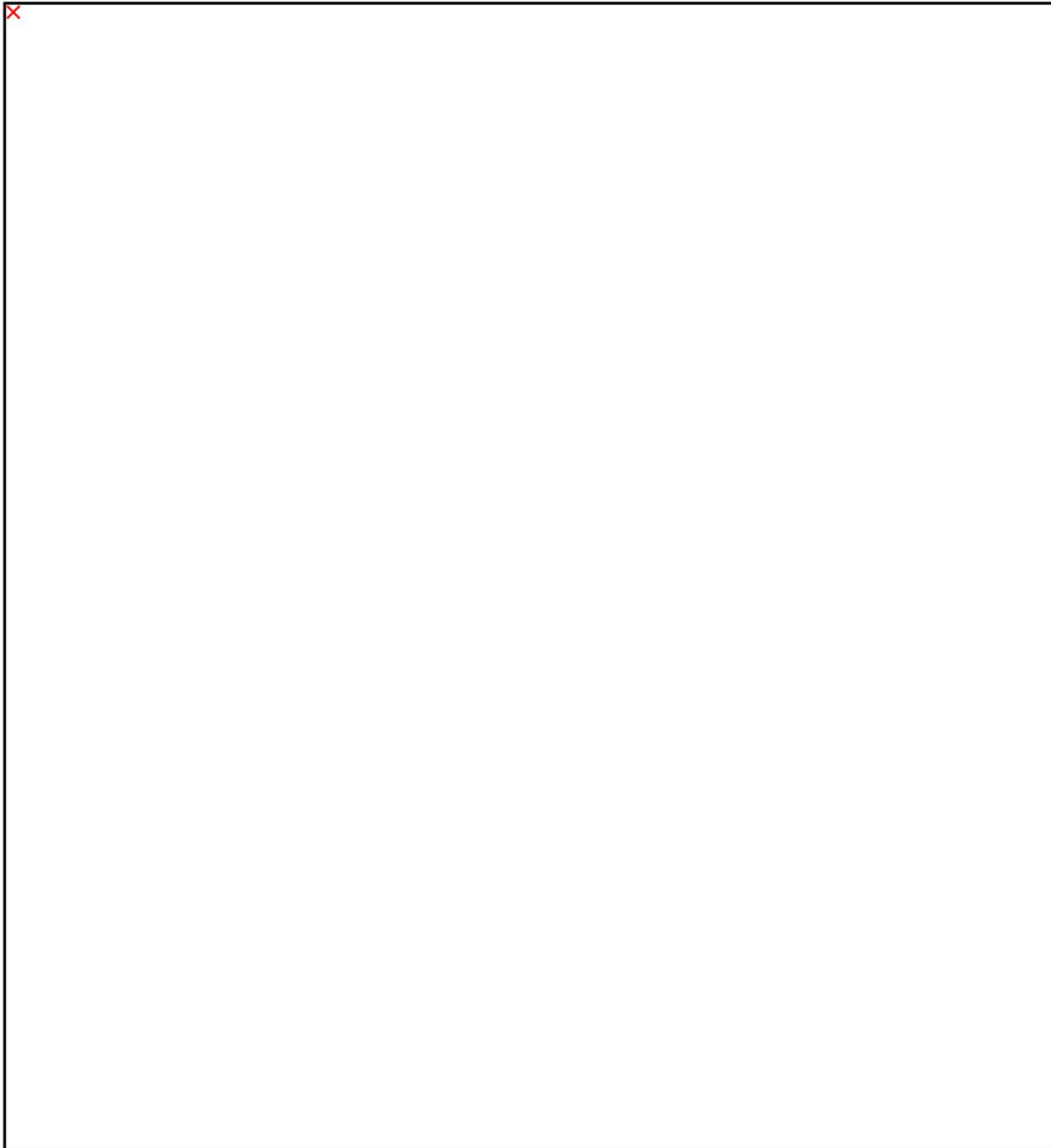


Figure 1-3 NASA Spectrum Management Program Documentation Tree

- 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, May 2006

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

6 International Telecommunication Union Radio Regulations

Chapter 2: NASA Spectrum Management Program Roles and Responsibilities

2.1 Agency-Level Responsibilities

The AA for SOMD is designated as the NASA Spectrum Manager and is, ultimately, responsible for ensuring compliance with pertinent international and national rules and regulations of all NASA RF spectrum users. Execution of these responsibilities is delegated to the Deputy Associate Administrator (DAA) for Space Communications and Navigation (SCaN). The DAA for SCaN nominates to the Department of State, the Chairperson of the United States Study Group 7 (ITU-R), appoints the NASA IRAC representative, and designates NASA representatives to official spectrum management forums, both national and international. Furthermore, the DAA for SCaN nominates to the Department of State, for consideration by the ITU-R Radiocommunication Assembly (RA), individuals to serve as ITU-R Study Group 7 Chairman and Vice Chairman and authorizes NASA personnel to serve as ITU-R Working Party Chairmen.

The DAA for SCaN has delegated authority for the overall planning, policy, and administration of the NASA Spectrum Management Program to the Director and Deputy Director of Spectrum Policy and Planning within the SCaN. The Director of Spectrum Policy and Planning also chairs and coordinates the Headquarters Spectrum Management Forum (HSMF), which consists of representatives from the NASA Mission Directorates and cross-cutting HQ support offices. The HSMF (see Appendix B) identifies new spectrum requirements needed to fulfill the program requirements of the Mission Directorates, in a timely manner, for initiation of analyses and planning activities to support both certification of existing spectrum allocations and potential need of acquiring new allocations. The Director of Spectrum Policy and Planning is assisted in carrying out delegated responsibilities by the NASA National Spectrum Program Manager and the NASA International Spectrum Program Manager.

The National Spectrum Program Manager shall oversee electromagnetic (EM) spectrum activities involving entities internal to the U.S., including the NTIA, the FCC, and other internal entities involved in the domestic management of the EM spectrum and ensure that all frequency assignments are carefully reviewed to determine if they should fall under the Sensitive But Unclassified Category in accordance with NPR 1600.1 and the desires of the responsible program offices. The National Spectrum Program Manager shall also ensure that the Spectrum Operational Plan, Five-year Plan, and Long-Range Plan are reviewed and updated annually if necessary and assist the NTIA in their Federal Spectrum Strategic Plan effort. The National Spectrum Program Manager shall also identify any programs at risk due to possible lack of spectrum allocation or non-sustainability because of commercial encroachment and other sharing conditions within the allocated bands due to possible electromagnetic interference (EMI) conflicts. The National Spectrum Program Manager shall serve as the focal point for spectrum-related Freedom of Information Act (FOIA) matters.

The International Spectrum Program Manager shall oversee EM spectrum activities

involving entities external to the U.S., including the ITU, the Inter-American Telecommunication Commission (CITEL), other non-NASA civilian space agencies (e.g., European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA) et. al., the Space Frequency Coordination Group (SFCG), and other external entities involved in the management of the EM spectrum. The International Spectrum Program Manager shall also coordinate NASA involvement in related NASA and U.S. preparatory activities for World Radiocommunication Conferences and other international spectrum conferences and meetings. 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.

Specifically, the Director of Spectrum Policy and Planning establishes the policies, and the National and International Spectrum Program Managers implement the necessary procedures to:

- (1) Obtain adequate spectrum to support Agency programs.
- (2) Ensure Agency compliance with national and international rules and regulations.
- (3) Ensure timely processing of spectrum allocations and frequency assignment requests.
- (4) Ensure timely dissemination of technical and regulatory changes to the Center/Facility Spectrum Managers and the JPL Spectrum Manager.
- (5) Provide the means for NASA Mission Program Managers to obtain guidance on spectrum matters so that spectrum-dependent devices are coordinated at the conceptual stage.
- (6) Ensure identification and mitigation of any RFI, which might be caused or suffered by Agency operational programs.
- (7) Provide planning (with coordination of the HQ Mission Directorates) and implementation of actions required to obtain new allocations or enhanced radio regulations through national and international organizations.
- (8) Provide spectrum planning and support to NASA's technology transfer mission.
- (9) Advocate rules and rule changes that support the lowest life-cycle cost technical solutions to NASA programs for meeting their communications needs.

The Director of Spectrum Policy and Planning will provide civil servant staff and necessary contract support for representing the Agency in national and international regulatory fora. Participation in these fora is required to advance and defend Agency spectrum allocation and regulatory needs in addition to securing license operating authority for flight and administrative programs. These fora include, nationally, the NTIA IRAC and its subcommittees, relevant entities established by NASA, the FCC, the NTIA, and the U.S. Department of State to deal with national and international regulatory proceedings, and the ITU and its relevant sectors, study groups, and working parties. 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.

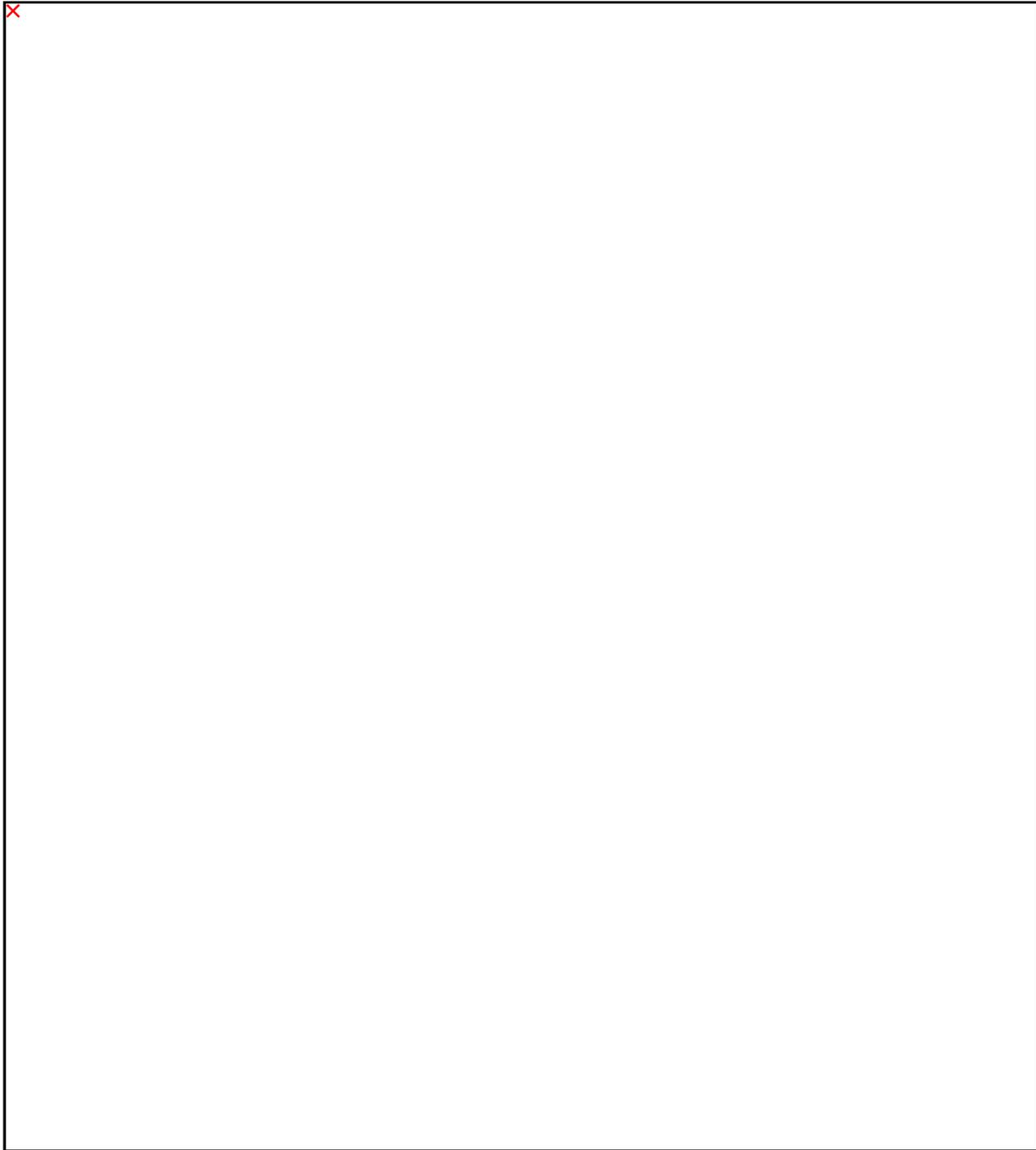
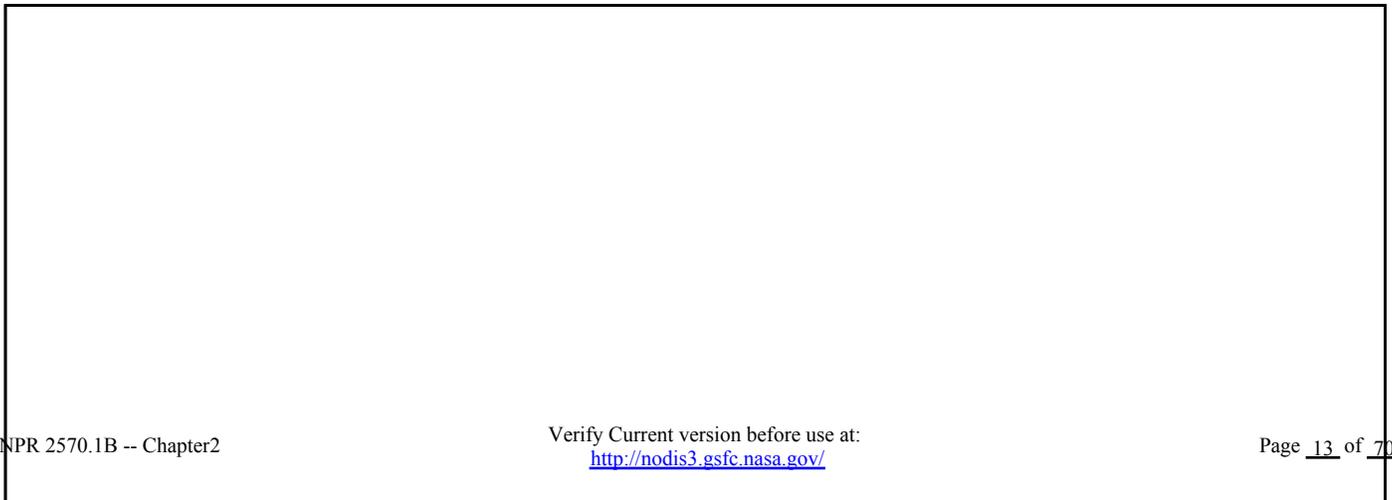


Figure 2-1 NASA Spectrum Management Program



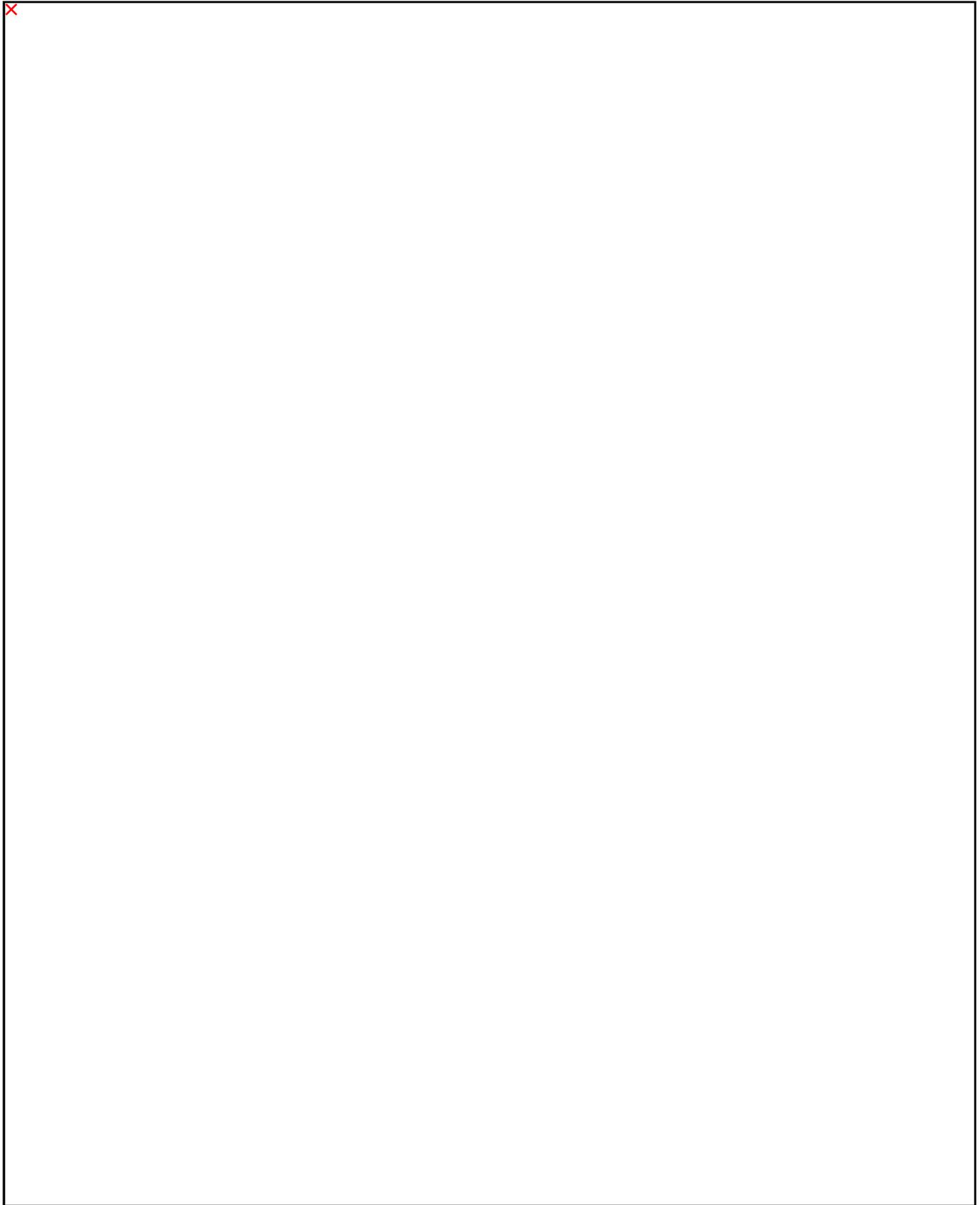


Figure 2-2 NASA/National Spectrum Management Structure

2.2 NASA Mission Directorates And Other Headquarters

Offices' Responsibilities

NASA Mission Directorates and other Headquarters Offices shall coordinate spectrum requirements with the Director of Spectrum Policy and Planning. Under the National Aeronautics and Space Act of 1958, as amended, 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 must provide adequate coordination and representation to work with the FCC.

For future Agency missions, each NASA Mission Directorate, through the HSMF, shall provide the latest conceptual spectrum requirements (communications, remote sensing, and any others) and an economic analysis justifying the need for the specific frequency and bandwidth, as required by OMB Circular A-11, to the Director of Spectrum Policy and Planning with respect to programs and future mission. This economic analysis must be completed and approved by the NTIA before funding can be provided.

2.3 NASA Centers Responsibilities

Each Center Director is responsible for implementing the Agency spectrum policies and applicable procedures through the publication of Center management instructions and adherence to this NPR and providing resources in support of the Center/Facility spectrum management function. Each Center Director will designate a qualified Center/Facility Spectrum Manager and a qualified alternate Center/Facility Spectrum Manager. The JPL, although not a Center, also provides a qualified JPL Spectrum Manager and a qualified alternate JPL Spectrum Manager.

Each Center/Facility Spectrum Manager and the JPL Spectrum Manager shall participate in their Center procurement process for all RF equipment in order that the above outlined responsibilities may be properly discharged.

Each program/project with radio frequency (RF) requirements at a NASA Center has the following responsibilities:

- Conceptual phase (Phase A)
 - Notify Center Spectrum Manager of RF use concept.
 - Include Center Spectrum Manager in feasibility assessment of systems involving RF.
- Prior to System Requirements Review (SRR) - pre-Phase B
 - Provide RF requirements and concept of operations to Center/Facility Spectrum Manager in support of engineering assessment to determine available frequency bands and in determining the necessity of preparing for a NTIA Stage 1 data package and request for certification.
- Between SRR and Preliminary Design Review (PDR) - Phase B

- Work with Center/Facility Spectrum Manager to complete the frequency selection process.
- Preliminary Design Review (PDR) - Phase B
 - Provide design details to Center/Facility Spectrum Manager for NTIA Stage 2 data package by at least 60 days prior to PDR.
 - Provide an economic analysis justifying the need for the specific frequency and bandwidth as required by OMB Circular A-11. The economic analysis shall be completed and approved by the NTIA before funding can be provided.
 - Center/Facility Spectrum Manager submits NTIA Stage 2 application no later than 2 months after PDR.
- Critical Design Review (CDR) - Phase C
 - Provide measured/as designed parameter updates to Center/Facility Spectrum Manager for NTIA Stage 4 data package no later than 60 days prior to CDR.
 - Center/Facility Spectrum Manager submits NTIA Stage 4 application no later than 2 months after CDR.
- Prior to system deployment/operation - Phase C
 - NTIA Stage 4 certification and frequency assignment licenses from the NTIA Frequency Assignment Subcommittee (FAS) must be in hand.

Each program/project hosting equipment/experiments/payloads with radio frequency (RF) requirements (NASA providing the platform but do not control/own the RF equipment - transmitters/receivers) at a NASA Center has the following responsibilities:

- Feasibility/Conceptual phase
 - 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.
 - Notify Center Spectrum Manager of the new RF equipment use concept
 - 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.
- o Aircraft platforms: no later than 8 weeks prior to 1st flight
- o Space platforms: no later than System Requirements Review (SRR) ? NTIA Spectrum Planning Subcommittee (SPS) process can be 6 months or longer.
- Prior to 1st Flight
 - Customer must provide approved RF license(s) to program for final validation by the Center Spectrum Manager.

-- Failure to provide approved RF license(s) will result in delay of 1st flight.

All Center/Facility Spectrum Manager, JPL Spectrum Manager, and their alternates shall:

- (1) Coordinate RF spectrum requirements for the site including the licensing of all transmitters (whether for active remote sensing or communications use and whether spaceborne or otherwise) and the registering in the Government Master File (GMF) of all transmitters, receivers, or radiometers (whether for passive sensing or communications use and whether spaceborne or otherwise). Such licensing and registration shall 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.
- (2) Ensure that all RF equipment belonging to other Government agencies, but are operating onboard NASA vehicles operated by the Center/Facility, have received proper authorization to operate (though responsibility for obtaining that authorization is not necessarily the responsibility of the Center/Facility Spectrum Manager).
- (3) Review any non-NASA systems which are identified within domestic or international system filing and coordination processes as potentially causing interference to the Center and provide comments as required.
- (4) Ensure Centers/facilities adhere to NTIA's channel plan for Very High and Ultra High Frequency allotments and NTIA's narrowband requirement.
- (5) Ensure that permanent assignments are renewed or deleted from the GMF at the time of their 5-year review.
- (6) Maintain accurate records of all frequency assignments in use at or by the Center and JPL.
- (7) Maintain the electromagnetic integrity of the site and its flight missions through proper selection of RF equipment frequencies and electromagnetic compatibility (EMC) testing.
- (8) Ensure day-to-day interference-free operations at the site and by its flight missions
- (9) Identify communication and other RF 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 at HQ for inclusion in NASA long-range spectrum forecasts.
- (10) Prepare technical analyses required to support spectrum applications for site projects.
- (11) Participate in local, national, and international spectrum management coordination groups, as appropriate, to provide representation and cognizance of the Center/Facility's project requirements.
- (12) Coordinate the development and maintenance of Center/JPL instructions for spectrum management with the National Spectrum Program Manager to ensure wide program consistency.
- (13) Serve as the representative for the Director of Spectrum Policy and Planning to the NASA programs/projects at their Centers and JPL.

- (14) In consultation with the local Center/Facility Radiation Safety Officer (RSO), ensure that RF and electromagnetic field emissions conform to the latest requirements of ANSI/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.
- (15) Ensure coordination of RF spectrum requirements with the NASA Center Safety and Mission Assurance Office. All RF spectrum requirements will be coordinated with the Center Occupational Health Office and the Center/Facility RSO. Based on the particular Center mission responsibilities, RF emissions shall be coordinated with other operations such as range safety, flight operations, operation safety, explosive safety, and propellant handlers.
- (16) Represent their Center at the NASA Spectrum Managers Group (NSMG) meeting, which meets at least annually to review issues pertinent to all Centers (see Appendix F).
- (17) Coordinate Freedom of Information Act related matters with the National Spectrum Program Manager to ensure consistency with Agency-level positions.

Chapter 3: RF Allocations and Assignments

3.1 General

- a. In order to effectively implement the national and international spectrum management policy, NASA has adopted procedures for requesting frequency assignments and for obtaining new frequency allocations. These procedures allow for a coordinated process starting with identification of Agency program/project needs and ending with national and international recognition of actual band usage.
- b. 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) and provided for information in Appendix A.
- c. In general, the frequency assignment process takes the form outlined in Figure 3-1 and is initiated at the user NASA Center and ends with issuance of a Radio Frequency Authorization (RFA) or Special Temporary Authorization (STA). If the use is not for a major terrestrial program or not 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).
- d. However, for major new programs or for programs involving spacecraft, NTIA has established a systems review process by which that use is coordinated within the United States and internationally. This process is described in Appendix G.

3.2 Frequency Allocations

In most cases, identification of RF spectrum support for Agency 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 (in fixed and mobile allocations) and space use (in space services that support the U.S. space programs). However, in some cases, particularly as new scientific, technological, and commercial requirements emerge and bands lower in the RF spectrum become congested, it may be necessary to move Agency operations elsewhere in the RF spectrum where appropriate allocations do not currently exist. 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.

In cases where new frequency allocations are deemed necessary, it is imperative that

long-lead-times be allowed for the national and international processes which are required for new allocations to be made. While ITU conferences are competent to reallocate portions of the RF spectrum and occur on a periodic basis, it is essential that NASA is prepared to identify new requirements well in advance of these conferences so that supporting technical and regulatory arguments can be prepared and presented.

✘

Figure 3-1 Frequency Authorization Process

3.3 Frequency Assignments

a. General

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

- (1) Whether a frequency allocation exists.
- (2) Whether the system is terrestrial or spaceborne.
- (3) Whether the system is considered a major telecommunications system, e.g., high investment.
- (4) The 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).

b. Process for frequency selection prior to design commitment (See Figure 3.2)

(1) Project Commitment (Funding Approved)

The dissemination of information of project commitment made at NASA Headquarters or within NASA programs and projects is key to the successful coordination of design decisions involving the selection of frequencies for systems requiring RF communications. An economic analysis justifying the need for the specific frequency and bandwidth is required by OMB Circular A-11. The project / program office is responsible for the generation and availability to submit to the NTIA SPS during system certification. The economic analysis shall be completed by the project/program office and approved by the NTIA Administration before funding can be provided.

(2) Initial Frequency Coordination Guidance

Due to the increasing complexity and usage of the RF spectrum, the availability/cost 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 and projects at the Center; and for preventing or mitigating radio frequency interference at the Center or to the Center's programs to enable mission execution. 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.

(3) Dissemination of Candidate Frequencies

The dissemination of information about candidate frequencies should include the relevant NASA Spectrum Managers at the Center level and the candidate Government or commercial launch sites that NASA may use in the future. The Center/Facility spectrum manager shall send their 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 Systems Review. 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 (see Figure 3-2). 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 better information for the selection of the best frequency for a particular mission and should be included in a submission to the NTIA for a Systems Review.

(5) Initiate Spectrum Planning Subcommittee Process

The conceptual phase of a mission ends when the necessary analysis has determined the best frequency candidate for a particular mission. The planning phase then begins with an initial submission of a Systems Review (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 Manual).

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

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 NTIA Form 33 and 34. The Center/Facility is still responsible for the remaining System Review package as described in Chapter 10 of the NTIA's "Manual of Regulations & Procedures for Federal Radio Frequency Management." Note the spaceborne systems utilizing the 2200 MHz to 2290 MHz band are limited to bandwidths of less than 6 MHz, unless approved by the NTIA through a waiver. Justification is required by the NTIA before any system can be certified.

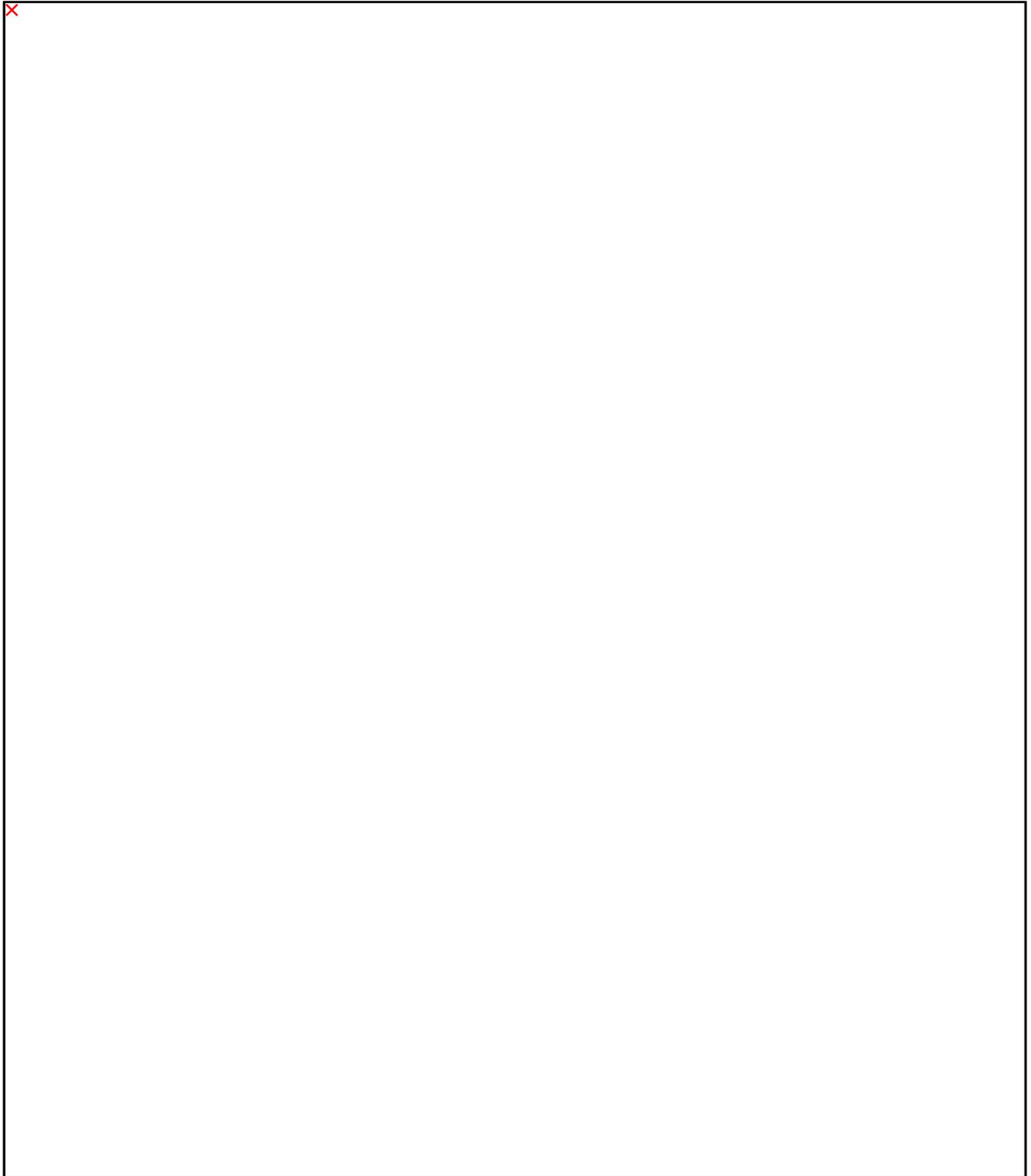


Figure 3-2 Process for Frequency Selection

c. Terrestrial Assignments

(1) 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 a systems review because they have large bandwidth requirements, new modulation techniques, novel applications, or are considered to have a significant impact on the existing electromagnetic environment. This systems review procedure is referred to in Appendix G of this NPR.

(2) NASA users requiring assignments for radio frequencies for non-major terrestrial use should provide the specific technical information to the Center/Facility Spectrum Manager. This information should be submitted for all frequency assignment actions (new, renewal, and modifications) by the appropriate NASA Center/Facility Spectrum Manager for review and submission to the NASA FAS representative and alternate NASA FAS representatives in the proper NTIA computer mnemonic format as described in Chapter 9 of the NTIA Manual. It is mandatory that Center/Facility Spectrum Managers use NTIA's Spectrum XXI (or current successor) software program to request and receive radio-frequency assignments.

(3) The following procedures and notes will aid NASA spectrum applicants in the preparation of applications for frequency assignments, and facilitate the processing of the applications:

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 time process commences when the application appears on the FAS electronic agenda.

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).

Step 3: Refer to paragraph 3.4 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 involved. When such coordination is extensive, the user (applicant) shall provide funds for such coordination, including the preparation of coordination contour charts.

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.

(4) NASA Center/Facility Spectrum Managers and/or JPL Spectrum Manager are responsible for processing the information into the proper NTIA computer mnemonic format. For short term uses of RF equipment, the Center/Facility Spectrum Manager may determine that only a Special Temporary Authority (STA) is required. Submit this data via NTIA's Spectrum XXI (or current successor) software to the National

Spectrum Program Manager.

(5) Submission of data or acknowledged receipt does not constitute an 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.

d. Space Assignments

(1) 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 Radiocommunications (TSP-R)" states that for Government agencies the systems review process is applicable to certain systems and subsystems. The systems review is intended for:

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

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

(c) Such systems or facilities as may be referred to the SPS on a case-by-case basis.

Note: Telemetry, tracking, and control for spaceborne systems require a STAGE 4 (operational) system certification (from NTIA) before any spaceborne system is launched (even if the spaceborne system is experimental).

(2) 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:

Stage 1. Conceptual

Stage 2. Experimental

Stage 3. Developmental

Stage 4. Operational

(3) This review process is mandatory for space systems except those that operate under Appendix K of the NTIA manual regarding low power nonlicensed devices. For those systems which require review and certification by the SPS, the Center/Facility

Spectrum Manager shall be required to coordinate with the NASA SPS representative throughout the review process. The Center/Facility Spectrum Manager may request a waiver from the NTIA's SSS of the requirement to file the ITO notification, provided that the space system shall operate for less than one year.

(4) Details of the systems review procedure can be found in Appendix G.

3.4 U.S. Coordination Requirements

a. NASA Components as Tenants at Other Government Agencies

The Centers 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 National Spectrum Program Manager reflecting the recommendations of the host Agency under whose jurisdiction the operation is proposed.

b. Joint Radio Frequency Coordination for National Test Ranges

(1) 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 shall 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 of July 28, 1980. Area coordinators are found in the NTIA Manual.

(2) The areas in which Military Interservice Frequency Coordination is required are shown in Figure 3-3 and further defined in Table 8.3.26 of the NTIA Manual. Table 8.3.26 also lists the DoD AFC responsible for coordination within each area.

(3) DoD AFC maintain current records of frequencies that have been coordinated with them 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.

(4) 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:

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.

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.

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.

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

Step 5: Should a frequency conflict arise between DoD AFC and NASA Center/Facility Spectrum Managers and/or JPL 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, NASA FAS Representative, and alternate NASA FAS representative(s) who will attempt to resolve the conflict at the Agency level.

c. Coordination Procedures for the National Radio Quiet Zone (NRQZ)

(1) The NRQZ is an area approximately 100 miles square set aside for radioastronomy 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 (Figure 3-3).

(2) To protect the NRQZ from interference, the following criteria have been established for the maximum field strength limits:

50 MHz to 1 GHz Less than 0.1 microvolt per meter
1 GHz to 10 GHz Less than 1.0 microvolt per meter
10 GHz to 100 GHz Less than 10.0 microvolts per meter

(Measured at 38°31' 16" N, 79°16' 36" W at 2,292 feet above mean sea level.)

(3) All proposed frequency assignments to NASA radio stations within the NRQZ shall be coordinated by the NASA FAS representative per the NTIA Manual Part

8.3.9, prior to authorization.



Figure 3-3 Geographic Locations of National Ranges and National Radio Quiet Zone

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

(1) Coordination procedures are applicable for all frequency assignment actions for use of frequencies in the bands 1435-1535 MHz and 2310-2390 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.

(2) All frequency applications (proposed and renewal) for NASA radio stations shall be accompanied by an AFTRCC concurrence letter submitted in accordance with the NTIA Manual Chapter 8.3.17 and Annex D of the NTIA Manual.

3.5 NASA Contractors (NASA FAR Supplement, Subpart 1823.71 and Section 1852.223-71)

Center/Facility Spectrum Manager

The Center/Facility Spectrum Manager shall request the contracting officer to insert the clause from NASA FAR Supplement Section 1852.223-71, Frequency Authorization, in any contract which calls for the development, construction, or operation of a device for which an RFA or STA is required.

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.

NASA Contracting Officers

Commercial contractors, providing or operating RF equipment for NASA use, shall obtain RF spectrum authorization in accordance with the terms of the contract through the NASA contracting officer. Commercial 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 shall ensure it maintains operational control of the radio equipment, should the need to cease transmissions arise.)

3.6 Foreign Frequency Assignments

Foreign frequency assignments shall be obtained by the senior NASA official available at, or convenient to, the site of operations. In some circumstances, NASA may request cooperating space agencies to obtain frequency assignments. Reports of all such actions will be made to the National Spectrum Program Manager, Washington, DC 20546.

3.7 Conditions of Assignment

- a. All Center activities will be assigned frequencies by NTIA through the NASA FAS representative. The NASA FAS representative will forward these assignments, using NTIA-supplied software, Spectrum XXI (or current successor), to the appropriate Center/Facility Spectrum Manager upon completion of the frequency coordination process. The NASA FAS representative will also inform the National Spectrum Program Manager when the assignment has been approved by NTIA. Based on this authorization, Center/Facility Spectrum Managers may issue Center RFA's.
- b. 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 HQ Spectrum Management Office when published by the NTIA.
- c. All NASA frequency assignments are issued subject to the following conditions:
 - (1) 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 Spectrum XXI, (or equivalent successor) to any radio frequency assignment due for its five or ten year NTIA justification.
 - (2) Radio transmitters shall be operated by adequately trained and designated personnel and in a manner conforming to established and accepted procedures.
 - (3) Transmitter operations shall be 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.
 - (4) Approved power, emissions, and conditions of assignments shall be adhered to at all times.
 - (5) All land mobile radio transmissions shall be identified by the use of the authorized radio call signs pursuant to Appendix H of this NPR.
 - (6) Transmitter operations shall be held within the prescribed tolerances outlined in Chapter 5 of the NTIA Manual unless otherwise authorized.

- (7) 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.
- (8) An RF evaluation should be conducted to determine the effects on human health, including interference with personnel operations such as maintenance procedures. Evaluations shall be handled at a local level with the Center/Facility Spectrum Manager and in collaboration with the Center/Facility Radiation Safety Officer. Local procedures will vary at each site and, as a minimum, follow ANSI C95.1, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields."
- d. Chapter 7 paragraph 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 RFA's without referral to the National Spectrum Program Manager to cover those operations that meet the criteria established in this chapter of the NTIA Manual for the particular frequency usage involved.
- e. All Ground Penetrating radar and Global Positioning Satellite re-radiators shall receive NASA and NTIA approval prior to use (see NTIA Manual).

3.8 Emergency and Wartime Procedures

Emergency Procedures

- (1) 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:
- (a) The nature and duration of the requirement are such that the normal frequency assignment procedures are impractical.
- (b) All reasonable measures are taken before such frequencies are used to ensure that harmful interference will not be caused to other users.

Wartime Procedures

- (1) 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 NTIA take into account all aspects of the President's communications requirements for the national defense in time of war.
- (2) NASA's role in providing support for these wartime procedures is established through 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: Radio Frequency Interference Procedures

4.1 Radio Frequency Interference Reporting Procedures

The probability of harmful RFI increases as more and 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.

Occurrences of interference should be investigated initially at the lowest possible echelon of NASA spectrum management. Reports of harmful interference or jamming of NASA emitters should normally be distributed by the Center/Facility Spectrum Manager as follows:

At the impacted Center:

- Local Security Office
- Local Office of Safety and Mission Assurance
- Occupational Health Office

At NASA Headquarters:

- National Spectrum Program Manager
- Office of Security and Program Protection
- Office of Inspector General
- Office of the Chief Health and Medical Officer

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 shall be made only if the interference is prolonged and disruptive and cannot be cleared through normal procedures.

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 that are not protected from interference).

4.2 RFI Control Procedures

a. Radio Frequency Users

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

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

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.

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

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

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

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.

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 as appropriate to support the investigation.

Step 7: Measure the interference signal strength.

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.

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.

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., tape recordings or spectrum photographs).

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

b. Center/Facility Spectrum Managers

(1) 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.

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

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).

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)).

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.

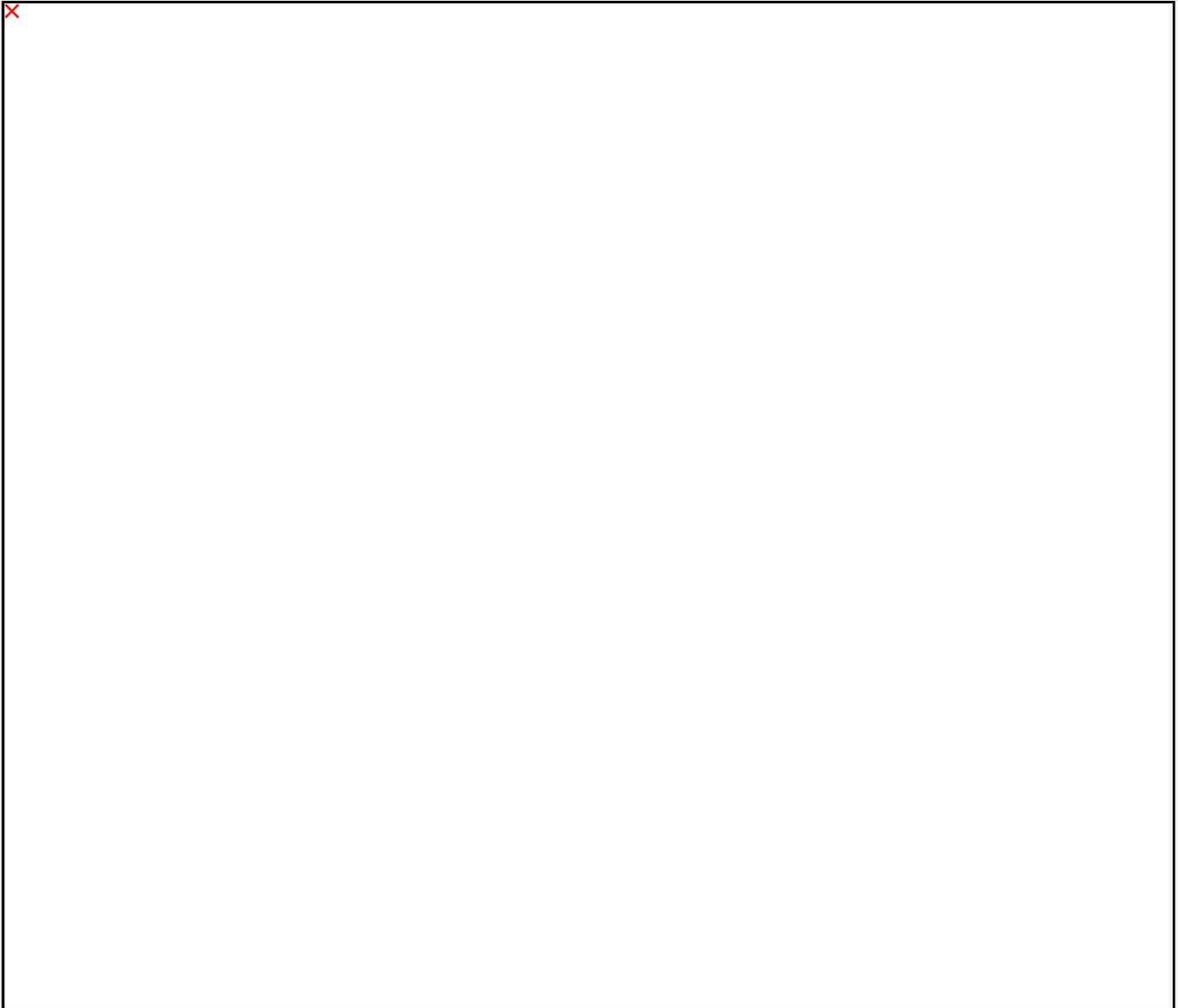
Step 4: If the interference is encountered on or from a DoD Test Range, report the RFI to the local DoD Test Range Spectrum Manager for resolution. If there is NO satisfactory resolution then elevate the RFI to the DoD Area Frequency Coordinator (AFC) (see Table 3-1) in accordance with appropriate range communications instructions.

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.

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. 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.

(3) 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.

Figure 4-1 Standard RFI Reporting Format



c. National Spectrum Program Manager

(1) When an RFI problem cannot be resolved at the Center, the National Spectrum Program Manager must 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.

(2) The National Spectrum Program Manager should follow the steps below as they apply to the particular situation:

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.

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 Interdepartment Radio Advisory Committee (IRAC), including a full report of the interference and a request for action or assistance, as required.

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 as appropriate. NTIA or the FCC will assume the coordination necessary to resolve the problem at the International level through the ITU, if required.

(3) 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.

d. STS RFI Management

Procedures for RFI Management for the Space Transportation System (STS) are defined in NASA Publication, Space Shuttle Program (SSP) Radio Frequency Interference Management Manual (RFIMM), NSTS 37372 dated October 12, 2006.

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

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

(2) 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.

(3) 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).

f. 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) shall 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.

g. Space Frequency Coordination Group (SFCG)

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

(2) 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. 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.

(3) 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.

h. 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

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 must operate. 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 aware of new concepts, which may require spectrum support with sufficient time available to accomplish changes.

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 10 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

General

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). NASA expects that most mission RF 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.

Mission Directorate Responsibilities

For future Agency missions, it is the responsibility of each NASA Mission Directorate, through the HSMF, to provide the latest conceptual communications requirements to the Director of Spectrum Policy and Planning in respect of programs and future mission concepts over 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.

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 HSMF.

Center Responsibilities

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 over 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.

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.

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 at the execution site will be coordinated between the RFA owner and the execution site Center/Facility Spectrum Manager.

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

Applicable to NASA RF Spectrum Management

A.1 General Terms

Experimental Station: A station utilizing radio waves in experiments with a view to the development of science or technique. This definition does not include amateur stations.

Facsimile: A system of telecommunication for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

Frequency Allotment: Entry of a designated frequency channel in an agreed 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.

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 shall also be applied to the frequency band concerned.

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

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.

Frequency Management (RF 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.

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

Frequency-Shift Telegraphy: Telegraphy by frequency modulation in which the telegraph signal shifts the frequency of the carrier between predetermined values. There is phase continuity during the shift from one frequency to the other.

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.

Noninterference Basis: Use of radio frequencies, not in accordance with all applicable RR, shall not cause harmful interference to, or claim protection from stations of, other services operating in accordance with the RR.

Radioastronomy: Astronomy based on the reception of RF waves of a cosmic origin.

Radio Waves: Electromagnetic waves of frequencies lower than 3000 GHz, propagated in space

without artificial guides.

Radiocommunication: Telecommunication by means of radio signals.

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.

Radiotelemetering: Telemetering by means of radio signals.

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.

Telegraphy: A system of telecommunication which is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such a form.

Telemetering: The use of telecommunication for automatically indicating or recording measurements at a distance from the measuring instrument.

Telephony: A system of telecommunication set up for the transmission of speech or, in some cases, other sounds.

Television: A system of telecommunication for the transmission of transient images of fixed or moving objects.

Terrestrial Service: Any radio service other than a space service or the radioastronomy service.

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

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

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.

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.

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.

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:

- 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.
- Similar information is collected from airborne or Earth-based platforms.
- Such information may be distributed to Earth stations within the system concerned.
- Platform interrogation may be included.

This service may also include feeder links necessary for its operations.

Fixed and Mobile Satellite Service: A space service (1) between Earth stations, when using active or passive satellites for the exchange of communications of the fixed or mobile service, or (2) between an Earth station and stations on active satellites for the exchange of communications of the mobile service, with a view to their retransmission to or from stations in the mobile service.

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.

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.

Maintenance Space Telemetry: Space telemetry relating exclusively to the electrical and mechanical condition of a spacecraft and its equipment together with the condition of the environment of the spacecraft.

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.

Passive Satellite: An Earth satellite which does not require a transmitter, such as one which reflects radiocommunications signals or observes emission from the Earth's or another planet's surface and constituents of its atmosphere.

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.

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

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

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

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.

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.

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.

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.

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

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.

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

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.

Deep Space: Space at distances from the Earth equal to or greater than 2×10^6 km.

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.

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 0° .}

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

Nongeostationary: 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.

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

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.

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

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

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.

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

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.

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

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, as applicable.

Gain on 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.

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.

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.

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.

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.

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.

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
AFTRCC	Aerospace & Flight Test Radio Coordinating Council
ANSI	American National Standards Institute
ARC	Ames Research Center
BR	Radiocommunications Bureau
DAA	Deputy Associate Administrator
DFRC	Dryden Flight Research Center
DoD	Department of Defense
EL-CID	Equipment Location - Certification Information Database
EMC	Electromagnetic Compatibility
ESA	European Space Agency
ER	Eastern Range
FAR	Federal Acquisition Regulation
FAS	Frequency Assignment Subcommittee
FCC	Federal Communications Commission
GHz	gigaHertz
GMF	Government Master File
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HF	High Frequency
HQ	Headquarters
HSMF	Headquarters Spectrum Management Forum
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
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
NRFA	NASA Radio Frequency Assignment
NRQZ	National Radio Quiet Zone
NSF	National Science Foundation
NSMG	NASA Spectrum Managers' Group
NTIA	National Telecommunications and Information Administration
NTIA Manual	Manual of Regulations and Procedures for Federal Radio Frequency Management
OMB	Office of Management and Budget

OSMA	Office of Safety and Mission Assurance
RCS	Radio Conference Subcommittee
RF	Radio Frequency
RFA	Radio Frequency Authorization
RFI	Radio Frequency Interference
RR	Radio Regulations
SFCG	Space Frequency Coordination Group
SOMD	Space Operations Mission Directorate
SPS	Spectrum Planning Subcommittee
SSC	Stennis Space Center
SSS	Space Systems Subcommittee
STA	Special Temporary Authorization
STGT	Second TDRS Ground Terminal
TDRS	Tracking and Data Relay Satellite
TSC	Technical Subcommittee
UHF	Ultra High Frequency
VHF	Very High Frequency
WFF	Wallops Flight Facility
WRC	World Radiocommunication Conference
WSTF	White Sands Test Facility

Appendix C: Headquarters Spectrum Management Forum (HSMF)

The HSMF is organized to provide a forum for the exchange of information on radio frequency spectrum management requirements, policies, and issues among all Mission Directorates and crosscutting HQ support offices of the Agency.

C.1 Purpose

The forum is established to provide the means by which the AA for SOMD ensures other Headquarters Offices of NASA's compliance with Office of Management and Budget (OMB) Circular A-11, Section 33.4.

The forum also provides the means of assuring spectrum availability and compatibility between the different communications systems requirements in support of each Mission Directorate's program goals.

C.2 Objectives

To facilitate Agency-level integration of communications requirements for all current and future programs sponsored by that Mission Directorate, in a timely manner, and to ensure that spectrum support is available to meet program/project milestones.

To enable Headquarters Offices to review and comment on the status and progress of frequency spectrum support issues and activities in the national and international frequency spectrum arenas.

To ensure intra-NASA compatibility by reviewing, for coordination purposes, spectrum support submissions prior to frequency assignment application.

C.3 Organization

The Director of Spectrum Policy and Planning, on behalf of the AA for SOMD, chairs the forum. The chairman is supported by the national and international Spectrum Program Managers. Meetings of the group are convened by the Chairperson, and meet as necessary, but not more than 90 days should elapse between meetings.

Each Mission Directorate provides one representative, knowledgeable in the communications requirements of all current and future programs sponsored by that office. In addition, the Office of Safety and Mission Assurance (OSMA) will provide a representative to the group.

The work of the forum will be recorded by means of three documents:

1. Meeting Minutes⁷, published after each meeting no later than two weeks after the meeting date.
2. Action Item List, reviewed and updated at each meeting.
3. Calendar of Events for one year, updated monthly.

These documents, published by the Chairperson, will be distributed to all members.

⁷ 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, contact your Center Records Manager for assistance.

Appendix D: International Telecommunication Union (ITU) Structure

Structure

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 D-1 presents the ITU structure with its components.

The structure of the ITU comprises:

- The Plenipotentiary Conference, which is the supreme policy-making body of the Union.
- The Council, which acts on behalf of the Plenipotentiary Conference.
- World conferences on international telecommunications.

The ITU is further divided into three major Sectors:

- The Radiocommunication Sector, including world and regional radiocommunication conferences, radiocommunication assemblies, and the Radio Regulations Board.
- The Telecommunications Standardization Sector, including World Telecommunications Standardization Conferences.
- The Telecommunication Development Sector, including world and regional telecommunication development conferences; and The General Secretariat.

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

D.1 Plenipotentiary Conference

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

- Elect the Secretary-General and the Deputy Secretary-General.
- Elect the ITU council members (a maximum of 25 percent of the total number of member States).
- Elect the Directors of the Bureaus of the Sectors and the Radio Regulations Board Members.
- Authorize any World or Regional Radiocommunication Conferences.

- Approve any changes to the ITU Constitution or ITU Convention.
- Determine the budget for the Union.

D.2 Council

The Council meets annually and is presently comprised of 43 members elected by the Plenipotentiary to serve until the next Plenipotentiary. The functions served by the ITU Council include:

- Establish agenda and actual dates for upcoming conferences.
- Manage Union resources between Plenipotentiary meetings.

D.3 Radiocommunication Sector

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

- By ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services.
- By carrying out studies without limit of frequency range and adopting recommendations on radiocommunication matters.

The Radiocommunication Sector works through:

- World and regional radiocommunication conferences.
- The Radio Regulations Board.
- Radiocommunication assemblies, which are associated with world radiocommunication conferences held once every two to three years.
- Radiocommunication study groups and their associated working parties and task groups.
- The Radiocommunication Bureau, headed by the elected Director.

D.4 Telecommunications Standardization Sector

The functions of the Telecommunications Standardization Sector shall be to fulfill the purposes of the Union relating to telecommunication standardization:

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

The Telecommunications Standardization Sector works through:

- World telecommunication standardization conferences.

- Telecommunication standardization study groups.
- The Telecommunication Standardization Bureau headed by the elected Director.

D.5 Telecommunications Development Sector

The functions of the Telecommunications Development Sector shall be to fulfill the purposes of the Union relating to telecommunication development:

- By promoting and offering technical assistance to countries in the field of telecommunications.
- By promoting the mobilization of the material and financial resources needed for implementation.
- By promoting the extension of the benefits of the new telecommunication technologies to all the world's inhabitants.

D.6 Radiocommunication Study Groups

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	Fixed-Satellite Service
5	Terrestrial Service
6	Broadcasting Service
7	Science Services

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

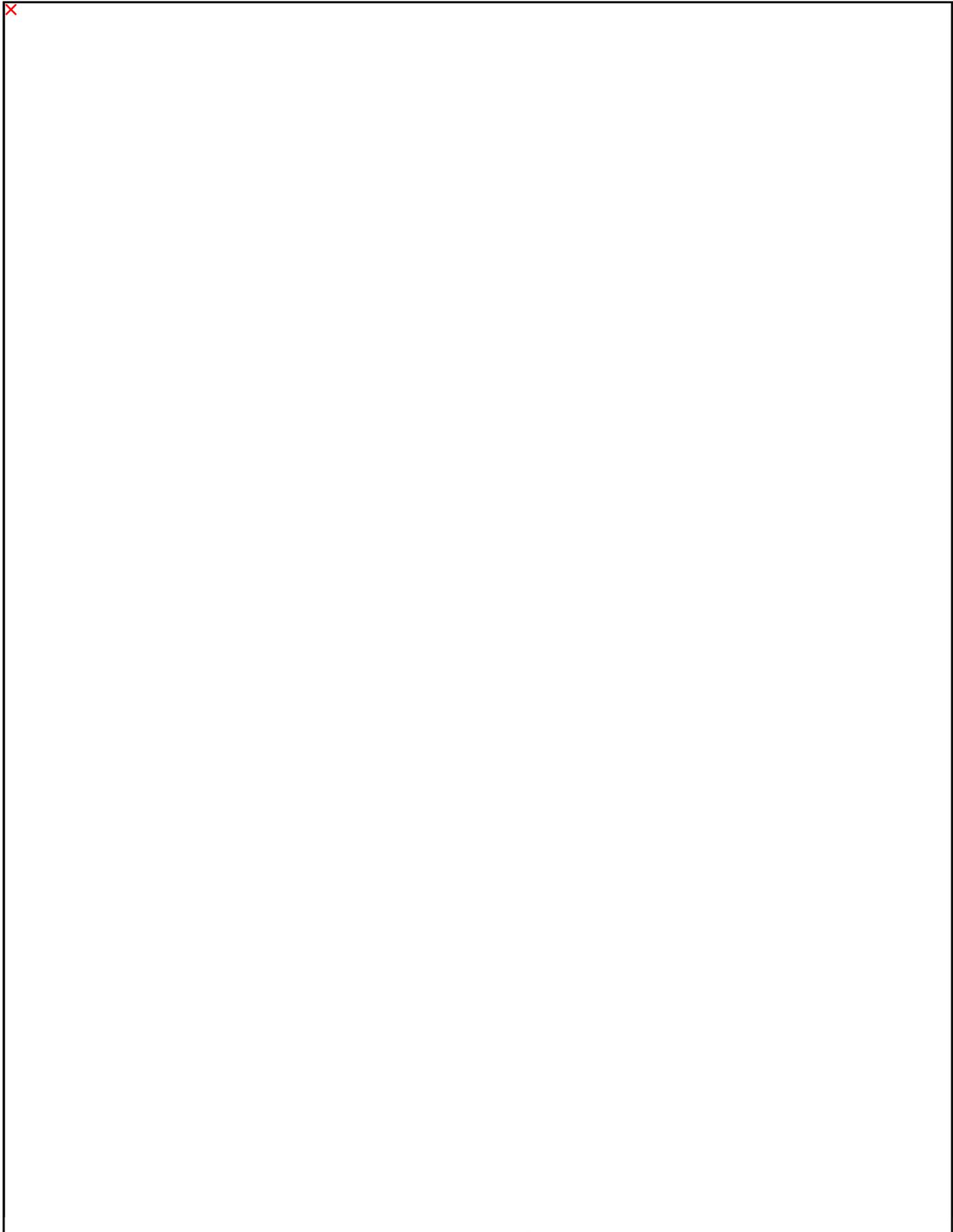


Figure D-1 The ITU Structure

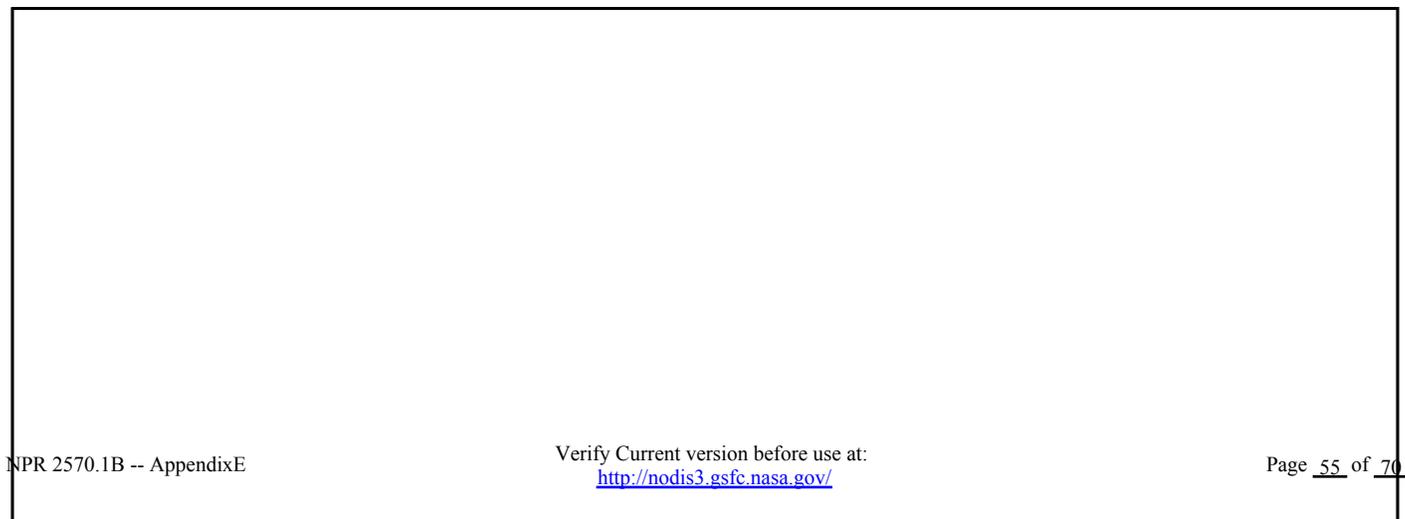
Appendix E: U.S. and International Telecommunications Union (ITU) Spectrum Interfaces

The relationship between the U.S. and international spectrum management structures is shown as Figure E-1. The figure depicts two paths. One is the technical path where studies of radio matters are conducted; the other depicts the preparations within the United States leading to a Radiocommunication Conference.

Conference preparation follows the flow as shown in Figure E-1. NASA, as well as other Federal agencies, inputs proposals to the IRAC Radio Conference Subcommittee (RCS). Upon approval within the RCS, proposals are then coordinated with the FCC Advisory Committee for acceptance by the private sector. In a similar fashion, private sector proposals are coordinated through the RCS for approval by the Federal sector. Proposals are ultimately reconciled between the FCC and NTIA before going to the U.S. Department of State for submission to the conferences.

Significant technical interests for NASA are in the Study Group and its associated Working Parties concerned with the space science services (Study Group 7 and Working Party 7A, 7B, 7C, and 7D), which support Federal and commercial space programs (See Figure E-2). In general, technical studies of current interest are supplied to the United States Study Group or cognizant Working Party by member agencies. When approved by the Study Group or Working Party, they are forwarded to the National Committee of the U.S. Department of State's International Telecommunications Advisory Committee for the Radiocommunication Sector (ITAC-R) for national policy review prior to being submitted to Radiocommunication Assemblies or to a special conference preparation study group. The results of these studies provide the technical bases for Radiocommunication Conferences.

In addition to the space sciences services, NASA also contributes to the work of Study Group 1 (Spectrum Management), Study Group 3 (Radiowave Propagation), Study Group 4 (Satellite Service), Study Group 5 (Terrestrial Services), and Study Group 6 (Broadcasting Services), to assist the commercial industry in better meeting the long-term communications requirements of NASA, as well as to protect and promote NASA use of allocated frequency bands.



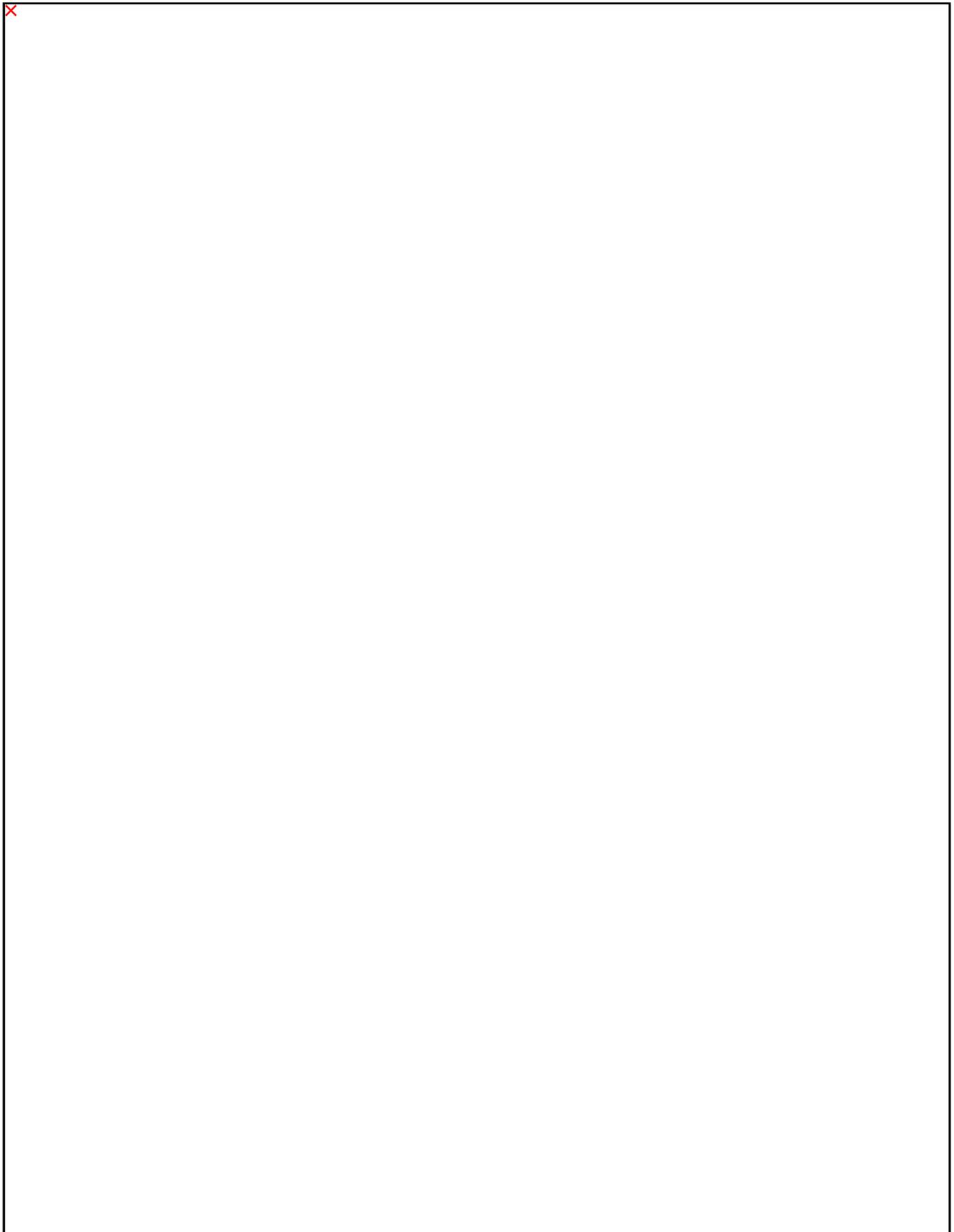


Figure E-1 U.S. and ITU Spectrum Interfaces

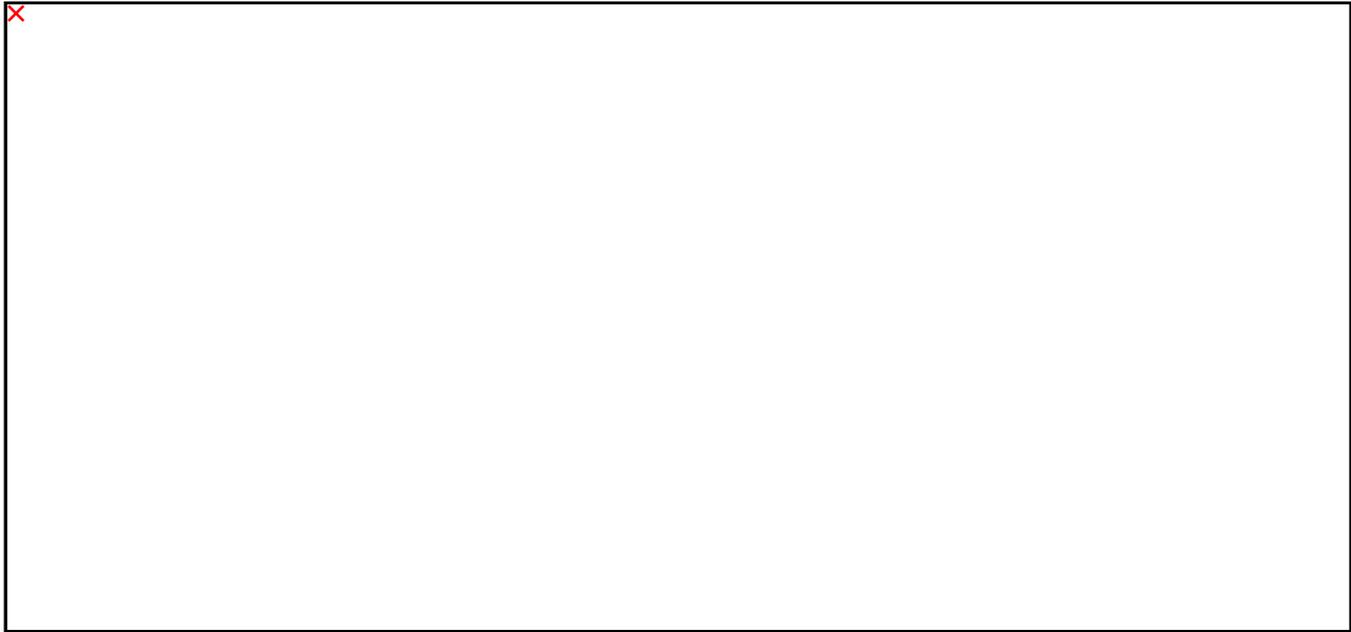


Figure E-2 U.S. Radiocommunication Study Group 7 Structure

Appendix F: NASA Spectrum Managers' Group (NSMG)

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.

F.1 Purpose

The group provides the assurance to NASA Headquarters of the Centers' compliance with NASA policy.

F.2 Objectives

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 SOMD, in a timely manner, to ensure that spectrum support is available as and when required by each project.

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.

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

F.3 Organization

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

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 OSMA to the annual meeting at their host NASA Center.

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.

The work of the group is recorded by means of three documents:

1. Meeting Minutes⁸, published after each meeting.
2. Action Item List, reviewed and updated at each meeting.
3. Calendar of Events for one year, updated monthly.

⁸ The Manual in NPR 1441.1D, 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 1441.1D, If an item is not

described in NPR 1441.1D, an entry needs to be developed and added to the NPR. In this instance, contact your Center Records Manager for the procedures.

These documents are distributed electronically to participants and will be made available on the SCaN internal Web site.

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

G.1 IRAC Spectrum Planning Subcommittee

Details of the NTIA Systems Review process can be found in the NTIA Manual Chapter 10. Note also Section 1.2 of this NPR. Briefly, the procedure consists of a four-stage review performed by NTIA's Systems Review Branch in the IRAC SPS. Note that this review process is mandatory for space systems except those that operate under Annex K of the NTIA Manual regarding low power nonlicensed devices.

All data shall 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 paragraph 10.7 and on the following forms found in chapter 10 of the NTIA Manual:

- NTIA Form 33 Transmitter equipment characteristics.
- NTIA Form 34 Receiver equipment characteristics.
- NTIA Form 35 Antenna equipment characteristics.

Stage 1 Conceptual

Here the initial planning effort has been completed, including proposed frequency bands and other available characteristics.

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, especially those that use new technological concepts or use existing technology in significant new ways, should be submitted. The guidance provided 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.

Because much of the system data will be estimated, 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 and will be subject to adjustment during later stages. The system will be reviewed in 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.

Note that with Stage 1 approval, the Agency may not apply for a temporary frequency assignment. Temporary frequency assignments are available after Stage 2 SPS approvals and above.

Stage 2 Experimental

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

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 shall be furnished to the SSS in accordance with the instructions in the current NTIA Manual for the purposes of ITU-R Advance Publication. This data may be used in lieu of the data required for Stage 1 or 2 Systems Review request. The Appendix 4 data shall be provided to the SSS at the same time as the request for Stage 2 Systems Review

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, if the system will be operational for less than one year and the system requests a waiver from the SSS of the IRAC.

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.

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 SPS, where appropriate, with more specific Electromagnetic Compatibility (EMC) analysis, against a typical environment, being added where experimental testing of technically defined equipments 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.

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 applied for in anticipation of the operational {Stage 4} approval.

Stage 3 Developmental

Here the major design has been completed, and radiation may be required during testing. For the Stage 3 Systems Review, the Agency shall 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).

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 frequency band will normally have been determined and certification at Stage 3 will be required for testing of proposed operational hardware and potential equipment configurations.

Detailed EMC analyses will be performed using test data and considering specific sites of equipment. A radiation hazard evaluation will be performed using ANSI-C95.1 maximum permissible exposure limits as the standard by or with the Center/Facility 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.

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.

Stage 4 Operational

Here 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.

When submitting for Stage 4 Systems Review, NASA shall update all previous information provided.

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

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.

For unclassified space systems that have not been waived from the requirements of international registration, information shall 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:

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

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.

As a matter of policy, advance publication information and notices of frequency assignments relating to space systems shall 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 The Jet Propulsion Laboratory (JPL)

Blocks of call signs are allotted to NASA Centers and JPL for assignment by the FCC through the NASA National Spectrum Program Manager who, in turn, allots them in groups to the Center or JPL Spectrum Manager. The Center/Facility Spectrum Manager assigns these call signs, as required, to all frequency users at the Center or JPL, including commercial contractors. The call signs allocated to each NASA Center and JPL 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
Dryden 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
Dryden 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
Dryden 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

WPBA275 through WPBA289

Applicable only to land mobile radio systems operations, i.e. repeater operations

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

1. The Center or JPL Spectrum Manager exercises complete control of the assigned block of call signs and reserves the right to cancel or make changes as appropriate. The Center/Facility Spectrum Manager must maintain 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.
2. One or more call signs may be assigned by the Center or JPL Spectrum Manager to any operation remotely located from the Center where the spectrum manager exercises responsibility for the NASA Radio Frequency Assignment (NRFA) specifically issued to NASA representatives of commercial contractors, research institutes, colleges, and universities under contractual jurisdiction of the activity.
3. Upon receipt of an NRFA, the Center or JPL 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, regardless of the organization or commercial activity conducting the operation.
4. Prior to the assignment of an initial radio call sign, the Center or JPL Spectrum Manager must first determine that a valid requirement exists and that no previous assignment of an experimental call sign has been made to this operation.
5. Upon receipt of a request for an additional call sign, the Center or JPL 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.

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.

H.5 Reporting of Call Sign Assignments

The Center or JPL Spectrum Manager will advise the National Spectrum Program Manager of each initial assignment of a call sign to an operation via the RFA five-year review process.

Appendix I: Terms of Reference of the Space Frequency

Coordination Group (SFCG) (November 2000)

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:

Space Research
Space Operations
Earth Exploration Satellite
Meteorological Satellite
Intersatellite
Radionavigation Satellite
Radioastronomy and Radar Astronomy to the extent that they are relevant to spacecraft missions

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.

The SFCG will:

- Facilitate early understanding of present and future plans for space systems and services and of other systems affecting these.
- Identify problem areas and coordination needs, and study potential solutions associated therewith.
- Identify issues and policy matters relating to the future orderly use of the frequency bands allocated to respective space radiocommunication services.
- 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.
- Identify those matters for which member agencies should facilitate contributions to regional bodies (e.g. APT, CEPT, CITEL), ITU-R Study Groups; or to encourage their administrations to make proposals to ITU WRCs.
- 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.
- Consider any other items of technical, operational, or administrative nature which affect the interests of the group.
- Maintain strong ties with other international bodies with related objectives.

Current list of SFCG Member Agencies:

ARGENTINA: Comisión 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'Études Spatiales (CNES)
GERMANY: Deutsche Forschungs - und Versuchanstalt für 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
REPUBLIC OF KOREA: Korea Aerospace Research Institute (KARI)
RUSSIAN FEDERATION: Russian Federal Space Agency (RFSA)
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 KINGDOM: British National Space Center (BNSC)
UNITED STATES: NASA
UNITED STATES: National Oceanic and Atmospheric Administration (NOAA)

Appendix J: Sample "Economic Value Form"

