NTIA REPORT 84-141

PLANNING GUIDE FOR THE REVIEW OF TELECOMMUNICATIONS SYSTEMS FOR FREQUENCY AVAILABILITY AND ELECTROMAGNETIC COMPATIBILITY

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JANUARY 1984

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ABSTRACT

This report is an update of a previous report of the same title published by the former Office of Telecommunications Policy. It provides guidance to Federal system planners in securing spectrum support for proposed new or modified telecommunications systems in compliance with procedures of the National Telecommunications and Information Administration (NTIA). These procedures are in response to an Office of Management and Budget Circular (OMB Circular No. A-11) requiring certification from NTIA of spectrum support prior to submission of budget estimates to OMB. This report summarizes the various steps involved in the process, suggests questions each agency should address in preparation for submission and provides example outputs.

KEY WORDS

Electromagnetic Compatibility
Frequency Availability
Life Cycle
NTIA System Review Process
Spectrum Planning Subcommittee
Spectrum Management

SECTION 1

INTRODUCTION

The electromagnetic spectrum is a valuable, highly-contested natural resource, and it is the medium upon which all wireless communications-electronics equipments depend for the transmission and receipt of intelligence. Like other resources, it is susceptible to overuse and pollution, and depends upon enlightened management for its efficient and effective use. Authority and responsibility for regulation of the use of the spectrum within the Federal Government rests with the President under the provisions of the Communications Act of 1934, as amended. These functions were transferred to the Secretary of Commerce by Executive Reorganization Plan No. 1 of 1977 and the 1978 Executive Order 12046, and further delegated to the Assistant Secretary of Commerce for Communications and Information who also serves as the administrator of the National Telecommunications and Information Administration (NTIA). Specific regulations adopted by NTIA relative to use of the radio spectrum are found in the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management (NTIA Manual) (NTIA, 1983).

This document provides guidance to those engaged in planning during the conceptual, experimental, development and operational planning phases of Government telecommunications systems. It has been generated for the purpose of promoting and insuring due consideration for those system aspects that involve the use of or impact upon the radio spectrum. Guidance is provided for the Federal system planner in securing spectrum support for proposed new or modified telecommunications systems through compliance with prevailing regulatory procedures. It is recognized that there are many approaches to telecommunications system planning. This document is intended to supplement those approaches and to ensure that consideration of spectrum planning is also recognized as fundamental to telecommunications system planning.

The Office of Management and Budget has established a policy, through its Circular No. A-11, updated annually, requiring Executive Departments and Agencies to secure assurance of spectrum support from NTIA prior to submission of budget estimates. The supporting policy stated in a paragraph of Section 13.2 of OMB Circular No. A-11 requires that:

> "Estimates for the development or procurement of major communications-electronics systems (including all systems employing satellite (space) techniques) will be submitted only after certification by the NTIA that the space in the radio frequency spectrum required for such systems is available."

The certification that spectrum support is available and the conditions such support is available is obtained through the system review procedures, contained in Part 8.3 of the NTIA Manual. These procedures call for the review of proposed new telecommunications systems and subsystems or major modifications thereto, to determine spectrum availability and compatibility. Systems requiring review are major communications-electronics systems including all systems employing satellite (space) techniques as defined in the procedure. Experimental projects are included in this procedure if a) the experiments look toward the development

or feasibility of an operational system or subsystem, b) the experiments are capable of causing harmful interference to authorized radio services, or c) the experiments require protection or international recognition.

System reviews are normally conducted on behalf of the NTIA by the Spectrum Planning Subcommittee (SPS) of the Interdepartment Radio Advisory Committee (IRAC) in its advisory capacity. The basic functions of the IRAC are to assist the Assistant Secretary for Communications and Information in assigning frequencies to U.S. Government radio stations and in developing and executing policies, programs, procedures, and technical criteria pertaining to the allocation, management, and use of the spectrum. The IRAC serves in an advisory capacity to the Assistant Secretary and reports to the Deputy Associate Administrator, Office of Spectrum Management of the NTIA. The SPS is responsible to the IRAC for the carrying out of IRAC functions that relate to planning for the use of the electromagnetic spectrum in the national interest to include the apportionment of spectrum space for the support of established or anticipated radio services, as well as the apportionment of spectrum space between or among Government and non-Government activities, and such other matters as the IRAC may direct. As a part of its responsibilities to the IRAC, the SPS conducts the System reviews. In the course of its review, the SPS gives primary attention to:

a) system compliance with prevailing NTIA spectrum management policy, allocations, regulations and technical standards (Government, National, and International);

b) predicted degree of electromagnetic compatibility (EMC) between the proposed system and the electromagnetic environment;

c) possible need for and the evaluation of the results of prototype EMC testing;

d) the electromagnetic compatibility of the wartime use of systems reviewed under Part 8.3 of the NTIA Manual. The subcommittee limits its review of wartime use to an assessment of potential incompatibility and does not address the relative priorities of the wartime functions being supported by the systems under consideration;

e) radiation hazards posed by the system to personnel; and

f) timeliness of submission in terms of the corresponding system life cycle, the appropriate part of the budget cycle, and the evaluation time needed for a reasonable systems review.

The importance of making accurate assessments of the EMC aspects of systems at the various stages of review is implicit in this policy and supporting procedure. The achievement of an acceptable level of realism and accuracy in making EMC assessments for support of management decisions is heavily dependent on the adequacy and clarity of system information to be submitted by user agencies.

This "Planning Guide" has been developed to aid Government agencies in preparing, in a timely manner, for the required stages of review. Contained herein are discussions specifically directed toward the frequency support and EMC

aspects of individual stages in a system life cycle. It is appropriate that system planners familiarize themselves thoroughly with Part 8.3 of the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management (see Appendix A). Included in the discussions of each review stage, are a series of questions which should, if addressed by the system planners, identify background data to support the systems review submissions. The questions, although not totally exhaustive, are sufficiently comprehensive to assure that areas of major concern are considered prior to each stage of review. It is recognized that the level of resources available to the various Federal agencies for purposes of EMC analysis is not uniform. In this regard, it is expected that each agency will provide data and analysis results commensurate with its capabilities and, as appropriate and necessary, take advantage of the services provided within the system review process.

SECTION 2

SYSTEM LIFE CYCLE AND STAGES OF REVIEW

Part 8.3 of the NTIA Manual contains the specific procedures for obtaining spectrum support. Contained within Part 8.3 are definitions of systems and subsystems covered by the review process, the four stages of review, the IRAC subcommittee responsibilities, EMC analysis support to the subcommittee, and data requirements. The four stages of the Spectrum Planning Subcommittee review, 1) conceptual, 2) experimental, 3) developmental, and 4) operational, relate directly to the typical agency system life cycle phases. The conceptual stage review takes place as soon as significant system definition data are available. The experimental stage review occurs to evaluate experimentation planning that occurs prior to actual experiments, looking toward the development or determination of the feasibility of an operational system or subsystem, including electromagnetic compatibility considerations. The development stage review is held prior to starting the primary system development action. The operational stage review is conducted before production procurement is contracted for systems intended for normal operational use.

The relationships between review stages and typical system life cycle phases are illustrated in Figure 1. As indicated, the review stages progress from conceptual to experimental to development to operational, while the system life cycle phases, as defined by certain of the major federal users of the spectrum, proceed from conceptual to design to acquisition to operational.

As illustrated in Figure 1, overlap exists between the various review stages and the systems life cycle elements. This overlap is complementary, and the timing of the various review stages is designed to use information that should normally be developed as the system evolves from a concept to an operational entity. It is important to note that not all systems will necessarily pass through all four stages of review. System review is recommended for both the conceptual and operational planning phases. Also, in the case of Government agency intentions to obtain "off-the-shelf" capabilities, procurement actions should not take place until the operational level systems review has occurred. After the conceptual stage systems review has been successfully concluded, it is possible that one or more of the stages of review may be unnecessary because of the system's technological state. The range of possible system review options is illustrated in Figure 2. TABLE 1 highlights the more important actions occurring during the four phases of planning, as pertaining especially to the life cycle process. The stages of systems review take place during the respective four planning phases. Review takes place during the latter part of a particular phase. Post phase 4 life cycle events occurring after the stage 4 operational stage review also are listed in TABLE 1. More specific EMC actions as well as a discussion of the data requirements for the four stages of systems reviews are presented in the following sections of this report.

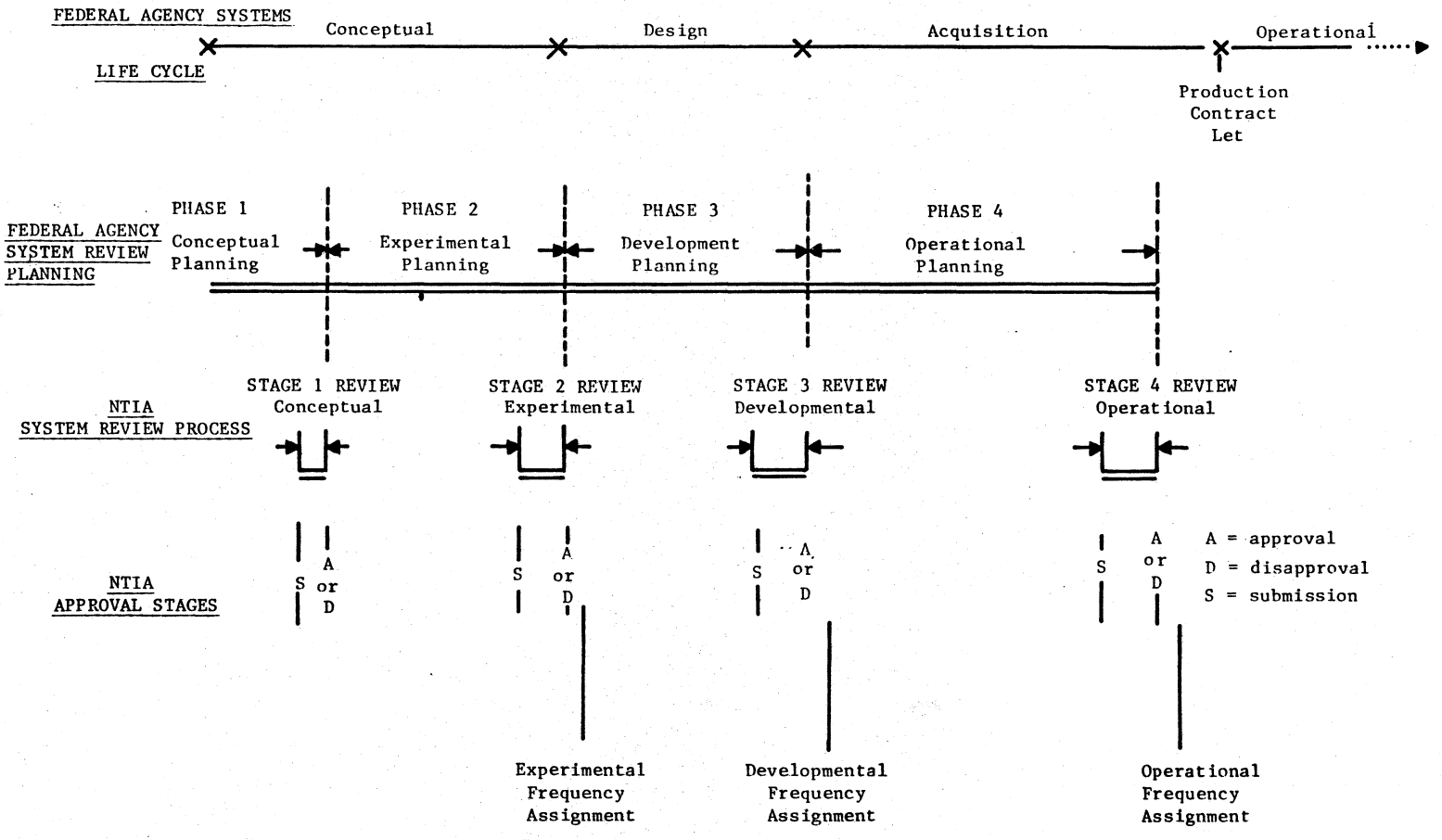


Figure 1. Relationship of the (A) Stages of Review of the NTIA System Review Process and (B) the Agency Phases of Planning to the (C) Life Cycle Phases of Federal Agency Systems.

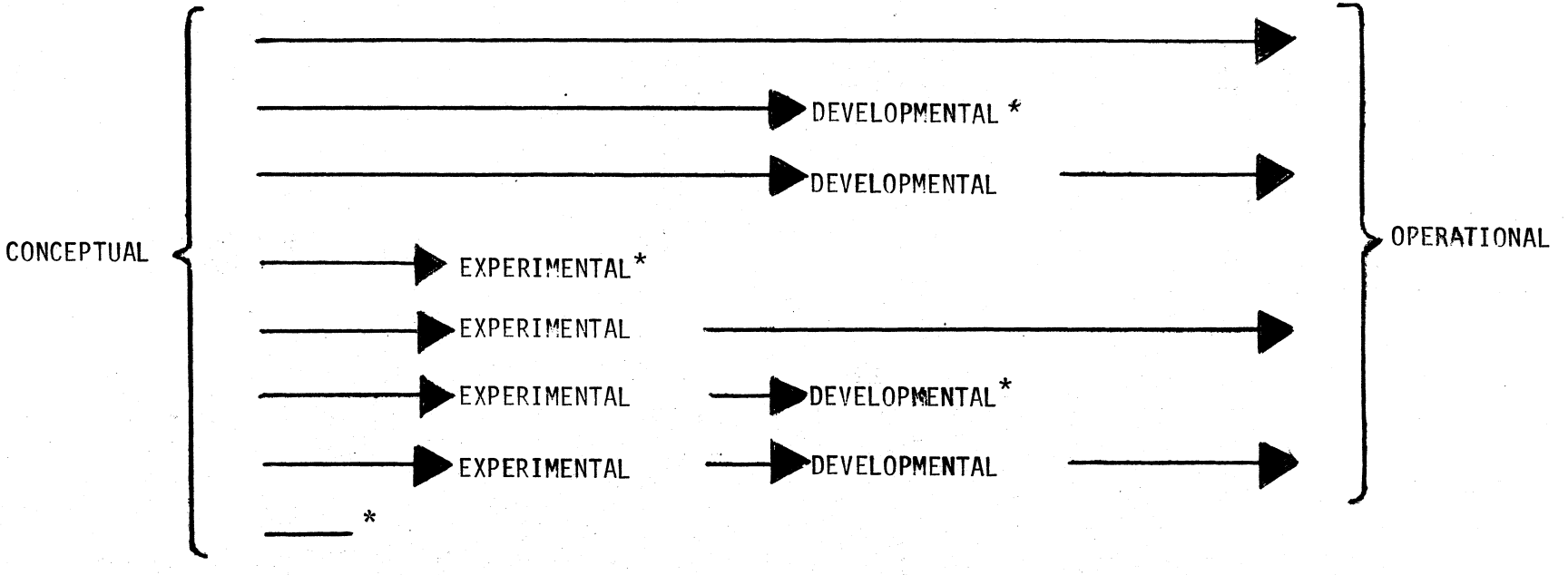


Figure 2. Possible System Review Stages

*Indicates that the system may be terminated at this stage and not proceed on to operational use.

TABLE 1

POSSIBLE AGENCY AND NTIA ACTIONS DURING PHASES OF PLANNING

Phase 1

Conceptual Planning

Basic Research Concept Formulated
System Operational Need Identified
Mission of System Outlined
System Descriptive Information Developed
System Data Estimates Determined
System Review Cover Letter and Attachments Submitted to SPS
Preliminary Spectrum Analysis Completed
Table Allocation Conforming Reviewed
Standards and Sharing Reviewed
NTIA Conceptual Spectrum Support May be Certified

Phase 2

Experimental Planning

New Techniques and Equipments Considered
Existing Equipment Considered in New Uses
Economic Tradeoffs Weighed
More Specific EMC Analyses Conducted
Operational Use and Deployment Analysis Considered
Improved Equipment Characteristics Developed
Experimental and Support Testing Planned
System Review Cover Letter and Attachments Submitted to SPS
Definition RFP Specs can be Prepared
Regulatory Calculations Conducted
NTIA Experimental Spectrum Support May Be Certified
Experimental Frequency Assignments Requested

Phase 3

Development Planning

Experimental Frequency Assigned
Proposals Prepared and Evaluated
Definition Contracts May be Let
Experimental & Demonstration Data Acquired
Hardware Data Evaluated for System Upgrading
Additional EMC Analysis Iterated Into Cohesive System Design
System Review Cover Letter and Attachments Submitted to SPS
Development Requirements Identified
Application Submitted for Development Frequencies
NTIA Developmental Spectrum Support May be Certified
Developmental Frequency Assignment Requested

Phase 4

Operational Planning
(Prior to Procurement)

Developmental Frequency Assigned
Development Models Constructed and Improved
Concurrent Development Data Acquired
Siting Plans Developed
Test & Evaluation Performance Determined
EMC Analysis Updated
Operational Use/EMC Plans Prepared
System Review Cover Letter and Attachments Submitted to SPS
Frequency Assignments for Operational Use Developed
Spectrum Operational Support by NTIA May be Certified
Prototypes Usually Completed for Production
Operational Frequency Assignment Application Prepared
Final System Documentation Prepared for Specific Frequency Incorporation
NTIA Operational Spectrum Support May be Certified
Operational Frequency Assignment Requested

TABLE 1 (CONTINUED)

POSSIBLE AGENCY AND NTIA ACTIONS DURING PHASES OF PLANNING

Post Phase 4

Operational Frequency Assigned
Remaining Development, Test and Evaluation Completed
Production Procurement Contracted
First Production Model Completed
Systems Produced
Deployment Is Effected
System Becomes Operational
System Modification Affecting Spectrum Use Submitted

SECTION 3

AGENCY CONCEPTUAL STAGE REVIEW PLANNING

During the conceptual planning phase and before the stage 1 review, statements regarding system requirements should be developed by the system planners. This should include the identification of specific missions or functions including intended employment or deployment to be accomplished by the system and its various subsystems. These should be related to the mission statements of the particular agency or department. From these requirements, specifications of telecommunication techniques and resources needed to support the proposed mission or capability can be stated. This, in turn, forms the basis for subsequent spectrum resource planning and electromagnetic compatibility considerations as the system design evolves. To provide a basis for evaluation of the spectrum use aspects of new telecommunication systems at the conceptual stage review, it is necessary to provide for the review the best available data on technical aspects and operational concepts associated with the system. To adequately prepare for the system reviews, a number of key areas should be considered. Those considered appropriate to prepare for the conceptual stage of review are illustrated in Figure 3 and are discussed further in the following subsections.

State System Mission. During the conceptual planning phase of a system, the functions and capabilities needed to satisfy a long-term operational need, capability, or service requirement are identified and structured. These functions and capabilities should be clear, concisely stated, and coupled to statements regarding the type/scope and extent of the missions that the system will support. Additionally, other existing or planned systems, known to the systems planner, that could or must work in close proximity or in conjunction with the proposed system, should be identified. This process of coupling the operational requirment or capability to statements of mission and necessary functions provide the planner with a means of arriving at the telecommunications needs of the system, as well as a meaningful basis for preparation of frequency requirement inputs for the conceptual stage of systems review. From the standpoint of those responsible for evaluation of system review inputs, a clear and detailed statement of system requirements/capability/mission must provide a comprehensive base for the review. This, in turn, will promote a more effective and timely review of the proposed system.

Define Telecommunications Requirements. If the mission were, for example, to provide combat readiness through continuing air coverage, subsystem functions of the telecommunications requirements type might include communications, navigation, identification, and electronic countermeasures. The specification of functions and capabilities, which the various subsystems and equipments must exhibit in order to accomplish the mission, leads directly to the identification of telecommunication needs. That is, one derives from the operational needs, 1) the mission, 2) system functions and capabilities, and 3) supporting telecommunications requirements. If the mission were one of worldwide communications, a telecommunications system of several satellites and associated earth stations might fulfill this requirement. The subsystem functions might detail such telecommunications specifics as frequency reuse through multiple

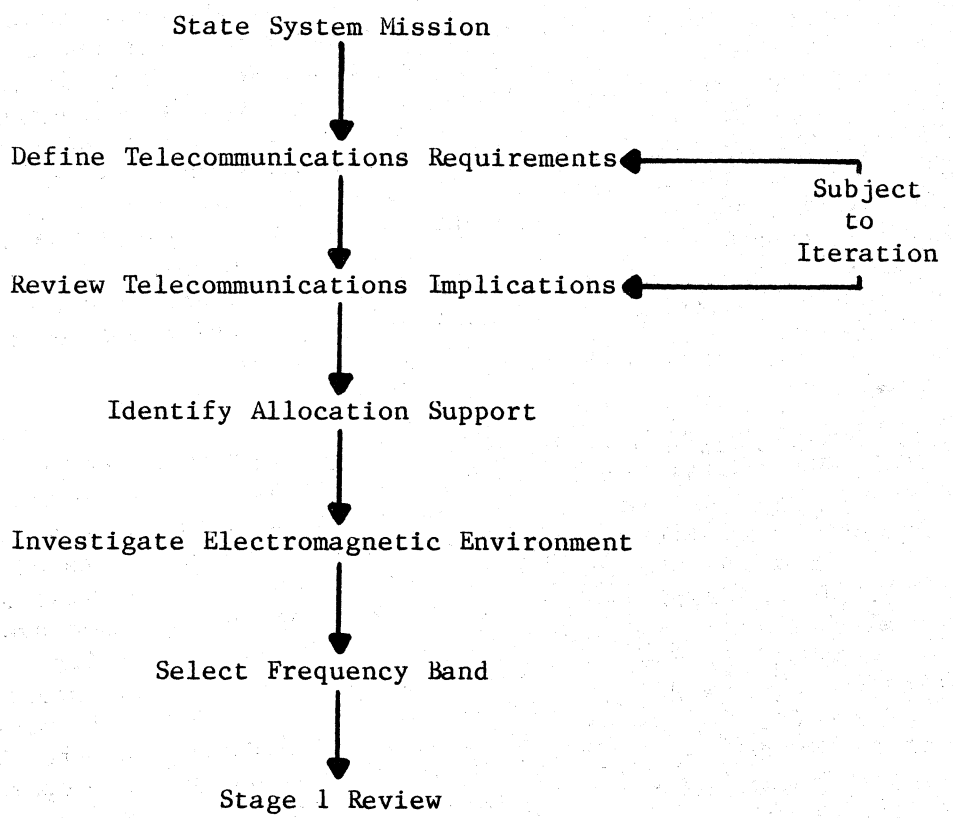


Figure 3. Agency Conceptual Planning Phases of Interest Prior to Submission of NTIA Stage 1 System Review Request

antenna area selection. Probable operating parameters should be established, including power requirements, modulation approaches, antenna types, expected duty cycles for telecommunication subsystems, class or type of information transmitted/received, priority or importance of the various telecommunication functions, and other factors deemed necessary to clearly articulate the proposed systems telecommunications requirements. Boundary parameters should be identified where absolute data values cannot be established.

Review Implications of Telecommunications Requirements. A review of telecommunications requirements should be conducted by the system planner. Numerous factors must be considered. Initially, a determination should be made if available off-the-shelf hardware/technology or commercially available systems can be employed to satisfy telecommunication needs. If developments leading to new hardware are required, it must be determined if this encompasses an extension of available techniques to meet the system's needs, or must state-of-the-art technique advances be achieved through research/experimentation before telecommunication needs can be satisfied. By overviewing system telecommunication requirements and the state of current technology, it may be evident that certain factors, (i.e., laws of physics, available equipment, technology etc.), would point to specific frequency ranges or bands that ideally satisfy requirements. It should be noted that telecommunications requirements and implications may be subject to an iterative process.

Identify Allocation Support. The identification of optimum frequency ranges and/or constraints must, however, be evaluated against existing national and international regulations and guidelines. When the optimum operating frequency bands have been selected, a review should be made of available bands for particular services in the U.S. Government Table of Frequency Allocations. This Table indicates the U.S. Government frequency allocation planning and the degree of conformity with the International Telecommunication Union frequency allocation table. Under exceptional circumstances and in the National interest, as consistent with obligations undertaken by the United States to other countries that may be affected, additional uses of frequencies in any band may be authorized to meet service needs other than those provided for in the U.S. Government Table. If a conflict exists, look for alternative frequency bands that conform with the U.S. Government table. Tradeoffs may have to be made between optimum bands/available bands and time/costs in developing equipment in new bands or getting a reallocation or both. Full justification appropriate to the severity of the situation will be required, if operations not in accordance with the U.S. Government table are contemplated. Operations to be conducted in foreign countries must consider the national tables of frequency allocation of those countries, as well as any agreements/understandings related to spectrum use by the United States with the countries involved or affected. Of particular concern are systems involving satellites.

Investigate Electromagnetic Environments. Knowing the technical requirements and implications and knowing the status of frequency allocation support, the electromagnetic environment can be investigated. Where possible and using available data, a general survey of the electromagnetic environment should be made. Consideration should be given to other occupants of the bands including other new systems being developed. Since the new system's impact in the environment depends on all of its operating parameters and those of competing

systems, all available information should be carefully considered in evaluating the potential electromagnetic interactions. These interactions should include the effects of the system on the electromagnetic environment as well as the effects of the electromagnetic environment on the new system. The impact on planned geographic areas of operations and, if appropriate, specific geographic locations should be included in this environmental review. The factors of time of utilization and duty cycle should also be clearly studied. Consideration should be given to both national and international impact. Conditions of utilization (peacetime, war or crisis) should also be examined for impact.

Select Frequency Band. Following a review of frequency band possibilities in the light of available information on the electromagnetic environment, several usable frequency bands may be apparent. Here, again, consideration should be given to tradeoffs with important development factors such as time and costs. When the tradeoff considerations have been made, it may be possible to narrow down the desirable frequency bands to those which will be most satisfactory under all the conditions reviewed to this point in the planning process. However, the system planner may prefer to select several possibilities with which to approach the conceptual stage review. In this case, the collective wisdom of the planning agency and the capability available through the review process would be used to make an optimum band selection.

Conceptual Planning Phase Summary. Clear statements of requirements and mission are needed, including subsystem functions, especially for the guidance and communication of systems planners. These should be pursued into telecommunication techniques, equipment characteristics, and resources required to support the mission. These, in turn, lead one to spectrum planning and analysis. Key areas treated separately here are listed in Figure 3 starting with system mission and going through the frequency band selection. If in-depth consideration is given to these areas in the conceptual planning phase, the systems planner will be well along to being prepared for the conceptual stage review. A list of spectrum management questions has been developed and is presented here in TABLE 4. By addressing each of these questions throughout the conceptual planning phase, the systems planner will be aided in his planning of the system as well as being better prepared for the conceptual stage review. While the questions have been designed to cover major areas of concern, they are not completely exhaustive and should be supplemented to meet the peculiarities of individual systems. In addition to the benefits described above, the system review process benefits the agencies by culminating in the NTIA carefully considered certification that space in the spectrum is available. This budget process requirement adds support to OMB consideration of continuing funding for the agencies as the system evolves.

TABLE 4

AGENCY CONCEPTUAL STAGE REVIEW PREPARATORY QUESTIONS

1. What operational capability will the proposed system provide? Based on its operational capability, what specific missions will be supported by the system and what functions must its various subsystems provide?

2. What are your telecommunication requirements needed to support the proposed mission? Consider such items as data rates, circuit quality/reliability, and others typical of the operational situation for required system and associated subsystem elements.

3a. Have you considered what existing Government or commercial system could meet your requirement?

3b. What systems will be replaced by the new system?

4. What signal and/or software approach is under consideration?

5. What techniques that use the radio spectrum will be necessary to support the telecommunications requirements? Consider such things as modulation characteristics, multiplexing characteristics, power requirements, antenna types, requirements for diversity, and other special techniques such as radar moving target indicator (MTI), waveform selection and coherent versus non-coherent design. Where specific values cannot be given, upper and lower bounds should be identified.

6. Has appropriate EMC consideration been given to the frequency tunability of the contemplated equipment/hardware?

7. Have you given consideration to factors such as the intrasystem implications on flexibility and EMC and the side effects on personnel and explosive materials?

8. Can off-the-shelf equipment be used or is new equipment necessary? Does this mean advancing the state-of-the-art in order to meet the telecommunications requirements?

9. Considering only technical factors, what are the idealized frequency bands or ranges that best support the telecommunications requirements?

10. Do the existing allocations provide for the services required by your system in the idealized frequency bands?

11. If there is no allocation support in the idealized bands, are there other appropriately allocated bands that could satisfy the telecommunications requirements?

TABLE 4 (CONTINUED)

AGENCY CONCEPTUAL STAGE REVIEW PREPARATORY QUESTIONS

12. What are the penalties in terms of time, cost and performance associated with the available frequency allocation alternatives?

13. In what areas or at what locations will the proposed system be deployed?

14. Has due consideration been given to the electromagnetic environment including: (1) idealized versus available frequencies and (2) tradeoffs of time, cost, and performance? Does this study support a rationale for band selection? Are there any system limitations that may be imposed by electromagnetic environment factors?

15. Considering the effects of tradeoffs and environmental factors, what band selections have been made, and what rationale has been used to support the selections?

16. After considering the preceding questions, consider whether the data requirements associated with Section 8.3 of the NTIA Manual on the system conceptual stage review can be satisfied. If these requirements cannot be met in a timely manner, what else is needed?

SECTION 4

AGENCY EXPERIMENTAL STAGE REVIEW PLANNING

The system planner must determine whether or not experimentation is a necessary part of the planned system development. In this regard, the results of the stage 1 system review may require experimentation to test or include EMC concepts. In the first phase, concept definition has occurred and significant system definition data have been formulated. This second phase is concerned with experimentation planning that supports the development of an operational telecommunication system or efforts to establish the feasibility of such a system or subsystem. The experimental phase usually involves consideration of new techniques and equipments or the testing of existing equipment for use in new operational modes. Where the first phase was more involved with outlining system characteristics, the second phase reviews the characteristics in more depth and detail, and normally involves identification of specific frequency assignment requirements that are desired for experimental testing. To adequately prepare for the experimental stage review, a number of key areas should be carefully considered. Appropriate areas to be considered are shown in Figure 5 and are discussed further in the following subsections.

Identify Systems Aspects Requiring Experimentation

If the system planner has determined that experimentation is necessary or if the stage 1 system review requires EMC testing, those systems aspects requiring experimentation/tests need to be identified. This experimentation planning may involve new techniques and equipments, or it may involve the testing of existing equipment for use in new operational modes or configurations. Telecommunications characteristics for those system aspects needing experimentation should be detailed, and an experimental/test plan of action for each of these areas should be prepared. Under consideration could be systems covering a range of applications and complexities, e.g., land mobile communications where new techniques are employed, new elements of existing space systems that encompass small earth terminals, microwave links employing new technology, or complex space and defense systems under consideration.

Detail Alternative Telecommunications Requirements

In cases where experimentation is determined to be appropriate in the process of defining and configuring a telecommunications system, specific characteristics of the various subsystems to be involved in the ensuing experimentation should be established insofar as possible. Ranges of parameters and/or alternative characteristics should be identified as a basis for investigation, i.e., signal processing techniques, ranges of equipment parameters, alternative operational configurations, special circuitry and the like. Similarly, characteristics or ranges of designs required by experimentation for the purpose of determining system feasibility need to be established.

The identification of key requirements and characteristics will provide a sound basis for realistic experimentation. In addition, it will furnish data

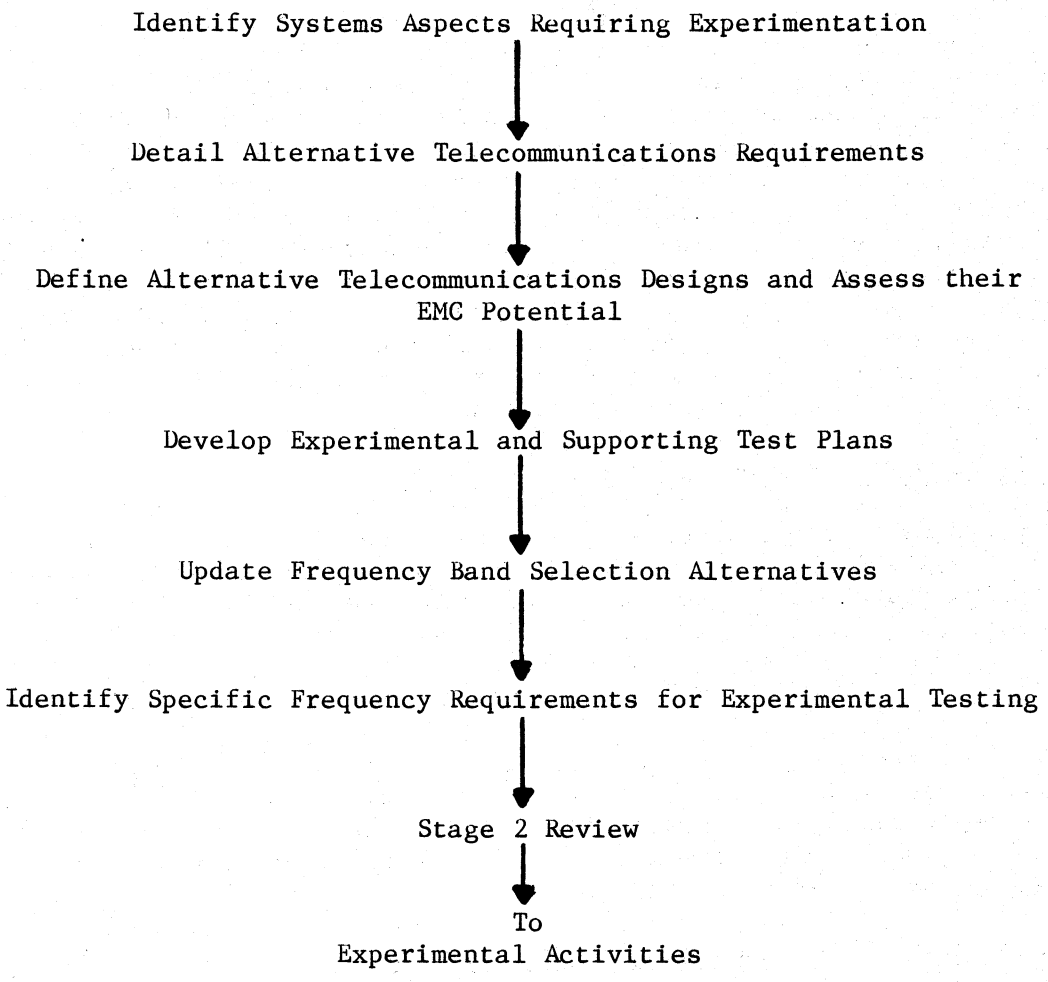


Figure 5. Agency Experimental Planning Areas of Interest (Looks to Development or feasibility)

required to support the stage 2 experimental system review, as required under Part 8.3 of the NTIA Manual.

Define Alternative Telecommunication Designs and Assess Their EMC Potential

In this phase, planning consideration is given to experimentation required to support development of the telecommunication system/subsystem or to establishing its feasibility. Alternative telecommunication approaches and associated ranges of parameters and alternative characteristics may be defined. These new approaches may lead to alternative telecommunications designs which require definition and assessment regarding their EMC potential. During the actual experimenting, other telecommunications factors may surface that require EMC assessment.

For example, during the phase 2 experimental planning, it may be determined that available off-the-shelf hardware or technology cannot be employed to fully satisfy telecommunication needs. It may further be determined that new hardware or developments that encompass an extension of available techniques are necessary to meet the system's needs, or that state-of-the-art advances must be achieved before telecommunication needs can be totally satisfied. Factors must be considered during the experimentation planning phase affecting system design, spectrum needs and EMC implications.

Develop Experimental and Supporting Test Plans

During the experimentation planning, particular attention should be given to the identification of factors that affect spectrum requirements for the system. Such factors as total bandwidth requirements, channel separation needs, any internal systems factor that affects frequency assignment flexibility, and EMC relationships to other major systems that occupy the same or adjacent bands would be of value in assessing the systems during the experimental stage review.

Update Frequency Band Selection Alternatives

Idealized frequency ranges and/or constraints must be continually evaluated against existing national and international guidelines, rules, and regulations. In this experimental planning phase, the frequencies specified during the conceptual stage review are evaluated and modified as appropriate as more detailed needs regarding alternative telecommunications requirements and designs are assessed. That is, the results of experimentation planning and the effect of possible frequency changes are considered, identified and justified. Selected frequency bands then are subjected to tradeoffs with development factors such as time and costs. At this point in the agency experimental phase planning, it may be possible to narrow down the desirable frequency bands to those most satisfactory in order of priority.

Identify Specific Frequency Requirements for Experimental Testing

The experimental planning phase has progressed to the point where those aspects of the system requiring experimental verification have been identified, associated telecommunication requirements and characteristics specified, alternative designs (if appropriate) developed, test plans generated, and frequency band selections updated and finalized to the extent possible. This

leads to the identification of specific frequency requirements needed to support the experimental activities. The identification of specific frequencies or bands of frequencies should be developed by the agencies for consideration during the experimental stage review. The degree of thoroughness associated with these planning efforts is dependent on the resources and capabilities available to the individual agencies. When these resources are limited, advantage should be taken of the analytical support available through the system review process in finalizing the solution of experimentation frequencies.

Experimental Planning Phase Summary

The experimental phase is concerned with experimentation planning that looks toward the development or feasibility of an operational telecommunication system or subsystem. It may involve new techniques for equipments or increased spectrum usage. In proceeding through the experimental planning phase, work starts with the consideration of all changes brought about by the conceptual stage review. These are incorporated in the experimental planning phase where more in-depth investigation into the system characteristics is carried out.

This phase encompasses a detailed review of the telecommunications requirements and designs, an updating of the frequency band selection alternatives, and the identification of specific experimental frequency requirements. This leads to the submission of appropriate data to support the experimental stage review. Satisfactory completion of this review results in the granting of frequency support. Frequency assignments for experimentation can be assigned, experimentation effort can then be conducted, system concepts tested, designs refined, feasibility identified, and system development planning can proceed in preparation for the stage 3 developmental review, as detailed in the next section.

A list of questions applying to the experimental phase are listed in TABLE 6.

TABLE 6

AGENCY EXPERIMENTAL STAGE REVIEW PREPARATORY QUESTIONS

1. Have changes been made from previously submitted data? If so, what are they?

2. What are the systems aspects which you have identified as requiring experimentation, and what are the associated telecommunications characteristics?

3. Have you specified in detail the alternative telecommunications requirements?

4. What signal and/or software processing philosophy techniques are now under consideration?

5. Has due consideration been given to EMC potential of alternative telecommunications designs to be investigated?

6. Has appropriate EMC consideration been given to the frequency tunability of the contemplated equipment/hardware?

7. Have you given adequate consideration, during the experimental stage planning to factors such as the intra-system implications on flexibility and EMC and the side effects on personnel and explosive materials?

8. Have all factors been identified that affect spectrum requirements and EMC, including those identified in the Stage 1 Conceptual System Review?

9. Have pertinent economic tradeoffs with respect to spectrum use been identified?

10. Are you including spectrum considerations in any request for procurement (RFP) preparation?

11. In updating the frequency band selection alternatives in this experimental phase, what frequency bands were found most satisfactory, in priority order?

12. Are there other studies available regarding the frequency selection process preparatory to filing for frequency support of the system?

13. After considering the preceding questions, consider whether the data requirements associated with Section 8.3 of the NTIA Manual on the experimental stage 2 system review can be satisfied. If these requirements cannot be met in a timely manner, what else is needed?

SECTION 5

AGENCY DEVELOPMENT STAGE REVIEW PLANNING

Depending on its design complexity, a telecommunications system may proceed directly from the conceptual stage review to the agency development planning phase. Some systems will require experimentation, while others, because of the ready availability of suitable equipment, will go directly to the operational phase. In this section, consideration is given to the first two types of systems, i.e., conceptual system review to development system review and experimental system review to development system review. Stage 3 system review occurs prior to the main development actions, i.e., normally three to nine months before actual concentrated development. During this period, efforts proceed from the technological base developed during the agency experimental and/or conceptual planning phases, including results of NTIA system reviews, and the system is examined in more depth and detail. During the agency development planning phase, proposals can be solicited and evaluated, and definition contracts awarded. Work is performed which leads to a system design that satisfies a stated operational need including spectrum support requirements. A number of key EMC areas should be carefully considered to prepare adequately for the NTIA stage 3 development stage review. Areas appropriate to this review stage are shown in Figure 7 and are discussed further in the following subsections.

Identify Systems or Subsystems Aspects that Require Development

During the development planning phase, systems or subsystems aspects that require development should be identified. For those systems proceeding from the experimental phase, experimental models or configurations may have been produced that require substantial engineering effort during the development phase to yield a prototype system or subsystem. Towards this goal, an analysis of data collected during the Experimental Phase could be used to aid in the identification of system or subsystem telecommunications aspects that require the most attention during the planned development activities. Similarly, for systems/subsystems coming directly from the conceptual stage review, sufficient data should be available or could be developed during the development planning phase activities to predict where development should be directed.

Analyze Results of Any Design Changes Made Subsequent to the Initial Planning Stage for effects on Overall System Configuration

Design changes developed subsequent to the conceptual stage review or those which evolve as the development planning phase progresses, should be analyzed for effects on the overall system configuration. As the life cycle proceeds, changes in the system design can occur. For example, changes in coverage areas, signal formats, technological advances/limitations, deployment constraints, siting restrictions, operational requirements, etc., can all occur as the system evolves. The effect of these changes on the overall system configuration must be identified and assessed. This assessment would be primarily directed towards developing the clearest definition possible of what the system configuration will be, any internal constraints with regard to EMC and spectrum utilization that this configuration will impose, and defining the systems radiated signal structure, within the dimensions of frequency/power/time. An accurate definition

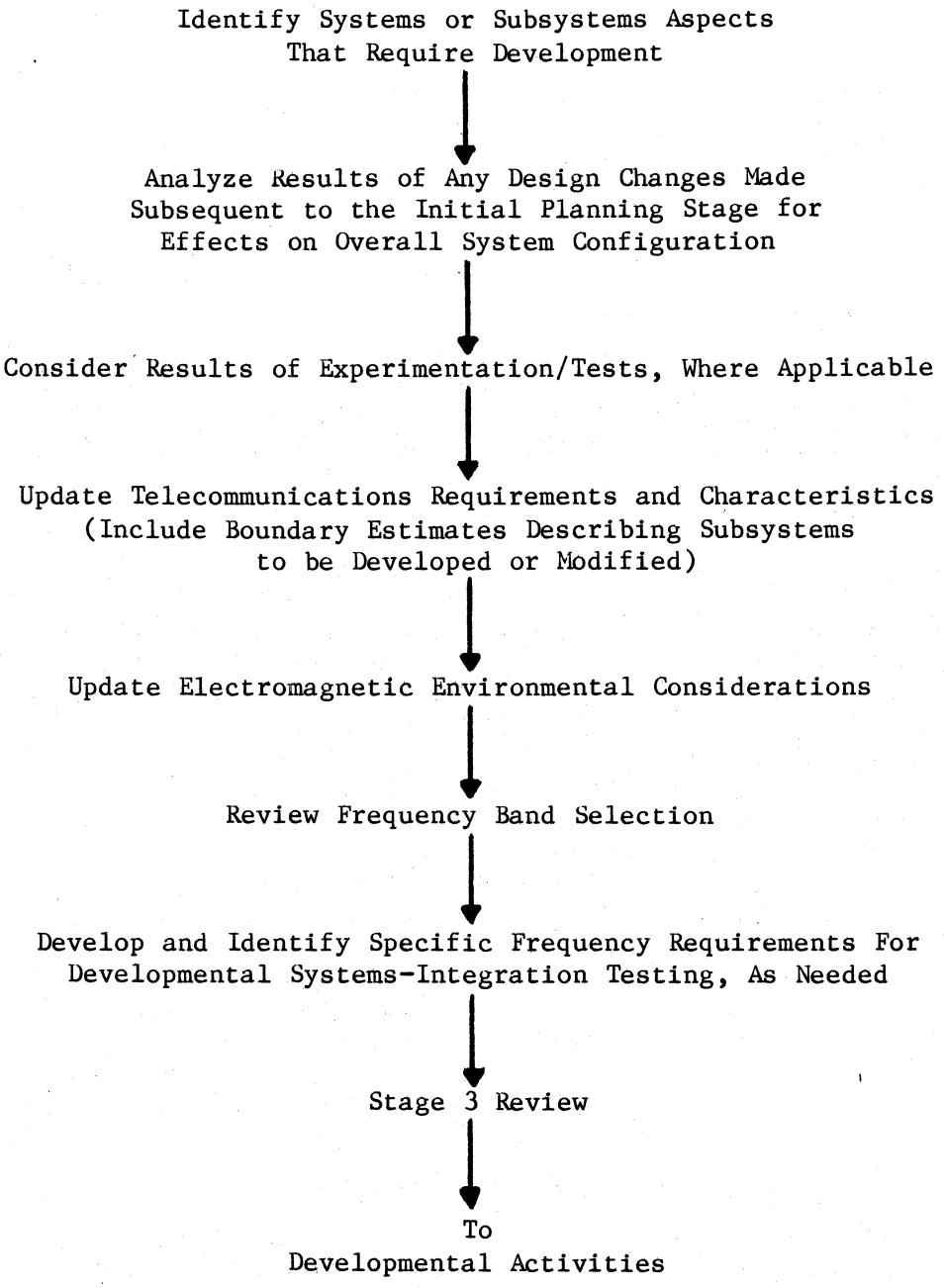


Figure 7. Agency development planning phase Areas of Interest (Prior to and During NTIA Stage 3 System Review Proceedings)

of the systems configuration will form the basis for subsequent investigations dealing with environmental factors, frequency band selection updates, and frequency requirements to support developmental activities.

Consider Results of Experimentation Where Applicable

Where available, the results of experimentation should be considered as they apply to meeting EMC specifications, defining system characteristics, and configurations. This information can be used to support or validate analytical studies regarding system performance, constraints, and design tradeoffs. Consideration of experimental data generalized during the experimental and/or developmental Phase of the system life cycle will significantly aid subsequent EMC-related analysis activities.

Update Telecommunications Requirements and Characteristics (Include Boundary Estimates Describing Subsystems to be Developed or Modified)

Due to modifications identified through the continuing experimentation with and development planning of the original system design, updating of the telecommunications requirements and characteristics may be necessary. This should include boundary estimates of characteristics and related telecommunication requirements for subsystems to be developed or modified. These changes must be considered in an updated system design which should be assessed from EMC and regulatory standpoints. Changes in resources, operational needs, and time constraints can manifest changes in telecommunication requirements. For example, the initial design for a system may have dictated the use of several satellites to provide worldwide communications; however, for reasons of economy and time, the modified system may use a combination of terrestrial microwave and ocean cable to satisfy a limited subset of the original requirements. Similarly, if the original system were to satisfy a requirement to communicate between rooftops of two large buildings spaced several miles apart, a laser or optical system might be preferred to the original microwave system. Both of these examples illustrate how changes in design brought about by time, money, technology, or other factors can significantly change a system's telecommunications requirements and characteristics. Where major changes are contemplated or anticipated, it is necessary to reexamine the system telecommunications requirement needs and restate or modify them as appropriate.

Update Electromagnetic Environmental Considerations

The improved system resulting from changes introduced by the experimentation needs to be updated with respect to the electromagnetic environment effects. Here, all system parameters should be considered, and the effects of the electromagnetic environment on the system should be considered along with the effects of the system on the environment to the extent that data availability and agency resources permit. In most instances, this effort should be directed towards an update of activity started during the conceptual planning phase. As appropriate, those agencies with limited capabilities in this area can take advantage of the analytic support provided within the framework of the system review process.

Review Frequency Band Selection

At this point in the development planning phase, it is appropriate to review the frequency band selection. A system in this present state of design has been subjected to significant review. The present system configuration is the most current available; it represents the best design to date, and further changes are expected to be minor. Hence, it is now possible to review the existing frequency band selections with the intent of making a final selection or narrowing the choice to a very limited number of options for development of a system intended for operational use. The basis for advancing various bands or options must be technologically justifiable, and consistent with national and international rules and regulations. In those cases where the bands proposed are not in accordance with national and international rules, a statement is needed from a responsible agency official indicating that he understands and commits the agency to comply promptly with the rules if interference is caused or received. Full justification must be provided if operations are to be conducted in contravention of national/international rules.

Develop and Identify Specific Frequency Requirements for Developmental Systems-Integration Testing, As Needed

There may be a need at this point for specific frequencies to support developmental systems-integration testing. These frequencies should be selected from those technologically justifiable bands or limited options considered in 5.6. The area for systems use should be given due consideration in frequency selection. Agencies should do the coordination that leads to frequency selection. Agencies may take advantage of the analytic services provided in the system review process. With these considerations, final recommendations for specific frequencies for systems-integration testing should be possible.

Development Planning Phase Summary

The development phase includes work on new systems and subsystems done subsequent to the experimental stage review and up to six months prior to commencement of the principal development actions. Experimentation planned in the experimental phase of planning takes place during the planning of the development phase. Systems/subsystems aspects requiring development are identified, design change results are analyzed for effects on system, and experimentation results are considered. Telecommunications requirements and characteristics and electromagnetic environmental considerations are updated. Frequency band selections are reviewed, and frequency requirements for development systems-integration testing are determined and identified.

A list of questions applying to the Development Phase is itemized in TABLE 8. These questions should be answered prior to the development stage review in order to be adequately prepared for the review.

TABLE 8

AGENCY DEVELOPMENT STAGE REVIEW PREPARATORY QUESTIONS

1. What changes have been made from previously submitted data?

2. What are the systems or subsystems aspects which you have identified that require development?

3. Have you made proper adjustments as a result of your experimentation? What were the effects on the overall system configuration?

4. In previous work have you done enough to consider intermodulation, unwanted emission, EM coupling, emission spectrum, antennas, receiver, and signal processing requirements and/or limits?

5. Do the EMC specifications at which you have arrived comply with prevailing standards and criteria? Can any differences be justified?

6. Have you identified the areas of your current system design where the system performance may be degraded due to the EM environment and will electromagnetic interference (EMI) problems be created in the other systems?

7. Based on your planning experience, have you identified any basis for modifications of EMC/EMI standards?

8. Have you defined the plans to do the special tests, measurement techniques, and simulation efforts that will aid in validating design?

9. In your development phase consideration of frequency band selection, how have the frequencies changed from the previous stage review? How were these technologically justified?

10. What specific frequency requirements were identified for development systems-integration testing?

11. After considering the preceding questions, consider whether the data requirements associated with Section 8.3 of the NTIA Manual on the system development stage review of the system can be satisfied. If these requirements cannot be met in a timely manner, what else is needed?

12. If the system must be operated not in accordance with national and international rules and regulations, have the proper authorities in your agency been advised of the implication of such use?

SECTION 6

OPERATIONAL STAGE REVIEW PLANNING

The operational stage review is initiated a minimum of six to 18 months prior to the commencement of procurement actions. During the operational planning phase, a number of key EMC areas are considered in depth in order to prepare for the operational stage review. Those EMC areas are shown in Figure 9 and are discussed in the following subsections.

Update Systems or Subsystems Aspects Required for Systems Operational Planning

Systems can enter this operational phase directly from the conceptual, experimental, or development stage reviews. As a result of these earlier stage reviews, decisions may have been made and conditional agreements reached which require that system or subsystem aspects be updated. This could include changes in such items as configuration, improved solid state componentry, new and more advanced subsystems, deployment restrictions, etc. These and other aspects that affect the systems design, application, or deployment must be updated as part of the operational planning phase and form the basis for subsequent procurement actions.

Proceed With Systems Operational Planning Using Experimentation and Prototype Telecommunications Results, as Appropriate

In addition to early updating of systems/subsystems aspects resulting from the decisions and conditional agreements made in earlier stage reviews, other telecommunications design information and systems data developed during the experimental and/or developmental phases must be utilized during the operational planning phase. Here the basic foundation of the system based on all earlier phases, some of which may have encompassed prototype testing and evaluation, will be utilized to specify refinements and provide quantitative inputs to the operational planning. The use of empirical and experimentally derived data during the operational planning activities will significantly enhance the final specifications for the system as well as the quality and thoroughness of the data submitted for the operational stage review of the system.

Include Changes in Telecommunications Requirements and/or Characteristics as System Life Cycle Has Progressed Towards Operational Use

During the early part of the operational planning phase, efforts have been made to consider the results of previous stage reviews and appropriate experimental and developmental data. During the operational planning phase process, these data must be carefully reviewed to assure that consideration is given to direct and implied changes in system telecommunication requirements and/or characteristics. It is essential that changes be identified and clearly stated prior to the operational stage review and other actions that precede system procurement. For major system procurements that encompass "fly-before-buy" concepts, it must be recognized that changes in telecommunication needs can occur during this process. Hence, as data on the test and evaluation models become available, it must be assessed relative to telecommunication needs and be subjected to an operational stage review prior to final procurment action.

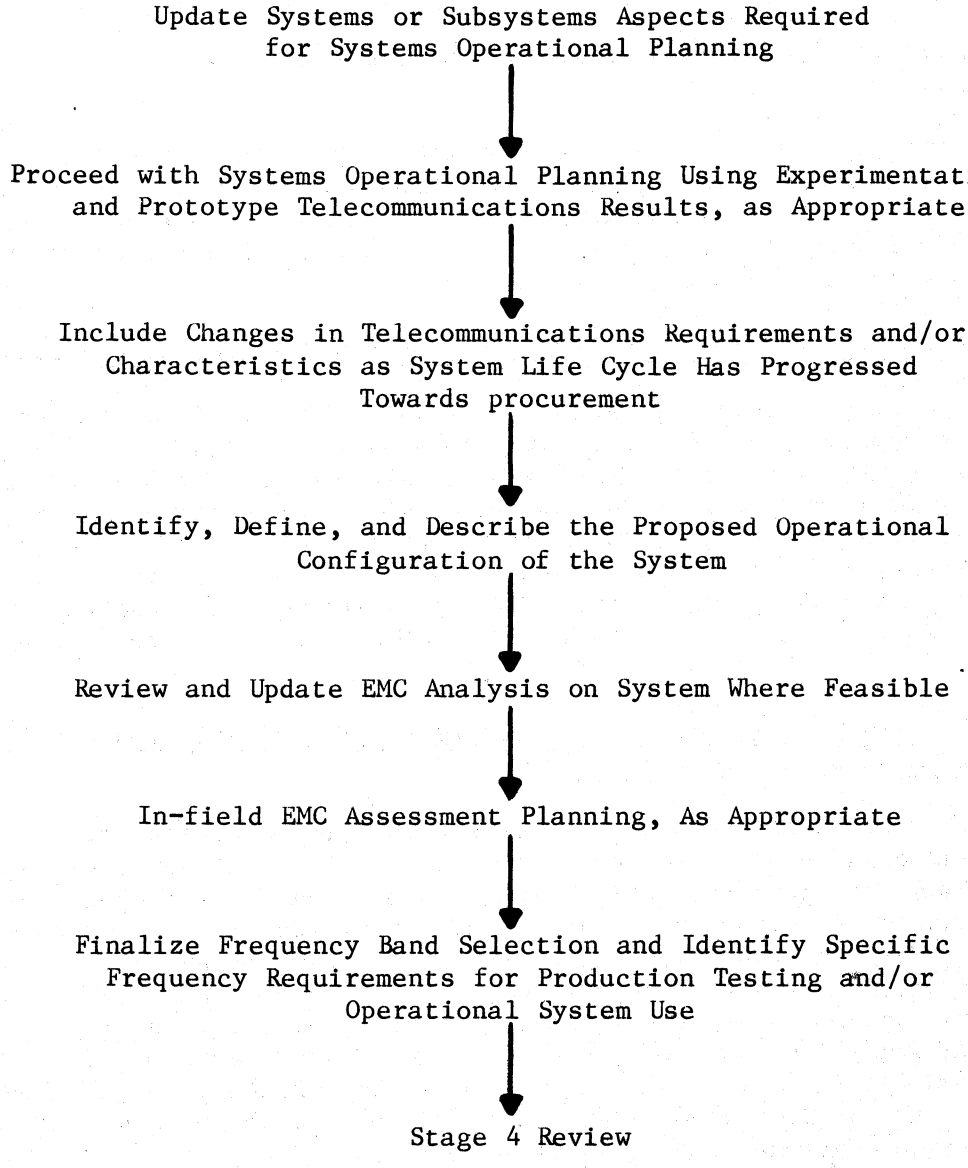


Figure 9. Agency Operation Planning Phase Areas of Interest (Prior to and during NTIA Stage 4 System Review Proceedings)

Identify, Define, and Describe the Proposed Operational Configuration of the System

It is appropriate at this point in the operational phase to have a clear understanding of what is being proposed for the operational configuration of the system. A special effort should be made to identify and define the specifics of this operational configuration, i.e., station locations/areas of proposed operation, subsystems relationships, hours/duration of intermittent operational periods, altitudes or orbital characteristics where appropriate, and any other significant operational peculiarities having a significant influence on the spectrum sharing potential of the system. Such description of the proposed operational configuration of the system needs to be prepared for the operational stage review.

Review and Update EMC Analyses on System

Of the four stages of review and corresponding phases, the operational phase requires the most in-depth and far-reaching consideration of a systems EMC aspect. During the operational planning phase, any available previous EMC studies should be reviewed and updated as appropriate. Consideration should be given to new data regarding frequency band options, electromagnetic environment effects, siting evaluations, EMC standards or specifications, electromagnetic hazard and natural environment evaluations, areas of deployment, etc. Through consideration of such factors, it will be possible to upgrade and fine-tune the systems review submissions and aid significantly in developing specifications for the first production systems and/or evaluating "fly-before-buy" models. It is recognized that the EMC analysis and review efforts required for a system are highly dependent on its scope, breadth, and availability of data, as well as on the availability of agency resources. As appropriate, those agencies with limited capabilities in this area should take advantage of the analytic support available within the NTIA framework supporting the system review process.

In-the-Field EMC Assessment Planning, as Appropriate

During the operational planning phase, several technical approaches can be considered that will lead to operational EMC assessments. One approach encompasses analytic EMC studies that employ a combination of theoretical and measured data that are collected on the system as the life cycle proceeds. A second approach would employ computer simulation of the system in its in-field environment where the actual system is subjected to laboratory constructed test gear that emulates a range of electromagnetic environmental conditions. If a "fly-before-buy" concept to system development has been employed, the pre-production model could be transported to its proposed operational site, or reasonable facsimile thereof, and be subjected to and evaluated under real in-the-field electromagnetic conditions. In the cases of EMC studies, fly-before-buy evaluations, or computer simulations where incompatibilities have been identified, coordination should be effected with those agencies involved. NTIA also should be made aware of such problems before (where possible) and during the system stage 4 review. The particular technical approach selected by an agency depends, among other things, on time, cost, and its assessment of the need for this level of activity. It is anticipated that major high cost and technology systems developed by DOD and NASA, for example, might justify this level of activity.

Finalize Frequency Band Selection and Identify Specific Frequency Requirements for Production Testing and/or Operational Use

In the previous phases, it was possible to reassess and review the existing frequency band selections with the intent of narrowing the choice to a very limited number of options. Based on data collected during the system life cycle to date, decisions regarding specific operating bands should be made after suitable analysis. Included as part of the systems review submission should be specific recommendations for frequencies to support needs of the system when it is operationally deployed. During this timeframe, changes in operational and/or test frequency needs must be continually monitored to assure that unanticipated EMC problems do not develop and that appropriate action is taken to assure continuing frequency support. Here again, those agencies with limited capability in the EMC analysis area should take advantage of the analytic service provided within the NTIA framework supporting the systems review process.

Operational Planning Phase Summary

The operational planning phase involves all systems definition and EMC work done on the system prior to the operational phase review. The previous reviews can be any or all of the three other stage reviews, depending on the complexity of the system under consideration. In the operational phase, the system is updated utilizing experimentation, prototype, and development results, as appropriate. Changes in telecommunications characteristics and requirements are specified as the system life cycle progresses toward a first-production model. Efforts are concentrated on the most thorough EMC analysis and review of system telecommunication requirements to date. The operational frequency band selections are finalized, specific frequency requirements are identified for the production and/or operational system(s), and deployment data is finalized to the extent possible.

Again, as in previous phases, a list of questions is included in TABLE 10. These questions should be considered prior to the operational stage review in order to be adequately prepared for the review. The operational stage review normally is initiated six to 18 months prior to the commencement of production procurement actions.

TABLE 10

AGENCY OPERATIONAL STAGE REVIEW PREPARATORY QUESTIONS

1. What changes have been made from previously submitted data?

2. What aspects of the system telecommunication design require updating before data can be submitted in support of the operational stage review?

   (a) Have basic technical characteristics been clearly defined, i.e., transmitted power, emission characteristics (bandwidth, modulation, data rate), antenna orientation and directivity, receiver characteristics (sensitivity, selectivity, etc.)?

   (b) Have all special technical characteristics that are peculiar to the proposed system which have a potential influence on EMC been adequately specified and described, i.e., complex modulation schemes, filters, special receiver circuitry, signal processing, etc.?

3. Have you considered and evaluated all data developed during the previous phases of the systems life cycle in finalizing the telecommunications requirements and/or characteristics?

4. Has a review of previous EMC analyses been conducted? Are they still current or are additional studies required to assess changes in system design, deployment, and other factors?

5. Have you considered specifying equipment tests to identify and validate performance aspects and susceptibility features of the total system to EMI as determined in previous and updated analyses? Have both static and dynamic electromagnetic environments been considered?

6. What in-field EMC assessment techniques are being considered to support procurement and deployment planning for the system? Items such as frequency assignment aids, equipment usage aids, grading of performance, measurement programs, EMC maintenance procedures for use in-field, should be considered.

7. Have you considered the following questions?

   (a) Has a discrete frequency plan been proposed? Or,

   (b) Has a quantitative frequency requirement been defined within a specified band or bands?

   (c) If the answer to (b) is affirmative, have channeling limitations, transmit/receive separation, and other pertinent limitations and system peculiarities been defined?

TABLE 10 (Continued)

AGENCY OPERATIONAL STAGE REVIEW PREPARATORY QUESTIONS

(d) With respect to (a) and (b), have all known factors potentially affecting intersystem and intrasystem compatibility been considered?

8. Have deployment data for the system(s) been developed? Will the system be mobile, transportable, and/or fixed?

9. How many systems/stations/facilities will be produced?

10. Where will the system be tested and operated?

(a) Have locations been identified for fixed systems or subsystems?

(b) Have proposed operational areas been identified for transportable or mobile systems or subsystems?

(c) Have operational altitudes and orbital locations and characteristics been identified for airborne and satellite borne systems as applicable?

11. Have operational modes and peculiarities of the proposed system been defined and stated [i.e., hours duration of intermittent periods of operation, unit/area density and the like (establish boundary conditions where appropriate)]?

12. If appropriate, how are user personnel to be educated in use of EMC procedures and techniques developed for use with the system?

13. After considering the preceding questions, consider whether the data requirements associated with Section 8.3 of the NTIA Manual on the operational stage review of the system can be satisfied. If these requirements cannot be met in a timely manner, what else is needed?

14. Has consideration been given to the security implications of registering the frequency assignments to the ITU?

15. Has adequate participation by agencies having systems competing for the same spectrum been included in your EMC studies, measurements, and analysis?

SELECTED BIBLIOGRAPHY

1. Air Force Systems Command Design Handbook 1-4, Electromagnetic Compatibility, Third Edition, January 5, 1975.

2. Department of the Army Pamphlet No. 11-13, "Army Electromagnetic Compatibility Program Guide", March 1975.

3. ECAC Electromagnetic Compatibility (EMC) Analysis Handbook, ECAC-TN-78-005, 1978.

4. Hiebert, A. L., and S. A. Scharff, "An Electromagnetic Compatibility Program for the 1970s", R-1114/1-PR, Rand Corporation, August 1974.

5. Janoski, J. R., Department of Defense, ECAC, "Electromagnetic Environment Considerations in the Conceptual Phase of C-E Development", February 1973.

6. Jansky and Bailey, Engineering Department, Atlantic Research Corporation, Interference Notebook, TR-66-1, Rome Air Development Center, Rome, NY, June 1966.

7. National Aeronautics and Space Administration, Radio Frequency Interference Handbook, NASA SP-3067, 1972.

8. NAVAIR EMC Seminar, 1972.

9. Naval Air Systems Command Electromagnetic Compatibility Manual, NAVAIR 5335.

10. NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management, May 1983.

11. OMB Circular No. A-11, Revised, Transmittal No. 51, "Preparation and Submission of Budget Estimates", June 15, 1983.

12. OMB Circular No. A-76, "Policies for Acquiring Commercial or Industrial Products and Services Needed by the Government", March 29, 1979.

13. OMB Circular No. A-109, "Major System Acquisitions", April 5, 1976.

14. OMB Circular No. A-120, "Guidelines for the Use of Consulting Services", April 14, 1980.

15. Parlow, R. D., E. R. Freeman, and H. M. Sachs, "An Intrasystem Compatibility Analysis Program (ISCAP)", ESD-TR-261, Electronics Systems Division (AFSC), L. G. Hanscom Field, Bedford, MA, June 1970.

16. Report to the Congress: Proposal for a Uniform procurement System, OMB, OFPP, October 1980.

17. Whitehead, J. B., "DD Form 1494-Preparation Guide", ECAC-CR-81-100, IITRI Consulting Report for USACECOM, 1981.

APPENDIX A

EXAMPLES OF DOCUMENTS RELATING TO A STAGE 4 SYSTEM REVIEW

For Agenda

SPS-9997/1-1.14.10

Date October 23, 1981

REPLY TO
ATTN OF

SUBJECT Stage 4 Submission for Fixed-Microwave System

TO Secretary
Spectrum Planning Subcommittee
National Telecommunications and
Information Administration

The Department of _____ submits the attached subject system for certification of spectrum support by the Spectrum Planning Subcommittee in accordance with Section 8.3 of the National Telecommunications and Information Administration Manual. This system supports Department wartime and emergency functions.

The Department requests that conflicting systems with other agencies that support war emergencies be identified for resolution at an appropriate higher management level.

Department
SPS Representative

Attachment

B1. Submission of System to SPS.

IN REPLY
REFER TO:

MEMORANDUM FOR CHIEF OF RADIO AND ELECTRONICS ENGINEERING, AD-642

SUBJECT: REQUEST FOR FREQUENCY SPECTRUM SUPPORT FOR FORT PECK - Havre MICROWAVE SYSTEM

In accordance with paragraph 8.3.7 of the Manual of Regulations and Procedures for Federal Radio Frequency Management, the following data is submitted for approval of a proposed microwave system between Havre and Fort Peck, Montana.

1. Stage of review requested: Stage 4 Analysis
2. Purpose of the system: This system will support the following operations:

   a. Supervisory Control and Data Acquisition (SCADA) and Energy Control System (ECS) associated with power system operation.
   b. Relay protection circuits.
   c. Automatic power generation control circuits.
   d. Operational voice and data circuits between dispatch/control centers and Area Office.
   e. Radio system control channels which provide communications between dispatch/control centers and maintenance crews at substations and on the transmission line.

3. Information Transfer Requirement: This system will use frequency modulated, 120-channel microwave equipment. All radio links will use the Government two gigahertz band. Fade margin for each radio link is designed for 40 dB to provide a propagation reliability of 99.999 percent. A signal-to-noise ratio of 30 dB was specified as minimum circuit quality in the design of this microwave system. The maximum data transmission rate for data circuits will be 9600 baud. System loading will consist of 50 percent data channels and 50 percent voice channels.

4. Estimated termination date: N/A

5. Estimated initial system cost:

Radio and multiplex equipment:	$835,000
Installation and construction:	45,000
Total system cost:	$880,000

An A-76 cost comparison demonstrates a savings with Government ownership versus leasing the required services. Operationally, it is imperative these circuits be under Government control to ensure the integrity of the power transmission system.

6. Target dates:

   Frequency Spectrum Approval: March 1982
   Completion of System Installation: October 1982
   Required Operational Date: March 1983

7. System relationship and essentiality: The Fort Peck - Havre microwave system is required to support the construction and operation of the Fort Peck - Havre 230 kV power transmission line. The microwave system will supply the communication circuits for supervisory control, data acquisition, relaying, and energy control functions. Additionally, the system will support vhf control channels for mobile radio communications necessary for transmission line and substation maintenance. Construction and installation of the microwave system will occur in the summer of 1982 in order to support transmission line construction which will start in the spring of 1983. Installation of this microwave system is required to provide the reliability and integrity of the power transmission system.

8. Replacement information: Existing point-to-point vhf radio links which will be replaced include:

LINK	FREQUENCIES
Fort Peck/Saco, Montana	164.775/165.5125 MHz
Saco/Rocky Boy, Montana	163.025/170.075 MHz

9. System interface: The proposed system will tie into the existing Fort Peck District, Montana, vhf radio system at Havre and Fort Peck.

10. Attachments: The following attachments are included with this letter:

    a. Summary of site data
    b. Line diagram showing site locations, direction of transmission and proposed frequencies. All proposed sites are FXR.
    c. Summary of radio equipment characteristics.
    d. OT-33 Form
    e. OT-34 Form
    f. OT-35 Form

11. It is requested that spectrum support _____ _____, conflicting spectrum requirements during war emergencies to be resolved bilaterally between affected agencies.

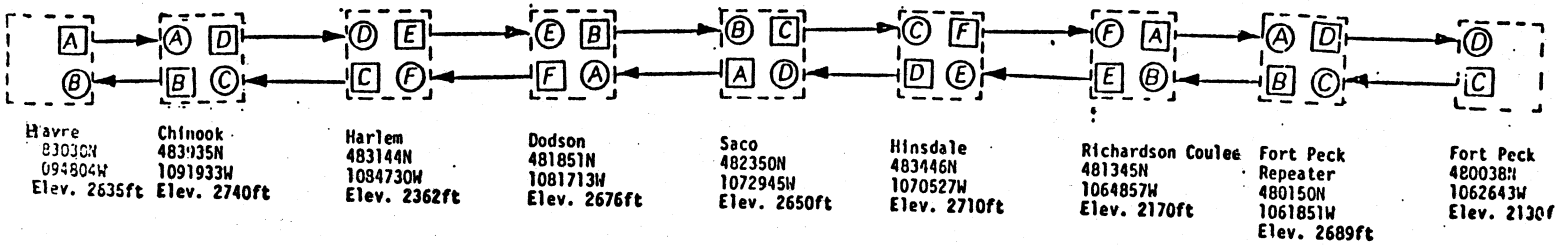
Chief, Telecommunications

SUMMARY
of
SITE DATA

LOCATION	FREQUENCY	LATITUDE	LONGITUDE	ELEVATION	ANTENNA HEIGHT	AZIMUTH
Havre to Chinook	1764	483030N	1094804W	2635	115	064
Chinook to Havre	1815	483935N	1091933W	2740	190	244
Chinook to Harlem	1804	483935N	1091933W	2740	190	110
Harlem to Chinook	1754	483144N	1084730W	2362	75	290
Harlem to Dodson	1744	483144N	1084730W	2362	75	123
Dodson to Harlem	1792	481851N	1081713W	2676	190	303
Dodson to Saco	1815	481851N	1081713W	2676	80	081
Saco to Dodson	1764	482350N	1072945W	2650	10	261
Hinsdale to Saco	1804	483446N	1070527W	2710	50	235
Saco to Hinsdale	1754	482350N	1072945W	2650	10	055
Hinsdale to Richardson Coulee	1792	483446N	1070527W	2710	150	151
Richardson Coulee to Hinsdale	1744	481345N	1064857W	2170	85	331
Richardson Coulee to Fort Peck Repeater	1764	481345N	1064857W	2170	50	121
Fort Peck Repeater to Richardson Coulee	1815	480150N	1061851W	2689	20	301
Fort Peck to Fort Peck Repeater	1754	480038N	1062643W	2130	20	077
Fort Peck Repeater to Fort Peck	1804	480150N	1061851W	2689	20	257

ATTACHMENT a

Chan.	(In MHz) Frequency
A	1764
B	1815
C	1754
D	1804
E	1744
F	1792



HAVRE-FORT PECK RADIO SYSTEM

ATTACHMENT b

SUMMARY OF EQUIPMENT CHARACTERISTICS

A. Transmitters

a. Nomenclature:

b. Manufacturer:

c. Frequency Range: 1700-1902.5 MHz

d. Frequency Stability: 10 ppm

e. Power Output: 1 watt

f. Emission Designator: M2F9

B. Receivers

a. Nomenclature

b. Manufacturer

c. Frequency Range: 1700-1902.5 MHz

d. Frequency Stability: 10 ppm

e. Emission Designator: M2F9

f. 1st IF Frequency: 35 MHz

C. Antennas

1. Nomenclature:

2. Manufacturer:

3. Type: Grid/Parabolic

4. GAIN: 29 to 36 dB

ATTACHMENT c

Agency No.

TRANSMITTER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model No.	1a. Manufacturer's Name
2. System Nomenclature	3. Transmitter Type: FREQUENCY MODULATION
4. Tuning Range: 1700 - 1850 MHz	5. Method of Tuning: FIXED CRYSTAL, PHASE LOCK LOOP
6. RF Channeling Capability: 120 CHANNELS	7. Frequency Tolerance: 10 ppm
8. Emission Type(s): M2F9	9. Emission Bandwidth: ☐ Calculated ☒ Measured -3dB 300KHz -20 dB 1.12MHz -40 dB 2.4MHz -60 dB 4.0MHz Occupied Bandwidth _____ (OOD)
10. Filter employed: ☐ Low Pass ☐ High Pass ☒ Band Pass, 3 POLE .01dB CHEBYCHEFF FILTER ☐ None	
11. Maximum Bit Rate: N/A	12. Maximum Modulation Frequency: 552 kHz BASEBAND, 607 kHz PILOT
13. Pre Emphasis: ☒ Yes ☐ No	14. Deviation Ratio: 0.79
15. Power (a) Carrier 30 dBm (b) Mean N/A (c) Peak Envelope N/A	16. Pulse Characteristics (a) Rate N/A (b) Width N/A (c) Rise time N/A (d) Fall time N/A (e) Compression Ratio N/A
17. Output Device: TRANSISTOR	
18. Spurious Level: NONE OUTSIDE OF THE 60 dB POINT	19. Harmonic Level (a) 2nd 90 dB (b) 3rd 90 dB (c) Other
20. FCC Type Acceptance No.: N/A	

21. Remarks:

Per Channel Deviation will be 50 kHz.

$$D = 50 \times 10^3 \times 3.76 \times \text{antilog}\left(\frac{-1 + 4 \log 120}{20}\right) = 436 \text{ kHz}$$

Necessary Bandwidth = 2P + 2D = 2(607 kHz) + 2(436 kHz)
= 2 MHz

$$\text{Deviation Ratio} = \frac{436}{552} = .79$$

8-33 REV 1/79

ATTACHMENT d

Agency No.

RECEIVER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model Number	1a. Manufacturer's Name
2. System Nomenclature	3. Receiver Type: SINGLE CONVERSION, SUPER HETERODYNE
4. Tuning Range: 1700 - 1850 MHz	5. Method of Tuning: FIXED CRYSTAL
6. RF Channeling Capability: 120	7. Frequency Stability: 10 ppm
8. Emission Type(s): M2F9	9. RF Selectivity: ☐ Calculated ☒ Measured (a) –3 dB: 18.5 MHz (b) –20 dB: 28.5 MHz (c) –60 dB: 64 MHz (d) Type of preselection used:
10. IF Selectivity (a) –3 dB: 3.55MHz (b) –20 dB: 6.84MHz (c) –60 dB: 16.11MHz	
11. Maximum Bit Rate: N/A	12. Maximum Post Detection Frequency: 552 kHz
13. De-emphasis Available: ☒ Yes ☐ No	14. Minimum Post Detection Frequency: 300 Hz
15. IF Frequency: 35 MHz	16. Sensitivity (a) -79.5 dBm (b) Criteria: 30 dB S/N, MEASURED AT ANTENNA PORT. (c) Noise Temperature: N/A °Kelvin
17. Oscillator Tuned Above tuned frequency ☐ Below tuned frequency ☐ Either above or below tuned frequency ☒	
18. Spurious Rejection: 70 dB	19. Image Rejection: 70 dB MINIMUM
20. Remarks	

REV 1/79

ATTACHMENT e

Agency No. _____

ANTENNA EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model Number	1a. Manufacturer's Name
2. System Nomenclature	3. Type GRID/PARABOLIC
4. Frequency Range 1.7 - 2.11 MHz	5. Polarization VERTICAL/HORIZONTAL
6. Gain (a) Main Beam 29 - 36 DEPENDING ON (b) Side Lobe ANTENNA SIZE	7. Scan Characteristics (a) Type (b) Vertical Scan (1) Max. Elev. (2) Min. Elev. (3) Scan Rate
8. Beamwidth (a) Horizontal 2.3 - 5.6° DEPENDING (b) Vertical ON ANTENNA SIZE	(c) Horizontal Scan (1) Sector Scanned (2) Scan rate
9. Remarks	

REV 1/79

ATTACHMENT f

FOR AGENDA

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

SPS-9998/1-1.14.10
Ref. SPS-9997/1-1.14.10

DATE: January 8, 1982

TO: Chairman, SPS

FROM: Chief, Systems Review Branch

SUBJECT: NTIA Preliminary Assessment of the Fort Peck-Havre Microwave System

This memorandum presents the results of NTIA's preliminary assessment of the request, SPS-5740, for a stage 4, operational, systems review of the Fort Peck-Havre microwave system.

The microwave system under review will be used in conjunction with a 230 kv power transmission line. Its function will be to facilitate communications for supervisory control, data transfer, relaying and energy control. Target dates for the system are as follows:

Spectrum support: March 1982
Completion of installation: October 1982
Operation: March 1983

Wartime Usage

The following statement was submitted with respect to wartime usage: "Although the attached system supports Department wartime and emergency functions, it is requested that spectrum support be granted for peacetime use. The Department also requests that conflicting systems with other agencies during wartime and presidentially declared national emergencies be identified for resolution at an appropriate higher management level."

DATA ADEQUACY

Data provided in SPS-5740 are adequate for a stage 4 systems review.

CONFORMANCE

Allocations

The use of six discrete frequencies from within the 1710-1850 MHz band have been requested for the Fort Peck-Havre microwave system. This usage would conform to the National Frequency Allocation Table since the 1710-1850 MHz band is allocated exclusively to the fixed and mobile services.

B2. NTIA Preliminary Assessment

Standards

Equipments to be used in the proposed microwave system meet all the applicable standards of paragraph 5.1 of the NTIA Manual.

Radiation Hazards

Field intensities produced by the Fort Peck-Havre microwave system will not exceed the 10 mW/cm^2 level specified in 29 CFR 1910.97 as the maximum safe exposure limit for personnel over any six minute interval.

Coordination

According to paragraph 3.4.6 of the NTIA Manual, two of the microwave links of the proposed system will require coordination with Canada. The two links are listed below.

LINK	TRANSMITTER DISTANCE FROM BORDER (statute miles)	AZIMUTH (degrees)
Havre to Chinook	33.9	064
Harlem to Chinook	32.6	290

ELECTROMAGNETIC COMPATIBILITY

Within the State of Montana, the only other frequency assignments found within the GMF for the 1710-1850 MHz band were for another microwave system. No EMC problems are expected because of the geographical separation between the existing system and the Havre-Fort Peck system.

EMC problems are not anticipated for the Fort Peck-Havre microwave system mainly because of the remoteness of its location; however, these same types of operations are carried out in other more congested areas. Since in the case of the system under review neither the transmission line or microwave system have been built as yet, perhaps this particular installation could serve as a test bed to determine the feasibility of using optical waveguide to perform the function of the proposed microwave system.

According to the literature, because they transmit signals in lightwave form, they are immune to electromagnetic interference from lightning, power line noise and other sources. There is a photograph of fibre-optic cable being installed along high tension overhead lines in the December 1981 issue of Telecommunications magazine, North American edition Volume 15, No. 12.

CONCLUSIONS

a) Adequate data has been submitted for a stage 4 systems review.

b) The requested spectrum support conforms to the National Allocation Table.

c) NTIA equipment standards have been met.

d) No radiation hazards are expected.

e) Coordination with Canada will be required.

f) No EMC problems are anticipated.

g) Spectrum support appears warranted.

RECOMMENDATIONS

a) Spectrum support as requested is recommended.

b) Coordination with Canada should be undertaken.

c) The Department should investigate the use of optical waveguides to perform power line monitoring functions in place of current and future microwave systems.

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
INTERDEPARTMENT RADIO ADVISORY COMMITTEE
Washington, D.C. 20230

SPS-9999/2-1.14.10
REF: SPS-9998
SPS-9997

DATE: February 16, 1982

TO: Deputy Associate Administrator
Office of Spectrum Management

SUBJECT: System Review - Fort Peck-Havre Microwave System - Stage 4

The Spectrum Planning Subcommittee has completed its review of the Fort Peck-Harve microwave system as described in Attachment 1 (SPS-2740) under the provisions of Part 8.3 of the NTIA Manual.

The SPS noted that:

a) The links of this proposed sytem are in the band 1710-1850 MHz.

b) This system will support uninterruptable wartime and emergency functions relating to the construction and operation of the 230 kv Fort Peck-Harve transmission power line.

c) No fixed links were identified which might cause interference to this system during times of war or national emergency. However, numerous mobile systems were identified which could cause interference.

The SPS considered the NTIA preliminary assessment given in Attachment 2 (SPS-5793).

The SPS recommends that:

a) Stage 4 spectrum support be granted noting that conflicting spectrum requirements during war emergencies have been identified and not yet resolved.

b) The issue of protecting this system during war emergencies, with respect to the competing systems identified, be resolved bilaterally between affected agencies and the results provided to NTIA.

Chairman, SPS

Attachment

B3. Recommendations of Chairman, SPS to NTIA Director, Spectrum Plans and Policies.

FOR INFORMATION

UNITED STATES DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Washington, D.C. 20230

Date

Chief, Spectrum Management Office
U.S. Department of
Washington, D. C. 20545

Dear Sir:

The stage 4 system review of the Fort Peck-Harve microwave system has been completed by the Spectrum Planning Subcommittee. The results of that review are enclosed.

This office concurs with the recommendations of the SPS. As noted in the review, the issue of protecting this system during war emergencies with respect to the competing systems has not been resolved. It is requested the affected agencies, in coordination with each other, review their emergency plans to determine means by which the potential conflicts involved with the operational use of the band 1710-1850 MHz by this system can be resolved and report the results thereof to this office.

Sincerely,

Deputy Associate Administrator
Office of Spectrum Management

Enclosure

cc: IRAC w/Ltr to DAA
FAS w/Ltr to DAA
SPS w/Ltr to DAA
Ad Hoc-134 W/Ltr to DAA

B4. NTIA Spectrum Certification Letter.

8.3 PROCEDURE FOR THE REVIEW OF TELECOMMUNICATION SYSTEMS FOR FREQUENCY AVAILABILITY AND ELECTROMAGNETIC COMPATIBILITY (EMC)

8.3.1 General

I. Government agencies planning the use of, conducting experiments relating to, or developing and procuring telecommunication systems requiring the use of radio frequencies shall take all reasonable measures to ensure that such systems will neither cause nor receive harmful interference to or from other authorized users when placed in their intended operational environments. In planning telecommunication systems within the scope of this procedure, Government agencies shall develop systems for operational use in accordance with the applicable portions of the National Tables of Frequency Allocations and the provisions of this Manual, unless an exception is recommended by the SPS and approved by NTIA.

II. OMB Circular No. A-11 specifies in Section 13.2: "Estimates for the development or procurement of major communication-electronics systems (including all systems employing satellite (space) techniques) will be submitted only after certification by the NTIA that the space in the radio frequency spectrum required for such systems is available". NTIA certification of spectrum support can be obtained using the procedures in this part.

III. To assist Government agencies in meeting this responsibility and to support the NTIA and the IRAC in the management of radio spectrum resources for the satisfaction of Government requirements, and in the national interest, these procedures provide for the review of certain new Government telecommunication systems and subsystems by the Spectrum Planning Subcommittee (SPS), at a number of the stages of their evolution prior to the assignment of frequencies. Such review will, as appropriate, require an examination of the existing systems in the frequency band(s) being considered. Full participation of the FCC in these procedures for the review of Government systems intended for operation in bands of mutual Government/non-Government interest occurs through the normal FCC liaison representation on the IRAC and its subcommittees. The matter of preparation and submission to OMB of budget estimates for Government systems is covered in Section 8.2.5.

IV. As part of the review, the SPS will identify those systems which may have incompatibilities within the US&P during war emergency situations.

8.3.2 Definitions

I. *A telecommunication system* for the purpose of this procedure, is a combination of facilities, stations, or circuits intended to perform an information transfer function by the use of the radio spectrum, e.g.:

—a space station(s) and its associated earth stations for provision of meteorological information;

—a combination of aeronautical stations for communication support of air traffic control;

—an interconnected network of fixed stations;

—a combination of fixed and land mobile stations intended to provide communication support for law enforcement or protection activities on a local or area-wide basis;

—a combination of facilities intended to provide a radionavigation service; or

—a combination of facilities intended to provide a radiolocation (radar) service.

II. *A telecommunication subsystem* for the purpose of this procedure, is a combination of facilities, stations, or circuits intended to provide telecommunication support to a broader functional telecommunication entity, e.g., the surveillance portion of an air defense system or an avionics package of a nomenclatured aircraft.

III. *A major terrestrial system or subsystem* is a telecommunication system or subsystem that does not involve the use of satellites or spacecraft, and which may have significant impact on existing or potential future use of the portion of the radio frequency spectrum in which it is intended to operate, taking into account systems of the same radio service and those of any other radio service with which the spectrum in question is shared.

IV. *A major modification* is any change of the technical or operational characteristics of an existing telecommunication system or subsystem which may have significant impact on existing or potential future use of the portion of the radio frequency spectrum in which it is intended to operate, taking into account systems of the same radio service and those of other radio services with which the spectrum in question is shared.

V. *The System 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 coming within the scope of Part 8.3 (see Section 8.3.3). A system can be reviewed at four stages as it matures into an operational status. These are:

Stage 1, Conceptual—the initial planning effort has been completed, including proposed frequency bands and other available characteristics;

Stage 2, Experimental—the preliminary design has been completed, and radiation, using such things as test equipment or preliminary models, may be required;

Stage 3, Developmental—the major design has been completed, and radiation may be required during testing; and

Stage 4, Operational—development has been essentially completed, and final operating constraints or restrictions required to assure compatibility need to be identified.

The Stages of Review are discussed in greater detail in Section 8.3.4.

8.3.3 Scope of Procedure

I. This procedure is applicable to systems and subsystems as defined in Section 8.3.2. It shall be limited to:

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 by the NTIA, the IRAC, the FAS, or a cognizant Government agency. Such referral may result from factors of systems cost or importance or follow from estimates of unusual potential impact on other spectrum uses.

II. Experimental projects are included in this procedure.

III. EW/ECM Threat Simulators are generally required by their mission to operate in bands not allocated to appropriate radio services. Such operations usually utilize special one-of-a-kind or limited sets of equipment. They usually operate at Military Installations specified in Parts 7.11 and 7.17. Operations are in accordance with Part 7.14. EW/ECM Threat Simulators frequency assignments are exempt from the provisions of Section 8.3 of the Manual. This does not preclude the review of EW/ECM Threat Simulators by the IRAC.

IV. An individual radio station, an individual point-to-point radio link, or an individual network in the mobile radio service, any of which is to become a part of an existing identified telecommunication system or subsystem, for example, will normally not be considered for the purpose of this review procedure. Application and plant for such individual stations, radio links, and services will be reviewed by the SPS only upon direct referral for cogent reasons such as given in paragraph I.C. of this section.

V. An indiviudal component of a system or subsystem as defined in Section 8.3.2 will normally not be considered for the purpose of this review procedure.

8.3.4 Stages of Review and Scheduling

I. The Stages of Review are:

A. *Stage 1, Conceptual*—Certification of spectrum support for telecommunication systems or subsystems at Stage 1 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 the 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 modifications, including more suitable frequency bands, necessary to assure conformance with the Tables of Frequency Allocations and the provisions of Chapter 5.

B. *Stage 2, Experimental*—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 systems that are subject to these procedures (see Section 8.3.3). It also provides guidance for assuring 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.

C. *Stage 3,* Developmental—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.

D. *Stage 4, Operational*—Certification of spectrum support for telecommunication systems or subsystems at Stage 4 is a prerequisite for NTIA authorization of radiation from a station with an operational station class (*i.e.* other than experimental) for systems that are subject to these procedures. It provides restrictions on the operation of the system or subsystem as may be necessary to prevent harmful interference.

II. *Scheduling of Reviews.* Systems or subsystems falling within the scope of Part 8.3 shall be referred to the SPS in sufficient time to permit guidance to be developed by SPS and NTIA and applied by the agency. System reviews normally can be completed and spectrum support guidance can be provided within three to nine months from the date of submission to SPS. The submitter shall consider this time period and the provision of paragraph III.A. of Section 8.3.5. requiring the FAS to withhold frequency assignments until the assignment particulars conform to the spectrum support guidance. The time require-

ments for international processing of advance publication, coordination, notification, and agreement documents, as discussed in the *Manual of Instructions for Notifying U.S. Radio Frequency Assignment Data to the International Frequency Registration Board,* shall also be considered for space systems.

8.3.5 Responsibilities

I. *The Spectrum Planning Subcommittee (SPS)*

A. In its systems review, the SPS shall give consideration to:

1. system compliance with prevailing spectrum management policy, allocations, regulations, and technical standards (Government, National, and International);

2. the predicted degree of EMC between the proposed system and the electromagnetic environment;

3. the possible need for and evaluation of the results of prototype EMC testing; and

4. the electromagnetic compatibility of the war emergency use of systems reviewed under Part 8.3. The Subcommittee will limit its review of war emergency use to an assessment of potential incompatibility in terms of the electromagnetic environment and technical standards. (The Subcommittee will not address the relative priorities of the war emergency functions being supported by the systems under consideration.)

B. Upon assessment of a proposed system or subsystem, considering these criteria and any other pertinent factors, the SPS will make recommendations with supporting documentation to NTIA with an information copy to the IRAC, for:

1. approval of spectrum support for the system at its proposed stage of development without qualification; or,

2. approval of spectrum support subject to stated limitations or to modification of the proposed system; or,

3. approval of spectrum support, subject to limitations, or modifications to systems already in the band; or

4. submission of information for advance publication, agreement of affected foreign administrations, notices for coordination, and notification of frequency assignments for unclassified space systems as appropriate, under the provisions of Articles 8, 11, 13, and 14 of the ITU Radio Regulations; or

5. disapproval of spectrum support.

C. Should the Subcommittee determine that there may be technical incompatibility among or between proposed and existing systems in a war emergency situation, the Subcommittee will:

1. advise each affected agency of the finding;

2. request that the affected agencies develop and document mutually-satisfactory solutions for the specific points of potential conflict (geographical location and/or frequencies sought—NTIA will assist with technical analyses upon request); and

3. review the recommendations of the agencies involved, or note their inability to reconcile war emergency conflicts in the Subcommittee's recommendations.

D. The Subcommittee will incorporate the war emergency use recommendations made by the involved agencies into its recommendations to NTIA. Upon receipt, NTIA shall annotate the *Emergency Readiness Plan for the Use of the Radio Spectrum (ERP)* to reflect the war emergency use agreement.

E. The Subcommittee shall notify NTIA, via the IRAC, when the agencies whose systems have been identified as being technically incompatible are unable to reach agreement as to war emergency use.

II. *The Space Systems Group of the SPS*

A. The SSG shall review the data furnished by Government agencies regarding the advance publication, agreement with affected administrations, and coordination and notification of frequency assignments for space telecommunication systems under the provisions of Articles 8, 11, 13, and 14 of the ITU Radio Regulations. The SSG shall give consideration to:

1. The conformance of the system to the provisions of Articles 8 and 28 and Appendices 3 and 4 of the ITU Radio Regulations and applicable IFRB Circular Letters.

2. The identification of those countries from whom agreement must be obtained under the provisions of Articles 8 and 14 of the ITU Radio Regulations.

3. The identification of those countries with whom the system must be coordinated under the provisions of Article 11 of the ITU Radio Regulations.

B. The SSG shall also review the correspondence furnished by the IFRB and by other countries regarding proposed space telecommunication systems in accordance with Articles 8, 11, 13, and 14 of the ITU Radio Regulations. The SSG will estimate the impact of foreign space systems on existing and planned Government space and terrestrial telecommunication systems and will develop appropriate replies. Information regarding foreign space systems that operate in bands shared with U.S. terrestrial stations will be furnished to the SPS for comment when it is appropriate.

C. Documents which have been approved by the SSG shall be coordinated with the Deputy Associate Administrator, Office of Spectrum Management and provided to the ING for transmittal to the IFRB and any concerned foreign countries.

III. *The Frequency Assignment Subcommittee (FAS)*

A. The FAS shall not recommend the assignment of frequencies to stations in systems that are subject to these procedures until notice is received that frequency support for the system has been certified. The particulars of the assignments shall conform to the terms of the system approval. Assignment applications for such stations received in FAS prior to systems review shall be tabled until the appropriate stage of the Systems Review Procedure has been completed. The FAS shall inform SPS of this action.

B. The FAS may recommend frequency assignment action for a) additional stations and b) the modification of assignments to stations in existing systems or systems approved under this procedure, provided the operations resulting from the assignment action

will have only minor local effect upon the electromagnetic environment.

C. The FAS shall place emphasis on the careful review of applications involving sharing of the same frequency bands by terrestrial and space services. When necessary, the FAS may recommend to IRAC that further EMC analysis by NTIA, or other cognizant agency, be completed prior to assignment action. Any matters that cannot be resolved, and those applications for which approval could result in major effects on the future use of the frequency band concerned, shall be referred to the IRAC.

IV. *The Technical Subcommittee (TSC)*

The Technical Subcommittee and its working groups shall provide information from the ongoing programs in standards, criteria for spectrum sharing, propagation, trade-offs among telecommunications techniques, radio noise and interference environments, side effects of spectrum use, and Government-wide EMC capability. In addition, the TSC shall be guided in its work, scope, and priority by requirements identified by the IRAC for support of EMC reviews underway and expected in accordance with these procedures.

V. *The Government Agencies*

A. Agencies will participate in the application of these procedures in the IRAC and its Subcommittees and shall provide information needed for the system review as specified in Section 8.3.7.

B. IRAC representatives shall be responsible for determining within their agencies which systems come within the scope of this procedure (see Section 8.3.3) and should, therefore, be submitted to the SPS for systems review. In making this determination, IRAC representatives should give serious consideration to the spectrum-related concerns of other member agencies. A system review under Part 8.3 entails consideration of a more detailed EMC analysis than is appropriate within the FAS.

C. Agencies are expected to determine the impact of any system referred to the SPS on telecommunication systems used in support of their war emergency functions, and to provide promptly to the SPS the technical and operational details supporting the determination of a possible conflict.

D. The interagency conference results called for in paragraph I.C.2. of this section shall be provided in a timely manner.

E. Agencies will take into account recommendations provided as a result of the system review in the modification and resubmission of proposals to improve system EMC characteristics and facilitate frequency support. Agencies may recommend and will consider modifications to existing facilities and will facilitate the accommodation of new systems. Agencies may participate in EMC studies specified in Section 8.3.6 as an active associate to the degree required to assure responsiveness to their requirements and responsibilities and shall be consulted to assure development of realistic assignment criteria and other technical system considerations.

VI. *NTIA*

A. NTIA will review the information submitted by the SPS in regard to apparently-conflicting agency war emergency spectrum requirements and determine the best means of reconciliation. Each agency involved will be notified of this determination.

B. Should one or more agencies object to the NTIA determination, the agencies will report the basis for the objection to NTIA. NTIA will review the objection and attempt a final reconciliation. If the proposed final reconciliation is still unacceptable to the agencies involved, NTIA will refer the matter to the appropriate authority for determination of relative mission priorities in war emergency situations. The recommendation of the authority will be disseminated to the agencies involved and noted in the *ERP.*

8.3.6 EMC Analysis Support

I. *General*

A. In reviewing and assessing the EMC and frequency availability aspects of proposed telecommunication systems, as defined herein, the SPS shall depend upon system and equipment characteristics data submitted by the proposing agency and upon available environmental information.

B. The SPS shall make use of the results of any available technical studies and any pertinent EMC analysis capabilities within Government agencies when assessing proposed systems. More specifically, the SPS shall arrange for and make use of existing EMC analysis capabilities and procedures of the DOD, NASA, and other Government agencies where they may expedite or enhance its assessment of a proposed system. Arrangement for such support will be obtained through NTIA. Moreover, the SPS shall promote the cooperative exchange of views and information among the agencies that may provide EMC analysis support to the Subcommittees.

C. The SPS will be supported by NTIA and may refer to NTIA, as appropriate, system proposals for evaluation and recommendations regarding:

1. compliance with prevailing standards and sharing criteria;

2. predicted degree of EMC with the environment;

3. relative efficiency in the use of the radio spectrum by the proposed system;

4. system modification or alternatives, including modifications to stations already operating in the band(s) in question, where appropriate;

5. technical solutions for systems having war emergency functions and having conflicting spectrum requirements within the US&P.

D. The SSG will be supported by NTIA and may refer to NTIA, as appropriate, U.S. and foreign space system proposals for evaluation and recommendations regarding:

1. conformance to applicable national and international rules and regulations;

2. predicted degree of EMC with the environment; and

3. system modifications or alternatives, including modifications to stations already operating in the band(s) in question where appropriate.

II. *Types of Analysis*

A. Types of analysis will vary from a determination of gross impact on the spectrum to detailed EMC analysis. The level and complexity of analysis must depend on the quality of the data available at the various stages of system development.

B. In analyses leading to certification of spectrum support at Stage 1, Conceptual, much of the system data will be estimated, only gross calculations may be achievable for a general evaluation of spectrum impact that 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.

C. In analyses leading to certification of spectrum support at Stage 2, Experimental, the foregoing types of analysis will be applies where appropriate with more specific 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/deployment will be provided, where 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 Radio Regulations will be performed to the extent practicable.

D. In analyses leading to certification of spectrum support at Stage 3, Developmental, more detailed EMC analyses will be performed, using measured data from experimentation when available. Appropriate recommendations as to equipment characteristics and/or operational equipment/deployment will be developed. Calculations in connection with national and international space system coordination procedures will be performed or updated as appropriate.

E. In analyses leading to certification of spectrum support at Stage 4, Operational, detailed EMC analyses will be updated, 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.

III. *Prototype EMC Testing*

When the results of EMC analyses so indicate, prototype EMC tests may be required as an input to the determination of spectrum availability and electromagnetic compatibility.

8.3.7 Data Requirements

I. *General*

A. Government agencies shall provide data, as appropriate and categorized below, to the SPS for review at the various stages as systems mature, in accordance with the provisions of this part. All of the specified categories of data that are appropriate to the system under review are required for Stages 2, 3, and 4. While no specific minimums of data are specified for a Stage 1 review beyond the guidance provided under the various categories below, agencies should provide sufficient data to allow determination of conformance with Allocation Tables and for space systems, conformance with power flux density limitations.

B. The SPS may request the submission of additional data or data estimates during the course of its system review or may endorse direct contact between the EMC analysis support agency (NTIA or other) and the requesting agency for development of data estimates.

C. Agencies proposing new systems shall be responsible for the upgrading of data provided to the SPS for the earlier stages, as more valid information becomes available and as the system progresses through the various review stages to its final operational configurations.

D. The SPS may request the selective upgrading of electromagnetic environmental data for specific areas and radio services, where necessary to support realistic EMC analyses of new systems.

II. *Specific*

Requests for system review shall contain the following (this data may be provided in the alternate format specified in Department of Defense Form DD 1494):

A. A cover letter with the following information:

1. *Stage of Review Requested*—Indicate the stage of review requested.

2. *Purpose of the System*—Submit for all stages a summary description of the function of the system or subsystem, e.g., collect and disseminate meteorological data using satellite techniques, transmission of radar data for air traffic control, a remote control of ATC radars.

3. *Information Transfer Requirement*—Submit for all stages the required character, quantities, data rates, and circuit quality/reliability

4. *Estimated Termination Date* (where applicable).

5. *Estimated Initial Cost of the System*—This item is for information to show the general size and complexity of the system. It is not intended to be a determining factor in system reviews.

6. *Target Date*—Submit dates on which spectrum-related decisions must be made relative to system planning, development, procurement, and employment.

7. *System Relationship and Essentiality*—Submit for all stages a statement of the relationship between the proposed system and the function of operation it is intended to support. Include a brief statement of the essentiality to the supported function or operation.

8. *Replacement Information*—Identify the existing system(s) and associated frequency assignments to be replaced by the proposed system, where applicable.

9. *Out-of-Band Operations*—Submit a justification for any telecommunication system or subsystem that does not operate in accordance with the applicable Tables of Frequency Allocations as required by paragraph I of Section 8.3.1, and details of how operations on a non-interference, unprotected basis are

feasible. This information is required for systems or subsystems that must operate out-of-band in the United States, its possessions, or in space.

10. *War Emergency Function*—A statement as to whether the proposed system, if it becomes operational, will support a war emergency function.

B. Attachments to the cover letter shall provide:

1. *Attachment 1*—line diagram(s) showing the links, direction of transmission, and frequency band(s).

2. *Attachment 2—For Space Systems*

a. Stage 1 and 2 Requirements

(1) Satellite orbital characteristics (longitude for geostationary satellites, and apogee, perigee, and inclination for non-geostationary satellites).

(2) Satellite transmitter maximum spectral power density for each transponder.

(3) Earth station locations within the US&P, and frequencies or frequency bands used at each (city, state, and coordinates).

b. Stage 3 Requirements

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

(a) Frequencies or frequency bands and satellites 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 pattern (only if PFD limits are exceeded).

c. Stage 4 Requirements. In addition to satisfying all Stage 3 requirements, the following data items are required for each earth station:

(1) Horizon elevation angle diagram.

(2) Antenna altitude above ground.

d. The format for providing these data is left to the discretion of each agency. However, for unclassified space systems which have not been waived from the requirements of international registration as described in Part 3.3, similar information must be prepared in specific formats and submitted to the SSG in accordance with instructions in Part 3.3 and the *Manual of Instructions and Procedures for Notifying U.S. Radio Frequency Assignment Data to the International Frequency Registration Board.* The data required by the SSG to satisfy the specifications in Appendix 4 of the ITU Radio Regulations shall be submitted at the same time as the Stage 2 system review request, and may be used in lieu of the Attachment 2 data for Stage 1 and 2 system review requests. Data required by the SSG to satisfy the specifications in Appendix 3 of the ITU Radio Regulations shall be submitted at the same time as Stage 3 system review requests and may be used in lieu of the Attachment 2 data for Stage 3 and 4 system review requests.

3. *Attachment 2—Terrestrial Systems (all stages)*

a. Station class(es).

b. Number of units (for mobile systems).

c. Station locations and/or areas of operation, as appropriate (geographical coordinates required for Stages 2, 3, and 4).

d. Frequency requirements, i.e., band(s) or discrete frequencies required, bandwidth and emission designators, and netting information, where appropriate.

e. Proposed date of activation.

The information in a. through e. above may be included in the line diagram submitted as Attachment 1 above, if desired.

4. *Attachment 3—Related Analysis Data*

For all stages, submit reports of any previous EMC studies, predictions, analyses, and prototype EMC testing that are relevant to the assessment of the system under review, or references thereto if previously provided to the IRAC/SPS, including references to previous system reviews of the same system or its predecessors.

5. *Attachment 4—Equipment Characteristics*

Submit completed forms NTIA-33, NTIA-34, and NTIA-35 for each equipment (transmitters, receivers, antennas) intended for use in the system under review. All applicable data items shall be completed for Stages 3 and 4 (estimated values or ranges of values may be submitted for Stage 3 in the absence of other available data). For Stages 1 and 2, provide actual equipment data, or in the absence of such data, estimated data and ranges of values shall be stated on the forms sufficient to support a realistic preliminary assessment of frequency availability and EMC characteristics.

NTIA forms need not be submitted for equipment whose required characteristics have been previously provided to the SPS or which are contained in the Equipment Characteristics File. In such cases indicate in Attachment 4 the Government nomenclature or manufacturer's model number of such equipment.

Instructions for the completion of the NTIA forms follow.

Instructions for Completing Transmitter Characteristics Form (NTIA-33)

Security Classification—This form will be classified in accordance with appropriate agency security directions. Downgrading instructions will be indicated.

The items or relationship of items which make this completed form classified will be stated in the remarks section, e.g., "The association of the frequency range and the equipment nomenclature are classified ———." Alternatively the classification may be indicated by a (U), (C) or (S) alongside each item as appropriate.

1. Enter the government alphanumeric equipment designation. Use the official designation as it appears or will appear on the nameplate of the transmitter, e.g., T128.

If a government nomenclature has not been designated, enter the manufacturer's model number, e.g., MTT 502.

If neither a government nomenclature nor a manufacturer's model number has been designated enter a short descriptive title, e.g., ATS-6 telemetry transmitter.

1(a). Enter the manufacturer's name. In those cases where a government nomenclature has not been entered in Item 1 this item is mandatory.

2. Enter the system nomenclature. The system nomenclature is defined as that nomenclature which has been assigned to a combination of equipments, e.g., AN/GRC-27.

3. Enter the generic class or grouping of the transmitter, e.g., High Resolution, Frequency Scan, Scan While Track Radar, Time Division Link, Pulse Doppler Monopulse Tracker, Communications AM, FM, etc.

4. Enter the actual frequency range through which the transmitter is capable of being tuned. For single frequency equipment, enter the frequency to which equipment is limited. Indicate units used, e.g., kHz, MHz, GHz, etc.

5. Enter the method of tuning, e.g., continuous, fixed, crystal synthesizer, etc.

6. Enter the RF channeling capability, i.e. enter the total number of channels, frequency of the lowest channel, frequency of the highest channel, channel spacing and if the device is capable of automatically hopping frequency, e.g., 10 channels, 406.125-406.350 MHz, 25 kHz spacing, with automatic frequency hopping capability.

7. Enter the frequency stability, i.e., the maximum departure of a transmitter from its tuned frequency, after normal warmup time has been allowed. Express in parts per million for all emission types, except single sideband which shall be expressed in Hertz.

8. Enter the emission designator(s), as shown in Section 6.3.1 of this Manual, for the types of emission capable of being used with this transmitter.

9. Enter the emission bandwidths for which the transmitter is designed at the −3, −20, and −60 dB levels. The bandwidth at −40 dB shall also be entered for pulse radar transmitters. The emission bandwidth is defined as that appearing at the antenna terminals and includes any significant attenuation contributed by filtering in the output circuit or transmission line. Values of emission bandwidth specified should be indicated as calculated or measured by checking the appropriate block. Indicate units used, e.g., kHz, MHz, etc. For Spread Spectrum, Frequency Hopping, Doppler Techniques, etc., enter full details in Item 21, Remarks.

9(a). Occupied Bandwidth is defined as the frequency bandwidth such that, below its lower and above its upper frequency limit, the mean powers radiated are each equal to 0.5% of the total power radiated by a given emission. (Required for DOD Agencies Only).

10. Check the appropriate block to indicate the absence of or the type of filter employed. The characteristics of the filter shall be provided in Item 21.

11. Enter the maximum information bit rate for digital equipment, in bits per second. If spread spectrum is used, enter the bit rate after encoding.

12. For frequency or phase modulated transmitters enter the maximum modulation or baseband frequency. This frequency is assumed to be the frequency 3 dB on the high frequency side of the modulator response curve. Indicate the units used, e.g., Hz, kHz, etc.

13. For frequency or phase modulated techniques check the appropriate block to indicate whether preemphasis is available.

14. For frequency or phase modulated transmitters enter the deviation ratio computed with the formula.

$$\text{Deviation Ratio} = \frac{\text{Maximum Frequency Deviation}}{\text{Maximum Modulation Frequency}}$$

15. Enter the power delivered to the antenna terminals in 1) carrier power for A3E sound broadcasting in the broadcasting service, 2) mean power for all other amplitude modulated emissions using unkeyed full carrier, and for all FM emissions and 3) peak envelope power for all classes of emission other than those referred to in 1) and 2) above, including A3F television and all pulsed emissions.

16. For pulse modulated transmitters:

(a) enter the pulse repetition rate in pulses per second.

(b) enter the pulse width at the half voltage levels in microseconds.

(c) enter the pulse rise time in microseconds. This time is required for the leading edge of the pulse to rise from 10% of its peak amplitude value (voltage) to 90% of its peak amplitude value.

(d) enter the pulse fall time in microseconds. This is the time required for the trailing edge of the pulse to fall from 90% of its peak amplitude value (voltage) to 10% of its peak amplitude value.

(e) enter the maximum pulse compression ratio, if applicable.

17. Enter a description of the device used in the transmitter output stage, e.g., ceramic diode, reflex klystron, varactor multiplier, triode, etc.

18. Enter the maximum value of spurious emission (dB) which occur outside the −60 dB point on the transmitter fundamental emission spectrum (Item 9) and do not occur on a harmonic of the fundamental frequency.

19. Enter the harmonic level relative to fundamental in −dB of the 2nd and 3rd harmonics. Enter in Item 19c the relative maximum level in ±dB of all harmonics above the 3rd.

20. Enter the FCC Type Acceptance Number if this transmitter has been type accepted by the FCC.

21. Use this space to amplify any of the information provided above. Particular emphasis should be placed on a thorough explanation of the emission characteristics. This information might include equipment multiplexing capabilities, and additional details of composite systems (a "9" in the emission designator). If spread spectrum is utilized, describe in detail. This item should be used to provide additional information which may be useful in assessing the electromagnetic compatibility of this equipment. Technical limitations integral to the equipment which limit its performance over the frequency range, the use of specified emissions, or radiated power should be explained.

For devices capable of automatically hopping frequency, indicate whether channels or band segments may be locked out.

Instructions for Completing Receiver Characteristics Form (NTIA-34)

Security Classification—This form will be classified in accordance with appropriate agency security directions. Downgrading instructions will be indicated. The items or relationship of items which make this completed form classified will be stated in the remarks section, e.g., "The association of the frequency range and the equipment nomenclature are classified———." Alternatively the classification may be indicated by a (U), (C), or (S) alongside each item as appropriate.

1. Enter the government assigned alphanumeric equipment designation. Use the official designation as it appears or will appear on the nameplate of the receiver, e.g., 2278.

If a government nomenclature has not been designated, enter the manufacturer's model number, e.g., NRD 1130BF.

If neither a government nomenclature nor a manufacturer's model number has been designated, enter a short descriptive title, e.g., ATS-6 telemetry receiver.

1(a). Enter the manufacturer's name. In those cases where a government nomenclature has not been entered in Item 1 this item is mandatory.

2. Enter the system nomenclature. The system nomenclature is defined as that nomenclature which has been assigned to a combination of equipments, e.g., AN/GRC-27.

3. Enter the generic class or grouping of the receiver, e.g., Dual Conversion Super Heterodyne receiver, Homodyne, etc.

4. Enter the actual frequency range through which the receiver can tune. For single frequency equipment enter the frequency to which equipment is limited. Indicate units used, e.g., kHz, MHz, GHz, etc.

5. Enter the method of tuning, e.g., continuous, fixed, crystal synthesizer, etc.

6. Enter the RF channeling capability, i.e. enter the total number of channels, frequency of the lowest channel, frequency of the highest channel, channel spacing and if the device is capable of automatically hopping frequency, e.g., 10 channels, 406.125-406.350 MHz, 25 kHz spacing, with automatic frequency hopping capability.

7. Enter the frequency stability, i.e., the maximum departure of a receiver from its tuned frequency, after normal warmup time has been allowed. Express in parts per million for all emission types, except single sideband which shall be expressed in Hertz.

8. Enter the emission designator(s) identifying the types of emission for which this receiver is designed.

9. Enter the RF bandwidths at the −3, −20, and −60 dB levels for all receivers. The RF bandwidth includes any significant attenuation contributed by filtering in the input circuit or transmission line. Values of emission bandwidth specified should be indicated as calculated or measured by checking the appropriate block. Indicate units used, e.g., kHz, MHz, etc.

10. List the IF bandwidths at the −3, −20, and −60 dB levels for the first IF amplifier. If additional IF amplifiers are employed, list these levels for second, third IF's in the remarks Item 20. Indicate units used, e.g., kHz, MHz, etc.

11. For digital equipment, enter the maximum bit rate (bps) that can be used. If spread spectrum is used, enter the bit rate after decoding. Describe any error detecting/correcting codes in remarks Item 20.

12. List the maximum post detection frequency. This frequency is the nominal frequency that is 3 dB down on the high-frequency side of the receiver base band. Indicate units used, e.g., kHz, MHz, etc.

13. For frequency modulated receivers, indicate whether de-emphasis is available.

14. For multichannel FM systems, list the minimum post detection frequency. This frequency is the nominal frequency that is 3 dB down on the low-frequency side of the receiver base band. (Indicate units used, e.g., Hz, kHz, etc.)

15. Enter the frequency of the first IF. If additional IF's are used, list the frequencies in remarks Item 20. (Indicate units used, e.g., kHz, MHz).

16.(a). Enter the sensitivity in −dBm.

16(b). Specify criteria used. For example: −100 dBm for a 6 dB S/N ratio, −110 dBm for 12 dB SINAD.

$$\frac{\text{Signal + Noise + Distortion}}{\text{Noise + Distortion}}$$

16(c). Enter receiver noise temperature in Kelvins or receiver noise figure in dB.

17. Check the appropriate block to indicate the location of the oscillator frequency with respect to the tuned frequency. If additional oscillators are used (i.e., additional IF stages) indicate the location of those oscillator frequencies in remarks Item 20.

18. Enter the spurious rejection in dB. Enter the single level of spurious rejection that the receiver meets or exceeds at all frequencies outside the −60 dB IF bandwidth. Spurious rejection is the ratio of the input signal at a particular out-of-band frequency required to produce a specified output, to the desired signal required to produce the same output.

19. Enter the image rejection in dB. Image rejection is the ratio of the input signal level at the image frequency required to produce a specified output, to

the desired signal level required to produce the same output.

20. Use this space to amplify any of the information provided above. Particular emphasis should be placed on a thorough explanation of the emission characteristics. This information might include system demultiplexing capabilities and details of composite systems (a "9" in the emission designator). It might also include such items as the characteristics of interference or noise suppression devices or unique signal processing techniques such as phase lock loops, optical correlators, etc. Any technical limitations integral to the equipment, which limit its performance over the frequency range or the use of specified emissions should be explained.

Instructions for Completing Antenna Characteristics Form (NTIA-35)

Security Classification—This form will be classified in accordance with appropriate agency security directions. Downgrading instructions will be indicated. The items or relationship of items which make this completed form classified will be stated in the remarks section, e.g., "The association of the frequency range and the equipment nomenclature are classified———." Alternatively the classification may be indicated by a (U), (C) or (S) alongside each item as appropriate.

1. Enter the government assigned alphanumeric equipment designation. Use the official designation as it appears or will appear on the nameplate of the antenna, e.g., AT197.

If a government nomenclature has not been designated, enter the manufacturer's model number, e.g., DS 6558.

If neither a government nomenclature nor a manufacturer's model number has been designated, enter a short descriptive title, e.g., ATS-6 telemetry antenna.

1(a). Enter the manufacturer's name. In those cases where a government nomenclature has not been entered in Item 1, this item is mandatory.

2. Enter the system nomenclature. The system nomenclature is defined as that nomenclature which has been assigned to a combination of equipments, e.g., AN/GRC-27.

3. Enter the generic name or describe general technical features, e.g., Horizontal log periodic; Cassegrain with polarization twisting, omnidirectional. Include the antenna dimensions in meters when available.

4. Enter the range of frequencies for which it is designed. Indicate units used, e.g., kHz, MHz, etc.

5. Enter the polarization; if circular, indicate whether it is left or right hand.

6(a). Enter the maximum gain in dB above isotropic.

6(b). Enter the maximum gain of the first major side lobe in dB above isotropic and the angular displacement from the main beam.

7(a). If this antenna scans, enter the type of scanning, e.g , vertical, horizontal, vertical and horizontal, etc.

7(b)(1). Enter the maximum elevation angle in degrees that the antenna can scan.

(2). Enter the minimum elevation angle in degrees that the antenna can scan.

(3). Enter the scanning rate in scans per minute.

7(c)(1). Enter the angular scanning range of the sector scanned in degrees.

(2). Enter the scan rate in scans per minute.

8(a)(b). Enter the 3 dB beamwidth in degrees.

9. Use this item to describe any unusual characteristics of the antenna, particularly as they relate the assessment of electromagnetic compatibility. Use this item to amplify or clarify items 1 through 8.

Radiation diagrams should be attached if available.

Agency No. _____

FORM NTIA-33
(6 83)

U.S. DEPARTMENT OF COMMERCE
NATIONAL TELECOMMUNICATIONS AND
INFORMATION ADMINISTRATION

TRANSMITTER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model No.	1a. Manufacturer's Name
2. System Nomenclature	3. Transmitter Type
4. Tuning Range	5. Method of Tuning
6. RF Channeling Capability	7. Frequency Stability
8. Emission Designator(s)	9. Emission Bandwidth ☐ Calculated ☐ Measured -3dB _____ -20 dB _____ -40 dB _____ -60 dB _____ Occupied Bandwidth _____ (DOD)
10. Filter employed: ☐ Low Pass ☐ High Pass ☐ Band Pass ☐ None	
11. Maximum Bit Rate	12. Maximum Modulation Frequency
13. Pre Emphasis ☐ Yes ☐ No	14. Deviation Ratio
15. Power (a) Carrier _____ (b) Mean _____ (c) Peak Envelope _____	16. Pulse Characteristics (a) Rate _____ (b) Width _____ (c) Rise time _____ (d) Fall time _____ (e) Compression Ratio _____
17. Output Device	
18. Spurious Level	19. Harmonic Level (a) 2nd _____ (b) 3rd _____ (c) Other _____
20. FCC Type Acceptance No.	

21. Remarks:

USCOMM-DC 83 11031

Agency No. _____

FORM NTIA-34
(6 83)

U.S. DEPARTMENT OF COMMERCE
NATIONAL TELECOMMUNICATIONS AND
INFORMATION ADMINISTRATION

RECEIVER EQUIPMENT CHARACTERISTICS

1. Nomenclature/Model Number	1a. Manufacturer's Name
2. System Nomenclature	3. Receiver Type
4. Tuning Range	5. Method of Tuning
6. RF Channeling Capability	7. Frequency Stability
8. Emission Designator(s)	9. RF Selectivity ☐ Calculated ☐ Measured (a) –3 dB _____ (b) –20 dB _____ (c) –60 dB _____ (d) Type of preselection used _____
10. IF Selectivity (a) –3 dB _____ (b) –20 dB _____ (c) –60 dB _____	
11. Maximum Bit Rate	12. Maximum Post Detection Frequency
13. De-emphasis Available ☐ Yes ☐ No	14. Minimum Post Detection Frequency
15. IF Frequency	16. Sensitivity (a) _____ dBm (b) Criteria _____ _____ (c) Noise Temperature/Noise Figure _____ Kelvin/dB
17. Oscillator Tuned Above tuned frequency ☐ Below tuned frequency ☐ Either above or below tuned frequency ☐	
18. Spurious Rejection	19. Image Rejection

20. Remarks

Agency No. _____

FORM NTIA-35
(6-83)

U.S. DEPARTMENT OF COMMERCE
NATIONAL TELECOMMUNICATIONS AND
INFORMATION ADMINISTRATION

ANTENNA EQUIPMENT CHARACTERISTICS

1. Nomenclature Model Number	1a. Manufacturer's Name
2. System Nomenclature	3. Type
4. Frequency Range	5. Polarization
6. Gain (a) Main Beam _____ (b) Side Lobe _____ _____	7. Scan Characteristics (a) Type _____ (b) Vertical Scan (1) Max. Elev. _____ (2) Min. Elev. _____ (3) Scan Rate _____
8. Beamwidth (a) Horizontal _____ (b) Vertical _____	(c) Horizontal Scan (1) Sector Scanned _____ _____ (2) Scan rate _____
9. Remarks	

FORM **NTIA-29**
(4-80)

U.S. DEPARTMENT OF COMMERCE
NAT'L. TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

BIBLIOGRAPHIC DATA SHEET

	1. PUBLICATION NO.	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

PLANNING GUIDE FOR THE REVIEW OF TELECOMMUNICATIONS SYSTEMS FOR FREQUENCY AVAILABILITY AND ELECTROMAGNETIC COMPATIBILITY

5. Publication Date
DECEMBER 1983

6. Performing Organization Code

7. AUTHOR(S)
Robert T. Watson

9. Project/Task/Work Unit No.
9014101

8. PERFORMING ORGANIZATION NAME AND ADDRESS
National Telecommunications and Information Administration
179 Admiral Cochrane Drive
Annapolis, Maryland 21401

10. Contract/Grant No.

11. Sponsoring Organization Name and Address
U.S. Department of Commerce/NTIA
179 Admiral Cochrane Drive
Annapolis, Maryland 21401

12. Type of Report and Period Covered
Technical

13.

14. SUPPLEMENTARY NOTES

15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report is an update of a previous report of the same title published by the former Office of Telecommunications Policy. It provides guidance to Federal system planners in securing spectrum support for proposed new or modified telecommunications systems in compliance with procedures of the National Telecommunications and Information Administration (NTIA). These procedures are in response to an Office of Management and Budget Circular (OMB Circular No. A-11) requiring certification from NTIA of spectrum support prior to submission of budget estimates to OMB. This report summarizes the various steps involved in the process, suggests questions each agency should address in preparation for submission and provides example outputs.

16. Key Words *(Alphabetical order, separated by semicolons)*

Electromagnetic Compatibility; Frequency Availability; Life Cycle; NTIA System Review Process; Spectrum Planning Subcommittee; Spectrum Management

17. AVAILABILITY STATEMENT	18. Security Class. *(This report)*	20. Number of pages
☒ UNLIMITED.	UNCLASSIFIED	64
☐ FOR OFFICIAL DISTRIBUTION.	19. Security Class. *(This page)* UNCLASSIFIED	21. Price:

☆ U.S. Government Printing Office: 1980—678-495/529