Department of Energy
Washington, DC 20585

November 29, 2007

Ms. Meredith Attwell Baker
Acting Assistant Secretary of Commerce
For Communications and Information
1401 Constitution Avenue, N.W.
Washington, DC 20230

Dear Ms. Baker:

In response to your letter dated August 2, 2007, I am pleased to provide the Department of Energy's 2007 Strategic Spectrum Plan. Our submission is provided in support of the Department of Commerce's development of the 2007 Federal Strategic Spectrum Plan. The Department of Energy appreciates the opportunity to provide this submission. If you or your staff require any further information, please contact TheAnne Gordon, Associate CIO for IT Planning, Architecture, and E-Government, at (202) 586-3705.

Sincerely,

Thomas N. Pyke, Jr.
Chief Information Officer

Enclosure

The Department of Energy

Strategic Spectrum Plan

In Support of the President's Spectrum Policy Initiative

November 30, 2007

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1. INTRODUCTION

Background: On November 30, 2004, President George W. Bush issued a Presidential Determination regarding improving spectrum management for the 21st century. The Presidential Determination established the requirement for the heads of federal agencies to provide an agency-specific strategic spectrum plan by November 2005 and to update the plan biennially. The Department of Energy's 2007 Strategic Spectrum Plan is organized according to the outline template provided by the National Telecommunications and Information Administration (NTIA) staff in the NTIA Strategic Spectrum Planning and Reform Division. The plan provides a description of the Department of Energy's current spectrum uses and future spectrum requirements, planned uses of new spectrum-dependent technology, and efforts to implement more efficient approaches to meeting spectrum requirements.

Agency Mission: The Department of Energy's overarching mission is "Discovering the solutions to power and secure America's future." Specific elements of this mission are: to advance the national, economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex. The Department's sixteen strategic goals to achieve the mission are designed to deliver results along five strategic themes:

1. Energy Security: Promoting America's energy security through reliable, clean, and affordable energy.

2. Nuclear Security: Ensuring America's nuclear security.

3. Scientific Discovery and Innovation: Strengthening U.S. scientific discovery, economic competitiveness, and improving quality of life through innovations in science and technology.

4. Environmental Responsibility: Protecting the environment by providing a responsible resolution to the environmental legacy of nuclear weapons production.

5. Management Excellence: Enabling the mission through sound management.

The Department of Energy stands at the forefront of helping the Nation meet our energy, scientific, environmental, and national security goals. These include developing and deploying new energy technologies, reducing our dependence on foreign energy sources, protecting our nuclear weapons stockpile, and ensuring that America remains competitive in the global marketplace. As the steward of the Nation's nuclear weapons stockpile, DOE is responsible for maintaining nuclear deterrents and leading the international nuclear nonproliferation efforts in a world where terrorism is a real threat to national security and world sustainability. DOE is also responsible for the safe cleanup of the environmental legacy of the National nuclear weapons program and government-sponsored nuclear energy research. This includes mitigating the risks and hazards associated with disposing of nuclear materials and deactivation and decommissioning facilities no longer needed to support the Department's mission.

Strategic Vision for Spectrum Management: The Department of Energy's strategic vision for spectrum management is that federal spectrum resources will be prudently used, federal spectrum management processes will be effectively conducted, and NTIA certifications for DOE spectrum-dependent systems be fully documented.

DOE has the following three Spectrum Management goals:

1. Improve spectrum management at DOE by 1) publishing a DOE Spectrum Management guidance document, 2) improving planning for future spectrum requirements, and 3) facilitating an integrated management approach through the DOE Spectrum Management Program.
2. Integrate spectrum management into Departmental EA by 1) ensuring spectrum investments are in line with the Department's strategic goals and target architecture and 2) evaluating and improving the capital planning and investment control process for spectrum management.
3. Improve interoperability, spectrum resource sharing, and spectrum support for emergency planning by 1) further developing interoperability capabilities and 2) increasing sharing of spectrum and telecommunications assets within the Department, among other federal departments, and with state, local, and energy sector partners.

2. EXECUTIVE SUMMARY

2.1. Key spectrum requirements: The Department of Energy (DOE) has an investment in spectrum dependent assets that is well over $1 billion. This investment is in Government-owned, radio communication equipment and other spectrum dependent systems that employ over 8,300 Government allocated frequency assignments. The largest portion (85%) of DOE's frequency assignments fall into the two areas of Land Mobile Radio (LMR) systems and fixed microwave point-to-point radio systems. DOE also uses frequency assignments to support radars, unmanned airborne vehicles, unmanned ground vehicles, and sensors.

2.2. Summary of trends in spectrum use: There are several major trends in DOE's primary uses of spectrum. DOE is engaged in a major congressionally mandated effort to relocate all systems out of the 1710 – 1755 MHz band into alternate bands or alternate solutions. DOE will be relocating approximately 596 frequency assignments under this effort. Most of the 596 frequency assignments support fixed point-to-point microwave systems. These systems will primarily be relocated to either the 4400 – 4940 MHz band or the 7125 – 8500 MHz band. The other trend for DOE spectrum relates to Land Mobile Radio systems where DOE sites and facilities around the country have made significant progress in implementing "trunking" systems that enable sharing of spectrum resources among federal agencies and also in implementing narrowband radios that enable improved spectrum efficiency. The Department's future spectrum needs will be driven by mission-influenced requirements, policy-mandated requirements, and responses to technology and new service advancements. DOE anticipates the need for upgrading or purchasing new systems or equipment to support land mobile radio, ultra high frequency data and voice, microwave, satellite, supervisory control and data acquisition, radar, ultra wideband, and radio frequency identification.

2.3. Summary of strategies for meeting spectrum requirements and successes in implementing more efficient spectrum approaches (e.g., technologies, policies, and/or procedures): DOE has been aggressively pursuing the implementation of narrowband (i.e., 12.5 KHz channels) in both the 162 – 174 MHz (VHF) band and the 406 – 420 MHz (UHF) band, as mandated by the NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management, paragraphs 4.3.7 and 4.3.9. Most of DOE's sites have completed the implementation of narrowband capabilities and only a few systems remain to be transitioned off of the legacy wideband (i.e., 25 KHz or wider) channels.

2.4. Summary of DOE spectrum management and capital planning goals, objectives, and accomplishments:

- The November 30, 2004 Executive Memorandum provided direction to agencies to "implement a formal process to evaluate their proposed needs for spectrum." Under the DOE Office of the Chief Information Officer (OCIO), spectrum management has been incorporated into the DOE Enterprise Architecture. As such, spectrum is included in the Enterprise Architecture – Capital Planning and Investment Control (EA-CPIC) reviews of the Information Technology Portfolio.

- DOE programs that either acquire new spectrum-dependent systems or plan major upgrades/expansions of existing spectrum-dependent systems submit spectrum certification documentation for review and assessment to the DOE Headquarters Spectrum Management program. The review includes an evaluation with respect to the system's spectrum efficiency attributes. System configurations or approaches that are not consistent with efficient use of spectrum resources are addressed with the sponsoring DOE field organization and must be justified before the certification proposal is submitted to the NTIA IRAC Spectrum Planning Subcommittee.

- DOE is updating the Department's Information Technology Management policy (DOE Order 200.1) to incorporate the formal responsibilities of the CIO for federal spectrum management. The updated policy will be complemented with the revision of the DOE Radio Services Procedural Guide (RSPG). The RSPG describes federal spectrum management responsibilities for all DOE organizations employing spectrum and will be revised to incorporate guidance from OMB Circular A-11 regarding NTIA certification of spectrum dependent systems.

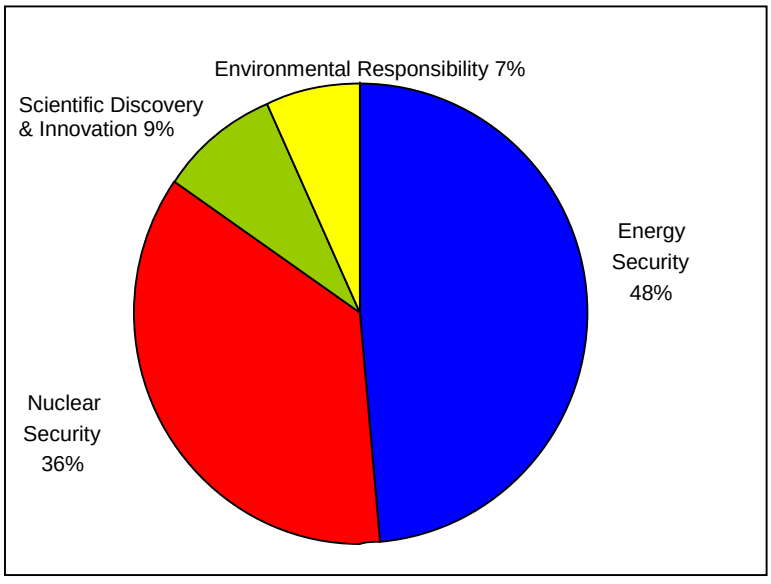
3. CURRENT SPECTRUM USE BY THE DEPARTMENT OF ENERGY

The Department of Energy owns and operates a myriad of radio communication systems and other spectrum-dependent systems in support of DOE's missions. These systems include point-to-point microwave systems that support data and voice transmissions across long distances for DOE's Power Marketing Administrations (PMA's), land mobile radio (LMR) networks that provide voice communications for DOE's mobile workforce, unmanned ground and aerial platforms, remote controlled cranes for handling hazardous nuclear materials, and several types of radar systems. At the current time DOE holds more than 8,300 distinct Government frequency assignments to operate these various systems across the country. This section provides a description of DOE's current frequency usage by DOE mission area and also by the major system types. DOE mission areas are explained in more detail in Section 8.

The information presented within this section is based on data contained in the National Telecommunications and Information Administration's (NTIA) Government Master File (GMF), which contains frequency assignment information for all government agencies. The September 2007 edition of the GMF was used as the baseline.

Figure 3-1 illustrates the proportion of DOE's 8,300 frequency assignments that are employed by each of the different DOE mission areas. The Management Excellence strategic theme is incorporated within the percentages of the DOE mission areas.

Figure 3-1: Percentage of Frequency Assignments by Mission Area



The DOE frequency assignments documented in the September 2007 edition of the GMF can be associated with 21 DOE entities or organizations that use Government-allocated frequencies to support DOE operations. Table 3-1 identifies the primary communications functions that DOE supports within each of the general segments of the radio frequency spectrum.

Table 3-1: Spectrum Uses by Frequency Band

Frequency Band	Use					
	Aerial Tracking	Long Distance Communications	LMR	Satellite	Telemetry	Microwave
Below 3 MHz	✓					
High Frequency (HF) (3 MHz–30 MHz)		✓				
Very High Frequency (VHF) (30 MHz–300 MHz)			✓			
Ultra High Frequency (UHF) (300 MHz–3 gigahertz [GHz])			✓	✓	✓	✓
Above 3 GHz						✓

Figure 3-2 below identifies the percentages of DOE assignments that are employed within these five general bands or segments. Of the frequency assignments represented in Figure 3-2, it can be seen that the majority (i.e., VHF, UHF, and Above 3 GHz) are used for LMR and microwave links, with 27.2 percent of the assignments in the VHF band and 37.3 percent in the UHF band.

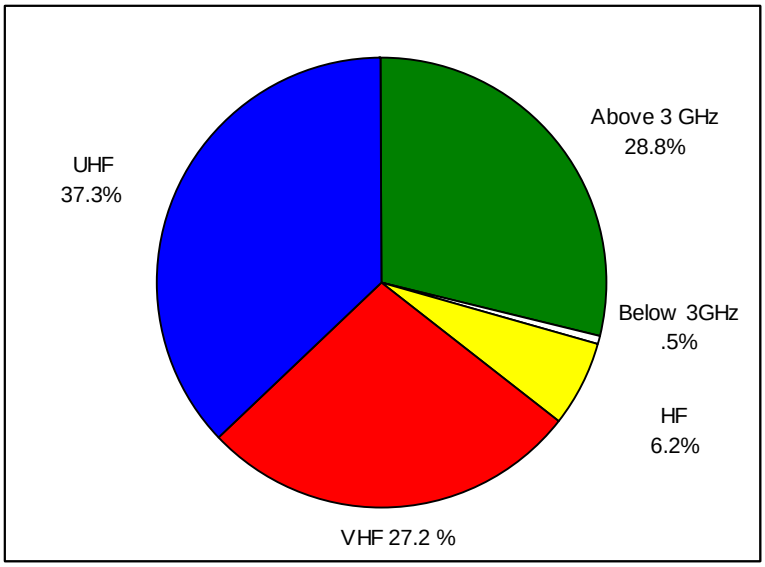


Figure 3-2: Frequency Assignment Percentages by Band

Table 3-2 below provides specific quantities of frequency assignments used by each of the 21 DOE entities for the five general bands.

Table 3-2: Frequency Assignments by Office and Type

Office	Below 3 MHz	HF	VHF	UHF	Above 3 GHz	TOTAL
Albany Research Center			8			**8**
Albuquerque Operations Office	10	130	190	586	99	**1,015**
Bonneville Power Administration (BPA)		2	442	291	866	**1601**
Chicago Operation Office	2	30	150	122	16	**320**
DOE Headquarters	5	43	85	23	8	**164**
Idaho Operations Office	1		35	90	21	**147**
Federal Energy Technology Center (FETC)				33	2	**35**
Nevada Operations Office	1	23	112	194	146	**476**
National Nuclear Security Administration (NNSA)				2		**2**
NNSA Service Center	10	157	183	525	166	**1,041**
Oak Ridge Operations Office	1	8	19	185	2	**215**
Oakland Operations Office		30	69	132	40	**271**
Ohio Field Office		1		2		**3**
Pittsburgh Naval Reactors			33	17		**50**
Richland Operations Office	3	31	120	67		**221**
Rocky Flats Field Office			13	24	4	**41**
Savannah River Operations Office	3	49	80	76	3	**211**
Schenectady Naval Reactors			14	16		**30**
Southwestern Power Administration (SWPA)			125	106	152	**383**
Strategic Petroleum Reserve		3	91	20	2	**116**
Western Area Power Administration (WAPA)			413	555	876	**1,844**
Miscellaneous	3	11	90	46	7	**157**
TOTAL	**39**	**518**	**2,272**	**3,112**	**2,410**	**8,351**

Table 3-3 below provides another perspective on DOE frequency usage by showing the number of assignments within each of 11 allocated frequency bands that are fairly commonly used by Government agencies. In addition to the number of DOE assignments, the table indicates the DOE entities with the most assignments in each band, and the primary type of system using the band.

Table 3-3: Most Commonly Assigned Frequency Bands

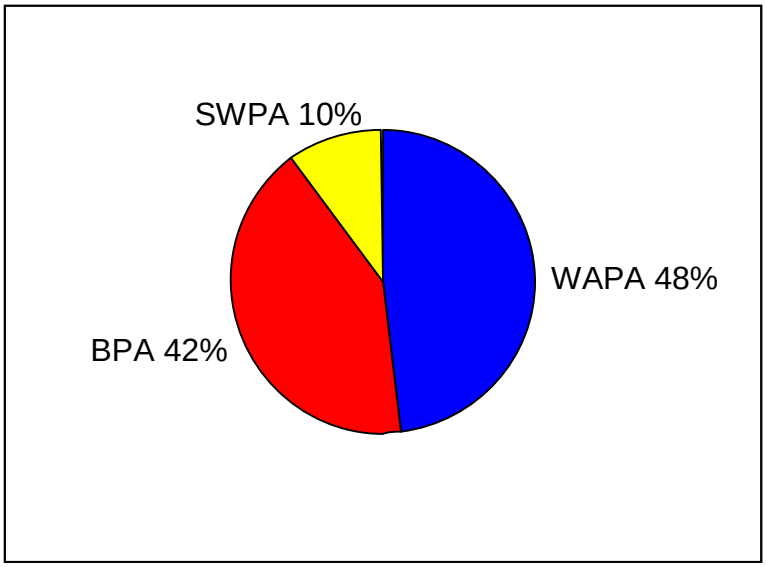
Frequency	No. of Assignments	Most Common Offices	Type of System
162.01–173.4 MHz	1713	WAPA, BPA	LMR
406–410 MHz	608	NNSA Service Center, Nevada Operations Office	LMR
410–420 MHz	1,022	NNSA Service Center, Nevada Operations Office, Albuquerque Operations Office	LMR
932–944 MHz	259	BPA, WAPA	LMR
1710–1755 MHz	213	WAPA, BPA	Microwave
1755–1850 MHz	378	WAPA, BPA	Microwave
2200–2290 MHz	207	NNSA Service Center	Microwave
7.3–7.45 GHz	256	WAPA, BPA	Microwave
7.55–7.75 GHz	569	BPA, WAPA	Microwave
7.75–7.9 GHz	274	BPA, WAPA	Microwave
8.025–8.175 GHz	260	BPA, WAPA	Microwave
8.215–8.4 GHz	275	BPA, WAPA	Microwave

The remainder of this section discusses DOE's current spectrum usage according to each mission area. Each subsection identifies the offices and administrations that hold spectrum assignments and discusses the use of the spectrum. Additionally, unique requirements and current asset sharing arrangements are included when applicable.

3.1 Spectrum Supporting the Energy Security Mission Area

The Energy Security Mission Area protects national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy. DOE uses 3,987 assignments or almost half of its spectrum assignments to support the Energy Security Mission Area. DOE's primary entities using spectrum in support of the Energy Security Mission Area are the power marketing administrations which include BPA, SWPA and WAPA. The Albany Research Center, FETC, and the Strategic Petroleum Reserve are also included in the Energy Security Mission Area but use much fewer assignments (e.g., 159 total) than the power marketing administrations. Of the DOE Energy Security entities, BPA and WAPA hold the largest number of spectrum assignments (3,445 collectively). Figure 3-3 shows the distribution of DOE assignments supporting the Energy Security Mission Area among the three identified power marketing administrations.

Figure 3-3: Spectrum Supporting the Energy Security Mission Area by PMA



3.1.1 Bonneville Power Administration (BPA)

BPA uses the majority of its spectrum assignments for LMR and point-to-point microwave links. BPA employs 437 VHF (162 – 174 MHz) frequency assignments to support a 66-repeater/remote base site voice LMR system that provides service to more than 1,000 users. This LMR system supports power operations and maintenance. Point-to-point applications use UHF links in the UHF bands (406-410 MHZ, 410-420 MHz, 932-944 MHz), and microwave links to support power operations and maintenance activities. BPA has examined using other technologies, such as commercial cellular and satellite communications to meet its power operations and communications needs, but these technologies do not currently provide the reliability, availability, and ease of control needed to support BPA's mission requirements.

BPA also has extensive point-to-point microwave networks that are integrated with fiber optics and cable systems to support long-haul connectivity for power operations and maintenance. Table 3-4 shows the number, general geographical location, and general band of operation for these microwave links.

Table 3-4: BPA Microwave Links

Frequency Band	Location	Number
2 GHz	Washington, Oregon, Idaho, Montana	115
4 GHz	Washington, Montana	14
6 GHz	Washington, Oregon, Idaho	6
7 GHz and 8 GHz	Washington, Oregon, Idaho, Montana	844

BPA has considered using other technologies or commercially owned assets as a replacement for these microwave systems. However, the limited availability of commercially owned fiber and commercial microwave links makes these services an unrealistic option. Federal power marketing administrations, as well as all major utilities, typically require the use of privately-owned communications for critical power system operation in order to insure the reliability of operational telecommunications and electric power transmission systems. BPA has pursued

government-owned fiber to replace many microwave links; however, microwave links are still the best alternative when fiber is not physically or economically practical.

3.1.2 Western Area Power Administration (WAPA)

WAPA uses most of its spectrum assignments for LMR systems and point-to-point microwave links in a similar manner to BPA. Because of the large geographic size of WAPA's area of responsibility, its LMR networks have been split into four regions, with 413 VHF frequency assignments supporting four separate voice LMR networks used for power operations and maintenance. WAPA has examined the potential use of other technologies, such as commercial cellular providers and push-to-talk devices, in place of its LMR systems. Service unreliability, unavailability in remote areas, and lack of dispatcher control were cited as reasons for not adopting these technologies.

WAPA also owns numerous point-to-point UHF and microwave links to support power operations and maintenance activities. These links operate in the 400 MHz, 900 MHz, 2 GHz, 6 GHz, 7 GHz, and 8 GHz frequency bands. Table 3-5 provides a breakdown of WAPA sites or frequencies by region and state location.

Table 3-5: WAPA Microwave Links

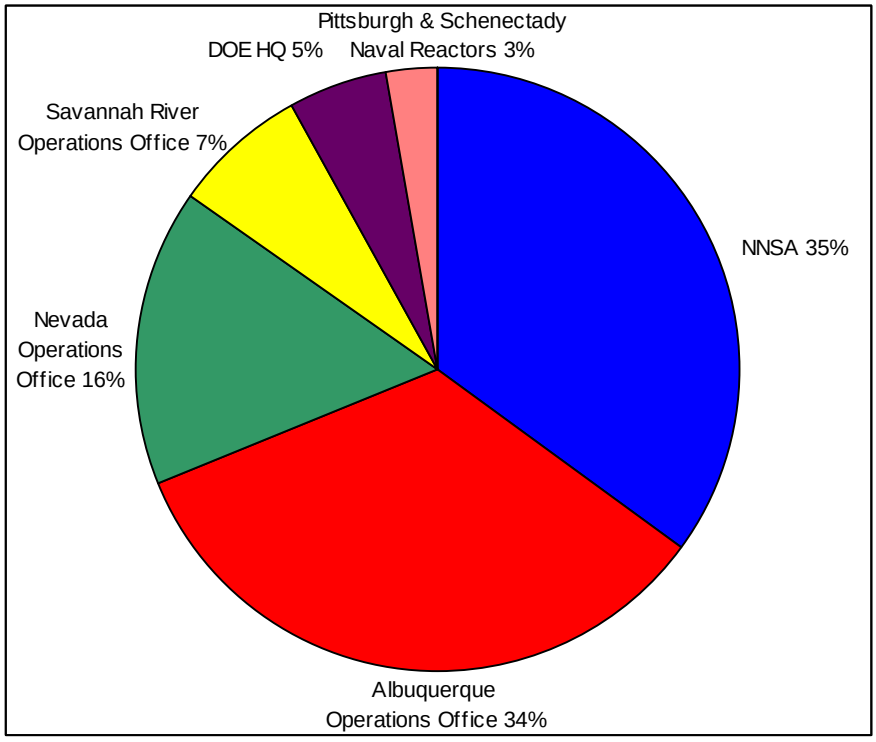
Region	Location	Number
Desert Southwest	Arizona, Nevada, Southern California	237
Rocky Mountain	Colorado, New Mexico, Utah, Wyoming, Nebraska	780
Sierra Nevada	Northern California	45
Upper Great Plains	Montana, North Dakota, South Dakota, Iowa, Minnesota, Nebraska	364

WAPA has also considered using other technologies or commercially owned assets to replace its microwave links. Several links have been replaced by government-owned fiber. Commercially owned fiber and microwave links were also considered, but limited availability and the unreliability of the transmission medium were cited as reasons for not using these services.

3.2 Spectrum Supporting the Nuclear Security Mission Area

Spectrum that is used to protect our national security by applying advanced science and nuclear technology to the Nation's defense falls under the Nuclear Security Mission Area. More than 36 percent (2,989 assignments) of the Department's spectrum assignment assets support this mission area. Entities holding these spectrum assignments include the NNSA, Nevada Operations Office, DOE Headquarters Security, Albuquerque Operations Office, Pittsburgh Naval Reactors, Savannah River Operations Office, and Schenectady Naval Reactors. Of these entities, the NNSA Service Center and the Nevada Operations Office hold the greatest number of assignments. Figure 3-4 provides a depiction of the distribution of these assignments by major Nuclear Security field organization.

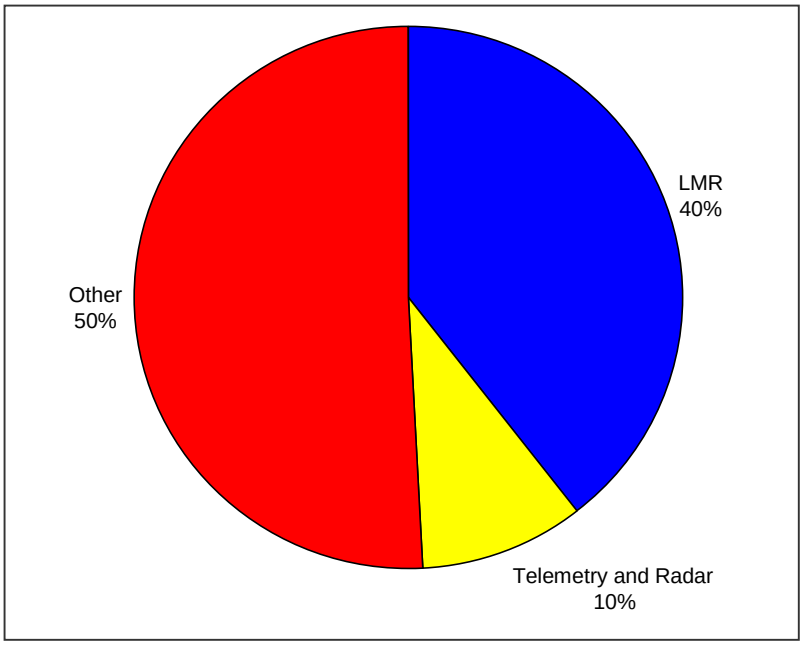
Figure 3-4: Spectrum Supporting the Nuclear Security Mission Area by Office



3.2.1 NNSA Service Center

The NNSA Service Center oversees the spectral assets of several national laboratories and area offices. These include the Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia National Laboratory, and the Amarillo Area Office. About 40 percent of these spectrum assignments are used to support LMR systems at the laboratories and field offices. Most of these LMR systems use spectrum in the UHF bands (406 – 410 MHz and 410 – 420 MHz). Approximately 10 percent of the assignments are used for airborne and space telemetry in the 2200–2290 MHz band to track radioactive waste as it is moved across the country. The remainder of the NNSA Service Center assignments are for uses that include HF voice networks, microwave links, satellite communications, and research purposes. Figure 3-5 provides an indication of the proportion of NNSA Service Center assignments according to their major category of use.

Figure 3-5: NNSA Frequency Assignments by Usage



Some of the DOE entities whose spectrum is managed by the NNSA Service Center share spectrum resources with other federal agencies and local public safety agencies. The Lawrence Livermore National Laboratory shares its UHF LMR system with the U.S. Army and serves as the Public Safety Answering Point for the system, dispatching all medical and fire responses for Alameda County, California. The Los Alamos National Laboratory shares its UHF LMR system with local public safety agencies and with the Department of the Interior's Bureau of Indian Affairs.

3.2.2 Nevada Operations Office

The Nevada Operations Office manages spectrum for the Nevada Test Site, the NNSA Las Vegas Campus, Yucca Mountain, and DOE assets located on Nellis Air Force Base (AFB). Slightly more than 50 percent of the frequency assignments are used for LMR communications. For example, a UHF LMR system provides voice communications to nearly 6,800 users at the Nevada Test Site and the NNSA Las Vegas Campus. Spectrum is also used for numerous other activities, including telemetry, microwave communications, and environmental quality monitoring at test sites.

The Nevada Operations Office has made numerous efforts to increase the efficiency of its spectrum use. In addition to sharing with the U.S. Air Force at Nellis AFB, the office shares spectrum resources for incident response with the National Park Service, U.S. Forest Service, and the Department of the Interior's Bureau of Land Management. The Nevada Operations Office has also considered using commercial services to replace some of its LMR systems, but the lack of sufficient encryption capabilities prevented a transition from government-controlled systems.

3.3 Spectrum Supporting the Scientific Discovery and Innovation Mission Area

Spectrum supporting activities that protect our national and economic security by providing world-class scientific research capacity and advancing scientific knowledge falls under the Scientific Discovery and Innovation Mission Area. More than 8 percent of the Department's spectrum assignment assets are used to support this mission area. Entities with spectrum assignments supporting the Science mission area are the Chicago Operations Office, the Idaho Operations Office, and the Oak Ridge Operations Office. As shown in Figure 3-6, the Chicago Operations Office employs the majority of these resources.

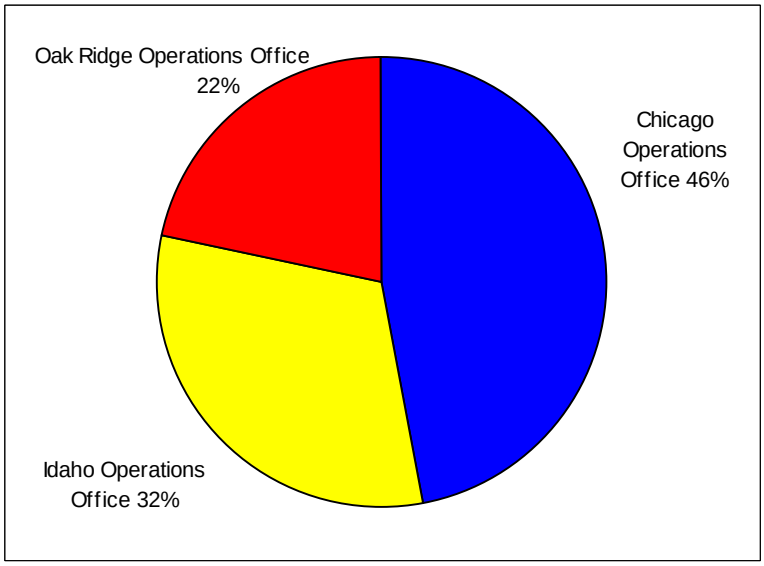


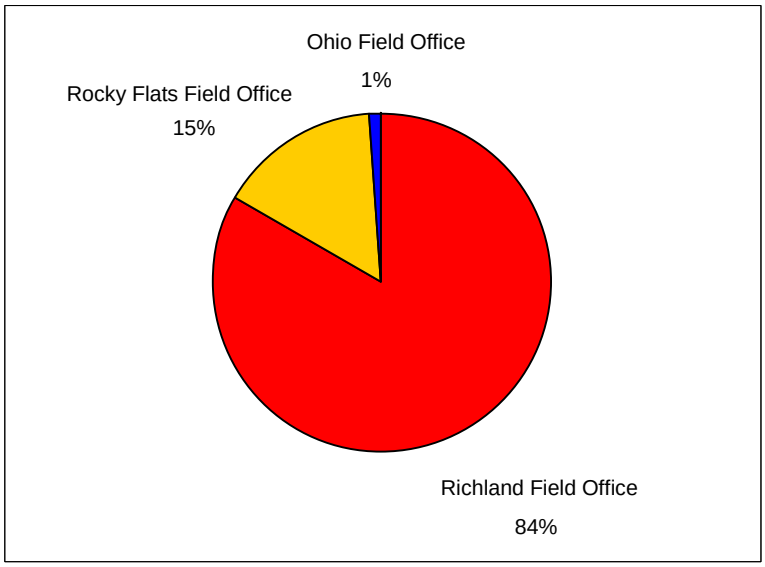
Figure 3-6: Spectrum Supporting the Scientific Discovery and Innovation Mission Area by Office

Most of these frequencies support LMR communications at the national laboratories and area offices or operations offices. Assignments are also used for a small number of microwave links, satellite communications, radar, and scientific instrumentation systems.

3.4 Spectrum Supporting the Environmental Responsibility Mission Area

Spectrum assets supporting the Environmental Responsibility are used to protect the environment by providing a responsible resolution to the environmental legacy of the cold war and by providing for the permanent disposal of the Nation's high-level radioactive waste. DOE uses 3.1 percent of its spectrum assignments to support this mission area. The Ohio Field Office, Richland Operations Office, and Rocky Flats Field Office hold assignments under this mission area. As seen in Figure 3-7, the Richland Operations Office holds most of the frequency assignments under this mission area.

Figure 3-7: Spectrum Supporting the Environmental Responsibility Mission Area by Office



Nearly two-thirds of these frequency assignments are used for LMR systems at the cleanup sites, with the other assignments being used for satellite communications and HF communications.

3.5 Interoperability

In today's world, the ability for public safety agencies to be able to communicate via radiocommunication in emergency response situations is critical. Although not generally considered a public safety agency, DOE is a valuable participant in emergency response at a large number of its operating locations. This is very important since an incident could occur at or near a DOE facility. Therefore, it is imperative that personnel at DOE field offices be able to communicate with public safety first responders.

Many field offices have established relationships with state and local public safety agencies, including—

- The Fermi National Accelerator Laboratory has a separate Letter of Agreement with 11 state and local public safety agencies to operate on shared frequencies from DOE-owned onsite transmitters.

- The Argonne National Laboratory is transitioning to the Illinois state LMR system and serves as a Joint Operations Center (JOC) for the Chicago, Illinois, area.

- The Oak Ridge National Laboratory hosts mutual aid channels for local public safety agencies.

- The Los Alamos National Laboratory shares a UHF system with state and local public safety agencies.

- The Lawrence Livermore National Laboratory dispatches fire and medical responses for Alameda County, California.

- The Brookhaven National Laboratory has letters of agreement with the local police department and the county fire department to allow them to transmit on DOE-owned equipment during emergencies and mutual aid situations.

Additionally, many field offices noted that they are using the Department of Homeland Security's (DHS) SAFECOM Program[1] guidelines when installing or upgrading LMR systems. These examples show that many DOE field offices are actively engaged in improving interoperability and relationships with state and local public agencies.

[1] SAFECOM is a communications program of the Department of Homeland Security. SAFECOM provides research, development, testing and evaluation, guidance, tools, and templates on interoperable communications-related issues to local, tribal, state, and Federal emergency response agencies.

4. FUTURE SPECTRUM REQUIREMENTS

DOE's use of spectrum resources is expected to continue as described in the previous section that addressed current spectrum requirements. In addition, DOE will have future spectrum needs emerge due to requirements to support policy mandates and adaptation to technology shifts and mission scope changes. This section addresses DOE's future spectrum needs using the DOE mission area framework. It is expected that spectrum needs will be impacted by future spectrum policy directions, evolving short term technology impacts, as well as longer term technology shifts shaping spectrum usage. DOE's future spectrum needs are expected to ultimately be affected by—

- Advances in technology offering unique applications
- Greater need for interoperability between organizations with complementary missions
- Increased emphasis placed on national and homeland security
- Added emphasis on communications resource sharing
- Advanced research associated with the development of computer and communications services.
- The requirement to relocate key communication links operating in the 1710 – 1755 MHz band.
- The requirement to operate narrowband in the 406 – 420 MHz band.

DOE has taken the initiative to begin planning for these new and changing spectrum requirements by discussing and capturing the Department's future spectrum direction, and documenting the anticipated requirements of field offices, as presented within this report. The following sections discuss future DOE spectrum direction and requirements according to DOE's mission and current policy mandates, and are based on insights with respect to emerging technologies and their potential impacts.

4.1 Mission Influenced Requirements

The **Energy Security Mission Area** requires wireless voice and data systems to continue to support a reliable power grid and growing automation demands. System sharing and interoperability will likely result in commonality of federal and private utility systems. Wireless systems for LMR, supervisory control and data acquisition (SCADA), microwave, point to multipoint applications, Radio Frequency Identification (RFID), and Ground Penetrating Radar (GPR) will be needed. The primary types of systems and associated bands are—

- **LMR[2] and SCADA**: 162–420 MHz bands
- **Point-to-multipoint**: 406–900 MHz bands
- **Digital microwave**: 2–15 GHz bands.
- **GPR**: 0.4-4 GHz bands
- **RFID**: 918-920 MHz
- **HF**: 2-30MHz

The **Environmental Responsibility Mission Area** is expected to use airborne and satellite systems to detect and monitor the environment and share resources with National Aeronautics and Space Administration (NASA) and the Department of Defense (DoD). The Earth Exploration Satellite Service and Airborne Synthetic Aperture Radars currently operating in the 1–30 GHz bands will probably satisfy most of these needs. Localized communications needs will most likely use commercial voice communications services in all but the most isolated areas where commercial services are not offered. In those situations, LMR systems will be necessary and will most likely operate in the 406–420 MHz band. The Environmental Responsibility Mission Area plans to use RFID and GPR capabilities and technologies.

The primary types of systems and associated bands are—

- **LMR and SCADA**: 162–420 MHz bands
- **Point-to-multipoint**: 406–900 MHz bands
- **Digital microwave**: 2–15 GHz bands.
- **GPR**: 0.4-4 GHz bands
- **RFID**: 918-920 MHz
- **HF**: 2-30MHz
- **RADARS:** 1-30 GHz
- **WLAN:** 2-5 GHz

The **Nuclear Security Mission Area** requirements will be greatly influenced by homeland security and interoperability requirements, for which some consolidation between federal and state systems is anticipated. The following functions and bands are projected:

- Nuclear nonproliferation detection will require satellite surveillance using passive and active bands between 200 MHz and 20 GHz. Telemetry Tracking and Command links will use the 1.8 GHz and 2.2 GHz bands for satellite monitoring and control.

- Detecting, measuring, tracking, and monitoring radioactive materials will be accomplished by using satellite capabilities, airborne remote controlled radar, and a variety of commercial and government voice and data mobile systems operating in bands between 162 MHz and 2 GHz.

[2] DOE must migrate to LMR systems capable of operating on 12.5 kilohertz (kHz) channel bandwidths by 2008.

- Deterring, contamination and monitoring, and resolving radiological incidents will require the use of ultra wideband (UWB) technology and robot-controlled and secure LMR systems operating in the 162 MHz, 406 MHz, and 800 MHz bands to communicate with various public safety organizations.

- Nuclear storage and laboratory control will require robust LMR systems using secure voice and data systems operating in the 406–420 MHz band and commercial wireless services for administrative and operations functions. HF heating devices to melt glass for material storage are expected to continue to operate in the Industrial, Scientific, and Medical (ISM) frequency bands.[3] Field offices will strengthen security by using more radars operating in the 1.3 GHz, 3 GHz, and 5 GHz bands. Security sensors may be deployed using LMR systems in the 162 MHz and 406 MHz bands or UWB systems in the 1-5 GHz range.

The primary types of systems and associated bands are—

- **LMR and SCADA**: 162–420 MHz bands
- **Point-to-multipoint**: 406–900 MHz bands
- **Digital microwave**: 2–15 GHz bands.
- **GPR**: 0.4-4 GHz bands
- **RFID**: 918-920 MHz
- **HF**: 2-30MHz

The **Scientific Discovery and Innovation Mission Area** spectrum needs will likely be heavily influenced by DOE nuclear mission requirements. While future spectrum needs are very difficult to project, some areas where DOE anticipates growth in its need for spectrum include various closed experiments using spectrum in the 2–60 GHz band (e.g., ion accelerators), packet switching or spread spectrum technologies operating in frequency bands in the 1–30 GHz band, and climate research using spectrum above 2 GHz. UWB uses will be broadened, and interference avoidance techniques may require development to allay user fears. DOE may provide more support in the development of unmanned flight test and rocket systems operating in the 2–14 GHz band. The need for portable communications devices for use among scientists is expected to be satisfied by use of commercial personal communications services (e.g., BlackBerry devices), especially because this community includes extensive computer and Internet users.

The primary types of systems and associated bands are—

- **LMR and SCADA**: 162–420 MHz bands
- **Point-to-multipoint**: 406–900 MHz bands
- **Digital microwave**: 2–15 GHz bands.
- **GPR**: 0.4-4 GHz bands
- **RFID**: 918-920 MHz
- **HF**: 2-30MHz

[3] ISM frequencies are located in the 900 MHz, 2.4 GHz, and 5.8 GHz bands.

Management Excellence Mission Area will, in large part, be expected to use commercial services for voice and data communications and interconnection to the public switched telephone network (PSTN). Commercial systems will provide value-added services not normally available through DOE owned and authorized systems. High-end DOE-licensed LMR systems will operate in multiple bands to satisfy in-building communications, connect with the PSTN, and communicate with secure, on-scene radios. Unlicensed devices will provide wireless local area network and private branch exchange services and will largely operate in the ISM and National Information Infrastructure (NII) bands.[4] The only exception is expected to be DOE facilities that may require highly secure LMR systems operating in the 406–420 MHz bands.

The primary types of systems and associated bands are—

- **LMR:** 162–420 MHz bands
- **Point-to-multipoint**: 406–900 MHz bands
- **Digital microwave**: 2–15 GHz bands.
- **RFID**: 918-920 MHz
- **WLAN:** 2-5 GHz

4.2 Policy Mandated Future Requirements

In addition to meeting internal DOE spectrum requirements, the Department will continue to comply with policy mandates, congressional directions, Presidential directives, and other regulatory and legislative requirements impacting how spectrum is used and managed. One such mandate that will continue to affect DOE for the foreseeable future is the requirement to migrate from technology that operates on 25 kHz channel bandwidths to technology that supports 12.5 kHz channel bandwidths. The "Narrowbanding Mandate" is designed to increase the efficiency of spectrum use within a given frequency band.[5] Deadlines have been imposed by the NTIA for federal users to transition to 12.5 kHz channel bandwidth technology—

- 138–150 MHz band: January 1, 2008
- 162–174 MHz band: January 1, 2005
- 406–420 MHz band: January 1, 2008.

4.3 Technology and Service Advancement Requirements

In collecting information for the development of this report it is clear that the DOE field offices have a variety of anticipated spectrum and technology requirements planned or anticipated. Table 4-1 below depicts the technologies that are projected to be used, the number of field offices planning to implement or significantly upgrade various wireless communications systems using those technologies, and which mission area the technology will support.

[4] NII frequencies are also located in the 900 MHz, 2.4 GHz, and 5.8 GHz bands.

[5] It is important to note that the efficiency gains are not 100 percent across each step down in channel bandwidth size because of the need for acceptable channel spacing to prevent interference.

Table 4-1: Planned Technology Implementations by aArea

Technology	No. of Offices Planning Implementation	Line of Business				
		Energy	Environment	Defense	Science	General Management
LMR	13	✓	✓	✓	✓	✓
Wireless Local Area Network	14	✓	✓	✓	✓	✓
Radio Frequency Identification (RFID)	17	✓	✓	✓	✓	✓
Microwave	9	✓	✓	✓	✓	✓
Wireless Data	11		✓	✓	✓	✓
Satellite	4			✓	✓	
Cellular/Paging	8			✓		✓
UWB	4			✓	✓	✓
Other Government Services	1			✓		
Other Commercial Services	2				✓	✓

As described and illustrated above, DOE has a significant need for dedicated, secure wireless communications and will continue to demonstrate that need in the future.

4.4 Broadband Public Safety Applications

As requirements for future services are developed, there is an emerging technology that is likely to have direct applications to each of DOE's mission areas. Recent developments in the application of broadband technology to public safety incident response and command and control make it a real possibility for application to federal agencies with similar missions. Although to date, no federal spectrum has been allocated for this purpose, and no specific application has been addressed at DOE, the technology is expected to have a near-term impact on DOE's spectrum needs and additional research may need to be conducted to assess the extent of potential application of this technology.

5. CURRENT AND FUTURE USE OF NON-FEDERAL SPECTRUM OFFERED BY COMMERCIAL SERVICE PROVIDERS

Almost all of DOE's sites, facilities, and capabilities employ commercial wireless telecommunications services. Most facilities employ commercial cellular telephones and BlackBerry devices. These same facilities also use commercial pagers and a significant subset use a combination of commercial pagers for national coverage and government owned pagers for local high-reliability coverage. There are also DOE uses of commercial satellite communications systems for certain missions.

The primary determining factor in DOE's decision to employ commercial wireless telecommunications services is the functionality of the capability to the mission or function being accomplished and the price of the service. The decision to employ commercial services does not take into account the fact that the wireless capability is employing non-federal spectrum. There is essentially a "market" influence in making the decision.

DOE anticipates that there will be a continued growth in the use of commercial services, both with respect to services that are available today and for emerging commercial wireless services and products that are not currently on the market.

There are certain situations where DOE's performance requirements for specific capabilities are such that commercial services and products are not a satisfactory solution. One example is where extremely high reliability coverage for pager functions is necessary and there is no local commercial solution that meets the requirement. Another example is where the DOE Power Marketing Administrations (PMA) require 99.9999 percent reliability for microwave systems supporting the control of the power grid. This reliability requirement equates to an outage constraint of less than 45 seconds a year. Commercial telecommunications companies are reluctant to accept responsibility and liability for failing to provide service at this very stringent reliability level. The advertising and general literature for commercial services typically equate reliability with "customer satisfaction" and discuss customer satisfaction in terms of "fewer dropped calls". A level of satisfaction for fewer dropped calls can be economically achieved with 97% or 98% reliability. What for the average user may be a "reliability level" that is inconvenient may for a PMA be a reliability level that is catastrophic. For example, a major regional power outage such as the major North American blackouts of 1965, 1977, and August 2003 caused severe disruption and economic loss and are prime examples of what could happen if a critical spectrum dependent circuit used to control the electric grid were to fail. DOE published a total cost estimate of about $6 billion dollars as attributable to the 2003 power outage.[6]

6 *"Transforming the Grid to Revolutionize Electric Power in North America", Bill Parks, US Department of Energy, Edison Electric Institute's Fall 2003 Transmission, Distribution and metering Conference, October 13, 2003*

6. AGENCY CURRENT AND FUTURE USE OF "NON-LICENSED" DEVICES

DOE does employ a significant number of "non-licensed" devices in support of its missions, but each situation or usage is unique to the facility or organization.

Wireless local area networks (WLANs) are used at some sites and employ 802.11 (2.4 GHz and 5.8 GHz bands) devices to provide mobile network access throughout the site. Other sites use WLAN capabilities to provide only limited coverage. The basic functions supported with WLANs include corporate management, research, incident management, law enforcement, environmental monitoring, as well as material and vehicle tracking. There are also WLAN capabilities used in the 900 MHz band to support remote data acquisition for environmental monitoring. However, many DOE sites are not able to use any WLAN wireless devices due to operational and security concerns.

Radio Frequency Identification (RFID) devices are also used at a number of DOE sites. DOE uses RFID capabilities for a number of functions to include asset tracking and control (i.e., property management, inventory management, part number identification, and vehicle accountability), corporate management, and security.

Some DOE facilities that handle hazardous materials, to include nuclear waste and nuclear weapons, use wireless remote control capabilities for cranes and other robotic devices. These devices are typically used inside of facilities where the construction of the structure is such that no emanations from them escape outside the facility.

7. NEW TECHNOLOGIES

New technologies that may impact DOE's spectrum needs include ultra-wideband (UWB) and radios with Dynamic Spectrum Access (DSA) protocols. UWB emissions processing systems have been shown to have the capability to enable forming of images of structures and human beings that otherwise may be obscured by smoke or walls. This technology has also been shown to have the capability to provide images of buried structures. Dynamic Spectrum Access protocols, which leverage features derived from Software Defined Radio and Cognitive Radio enabling technologies, have also been demonstrated and are expected to be implemented in the far-term. DSA capable radios are able to sense current use of spectrum and then occupy only the "free" areas of spectrum for their communications.

UWB imaging capabilities have several applications such as force protection, emergency response, and checking the integrity of physical structures. DSA protocols have the capability to enhance interoperable communications by enabling the successful sharing of spectrum. DOE's use of UWB imaging technology will be limited to localized environments, typically not to exceed 50 meters from the transmitter. DOE recognizes that UWB and DSA technologies will require regulatory policy issues to be addressed and guidelines for use to be developed to ensure interference issues are controlled.

The DOE National Nuclear Security Administration (NNSA) is pursuing a technology concept that would use mesh networking to provide connectivity among a variety of fixed and mobile users within a site or facility. The mesh network concept would use multi-hopping technology to allow user devices to "become the network". The technology would employ intelligent routing to enable connectivity at high vehicular speeds; support ad-hoc networking due to its self-forming, self-healing, and self-balancing nature; and incorporate position location capabilities. The vision is for the mesh network to support mobile wireless broadband data to include real-time, high-resolution, full screen video. NNSA is pursuing the establishment of an "enterprise solution" for mesh networks such that all subordinate sites would be able to implement a common or standardized solution with a flexible architecture. The mesh network concept would employ products and services that operate in both the unlicensed 2.4 GHz band and the licensed 4.9 GHz band. The effort is called the NNSA Complex-Wide C3I / MotoMesh Enterprise Plan. Most other DOE field organizations are not anticipating any significant use of new technologies to accomplish their wireless and radio functions.

8. DEPARTMENT OF ENERGY STRATEGIC SPECTRUM PLANNING

8.1 Department of Energy Missions and Themes

The Department of Energy's overarching mission is "Discovering the solutions to power and secure America's future." The Department of Energy stands at the forefront of helping the Nation meet our energy, scientific, environmental, and national security goals.

In FY 2007, the Department developed a new Strategic Plan to meet the Nation's Energy and National Security challenges into the future. The DOE Strategic Plan provides direction for the next 25 years with the focus on "discovering the solutions to power and secure America's future." The Department has further integrated the DOE Strategic Plan's long-term and intermediate goals into the annual performance budget. This performance structure establishes a concrete link between the Strategic Plan's themes and the Department's annual budget, performance metrics, and performance reporting.

Table 8-1 below illustrates the strategic goals for each of the five strategic themes to which the performance structure ultimately aligns.

Table 8-1: Alignment of DOE Strategic Themes

Strategic Themes	
Energy Security	Promoting America's energy security through reliable, clean, and affordable energy
Nuclear Security	Ensuring America's nuclear security
Scientific Discovery and Innovation	Strengthening U.S. scientific discovery, economic competitiveness, and improving quality of life through innovations in science and technology
Environmental Responsibility	Protecting the environment by providing a responsible resolution to the environmental legacy of nuclear weapons production
Management Excellence	Enabling the mission through sound management

8.2 Spectrum Management and Enterprise Architecture (EA)

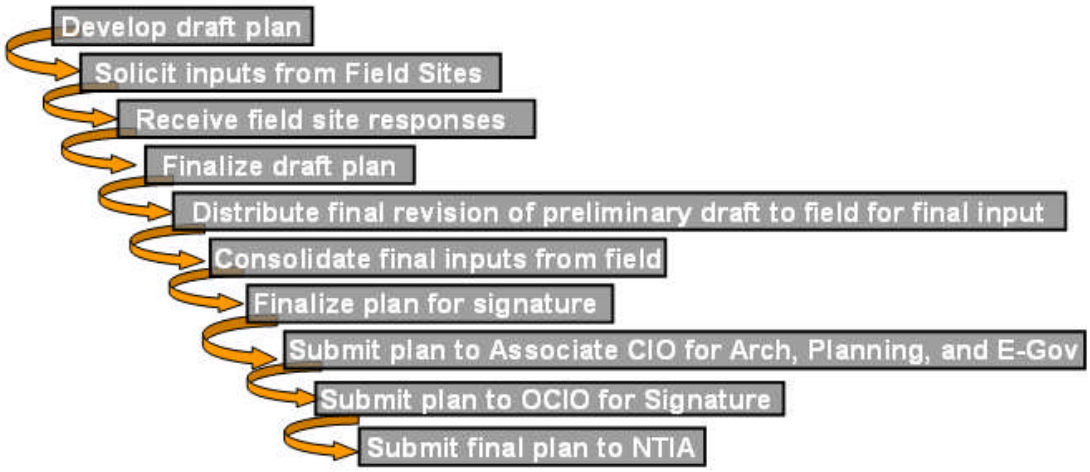
DOE's support and pursuit of implementing the recommendations from the President's Spectrum Policy Initiative (SPI) has provided the Department with a solid foundation for continuing to enhance its spectrum management processes. DOE continues to evaluate and improve its methods of efficiently and effectively managing the way the Department uses spectrum. This Strategic Plan, in response to the Presidential Determination, assesses DOE's spectrum requirements, including bandwidth and frequency location for future technologies or services; the planned uses of new technologies or expanded services requiring spectrum; and suggested spectrum efficient approaches to meet identified spectrum requirements. Examining the planned uses for new and future technologies allows DOE to incorporate spectrum resources into the EA, further enhancing that framework as indicated in the DOE Information Resource Management (IRM) Strategic Plan FY2008 - 2010. The DOE Strategic Spectrum Plan is organized around the DOE strategic themes to provide a more organized and holistic approach to the spectrum management process regarding resource allocation and future investments.

8.3 Strategic Spectrum Plan Process

The DOE 2007 SSP was developed using the following basic 10-step approach that is depicted in Figure 8-1 below.

1. The 2005 DOE Strategic Spectrum Plan was used as a baseline starting point for the development of the draft 2007 SSP. The content of the DOE 2005 Strategic Spectrum Plan was mapped to the maximum extent possible to the suggested outline provided by NTIA for 2007 agency-specific strategic spectrum plans.
2. DOE Headquarters reviewed survey responses that had been submitted by DOE field organizations in development of the 2005 Strategic Spectrum Plan. The survey responses from 2005 were distributed to the associated DOE field organizations to be updated with 2007 information.
3. The DOE field organizations all provided updated 2007 information to DOE Headquarters.
4. The updated information was used in the final development of the various sections of the DOE 2007 SSP.
5. The draft of the 2007 DOE Strategic Spectrum Plan was then distributed to the field organizations for review and comment.
6. Comments provided by the field organizations were incorporated by the DOE HQ staff into the final version of the plan.
7. The plan was revised and edited for signature.
8. The plan was submitted to the Associate CIO for IT Planning, Architecture, and e-Government for review and approval.
9. The plan was submitted to the DOE CIO for signature.
10. The plan was signed by the CIO and forwarded to NTIA as required.

Figure 8-1: 10-Step Coordination Process

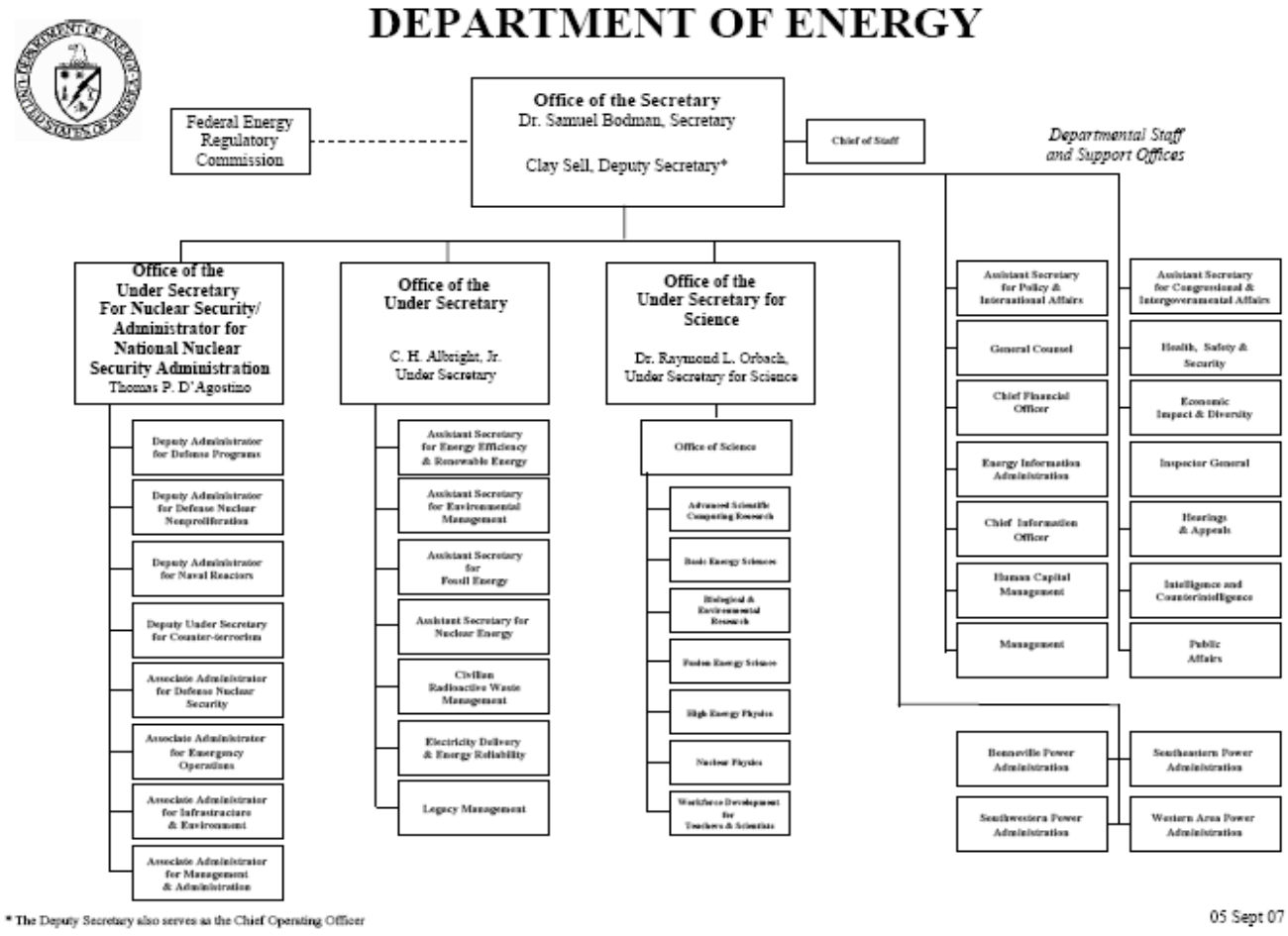


8.4 DOE Organizational chart

The mission of the Department is accomplished through 21 laboratories and technology centers, 4 Power Marketing Administrations, 8 Program Offices, 14 Staff Offices, operations and field organizations located in 13 locations across the United States, the Energy Information Administration, and the National Nuclear Security Administration. Supporting these entities are over 100,000 federal and contractor employees.

DOE's organizational structure is decentralized and aligned according to its multiple missions. Department senior management provides strategic plans, EA targets, and standards to Program Offices to guide program planning, decision making, and capital investment. Program officials are responsible for acquiring and implementing approved programs and investments to achieve performance goals. In this way, the Department ensures that within the decentralized organizational structure, all decisions and activities continue to support the Department's overall strategic goals. This structure is illustrated in Figure 8-2.

Figure 8-2: DOE Organizational Structure



These offices are further classified under seven categories based on their functional type—

- **Program Offices—** DOE is principally a national security and science agency. These missions are managed by Program Offices at DOE.

- **Staff Offices—** DOE Staff Offices provide administrative, management, and oversight support to the various headquarters programs and offices.

- **The Energy Information Administration (EIA)—**The EIA, created by the Congress in 1977, is the statistical agency of DOE. It provides policy-independent data, forecasts, and analyses to promote sound policy making, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment.

- **National Nuclear Security Administration (NNSA)—**The NNSA serves to enhance national security through the military application of nuclear energy and to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons

stockpile. NNSA also provides the U.S. Navy with safe, militarily effective nuclear propulsion plants and ensures the safe and reliable operation of those plants. NNSA also seeks to promote international nuclear safety and nonproliferation, reduce global danger from weapons of mass destruction, and support U.S. leadership in science and technology.

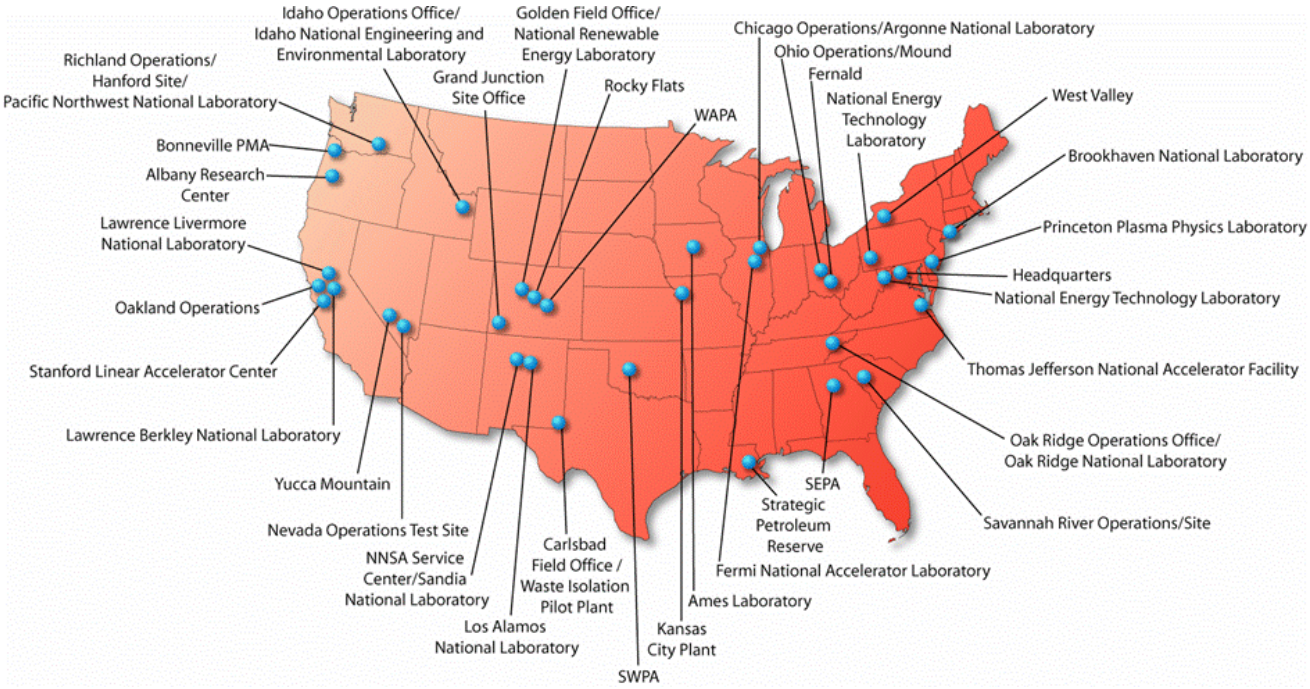
- **National Laboratories and Technology Centers—** DOE's laboratories and technology centers house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research.

- **Power Marketing Administrations—** The Federal Power Marketing program began in the early 1900s when power produced at Federal water projects in excess of project needs was sold in order to repay the Government's investment in the projects. Power Marketing Administrations market this power to encourage the most widespread use at the lowest possible rates to consumers consistent with sound business principles. Each of the four power marketing administrations is a distinct and self-contained entity within the Department of Energy, much like a wholly owned subsidiary of a corporation.

- **Operations Offices and Field Organizations—** Operation Offices are DOE offices located outside of the Washington, DC area. These offices oversee activities in support of two or more of the four missions assigned to the Department.

Not all Field Offices, laboratories, or field facilities require the use of dedicated spectrum to accomplish these goals, however. As a result, this Plan focuses on only those offices, and their respective geographic locations, that use spectrum resources and spectrum-dependent technologies. Figure 8-3 highlights the entities that meet these criteria.

Figure 8-3: DOE Spectrum Asset Locations



Although each of these DOE entities uses spectrum in some form, many of the smaller offices receive spectrum management assistance and oversight from larger organizational entities.

8.5 Spectrum Management Program Contact Information

The Spectrum Management Program contact information is provided below:

Primary Point of Contact: Mr. Bruce Washington.
Telephone: 202.586.5066
Email: Bruce.Washington@hq.doe.gov.

DOE also has a spectrum management program website that provides both general DOE spectrum information and information specifically focused on the 1710 – 1755 MHz band relocation effort. The website link is: http://www.cio.energy.gov/services/spectrum.htm.

The DOE Spectrum Program can also be reached via telephone at 202.586.3681 or via email using the following address: Spectrum.Relocation@hq.doe.gov.

9. REFERENCES:

a. Department of Energy Information Resource Management Strategic Plan FY2008-2010. July 2007.

b. Department of Energy Information Technology Capital Plan. September 2007.

c. Department of Energy Strategic Plan, 2006. Available at www.energy.gov/about/strategicplan.htm.