# Environmental Management Reference Manual

NASA

## NASA's Mission

- Explore, use and enable the development of space for human enterprise
- Advance scientific knowledge and understanding of the Earth, the Solar System, and the Universe and use the environment of space for research
- Research, develop, verify, and transfer advanced aeronautics, space, and related technologies

# Purpose

This document has been prepared by the NASA Headquarters Environmental Management Division, Code JE, in order to provide the NASA non-environmental professional with the information and guidance needed to better understand and reduce the impacts of his or her work activities on the environment. As stated by Administrator Goldin, *Environmental excellence is not a program nor can it be achieved through a policy statement. Environmental excellence is a way of life and must be ingrained as part of our culture.* The Environmental Management Division and the environmental staff at the Centers and component facilities hope that by using the information and suggestions contained in this manual, all NASA personnel will be better able to identify and act upon opportunities to attain environmental excellence. Capturing these opportunities will often require the assistance of NASA environmental professionals, and the manual provides detailed guidance on how to obtain help when such guidance is needed. Importantly, however, there are many large and small ways in which the environmental performance of NASA can be improved, and all employees should feel empowered to take actions, as appropriate and within their influence and areas of expertise, to identify and take advantage of these opportunities.

This manual is a supplement to and reference for an Academy for Program Project Leadership (APPL) training course that is being made available to all NASA employees. While this manual has been prepared to stand alone and be accessible to the non-environmental professional, the Environmental Management Division recommends that such personnel arrange to receive the training course where possible. Trained personnel obtain a deeper understanding of how environmental issues affect the NASA workplace and at the same time gain some hands-on experience (through exercises) in applying environmental concepts.

# Environmental Management Reference Manual


Chapter 1 Introduction ..... 1-1

Chapter 2 NASA's Environmental Commitment ..... 2-1

Chapter 3 NASA's Environmental Management Program ..... 3-1

Chapter 4 Overview of Environmental Laws ..... 4-1

Chapter 5 How Environmental Laws Apply to NASA ..... 5-1

- Air Pollution ..... 5-1
  - National Ambient Air Quality Standards ..... 5-1
  - Construction and Operating Permits ..... 5-3
  - Best Available Control technology or Lowest Achievable Emission Rate ..... 5-4
  - New Source Performance Standards (NSPS) ..... 5-4
  - National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technology (MACT) Requirements ..... 5-5
  - Chemical Accident Prevention Provision – Clean Air Act Section 112(r ) Risk Management Program ..... 5-7
  - Compliance Monitoring ..... 5-8
  - Conformity ..... 5-8
  - Stratospheric ozone protection ..... 5-9
- Water Pollution ..... 5-14
  - Clean Water Act (CWA) ..... 5-15
  - Safe Drinking Water Act (SDWA) ..... 5-17
- Chemical Uses ..... 5-19
  - Documentation and Reporting ..... 5-20
  - Hazardous Materials Use and Management ..... 5-22
  - Hazardous Materials Storage and Shipment ..... 5-23
- Management of Specific Products/Chemicals ..... 5-26
  - Underground Storage Tanks ..... 5-26
  - Pesticide Use ..... 5-29
- Waste Materials ..... 5-30
  - Municipal Solid Waste ..... 5-31
  - Non-Hazardous Industrial Waste ..... 5-31
  - Hazardous Waste ..... 5-31
  - Medical Waste ..... 5-33
- Remediation of Chemical Releases ..... 5-36
  - Remediation Under CERCLA (Superfund) ..... 5-36
  - Remediation Under RCRA ..... 5-38

Pollution Prevention ..... 5-41
NASA's Pollution Prevention Strategy ..... 5-44
Strategies to Achieve Pollution Prevention ..... 5-46
Source Elimination and Source Reduction ..... 5-46
Reuse and Recycling ..... 5-47
National Environmental Policy Act and Related Environmental Statutes and Regulations ..... 5-51
National Environmental Policy Act ..... 5-51
Endangered Species Act ..... 5-59
Cultural Resources ..... 5-60
Land Use ..... 5-62
Environmental Justice ..... 5-63
Environmental Health ..... 5-64
Safe Drinking Water Act ..... 5-64
Lead-Based Paint ..... 5-65
Radon ..... 5-66
Asbestos ..... 5-67
Radioactive Materials Management ..... 5-69
Storage ..... 5-72
Transportation ..... 5-72
Radiation Safety ..... 5-73
Emerging Issues ..... 5-75
Climate Change ..... 5-75
Persistent Organic Pollutants ..... 5-77

Chapter 6 Preparing for Environmental Assessments, Audits, Spot Checks, and Inspections ..... 6-1

Chapter 7 Environmental Compliance Resource Budgeting ..... 7-1

Glossary

Appendix A: NASA Environmental Management Contact Information

Appendix B: Overview of APPL Training Course

Appendix C: Environmental Web Sites and Additional Information Resources

Appendix D: Applicable Executive Orders

Appendix E: Index of Federal Environmental Regulations

Appendix F: Example Pollution Prevention Opportunity Assessment Checklist

# 1 Introduction

This Environmental Management Reference Manual (EMRM) was prepared by the NASA Headquarters Environmental Management Division (EMD) to help the Agency's non-environmental professionals gain a deeper understanding of environmental issues affect the NASA workplace. While the Agency's science and research missions are primary, they should not be pursued at the expense of the environment. As stated by NASA Administrator Goldin, *"Whether it is designing and fabricating robotic spacecraft, launching the Space Shuttle, or conducting basic research, we must seek solutions that are as environmentally benign as possible."* This manual is part of NASA's efforts to follow up on its commitment to environmental excellence and to implement the Agency's environmental strategic plan, which is detailed in Chapter 2 of this manual.

The EMRM should be used to gain an understanding of environmental programs and how they apply to NASA. Environmental issues are of concern to NASA, and with new laws and regulations emerging all the time, they will continue to have a growing impact on how NASA does business. Non-compliance with environmental laws, regulations, and policies places NASA at risk of project delays, fines, temporary facility closures, and, in extreme cases, loss of life and even criminal prosecution. This EMRM will help each employee to better understand and reduce the environmental impacts of his or her work.

Several sections of the EMRM are dedicated to subjects such as pollution prevention, which represent environmental activities where non-environmental professionals are the primary project leaders. The Environmental Management Division hopes that by using the information and suggestions contained in this document, all NASA personnel will be able to better identify and act upon opportunities to attain environmental excellence. The manual provides detailed guidance on how and when to obtain assistance from NASA's environmental staff. Non-environmental professionals will need to work with environmental professionals to ensure compliance and help attain the Agency's other environmental goals.

The EMRM also will serve as a supplement to and reference for an Academy for Program Project Leadership (APPL) training course that is being made available to NASA personnel. (Appendix B presents an overview of the APPL training course.) The Environmental Management Division highly recommends that all non-environmental professionals arrange to receive the training course where possible. Training will

reinforce the requirements, concepts, and ideas presented in the EMRM, as well as provide some hands-on experience (through exercises) in applying environmental concepts.

Chapters 2 and 3 of the EMRM provide an overview of NASA's environmental management strategy and program. Chapter 4 contains the history and philosophy of environmental law in the United States as well as a summary of the primary laws that apply to NASA. Chapter 5 builds upon Chapter 4 and covers the major environmental regulations, protocols, and emerging issues in terms of their relevance to NASA, principal requirements, and the responsibilities of non-environmental professionals in maintaining compliance or otherwise attaining NASA goals. Chapter 6 discusses preparing for environmental assessments and spot checks. Lastly, Chapter 7 provides a brief overview of environmental compliance resource budgeting and life cycle cost analysis.

# 2 NASA's Environmental Commitment

NASA's environmental strategy is laid out in *NASA Environmental Excellence for the Twenty-first Century.* This strategy, signed by the NASA Administrator, provides the framework and guidance necessary to attain the NASA environmental vision. It also provides the philosophical context by which all environmental efforts at NASA can be guided. The strategy consists of four focus areas—prevention, compliance, restoration, and conservation. These focus areas, when viewed in the simplest of terms, can be expressed as minimizing future problems through an active pollution prevention program; bringing all operations into compliance with current environmental requirements; cleaning up all problems resulting from past operations; and preserving our rich natural and cultural heritage for future generations. Woven throughout the fabric of the strategy are the crosscutting issues of awareness, community outreach, and resource advocacy. Attainment of our environmental vision depends on the support of the entire NASA family and dedication of the resources required to execute the strategy.

**"NASA will Continue as a World Leader in Space Exploration and Aeronautics While Maintaining Environmental Excellence"**

Vision Statement, NASA Environmental Excellence for the Twenty-First Century

## Prevention

This area focuses on developing an environmental ethic at NASA that will avoid future compliance and restoration problems. Additionally, pollution prevention shall be considered in all new projects and programs at NASA to minimize environmental impacts and preserve our natural and cultural resources. This requires strengthening the National Environmental Policy Act (NEPA) planning process, assessing industrial processes, and developing substitute materials to minimize environmental impacts. Because taking these actions may impose somewhat higher initial costs, final decisions will be based on project life-cycle costs, while seeking the most environmentally benign solution.

## Goal 1

***Incorporate Pollution Prevention Considerations in All Agency Decisions***

Objectives

- Consider life-cycle costs and pollution prevention in Agency decisions including research and development, facility construction, and operations as part of the Program and Project Management review cycle

- Establish and develop environmental partnerships with public and private groups to promote sharing of technical resources and enhance commitments
- Promote and expand the use of NASA's environmental monitoring systems technology in all aspects of environmental decision making

## Goal 2

### *Develop Visibility for Implementing Pollution Prevention*

Objectives

- Instill a pollution prevention ethic throughout the NASA Team, through an aggressive awareness building program
- Systematically reduce or eliminate the use of hazardous materials and operations or processes that produce hazardous/solid wastes and other emissions, both by NASA and its contractors and suppliers
- Establish pollution prevention partnerships with federal and state agencies, academic institutions, industry, and the public
- Pursue new technologies using environmentally benign substances and processes and transfer this technology to industry

## Compliance

This focus area addresses all activities, ensuring that NASA's current and future operations meet all federal, state, or local environmental regulations. This is the highest priority in the NASA environmental strategy and NASA will strive to be in compliance with all new requirements in advance of the regulatory deadline to further demonstrate NASA's commitment to the environment.

## Goal 1

### *Bring All Current Operations into Compliance*

Objectives

- Identify all operations that are not currently in compliance, and develop a tracking system for all known compliance issues, notices of violations, and any long-standing problems
- Build and adequately staff, at the Center level and related component facilities or field installations, a high quality, multidisciplined organization to manage and execute the compliance attainment program
- Establish a priority-setting system to ensure timely funding and correction of all compliance actions

## Goal 2

### *Enhance Management Visibility*

Objectives

- Identify management metrics that accurately measure the impact of pollution control and other compliance activities in achieving environmental results
- Provide clear, concise policy direction for implementing the environmental program
- Develop a comprehensive management information system to identify the cost of compliance and the appropriate fund source and ensure adequate multiyear budget coverage
- Identify, promote, quantify, and gain support for validated environmental funding and personnel requirements
- Provide continuing environmental awareness training for all members of the NASA team

## Goal 3

### *Develop and Implement a Compliance Monitoring Program*

Objectives

- Conduct comprehensive in-house compliance assessments
- Establish contractor environmental performance metrics, which will be used to evaluate all major contract decisions
- Solicit assistance from the EPA and other regulatory bodies to resolve long-standing problems
- Closely monitor pending environmental regulations to permit advance planning that would enable a proactive program to maintain compliance

## Restoration

This focus area addresses cleaning up all contaminated sites as rapidly as possible to protect human health and the environment. Funds availability and technical limitations require that this effort be carried out in a prioritized sequence. The priority system must be clear and easily understood to permit NASA managers to make funding decisions and communicate the basis for decisions on which sites to clean up first. NASA will actively seek public involvement in the decision making process.

## Goal 1

### *Clean Up Contaminated Site as Rapidly as Funds Permit*

Objectives

- Identify and set priorities among all sites
- Allocate resources based on human health and environmental risks
- Aggressively identify, justify, and defend resource requirements
- Seek and employ innovative cleanup strategies, including technology, contracting, and project management approaches
- Initiate removal actions to prevent the spread of contamination

## Goal 2

### *Establish and Maintain a Positive Reputation with the Regulators and the Public*

Objectives

- Negotiate and sign Federal Facility Agreements and consent agreements with EPA and states addressing contaminated sites
- Work closely with all regulators and jointly seek solutions to environmental cleanup issues
- Use community awareness and outreach programs and involve local communities in restoration processes, decisions, and activities

## Conservation

This area focuses on careful land-use planning, enhancing existing natural resources, and preserving those cultural resources associated with significant aspects of our historic and prehistoric heritage. Conservation reduces the impact of NASA's activities on the environment, especially through programs such as recycling and energy conservation.

## Goal 1

### *Assess and Protect Natural Resources*

Objectives

- Obtain natural and cultural resources baseline data
- Establish an innovative funding strategy for natural resource programs
- Incorporate natural and cultural resource considerations and constraints into land-use planning decisions

- Establish partnerships with federal and state agencies, academic institutions, industry, special action groups, and the general public to manage cultural and natural resources and make them available to the largest possible community

## Goal 2

### *Enhance Recycling and Energy and Water Conservation Programs*

Objectives

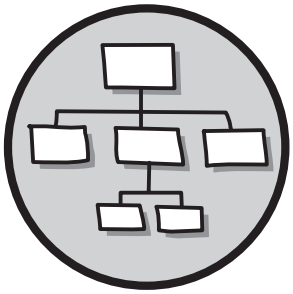
- Use products manufactured from recovered materials whenever they are available, including those used by contractors and suppliers
- Conduct an aggressive, continuing awareness program to build an understanding of the opportunities for and benefits of recycling
- Seek to stimulate industry to develop recycling and other environmentally related technologies by encouraging business opportunities
- Reduce energy usage to meet or exceed statutory and executive order goals
- Expand the use of renewable energy and "green power" to reduce the emission of greenhouse gases attributable to energy use
- Reduce the use of potable water through conservation, recycling, and conversion to non-potable water sources.

Everyone at NASA, civil servant and contractor alike, has responsibility for implementing this strategy.

Everyone at NASA, civil servant and contractor alike, has responsibility for implementing this strategy. The environment, like safety, has to be something everyone incorporates into their jobs and makes a core business value. The environmental management program and its professional environmental staff will provide the policy, framework, guidance, and expertise to help NASA accomplish its mission and, at the same time, be a good steward of the environment.

Other than being in compliance with the law, being a good environmental steward has benefits. Private sector businesses and other public sector organizations are recognizing that sound environmental management also makes good business sense. Many companies with above average environmental programs (i.e., environmental programs that go beyond compliance) have higher revenues and stock prices than companies that have average or below average environmental programs. Environmental projects, such as pollution prevention and energy conservation initiatives, not only offer net monetary benefits, but also stimulate more extensive evaluation of processes that in turn, often leads to further improvements that save money and time. NASA's environmental strategy is an important step toward building an Agency-wide environmental program that benefits both the environment and NASA.

# 3 NASA's Environmental Management Program



Although everyone is responsible for environmental stewardship at NASA, achieving environmental excellence depends on NASA's environmental management program. This program is laid out in NASA Policy Directive (NPD) 8800.16 and applies to NASA Headquarters, all Centers and related facilities and component installations. In addition to laying out NASA's environmental policy, the NPD defines the roles and responsibilities for both environmental and non-environmental professionals at NASA.

NASA employs approximately 88 professional environmental civil servants and about 225 contractors Agency-wide to implement its environmental program. Every Center has an environmental office, as does NASA Headquarters. Overall Agency-wide policy is reviewed and approved by the Environmental Management Board (EMB) consisting of representatives from each of the Center's environmental offices and related components and facilities, the Deputy Associate Administrators of the Strategic Enterprises, and is chaired by NASA Headquarters Environmental Management Division. The NASA General Counsel, Agency Safety Managers, Occupational Health Managers, Energy Managers, the Facilities Engineering Division, NASA Headquarters, and the NASA Operational Environmental Team serve the EMB in an advisory role. The EMB meets at least four times a year-either face-to-face or via videoconference. Moreover, the EMB facilitates information sharing, develops and refines NASA environmental policies and strategy, and provides a forum to elevate Center needs and issues. The EMB reports to NASA's Capital Investment Council and senior management.

**"Environmental excellence is not a program nor can it be achieved through a policy statement. Environmental excellence is a way of life and must be ingrained as part of our culture."**

Dan Goldin, NASA Administrator in *Environmental Excellence for the Twenty-First Century*

**NASA Policy Directive 8800.16A**
**NASA Environmental Management—Policy**

1. NASA shall comply with all pertinent statutory and regulatory environmental requirements and Executive Orders. Environmental requirements encompass issues related to environmental management including, but not limited to, energy efficiency and water conservation, hazardous waste management, protection of cultural and natural resources, environmental justice, restoration and remediation of contaminated sites, and pollution prevention. NASA recognizes and will comply with pertinent federal, state, local, and territorial environmental regulations.
2. Environmental factors shall be a significant consideration at every step in program development and execution. This requirement shall include life-cycle analysis of costs and environmental impacts of program and process alternatives. Review of this requirement will be a regular part of the program management process.
3. NASA shall foster and actively support environmentally related technology transfer and research and development.
4. It is NASA's policy to consult, as appropriate, with federal, state, and local regulatory agencies on the best techniques to prevent pollution, control and manage energy and hazardous waste, and comply with environmental requirements.

## NASA Headquarters Environmental Management Division

NASA Headquarters Environmental Management Division (EMD) provides leadership and overall Agency environmental policy and guidance. The Division has three main internal customers—the NASA Administrator, the Strategic Enterprises, and the Centers. NPD 8800.16A further delineates the following responsibilities of the Headquarters Environmental Management Division:

1. Responsible for the NASA Environmental Strategic Plan
2. Leading the Agency in the creation of environmental policy and providing agency-wide environmental guidance
3. Advocating and supporting the funding and assignment of resources, as defined and budgeted by the program and facility managers, and allocating assigned resources
4. Serving as a focal point for external Agency-level interfaces
5. Ensuring oversight and independent assessments to ascertain that appropriate environmental compliance and management techniques are used for the identification, documentation, evaluation, and disposition of all environmental requirements for programs, projects, facilities, systems, and operations
6. Providing technical advice, assistance, and consultation to responsible managers based on overall awareness and insight into Agency-wide program execution and national requirements

7. Ensuring the appropriate coordination and approval of Principal Centers to lead or oversee designated environmental initiatives or activities

The EMD also requires that each Center and Component Facility conducts an annual environmental self-assessment. The EMD reviews these self-assessments to ascertain if a Center is at risk of not being in compliance or not having enough resources to carry out the Center's environmental mission. Every year, the EMD conducts environmental spot checks at selected NASA Centers to check the compliance status with respect to selected environmental media (see Chapter 6 for more information).

**The EMD has identified the following stakeholders:**

Congress • Council on Environmental Quality (CEQ) • Department of Energy (DOE) • Environmental Protection Agency (EPA) • Federal Environmental Executive • General Accounting Office (GAO) • NASA Inspector General (IG) • Office of Federal Procurement Policy • Office of Management and Budget (OMB) • Other Branches of Government • The Public

The NASA Headquarters EMD also tracks environmental legislative and regulatory initiatives and often has the opportunity to help shape environmental regulations by participating in negotiated rulemakings and other EPA advisory activities. Headquarters staff participate in over 40 external environmental groups. Some of these groups help NASA Headquarters track and shape new environmental regulations and programs, while others are interagency or industry working groups that share best practices and promote technology transfer. Participation in both types of group offers potential cost-savings to NASA (and other agencies) by leveraging external resources.

The NASA Headquarters EMD establishes its priorities and initiatives from the NASA Environmental Strategic Plan and by focusing on customer and stakeholder requirements. Internal teaming is one primary method that EMD employs to accomplish its goals. Internal NASA teams, which consist of parallel networks, virtual teams, and lead Centers, are comprised of members from the EMD, other Headquarters functional staff offices, Strategic Enterprises, and Centers. There are formal teams that meet regularly and "virtual teams" that are formed ad hoc to address issues as the need arises. The following are the EMD's formal teams:

- Environmental Management Divisional Team
- Compliance Team
- Conservation Team
- National Environmental Policy Act (NEPA) Team
- Pollution Prevention Team
- Resource Advocacy Team
- Restoration Team
- Environmental Management System Team

All of these teams are led by the EMD staff and have annual work plans and priorities set forth in the EMD Annual Operating Plan.

## NASA Center Environmental Offices

Each of the NASA Centers and Component Facilities have an environmental office. These offices are funded by their Centers and are responsible for ensuring compliance with all federal, state, and local laws, regulations, and policies. Most of the environmental offices report to senior management at the Center, who according to the NPD, are responsible for compliance with environmental laws. The Center Environmental Office should be the first place a non-environmental professional at NASA should look for help regarding any environmental issue, problem, or question. (See Appendix A for contact information).

The Center Environmental Office should be the first place a non-environmental professional at NASA should look for help regarding any environmental issue, problem, or question.

The Center Environmental Offices have primary responsibility for interfacing with external regulatory agencies, (federal, state, and local) for Center specific issues and requirements. The Center environmental staff interface on a regular basis with the regulatory entities responsible for enforcement. In contrast, Headquarters mostly interacts with federal agencies that develop regulations and policy. Most likely, the environmental staff at each Center has spent a lot of time cultivating relationships with local regulators and educating them about NASA. Non-environmental professionals at NASA should not initiate contact with these regulatory agencies without first involving their Center environmental staff. Although it is highly unlikely that an environmental regulator would contact a NASA non- environmental employee, in any such instance theemployee should request that the regulator contact the Center Environmental Office for information and assistance. Regulatory agencies regularly inspect NASA Centers (see Chapter 6), in which case they are accompanied by a member of the Center environmental staff. If a regulator is not accompanied by an appropriate NASA official at all times, the Center Environmental Office should be notified.

The Center Environmental Offices also are responsible for tracking environmental legislation and regulations, especially state and local ones that may affect the Center. Similarly, Center environmental staff also participate in external groups to influence and shape regulations as well as share best practices among other government agencies, industry, and other stakeholders. The Center Environmental Offices also play a large role in stakeholder relations. Environmental groups, community groups, local emergency preparedness providers, and local governments are concerned about what occurs “inside NASA’s fence line” that could affect the environment. Some Centers conduct regular stakeholder meetings to reach out to the community and others regarding potential environmental impacts at the Center. Other Centers may reach out to stakeholders one at a time in a formal or informal way. In addition, some environmental laws, such as NEPA and CERCLA, require stakeholder involvement.

Another function performed by the Center Environmental Offices is the management of environmental remediation/restoration as well as large compliance projects. These projects are often very complex, take a minimum of five years to complete, and are very resource intensive. Remediation/cleanup projects are performed to restore parts of the environment that were contaminated by past NASA activities. Most non-environmental professionals will not be involved in these projects, except to help ensure that there is no new contamination of the environment from present NASA activities.

## Other Environmental Resources/Teams at NASA

In addition to the environmental entities listed above, there are other resources/teams that address specific environmental concerns within NASA. *Ad hoc* teams are frequently formed at the Centers to focus on particular environmental issues, such as materials substitution. Some teams like the NASA Operational Environmental Team (NOET) are chartered by senior management for a specific period of time (e.g., five years). The following is a description of some environmental resources/teams on which non-environmental professionals may play key roles or draw upon for expertise:

NOET—formed in 1992 to address operational environmental issues. NOET is located at the Marshall Space Flight Center's Productivity Enhancement Complex. It is composed of two groups: the Replacement Technology Team and the Propulsion Technology Team. The Replacement Technology Team identifies and consolidates NASA specifications that are affected by environmental regulations and pursues replacement technologies for such materials and processes NASA-wide. The Propulsion Technology Team promotes improvements in propellant waste disposal practices, pursues hybrids, and examines other cleaner propulsion issues. One of NOET's successes was the identification of alternatives to ozone-depleting substances (ODS) for Shuttle and other applications.

Offices of the General Counsel—have responsibility to review certain environmental documents, such as NEPA environmental assessments and environmental remediation documentation. The General Counsel also is available to provide legal advice and interpretation of environmental regulations to NASA staff. Additionally, formal Agency comments on Executive Orders and other environmental regulations are consolidated and submitted by the Office of the General Counsel. Each Center and Headquarters has an Office of General Counsel and the environmental management offices generally work closely with them on environmental issues.

**Lead Centers for Environmental Issues**

Examples:

**MSFC:** NOET, Shuttle Replacement Team

**GRC:** NASA Environmental Tracking System

**KSC:** Recycling

Lead Centers—manage and direct a particular issue or initiative for the Agency. For example, Kennedy Space Center is the Lead Center for NASA's recycling and affirmative procurement program. The Lead Center acts as an advocate for the Agency's programs to other Centers. The Lead Center reviews regulations and develops implementation strategies, issues data calls to all Centers and compiles Agency-wide reports, provides a forum for sharing best practices and lessons learned, and provides technical assistance to all other Centers. Headquarters EMD provides functional oversight of the Lead Center, interfaces with the Federal Environmental Executive and steering groups, signs correspondence external to the Agency, and provides funding. When there is a Lead Center for an environmental initiative, non-environmental professionals are encouraged to contact that Center for information and technical assistance related to that initiative.

Shuttle Replacement Team—is made up of approximately 30 civil servants and contractors that meet semi-annually and hold a conference call once per month. Its primary focus is materials replacement for the Space Shuttle. Many materials used in the manufacturing and maintenance of the Shuttle are becoming obsolete, have few or no current suppliers, and/or are harmful to the environmental. This team addresses the material compatibility and performance requirements of proposed new materials for the Shuttle and other spacecraft.

## Responsibility of Environmental and Non-Environmental Professionals in NASA's Environmental Management Program

NASA's environmental professionals are on the front line of environmental management. They facilitate and provide leadership and expertise to implement NASA's Environmental Management Programs. Environmental professionals have primary responsibility for tracking environmental issues and regulations and interfacing with federal, state, and local environmental regulatory agencies. They also educate stakeholders, regulatory agencies, and other branches of government about NASA and its environmental management program. In addition, they serve as a source of information for all other NASA personnel and help them understand the environmental impacts of their particular job/program.

Non-environmental professionals at NASA are responsible for understanding the environmental impacts of their job/program and taking steps to minimize these impacts by implementing pollution prevention and good housekeeping practices. They should consult with their Center Environmental Office before they take actions that might affect the environment (i.e., before they embark on new projects or activities, or significantly modify old ones). This often means involving the professional environmental staff early on in the project planning phase, so that they can help project and program managers obtain all required environmental permits,

thereby avoiding environmentally-related cost and schedule impacts. This is especially important on programs and projects that trigger compliance with NEPA. Furthermore, NASA executives and senior managers need to plan for and provide resources for environmental compliance activities.

## NASA's Relationship with External Stakeholders

NASA's Environmental Management Program is defined and overseen by the EPA, Occupational Safety and Heath Administration (OSHA), Nuclear Regulatory Commission (NRC), and state and local governments. Although federal facilities are often regulated under different divisions within these agencies and entities than the private sector, NASA is still subject to the same unannounced inspections, fines, and procedural requirements as the private sector. In an extreme situation of perceived environmental threat, these government agencies and their representatives can close a NASA Center/facility and press criminal charges against federal employees and contractors working at that facility involved with, or responsible for, the environmental threat. Although this is a highly unlikely situation at NASA due to its sound environmental management program, it has happened at other federal installations.

Both NASA Headquarters and Center Environmental Offices, along with other environmental resources and teams, spend time educating regulatory agencies about NASA, its activities, and some of the unique requirements/challenges that NASA faces on environmental issues due to its mission-related performance criteria. For example, NOET and NASA Headquarters EMD spent four years in a negotiated rulemaking process with EPA developing the Aerospace National Emissions Standard for Hazardous Air Pollutants (NESHAP). NASA worked very hard to educate the regulation writers about the distinctive performance specifications of coatings, adhesives, and other materials that are applied to space vehicles. As a result of this effort, EPA excluded space vehicles from being subject to the regulations of the Aerospace NESHAP. Not all of these educational efforts result in categorical exemptions from regulations; instead, they result in other useful outcomes such as technological assistance from the regulatory agency on compliance methods. For example, EPA's Stratospheric Protection Division consulted with NASA engineers on alternatives to ODS.

A tenet of NASA's environmental strategy is to create partnerships, wherever possible, with other agencies, states, local governments, universities, and industry.

A tenet of NASA's environmental strategy is to create partnerships, wherever possible, with other agencies, states, local governments, universities, and industry. NASA has developed several partnerships with other federal agencies. For example, NASA Headquarters EMD has partnered with the DoD on the Joint Group on Pollution Prevention (JG-PP) to cost-effectively identify and qualify alternative materials and processes (see chapter 5 for further information). The public also is a NASA stakeholder. The communities surrounding NASA Centers often play an active role in the Center's environmental program. Non-environmental profes-

sionals are encouraged to seek out such opportunities to partner and bring them back to NASA and the environmental community for incorporation into NASA activities.

# 4 Overview of Environmental Laws

This chapter provides an introduction to the environmental laws that govern NASA activities throughout the United States, emphasizing both how they impose limits on these activities and, in some cases, how they can provide opportunities for all NASA installations to improve their environmental and mission-related performance.

We begin with some questions and answers that may help to bring into focus why non-environmental staff should become better acquainted with environmental laws and their underlying logic.

**From this chapter, NASA managers will gain an understanding of why environmental laws impose requirements that may seem onerous, confusing, inconsistent, and/or arbitrary, through an examination of how these legal systems came to be instituted and applied to organizations such as NASA.**

## Environmental Pop Quiz

(Select one answer for each question)

| | | | |
|---|---|---|---|
| 1. Federal Departments and facilities are exempt from most environmental laws. | ❑ True | ❑ False | ❑ It Depends |
| 2. Liability for violating environmental laws is limited to those immediately responsible for the violation; senior managers are accountable only if they had direct control or knowledge of the activity leading to the violation. | ❑ True | ❑ False | |
| 3. Under the federal "Superfund" program, if a NASA Center contributed 5 percent of the waste responsible for a contamination problem, then its financial responsibility for cleaning it up would be a maximum of 5 percent. | ❑ True | ❑ False | ❑ Depends on location (state) |
| 4. NASA Centers and other federal entities are exempt from citizen lawsuits for violating environmental laws or creating nuisance conditions. | ❑ True | ❑ False | |
| 5. A used material or supply is only considered a "waste" if it is thrown away or abandoned. | ❑ True | ❑ False | |
| 6. At NASA facilities, adverse environmental audit findings are confidential and help provide immunity from enforcement actions if they are corrected in a timely manner. | ❑ True | ❑ False | ❑ Depends on location (state) |
| 7. Under certain conditions, EPA has the authority to unilaterally bar NASA from using the services of particular contractors. | ❑ True | ❑ False | |
| 8. Violations of environmental laws generally do not result in substantial (>$10,000) financial penalties. | ❑ True | ❑ False | |
| 9. Violators of environmental laws cannot be found to be criminally liable if they had no knowledge of the law being violated. | ❑ True | ❑ False | |
| 10. Violations of environmental laws by NASA contractors do not affect the agency or have legal repercussions for senior managers. | ❑ True | ❑ False | |

Answer: False for all but No. 7.

If you answered all of these questions correctly, congratulations! You understand the philosophy behind environmental laws to a much higher degree than do most people. You could probably safely turn your attention to Chapter 5 for some important, more detailed discussion of specific environmental regulatory programs that apply to your Center or program. If you did not answer all (or most) of these questions correctly, read on. The money and time that you save may be your own (or at least, your program's).

This chapter continues with a general description of how most environmental laws are structured and operate. While the scope and provisions of these laws vary substantially, they share many common characteristics. Understanding some of these common aspects will make it easier to grasp and remember the many relationships among these different programs. Next, we present a discussion of important terminology that is needed to fully understand how environmental laws work, and what they do and do not control. The bulk of this chapter is then devoted to a discussion of the major environmental laws and what they address. These laws are organized into groupings that reflect the emphasis of the particular program in question, so that the reader can more easily understand how these myriad laws fit together into a comprehensive system to protect the environment. For each of the major programs, this chapter provides some information on its genesis and underlying philosophy, major elements, relationships among various levels of government, and principal impacts on NASA. For reference, the location and principal features of the major statutes and regulations described in this chapter are provided in Appendix E.

## What is a law? What is an environmental law?

Laws and legal requirements arise from several different places within our system. The ultimate source of authority for enacting laws in the U.S. is the Constitution, which grants specific rights to and imposes restrictions on each of the three branches of the federal government: the executive, legislative, and judicial. Generally, the right to enact new laws rests with the Congress, the members of which are directly elected by the American people. The executive branch may present legislation for consideration by the Congress, but has no direct right to impose new laws on the American people. As a practical matter, however, the Congress generally confers authority to the executive branch and its agencies to implement new statutes, which commonly involves developing specific requirements in regulations, and overseeing compliance by the regulated community. Both executive and legislative authorities are tempered by the oversight and approval function played by the judiciary (through the courts). Legislative activity may be challenged with respect to its conformance to the Constitution, and executive branch activity may be challenged and overturned if it is found to substantially diverge from congressional intent. These well-known "checks and balances" play key roles in defining how environmental

(and other) regulations are developed. Some regulations have been promulgated that may seem to defy common sense and reject the preferred course of action on an Agency's part, but have been crafted to reflect specific (usually well-intentioned) Congressional mandates. This often occurs following a successful court challenge to a regulation by representatives of industry, public interest groups, and/or other stakeholders, or in response to threats of litigation during regulatory deliberations. In addition, court decisions and opinions in some cases comprise part of "the law" when they address issues that have not been fully articulated in statutes and regulations. An additional area of law is based upon English common law, which is the basis for many civil actions ("torts"). Common law establishes a general duty on everyone to avoid doing harm to others, either willfully or through negligence or inaction. Finally, treaties between the U.S. and other nations (once ratified by the U.S. Senate) carry the force of law, and may impose additional requirements on entities and individuals that would not exist otherwise.

As an additional note, executive branch organizations such as NASA are subject to directives from the President in the form of executive orders that generally apply to all federal executive branch entities and employees.

In the environmental arena, major programs have typically begun in the form of federal legislation crafted in response to a perceived problem or important issue.

Until the early 1990's federal departments and agencies enjoyed broad exemptions from most environmental statutes and regulations. That changed dramatically with the passage of the Federal Facilities Compliance Act in 1992, which decreed for the first time that all federal entities would conform to the same requirements as other regulated entities. In addition, the Justice Department will not defend federal agencies for violations of law or regulations that apply to the private sector and not the federal government. Other executive orders impose requirements that mirror and in some cases exceed the mandates that apply to private sector organizations. These are described further in Chapter 5.

National programs such as our major environmental statutes and implementing regulations are often delegated in large part to state government agencies. Typically, this occurs after a particular state has enacted legislation that parallels or is more stringent than the corresponding federal requirements, and has demonstrated that it has sufficient authority to oversee and enforce the federal (and its own) requirements.

In the environmental arena, major programs have typically begun in the form of federal legislation crafted in response to a perceived problem or important issue. That is, the creation of most major environmental laws, particularly in the early years, has been reactive in nature. Some major statutes were passed without lengthy debate and in the absence of detailed supporting studies or analyses. In all cases, statutes are a product of the give and take of the political and legislative processes. Consequently, some statutory provisions have been difficult to implement, created inconsistencies and conflicts, or provided incomplete coverage across industries,

pollutant sources, or other important dimensions. As discussed above, the responsible agencies are bound to implement these statutes as they are written, and generally face significant constraints on their ability to creatively interpret legislative intent. The result of this process is an overall environmental regulatory system that is perfect from no one's perspective, but is acceptable to most people. One might say that it more closely resembles a patchwork quilt than a tightly woven blanket.

The major environmental statutes contain articles (titles and subtitles) that address particular concerns and that direct a specific federal agency or agencies to develop detailed regulations that establish specific requirements, limits, procedures, and the like. Typically, environmental issues are referred to the U.S. Environmental Protection Agency (EPA), though other entities such as the Occupational Health and Safety Administration (OSHA), U.S. Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), Council on Environmental Quality (CEQ), U.S. Army Corps of Engineers (COE), U.S. Fish and Wildlife Service, and other federal departments and agencies also have regulatory or advisory responsibilities with respect to certain environmental issues. EPA, however, has primary responsibility for most environmental programs and has by far the most involvement in regulating potential impacts on the environment.

EPA typically develops policy and regulations at its headquarters locations, and provides permitting, oversight, enforcement, and technical assistance through a network of ten regional offices located across the U.S. Regional offices carry out these functions directly in states within their respective regions that have not been authorized to carry out a particular regulatory program, and serve as a source of information and guidance to analogous state government agencies in authorized states. In many cases, these decentralized portions of the environmental regulatory structure establish (generally through permits) the specific operating conditions that will apply to a particular facility.

In addition, many state governments have developed their own programs to address pressing environmental issues in the absence of federal action. These include state-level statutes and regulations addressing oil and petroleum products, recycling, toxic materials use, air and water pollution control, hazardous waste, and other issues. NASA Centers located in such states are, obviously, obliged to conform to any additional requirements imposed by these state laws.

In sum, the legal landscape faced by any particular NASA facility will include pervasive federal requirements, specific conditions stipulated by regional and/or state government officials (e.g., permitlimits), and in some cases, additional and perhaps profound state and/or local requirements.

## The Genesis and Development of Environmental Law in the U.S.

As a general matter, it is important to note that environmental control law is relatively new and in some respects is not fully mature. In fact, prior to 1969, there were no nationally uniform, enforceable restrictions on pollutant emissions to the environment or manufacturing or use restrictions on environmentally harmful substances in the U.S. That is, during the time that NASA was first achieving monumental successes in manned space flight, environmental protection efforts in the U.S. and elsewhere were only beginning to form. At that time, environmental restrictions in most jurisdictions, if any, tended to be limited to localized remedies (e.g., zoning restrictions) to control specific nuisances such as odors, unacceptable noise levels, uncontrolled dust, and the like. Following the first Earth Day celebration in 1969, however, this began to change dramatically and rapidly. In 1970, the National Environmental Policy Act (NEPA) was enacted, followed shortly thereafter by the formation of EPA. NEPA required, for the first time, that major federal actions be preceded by an evaluation of whether they might impose significant environmental impacts, and if so, that alternatives to reduce or mitigate these impacts be formally considered. Almost 30 years later, NEPA requirements remain the most significant environmental issues facing many federal government organizations, including (as described in more detail below) NASA and its installations.

Prior to 1969, there were no nationally uniform, enforceable restrictions on pollutant emissions to the environment or manufacturing or use restrictions on environmentally harmful substances in the U.S.

The early 1970's also witnessed the enactment of federal statutes and amendments establishing (or authorizing) acceptable concentrations of pollutants in air and water, and limiting the permissible amounts and/or concentrations of pollutants discharged to the environment by companies, government entities, and individuals. The federal Clean Air Act and Clean Water Act (as amended) and their implementing regulations for the first time defined, in part, measures of acceptable environmental quality as well as technology-based constraints on what numerous entities could and could not emit to the environment, and by extension, how they could and could not operate their enterprises.

In the mid-1970's and into the 1980's, the generation and appropriate management of waste materials became a focus of attention. Industrial and research operations as well as active control of pollutant emissions to air and water often resulted in the generation of new solid and liquid materials for which there was no productive use. Disposition of these materials, many of which contained toxic, corrosive, and/or other potentially harmful constituents, became a pressing and increasingly important issue. In addition, environmental problems arising from the improper disposal of hazardous materials were becoming an increasingly prominent public concern. To address these issues, in 1976 the Congress enacted the Resource Conservation and Recovery Act (RCRA), which provided the direction and authority for EPA to develop a "cradle to grave" system for the proper management of hazardous wastes, and also mandated that EPA

develop standards for municipal solid waste (i.e., "garbage") landfills. In 1980, to combat the apparent spate of uncontrolled hazardous waste sites being detected across the country, the Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which is more commonly known as "Superfund." RCRA and CERCLA (as amended) and their implementing programs define how NASA and other regulated entities must manage any hazardous wastes that they generate, and whether and how cleanup of environmental contamination that may have occurred must be addressed. NASA environmental personnel spend considerable time and resources addressing these mandates.

As the system of environmental control law in the U.S. has developed and matured, and as industrial and other regulated entities have modified their operations to comply and improve their environmental performance, the emphasis of new legislative activity has shifted. While several very significant amendments to existing statutes have simply regulated new pollutants and/or sources using traditional approaches, much of the legislation enacted during the late 1980's and throughout the 1990's has been oriented in new directions. One distinct trend is toward preventing environmental problems at the source rather than controlling them at emission points. Another is toward securing greater awareness by members of the public of potential environmental hazards within their communities and to some degree, participation in decisions made by other entities that may affect environmental quality and/or public safety. For example, in the wake of the Bhopal, India tragedy (a chemical accident by a US company that killed or injured hundreds of people), community right-to-know provisions were enacted as part of Superfund reauthorization in 1986, and in 1990, the Pollution Prevention Act was passed, making reduction of pollution at the source wherever possible the explicit policy of the United States. A third major trend is the globalization of environmental issues, beginning with concerns for protecting the stratospheric ozone layer resulting in adoption of the Montreal Protocol in 1989. The importance of understanding and addressing global issues continues today, with profound multilateral discussions surrounding global climate change suggesting that additional expectations concerning limits on certain activities may be forthcoming.

**Trends in Environmental Policy**

1. Pollution Prevention
2. Community Involvement
3. Globalization of Environmental Issues

These trends have been accompanied by a desire on the part of many to move from centralized control over environmental performance to approaches that are more flexible and economically efficient. Recent legislative measures in many cases explicitly encourage the evaluation, and potentially the use, of market-based approaches to achieving greater environmental protection. In addition, even in the absence of clear legislative direction or guidance, many regulatory bodies are performing experiments and pilot projects around voluntary measures to improve environmental performance at lower cost to the otherwise regulated entity as well as to the regulatory body. Such trends are likely to continue, and

will provide new opportunities for NASA to accomplish its environmental stewardship objectives more effectively and at lower cost. In addition, a number of public-private partnerships have been developed that address socially important objectives (e.g., lower pollutant emissions or energy consumption) by providing education and technical assistance to various large and small entities in lieu of new regulatory initiatives.

This very limited discussion of the history of environmental control law in the U.S. provides the backdrop for several key facts that should be understood by members of the NASA community, whether directly involved with environmental compliance or otherwise. The first is that our system of environmental laws has developed on a piecemeal basis, rather than as an integrated and comprehensive strategy. These laws were enacted to address specific problems and issues and almost without exception have a media- or activity-specific focus, instead of an industry-wide or enterprise-specific basis. As a consequence, environmental laws provide incomplete coverage of environmental risks in some areas, and excessively complex and sometimes conflicting requirements in others. While EPA and state regulatory agencies are now attempting to develop multi-media (water, air, soil, etc.) compliance and enforcement strategies, statutory requirements will constrain the extent of streamlining and harmonization that can be accomplished, at least until suitable legislative amendments are enacted. In the interim, NASA, other regulated entities, and the regulatory community will need to make difficult decisions about what to do and how to do it, so that continuous compliance is attained efficiently and at low cost. The environmental professionals at each Center and the specialized groups listed in Chapter 3 can provide important assistance to you in deciding how to accomplish your operational objectives under multiple, and sometimes conflicting, environmental regulatory constraints.

A second important point is that increasingly, environmental expectations are being set or influenced by a wider array of stakeholders, including multilateral government entities. Existing environmental statutes and regulations provide the context within which several important international treaties and their requirements are implemented. For example, the Montreal Protocol, which mandates elimination of certain ozone-depleting substances, is implemented in the U.S. through the Clean Air Act. The Montreal Protocol has imparted very significant effects on NASA operations, through its mandates to eliminate or replace halogenated solvents and other materials previously in widespread use within NASA. Multilateral discussions concerning global climate change may ultimately lead to new restrictions on NASA activities that also would likely be implemented through major existing environmental programs. Again, environmental professionals at the Centers, as well as in NASA Headquarters EMD, are evaluating this emerging issue and can provide valuable information and advice concerning how best to manage NASA's potential exposure to new environmental regulatory constraints.

## Important Terms

The following words and phrases appear frequently in environmental statutes and implementing regulations as well as in executive orders that affect NASA and other federal executive branch organizations. Accordingly, these terms should be reviewed and understood prior to examining the requirements of individual environmental control laws. The reader should be aware that many of the entries in the following table are terms of art, and have a distinctly different meaning in an environmental legal context than they do in ordinary usage.

**Compliance** - Operating within the conditions established by all environmental laws, including statutes, regulations, executive orders, and permits.

**Emission** - The release or discharge of any solid, liquid, or gaseous material to the ambient environment.

**Environmental audit** - An on-the-ground assessment of compliance status at a particular location.

**Environmental media** - One or more of the following: air, soils, ground water, or surface water.

**Permit** - A written entitlement granted by an authorized regulatory body allowing emissions or waste management activities under prescribed conditions.

**Release** - Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (includes containers that previously held, or still contain hazardous materials).

**Transfer** - The movement of material from a site to another permitted facility or the shipment of materials to a recycling facility.

**Violation** - An event or condition in which compliance has ceased.

**Solid Waste** - Any solid, liquid, semi-solid, or contained gaseous material that is discarded or abandoned; in some cases, recycled and reclaimed materials are considered wastes under prevailing environmental law.

## Major Environmental Programs

As highlighted briefly above, environmental laws tend to share certain common elements in terms of their objectives, the structures that they establish, and the ways in which they operate. An understanding of these elements will help to illuminate how far-reaching environmental legal requirements are, and the many ways in which NASA managers and executives can contribute to the attainment of the organization's environmental stewardship commitments and goals. This section provides a summary of the major environmental regulatory programs within the U.S. that are most likely to affect NASA operations. These programs have been grouped into categories for ease of exposition, as discussed above.

### *Laws that regulate NASA Programs and Projects, land use, and/or cultural resources*

The **National Environmental Policy Act** (NEPA) is considered by many to be the foundation of environmental law in the U.S. NEPA was enacted in 1969 and signed into law on 1 January 1970, thereby establishing a radically new set of requirements for and expectations of federal agencies and departments. Under NEPA, all federal agencies are required to consider whether major actions that they might undertake could have significant impacts on human health and the environment. In the event that significant environmental impacts could occur, the agency must evaluate and consider alternatives that might mitigate or reduce these impacts. Moreover, these studies and deliberations may not be conducted in a vacuum, but instead must incorporate input from interested members of the public as well as from other agencies. NEPA expressly directs Executive Branch entities to consider environmental issues along with all other issues within their jurisdiction when formulating policy and making decisions.

Under NEPA, all federal agencies are required to consider whether major actions that they might undertake could have significant impacts on human health and the environment.

Procedurally, NASA and other federal organizations can conduct screening analyses (environmental assessments-"EA") to determine whether any action that they might take is past a threshold level that suggests the possibility of significant environmental impact. If so, then a more detailed and extensive study (environmental impact statement-"EIS") is required. Agencies may prepare an EIS instead of an EA when the agency can determine from the outset that the "proposed action" would likely result in significant impacts. Procedures for NEPA compliance have been developed by all federal agencies, and are based upon guidance issued by the Council on Environmental Quality (CEQ), which was created by the NEPA statute and is housed in the Executive Office of the President.

It is worthy of note that terms such as "major" and "significant" have been interpreted broadly by the courts. As a consequence, NEPA compliance issues arise frequently in NASA's programmatic and institutional planning and operating activities. All core mission activities such as shuttle launches and the X-33 program require EAs and EISs. The key is that all Programs and Projects (programmatic, R&D, or institutional) require a full-blown environmental impact statement *prior* to being conducted. In addition, the regulations implementing NEPA require that agencies prepare *supplements* to either EA's or EISs if the agency substantially changes the proposed action in a way that affects human health or the environment or if there are significant new circumstances or information relevant to public concerns. Accordingly, it is critically important that Center environmental staff be continually apprised of new or planned major initiatives and possible changes to existing, approved activities, so that the NEPA process is applied, schedules are maintained, and mission success is ensured.

The **Endangered Species Act** (ESA) of 1973 was enacted to address rising concerns about the continued survival of plants and animals that are important to the American people, and was stimulated by the tenuous status (at that time) of several larger animals such as the Bald Eagle, Whooping Crane, and American Alligator. The Act and its implementing regulations provide protection for both plants and animals that have been identified as "endangered" or "threatened" and importantly, recognize the critical role of defined natural habitats in stabilizing and expanding populations of endangered species. The ESA also explicitly prohibits the "taking" of (harming or in any way disrupting) any threatened or endangered species. Because the ESA programs both prohibit activities that might harm endangered species wherever they might be found and place limits on whether and under what circumstances endangered species habitat may be modified, they can impose important restrictions on NASA activities.

For any project or action undertaken by a federal agency, or that requires a federal permit (e.g., U.S. Army Corps of Engineers dredge and fill permit under the Clean Water Act), the sponsor must engage in formal consultation with the U.S. Fish and Wildlife Service (FWS) if the action could directly or indirectly affect any proposed or listed species. Agencies also may enter into informal consultation with FWS to ascertain what species are known to occur in the county surrounding the proposed action and whether there have been any sightings at or near the site of the proposed action. Federal agencies are required to ensure that proposed actions are not likely to "jeopardize the continued existence" of a listed species, and undertake substantive protective and affirmative conservation actions to promote the recovery of threatened and endangered species. These requirements are particularly relevant to agencies like NASA that have large facilities, which may contain substantial amounts of habitat suitable for listed species. In the event that FWS determines that the proposed action could adversely affect listed species, mitigation options will need to be specified and approved. In some cases, this may involve requirements to conduct continuing, even daily, proactive measures.

As a practical matter, agencies usually conduct their consultations with FWS concurrently with the NEPA process (i.e., during the preparation of an EA or EIS), as described above. As with the NEPA process, it is important to begin consultations as early in the planning process as possible for a proposed action, to avoid the possibility of costly delays either late in the NEPA process or worse, while a project is under construction.

The **National Historic Preservation Act** (NHPA) of 1966 provides the mechanism through which historically or culturally significant buildings, structures, and other objects are protected and preserved. The Act established a National Register of Historic Places and the Advisory Council on Historic Preservation. The Council evaluates potential impacts on proper-

ties on or eligible for the Register, which includes archaeological resources as well as structures. Federal agencies are required to consult with the Council before undertaking any action that might create such impacts. Although NHPA is a federal program, properties listed on the Register are not necessarily significant nationally; instead, most are significant primarily at the state or local level. Properties may be listed simply because of the period in time represented by a building and the activities that occurred within it. Similarly, sometimes the most innocuous locations contain major historic objects or archaeological sites (e.g., Native American settlements or burial grounds).

Determination of eligibility for listing on the Register is a process conducted by the federal agency contemplating an action, the State Historic Preservation Officer (SHPO), and the National Park Service, with input from archaeologists, Native Americans (as appropriate), and other concerned parties. The ultimate determination of "no effect," "no adverse effect," or "adverse effect" is made through ongoing consultation with local experts and the SHPO. If the SHPO determines that there are recorded sites on or eligible for the National Register, the agency can usually mitigate archaeological sites through excavation and documentation. Buildings having substantial historical significance generally must not be adversely affected or, alternatively, can be used through adaptive reuse. For less important structures, the SHPO may allow demolition following careful documentation.

Agencies are required to baseline their location to comply with NHPA. The Historic Preservation Officer at each NASA Center maintains this baseline. NHPA requirements are addressed during the NEPA process as are the Endangered Species Act requirements (i.e., the preparation of an EA or EIS). As with the NEPA process, it is important to begin consultations as early in the planning process as possible for a proposed action, to avoid the possibility of costly delays either late in the evaluation process or worse, while the project is under construction (or demolition).

### *Laws that regulate emissions to the environment*

Two major federal statutes regulate emissions of pollutants to the environment, the Clean Air Act and the Clean Water Act. Each of these landmark programs was enacted in the 1970's in response to widespread and deep public concerns about the condition of the nation's air and water resources, respectively.

The **Clean Air Act** (CAA), as amended, along with its implementing regulations, exerts extremely profound impacts on all levels of government, industry, and the public. To combat the very serious human health impacts of excessively polluted air in the U.S. (including air-related deaths of otherwise healthy people), the Congress developed a sweeping statutory program that requires the states to develop comprehensive plans to protect

and improve their air resources. Failure to submit plans or develop them adequately can result in significant sanctions, such as loss of federal funds to build roads and other measures that might limit economic activity and growth. The Clean Air Act is unique in this regard. The Act also requires that controls on air pollutant sources that are located in areas with existing air quality problems be more stringent than they would be otherwise. This may pose additional challenges in installing equipment or building new facilities or mounting new research or testing initiatives at NASA Centers that are located in certain areas. The table below lists the status of all locations housing NASA Centers relative to acceptable air pollutant levels. As may be observed from this table, at many Centers, any new major source of certain so-called criteria air pollutants will need to be equipped with the most effective pollution control equipment available, regardless of cost. In addition, sources of air pollution may require permits, which must be obtained prior to construction and operation.

| NASA Field Location | | | Areas in Non-Attainment with Standards - by Pollutant | | | | | |
|---|---|---|---|---|---|---|---|---|
| Facility Name | Location | County | Ozone | $NO_2$ | $SO_2$ | Lead | $PM_{10}$ | CO |
| Ames Research Center | Moffett Field, CA | Santa Clara | ✓ | | | | | |
| Dryden Flight Research Center | Edwards Air Force Base, CA | Kern | ✓ | | | | ✓ | |
| Glenn Research Center | Cleveland, OH | Cuyahoga | ✓* | | ✓ | | ✓ | |
| Goddard Space Flight Center | Greenbelt, MD | Prince George's | ✓ | | | | | |
| Goldstone Tracking Facility | Ft. Irwin, CA | San Bernadino | ✓ | ✓ | | | ✓ | ✓ |
| Jet Propulsion Laboratory | Pasadena, CA | Los Angeles | ✓ | ✓ | | | ✓ | ✓ |
| Johnson Space Center | Houston, TX | Chambers | ✓ | | | | | |
| Kennedy Space Center | Kennedy Space Center, FL | Brevard | | | | | | |
| Langley Research Center | Hampton, VA | Hampton | ✓* | | | | | |
| Marshall Space Flight Center | Huntsville, AL | Madison | | | | | | |
| Michoud Assembly Center | New Orleans, LA | Orleans Parish | ✓* | | | | | |
| Plum Brook Station | Sandusky, OH | Erie | | | | | | |
| Santa Susana Field Laboratory | Ventura County, CA | Ventura | ✓ | | | | | |
| Stennis Space Center | Bay St. Louis, MS | Hancock | | | | | | |
| Wallops Flight Facility | Wallops Island, VA | Accomack | | | | | | |
| White Sands Test Facility | Las Cruces, NM | Dona Ana | ✓ | | | | ✓ | |

* This area was formerly designated as an ozone Nonattainment Area. It has been redesignated as a Maintenance Area based on 3 consecutive years of ambient air quality monitoring data showing that ozone concentrations are below limits allowed by the Clean Air Act. Maintenance areas must continue to follow air quality planning requirements.

In sum, the Clean Air Act program is a sweeping and powerful set of environmental control laws that affects the ways in which NASA carries out its mission. This influence is likely to grow in the future, as air pollutant standards become more stringent. In addition, if mounting concerns about global climate change result in new regulatory controls or "voluntary" mandates within the Executive Branch, NASA will be faced with new challenges in meeting its obligations with respect to air quality protection.

The **Clean Water Act** (CWA) and implementing programs have been developed to protect the nation's surface water resources from damage due to uncontrolled discharges of pollutants from diverse sources. The original intent of this law was to *completely eliminate* pollutant discharges to the nation's rivers, streams, lakes, and oceans or areas that feed them. The early focus of CWA programs was to limit discharges of pollutants from defined ("point") sources such as factory discharge pipes to rivers, streams, and lakes, through standards developed industry by industry. Specific limits were then established at the facility level through permits. Although the technology-based approach embodied in the CWA has been very successful in reducing pollutant loadings to the nation's surface water bodies, it is clear that after 25 years, the goal of eliminating all pollutant discharges to the nation's surface waters has not been and will not be attained.

Nonetheless, Clean Water Act programs have continued to develop, and now encompass not only industrial discharges to surface waters, but also treatment of municipal sewage, pretreatment of industrial wastewater prior to discharge to a municipal treatment facility (known as a Publicly Owned Treatment Works, or POTW), and the control and treatment of stormwater run-off. National Pollution Discharge Emission System (NPDES) permits now encompass not only so-called conventional pollutants (biochemical and biological oxygen demand, suspended solids, pH, chlorine, oil & grease, coliform organisms), but also a large array of toxic chemical pollutants. One additional long-standing feature of the CWA is that it provides for strict limits on the discharge or placement of fill or dredged material in any surface water body, which generally has been interpreted as including wetlands. This activity is allowed only under a permit issued by the U.S. Army Corps of Engineers, and may pose significant obstacles to facility construction or expansion in some areas. In recent years, CWA programs have been amended to address spills of oil and hazardous substances into surface waters. This may require NASA Centers to develop and maintain detailed plans for spill prevention and mitigation.

### *Laws that regulate waste materials*

In response to the widely publicized problems arising from the uncontrolled dumping of hazardous chemicals, the Congress enacted two major programs in the mid-1970s and early 1980s. The first was designed to

ensure that waste materials that might pose hazards to human health and the environment were properly managed, and the second was enacted to provide a mechanism for undertaking the daunting task of cleaning up the large but unknown number of uncontrolled hazardous waste sites being discovered across the U.S. Subsequently, another statute was enacted to control shipment of hazardous materials and the hazards that this activity could pose.

The **Resource Conservation and Recovery Act** (RCRA) and its implementing regulations were designed to provide a "cradle to grave" management system for the disposition of hazardous wastes, and to develop a state-led effort to control risks from the nation's thousands of municipal solid waste (MSW) landfills. In effect, RCRA was enacted to *prevent* future Superfund sites. The RCRA program, which has taken more than 20 years to fully develop, provides an extremely rigorous system by which wastes that have been specifically identified or exhibit certain characteristics are tightly regulated in terms of how they must be managed, where, and by whom. Although numerous special conditions and exemptions to the stringent hazardous waste management standards exist, as a general matter, the handling, storage, and ultimate disposition of such wastes at NASA and other facilities is tightly regulated. Given high waste management costs and substantial scale economies, at most facilities (and many NASA locations) hazardous waste treatment, recycling, or disposal is performed at dedicated off-site commercial facilities. In other cases, NASA and other hazardous waste-generating installations include on-site RCRA Treatment, Storage, or Disposal (TSD) facilities, which operate under very strict terms and conditions defined by an EPA (or delegated state) permit. The nature and costs of these types of arrangement have provided substantial incentives for NASA environmental and operating personnel to find ways to reduce or eliminate the generation of designated RCRA hazardous wastes in the first instance. Such "waste minimization" initiatives offer tangible financial value to the NASA enterprise.

**Pollution Prevention Program at NASA's Dryden Flight Research Center**

In May 1996, at the Dryden Flight Research Center's Aircraft Maintenance division, a new chemical use tracking program was implemented to reduce the reporting burden on employees, facilitate tracking, decrease product waste, and increase efficiency and savings. Entitled the Chemical Crib, the program modernized the way chemicals were handled. Prior to the program, there was no program in place to track what chemicals were being used, by whom, where, and in what quantities. The Chemical Crib is a central issue control point where chemicals are stored properly, in compliance with OSHA and EPA regulations. Chemicals are "checked out" by workers on an as needed basis where they are weighed before and after each use to track the amount used more precisely and efficiently. The tracking system within the Chemical Crib provides on-line Material Safety Data Sheets (MSDSs) and required EPA reports, and controls chemical usage by authorizing appropriate User, Zone, and Task categories for each chemical. The system capabilities include tracking of chemical usage, training requirements, exposures, inventories, and personal protective equipment. Since implementation, the program has proven to be a success and continues to be adopted by other NASA organizations.

**How successful is the Program?**

- The Aircraft Maintenance division decreased its annual wate disposal cost from $120,000 to $69,000 within the first year of program implementation
- The purchase savings on the top ten chemicals used was $7,200
- Chemical purchases were reduced by 25% in the first year
- The Chemical Inventory has been reduced to approximately 125 products
- Waste disposal costs dropped by 43% in the first year the program was implemented.

RCRA also addresses underground storage tanks (USTs), which by regulation, were required to be protected from failure and leakage in one of several ways by 22 December 1998 or be taken out of service. At most NASA locations, replacement or upgrading of USTs was completed far in advance of the deadline, and this issue is not expected to significantly affect NASA operations in the future.

The **Comprehensive Environmental Response, Compensation, and Liability Act** (CERCLA) was passed by the Congress in an attempt to assign responsibility for cleaning up abandoned hazardous waste sites to the most appropriate parties, and to marshal the financial resources necessary to expeditiously begin cleanup on the sites most in need of immediate attention. CERCLA is commonly known as "Superfund" because it established a multi-million dollar trust fund to cover the costs of site cleanup. EPA's implementing regulations affect sites that have been identified as posing substantial actual or potential harm to human health and the environment. Sites requiring long-term response actions are identified on a "National Priorities List" (NPL) maintained by the EPA; the NPL contains several NASA facilities among more than 1,000 other sites.

CERCLA defines the substances that are considered "hazardous" under the program and that thereby trigger reporting and/or remediation responsibilities if released in excess of defined (generally small) quantities. For locations at which those substances are released, the statute and EPA regulations define in a fairly precise way which sites require cleanup, how that decision is to be made, the criteria that are considered in defining an acceptable type and level of remedial action, and numerous other program provisions. Within the context of NASA operations, Superfund is very important because of the ongoing financial impact that mandated cleanup activities impose, as well as continuing obligations to report and respond to any spills or other releases of defined hazardous substances that may occur.

The **Hazardous Materials Transportation Act** (HMTA) of 1975 and its implementing regulations govern the transfer of substances that may pose unreasonable risks to human health or property when transported in commerce. Within the context of HMTA, these substances include not only such obvious materials as hazardous wastes but also a large array of commercial chemicals and other products that can create problems if they are spilled or released while being moved. HMTA authorizes the federal Department of Transportation (DOT) to develop and deploy two complementary programs to address these risks. The first is to identify and designate requirements for the transport of individual substances posing unreasonable risks. By definition, many substances identified by regulatory agencies such as the EPA and the Nuclear Regulatory Commission (NRC) are covered, and for each of these (and many other) materials, specific requirements for packaging, labeling, and transportation is specified. The second program relates to hazard communication, and specifies how packaging and transport vehicles (motor vehicles, airplanes, and boats or ships) must be labeled. The latter program is the source of the distinctive DOT system of labeling and placarding, which helps material and package handlers to appropriately segregate incompatible substances, and also provides important visual clues for responders to hazardous material incidents, e.g., traffic accidents involving tanker trucks. NASA managers should be aware of these requirements, and the fact that materials and supplies that they procure or use may trigger additional HMTA compliance obligations and their attendant costs.

### *Laws that require or enable community and stakeholder involvement*

Following the Bhopal tragedy in India in 1985 and several high-profile chemical accidents in the U.S., the Congress enacted the **Emergency Planning and Community Right-to-Know Act** (EPCRA) as a component (Title III) of the Superfund Amendments and Reauthorization Act of 1986. This statute established several new and far-reaching requirements that collectively provide for an unprecedented level of public scrutiny of pollutant emissions (regulated or otherwise) from manufacturing facilities,

as well as very substantial coordination with local emergency response agencies on a facility-specific basis. Again, NASA Centers are subject to EPCRA requirements under Executive Order No. 12856.

The EPCRA program has three main components, all of which apply at one or more NASA locations. The first is emergency planning. EPA has defined a list of Extremely Hazardous Substances (EHS) and requires that the operator of any facility that uses more than a threshold quantity of any of these chemicals notify his/her State Emergency Response Commission (SERC) and report any release of one or more listed substances that results in an exposure to any person off site. The second component is community right-to-know, and is based upon use of chemicals for which material safety data sheets (MSDS) are required by the U.S. Occupational Safety and Health Administration (OSHA). The operator of a regulated facility must provide to the SERC storage and use information for these chemicals, aggregated by hazard category (e.g., fire, acute health, reactive) if desired, on an annual basis. The third element is toxic release inventory (TRI) reporting, which applies to all federal agencies regardless of operations and to manufacturing and other defined commercial entities as well as federal facilities that manufacture, process, or otherwise use any of more than 600 chemicals above defined threshold quantities. Operations regulated under TRI requirements must submit annually a separate report for each listed chemical quantifying releases to the environment (planned or otherwise) and transfers off-site. Reporting on pollution prevention activities has been added to the TRI reporting requirements in recent years. In addition, Executive Order 12856 requires that federal agencies develop voluntary goals and plans to reduce emissions and transfers of TRI chemicals by 50 percent by 1999, relative to a 1994 baseline.

The EPCRA program imposes some very significant planning, coordination, and reporting responsibilities upon the NASA Centers, and also provides a high degree of transparency of NASA operations to members of the communities in which the Centers are located. Center environmental professionals must continually interact with and provide updates to local emergency response personnel, and are responsible for reporting (and helping to reduce) emissions of toxic chemicals to the environment. The quantity and type of information that must be reported to the public on toxic chemical use also require that Center personnel be sensitive to community concerns regarding the use of these materials, and informed as to what steps are being taken to control or reduce toxic chemical use.

The EPCRA program imposes some very significant planning, coordination, and reporting responsibilities upon the NASA Centers, and also provides a high degree of transparency of NASA operations to members of the communities in which the Centers are located.

### *Laws that regulate the use and sales of chemicals*

In contrast to most other "environmental" statutes, the **Toxic Substances Control Act** (TSCA) and **Federal Insecticide, Fungicide, and Rodenticide Act** (FIFRA) and their respective implementing regulations mainly affect whether and under what conditions a particular chemical substance can be

manufactured and used for a particular purpose, rather than what must be done after chemical use occurs. Both programs require a balancing of the benefits and costs inherent in allowing a particular chemical to be distributed in general commerce or used in a particular application. That is, the benefits to society of chemical or use approval must exceed the associated costs, which often arise in the form of environmental impacts. Interestingly, and in contrast to many other regulatory programs, virtually all of the major decisions are made and implemented at the federal level by EPA, rather than at regional, state, or municipal levels of government.

TSCA and FIFRA principally affect NASA only to the extent that certain chemicals that are important to its mission may be restricted to or from a particular use, either at present or potentially in the future. FIFRA regulations also impose some requirements on who may apply pesticides and under what conditions. In addition, several amendments to TSCA relate to controls on particular substances in the man-made and natural environments that may pose hazards to NASA personnel. These are discussed below.

### *Laws that ensure the environmental health of NASA employees, contractors, and visitors*

Several major statutes and regulatory programs include provisions that are focused on ensuring that safe and healthful conditions exist and are maintained in commercial, public, and residential settings. Some of these programs establish limits on environmental quality, such that parameters that are above or below certain limits are defined as unhealthful and must be corrected. Others address specific pollutants or substances that pose an extreme hazard under particular circumstances and must be addressed in a prescribed way. These narrowly focused, yet important, programs are described below in turn.

The **Safe Drinking Water Act** (SDWA) requires EPA to establish standards that define acceptable levels (concentrations) of physical, chemical, and biological constituents in water to be used for human consumption. These standards are called either primary drinking water standards (PDWS), which are health-based, or secondary drinking water standards, which address aesthetic issues such as color and odor. Secondary standards are guidelines (i.e., are not federally enforceable), though they may be adopted by state programs, in which case they may become requirements. SDWA standards apply only to "public drinking water systems." Public drinking water systems are drinking water supply systems that provide water to the public and have 15 or more service connections or regularly serve more than 25 people. Consequently, NASA Centers that employ wells to supply drinking water to on-site personnel are subject to the SDWA requirements. As a practical matter, this means that the Center Manager (or designee)

must ensure that the well water provided on-site for human consumption meets the PDWS, and may be required to conduct monitoring, reporting, and operator certification activities.

Several other occupational health and safety issues are intertwined with effective environmental management. These are addressed by regulatory programs arising from at least two different statutes and may be complicated by shared or duplicative oversight and enforcement responsibilities among federal departments and agencies. For example, PCB's, asbestos, radon in drinking water, and lead-based paint are all addressed by separate subtitles of the **Toxic Substances Control Act** (TSCA), which as discussed above, empowers EPA to establish and enforce controls and restrictions on the manufacture, distribution, and use of various chemicals and substances. In addition, asbestos and lead exposures in the workplace are addressed under regulations developed under the **Occupational Safety and Health Act** (OSHA), which is administered by the Occupational Safety and Health Administration of the Department of Labor.

### *Laws that regulate use of nuclear materials*

Several related statutes and implementing regulations govern the use and disposition of radioactive materials, both high-level fissionable material and low-level materials that are used in research, commercial, and industrial applications. Because radioactive materials are used within the NASA complex in a number of mission-critical activities, it is important to recognize and be aware of some of the difficulties that are posed by the safe management of radioactive materials, particularly disposal of radioactive wastes.

On August 1, 1946, President Truman signed the **Atomic Energy Act**, transferring the control of atomic energy from the military to the newly formed Atomic Energy Commission (AEC). Initially, the AEC focused on designing and producing nuclear weapons and developing nuclear reactors for naval propulsion, but over time broadened this perspective to consider civilian uses. The **Atomic Energy Act of 1954** ended the government's exclusive use of atomic energy, giving the AEC authority to regulate the emerging commercial nuclear power industry. This statute encouraged the development and use of nuclear energy and research for the general welfare as well as national defense. In 1974, Congress separated the AEC into the Nuclear Regulatory Commission (NRC) and the Energy and Research and Development Administration (ERDA). In 1977, ERDA became part of the Department of Energy. The Atomic Energy Act provides the basis of authority for NRC, DOE, and EPA to regulate radioactive materials.

More specifically, the Atomic Energy Act provides NRC with regulatory authority over the use and possession of radioactive source material, byproduct material, and special nuclear material within the United States. This authority includes not only the regulation of the commercial nuclear

power industry but also other uses for radioactive materials, including use by nuclear fuel cycle facilities, hospitals, laboratories, universities, pharmaceutical and manufacturing companies, and waste handling and disposal companies. NRC's regulations have been developed to ensure reasonable protection of health, safety, and the environment.

The **Resource Conservation and Recovery Act** (RCRA), as previously described, authorizes EPA to regulate hazardous wastes from "cradle-to-grave." However, the RCRA statute specifically excludes source, special nuclear, or byproduct material as defined by the Atomic Energy Act from the definition of solid waste. Because "hazardous wastes" must first be "solid wastes" to be regulated under RCRA, these radioactive materials are not considered hazardous wastes under the RCRA program. As a general matter, in the event of conflicting regulations of radioactive materials between RCRA and the Atomic Energy Act, the latter takes precedence. However, mixed radioactive/hazardous wastes must be managed in compliance with both RCRA and the Atomic Energy Act.

The **Low-Level Radioactive Waste Policy Act** (LLRWPA) established the initial legal and regulatory framework governing the disposal of low-level radioactive waste in the United States. This statute authorized a system of interstate compacts, under which states would form multilateral agreements to provide for the regional disposal of low-level waste in new low-level waste disposal facilities. Nonetheless, as of 1985, very little had been done to site, much less build, such new disposal facilities. Accordingly, in 1985, Congress amended the Act by establishing deadlines for the achievement of milestones toward developing new disposal capability within each interstate compact. The states have failed to meet some of these milestones, which has resulted in restrictions on access to disposal capacity for most low-level waste generators, as well as excessive disposal costs.

The **Nuclear Waste Policy Act of 1982** established a corresponding national program for interim storage of spent nuclear fuel and high-level radioactive waste, identification of a suitable location for ultimate, long-term disposal in a deep geologic repository, and the development and licensing of such a repository. Most of the deadlines established in this Act have not been met. The program remains intact, however, and the Department of Energy continues to make slow progress on designation of the Yucca Mountain, Nevada site as the national high-level waste repository. While specific performance requirements for deep geologic disposal continue to be debated, NRC is actively developing plans to evaluate the license application to be filed by DOE.

### *Executive Orders*

As discussed above, NASA and other federal entities are subject to directives from the President that may be issued from time to time. These directives are called Executive Orders and carry the force of law within the

Executive Branch until they expire or are rescinded. Numerous Executive Orders relate to the environment and place additional requirements upon NASA operations. A brief description of some of the most significant of these orders follows. A complete list may be found in Appendix D.

Executive Order 11514 (as amended by Executive Order 11991) addresses protection and enhancement of environmental quality, while Executive Order 11593 directs federal agencies to afford similar measures to cultural resources.

Executive Orders 11988 and 11990 address water resources, and speak specifically to floodplain management and wetlands protection, respectively.

Executive Order 12088 (as amended by Executive Order 12580) addresses federal entity compliance with pollution control measures, and Executive Order 12114 directs agencies to consider and limit the environmental effects of major federal actions in other countries.

Several executive orders issued over the past several years address pollution prevention within the federal government. Specifically, Executive Order 13123 speaks to energy management; Executive Order 12843 establishes procurement requirements for ozone-depleting substances, and Executive Order 12844 mandates federal use of vehicles that use alternative fuel.

Executive Order 12856 imposed substantial new requirements on federal agencies by requiring them to comply with existing community right-to-know laws as well as with some new pollution prevention requirements. Executive Order 13101 established new directives to purchase "environmentally sound" products, and new recycling and waste prevention goals. Finally, Executive Order 12898 requires federal agencies to address environmental justice concerns in their planning and operational activities.

# 5 How Environmental Laws Apply to NASA

This "how to" chapter covers the major environmental regulations, protocols, and emerging issues outlined in chapter 4, with special emphasis given to those regulations that affect NASA. For each of the major environmental laws and program areas described in Chapter 4, we present and discuss a number of key issues: relevance; major requirements; responsibilities of non-environmental staff; when to call environmental staff and other applicable NASA organizations; and sources of help. In addition, for certain topics, we provide more extensive information addressing compliance methods and potential pitfalls and solutions. Of particular note to the non-environmental professional at NASA is the fact that many different environmental laws and regulations could apply to any given activity at NASA, and that activities and functions that may not have a clear or obvious environmental dimension may be significantly affected by environmental control regulations that apply to the NASA installation at large.

One additional note concerns the content and order of the substantive sections that follow. In contrast to Chapter 4, which presented environmental control laws in categories defined by the issues that they address, the focus in this chapter is on how these laws, individually and collectively, affect the decisions and activities of NASA non-environmental personnel. This minor inconsistency allows us to provide the reader with clear, unambiguous, and non-repetitive guidance on how to understand and respond effectively to environmental compliance mandates and NASA environmental objectives.

## Air Pollution

### Relevance

As discussed in Chapter 4, under authority of the Clean Air Act (CAA), EPA regulates criteria pollutants, hazardous air pollutants or air toxics, and substances that deplete the stratospheric ozone layer. Typically, EPA imposes emission reduction requirements for specific types of processes or operations. Periodic monitoring, recordkeeping, and reporting activities conducted by the environmental staff at all Centers may be required to support these efforts to ensure that these air pollutant sources are in compliance with pertinent requirements. These air quality requirements are imposed on and often differentiate between existing and new sources. Consequently, whenever a change is made to a process, operation, or facility or when a new operation is added, NASA environmental professionals must be notified of the changes so they can ensure that the Center

remains in compliance with the air quality requirements. The major provisions that may affect NASA operations are described below, according to the specific air quality requirements of the Clean Air Act program:

- National Ambient Air Quality Standards.
- Construction and Operating permits.
- Best Available Control Technology and Lowest Achievable Emission Rate.
- New Source Performance Standards.
- National Emission Standards for Hazardous Air Pollutants/Maximum Achievable Control Technology.
- Mobile Sources, Fugitive Emissions, and Fuel Dispensing.
- Clean Air Act Section 112(r) Risk Management Plan.
- Compliance Monitoring.
- Conformity, and
- Stratospheric ozone protection.

## Major Requirements

*National Ambient Air Quality Standards (NAAQS)*

EPA has established air pollutant emission standards to protect human health and welfare. These standards cover what are called the criteria pollutants. EPA typically regulates these criteria pollutants as well as their precursors-chemical compounds that react to form the criteria pollutants. Criteria pollutants include ozone (and nitrogen dioxide and volatile organic compounds as precursors), sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter, and lead. Although a facility does not directly have to comply with these standards except under certain circumstances[1], a NASA facility may have to meet other requirements that help an area (typically a county or a group of counties) to achieve these standards. For example, NASA facilities and contractor facilities in California's South Coast Air Quality Management District (JPL ,DFRC, and Rocketdyne at Canoga Park) may have had to implement significant air pollution reduction measures such as switching to alternative coatings with a lower volatile organic compound content. NASA's environmental staff is familiar with the requirements specifically related to the NAAQS, and can help you better understand and address any related compliance issues that may pertain to program and facility operations.

[1] When NASA wants to expand a facility, it may have to show that its facility in combination with other facilities in an area does not contribute to a violation of the NAAQS. Computer models can estimate the air quality concentration levels in the area both before and after the planned expansion, which can then be compared to the NAAQS.

*Construction and Operating Permits*

Recent attempts to streamline the CAA program have resulted in the establishment of facility-wide permits that specify not only how much of various pollutants may be emitted to the air, but also how equipment and processes having the potential to emit these pollutants may be operated. These so-called "Title V" operating permits consolidate many of the CAA program requirements (discussed more fully below).

In addition to the Title V operating permit, NASA is required to obtain a construction permit for equipment or processes that trigger air quality requirements. Only major sources of air pollutants are required to obtain a federal construction permit. NASA also may be required to obtain or modify an existing Title V operating permit before beginning operation of a changed process or new equipment. Major sources and/or sources subject to New Source Performance Standards (NSPS) or National Emission Standard for Hazardous Air Pollutants (NESHAP) also are required to obtain a Title V operating permit. (Note that some states also require construction and operating permits with emission threshold levels that differ from the federal requirements.) In attainment areas, major sources are defined as emitting 250 tons per year or more of any one air pollutant, and major modifications trigger the permitting threshold if they exceed the emission thresholds. If these emission thresholds are exceeded, then the facility must obtain a construction permit and a Title V operating permit.

A NASA facility may hold one or more air emission operating permits. These operating permits will list the conditions and limitations under which NASA can operate its equipment or processes. The permits also may list periodic monitoring, recordkeeping, and reporting requirements. Center Environmental Office personnel are familiar with the requirements of all permits held by your installation, and can explain them to non-environmental staff as needed. It is worth remembering that a violation of a permit could result in the facility facing stiff penalties (at least $10,000 per day), and in extreme situations, even imprisonment of the Center Director.

**Typical Activities Potentially Requiring a Construction Permit**

- Adding a coating line
- Adding a degreaser
- Adding a paint booth

Consequently, whenever a NASA employee *plans* to make any changes to a process or operation or add new equipment or processes, s/he should notify the environmental staff in the design phase or as soon as possible thereafter to ensure that the requisite air permits are obtained, if necessary. This also applies to any operational changes that may alter air pollutant emission rates (e.g., increasing the amount of coatings used). Bear in mind that NASA employees cannot begin to assemble the new equipment or operation or even break ground until NASA has obtained an approved construction permit. Note also that air pollutant emission thresholds are based on the potential or maximum emissions that could conceivably be emitted from the equipment, NOT just the expected emissions. This being the case, even seemingly minor operational changes can have major

implications for your Center's permit status. The states and the EPA have the power and authority to shut down any facility process or piece of equipment that violates the permit or the regulation.

On a day-to-day basis, a NASA employee also may need to operate specified equipment and processes such as vapor degreasers and printing within the limitations and conditions stipulated on the operating permit. For example, the permit may limit the number of hours a vapor degreaser can operate or remain uncovered during a 24 hour period, or it may limit the amount of a chemical compound that can be used for handwiping operations per shift. The permit also may require NASA to monitor, record, and report certain activities periodically. For example, a NASA employee may need to monitor and record fuel or chemical usage. The Center Environmental Office then reports the data to the state or EPA, and keeps the records on file for a specified period of time.

Most provisions (e.g., control equipment, monitoring, recordkeeping) of the air quality requirements discussed below would be included in NASA's operating permit(s).

*Best Available Control Technology or Lowest Achievable Emission Rate*

If a facility triggers the major source threshold, then control equipment or specific processes will be required. Specific CAA program provisions require the use of the Best Available Control Technology (BACT) in attainment areas (see glossary) or the use of the Lowest Achievable Emission Rate (LAER) in nonattainment areas (see glossary). The purpose of these specifications is to maintain the air quality in the area where the new equipment or process is used. The Center Environmental Office will know what constitutes BACT or LAER. If your Center is a major source of air pollutants and exceeds the thresholds, then the appropriate equipment or process should be used. For example, a certain type of spray booth may be required. Any BACT or LAER requirements will be specified in your construction and operating permits.

*New Source Performance Standards (NSPS)*

The New Source Performance Standards (NSPS) are regulations that impose certain control technologies or operating practices on defined emission sources to maintain the air quality in an area. NSPS provisions usually apply to new or modified equipment or processes falling into certain source categories. As noted above, NASA employees should notify their Center Environmental Manager before planning to purchase any new equipment or change a process. The Environmental Manager will need to determine if additional pollution control equipment or other equipment, such as monitoring devices, is necessary. The requirements of any applicable NSPS provisions will be listed in the operating permit.

*National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Maximum Achievable Control Technology (MACT) Requirements*

NESHAPs and MACT standards are regulations that impose certain control technologies or operating practices on emission sources by industry category, such as the aerospace industry, to lower health risks associated with hazardous air pollutants or air toxics. NESHAP/MACT provisions usually apply to existing, new, or modified equipment or processes falling into certain source categories. As noted above, a NASA employee should notify the environmental manager before planning to purchase any new equipment or make major changes to a process. The environmental manager will need to determine if additional control technology or other equipment, such as monitoring devices, is necessary. Current operations also may need to be in compliance with new MACTs or NESHAPs. These regulations usually require NASA to install air emission control technologies and/or change a process. In addition, a NASA employee is usually required to monitor, record, and report certain activities.

**Examples of HAPs**

Chlorine • cadmium compounds • hydrazine • chromium compounds • hydrochloric acid • xylenes • methyl chloroform • lead compounds • trichloroethylene • nickel compounds • toluene • glycol ethers

Currently only two NASA Centers—KSC and MSFC—qualify as "major sources" of Hazardous Air Pollutants (HAPs). A major source is defined as emitting 10 tons of any one HAP per year, or 25 tons of combined HAPs per year (there are 188 listed HAPs). Although the Aerospace NESHAP comprises the main regulation that applies to NASA's activities, many other NESHAPs apply as well. As mentioned in Chapter 3, NASA Headquarters EMD and NOET participated in the negotiated rulemaking process with EPA and others in crafting the Aerospace NESHAP and are continuing to participate in the rulemaking process for other NESHAPs that could potentially affect NASA, its contractors, and its suppliers.

The Aerospace NESHAP is applicable to facilities engaged in the manufacture or rework of aerospace vehicles or components. It does not, however, regulate the following: research and development; quality control and laboratory testing activities; chemical milling; metal finishing; electrodeposition (except for electrodeposition of paints); composites processing (except for cleaning and coating of composite parts or components); or electronic parts and assemblies (except for cleaning and topcoating of completed assemblies).

**Aerospace vehicle or component** is defined as any fabricated part, processed part, assembly of parts, or completed unit, with the exception of electronic components, of any aircraft including, but not limited to airplanes, helicopters, missiles, rockets, and space vehicles.

The Aerospace NESHAP applies to all major sources of HAPs. Space Vehicles are exempt from all requirements in the Aerospace NESHAP except those for depainting. At the time of this writing, none of NASA's depainting activities met the threshold requirement of depainting six or more complete vehicles per year that would make them subject to the regulations in the Aerospace NESHAP. No other NASA activities trigger the Aerospace NESHAP thresholds at this time.

**Space vehicle** means a man-made device, manned or unmanned, designed for operation beyond the earth's atmosphere. This definition includes integral equipment such as models, mock-ups, prototypes, molds, jigs, tooling, hardware jackets, and test coupons. Also included is auxiliary equipment associated with test, transport, and storage, which through contamination can compromise space vehicle performance.

Nonetheless, other NASA activities are and will be regulated by other NESHAPs. Almost all types of surface coating operations will be covered by a NESHAP and rules also may cover coating formulations, application methods, surface preparation, cleaning, and coating removal. Many of these regulations will affect NASA indirectly by imposing requirements on NASA's main contractors and suppliers. At the time of this writing, the majority of these NESHAPs are still in draft form. The following are examples of some draft NESHAPs and their potential to impose impacts on NASA:

- Miscellaneous Metal Parts Surface Coatings NESHAP—covers most metal painting operations not covered under another NESHAP. (This requirement would place restrictions on what paints could be used and how they are applied.) NASA impacts would be associated with the GSE, crawler and mobile launch platform, rail cars, and non-structural equipment.
- Rocket Engine Test Firing NESHAP—covers static test firing, including tests associated with research and development . This could potentially affect test firings at MSFC, SSC, WSTF, GRC, and GRC/Plum Brook.
- Miscellaneous Organic NESHAP—covers the production of propellants, explosives, and pyrotechnics. This could potentially affect the chemical content and performance characteristics of materials and products that NASA buys, including the following: alkyd resins, chelating agents, explosives and propellants, hydrazine, paints, coatings, adhesives, photographic chemicals, phthalate plasticizers, and rubber chemicals (additives).
- Plastic Parts Surface Coating NESHAP—addresses coating of plastics not covered under another NESHAP and includes the use of sealants and adhesives. This regulation would, for example, affect the bonding of plastic surfaces on the Orbiter.

*Mobile Sources, Fugitive Emissions, and Fuel Dispensing*

Mobile Sources

Mobile Sources are engines and fuels used in motor vehicles and nonroad vehicles and equipment, (e.g., construction equipment, lawnmowers, boats, locomotives, etc.) that generate air pollutant emissions. The majority of regulations on mobile sources are standards that the engine manufacturer must meet in order to sell the engine in the U.S. Other federal initiatives include integrating clean-fueled vehicles (compressed natural gas and electric) into the market place. States implement mobile source regulations through the State Motor Vehicle Emissions Inspection and Maintenance Programs.

Fugitive Emissions

Fugitive emissions are those that do not pass through a stack, chimney, vent, or an equivalent opening. Fugitive emissions include VOC emissions from equipment leaks (such as valves, flanges, and pump seals) and dust emissions from roads (due to vehicular traffic), open piles (such as coal stockpiles), or other sources.

Fugitive VOC emissions are controlled under the federal NSPS and NESHAP. The requirements include leak detection and repair (LDAR). Compliance is achieved through a monitoring, recordkeeping, and reporting procedure.

Fugitive dust emissions are controlled under various state and local statutes. In most cases, compliance is achieved through monitoring of visible emissions from dust generated from the source.

Fuel Dispensing

Fuel dispensing means dispensing fuel to motor vehicle tanks from stationary storage tanks. Fugitive air pollutant emissions occur when fuel is dispensed into motor vehicle tanks. In ozone nonattainment areas (e.g., the Baltimore-Washington DC area), these emissions are controlled by vapor caps or vapor return lines installed in fuel dispensers.

Emissions also occur when fuel storage tanks (from which fuel is dispensed) are filled from delivery trucks. These emissions are controlled by submerged fill pipes (fill pipes extended close to the bottom of the tank). Emissions also are controlled by a vapor recovery system (a system that collects displaced vapors).

### *Chemical Accident Prevention Provisions - Clean Air Act Section 112(r) Risk Management Program*

The goal of the Chemical Accident Prevention provisions, or the Clean Air Act Section 112 (r) Risk Management Program, is to prevent accidental releases of substances that can cause serious harm to the public and the environment from short-term exposures. This program also seeks to mitigate the severity of releases that do occur. These regulations build on the chemical safety work of the Emergency Planning and Community Right-to-Know Act (EPCRA) and the Process Safety Management regulations of the Occupational Safety and Health Administration (OSHA). (These programs are described further below.) The 112(r) program requires a facility operator to develop and implement a risk management program that includes a hazard assessment of the off-site consequences of releases under worst case and alternate scenarios, a prevention program, and an emergency response program.

NASA's chemical accident prevention program may include various elements:

- Review and documentation of the Center's chemicals, processes, and equipment.
- Detailed process hazard analysis to identify hazards, assess the likelihood of accidental releases, and evaluate the consequences of such releases.
- Development of standard operating procedures.
- Training of employees on procedures.
- Implementation of a preventive maintenance program.
- Management of change in the operation that may affect the safety of the system.
- Reviews before initial start-up of a process and before start-up following a modification to a process.
- Investigation and documentation of accidents, and
- Periodic safety audits to ensure that procedures and acceptable practices are followed.

All NASA employees should be familiar with many, if not all, of these elements of the program. In particular, a NASA employee must conduct business according to the standard operating procedures. In addition, all NASA employees must receive the relevant training on the preventive programs procedures. If a NASA employee is unclear of his/her responsibility, then s/he should contact the Center Environmental and/or Safety Office.

*Compliance Monitoring*

The compliance monitoring provisions of the CAA program require NASA to monitor certain activities in addition to the activities mentioned above, such as chemical usage, operating hours, and fuel usage, to ensure that NASA is in compliance with its air permits and state, local, and federal air quality requirements. These surrogate data allow for NASA and air regulatory agencies to determine compliance with emission limits without specifically measuring the air pollutant emissions. NASA employees are responsible for contacting the Center Environmental Office to become aware of all activities that must be performed by non-environmental staff in order to ensure compliance.

*Conformity*

General conformity ensures that federal facilities and federal actions do not adversely affect a pertinent state or local agencies' plans for improving air quality in the area. The general conformity provisions are applicable only

in non-attainment and maintenance areas of the country. If a proposed NASA activity does not meet one of the exemptions listed in the text box below, then a general conformity determination must be made if the activity will occur in a non-attainment area or maintenance area. (See Chapter 4.) Consequently, if a NASA employee is initiating an activity that will release chemicals of any sort to the air, the employee must notify the Center Environmental Office. Depending upon the results of the general conformity determination, the proposed activity may require mitigating factors so that air quality is not adversely affected. Other than notifying the Center Environmental Office of a proposed activity, non-environmental staff will most likely not need do anything related to this requirement. If, during the conformity determination, it is determined that the proposed action does adversely affect air quality and requires mitigating factors, non-environmental staff may be required to implement specific limitations on the activity, such as limiting rocket engine testing to one test per day. General conformity determinations are closely related to the NEPA analysis that is required. (See the NEPA section of this chapter for more information.)

**Examples of Federal Actions Exempt from Conformity Determination Requirements**

- Actions where the total of direct and indirect emissions are below the threshold emissions levels for nonattainment areas and maintenance areas.
- Actions which would result in no emissions increase or an increase in emissions that is clearly de minimis.
- The portion of an action that includes major new or modified stationary sources that require a permit under the new source review (NSR) program (section 173 of the Act) or the prevention of significant deterioration program (title I, part C of the Act).
- Actions in response to emergencies or natural disasters such as hurricanes, earthquakes, etc., which are commenced on the order of hours or days after the emergency or disaster.
- Research, investigations, studies, demonstrations, or training, where no environmental detriment is incurred.
- Alteration of and additions to existing structures as specifically required by new or existing applicable environmental legislation or environmental regulations (e.g., hush houses for aircraft engines and scrubbers for air emissions).

*Stratospheric Ozone Protection*

The stratospheric ozone layer is an approximately 1/8 inch thick layer of ozone ($O_3$) that lies between 15 and 20 miles above the surface of the earth. The ozone layer serves as a shield to protect life on earth from the harmful effects of ultraviolet radiation imparted by the sun. Without it, life on earth as we know it would not be able to exist.

Over the last several decades, scientists have become increasingly convinced that the use of certain man-made chemicals is causing damage to the stratospheric ozone layer. Specifically, emissions of these chemicals are causing a thinning of the ozone layer, which is resulting in increased levels of radiation reaching the earth's surface. If allowed to continue, this

increased radiation would result in a dramatic rise in skin cancer and cataracts, suppression of the immune system in humans and animals, and serious damage to the food chain.

Chemicals that are believed to be causing damage to the ozone layer have been termed "ozone-depleting substances (ODS)," and many have been or are currently being used by NASA in a wide variety of applications. Most notable are the uses of chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) for refrigeration/air-conditioning, the use of CFCs and 1,1,1-trichloroethane for solvent cleaning, and the use of halons for fire extinguishing. The following table provides a list of the most common uses of ODS within NASA:

| Ozone-Depleting Substance | Examples of NASA Uses of ODS |
|---|---|
| CFC-11 | Chillers that cool the Shuttle on the launch pad and cool wind tunnels. |
| CFC-113 | Precision cleaning and verification for the Shuttle's main engine and for long-life satellite instrumentation. |
| CFC-114 | Ground support systems for the Shuttle - cooling unit. |
| 1,1,1-trichloroethane (TCA) | As a binder in Solid Rocket Booster rubber insulation. |
| Halon 1211 and Halon 1301 | Mobile launch platform fire suppression. |
| HCFC-121 | Cooling loop on the orbiter's doors. |
| HCFC-141b | Foam-blowing agent for external tank. |

As a result of the extreme impacts that would result from continued damage to the ozone layer, the nations of the world convened in 1989 to draft the Montreal Protocol on Substances that Deplete the Ozone Layer. The overall goal of the Protocol, which has been amended and adjusted several times since 1989, is to limit and ultimately phase out the production and consumption of ODS so as to prevent extensive further damage to the ozone layer. By signing the Protocol, countries (known as Parties to the Protocol) agreed to implement the mandates of the Protocol through appropriate domestic mechanisms. In the U.S., the Montreal Protocol is being implemented through Title VI of the Clean Air Act Amendments (CAAA) of 1990.

The regulations implemented under Title VI to control the production and use of ODS are quite extensive. There are dozens of chemicals that have been designated as ODS and are therefore controlled by these regulations. Most important is the fact that, under Title VI, the production of Class I[2] ODS was banned in the United States as of January 1,

[2] Class I ODS are: CFC-11, CFC-12, CFC-13, CFC-111, CFC-112, CFC-113, CFC-114, CFC-115, CFC-211, CFC-212, CFC-213, CFC-214, CFC-215, CFC-216, CFC-217, 1,1,1-trichloroethane, carbon tetrachloride, halon 1211, halon 1301, halon 2402, methyl bromide, and numerous hydrobromofluorocarbons (HBFCs).

1996 and Class II[3] are scheduled to be phased out in 2030. Due to its high ozone-depleting potential HCFC-141b will be phased out in the U.S. in 2003. While this ban did not prohibit the use of ODS, it severely limited the supply of the banned chemicals. As a result, the chemicals are still used in some applications, but their continued use relies upon supply solely from stockpiles or upon the use of recycled materials.[4] The following is a listing of relevant regulations that have been promulgated under the CAA relating to ODS.[5] Additional detail is available from the EPA through its hotline and web site (see "Sources of Help" for contact information).

| Regulation | Brief Summary |
|---|---|
| Ozone-Depleting Substance Production Phaseout (sections 601-607) | Sets a phaseout schedule for the production of a wide variety of ODS. |
| Stationary Refrigeration and Air Conditioning, Halon Blends & Handling (section 608) | Describes the requirements governing the recycling of refrigerants and halons in stationary systems to end the practice of venting these chemicals to the atmosphere. |
| Methyl Bromide (section 608) | Discusses findings of the need for the use of tarps to control methyl bromide emissions. |
| Motor Vehicle Air Conditioning (section 609) | Governs the substitutes that may be used for CFC-12 in motor vehicle air-conditioning systems. |
| Nonessential Products Ban (section 610) | Bans the sale, distribution, and offer of sale of a number of products containing or manufactured with CFCs or hydrochlorofluorocarbons (HCFCs). The banned products include flexible and packaging foams and most aerosols and pressurized dispensers. |
| Labeling (section 611) | Describes the requirements for manufacturers to label products either containing or made with ODS. |
| Substitutes for Ozone-Depleting Substances (Significant New Alternatives Policy (SNAP) Program) (section 612) | Lists the legally acceptable (and unacceptable) substitutes that may be used to replace ODS in a wide variety of applications. |
| Federal Procurement (section 613) | Describes the requirements that each federal department, agency, and instrumentality conform its procurement regulations to the policies and requirements of Title VI of the Clean Air Act and to maximize the substitution of safe alternatives for ozone-depleting substances found acceptable under the SNAP Program. |

[3] Class II ODS include all hydrochlorofluorocarbons (HCFCs).

[4] When using recycled materials, especially in critical applications, it is important to make sure that the material meets the required purity specifications to ensure effective results.

[5] It is important to note that, due to a variety of factors, NASA has received an exemption for the continued use of 1,1,1-trichloroethane for use as a bonding material for the insulation of the Shuttle's Solid Rocket Motors. It is, however, very difficult to obtain such an exemption, and they are only pursued in the case of extreme mission-critical needs. Applications for exemption take a long time and are costly, so they should be used only as a last resort, after all available alternatives have been considered and ruled out. In any event, an exemption is not guaranteed, even for mission activities.

The following are the most commonly used ODS that are subject to the regulations listed above:

| Chemical | Most Common Use(s) |
|---|---|
| CFC-11 (Trichlorofluoromethane) | Refrigeration/air-conditioning, foam blowing (insulating and non-insulating). |
| CFC-12 (Dichlorodifluoromethane) | Refrigeration/air-conditioning, aerosol propellant (also used in aerosols for thermal stress testing of circuit board connections). |
| CFC-113 (Trichlorotrifluoroethane) | Solvent cleaning (precision cleaning and verification), dry cleaning. |
| CFC-114 (Dichlorotetrafluoroethane) | Refrigeration/air-conditioning. |
| CFC-115 (Monochloropentafluoroethane) | Refrigeration/air-conditioning. |
| Methyl Chloroform (1,1,1-Trichloroethane) | Solvent cleaning, dry cleaning, constituent in aerosol products (including mold releases and paints). |
| Carbon Tetrachloride | Solvent cleaning, laboratory uses. |
| Halon 1211 (Bromochlorodifluoromethane) | Fire protection/extinguishing. |
| Halon 1301 (Bromotrifluoromethane) | Fire protection/extinguishing. |

### Responsibilities of Non-Environmental Staff

The most important point that non-environmental staff should remember is that when the initial discussions for a new or modified activity begin, the Center Environmental Office should be notified. These activities include, but are not limited to, any major overhauls that may occur during maintenance, the addition of new equipment or new process lines, additional rocket testing, changes in operating hours, changes in fuel type, and changes in types or amounts of chemicals used, in general, any activity that discharges materials to the air. To avoid any delays with a new project or process changes and to avoid substantial environmental penalties, the non-environmental staff must consider the following issues:

- Allow sufficient time (several months) to conduct any requisite environmental assessments.
- Allow sufficient time (several months to a year) to obtain any requisite air permits or modifications to existing permits.
- Order equipment only after initial approval has been obtained for any requisite construction permits.
- Do not make any changes in equipment, process, or operating practices without first checking with your Center Environmental Office.
- Be sure to monitor, record, and report any data required for air quality management purposes.

- Ensure that emissions of ODS from use in approved applications, such as refrigeration and air conditioning, are minimized using all means necessary, and
- Ensure that suppliers are not using ODS in applications in which they are prohibited.

In addition, over the next several decades, an increasing number of chemicals will be subject to more extensive controls under Title VI of the CAA. Most important for NASA are the HCFCs, for which use is scheduled to be phased out before the year 2030, but possibly sooner. As a result, it is beneficial to design new processes and procedures to avoid the use of not only the currently controlled ODS, but also those that will be eliminated in the foreseeable future. Such planning will help to avoid the need to identify and implement additional replacements in the future.

### When to Call Environmental Staff

- Notify the Center Environmental Office if any monitoring or recordkeeping equipment fails.
- Notify the Center Environmental Office if a NASA employee is unclear whether an action affects air quality.
- Notify the Center Environmental Office if a spill occurs.
- Whenever you believe that CFC or HCFC refrigerants are being vented to the atmosphere during servicing or installation (may occur in stationary refrigeration and air-conditioning equipment as well as mobile air conditioners in vehicles and refrigerated transport vehicles), and
- Whenever equipment containing ODS is to be decommissioned and/or destroyed.

### Sources of Help

Headquarters Environmental Management Division

Center Environmental Office

NOET - NASA Operational Environmental Team

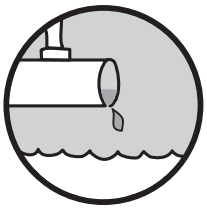
Shuttle Replacement Team

U.S. EPA Ozone Protection Hotline
Tel: 1-800-296-1996

U.S. EPA Ozone Depletion Web Site
http://www.epa.gov/docs/ozone/

United Nations Environment Program Ozone Secretariat
http://www.unep.org/unep/secretar/ozone/home.htm

Technology Transfer Network on the Internet
http://www.epa.gov/ttn/



## Water Pollution

The EPA defines water pollution as "any human-caused contamination of water that reduces its usefulness to humans and other organisms in nature." This can include both direct (e.g., chemical spill) and indirect (e.g., nutrient loading from septic tank effluent) human actions. Consistent with the EPA's definition of water pollution, NASA defines wastewater as "by-products suspended or dissolved in water resulting from human biological processes, manufacturing, materials processing, or any other such activity. This does not include the processing and storage facilities for such waste. This does not include any latent waste released into or present in the environment."[6]

### Relevance

In carrying out NASA's mission, some activities may negatively affect waters on or near NASA installations. Even a partial list of possible sources of water pollution at NASA facilities is diverse:

- Stormwater run-off (e.g., from parking lots, fields, pavement).
- Wastewater treatment and discharge.
- Underground injection wells.
- Construction.
- Industrial activities (e.g., assembly and testing of aeronautical technologies).
- Test standard operations, and
- Launch complex operations.

Other similar activities conducted at NASA installations also may be potential sources of water pollution. This list should serve as a starting point for considering how the activities of NASA managers and non-environmental staff may adversely affect the nation's water resources.

In considering this issue, it may be helpful to think of the particular activities within one's span of authority and regular activity and ask the following questions:

- Does material from a particular activity flow outside to the ground or a ditch or directly into a water body?
- Does material from a particular activity flow into a drain of some sort or near drains?
- Does the particular activity occur outside where wind or water may distribute materials?
- Are materials stored in areas exposed to either wind or water?

[6] Sustainable Development Indicator (SDI) Group, SDI Inventory, Organized by Framework Element Working Draft, Version 3, October 8, 1996, http://www.hq.nasa.gov/iwgsdi/Wastewater.html.

Answering "Yes" to any of these questions indicates a potential for water pollution to occur. In such instances, NASA managers and non-environmental staff should be aware of the federal and state regulations that apply to the various potential sources of water pollution, and how they can contribute to protecting nearby water resources.

### Major Requirements

Controlling water pollution at NASA installations is accomplished by compliance with both regulations and Executive Orders. While three pieces of legislation guide federal efforts to limit water pollution, the Clean Water Act (CWA) is the statutory program most likely to affect NASA installations. The Safe Drinking Water Act (SDWA) protects human health by protecting the nation's water supply. The Marine Protection, Research, and Sanctuaries Act focuses primarily on prohibiting ocean dumping of waste materials.

In a more limited way, Executive Orders (EO) 11988, 11990, and 12902 also have helped prevent water pollution. The first two Executive Orders, 11988 and 11990, were enacted during the 1970s and focused on floodplain management techniques and wetland protection, respectively. EO 12902 was enacted in 1994 and encourages federal agencies and facilities to increase energy efficiency and implement water conservation practices.

*Clean Water Act (CWA)*

The CWA, originally enacted as the Federal Water Pollution Control Act of 1972, was designed to help localities build sewage treatment plants and to require treatment of all municipal sewage and industrial wastewater prior to its discharge. It embodies two primary goals:

- Eliminate the discharge of pollutants into the nation's waters, and
- Achieve water quality levels that are fishable and swimmable.

Accordingly, Congress vested in EPA the authority (i.e., use of standards, technical tools, and financial assistance) to combat the nation's water quality problems.

To meet its goals, EPA needed both to establish water quality and effluent guidelines and record what each municipal and industrial facility was discharging to the nation's waters. EPA now has established 126 technology-based effluent guidelines that address these facilities. These guidelines balance effluent limit goals with what is the "best available technology economically achievable." EPA regions and states use the effluent guidelines when issuing mandatory National (or State) Pollutant Discharge Elimination System (NPDES (or SPDES)) permits to facilities discharging water pollutants. In addition to meeting NPDES requirements, permit holders must ensure that their discharges are not causing harm to the receiving water body and that it remains within state water quality standards.

**Point Source vs. Non-Point Source**

EPA defines a Point Source as "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged."

Alternatively, a Non-Point Source (NPS) exists when the pollutant(s) cannot be traced to one unique discharge point. For example, runoff (e.g., rainfall or snowmelt) moves and deposits natural and human-made pollutants in lakes, rivers, wetlands, coastal waters, and underground sources of drinking water.

Source: U.S. EPA
http://www.epa.gov/OWOW/NPS/qa.html

NASA managers should consider that CWA non-compliance might result from both intentional and unintentional waste disposal patterns. For example, all NASA installations are anticipated to have either on-site septic facilities or to be connected to a publicly owned treatment works (POTW). Pouring chemicals or industrial process wastes down a drain (i.e., into a septic system or POTW) is an example of improper waste disposal. Because the treatment facility is both unaware of and unprepared for these wastes, they may not be treated and may result in both the NPDES permit and state water quality standards being violated. In addition, this type of improper waste disposal may result in a violation of hazardous waste regulations. Another example might be if a NASA-sponsored event causes extra wastewater volume that overwhelms treatment facilities, which can result in untreated wastewater releases. Yet another example might be if fill or construction materials are placed too close to a water body where rain or wind could cause runoff and thereby violate state water quality standards.

The solution in each of these instances is for NASA to plan for proper waste disposal and understand treatment system limitations. Center Environmental Offices have the final say and authority in determining waste disposal methods.

NASA installations contain both point and non-point sources of water pollution. Point sources include discrete discharge points such as pipes entering a river. These are relatively easy to identify and examine for whether treatment complies with the existing NPDES permit. Non-point sources, however, are difficult to identify and control. Examples of non-point sources that may be present at NASA installations include, but are not limited to, the following:

- Excess fertilizers, herbicides, and insecticides from installation lawn areas.
- Oil, grease, and toxic chemicals from industrial processes and energy production.
- Sediment from improperly managed construction sites, forest lands, and eroding stream banks.
- Stormwater and urban run-off (if discharged to surface waters), and
- Bacteria and nutrients from faulty septic systems.

Non-point source water pollution can be difficult to conceptualize because the result (i.e., water pollution) often is difficult to attribute to a single, particular action or source. Non-point source pollution typically results from the aggregation of pollution from many, small individual generation points. For example, runoff from NASA parking lots after a rain may pollute local surface waters due to motor vehicles leaking oil. Identifying which of the vehicles originally leaked the oil may not be possible. And

after the next rain, parking lot runoff will collect and carry the oil from those vehicles and discharge it to local waters. Storm drains at NASA installations may discharge rainwater contaminated by such materials as oil and grease, paints, antifreeze, nutrients, heavy metals, toxic chemicals, bacteria, viruses, and oxygen-demanding compounds.

These discharges would be violations of the CWA and could subject the installation to significant fines. The installation and its Director would be responsible even though identification of exactly where the contamination originated is likely to be impossible. The solution is for NASA managers at installations near surface waters to initially assume that whatever they put on the ground will likely flow to a water body and then ask whether that discharge is likely to cause harm to the receiving waters. The Center Environmental Office should be contacted if NASA personnel have any questions or are uncertain if their actions require CWA compliance.

*Safe Drinking Water Act (SDWA)*

The SDWA requires EPA to determine which contaminants threaten public health and then to establish standards for those contaminants. These standards apply to any public water supply system servicing 25 or more individuals. EPA also is required to issue rules governing the disposal of wastes by underground injection. States are empowered to enforce the SDWA and supervise U.S. water supplies.

Septic systems used by many of NASA's remote locations fit the SDWA definition of injection wells. It is NASA policy to use injection wells only as a last resort or as part or a remediation activity where the discharged water meets SDWA standards.

### Responsibilities of Non-Environmental Staff

The requirements discussed above affect non-environmental staff in many ways. While the Center Environmental Offices have the final say and authority in obtaining permits and determining CWA compliance, NASA Headquarters encourages the involvement of non-environmental staff in understanding how their activities are related to efforts to prevent water pollution. Specifically, NASA employees should focus on pollution prevention whenever possible but also be aware of pertinent water-related regulatory requirements. These efforts can include the following:

- Focus on preventive actions, such as proper waste disposal.
- Do not dispose of untreated waste materials in water bodies.
- Do not dispose of untreated waste materials on land near water bodies.
- Consider whether land placement or storage of materials may result in water pollution.
- Do not pour excess or waste chemicals down drains.

- If a release or spill does occur, then notify your Center Environmental Office, which will in turn notify the proper official as appropriate.
- Understand what actions may trigger regulatory requirements, and
- Before dumping or siting materials, verify that the proper permit is in effect.

### When to Call Environmental Staff

The actions precipitating a call (e.g., spills, construction activities, and sewer overflow) to environmental staff will largely depend on each installation's standard operating procedures. For further information, please contact your Center Environmental Office.

### Sources of Help

Center Environmental Office

U.S. Environmental Protection Agency
www.epa.gov

EPA/Office of Water
www.epa.gov/OW

EPA/Office of Water/Office of Wastewater Management
www.epa.gov/owm

EPA/Office of Water/Office of Ground Water and Drinking Water
www.epa.gov/safewater/

## Chemical Uses

### Relevance

Many materials that are routinely used during operations at NASA Centers are considered to be hazardous materials. Proper use, handling, storage, and overall management of these materials are vital to protect personnel who work with these potentially dangerous substances.

*Hazardous Materials*

As a starting point, it is important to understand the difference between hazardous materials and hazardous wastes, because they are regulated in different ways under different programs. ***Hazardous materials*** are useful products that are potentially dangerous to human health and safety or the environment when they are improperly used, handled, stored, or transported. Any chemical that has a warning label or that arrives at your Center accompanied by a Material Safety Data Sheet should be considered a hazardous material. The handling and management of hazardous materials are generally regulated by the Occupational Safety and Health Administration (OSHA) under the Hazard Communication (HAZCOM) program.

A hazardous material becomes a ***hazardous waste*** when it can no longer be used for its intended purpose because it is spent, obsolete, or contaminated. As discussed elsewhere in this chapter, hazardous wastes are regulated by EPA under the Resource Conservation and Recovery Act (RCRA) program.

Whenever hazardous materials or wastes are released into the environment, they are subject to cleanup under many different laws from the CWA to RCRA to TSCA to CERCLA depending upon the material spilled, the source of the release, and the locations, characteristics, and time frame of the release.

### Major Requirements

This section discusses the requirements for hazardous materials management. First, it covers the general documentation and reporting requirements associated with having the materials on-site. Second, it addresses the requirements that affect the actual use and storage of chemical products. Requirements that pertain to cleanup of sites where chemicals have been spilled or released (e.g., under CERCLA) are addressed later in this chapter, as are the requirements that pertain to the management of hazardous wastes under RCRA.

**Documentation and Reporting**

When hazardous chemicals are brought into and kept at a facility, different sets of paperwork and reporting requirements under various statutes are triggered. The major requirements are highlighted below.

*Toxic Substance Control Act (TSCA)*

Although there are no specific requirements that address the purchase of hazardous materials, you should be aware that the Toxic Substances Control Act (TSCA) authorizes EPA to control the manufacture and sale of certain chemicals. TSCA requirements include testing of chemicals that are currently in commercial production or use, pre-market screening and regulatory tracking of new chemical products, and controlling unreasonable risks once a chemical substance is determined to have an adverse effect on health or the environment. If EPA determines that a chemical may pose unreasonable risks, it can prohibit the manufacture or certain uses of the chemical, require labeling, limit volume of production or concentration, require replacement or repurchase of products, and control disposal methods.

*Material Safety Data Sheet (MSDS) Requirements*

Under the OSHA HAZCOM program, a facility must keep a Material Safety Data Sheet (MSDS) for any hazardous chemical on-site. Manufacturers routinely provide MSDSs on products (that require MSDSs) to their customers, generally along with the delivery of the product. An MSDS is a form that provides specific information on a chemical and is designed to provide both workers and emergency personnel with the proper procedures for handling or working with that substance. These MSDSs must be available to any personnel who use or are potentially exposed to hazardous materials. An MSDS provides several key information items: chemical components, exposure symptoms, physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, waste disposal, and spill/leak procedures. This information is especially important if a spill or other accident occurs.

*Hazardous Chemical Reporting*

The Emergecy Planning and Community Right-to-Know Act (EPCRA) established a program to provide the public with important information on the hazardous and toxic chemicals used in their communities. Executive Order 12856 requires federal agencies to comply with all sections of EPCRA and to report to local communities the toxic and hazardous chemicals at federal facilities. The Executive Order also requires federal facilities to have emergency preparedness plans to prevent harm to the public through planned or unplanned releases of chemicals.

EPCRA sections 311 and 312 require that facility operators submit certain information annually on March 1, to their Local Emergency Planning Committee (LEPC) and the local fire department. First, facilities must submit MSDSs or lists of hazardous chemicals on-site. This is required for all chemicals that fit the definition of "hazardous chemical" under OSHA's requirements and that are present at the facility at any one time in excess of 10,000 pounds. It also is required for all "extremely hazardous substances" (EHSs) defined by EPCRA, which are more toxic and have lower reporting thresholds (as low as 1 pound). Second, using the "Tier II" form, a facility must report the maximum on-site quantity of a chemical at any one time during the preceding year. This also applies to the same hazardous chemicals and EHSs that are present in amounts above the thresholds.

*Toxic Chemical Release Reporting*

Under Section 313 of EPCRA, facilities must submit annual reports on yearly, cumulative, toxic chemical releases. This requirement applies to facilities that manufacture, process, or use more than the threshold amounts of some 500+ "toxic chemicals." These reports are sent to EPA and State Emergency Response Commissions (SERCs), and are intended for use by the community and LEPCs, SERCs, and fire departments. EPA also compiles these reports into a national database called the Toxic Release Inventory or TRI, which is available to the public. These annual reports are due July 1st.

**Documentation responsibilities of non-environmental staff**

- Be familiar with the information on an MSDS and in which sections it is located.
- Be aware of the chemicals and products that require MSDSs that are or may be used at your facility.
- Know where MSDSs are located in all relevant areas within your responsibility.
- Be aware of product labels, and
- Be aware of the quantities of chemicals and hazardous materials that are used at your facility.

**When to call environmental staff**

- When you are considering the purchase or use of a new chemical substance or product.
- If there are questions regarding information/data on an MSDS.
- If the MSDSs are not readily accessible, and
- If there is a problem with a chemical or hazardous material (spill, leak, or accident).

**Definitions**

**Hazardous Material** - Any useful product that is potentially dangerous to human health and safety or the environment when improperly handled, stored, or transported. This includes hazardous chemicals as defined by OSHA.

**Hazardous Chemical** - As defined by OSHA in 29 CFR 1910. 1200, a hazardous chemical is any chemical that poses a physical or health hazard. There is no specific list of these chemicals, so the term can cover many thousands of chemicals.

**Hazardous Waste** - As defined by RCRA regulations at 40 CFR Part 261.10, a solid waste that EPA or state agencies have determined to be ignitable, corrosive, reactive, or toxic or is a listed waste generated from specific processes such as plating and photo processing.

**Hazardous Substance** - As defined by CERCLA section 101(14), any element, compound, mixture, or solution subject to cleanup liabilities under Superfund. This includes substances specifically listed under CERCLA section 102 as well as all RCRA hazardous wastes and hazardous chemicals listed under some other statutes. It does NOT include petroleum.

## Hazardous Material Use and Management

Although the handling and management of hazardous materials (as useful products) is generally regulated by OSHA under the HAZCOM program, there are no specific *environmental* programs that focus on hazardous materials use. Thus, the most appropriate guidelines to follow in managing hazardous materials that are being used is to take common sense steps to ensure that such materials aren't accidentally released or turned into hazardous waste.

### *Pollution Prevention*

One of the best ways to ensure that hazardous materials don't turn into hazardous waste is to reduce the amount of hazardous materials used. This is often referred to as "pollution prevention" or "P2." Creating less hazardous waste will save money and time. Less effort will be required to label containers, update inventories, prepare documentation, and properly dispose of wastes. There are a number of steps you can take to prevent pollution (see also the section on Pollution Prevention in this chapter):

- *Inventory control—buy and use only products that you need.* One of the most important things you can do is practice good inventory control. Hazardous materials should not be stockpiled. Order and use only what is required. Use the supply rule of "First in, first out"—use the oldest product first. If a hazardous material has an expired shelf life, it can cost anywhere from 2 to 100 times more for disposal than what was paid to purchase it. The same can be true for excess hazardous material that does not have an expired shelf life.
- *Product substitution—use something less hazardous.* An easy way to avoid generating hazardous waste is to substitute your hazardous material with something less dangerous. Review the inventory of hazardous materials used at the Center and check to see whether there is a substitute available that is non-hazardous or less hazardous and meets performance specifications.

- *Process changes.* Process changes also can reduce the amount of hazardous waste generated. For example, if you are verifying cleanliness, instead of using solvent to flush the entire part, consider flushing sample sections.

As a pollution prevention functional lead center, KSC can support process and material substitution efforts.

You also should note that pollution prevention goes beyond just hazardous materials and hazardous wastes. For example, paper and glass recycling to reduce the amount of trash that goes into our landfills are also pollution prevention measures. Recycling also is commonly used for solvents, waste oil, vehicle batteries, waste antifreeze, scrap metal, and other substances.

**Hazardous Material Storage and Shipment**

For those hazardous materials that are being used or stored, better management is the key to avoiding generation of hazardous wastes or releases into the environment. When storing or handling hazardous materials, adhere to the following:

- *Be sure that hazardous materials are properly labeled.* When storing new inventory, make sure that all containers are properly marked or labeled. Hazardous materials must be appropriately labeled, tagged, or otherwise marked to identify the material and to warn personnel using the materials. In particular, the name of the chemical on the label should be the same as the name on the MSDS. Also include all appropriate warnings, as well as manufacturer contact information. If the original label has been removed or is unreadable, you must relabel the container. If you transfer a material to an unlabeled container, you must immediately label the new container.
- *Properly store hazardous materials.* Large or heavy containers should be placed on pallets for easy access by a forklift. Make sure that containers don't block an exit. New 55-gallon drums should be stored horizontally rather than vertically. Don't stack drums more than three high. Dispensing drums should have spring action or automatic closing devices.
- *Use extreme care in storing compressed gases.* Because compressed gases may be flammable, explosive, or extremely toxic, they require special precautions. For example, all compressed gas storage areas should be at least 50 feet away from other buildings. Lifting and moving cylinders requires special equipment. Empty cylinders should not be stored in the same stack or on the same pallet as full cylinders. Keep valves on cylinders tightly closed and store cylinders upright to prevent valve damage.

- *Segregate incompatible materials.* When certain hazardous materials are stored too close together, fire, toxic fumes, intense heat, or explosions can occur. Take your hazardous material inventory to your Environmental Manager and/or Safety Manager to determine which materials are incompatible. Incompatible materials should be separated by a dike, berm, or wall.
- *Label all "empty" containers.* A container that held hazardous materials is not empty if you can still pour or pump material from it. The container is legally empty only if all materials have been removed or no more than one inch of residue remains on the bottom. Label such containers as empty but do not cover the original label. Check with your Environmental Manager about disposing of empty containers.
- *Restrict access to the hazardous material storage area to authorized personnel only.* Be sure that the entrance to the storage area is posted with signs of "Danger—Unauthorized Personnel Keep Out." If there are flammables, pyrotechnics, explosives, or propellants present, also post "No smoking" signs.
- *Rotate inventory* so that older materials are used before the newer ones. By making sure that products don't reach their expiration date, you can avoid having them turn into hazardous waste. Remember: first in, first out.
- *Do not mix hazardous materials with hazardous wastes.* Doing so will likely turn the entire mixture into hazardous waste and, thus, trigger RCRA requirements and higher management costs.
- *Be prepared for spills or accidents.* Make sure that emergency equipment, such as a spill alarm and fire extinguisher, are present and easily accessible to minimize fires. For accidental releases, there should be sufficient absorbent material and decontamination equipment. Spilled materials should be cleaned up immediately. Your Environmental and Safety Offices have a spill response plan. You should become familiar with its requirements and procedures.
- *Keep MSDSs accessible.* When a material is issued to you or personnel working under your direction, make sure that supply personnel have provided an MSDS. If no MSDS is provided, contact your Environmental Manager or Safety Manager. A file containing the MSDSs of all materials in the storage area should be located nearby.
- *Regularly inspect all storage areas.* Look for leaking or severely corroded drums. Also look for any unneeded or excess hazardous materials and turn these in to the Center Environmental Manager. Make sure that inspection results are recorded and available for review.

**Steps That You Should Take for Proper Storage and Shipment**

- Be sure that hazardous materials are properly labeled
- Properly store hazardous materials (e.g., do not block fire exits or stack more than three storage drums)
- Use extreme care in storing compressed gases
- Segregate incompatible materials - Take your hazardous material inventory to your Environmental Manager and/or Safety Manager to determine which materials are incompatible
- Label all "empty" containers
- Restrict access to the storage area to authorized personnel only
- Rotate inventory
- Do not mix hazardous materials with hazardous wastes
- Be prepared for spills or accidents
- Keep MSDSs accessible
- Regularly inspect all storage areas
- Label containers properly for shipment

- *Label containers properly for shipment.* When shipping hazardous materials, use the appropriate standard yellow labels. Make sure that the labels are properly placed on the container and are not obscured by markings or attachments. Labels must be durable and weather resistant. Logistics personnel at your centers should be contacted for support.

### When To Call Environmental Staff

- If there is a problem with a hazardous material (spill, leak or accident).
- If any of the above documents are not readily accessible, and
- If you have questions about whether a Tier II form needs to be submitted.

### Compliance Methods And Checklist

OSHA requires hazard communication training for all personnel who load, unload, handle, prepare, or transport hazardous materials. In addition, OSHA requires hazardous material emergency response training for personnel who respond to hazardous material spills.

### Sources Of Help

Center Environmental Office

Center Safety or Occupational Health Office

Center Logistics Office

U.S. Environmental Protection Agency
www.epa.gov

Occupational Safety and Health Administration
www.osha.gov

U.S. Department of Transportation
www.dot.gov

## Management of Specific Products/Chemicals

### Relevance

Although there are general regulatory programs that address hazardous chemical use (i.e., OSHA's HAZCOM program) and hazardous waste management (i.e., RCRA), there are some products and situations that are covered by very specific regulatory programs. Two of these are addressed in this section: (1) the storage of petroleum and hazardous substances in underground storage tanks; and (2) use of pesticides.

*Underground Storage Tanks*

The need to regulate storage of petroleum and hazardous materials in underground storage tanks (USTs) has only recently been recognized. The impacts of leaking USTs to both human health and the environment have become too great to ignore. Releases from USTs pose an imminent threat to soil, groundwater, and drinking water supplies, and they also can pose a fire hazard or cause an explosion. Once a release occurs, cleanup and remediation are not only imperative but also usually costly. Given the nature and magnitude of the threats posed by leaking USTs, EPA instituted a comprehensive and rigorous regulatory program in the late 1980's. NOTE: The regulatory program discussed below addresses the storage of petroleum and gasoline, as well as certain hazardous materials, in underground tanks. Although underground tanks also can be used to store hazardous wastes, this would be covered under Subtitle C of RCRA, which is discussed in the Waste Materials section of this chapter.

Prior to 1984, underground storage tanks were not fully addressed by federal regulations. When RCRA was enacted in 1976 and CWA in 1972, USTs were regulated conditionally in that only those tanks containing hazardous wastes were regulated, and not those tanks storing petroleum or hazardous chemical products. Also, only large underground storage tanks (42,000 gallons or more) that could potentially be a direct source of pollution to navigable waters were regulated. The CWA could not be used as a basis for regulating USTs generally because UST releases, while potentially contaminating groundwater supplies, only indirectly affect surface waters. The Superfund program (CERCLA) also could not be used as a basis for regulating USTs because petroleum is specifically excluded as a hazardous substance under the statute. The 1984 amendments to RCRA added a new Subtitle I, which includes requirements for the regulation of UST systems storing petroleum and hazardous substances. Requirements address tank notification, interim prohibition, tank standards, reporting and record keeping procedures, financial responsibility, corrective action, compliance monitoring, enforcement, and other issues. In 1986, the Superfund Amendments and Reauthorization Act (SARA) authorized the use of federal funds for corrective action on petroleum releases from UST systems by establishing the Leaking Underground Storage Tank (LUST) Trust Fund.

### Major Requirements

There are two primary requirements of the UST regulations (40 CFR Part 280). First, tanks must be in full compliance with federal regulations regarding installation, spill and overfill protection, and corrosion protection by the upgrade deadline of December 22, 1998. (Note: All tanks should already be in compliance with pertinent federal and state regulations.) The second requirement is that tanks meet additional performance requirements outlined in federal regulations.

UST regulations require that petroleum storage tanks be properly installed by a certified installer and operate under the appropriate guidelines established by the manufacturer (e.g., the tank has secondary containment to retain any spills that may

occur and the spill protection device/equipment fits properly). At the time of installation, a notification form must be submitted to the appropriate regulatory authority regarding the installation of the UST. Once the tank has been installed, the tank must be monitored continuously using an approved monitoring method for leak detection. Depending on the piping and size of the tank, additional requirements or alternative monitoring methods may be employed. As part of the continuous monitoring process, it is critical to accurately record and maintain all information related to the tank. Compliance also requires that the UST has overfill protection that meets industry standards, that correct filling practices and all overfill protection devices are utilized, and ensuring that the tanks are filled properly. It also means that the UST is made of non-corrodible material and the tank and interior are inspected for corrosion and meet established guidelines. UST regulations also require that if a release is detected then the appropriate authorities and the National Response Center must be notified. Finally, should the tank need to be closed temporarily or permanently, proper tank closure procedures must be followed. These requirements are similar to those that apply to hazardous substance USTs. Both new and existing hazardous substance USTs must be equipped with secondary containment devices.

Because NASA uses USTs for both petroleum product storage and for hazardous materials, it is important that you familiarize yourself with the UST requirements and precautions. Although your position may not include direct contact with UST management issues, there are special considerations of which you should be aware should you be even peripherally involved with UST management. Therefore, the remainder of this section will describe your responsibilities regarding USTs at your facility. If you desire more information regarding the UST requirements and procedures, contact your Center Environmental Office for assistance.

### Responsibilities of Non-Environmental Staff

Most likely, the responsibility for handling and maintenance of USTs at your location resides with the Center Environmental Office. The Center Environmental Office will advise the operator regarding whether the UST is in compliance with federal and state requirements, inspect and monitor the UST and piping, oversee installation of the tank, and ensure that the tank is fully equipped with spill and overfill prevention devices and corrosion protection. Most importantly, the Center Environmental Office will serve as the primary point of contact for release detection and reporting, or any other question you may have related to the UST. Once a release is reported, the Center Environmental Office will ascertain whether a leak may be substantiated and if verified, ensure that the site is properly remediated. Although you may not have direct contact with UST management activities in most cases, your primary responsibilities with regard to USTs are as follows.

- **Pay special attention to warning stickers that may be posted on tanks, especially for underground storage tank systems that house hazardous substances.** Although tanks are underground and evidence of contamination may not be visible, you may still want to maintain a safe distance from the area where the tank is located. Exercise caution when working in an area that houses a hazardous substance UST and if you notice damp soil around the location where the tank is housed, do not necessarily assume that the liquid is water. The liquid may potentially be a sign of a leak. If uncertain, report the suspected leak to the Center Environmental Office for further investigation

- **Report any unusual smells, odors, gases, or tastes in water, especially if the odor or taste is of gasoline or petroleum, or you encounter chemical tasting or discolored water.** You may want to evaluate operating conditions for a few days and check with co-workers or environmental staff to determine if others have reported similar smells. You may also want to suggest that the Center Environmental Office check with adjacent property owners, facilities, or residential areas near the center to see if they have noticed similar smells or changes in drinking water. If your suspicions are confirmed, this may be a evidence of a release.

- **If you need to break the surface of the ground and you are uncertain whether a tank is housed in that area, check with your Center Environmental Office beforehand.** Similarly, if you are in an area in which a tank is housed and are unsure whether the tank contains hazardous substances, notify your Center environmental staff so that necessary precautions can be taken prior to the start of work.

- **Become familiar with safety alarms and procedures should an emergency arise.** Know what to do when the alarm goes off and what that alarm means. As a reminder, releases from USTs can cause fires or explosions, posing an imminent threat to human safety and the environment. Again, exercise caution and safe practices when in an area that houses a petroleum or hazardous substance UST. Use appropriate personal protective equipment as necessary.

  If a release occurs, you will need to follow your emergency procedure and also notify the Center Environmental Office.

- **Adhere to any Center or Agency rules or regulations regarding underground storage tanks, if applicable.** Each Center may have different state rules and/or internal policies regarding underground storage tanks. Contact your Center Environmental Office for further information.

### When to Call Environmental Staff

- If you notice any unusual smells, odors, gases, or tastes in water, especially if the odor or taste is of gasoline, petroleum, or chemical, or

- If there is a release or spill of petroleum or chemicals stored in an UST.

### Sources of Help

Center Environmental Staff

U.S. Environmental Protection Agency's Office of Underground Storage Tanks
http://www.epa.gov/oust.

*Pesticide Use*

NASA generally outsources pest control and therefore most of the regulatory burden associated with the application of pesticides resides with the contractor. Nevertheless, because the pesticides are used on site, it is important to be familiar with the major requirements controlling pesticide use.

### Major Requirements

Manufacturing, use, and disposal of pesticides are covered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), which was first passed in 1947. Today, FIFRA requires that no one sell, distribute, or use a pesticide unless it is registered by the EPA. Registration includes approval by the EPA of the pesticide's label, which must give detailed instructions for its safe use. EPA must classify each pesticide as either "general use," "restricted use," or both. "General use" pesticides may be applied by anyone, but "restricted use" pesticides may only be applied by certified applicators or persons working under the direct supervision of a certified applicator. Because there are only limited data for new chemicals, most pesticides are initially classified as restricted use. Applicators are certified at the state level if the state operates a certification program approved by EPA.

Although FIFRA applies broadly to the majority of activities performed by NASA, in practice it plays a very small role influencing facility maintenance. The regulations under FIFRA that are relevant to NASA stipulate that pesticide users follow the labels found on the pesticide container and that any persons applying or supervising the use of pesticides under the "restricted use" list must be certified by the State. FIFRA regulations also specify the procedures that are recommended and not recommended for disposal of pesticides.

### Responsibilities of Non-Environmental Staff

- Ensure that only certified handlers are being used to apply pesticides in your facilities.

## Waste Materials

### Relevance

Nearly every product, piece of equipment, and material we use every day eventually becomes waste. The paper this document is printed on, the computer on your desk, the building you are in, and the equipment and materials used in your job will one day no longer be useful and will thus be discarded. Each year, America generates over 200 million tons of common trash and over 250 million tons of hazardous industrial waste. Waste materials take up space, represent lost energy and material resources, and, if they are improperly managed, contaminate the environment on which we and all other forms of life depend. On a more tangible level, waste management is a costly enterprise that siphons away resources that might otherwise be used for more productive purposes. Although most of us do not participate directly in waste management activities, whether we know it or not, we all contribute to the waste problem. By understanding a few basic principles about waste generation and management systems, we can all help to reduce waste management costs, prevent future remediation activities and liabilities, and contribute to a cleaner, more sustainable environment.

A solid waste is any material that is discarded, regardless of its form or origin, unless it is explicitly excluded from the definition of solid waste. Solid wastes may be solid, semi-solid, or liquid in form, and they also include contained gases.

As discussed above in Chapter 4, the Resource Conservation and Recovery Act (RCRA), enacted in 1976, forms the basis of the legal and regulatory system that today governs solid waste generation and management. To understand the statutory and regulatory system established by RCRA, it is helpful to understand how this system defines solid waste and important subcategories of solid waste. Unfortunately, these definitions are often complex, counter-intuitive, and controversial, particularly with respect to materials that are recycled. Important classes of materials that are not solid wastes according to RCRA programs include (1) domestic sewage, (2) industrial wastewater discharges regulated under Section 402 of the Clean Water Act, (3) irrigation return flows, (4) source, special nuclear, or byproduct materials as defined by the Atomic Energy Act of 1954 as amended, and (5) certain types of recycled materials or materials recycled in specific ways.

### Major Requirements

There are at least four important subcategories of solid wastes at NASA facilities: municipal solid waste, non-hazardous industrial waste, hazardous waste, and medical waste. Different regulatory programs place different types of requirements on each. For obvious reasons, the requirements are more stringent and the related waste management costs are higher for

hazardous wastes and medical wastes than for non-hazardous wastes. Accordingly, one of the simplest and most effective ways of minimizing waste management costs is to strictly segregate wastes of different types—avoid commingling non-hazardous waste with hazardous and medical wastes. The following sections describe what types of materials are included in each category of solid waste and highlight the basic regulatory requirements for each category.

*Municipal Solid Waste Requirements*

Municipal solid waste (MSW) includes discarded (1) durable goods such as appliances, tires, and batteries; (2) nondurable goods such as newspapers and magazines; (3) containers and packaging; (4) food wastes; (5) yard trimmings; and (6) miscellaneous organic wastes from residential, commercial, or industrial sources. Municipal solid waste requirements are generally determined by state and local authorities and are the least onerous and least costly of the solid waste management rules. Therefore, to minimize costs, it is important to keep MSW from being mixed with and hence managed as other types of waste. From an environmental and potentially a legal point of view, it is important to keep other types of solid wastes out of the MSW stream. States and localities have the primary responsibility for overseeing MSW disposal.

*Non-Hazardous Industrial Waste Requirements*

Non-hazardous wastes are solid wastes that are not municipal solid waste and do not meet any of the criteria that would make them hazardous waste. Non-hazardous industrial wastes include some types of sludges from industrial wastewater treatment plants or air pollution control equipment and material from the decommissioning or demolition of industrial facilities. With exceptions for a few specific types of waste (e.g., construction debris), programs and requirements for non-hazardous solid waste are similar to MSW programs. Solid waste is typically managed by maintenance and/or operations offices at Centers, not by the Center Environmental Office.

*Hazardous Waste Requirements*

Hazardous wastes are industrial solid wastes that EPA or state agencies have determined to be ignitable, corrosive, reactive, or toxic. Hazardous wastes include (1) some types of sludges from wastewater or air pollution control equipment, (2) by-products from industrial processes, (3) spent industrial materials such as solvents or catalysts, (4) commercial chemical products that are off-specification or have exceeded their shelf life, and (5) some scrap metal. Wastes can be determined to be hazardous in one of two ways. First, certain hazardous wastes are specifically identified on hazardous waste lists contained in federal or state regulations. The second way is that the waste exhibits hazardous characteristics under standard test

procedures specified in federal or state regulations. Such tests are generally established for ignitability, corrosivity, reactivity, and toxicity. Federal toxicity criteria, which may be superseded by more stringent state requirements, are established based on the presence of specific heavy metals, pesticides, or other toxic organic chemicals.

On the whole, NASA has made substantial progress in reducing its generation of hazardous wastes. Overall hazardous waste generation rates have declined by more than 80 percent across the agency since 1989. Nonetheless, more remains to be done. As displayed in the table below, NASA Centers continue to generate substantial numbers and quantities of hazardous wastes that could probably be eliminated, thereby reducing potential environmental impact and liabilities, increasing efficiency, and saving money.

**Most Frequently Generated Hazardous Wastes at NASA Centers (1995 data)**

| Description | Number of Reported Wastes | Quantity Generated (tons) |
|---|---|---|
| Discarded expired products & chemicals | 71 | 76 |
| Laboratory wastes | 50 | 18 |
| Cleaning & degreasing wastes | 46 | 55 |
| Painting wastes | 42 | 116 |
| Off-spec materials | 38 | 30 |

**Hazardous wastes** are ubiquitous and include materials that many of us use and discard on a regular basis. Many types of cleaners, solvents, pesticides, paints, electrical and electronic devices, fuels, laboratory chemicals, and scrap materials must be discarded as hazardous wastes.

Hazardous wastes present important challenges and major opportunities for most of us to help lower waste management costs and reduce our impact on the environment. Hazardous wastes must be stored, transported, treated, and disposed according to strict requirements imposed by state or federal regulations. Each shipment of hazardous waste must be tracked and reported. Hazardous waste Treatment, Storage, and Disposal (TSD) facilities must obtain special permits and undergo frequent inspections to confirm that rigorous design and operating requirements are being met. Hazardous wastes must be treated using best available technologies before they may be land disposed. Even once they have been treated, most hazardous waste must be sent to specially designed disposal facilities. Consequently, hazardous waste management typically costs hundreds of dollars per ton, and in some cases may exceed a thousand dollars per pound. Several NASA Centers operate hazardous waste TSD facilities on site. The Center Environmental Offices operate extensive hazardous waste management programs and will assist you in safely and legally managing these wastes, as needed.

One particularly important and ubiquitous hazardous waste issue that relates to non-environmental professionals is the handling and management of used oil. EPA defines used oil to be any oil that has been refined from crude or synthetic oil, used, and as a result of use is contaminated by physical or chemical impurities. If properly managed through recycling, used oil can be reprocessed into useful, environmentally beneficial products at relatively little cost to NASA. This is in part due to the fact that the US EPA exempts recycled used oil that is not mixed with hazardous

waste from onerous hazardous waste management requirements. Used oil that is mixed with hazardous waste, such as halogenated solvent, and used oil that is not recycled, requires costly disposal as hazardous waste.

Like used oil, certain waste petroleum products (e.g., gasoline or diesel fuel tank clean-out wastes) can be beneficially used as fuels without triggering costly hazardous waste requirements provided that they are not mixed with hazardous waste, and they are comparable in composition to standard fuels. Like used oil recovery, the use of relatively "clean" petroleum wastes as comparable fuels reduces waste disposal cost and benefits the environment by reducing demand for virgin fuels.

Regulations governing both used oil and other petroleum product wastes vary from state to state. Non-environmental staff should handle waste oil and petroleum products in a way that minimizes their potential to require disposal as hazardous waste. Please consult your Center Environmental staff if you have questions or concerns about how you can help.

*Medical Waste Requirements*

Responding to public outcry concerning the fact that syringes and other medical wastes were washing up on mid-Atlantic beaches, Congress enacted the Medical Waste Tracking Act in 1988. Under authority granted by this act, EPA identified medical wastes to be regulated and developed tracking and management requirements for facilities that handle medical wastes. The federal regulatory program was designed to be a two-year demonstration program, and as such has expired. Today, most states have medical waste programs that are similar to the original federal program. Medical wastes generally include (1) cultures and stocks of infectious agents, (2) human pathological wastes such as tissues and body parts, (3) human blood and blood products, (4) used sharps such as scalpel blades and hypodermic needles used in human or animal treatment, (5) certain animal wastes, (6) certain isolation wastes from patients with communicable diseases, and (7) unused sharps. Medical waste requirements generally include specific provisions for segregation, packaging, labeling, marking, and storage of medical wastes where they are generated in addition to tracking (via manifest) of wastes from generator to ultimate disposal facility (generally, a permitted incinerator). Medical waste incinerators are subject to specific air emission requirements developed under Clean Air Act programs. Because medical wastes are relatively uncommon and the associated requirements are fairly arcane, you should contact your Center Environmental Office if you deal with medical wastes or have questions about the safe handling of medical wastes.

## Responsibilities of Non-Environmental Staff

The most desirable approach to dealing with hazardous wastes (and other wastes for that matter) is to not generate them at all. Such source reduction can often be accomplished through simple housekeeping improve-

ments, such as using less cleaner, and preventing non-hazardous materials from becoming contaminated in the workplace. Another way to reduce hazardous waste is through product substitution, such as replacing disposable batteries with rechargeable ones, and substituting aqueous cleaners for organic solvents, aqueous cutting fluids for oil-based fluids, or powder coatings for solvent-based paints. Process changes such as staged rinsing and the use of low over-spray paint guns are another means of reducing waste from production activities. Material inventory management, particularly in laboratory settings, is yet another way to reduce hazardous waste generation. Inventory management means ensuring that only the required amounts of chemicals are purchased and that chemicals are used prior to exceeding their shelf life. Waste exchanges, which are clearinghouses for surplus chemicals, can be a useful tool for inventory management. If you have any chemicals or product that you believe could be exchanged please contact your Center property disposed office and/or Environmental office for assistance.

**NASA Recycling Program:** NASA recovers from $400,000 to $800,000 per year from selling recyclable materials generated by its operations. Each NASA Center has a recycling coordinator and the Kennedy Space Center is the lead Center for recycling. Recyclable materials include paper products, aluminum cans, toner cartridges, batteries, tires, scrap metal, and fluorescent light tubes.

Recycling is generally the most desirable alternative for managing wastes that can not be eliminated through source reduction. Recycling may entail reusing a material in a manner different from its initial purpose. For example, leftover paint from one project might serve as a base coat for another, and solvents used in fairly clean environments remain useful for dirtier jobs. Recycling might also entail reclamation, such as distilling used solvents or sending scrap metal or metallic dusts to a smelter. One of the most important factors that will determine the feasibility of recycling is the relative purity?of the waste material — segregating wastes at the source is often the critical determinant of sufficient purity. If you generate a hazardous waste material that you believe may have value to another application, you should contact your Center Environmental Office.

In addition to looking for recycling opportunities for wastes generated by activities within your purview, you should look for opportunities to reuse wastes generated by other parts of the Center or to purchase materials made from recycled materials. Please contact your purchasing department and Center Environmental Office to determine if your material needs may be met by recycled materials.

Despite our best efforts toward source reduction and recycling, disposal is likely to remain the only feasible management option for many waste materials. As noted above, hazardous waste regulations prescribe specific treatment and disposal requirements for each type of hazardous waste. Hazardous waste management is generally carried out by specialized NASA and contractor personnel. If you have any questions about what types of materials are hazardous waste and what you can do to further reduce the hazardous waste disposal burden, please contact your Center Environmental Office.

### When to call the Center Environmental Office

- Whenever you are planning a new project or process, or making a change to an existing one that entails the use of new chemicals or materials that might end up in waste.
- If you have questions regarding the regulatory status of a waste generated in your department.
- To inquire about potential sources and outlets for surplus chemicals or recycled materials, and
- Before using new chemicals or starting a new process, avoid accidents, compliance violations, and unnecessarily high waste disposal costs by consulting your Center Environmental Office.

### Sources of Help

Center Environmental Office

EPA's RCRA Hotline provides access to regulatory specialists at:
(800) 424-9346.

EPA Office of Solid Waste and Emergency Response Internet site posts recent or pending changes to regulations and provides access to hundreds of potentially useful publications. The address is www.epa.gov/swerrims.

http://www.epa.gov/epaoswer/hazwaste/usedoil/index.htm

## Remediation of Chemical Releases

### Relevance

Because of the substantial volume of hazardous chemicals used and stored at NASA Centers, and NASA's responsibilities for managing hazardous wastes under RCRA, there is great potential for these hazardous substances and wastes to be released into the environment. Releases of special concern may occur through accidental spills, from undetected leaks in storage facilities and containers, and even after disposal. NASA will bear the financial burden of addressing these releases, either under the Superfund program (for releases of hazardous substances) or under RCRA (for releases of hazardous wastes). The major implications of these cleanup programs are discussed below.

### Major Requirements

*Remediation Under CERCLA (Superfund)*

As discussed in Chapter 4, NASA faces a significant financial burden because of its obligations to conduct cleanup at Superfund sites. As you may recall, one of the questions in the previous chapter's "environmental pop quiz" was as follows: True or False—if a Center contributed 5 percent of the waste then it would responsible for 5 percent of the cleanup costs. The correct answer is: *False*. Because of the way that CERCLA establishes liabilities and responsibilities for cleanup, NASA could actually be held responsible for 100 percent of the cleanup costs.

The Superfund program was founded on a "polluter pays" principle. If EPA can identify a potentially responsible party (PRP), it will try to persuade them to undertake the cleanup themselves. Alternatively, EPA will pay for the cleanup from the Superfund Trust Fund, and recover the costs by taking the PRPs to court. If no PRPs are identified, then the cleanup is paid for by the Superfund. The legal basis of EPA's approach is "strict, joint and several, and retroactive liability." "Strict liability" means without a showing of fault; EPA has only to show that a PRP is responsible for some of the hazardous substances at the site, but does not have to establish willful or inadvertent negligence. "Joint and several liability" means that where the harm caused by the contamination cannot be divided (i.e., because the wastes are sufficiently commingled or some of the PRPs are no longer available), PRPs can be sued together or separately; EPA does not have to identify each and every PRP in order to take enforcement actions and require cleanup. IF EPA sues one PRP, however, that PRP can sue other PRPs to seek reimbursement of cleanup costs. "Retroactive" liability means that PRPs are responsible for wastes that were released before the Superfund law was enacted, even if such releases were legal at the time. These liability principles have been effective in ensuring that at least some of the responsible parties pay for cleanup costs at

Superfund sites, where massive amounts of wastes of all types have been systematically released and/or disposed over the years by one or more parties, known or unknown.

Because of the way the courts have interpreted these liability concepts at Superfund sites, even the most seemingly insignificant of actions may have serious financial ramifications. There have been cases where EPA has held accountable PRPs who can be traced to the most miniscule amounts of wastes at Superfund sites. As a result, defendants at Superfund sites include not only large industrial firms, but also municipalities, hospitals, local dry cleaners, and other small businesses. EPA also has held responsible PRPs who disposed of hazardous wastes in a manner that was the legal or acceptable practice at the time; in some cases, parties held liable not only were in compliance with existing laws at that time, but also were following a state government's explicit directive to dispose of their wastes at a particular site. Perhaps most importantly, it is easier for EPA to hold accountable a party that is known and that has the financial resources to conduct the cleanup than conduct an exhaustive search for all potentially responsible entities. This puts pressure on these fewer, larger parties to conduct their own searches for PRPs to recover costs from other parties, some of which may be unable to pay or no longer be in existence.

Regardless of who pays for the cleanup, the cleanup process itself is covered by EPA's regulations in the National Contingency Plan (NCP) and consists of several stages. After a potential site is discovered, NASA or the owner of the land conducts a Preliminary Assessment and/or Site Inspection (PA/SI) to ascertain the risks posed by the site. These risks are scored under the Hazard Ranking System (HRS), and sites that receive a score above a given cut-off are placed on the National Priorities List (NPL). At NPL sites, a Remedial Investigation and Feasibility Study (RI/FS) is conducted to further examine the site risks and identify possible remedies that will meet NASA's cleanup standards. The Record of Decision (ROD) then documents the alternative remedies and costs, and defines the selected remedy. Cleanup then begins. The entire process may take more than 10 years, and the site may be parceled out into separate Superfund sites (known as operable units), each of which must undergo the process.

The lesson to take away from this is that you must be sure that your actions do not eventually lead to environmental contamination from NASA-related processes or materials. The liability provisions of Superfund also hold accountable the owner of the contaminated land, so NASA Centers may also be responsible for any releases that occur on-site regardless of the source. Therefore, is it imperative that Center employees carefully manage their contractors and the hazardous materials used in Center processes to avoid any accidental releases or improper disposal.

*Remediation Under RCRA*

RCRA requires that owners and managers of locations that generate hazardous waste clean up any contamination resulting from current and past hazardous waste management practices. These cleanups take place under RCRA Corrective Action. The RCRA Corrective Action program is similar to the CERCLA program in its intent- the cleanup of hazardous waste contamination. The difference between RCRA Corrective Action and CERCLA is that the RCRA Corrective Action program generally applies at facilities that continue to operate, and the current facility owner is involved in the cleanup. In addition, the RCRA Corrective Action process is generally more flexible that the CERCLA process, thus providing facilities with a more favorable regulatory environment for conducting cleanup activities than under CERCLA. RCRA does not, however, have provisions for cost recovery using the PRP concept land therefore, the land owner and/or operator are fully responsible for the cleanup.

As with the rest of the RCRA program, state environmental agencies are typically "authorized" by EPA to implement RCRA Corrective Action programs in their respective states. Where EPA has authorized a state to implement the RCRA Corrective Action program, EPA plays an oversight role. EPA implements the RCRA Corrective Action program in states that have not been authorized for its implementation. At the federal level, corrective actions may take place under a RCRA permit or as an enforcement order under RCRA section 3008. In authorized states, corrective action may take place under a state-issued RCRA permit, a state cleanup order, a state voluntary cleanup program, or some other state cleanup authority.

RCRA 3008(h) orders may be used to get corrective action started in advance of facility permitting or when a facility is closing under interim status. RCRA 3008(h) orders may be issued on consent or unilaterally. A consent order is issued when the facility and the regulatory agency have come to agreement about the corrective action; a unilateral order is issued when the regulatory agency and the facility have been unable to agree on the need for or scope of a corrective action. It is important to note that although the substantive elements of corrective action are the same under a permit or an 3008(h) order, the corrective actions occurring under the order carry significant administrative differences. For example, there may be limitations on the permitting agency's ability to release information to the public.

There are five basic elements of the corrective action process, similar to the steps in a CERCLA cleanup:

1. RCRA Facility Assessment (RFA) - initial site assessment done by the landowner or operator to determine location, nature, and magnitude of contamination.

2. RCRA Facility Investigation (RFI) - in-depth sampling and testing normally done by the site owner/operator to verify and more accurately characterize the releases identified by the RFA.

3. Interim Actions - short-term actions to address imminent threats before site remedy is selected.

4. Corrective Measures Study (CMS) - evaluation of alternatives by the owner/operator for cleaning up the site.

5. Corrective Measures Implementation (CMI) - detailed design, construction, and operation of the chosen remedy, all of which are performed by the owner/operator with EPA or state oversight and with public involvement.

### Responsibilities of Non-Environmental Staff

- Be cognizant of improperly operated or deteriorating equipment and structures and report any imminent or existing contamination to environmental staff (e.g., leaks or spills).

- Get training on job responsibilities and functions to minimize the likelihood that human that error could lead to contamination, and

- Be aware that the chemicals you use may qualify as hazardous wastes when discarded and lead to contamination at the site if improperly managed.

### Potential Pitfalls And Solutions

- *Not keeping adequate on-site records of inspections and remedies taken.* At the beginning of the RCRA Corrective Action process, regulators and owner/operators review the facility's files, among other things, to identify clues about contamination at the site. Regulators review the facility's records (e.g., aerial photos) to identify waste management units and areas of likely contamination. These areas become a primary target for inspection during the RCRA Facility Assessment described above. By the same token, however, regulators also use facility records to identify areas of the property that may not need intensive inspections. For example, if the facility's records show that proactive or otherwise compliant inspections and cleanups have been taken, such information could be useful to regulators in concluding that portions of the site have been responsibly operated and need no further action. Therefore, it is important for owner/operators to maintain comprehensive records about their operations and practices as well as efforts to inspect for and clean up contamination at the site.

- *Not being proactive in addressing imminent or existing contamination.* Some facility owner/operators fail to take immediate steps to minimize or prevent contamination from occurring. Some of them believe the best way to address a problem is by ignoring it. Other owner/operators do not even recognize that problems exist. However, the best way to

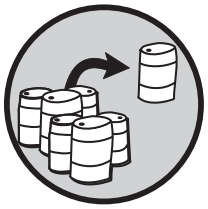
avoid serious or widespread contamination and its associated cleanup costs is to proactively inspect for and address imminent and existing problems that could lead to site contamination. Due to the limited number of environmental staff at each Center, it is imperative that non-environmental professionals monitor Center activities, and report to the Center Environmental Offices anything that they believe could be a problem.

### Sources of Help

Center Environmental Office

NASA Headquarters Environmental Management Division

## Pollution Prevention



Pollution Prevention (P2) is, in the broadest sense, the maximum feasible use of all raw materials and energy and the reduction of all wastes generated at a facility. P2 involves the comprehensive assessment of a facility's purchasing decisions, operations, maintenance, and waste management and disposal methods. P2 includes developing and implementing practices that reduce the purchase and use of hazardous and non-hazardous materials, the use of energy, water, and other resources, and the generation of and/or treatment and disposal of wastes. For certain specific elements of P2 (e.g., recycling of solid waste) federal agencies, including NASA, and their contractors are required to set goals under requirements of Executive Orders and federal regulations. In general, however, implementation of specific P2 programs is not strictly required by regulation, but rather constitutes the best economic and environmental management practice for NASA's operating facilities.

### Relevance

Historically, industrial and government facilities have relied on conventional end-of-pipe controls to limit air and water pollutant emissions and treat and manage hazardous wastes. Non-hazardous solid wastes have typically been managed in landfills or through other disposal methods. The reason(s) that a particular operation generated emissions or waste, and whether such materials could be reduced, recycled, or eliminated, rather than simply treated and disposed of, were not assessed in a comprehensive manner. In other words, whether it was necessary to generate emissions or waste to conduct a particular operation was not assessed in a comprehensive manner. Similarly, the amount of resources, such as electricity, natural gas, water, and raw materials used by a particular operation, and whether the operation used the minimum amount of such resources, also was not evaluated in a systematic fashion.

Over time, operators of industrial and government facilities, including NASA, have realized that it is often more cost-effective to prevent the generation of emissions and waste at the source, or to employ methods of reducing or reusing these residual materials. The managers of these organizations found that no matter how much money they spent on pollution control, they always had residual waste that had to be managed, often using expensive treatment and disposal technologies. For example, prior to enactment of the RCRA hazardous waste regulations, spent chlorinated organic solvents often were disposed of in relatively inexpensive ways (e.g., in landfills) that later turned out to be environmentally unsound. RCRA regulations required that spent chlorinated organic solvents be treated and disposed of using much more expensive and more environmentally sound technologies, such as hazardous waste incineration. Consequently, proper hazardous waste management of solvents is very costly. As organizations started to spend more and more money on these

expensive treatment and disposal technologies, they began to search for ways to either eliminate the use of RCRA-regulated solvents in their processes, reduce the volume of solvents used, or recycle the solvents either on-site or off-site rather than treat and dispose of them. This type of process analysis is one element of pollution prevention.

Applying a somewhat different perspective, many organizations such as NASA have learned that "pollution equals inefficiency," and that process residues represent nothing more than wasted raw materials and unrealized products. There are economic costs associated with the inefficient use of resources and generation of wastes. Managers also came to realize that their past reliance on end-of-pipe treatment and disposal had significant economic costs in terms of environmental liability, as hazardous chemicals began to leach from landfills, which were initially thought to be safe and secure indefinitely. Organizations such as NASA have since demonstrated that substantial savings can be obtained if they changed the way they did business, i.e., became more efficient, used less energy and raw materials, recovered and/or recycled process residues, and generated less waste, by implementing P2. Lower operating and waste management costs resulting from implementation of P2 can free up NASA budget dollars for more productive uses. Every dollar not spent managing waste or purchasing resources that are not used efficiently is a dollar that can be spent on NASA operations and programs.

P2 can have significant benefits with respect to 1) the economics of NASA's operations, 2) human health and the environment, 3) compliance with regulatory requirements.

P2 is important to NASA for three main reasons. P2 can have significant benefits with respect to 1) the economics of NASA's operations, 2) human health and the environment, 3) compliance with regulatory requirements. These benefits are often related to one another, as illustrated below.

Implementation of P2 can significantly reduce the cost of NASA's operations, and allow more productive use of budget dollars. An effective P2 program can yield cost savings, measured, for example, in terms of reduced waste management and disposal costs, energy costs, and raw material costs that will more than offset the costs of P2 program development and implementation. This is an important point because development and implementation of P2 programs may appear to be complex and expensive at first blush. In fact, P2 programs can actually result in lower operating costs and more than pay for themselves. P2 programs can have a very attractive return on investment (ROI), as discussed further below.

P2 also may yield significant benefits to human health and the environment. Implementation of P2 can significantly reduce the volume, toxicity, and/or persistence of wastes released from NASA's operations. P2 can reduce the potential for worker exposure to hazardous substances in the workplace, as well as for off-site human health risk from wastes released from NASA's operations. The benefits of reduced worker exposure and off-site human health risk from P2 programs can manifest themselves in lower environmental liability costs, lower occupational exposure liability

costs, and in other ways. For example, workers using a hazardous substance in a process operation may be required by regulation to be trained in hazardous materials health and safety, provided with personal protective equipment, and may even need to be medically monitored. If, however, the hazardous substance used in the operation were to be replaced with a non-hazardous substance, not only would waste treatment and disposal costs be reduced, but **all of the associated costs** of training, equipping, and monitoring workers for compliance with workplace standards **also would be eliminated.**

Finally, federal and state environmental regulations and Executive Orders applicable to NASA facilities require implementation of P2 for certain NASA operations. For example, Executive Order 12856 (Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements), issued in 1993, and Executive Order 13101 (Greening the Government Through Waste Prevention, Recycling, And Federal Acquisition), issued in 1998, require federal agencies, including NASA and its contractors, to set short term and long term goals for solid waste source reduction, recycling, or waste minimization. Short term goals are to be achieved by January 1, 2000, and long term goals are to be achieved by 2005 and 2010. Also, under Executive Order 12856, NASA facilities must report annually their use and emissions of toxic substances under the federal Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA regulations do not specifically require federal facilities to implement any particular P2 program, however, the process of identifying the use of and emission of toxic substances required under the regulation promotes public awareness of such uses and emissions by NASA facilities, and highlights opportunities for NASA facilities to reduce them. To the extent that use or emissions of EPCRA-regulated toxic substances are reduced or eliminated by a NASA facility, NASA's reporting requirements under EPCRA (and their costs) also may be reduced or eliminated.

## Major Requirements

Executive Order 12856 directs federal agencies and facilities to take steps to embrace pollution prevention as a government-wide ethic in the day-to-day management of their facilities, and sets ambitious goals for reducing or eliminating the release of toxic and hazardous pollutants from federal facilities into the environment. The Executive Order further supports these goals by committing the federal community to modify acquisition and procurement practices by adopting pollution prevention as standard practice for government purchases of goods and services.

Executive Order 13101, entitled Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition, requires that the Federal Environmental Executive, appointed by the President, develop a Federal Waste Prevention and Recycling Strategic Plan ("Strategic Plan") to

further implement the order. Federal agencies, including NASA, are required to prepare agency-specific plans to implement the Federal Strategic Plan. The Federal Strategic Plan should include, but is not limited to, the following elements:

- Direction and initiatives for acquisition of recycled and recyclable products and environmentally preferable products and services.
- Development of affirmative procurement programs (in accordance with Federal Procurement requirements under Section 6002 of RCRA),.
- Review and revision of standards and product specifications.
- Assessment and evaluation of compliance.
- Reporting requirements.
- Outreach programs to promote adoption of practices endorsed in the order, and
- Development and implementation of new technologies that are of environmental significance.

EO 12843, Procurement Requirements and Policies for Federal Agencies for Ozone Depleting Substances;

EO 13031, Federal Alternative Fueled Vehicle Leadership;

EO 12845, Requiring Agencies to Purchase Energy Efficient Computer Equipment;

EO 13123 Greening the Government Through Efficient Energy Management

Several other Executive Orders are relevant to Pollution Prevention at Federal facilities, including NASA, as shown in the adjacent box.

NASA and its contractors are already implementing P2 to a substantial degree at NASA facilities. Drivers behind NASA's implementation of P2 include economic and regulatory requirements, including the Executive Orders and federal regulations described above. In implementing these Executive Orders, NASA has set waste minimization goals and has taken specific measures to implement pollution prevention:

- NASA established a 1994 baseline for toxic chemical releases and set the goal of attaining a minimum of a 50 percent reduction from that baseline by the turn of the century. To the maximum extent possible, NASA has committed to achieving this goal by using source reduction practices.
- NASA has prepared and implemented written pollution prevention plans at all Field Installations. These pollution prevention plans address each facility's approach to meeting NASA's 50 percent toxic chemicals release reduction goal.

*NASA's Pollution Prevention Strategy*

NASA's Pollution Prevention Strategy is encompassed in an implementation guidance document, NPG 8820.3 Pollution Prevention, designed to help NASA implement and comply with the requirements of Executive Order 12856 and other related Executive Orders. NASA's current Pollution Prevention Strategy includes the following elements:

- Delineates NASA's policy to prevent or reduce pollution at the source whenever possible.
- Presents an overview of Executive Order requirements by section and includes key deadlines, responsible NASA elements, and specific action items.
- Commits NASA to reviewing and revising specifications to reduce the use of products containing extremely hazardous substances and toxic chemicals consistent with safety and reliability requirements.
- Commits NASA to submit emergency planning notification, emergency response plans, materials safety data sheets or lists, and/or hazardous chemical inventory forms to the appropriate agencies, for Field Installations that meet or exceed the EPCRA thresholds.
- Contains a commitment to evaluate progress annually by comparison of tonnage and percentage of toxic chemical release reduction from the 1994 baseline by calendar year, and
- Provides facility-level implementation guidance for major Executive Order requirements.

The NPG also provides specific guidance to NASA facilities in meeting the goals of Executive Orders relevant to pollution prevention:

- Requiring all NASA installations (whether covered under Executive Orders or not) to develop pollution prevention plans.
- Procuring materials that contain recycled content and are environmentally preferable (as required under EO 12873).
- Purchasing computer equipment that meets EPA Energy Star requirements (as required under EO 12845).
- Increasing purchases of alternatively fueled vehicles (as required under EO 12844), and
- Minimizing the procurement of ozone-depleting substances (ODS) in anticipation of the phaseout of ODS production (as required under EO 12943).

Historically, there has been no consistent method of identifying and evaluating shared P2 needs and experience among NASA and other federal agencies. Recently NASA became a voting member of the Department of Defense's (DoD) Joint Group on Pollution Prevention (JG-PP). NASA's membership in the JG-PP creates a partnership between NASA and DoD in which we both benefit from P2 and related hazardous materials and waste management experiences.

*Strategies to Achieve Pollution Prevention*

P2 may involve Source Elimination, Source Reduction, Reuse and Recycling, or other Waste Minimization activities.

Source Elimination and Source Reduction

Source reduction is the reduction of the volume, toxicity, and/or persistence of waste at its source. Source reduction can include energy efficiency and water conservation measures, raw material substitution, or other measures to achieve reduction or elimination of waste. The most desirable approach to dealing with wastes from a process or operation is to not generate them in the first place. If a process or operation can be designed, or redesigned, such that a specific waste that would otherwise be generated by the process or operation is not generated, this is referred to as "Source Elimination". For example, changing the production process for printed circuit boards such that lead solder is replaced by lead-free solder would eliminate a source of RCRA-hazardous lead waste. Similarly, changing the cleaning solvent for the circuit boards from a chlorinated organic compound to an aqueous compound would eliminate a source of RCRA-hazardous chlorinated solvent waste.

**Source Elimination at a Small Metal Parts Cleaning Facility**

A small metal parts fabrication facility used 50 gallons of trichloroethylene (TCE) per week to clean small parts prior to chrome plating and painting. The facility stored the TCE in an open tank, from which approximately 30% was lost through evaporation and spillage. The facility typically generated 10-20 gallons of spent TCE per week which was shipped off-site for disposal. The raw material cost for TCE was $20,800/yr and it cost $5,000/yr to ship spent TCE off-site.

Implementation of **Process Changes** enabled the facility to eliminate generation of a hazardous waste and reduce raw materials costs. The facility operator modified its parts cleaning tank by adding a hose sprayer and heating element and switched to using an aqueous cleaner. These changes resulted in the following savings:

- reduced raw material cost to $1,300/yr
- eliminated generation of hazardous waste
- enabled the facility to discharge spent aqueous cleaner to a treatment plant.

The facility saved more than **$24,000/yr** and the project had a **payback period measured in weeks.**

Source reduction often can be accomplished through simple improvements in operating procedures. These may include redesigning maintenance operations such that less cleaning solvent is used, and preventing non-hazardous materials from becoming contaminated with hazardous materials during maintenance activities. This is important because non-hazardous materials are much less expensive to manage than contaminated materials, which may need to be managed as RCRA-hazardous waste. Source reduction activities may be broadly characterized as product changes or process changes.

"Product changes" involve changes that can be made by a manufacturer of a product to alter the characteristics of the product in one of two ways, either by using less energy, fewer toxic and other raw materials, or generating less waste when manufacturing the product (e.g., changing circuit

board production to use lead-free solder), or designing a product such that it lasts longer or uses fewer resources when being used (e.g., energy-efficient and longer lasting light bulbs).

"Process changes" involve changes to how a product is made, and include raw material changes (e.g., substitution of aqueous cleaners for chlorinated organic solvents), technology changes (e.g., redesigning piping systems) or improved operating or maintenance practices (e.g., improved maintenance scheduling for piping leaks).

Reuse and Recycling

Recycling has many elements, and a recycling program is more than simply sending waste paper and aluminum cans to the local off-site recycling facility. In addition to office paper, aluminum cans, and other common materials that would otherwise become solid waste, many other types of materials can either be reused or recycled, in some cases on site, with little or no reprocessing required. Process operations also can be designed to use recycled raw materials rather than newly purchased raw materials.

Materials that can be reused or recycled range from wooden pallets to construction debris to spent organic solvents. Reuse of a "waste product" involves using the material as a raw material in either the original operation from which it was generated, or in a different operation. Wooden pallets, for example, may be refurbished and reused on site. Construction debris, if uncontaminated, may be used for making road beds or as fill material. Other materials must be reclaimed or recycled prior to use. For example, spent organic solvents can be reclaimed on site using a distillation unit, and spent rinse waters resulting from electroplating operations can be concentrated and used as makeup to the plating bath.

One method for organizations to identify opportunities for reducing and/or eliminating the generation of wastes and promoting more efficient use of resources involves conducting a P2 Opportunity Assessment (P2OA). P2OA is methodological procedure for

**Recycling and Source Reduction at NASA Facilities**

A significant reduction in waste stream volumes at NASA facilities around the country was obtained through implementation of P2 recycling and source reduction programs. Improved operations and several alternatives to past disposal practices reduces purchase and disposal costs and generated revenues through reuse and sale of recyclable materials. Examples of P2 practices implemented at NASA facilities include the following:

- There are 28 P2 No-Cost Initiatives at NASA facilities that are improving processes, recycling, and reducing the amount of resources needed. Among seven initiatives at Wallops Flight Facility are antifreeze recycling, reuse of packing material, and reissue of drums.
- At the Jet Propulsion Laboratory, a total cost savings of $16,454 was realized through chemical substitution of cleaning and degreasing products.
- At the Ames Research Center, a total cost avoidance of $392,746 was realized through modifications to the Photolab treatment systems. The systems are used for the recycling of photo processing rinsewater, regeneration/reuse of bleach, and recovery of silver.
- Modifications to an integrated pest management process have resulted in a reduction of chemical applications and $119,604 in avoided costs.
- The Michoud Assembly Facility, an on-site remediation technology was implemented versus excavation and offsite disposal which yielded $4,310,000 in cost avoidance.

examining an organization's total operations to gain an understanding of how raw materials are converted to products and wastes, and how resources are used in conducting operations. In general, the implementation of P2 and conducting P2OAs involves seven principal elements, described in the box below.

### Responsibilities of Non-Environmental Staff

Relative to many other NASA environmental activities, non-environmental management and operating staff have greater involvement in developing and implementing P2 programs. This is because P2 is not strictly an environmental function, even though a principal focus of P2 is waste management. P2 involves a detailed assessment of how an organization's operations are conducted, and therefore the entire operation must be assessed as a whole. Also, P2 often involves changes to operations that are implemented at the shop floor level. Non-environmental NASA management and operations staff will therefore have a principal role in implementing the P2 process.

NASA facility managers must first understand the importance of P2 to their operations and establish a commitment to implement P2 programs that go beyond the requirements of Executive Orders and federal regulations. This is important because there are many elements of P2 that are not strictly required by order or regulation, but that offer potentially significant economic and environmental benefits to the organization.

A P2OA assessment team may involve NASA management and operations staff in Maintenance, Production, Operations, Procurement/Purchasing, Quality Control, Engineering, Environmental, Safety and Health, and Labor. For example, a P2 opportunity assessment of waste generation from an operation manufacturing aerospace components may involve an assessment of how production equipment is cleaned and maintained, to address whether it is necessary to use organic solvents in this operation. To make this assessment, NASA staff from maintenance, production, operations (i.e., the end user of the components), engineering, and quality control would all need to be involved to determine whether the end use of the components would be affected if the procedures for maintaining production equipment were to be changed. NASA safety and health and environmental staff would need to be involved to assess the effects of the various alternative cleaning solvents on health, safety, and the environment. NASA procurement specialists and cost estimators would need to be involved in assessing the cost of the alternatives, and NASA labor organizations (i.e., the maintenance workers themselves) would need to be involved in developing and reviewing alternative maintenance procedures. Management must provide strong commitment and direction to secure the commitment and involvement of each part of the organization.

### Key P2 Program Elements

**P2 Mission Statement and Program Definitions:** This element explicitly identifies the goals and objectives for the organizations' P2 program in a written statement. This document demonstrates the organization's commitment to P2 and will define goals and performance expectations, including but not limited to requirements of regulations and orders.

**P2 Review:** This addresses operational units and the associated flow rates of energy and materials, including raw materials, wastes, products, and byproducts. Operations selected for review may be operations that generate large volumes of waste or wastes that are particularly toxic or hazardous, or operations that use large amounts of resources (e.g., water, natural gas, electricity) or that otherwise can contribute to accomplishing P2 goals. P2 review addresses planned and unplanned, and continuous and intermittent releases and losses to land (e.g., solid waste), air (e.g., fugitive emissions), and water (e.g., surface water discharge), as well as energy and other raw material usage. P2 review addresses current policies, practices, and procedures that influence material and energy use. These include legal and regulatory requirements, internal requirements, operating and maintenance procedures, measurement activities, mechanisms for employee input, and incentives and reward structures.

**P2 Opportunity Assessment and Identification:** The information generated during the P2 review is organized and evaluated to produce a comprehensive list of P2 opportunities for the operations evaluated. P2 Opportunity Assessment and Identification includes an assessment of the identified opportunities for improvement of product yield, reduction or elimination of waste generation, capital costs for implementation, operational cost savings from implementation, operations and maintenance requirements, product quality, and environment, health and safety compliance, as well as human health risk and environmental liability analysis.

**P2 Options Development:** The most promising P2 opportunities are then further evaluated and ranked according to their costs, economic and environmental benefits, technology requirements and energy and environmental impacts. Based on this evaluation, P2 options are identified for potential implementation.

**P2 Program Design and Implementation:** After promising P2 opportunities are identified, design and implementation is initiated to establish clear action plans and procedures for implementing the P2 programs (e.g., source elimination, source reduction, recycling and reuse). As discussed below, design and implementation will involve NASA management and operations staff, and may require capital expenditure (e.g., to purchase equipment to recycle spent solvents) and/or modification of purchasing, operating, or maintenance procedures (e.g., revision of purchasing procedures to favor aqueous instead of organic solvent cleaners). NASA management also may develop and deliver training programs to ensure successful follow through of the P2 program. P2 program design typically includes action plans, procedures, cost/benefit and performance measurements, and training goals.

**Integration with Existing Management Practices and Systems:** P2 programs perform most effectively when they are fully integrated with existing management practices and systems. This requires specific actions to integrate P2 goals and activities into capital project planning, operational procedures and controls, maintenance functions, compliance assurance systems, and environmental management systems.

**P2 Program Evaluation and Communication:** Once a P2 program is in place and high priority actions have been implemented, it is important for the program to not lose momentum. Any successful P2 program must include continual improvement procedures to track performance and take corrective action, as required, including (1) appropriate indicators and ongoing monitoring programs, and (2) periodic evaluations of overall program effectiveness. Management should publicize P2 success stories to highlight the potential of the P2 program and provide employees and the public with visible signs of NASA's commitment to P2 and its success.

### Source of Help

There is a wide variety of resources available to assist NASA's management and operational staff in implementing P2 programs, in addition to NASA's Pollution Prevention NPG and related materials. The EPA and the DoD have posted pollution prevention and waste minimization resources on their agency web sites. See, for example, http://www.epa.gov/wastemin and http://www.afcee.brooks.af.mil/AFCEEfrm.htm

Appendix F contains a table listing several series of questions that all NASA employees can use to evaluate the operations and activities within their own areas of responsibility and influence, either as part of a P2OA or more informally. The Environmental Management Division at Headquarters and your Center Environmental Office can provide assistance to you in pursuing any ideas that arise from applying these questions to the areas within your purview.

## The National Environmental Policy Act and Related Environmental Statutes and Regulations

This section presents a comprehensive look at the National Environmental Policy Act (NEPA) and several related statutes and regulations with review requirements that may affect NASA's ability to undertake proposed actions. These related environmental review requirements should be addressed in, or coordinated with, NEPA review requirements, to the maximum extent practical. The NEPA regulations published by the President's Council on Environmental Quality (CEQ) state that agencies shall integrate the requirements of NEPA and other planning and environmental review procedures required by law or agency practice so that the procedures run concurrently rather than consecutively. The related statutes and regulations discussed here include the Endangered Species Act, the National Historic Preservation Act, various land use regulations, and the Executive Order on Environmental Justice. This list is not exhaustive, but addresses some of the major requirements that arise during the environmental planning process.

An initial screening of the environmental statutes and regulations should be conducted as early as possible in the project development process to enable all environmental requirements to be included in overall project planning.

*National Environmental Policy Act*

In contrast to most environmental regulatory programs, in the NEPA process, the **non-environmental professional** has the primary role of decision-maker. One of NEPA's basic objectives is to ensure that the agency decision-maker fully weighs the environmental effects of a proposed new program or project in addition to its technical and economic considerations before actions are taken. NEPA does not, however, require an agency to select the most environmentally benign or beneficial alternative. While an agency may have to occasionally prepare a lengthy and controversial environmental impact statement (EIS) that is resource intensive and may consume more than a year, many proposed actions can be addressed in a short time frame, with concise categorical exclusions (CatEx) or environmental assessments (EA). Indeed, the NEPA regulations published by CEQ emphasize reducing delay and paperwork. It is well worth the time and highly recommended to plan for NEPA in the early phases of project planning. Failure to comply with NEPA can result in the program or project being slowed down or stopped until the NEPA process and documentation are completed. In addition, compliance with NEPA is subject to judicial review and is one of the most litigated areas of environmental law. In the event of a court challenge, time is lost and resources are expended in response to the court action, schedules may be delayed, and programs or projects are held up until the NEPA process has been successfully completed. The CEQ regulations require all agencies to publish their own regulations for complying with NEPA. The guidance for implementing NASA's procedures and guidelines can be found in NPG 8840. The CEQ regulations also require integration with other environmental review

**Major Federal Action.** A special form of federal action that may have significant environmental effects and that is potentially subject to federal control and responsibility.

**Sponsoring Entities.** These include NASA Headquarters, NASA Centers (including Component Facilities), Strategic Enterprises, and Program and Staff Offices.

**Environmental Management Office (EMO).** Each NASA Center and Field Installation has an EMO which is usually delegated the responsibility for implementing NEPA. The EMO may have a different designation at your installation. EMOs perform the working level functions of the NEPA process.

and consultation requirements. This topic will be addressed further below, followed by a discussion of the specific compliance requirements imposed by those regulations.

### Relevance

In general, NEPA applies to any NASA activities that have the potential to affect human health and the environment, whether NASA is directly involved in the undertaking, or is sponsoring, funding, or approving someone else's activities. This involves but is not limited to such activities as ongoing operations, constructing new or rehabilitating existing structures, leasing buildings to private entities, licensing an activity, conducting space missions, or funding other parties' activities. A primary area of focus within NEPA are activities that could be "major Federal actions."

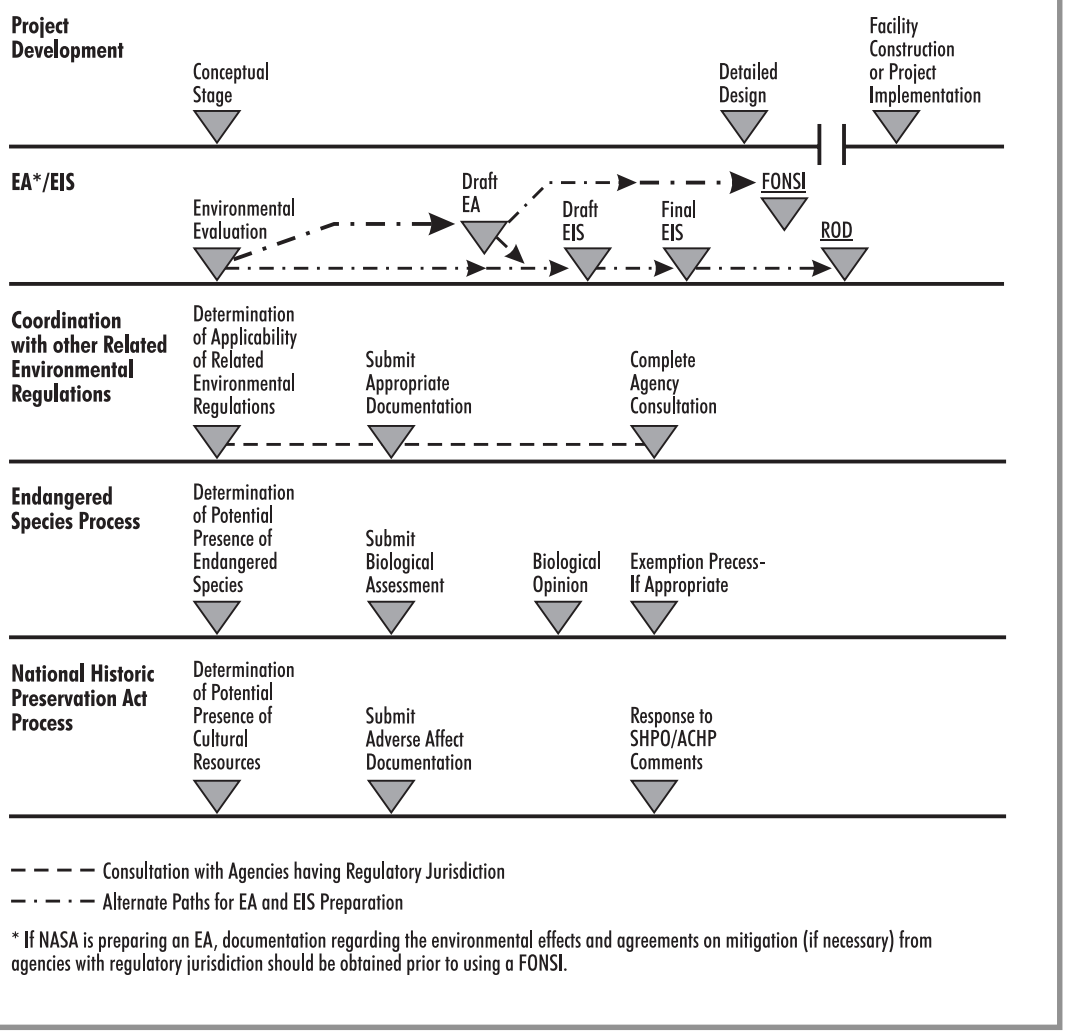
### Major Requirements

The CEQ regulations state that agencies ". . . shall integrate the NEPA process with other planning at the earliest possible time to ensure that planning and decisions reflect environmental values, to avoid delays later in the process, and to head off potential conflicts. "In addition, the CEQ regulations state that agencies shall integrate the requirements of NEPA and other environmental review procedures so that the procedures can run concurrently. Examples of these other environmental review requirements include issues such as endangered species, cultural resources, land use, and other aspects of the natural and physical environment. During the conceptual stage, the Sponsoring Entity should perform an "environmental evaluation" in consultation with the Center Environmental Management Office. An environmental evaluation is a preliminary review that determines aspects of the proposal likely to result in some level of environmental impact. The environmental evaluation also assists in determining whether to prepare a CatEx, an EA, or an EIS as well as what other environmental review requirements might apply. The distinctions among Categorical Exclusions, EAs, and EISs are addressed further below. An EA or EIS is normally completed during the detailed planning phase. As stated in NPG 8840, "the EA or EIS must be completed before project planning reaches a point where NASA's ability to implement reasonable alternatives is precluded (i.e., before hard decisions are made regarding project implementation)." Environmental planning factors should be integrated into the conceptual stage of project planning when the Sponsoring Entity is considering a broad range of alternative approaches. In the project development stage, a Sponsoring Entity makes decisions that affect the detailed planning stage. At a minimum, the Sponsoring Entity should work with the Center Environmental Management Office to prepare an environmental evaluation in the project development stage. The milestone chart below illustrates the relationship and timing among project development, the NEPA process, and the related environmental review process with two specific examples of review requirements that can arise. Non-

**Examples of NASA actions that can potentially fit under a CatEx include the following:**

- Certain types of research and development activities,
- Minor construction of new facilities, including rehabilitation, modification, and repair, and
- Continuing operations that involve only social and/or economic effects but no or minimal natural or physical environmental effects (See NPG 8840, Section 4.2).

## Milestone Chart for NEPA and Related Environmental Review Requirements




environmental professionals should be aware that failure to begin the NEPA process early enough in NASA's planning could render the EA or EIS vulnerable to judicial scrutiny in the event that a party filed a suit to stop a project.

NEPA litigation often results in substantial delays and occasionally the cancellation of a project.

If the proposed action (i.e., project) fits within a category of activities that NASA has already deemed as normally having no significant impact, the Sponsoring Entity can usually prepare a brief CatEx. Categorical Exclusions cannot be applied automatically, and cannot be used if the proposed action might affect endangered species, cultural resources, or wetlands without additional documentation. If a CatEx does not cover the proposed action, then the Sponsoring Entity can prepare an EA to "briefly provide sufficient evidence and analysis for determining whether to

prepare an environmental impact statement or a finding of no significant impact." If NASA already knows that the proposed action would likely have a significant impact, the Sponsoring Entity can skip the EA and prepare an EIS. A wide variety of NASA actions fit under categorical exclusions.

Examples of NASA actions that normally require an EA include the following:

- Specific spacecraft development and flight projects in space science.
- Reimbursable launches of non-NASA spacecraft or payloads.
- Major facility construction and rehabilitation projects, and
- Actions to alter ongoing operations at NASA installations that could lead, either directly or indirectly, to natural or physical environmental effects (See NPG 8840, Section 5.2).

NASA actions that normally require an EIS include the development and operation of substantial new facilities or equipment:

- New launch vehicles.
- Space vehicles likely to release substantial amounts of foreign materials into the Earth's atmosphere or into space, and
- Nuclear systems, including nuclear reactors and thermal devices used for propulsion and/or power generation (See NPG 8840, Section 6.2).

Alternatives analysis lies at the heart of the NEPA process. For EAs and EISs, an agency must consider alternatives to the proposed action, including the No-Action alternative. Reasonable alternatives have to meet several criteria:

- Technically feasible and capable of accomplishing the purpose and meeting the need.
- Economically feasible, not requiring the agency to expend exorbitant funds to develop or implement, and
- Available within the time frame of the action; specifically, a reasonable alternative is not speculative or potentially available at some indeterminate point in the future.

The No-Action alternative is defined as no change from existing conditions (i.e., continuing rather than modifying or expanding existing programs and activities). In some cases, the No-Action alternative may have adverse environmental effects (e.g., deciding not to replace old underground storage tanks). Failure to consider a reasonable range of alternatives in an EIS is one of the most common grounds for litigation.

In addition, the CEQ regulations require agencies to consider mitigation measures for adverse impacts. NEPA does not, however, require an agency to mitigate all (or any) of the adverse environmental impacts. Instead, an agency may determine that given the benefits of a proposed action, the impacts need not be mitigated. An agency also has the discretion to weigh the costs and benefits of implementing mitigation. The only time that mitigation is really required is in the situation when an agency wants to mitigate impacts to a level below "significance" so that an EA can result in a finding of no significant impact (FONSI). In practice, most EAs and EISs contain mitigation measures. Mitigation can become an important issue for a non-environmental professional, because while some measures might consist of best management practices for a construction site, some can affect the timing of project implementation. One type of mitigation might include minimizing the impacts by limiting the degree or magnitude of the action and its implementation (e.g., planning construction during a time of the year when protected species are not nesting on site). Another example is compensating for the impact by replacing or providing for substitute resources or environments (e.g., creating new wetlands to compensate for filling existing wetlands). In addition, the mitigation measures can affect a Sponsoring Entity's budget because they are responsible for implementing the mitigation. Non-environmental professionals should be aware that when mitigation measures are documented in a finding of no significant impact following an EA or a Record of Decision following an EIS, this becomes a commitment to perform the mitigation. It also is worth noting that mitigation measures may be relied upon to make a finding of no significant impact instead of a finding to prepare an EIS in the absence of such mitigation only if they are imposed by statute or regulation, or submitted by an applicant or agency as part of the original proposal. In addition, mitigation measures should be monitored during project implementation. For more details see NPG 8840, Section 3.6.4.

**Monitoring the implementation of an action is necessary because:**

- Implementation of the action may reveal environmental impacts not anticipated in the EA or EIS
- Conditions may change so that mitigation measures are not having the anticipated effect in reducing the severity of impacts, or
- New information may arise during implementation of the action that has a bearing on the perceived significance of the impacts

The mitigation measures may need to be modified and/or further NEPA documentation may need to be prepared, such as a supplemental EIS, a revised EA or FONSI, or a revised Record of Decision.

While a non-environmental professional would generally not be involved in the day-to-day preparation of a NEPA document (the Center Environmental Management Office or Sponsoring Entity would manage a contractor to prepare these documents), having an understanding of the appropriate length of various NEPA documents can help lower costs and avoid an unnecessarily lengthy process. A CatEx should be brief (e.g., one to three pages, not including attachments with back-up information). CEQ's guidance indicates that most EAs should only require 10 to 15 pages, but in practice they are normally longer because of requirements imposed by other environmental statutes, regulations, and Executive Orders. Also, complex EAs may require added length. A typical EIS requires over 100 pages. EISs for extraordinarily complex proposed actions sometimes result in much longer multi-volume documents (e.g., the EIS for Cassini was several volumes and took more than a year to complete).

Similarly, having an understanding of the typical time and human resource requirements of NEPA and the related environmental review requirements will assist a non-environmental professional in lowering costs, avoiding delays, and in successful overall planning of a project. Some of the related environmental review requirements that may arise during the NEPA process and that should be addressed concurrently include:

- The Endangered Species Act.
- The National Historic Preservation Act.
- Land Use, and
- Environmental Justice.

The table below provides examples of the two ends of the spectrum of time and human resource requirements across several of the more common environmental review activities. Non-environmental professionals should consult their Center Environmental Management Office for details on schedule and resource allocation for the environmental review process.

**Examples of Time and Resource Requirements for the Environmental Review Process***

| Review Requirement | Basic Project with Few, if any Resource Impacts | Complex Project with Resource Impacts |
|---|---|---|
| NEPA | 1 person for 3 - 4 days for a CatEx<br>12 or more people working for over one year | 1 to 3 years for an EIS<br>on a complex EIS |
| Endangered Species Act | 1 person for 1 - 3 days of informal consultation by phone | Several biologists working at varied levels over several months of formal consultation |
| National Historic Preservation Act | 1 person for several days or weeks reviewing existing survey information and preparing documentation | Several historians or archaeologists working at varied levels over several months |
| Land Use | 1 person for several days to several weeks | Several people for several months |
| Environmental Justice | 1 person for several days to several weeks more statisticians over several months | Several public involvement staff and one or |

*These are general time frames that are subject to change based on the nature of the project/program.

Given that agencies are supposed to begin the NEPA process as early in the proposal planning process as possible and that a complex proposal could require a substantial amount of time to plan, the schedule for the EIS and related environmental reviews should not typically pose an obstacle. If necessary, an agency can accelerate the EIS process (provided all of the necessary information is available to the preparers of the EIS), but given certain CEQ requirements for scoping periods and public comment periods, the process usually takes about one year.. One potential time-saver for some of NASA's environmental review processes is that each Center has an Environmental Resources Document. This document describes many of the Center's baseline activities and much of its existing

environment. Therefore, the staff preparing the NEPA documentation have less information to collect and can focus more resources on the impact analyses. Some of the reasons that agencies run into delays in the EIS process include an inability to finalize the details of a proposed action or alternatives to a point where environmental professionals can analyze them. This can lead to re-running of environmental analyses, which sometimes include complex air quality modeling and other time-consuming activities.

Common agency consultations that can occur during the NEPA process include consideration of threatened and endangered species and cultural resources (discussed more fully below). These consultations can affect the schedule of an EA or EIS, because the agencies with regulatory jurisdiction have at least 30 days before they are obligated to respond to an agency's initial inquiry and the analyses can involve substantial field surveys. For example, if a formal consultation is required under the Endangered Species Act, it can last several months under a fixed schedule. If, however, a Center Environmental Office has established a good relationship with the regional U.S. Fish and Wildlife office and the State Historic Preservation Officer, these consultations can potentially be less time consuming. Informal consultation under the ESA might only take a telephone call to the U.S. Fish and Wildlife Service or National Marine Fisheries Service field office to confirm that they are satisfied that while protected species are known to occur in the area, it would be highly unlikely that the proposed action would affect them. In order to develop good administrative records all findings and concurrences should be in writing. Because NASA facilities have a substantial amount of undeveloped habitat occupied by threatened and endangered species, many of the NASA facilities already have management plans in place and agreements with FWS, which can generally result in routine consultations.

When agencies disagree they should try to work out their differences (e.g., over the characterization of certain impacts or the use of certain analytical methodologies) agency-to-agency. When they cannot resolve their differences at the agency level, the matter may be referred to CEQ. This occurs infrequently, but CEQ has the authority to resolve these disagreements. To avoid this problem, it helps to engage in consultation early with agencies that may have regulatory jurisdiction over the proposed action. In this way, their concerns can be addressed early in the process, and alternatives can be discussed. While this is not guaranteed to avoid disputes, it can reduce the amount of adverse comments that NASA receives on an EA or EIS.

### Responsibilities of Non-Environmental Staff

As previously discussed, the decision-maker for a proposed action must consider its environmental effects as well as the technical and economic issues. For a CatEx, the roles and responsibilities of both the Sponsoring

Entity and the Center Environmental Office may include preparation and review/concurrence. The roles and responsibilities for an EA are similar, but the Office of Chief Counsel and/or of the General Counsel also has a review function. The Sponsoring Entity has a similar role in the EIS process as in the CatEx and EA process, but the review/concurrence, publication, and signature require higher levels of input/approval (e.g., Associate Administrator for Management Systems). An example of a Sponsoring Entity's involvement includes verification that the EA or EIS properly describes the proposed action and alternatives (e.g., technical accuracy and whether the alternatives are reasonable and feasible). For more details on roles and responsibilities designated by NASA, see NPG 8840. In addition, some of the responsibilities for the non-environmental staff in the environmental review process include the following:

- Being knowledgeable of the basic environmental review requirements.
- Contacting the Center Environmental Office as soon as possible when environmental review requirements might be triggered.
- Representing project information in an unbiased manner to the Center Environmental Office.
- Requesting, allocating, and/or managing funding to provide adequate resources to carry out NASA's environmental review responsibilities.
- Ensuring that the commitments entered into can be implemented.
- Implementing these commitments, and
- Contacting the Center Environmental Office when new and/or significant information becomes available.

### When to Call Environmental Staff

A non-environmental professional should contact his/her Center Environmental Office as early in the planning process as possible to avoid potential delays and noncompliance issues. When an agency lets the process of planning an action precede the NEPA process, NEPA becomes essentially a tool justifying prior or *de facto* decisions. This occurs when actions required for NEPA compliance occur too late or by making substantial commitments that limit the choice of alternatives or essentially drive the agency to choose a particular alternative. Hard commitments can include activities such as building or purchasing major long lead-time components of a project (e.g., turbines); establishing design or operating requirements that essentially pre-ordain that a particular alternative be chosen; or building foundations before the EA or FONSI are completed to support the new facility construction. In such cases, a court injunction halting the activity may be issued. In addition, for ongoing actions already covered by NEPA, contact the Center Environmental Office if new information becomes available that indicates a change in project implementation resulting in unpredicted impacts, a change in the existing environment resulting in unpredicted impacts, or ineffective mitigation measures.

### Compliance Methods and Checklists

For more information on compliance methods and checklists see NPG 8840 and/or the relevant facility Environmental Resources Document, or contact your Center Environmental Office.

### Sources of Help

Aside from the Center Environmental Office, NPG 8840 contains NEPA and environmental review-related guidance documents in its appendices as well as references to Internet sites with NEPA and environmental review guidance.

*Endangered Species Act*

### Relevance

NASA "manages" more endangered species than most other federal agencies.

There are a number of key issues associated with the Endangered Species Act (ESA) that are important for non-environmental professionals to understand. Because of the amount of undeveloped habitat at many of NASA's facilities, NASA "manages" more endangered species than most other federal agencies. KSC alone provides habitat for more than 30 federally listed or candidate species. The ESA requires federal agencies to not only avoid disturbing or killing protected species, but to implement substantive protective and affirmative conservation actions. Therefore, many NASA facilities with sensitive habitat have management plans addressing the protected species and providing guidance for new and ongoing activities. The management plans likely address the conservation measures contained in a Biological Opinion (BO) from either the U.S. Fish and Wildlife Service or the National Marine Fisheries Service, or both. The BO forms the basis of an incidental take permit, which specifies how many of a given species an agency can accidentally destroy or disturb after all other mitigation measures are in place, in other words, the level of destruction or disturbance that is unavoidable. In addition, non-environmental managers need to know that government employees can be held personally liable for violating the ESA and can be subject to criminal penalties.

### Major Requirements

ESA applies to NASA activities any time an action might directly or indirectly affect any candidate or listed species. For a proposed action at an existing NASA facility, the Center Environmental Office would be able to indicate whether an activity was already covered by a BO (i.e., NASA has previously consulted with the U.S. Fish and Wildlife Service or National Marine Fisheries Service on the potential impacts and how to mitigate them). If the action is not covered by a BO, NASA could first engage in "informal consultation" with the U.S. Fish and Wildlife Service or National Marine Fisheries Service to determine whether they think the proposed action could adversely affect a listed species. If one of these

agencies has reason to believe that it might, they could ask NASA to prepare a Biological Assessment (BA) of the potential impacts (which begins the formal consultation process). Based on the BA, the relevant Service will either issue a BO or a jeopardy finding. A jeopardy finding results when the U.S. Fish and Wildlife Service or National Marine Fisheries Service believes that a proposed action would "jeopardize the continued existence" of a species.

For a proposed activity outside a NASA installation, NASA should contact the U.S. Fish and Wildlife Service or National Marine Fisheries Service to ascertain what species are known to occur in the county or counties surrounding the proposed activity and whether there have been any sightings at or near the site of the proposed action (informal consultation). If U.S. Fish and Wildlife Service or National Marine Fisheries Service believes that the proposed activity has the potential to affect a listed species, NASA prepares a BA and begins the formal consultation process.

### Responsibilities of Non-Environmental Staff

An action that triggers the ESA will usually trigger NEPA. Therefore, as soon as a Sponsoring Entity has enough information on a proposed action (e.g., location and a brief description), NASA (e.g., the Center Environmental Office) should begin informal consultation with U.S. Fish and Wildlife Service or National Marine Fisheries Service. Failure to start early could result in substantial delays because some plants and animals can only be surveyed during certain times of the year. Accordingly, the Sponsoring Entity should communicate the nature and intended or possible placement of the new project as early in the planning process as possible.

*Cultural Resources*

### Relevance

There are several aspects of the cultural resource regulations that are important for non-environmental professionals to understand. These regulations can significantly affect facility planning and operations. NASA has many facilities and structures that may be considered culturally significant, and therefore protected under cultural resource regulations. Because of the age of some of the NASA facilities and because of the national historic importance of some of those facilities, they are either on the National Register of Historic Places or may soon be eligible for listing. For example, Langley Research Center and John Glenn Research Center are over 50 years old and Marshall Space Flight Center is surrounded by the Redstone Arsenal so it contains structures that are over 50 years old. The eligibility of properties for protection under the cultural resource regulations is not as straightforward as one might think. As a starting point, however, each facility's Environmental Resources Document (ERD) will contain information on the archaeological and historical surveys and known site locations for the facility vicinity. While the process is complex, it is well understood by NASA environmental professionals.

### Major Requirements

The National Historic Preservation Act (NHPA) applies to NASA's activities any time that a proposed action might affect a property on or eligible for the National Register. The NHPA states that Federal agencies "must take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." The National Register is an inventory of the United States' historic resources and is maintained by the National Park Service. The National Register's historic resources also encompass archeological resources. It is noteworthy that the National Register is not simply composed of buildings over 50 years old that have architectural merit. A 50-year old warehouse could be eligible because it is associated with a nationally historic event or because of the period in time represented by that building and the activities that occurred in it. Moreover, properties of exceptional significance need not be at least 50 years old.

### Responsibilities of Non-Environmental Staff

An action that triggers the NHPA also will likely trigger NEPA. Therefore, as soon as a Sponsoring Entity has enough information on a proposed action (e.g., location and a brief description), NASA should begin the process of determining whether the proposed action might affect historic properties. Before undertaking an action, NASA works with the State Historic Preservation Officer (SHPO) to locate and evaluate the eligibility of possible historic properties for the National Register. This may involve a professional survey of the project area. If there are no properties on or eligible for listing on the National Register, NASA must provide documentation of that fact to the SHPO and notify other interested parties. If historic properties are present, NASA must determine whether the proposed action could affect the properties in any way. If the proposed action will not affect the historic properties, NASA prepares a determination of No Effect. If the proposed action will affect the historic properties, but the effect is not adverse, NASA must prepare a Determination of No Adverse Effect. If an undertaking may adversely affect an historic property, the NHPA regulations require consultation about ways to avoid, reduce, or mitigate the harm. At a minimum, consultation occurs between NASA and the SHPO. Consultation often also includes the Advisory Council on Historic Preservation and/or other interested parties. Consultation may result in a Memorandum of Agreement (MOA) which sets out specific steps for avoiding or minimizing the harm. The Advisory Council does not provide written comments for every consultation that has an adverse effect determination. Nonetheless, whenever the Advisory Council does provide written comments on an adverse effect documentation, NASA must notify the Advisory Council in writing of whether and how NASA will proceed with the proposed action and should include that decision in the NEPA document prepared on the action.

*Land Use*

For the purposes of this guidance, land use includes the actual use of the land (e.g., open space, industrial, commercial, and residential) as well as its resources and characteristics (e.g., soils, geology, topography, wetlands, and floodplains). The non-environmental professional should know that these are issues that NEPA Environmental Assessments and Environmental Impact Statements will routinely address. For the most part, wetlands and floodplains are the issues that can potentially warrant more attention and will occasionally require the alteration of a proposed action or the implementation of substantial mitigation measures. A change in land use outside of a NASA Center will likely involve approval from the local planning commission, which sometimes requires public hearings and other procedures separate from the NEPA process.

Some NASA Centers have significant amounts of wetlands. KSC is almost 80 percent wetlands. SSC is 100 percent woodland upland wetlands.

### Relevance

Land use concerns apply to NASA's activities any time a proposed action or the re-evaluation of ongoing operations indicates the potential to affect an existing land use or a land use resource. Each Center's Environmental Resource Document will have already characterized the land uses and resources on site and the Center Environmental Office would likely be familiar with the mitigation measures required by the local and regional offices of the regulatory agencies having jurisdiction over those resources. For example, if a proposed action were going to affect a wetland, the Center Environmental Office would work with the Sponsoring Entity to determine whether there are feasible alternatives that would avoid affecting the wetland. If there were no alternatives to affecting the wetland, the Center Environmental Office would consult with the Army Corps of Engineers to obtain a permit to fill the wetlands. Depending on the size of the wetlands, the permit would likely require NASA to replace the wetlands at a 2 to 1 or 3 to 1 ratio. NASA also would be responsible for 100 percent of the cost of creating new wetlands as well as for the maintenance. Even at that, because of the substantial volume of wetlands filled in the U.S. in recent history, these permits are difficult to obtain. The main concern with floodplains is to avoid building any structures that would adversely affect the effectiveness of a floodplain during a flood and/or could not withstand the flood.

### Responsibilities of Non-Environmental Staff

An action that triggers a land use issue also will trigger NEPA. Therefore, as soon as a Sponsoring Entity has enough information on a proposed action (e.g., location and a brief description), NASA should begin to determine whether the proposed action could affect any land uses or resources. Failure to start early with issues such as wetlands could result in substantial delays.

*Environmental Justice*

Non-environmental managers should maintain awareness of Executive Order 12898 on Environmental Justice for several reasons. In situations in which a federal program has the potential to have a disproportionately high and adverse human health or environmental effect on a minority or low-income population, a failure to involve the affected population could, at the least, lead to bad publicity and potential legal action. While some communities have used existing regulations such as NEPA to delay and occasionally terminate projects, Environmental Justice adds a new layer to project analysis and implementation. In addition, while the Executive Order has been in existence for several years, there are few widely used examples of how to implement an environmental justice analysis.

### Major Requirements

"Environmental Justice applies to any federal program that has the potential to have disproportionately high and adverse human health or environmental effects on minority or low-income populations."[7] While Environmental Justice analyses have the potential to drain resources if agency and consulting staffs have difficulty developing a methodology, all NASA Centers have their own Environmental Justice Strategies. NASA also has established an Agency-wide strategy, which, in addition to the requirements in the Executive Order, seeks to 1) minimize administrative burdens; 2) focus on public outreach and involvement; 3) encourage implementation plans tailored to the specific situation at each Center; 4) make each Center responsible for developing its own Environmental Justice Plan; and 5) consider both normal operations and accidents. At a basic level, this requires an analytical component to determine whether a program or project might have a disproportionately high and adverse effect, and a public outreach and involvement component. To place the issue in context for NASA, most of its facilities have been in existence for many years and they contribute substantial economic benefits to their local economies. Therefore, if a NASA installation has a good relationship with its neighbors, Environmental Justice may be a minor issue relative to ongoing operations and most proposed actions.

### Responsibilities of Non-Environmental Staff

For ongoing activities, a Center's Environmental Justice Implementation Plan should provide adequate coverage. For new programs or proposed actions, if they have a potential environmental or human health impact, they also would trigger NEPA. Therefore, as soon as a Sponsoring Entity has enough information on a proposed action to begin regular NEPA public outreach and involvement, they should merge those activities with those necessary to engage minority or low-income populations.

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[7] Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."

## Environmental Health

This section provides a brief discussion of several additional issues that may affect the health and well-being of NASA employees and other people who visit NASA installations. As in the preceding sections, we focus here on the regulatory requirements that have been established to protect the health of people in the NASA community, and on the key facts that the non-environmental professional should know to understand and deal effectively with these issues.

*Safe Drinking Water Act (SDWA)*

As mentioned in the Water Pollution section of this chapter, the SDWA was passed by Congress to ensure that water provided by "public" water systems is safe for its users to drink. A public water system is one that provides water to 25 or more people or to 15 or more service connections for at least 60 days out of the year. The SDWA, and its amendments, require the EPA to establish maximum contaminant levels (MCLs) to guarantee the safety of the nation's water supply. The SDWA also specifically restricted the amount of lead that can be found in drinking water.

Managers of public water systems are responsible for checking their water to ensure that the SDWA limits are met.

Under the SDWA, most states have developed their own drinking water programs for regulating public water systems (only Wyoming and the District of Columbia have not). These state regulations may cover more than the federal EPA regulations, and include operation and maintenance practices, design specifications, permit requirements, and operator certification provisions.

Major Requirements

If your drinking water is obtained from a local supplier, there are two items that you should be concerned about:

- *Stagnant water supplies.* When water sits for long periods of time in pipes, bacteria can grow. If portions of your facility are used infrequently, you should flush the stagnant water out of the system by running water at sinks for five minutes, or until the water is clear.
- *Dissolved lead.* If a lead-based solder was used to solder the drinking water pipes, lead contamination may get into the water in water fountains and ice machines.

Your state may require that NASA test the water fountains and/or ice machines.

If your facility buys its drinking water from an external supplier, its administrative or purchasing office should obtain and maintain the following records or documents from the supplier:

- Records of the supplier's monitoring results, and
- Records of lead testing for water fountains and ice machines.

If your installation treats its own water, then it is subject to SDWA monitoring and reporting requirements. The monitoring results are submitted to the appropriate state or regional office.

If your facility obtains its water from a well, the Center Environmental Office will develop and maintain testing records for the well water.

### When to Call Environmental Staff

- If there is a problem with the water.
- If there has been a public notification that the water has been contaminated.

### Sources of Help

Center Environmental Office

U.S. Environmental Protection Agency
SDWA Hotline (800) 426-4791
www.epa.gov/ow

*Lead-Based Paint*

### Relevance

Lead is harmful when inhaled or ingested. The absorption of large amounts of lead may cause diseases of the kidney as well as of the peripheral and central nervous systems. The effects of lead on the nervous system range from mild behavioral changes to fatal brain damage. Lead exposure also can result in impotence and sterility in men and decreased fertility in women, as well as permanent brain damage in children.

Lead based paint that is peeling, flaking, or chalking generates lead dust that is a source of lead exposure and must be controlled. Further, lead-based paint in "high-friction" areas such as door jambs and windows also may generate lead dust and should be controlled. Paint in good condition and not in high-friction areas is usually not a problem but should be monitored periodically.

### Major Requirements

RCRA regulations control how an agency should dispose of lead-based paint waste. OSHA has regulations for protecting workers who are exposed to lead. Often, states will have more stringent standards. Under TSCA, federal facilities do not have sovereign immunity and are required to comply with state and local lead-based paint regulations.

### When to Call Environmental Staff

The environmental staff and safety staff should be notified when there is any remodeling or paint removal planned or if any structures are scheduled for demolition or renovation.

### Potential Pitfalls And Solutions

During remodeling, the managers must be aware of the costs associated with lead abatement, if applicable.

### Sources of Help

Center Environmental Office

Center Safety or Occupational Health Office

Lead Information Clearinghouse
(800) 424-5323

TSCA hotline
(202) 554-1404

RCRA hotline
(800) 424-9346

U.S. EPA website
www.epa.gov

*Radon*

Radon is a colorless and odorless radioactive gas released by the natural decay of uranium, which is found in many soils and rocks. Although radon is naturally found at low levels outdoors, it can become concentrated in enclosed spaces in buildings such as basements, or anywhere that is not well ventilated. Radon gas can enter buildings through dirt floors, cracks in concrete floors and walls, floor drains, sumps, and joints, and tiny cracks or pores in hollow-block walls. The only known health effect from high levels of radon is an increased risk of lung cancer. That risk depends on how high the concentration of radon is, and how long a person is exposed.

### Major Requirements

EPA currently does not have any regulations addressing radon, but has developed voluntary action levels. The EPA action level for indoor radon contamination is 4 picocuries/liter (pCi/L) of air (ambient outside background levels range from 0.2 - 0.7 pCi/L). EPA suggests mitigation if concentrations exceed the action level, as detailed below. Mitigation strategies are technically simple, relatively inexpensive, and highly effective.

Mitigation to reduce radon levels should occur within the following time frames:

| Exposure Level | When to Take Action |
|---|---|
| 4-8 pCi/L | Take action within five years |
| 8-20 pCi/L | Take action within one to four years |
| 20-200 pCi/L | Take action within 6 months |
| > 200 pCi/L | Evacuate within one month if "mitigation action" has not reduced radon concentrations to an acceptable level within that time. |

Examples of documents that the Center Environmental Office should have on file to show compliance with the requirements of the radon reduction program include:

- Radon survey results, and
- Plans as required for mitigating excessive radon levels

### Responsibilities of Non-Environmental Staff

- Know whom to contact regarding information on radon and measurement protocols.

### When to call Environmental Staff

- If there is an inquiry regarding radon.

### Sources of Help

Center Environmental Office

U.S. EPA
http://www.epa.gov/iaq

*Asbestos*

Asbestos is a natural, fibrous material with many uses. It is often found in building materials such as floor tiles, ceiling tiles, piping, kitchen walls, and roofing materials, because it is durable and heat resistant. For these same reasons, asbestos also is found in brake assemblies for vehicles and in hoses of aircraft engines. In addition, asbestos is a good insulator, so you can also find it in boiler rooms and around hot water pipes.

### Relevance

Despite all its uses, asbestos poses some health problems. In particular, asbestos dust can damage lungs. For this reason, special care needs to be taken whenever handling or working with materials that contain asbestos. Materials suspected of containing asbestos that are damaged or falling apart should be removed or replaced by specially trained and certified personnel.

All buildings and structures at your Center or Component Facility should already have been surveyed to determine the presence and extent of asbestos use. To find out if asbestos is in your Center or any particular building or other structure, contact the Center Environmental Office.

### Major Requirements

The permissible occupational exposure limits (PEL's) for asbestos have been reduced by OSHA over the past decade from 5.0 fibers/cc air in the early 1970's, to 2.0 fibers/cc in 1976, to a newly proposed PEL of 0.5 fiber/cc. NASA safety procedures adhere to an exposure limit of 0.1 fiber/cc.

Worker protection is regulated by OSHA asbestos standards. These standards include requirements for regulated areas, employee exposure monitoring, personal protective equipment (including full body coveralls and respirators), work practices and engineering controls, defining "competent persons," employee training, hygiene facilities, housekeeping, and medical monitoring.

Environmental protection is covered by the EPA National Emission Standards for Asbestos. These regulations include requirements for regulated areas, negative pressure enclosures, worker training, and material disposal.

### Responsibilities of Non-Environmental Staff

- Alert environmental staff and safety staff when remodeling or demolition of facility structures is planned or being considered, and
- Alert the environmental staff and safety staff of any occurrence that would free asbestos fibers into an airborne state.

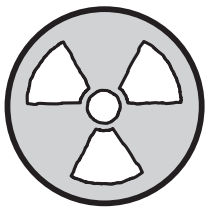
### Sources of Help

Center Environmental Office

Center Safety or Occupational Health Office

OSHA
http://www.osha.gov

## Radioactive Materials Management



This section elaborates upon the information on radioactive material management presented in Chapter 4. Many of the principles described earlier in this chapter addressing hazardous materials management (e.g., safe handling, waste minimization, transportation, and storage) are applicable to radioactive materials. The information provided below serves to augment those principles.

The uses of man-made radiation are subject to very stringent regulations to ensure proper control of the risk that they may pose. Government agencies at the international, federal, state, and local levels regulate the manufacture, use, transport, and disposal of man-made (and some naturally occurring) radioactive materials to ensure the protection of public and worker health and safety and the environment. Regulatory limits for worker and public exposures to radiation are set conservatively—far below the levels at which health effects have been observed.

The principal federal regulating bodies for radioactive materials are the EPA, U.S. Nuclear Regulatory Commission (NRC), U.S. Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and Food and Drug Administration (FDA). Although each agency maintains specific responsibilities for nuclear material regulation, these responsibilities frequently overlap.

### Relevance

Radioactive materials are used in a variety of fields, including energy, agriculture, medicine, industry, research, military applications, and space exploration. NASA uses radioactive material to power small generators used for space exploration and to conduct materials research and development in non-power reactors.[8]

### Major Requirements

Because of intense regulatory scrutiny, radioactive waste management is a necessarily complex topic. This section introduces non-environmental professionals to the basic principles of radioactive waste management. Because specific rules pertaining to particular types of radioactive wastes may override these basic principles, NASA employees should consult with their Radiation Security Officer (RSO) or Center Environmental Office for additional details.

#### Space Power

Radioisotope thermoelectric generators (RTGs) are used to provide power for interplanetary space probes. RTGs use the natural decay of plutonium dioxide to produce heat, which is transformed into electrical power through thermoelectric devices. A typical modern RTG produces about 300 watts and will operate unattended for many years. RTGs have been used to provide power for 24 U.S. space missions - with an unparalleled safety record. These include the Apollo Lunar Surface Experiment Packages, the Pioneer 10 and 11 spacecraft launched in 1972 and 1973 (whose RTGs are still operating), two Viking Mars spacecraft (1978), two Voyager spacecraft (1977), Galileo (1989), Ulysses (1990), and Cassini (1997).

[8] Currently, NASA's two non-power reactors are licensed for "possession only" (i.e., no authority to operate the reactor).

Radioactive (and other hazardous) waste regulations may change drastically and with little warning in response to actions by federal, state, and local agencies, waste brokers and processors, and disposal site operators. New or amended regulations may invalidate NASA policies and procedures. Therefore, users of radioactive material should consult frequently with their RSO for notice of new, revised, or revoked policies.

The federal government classifies radioactive waste by how it was generated. "High-level" waste is basically used reactor fuel and weapons processing waste. "Low-level" waste is nearly everything else. The federal government is responsible for high-level waste disposal, while individual states, or groups of states called "compacts" are responsible for low-level radioactive waste disposal. This classification scheme has little relevance for NASA employees because all radioactive waste produced by the Agency is low-level.

The most basic and useful classification of radioactive waste for NASA employees is according to the half-life - the time required for one-half of an isotope's disintegration to occur. Waste containing only isotopes with half-lives of less than 90 days is considered **short-lived waste**, while waste containing any (licensed) radioactive material with a half-life exceeding 90 days is considered **long-lived waste**.

Short-lived waste and long-lived waste are handled very differently regardless of activity (number of disintegrations per second, measured in millicuries) or the external radiation levels (measured in millirem per hour) generated by that radioactivity. Short-lived waste will, after the passage of a few months or years, become essentially non-radioactive and pose no radiation hazard to humans or the environment, whereas long-lived waste may present hazards, real or perceived, which persist for generations. Governments, therefore, insist that long-lived waste be consigned to licensed permanent disposal sites that have been engineered to isolate their radioactive material from the environment for hundreds or even thousands of years. The extended isolation required for long-lived waste greatly increases its disposal cost.

The best practice for storing short-lived waste for decay is to provide a separate container for each isotope, because the minimum retention period is determined by the longest lived isotope in the waste. The retention period for decay in storage begins when someone dates the waste. Each container of waste must be labeled with the *MONTH* and *YEAR* that the container was sealed, the isotope, and the approximate activity in the waste. This is the minimum information required to define the "decay-in-storage" period. Because short-lived radioactive waste will eventually be disposed as ordinary trash, it is absolutely essential that all radioactive material warning labels and symbols be defaced or destroyed before items are placed in any waste storage container. Only the outermost container should have warning labeling. You should develop the habit of defacing labels whenever placing any short-lived waste into a waste container.

Waste containing **any** radioactive material with a half-life exceeding 90 days, such as tritium (12.3 years) or C-14 (5730 years), is considered long-lived waste. Long-lived waste must be consigned to a licensed facility for

permanent disposal. Costs for long-lived waste disposal are very high, so it is very important for NASA employees to minimize the volume of waste generated and observe all the rules for managing long-lived waste.

The majority of long-lived radioactive waste, in terms of both activity and volume, produced at NASA will be aqueous liquids and dry solid waste. Aqueous wastes must be segregated from dry solid waste — only incidental amounts of liquid are permitted in any dry waste — and stored in containers approved by the RSO. These containers are provided with an instruction label and a manifest on which users must record the approximate activity of each addition to the container. When the container is filled, call the RSO to have it removed and supply a replacement container.

Radioactive waste, which is also considered hazardous by EPA, must be disposed of as chemcial hazardous waste.

Dry solid long-lived waste must be segregated into containers provided by the RSO according to the type of volume reduction treatment that may be applied. Items that may be incinerated (e.g., paper, most plastics, cloth), should be placed into clearly marked containers for INCINERABLE waste. Items that cannot be incinerated but can be compacted, such as aluminum foil, glass, halogenated plastics, and any high activity items, should be placed in a COMPACTIBLE waste container.

*Basic Rules of Radioactive Waste Management*

DO:

- Segregate **ALL** wastes by isotope or half-life.
- Use appropriate containers that provide sufficient shielding.
- Label each container with the **ISOTOPE**, **ACTIVITY**, and **MONTH/YEAR** placed in storage.
- Separate distinctively different physical types of long-lived radioactive waste.
- Segregate small quantities of high-activity waste from large quantities of low-activity waste, and
- Arrange for final disposal of radioactive waste as soon as practical.

**Non-Acceptable Methods for Radioactive Waste Disposal**

- No disposal of liquids in any solid waste.
- No disposal by burial in the soil.
- No disposal into the sewage system.

DO NOT:

- Discard any radioactive waste as ordinary trash.
- Use glass or flimsy plastic bottles to store liquid waste.
- Mix short-lived waste and long-lived waste.
- Add liquids of any kind to dry solid waste.
- Contaminate radioactive waste with chemical hazards, or
- Exceed the weight or volume limits for the container.

*Storage*

Radioactive material storage should follow these general principles:

- Radioisotope laboratories and storage areas (rooms, cabinets, safes, etc.) must be locked at all times when not in actual use to prevent theft and unauthorized use of radioactive materials.
- Radioactive materials stored in occupied areas shall be shielded in accordance with the "as low as reasonably achievable (ALARA) principle.[9]
- Unbreakable containers are recommended for storage of radioactive liquids. Bottles and other breakable containers used for storage must be kept in non-breakable, leak-proof containers or trays capable of containing the entire volume of liquid waste stored therein.
- Radioactive gases and volatile forms of radioisotopes should be stored in a well-ventilated area, preferably in a hood or dry box, and
- All active samples, including calibration sources, regardless of strength should be clearly labeled giving accurate information about the contents as well as the name of the person or area responsible for the sample. They must also carry the words "Caution Radioactive Materials." The RSO reserves the right to take possession of unlabeled sources.

*Transportation*

The transportation of radioactive materials is regulated jointly by DOT and NRC. Generally, DOT regulates shippers and carriers of radioactive material and the conditions of transport (such as routing, tie-downs, vehicle requirements, handling and storage). In contrast, NRC regulates users of radioactive material and the design, construction, use, and maintenance of shipping containers for more hazardous radioactive material shipments.

These regulations have reduced the possibility of any harm to people and the environment associated with the transportation of radioactive materials and waste. The packaging used is determined by the activity, type, and form of the material to be shipped. NASA is most likely to ship radioactive material in one of two types of containers:

- **Strong, tight containers:** Used for materials that present little hazard from radiation exposure because of their low level of radioactivity. These containers will retain and protect the contents, such as contaminated clothing and laboratory samples, during routine transportation.

[9] ALARA, a guiding principle behind all radiation and hazardous material management, seeks to reduce exposure to the lowest extent possible. Three techniques for lowering your radiation exposure are: (1) reducing your exposure time, (2) increasing your distance from the source, and (3) increasing the amount of available shielding.

- **Type A packages:** Used to ship radioactive materials with higher specific activity levels. Regulations require that these packages protect their contents under conditions normally encountered during transportation. Type A packages are typically used to transport radiopharmaceuticals and certain industrial products.

Most low-level waste is shipped to disposal facilities by ground transportation, and regulated by DOT and the NRC. NRC requires that radioactive materials be packaged for shipment to protect the public in case of an accident.

*Radiation Safety*

NRC, EPA, and DOT are the principal federal agencies responsible for establishing radiation protection regulations. These authorities come from the Atomic Energy Act, Clean Air Act, and other related statutes. In individual states, either the Department of Environmental Health or the Department of Health usually regulates radiation safety.

NRC has established an occupational dose limit of 5,000 mrem per year. Annual radiation exposure to the public from individual licensed sources is restricted to 100 millirem per year. The average exposure for each worker in the U.S. nuclear energy industry in 1995 was 160 millirem, less than 5 percent of the NRC limit. Rigorous applicable of the ALARA principle has allowed industry to keep worker doses far below the regulatory limit.

The average American receives 360 millirem of radiation each year, with most of this exposure resulting from natural sources such as the sun's rays, rocks, soil, building materials and other background sources. Less than 20 percent comes from human activities (e.g., x-rays) and consumer products. The table below illustrates the typical radiation exposures per activity on a yearly basis.

**Typical Radiation Exposures**
(millirem annually per individual averaged per activity)

| | | |
|---|---|---|
| Natural Background | Radon in air | 200 |
| | Food and water | 40 |
| | Soil, rocks | 28 |
| | Cosmic rays | 27 |
| Medical Examinations | Diagnostic X-rays | 40 |
| | Nuclear medicine | 15 |
| Consumer Products | Television | less than 1.0 |
| | Others | 0.3 |
| Other Activities | Water supply | 3.0 |
| | Building materials | 7.0 |
| | Mining and farming | 2.0 |
| | Burning fuels | 2.0 |

### Responsibilities of Non-Environmental Staff

You are ultimately responsible for the safe use of the radiation sources to which you have access. At a minimum you must perform the following actions:

- Keep your exposure ALARA.
- Wear assigned personnel monitoring devices in an approved manner.
- Be familiar with and comply with all NASA policies and procedures regarding radioactive material management.
- Be familiar with the nature of your area's radiation sources, the extent of their potential risk, and the use the proper means of coping with them safely.
- Monitor your area frequently for contamination.
- Clean up minor spills immediately.
- Dispose of radioactive waste in an approved manner.
- See that sources, containers, and the area are properly labeled and posted.
- Prevent unauthorized persons from having access to radiation sources in your area, and
- Immediately notify your supervisor and the RSO of unexpected difficulties with radioactive materials.

### Sources of Help

Center Environmental Office

Center Safety Office

Nuclear Regulatory Commission
http://www.nrc.gov

## Emerging Issues


Several additional areas may have important implications for NASA operations in the future. These are described below.

*Climate Change*

The issue of global warming/climate change has sparked a lot of interest and controversy over the past few years, as scientists and policy makers struggle to address the problem. The United Nations Framework Convention on Climate Change (UNFCCC), the international organization responsible for developing climate change policy, defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Human activities, such as the burning of fossil fuels and deforestation, have resulted in an increase of greenhouse gases in the atmosphere since the industrial revolution. The resulting accumulation of greenhouse gases in the atmosphere changes the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature and global sea level rise. The most recent scientific assessment released by the International Panel on Climate Change (IPCC) suggests that the global average surface temperature will increase by 2 to 6(F by the year 2100, with an associated rise in sea level of 6 to 36 inches. The most likely effects of these changes will be increased severe weather events, such as floods, heat waves, and hurricanes. In addition, climate change is expected to lead to a potential increase in the transmission of many infectious diseases, changes in ecosystems that could cause the extinction of entire species of plants and animals that cannot adapt quickly enough, and regional changes in crop yields and productivity.

The international community has been discussing/debating climate change for two decades, starting in 1979 with the First World Climate Conference. International action was taken in 1992 when the risks posed by climate change led virtually every nation to sign the UNFCCC at the Earth Summit in Rio de Janeiro, Brazil. Most developed countries (including the U.S.) committed to reduce their greenhouse gas emissions in the year 2000 to the same levels they emitted in 1990. The UNFCCC was ratified by the U.S. Senate in 1994. By 1995, it was clear that developed country commitments were not going to be met, and that greenhouse gas emissions were on a strong upward trajectory. At a meeting in Berlin, these countries established "The Berlin Mandate," which set the agenda for upcoming conferences, specifically one to be held in Kyoto, Japan. In 1997, the Parties to the UNFCCC met in Kyoto and drafted the Kyoto Protocol. The Kyoto Protocol establishes emission reduction targets for developed countries (U.S.: 7% below 1990 emissions levels) to be reached over five years (2008-2012) based on a five-year annual average. Emissions reductions under the Kyoto Protocol are for six

**Greenhouse Gases Listed in the Kyoto Protocol**

Carbon Dioxide—CO2

Methane—CH4

Nitrous Oxide—N20

Hydrofluorocarbons—HFCs

Perfluorocarbons—PFCs

Sulfur Hexafluoride —SF6

greenhouse gases, however, there are more than six greenhouse gases and the Protocol may be amended in the future to include emissions reductions of other greenhouse gases. At the time of the writing of this manual, President Clinton has signed the Kyoto Protocol, but has not sent it to the Senate for ratification. There are no laws at this time in the U.S. mandating the reduction of greenhouse gases, however, it is likely that there will be future requirements to reduce emissions of greenhouse gases.

### Relevance

As mentioned above, the Senate has not ratified the Kyoto Protocol, so there are no regulations requiring the reduction of emissions of greenhouse gases. There are, however, many voluntary programs under the President's Climate Change Action Plan that were created after signing the UNFCCC at the Earth Summit. By far the largest source of greenhouse gas emissions is the burning of fossil fuels for energy, and many of these voluntary programs, such as EPA's Green Lights and Energy STAR programs, are aimed at reducing energy consumption. In addition, there are several Executive Orders requiring federal agencies to purchase energy efficient products, reduce energy use by 35% below 1985 levels by 2010, increase the use of alternative fuels and renewable energy (hydroelectric, solar power, etc.), and reduce greenhouse gas emisions by 30%. NASA, through its energy conservation program, has considerably increased its energy efficiency and continues to reduce energy consumption through entering into energy savings performance contracts. In the future, NASA may be required to further reduce its fossil fuel use. This being the case, energy efficiency should be considered along with pollution prevention for all new projects.

High Global Warming Potential gases: The global warming potential of a greenhouse gas is the ratio of global warming or radioactive forcing (both direct and indirect) from one unit mass of a greenhouse gas to one unit mass of CO2 over a period of time.

*—The International Panel on Climate Change (IPCC) Climate Change 1995: The Science of Climate Change*

NASA's use of high global warming potential chemicals (PFCs, HFC, and SF6) will likely increase in the future. HFCs and PFCs are used as replacements for ozone-depleting chemicals in the following applications: air conditioning and refrigeration, solvents, fire suppression, and foam blowing. HFC-134a is the standard chemical used to replace Freon in refrigeration and air conditioning applications. HFCs have a global warming potential of 140—11,700 depending on the specific chemical. As NASA phases out the use of ozone-depleting refrigerants many systems will be replaced by HFC-134a systems. In addition, almost all automobiles built after 1994 use HFCs in their air conditioning systems. Unlike the Montreal Protocol (see the Air Pollution section) the Kyoto Protocol does not require the cessation of production of the chemical, but rather that each country reduce its total emissions of greenhouse gases. PFCs are versatile chemicals with many potential applications, however, the EPA under the Significant New Alternatives Program (SNAP), has placed restrictions on their use due to their global warming potential of 6,500-7,400. One of the uses for PFCs that is approved under SNAP is as an alternative to chlorofluorocarbon (CFC) -113 to clean gyroscope parts. $SF_6$ has the highest global warming potential of any of the six gases in the

Kyoto Protocol with a global warming potential of 23,900. It is mostly used as an insulating gas in electric transformers, as a test gas for fire suppression systems, and in some radar wave guides for airplanes and helicopters. It is likely that there will be regulations promulgated in the future that would prohibit the venting of these gases to the atmosphere and encourage their recapture and reuse.

### Responsibilities of Non-Environmental Staff

The environmental staff will remain apprised of climate change policy and participate in any rule making process on behalf of NASA. In support of any such rulemaking processes, the environmental staff may request information regarding the use of greenhouse gases. In addition, NASA non-environmental staff can contribute to solving the global change problem in the following ways:

- Consider energy efficiency in all new projects.
- Look for reductions in fossil fuel use in current programs and projects, and
- Consider alternatives to high global warming potential gases.

### Sources of Help

Center Environmental Office

UNFCCC web site
http://www.unfccc.de/

*Persistent Organic Pollutants*

Persistent Organic Pollutants (POPs) are chemical substances that persist in the environment, accumulate in the tissues of humans and animals, are passed through the food chain, and may pose a serious risk of causing adverse effects to human health and the environment. As a result of overwhelming evidence of the long-range transport of these substances to regions where they have never been used or produced, and the consequent threats they pose to humans and the environment, the international community has initiated urgent action to reduce and eliminate releases of some of these chemicals.

The United Nations Environment Program (UNEP) Governing Council, at its nineteenth session in February 1997, concluded that international action, including a global legally binding instrument, is required to reduce the risks to human health and the environment arising from the release of 12 POPs. These 12 POPs and their common uses are presented in the following table.

| Chemical Name | Common Use |
|---|---|
| Aldrin | **Pesticides** |
| Chlordane | |
| DDT | |
| Dieldrin | |
| Endrin | |
| Heptachlor | |
| Mirex | |
| Toxaphene | |
| | **Industrial Chemicals** |
| Hexachlorobenzene | Manufacture of fireworks, ammunition, and synthetic rubber, and as pesticide |
| | Polychlorinated biphenyls (PCBs) Heat exchange fluid in electrical transformers |
| | **Unintentional Byproducts** |
| Dioxins | Unintentional byproduct of certain industrial processes such as incineration of hospital waste, municipal waste, and hazardous waste, car emissions, and the incineration of coal, peat, and wood. No known use. |
| Furans | Unintentional byproduct of certain industrial processes such as incineration of hospital waste, municipal waste, and hazardous waste, car emissions, and the incineration of coal, peat, and wood. No known use. |

To address the risks posed by these 12 chemicals, representatives from approximately 100 nations have convened on two occasions to begin drafting a POPs Convention. This Convention will contain a schedule for reducing and eventually eliminating production, use, and/or releases of the 12 targeted POPs. There are expected to be a total of five International Negotiating Committee meetings before the Convention is completed in the Summer of 2000. Implementation of the Convention would follow soon thereafter if it is ratified by the required number of countries.

### Major Requirements

Because the Convention on POPs is still being negotiated, it is not possible to predict exactly what controls will be placed on the use and/or emissions of these chemicals. It is, however, likely that use of several of the chemicals will be banned outright, while others may be allowed for certain uses deemed to be essential by the Parties to the Convention. In addition, a mechanism is being built into the Convention to allow for the evaluation and possible addition of other POPs to the Convention at a later date. For those chemicals that are produced as inadvertent by-products of industrial processes, such as dioxins and furans, it is likely that the Convention may require some sort of measuring or monitoring of emissions, with possible corrective measures being prescribed/required if emissions exceed levels thought to be too high.

### Responsibilities of Non-Environmental Staff

- Become aware of the use or generation of any of the 12 POPs of concern in NASA processes.
- Avoid introducing the use of any of the 12 POPs of concern in any new or modified process, and
- To the maximum extent possible, limit the generation and emissions of dioxins and furans as byproducts from other processes.

### Sources of Help

Environmental Staff

United Nations Environment Program (UNEP) - Chemicals
http://irptc.unep.ch/pops/
Tel: 011-41-22-979-9193
Fax: 011-41-22-797-3460
E-mail: pops@unep.ch

U.S. Environmental Protection Agency Office of International Activities Home Page
http://www.epa.gov/oiamount/egei4.htm

World Wildlife Fund Home Page
http://www.worldwildlife.org/toxics/progareas/pop/index.htm


# 6 Preparing for Environmental Self-Assessments, Spot Checks, and Inspections

## Purpose

The purpose of environmental self-assessments, spot checks, and inspections is to ensure that all NASA facilities are in compliance with environmental regulations, and secondarily to ensure that all employees understand related requirements. In addition, they serve to demonstrate that NASA has an effective environmental management program.

## NASA Policy and Procedures

The policies and procedures that NASA follows for conducting environmental self-assessments, spot checks, and inspections are described below. Environmental self-assessments and spot checks are conducted internally, whereas inspections are conducted by the EPA, state, and local environmental agencies.

### *Internal Oversight*

Code JE conducts environmental self-assessments and spot checks at NASA facilities annually, and examines all significant media and compliance issues on a three-year cycle.

### *Environmental Self-Assessments*

Each January, NASA Headquarters Environmental Management Division (EMD) sends a letter to all Centers and Field Installations informing them which media will be covered in environmental self-assessments and spot checks during that year. The same media are reviewed every three years. For example, if water is covered in 1999, it will be covered again in 2002. Attached to the letter are a technical checklist and a management checklist, both of which must be completed as part of an environmental self-assessment. The Centers and Field Installations are given 2-4 months to complete and return the self-assessment. All Centers and Field Installations are required to complete and return the self-assessment every year, whereas spot checks are conducted periodically (approximately every three years) at selected Centers and Field Installations.

**Examples of Self-Assessment Environmental Media and Issues**

- Non-Hazardous Waste Management
- Hazardous Waste Management
- Superfund (remediation)
- Spill Control and Response
- Hazardous Materials Management
- Storage Tanks
- Water
- Air
- Environmental Management

### *Spot Checks*

*What happens during a spot check?*

During a spot check, non-environmental professionals (Center and Field Installation staff) are interviewed by Headquarters (EMD) spot check team consisting of EMD staff and their contractors. Contractors usually interview the technical staff at the Centers and Field Installations, whereas EMD staff interview the management staff. Spot checks typically take 4-5 days. On the final day of the spot check, the Center or Field Installation Environmental Manager is briefed on the findings.

Table 6-1 summarizes the differences between an environmental self-assessment and a spot check.

**Table 6-1: Environmental Self-Assessment versus a Spot Check**

| Environmental Self-Assessment | Spot Check |
|---|---|
| Completed by all Centers and Field Installations every year | Conducted at selected Centers and Field Installations |
| Entire management checklist completed by all Centers and Field Installations | Entire management checklist completed by Centers and Field Installations being spot checked |
| Entire technical review of the environmental protocol of that year's selected environmental media (NASA follows EPA's self-assessment protocol) completed by all Centers and Field Installations | Centers and Field Installations being spot checked complete a technical review of 15% of the environmental protocol |
| No site visit is required | Site visit is required |

*Why does NASA conduct spot checks?*

Spot checks are essential because NASA does not conduct audits. The Office of the Inspector General (OIG) or the General Accounting Office (GAO) can audit NASA facilities at any time. Being audited by OIG or GAO is a lengthy and detailed process. Spot checks can help avoid such audits, if they demonstrate effective environmental management and compliance with environmental regulations at NASA facilities.

*How does NASA decide which Centers and Field Installations to spot check?*

Throughout the year, EMD receives input from the Centers and Field Installations. Based on this input, EMD decides which Centers and Field Installations should be spot checked the following year. Three main criteria are used in determining whether to do a spot check:

- *Center and Field Installation Environmental Self-Assessment* - Responses are examined for completeness and accuracy.

- *Discussions with Center and Field Installation Environmental Managers* - Discussions are held throughout the year, and focus on the effectiveness of the Center's or Field Installation's environmental management program.
- *Date of Last Spot Check* - The last time the Center or Field Installation had a spot check is taken into account. EMD tries to avoid sequential visits.

*What happens before a spot check?*

EMD notifies the Centers and Field Installations at which a spot check will be conducted. Once the notification letter goes out, EMD representatives are in contact regularly with environmental staff at these Centers and Field Installations. The dates for the site visit and any prior meetings are decided during these communications.

*What happens after a spot check?*

After a spot check, EMD notifies Centers and Field Installations of all compliance issues (e.g., non-compliance with hazardous waste management requirements, failure to meet air quality or water quality standards) found during the spot check. These problems need to be rectified. (Note: If an error is found and corrected during a spot check, it is still reported as a compliance issue. It is, however, noted that the problem was corrected.)

If EMD recognizes a trend in compliance issues at Centers and Field Installations that were spot checked, it calls the Centers and Field Installations that were not spot checked and reviews their self-assessments to ensure that they do not have similar problems.

EMD prepares a draft report, which includes draft comments on the management checklist and the technical checklist. The report is sent to the Center or Field Installation for comments. Upon receiving comments from the Center or Field Installation, EMD finalizes the report. If any nonconformances are present in the final report, the Center or Field Installation is required to submit a plan of action to correct the problem within one month of receiving the final report. After receipt of the plan of action, the Center or Field Installation is given six months to correct the problem, or identify funding requirements of new facilities or equipment are needed to correct the problem.

**Questions for Non-Environmental Professionals During a Spot Check**

- Do you know the environmental aspects of your job?
- Do you know what regulations should be followed?
- Did you receive any environmental training?
- Does the Center/Facility offer environmental training courses? If so, how often are such training courses offered?
- Did you receive an environmental compliance checklist?

### *Role of Center and Field Installation Environmental Staff*

Center and Field Installation environmental staff should communicate continually with non-environmental staff. This ensures that the non-environmental staff are (1) aware of the laws and regulations; (2) know the procedures to be in compliance; and (3) are trained to be in compliance.

### *Role of Center and Field Installation Non-Environmental Staff*

Center and Field Installation non-environmental staff should provide information to and ask questions of environmental staff.

## External Oversight

Inspections are the mechanism for external oversight of NASA. EPA, state, and local environmental agencies have the legal authority to conduct inspections at NASA, and frequently conduct these inspections.

## Inspections

An inspection can be unannounced or a notice is sent by EPA, state, or local regulatory agencies in advance, to Centers and Field Installations that are going to be inspected. In general, the inspections tend to focus on a single medium. The most common inspections at Centers and Field Installations are air and RCRA inspections. Water inspections tend to be less frequent.

**Types of Inspections that Could Occur at Your Center or Field Installation**

- Multimedia Inspections
- RCRA Inspections
- Air Quality Inspections
- Water Quality Inspections

*What should you do prior to an inspection?*

- Recognize that EPA protocol is used for inspections, unless local requirements are more stringent than EPA requirements.
- Be cognizant of the types of inspections that you could have, either from EPA or from state and local agencies.
- If your Center or Field Installation has permits for hazardous waste, water, or air pollution, be aware of what your permit states and allows.
- A NASA environmental professional should accompany the inspector(s) to answer questions during the inspection.

### *Role of the Non-Environmental Professional During an Inspection*

- Be forthcoming with information.
- Be courteous at all times to the inspector(s).
- If the inspector(s) are not accompanied by a staff member from the Center Environmental Office during the inspection notify appropriate staff in your Center Environmental Office.

### *Role of the Environmental Professional During an Inspection*

- Serve as a guide.
- Arrange the itinerary.
- Answer questions.
- Provide information, as appropriate.

*What happens after an inspection?*

Following an inspection a debriefing is held. The Environmental Manager is given a checklist of problems that were found at the Center or Field Installation as well as informed of things that worked well.

For further information on environmental self-assessments, spot checks, and inspections contact your Center or Field Installation environmental office. (See Appendix A for contact information).

# 7 Environmental Compliance Resource Budgeting

This chapter provides an overview of the requirements to plan, budget, and fund environmental compliance activities. It also briefly describes the elements of life cycle cost analysis, and the general processes for developing a cost estimate for an environmental project.

For NASA to be in compliance with all pertinent environmental laws, regulations, policies, and Executive Orders, the Agency must plan, budget, and fund environmental activities and the necessary personnel to manage and implement them. Failure to adequately budget and fund compliance-based activities will mostly likely lead to NASA's non-compliance with environmental regulations. Depending on the nature of the non-compliance, NASA would be at risk for fines, possible temporary closure of a facility, and in extreme circumstances, criminal prosecution against those responsible, including the staff responsible for planning, budgeting, and funding environmental activities. To avoid putting the Agency at risk of these penalties, NASA policy requires line managers to plan, budget, and fund all environmental compliance activities.

Accordingly, NASA policy directive NPD 8800.16A states "Compliance with environmental regulations and NASA policy is the responsibility of every NASA employee. Each NASA organizational element has responsibility for incorporating this environmental policy into planning and budgeting; allocating and maintaining appropriate levels of authority and funding; assuring appropriate training; overseeing environmental process and material selection; minimizing hazardous waste; and stewardship for energy and water usage." Enterprises/Centers fund much of the compliance-based activities through the Center Environmental Offices. There are, however, compliance related activities that are specific to a program or project that should be planned and funded by the program's budget.

Resources for environmental activities should be requested through NASA's formal budget process. At some Centers, the majority of compliance resources will be requested and managed by the Center Environmental Office. Program managers should work with their Center Environmental Office to determine their compliance-based budget. For example, if a program plans to implement a new project in the coming year, the program manager should meet with the Center environmental staff to budget for environmental compliance needs.

**Eliminating the Compliance Burden**

The Shuttle Program eliminated some of its compliance burden by changing the way the solid rocket motors are processed. In the past, CONOCO grease was applied to the recovered solid rocket motor segments for protection during transport, thus requiring degreasing at the arrival point. Due to the size of the segments, a very large vapor degreaser using 1,1,1-trichloroethane (an ozone-depleting chemical) was used. Because of the phaseout of ozone-depleting chemicals, the Shuttle Program was faced with finding a new degreasing chemical to use in the vapor degreaser. Instead, the Program developed a covered carrier (with a nitrogen blanket) to protect the segments during transport, thereby eliminating the need to apply the grease in the first place, and consequently the need to degrease. Not only did the Program eliminate the need to find an alternative chemical; it eliminated the regulatory burden associated with vapor degreasers (myriad clean air regulations apply to vapor degreasers, depending on type of chemical used and the location).

As mentioned in previous chapters, NASA can significantly reduce the amount of resources that it spends on compliance by implementing pollution prevention. Pollution prevention can significantly reduce, or in some cases even eliminate, the compliance burden altogether as well as provide a cost avoidance or savings. Managers can determine if a project will lead to cost avoidance/savings by doing a life cycle cost analysis as described below. The life cycle cost approach also can be used to help determine which materials and products should be used in processes to avoid paying a penalty at the end of a project in the form of high waste disposal costs and/or the need to remediate. Some environmentally preferable products and materials have a higher initial cost than less environmentally friendly products, but may save money overall when the costs of compliance are considered.

## Life Cycle Approaches to Budgeting

Life cycle cost (LCC) analysis is used to evaluate alternative systems that compete on the basis of cost. Thus, only candidate systems that satisfy all performance requirements (e.g., code, safety, reliability) can be legitimately compared using this method. The system with the lowest LCC over the project study period is the most cost-effective choice. At most facilities, however, LCC analysis is applied to a project based not only on cost information, but technical and schedule considerations as well.

The LCC of a project alternative is the sum of its initial investment costs, I, present value of replacement costs, R, present value of energy costs, E, and the present value of operation, maintenance, and repair costs, OM&R, minus the present value of salvage, S.

$$LCC = I + R + E + OM\&R - S$$

These cost categories should capture the direct, indirect, recurring, nonrecurring, and other related costs for the design, development, production, operation, maintenance, support, and retirement of a program or project.

The following list shows the steps to follow in conducting an LCC analysis:

- ✓ Identify acceptable alternatives.
- ✓ Establish common assumptions (e.g., study period, discount rate, and base date).
- ✓ Estimate all project costs and their timing.
- ✓ Discount future costs to present value.
- ✓ Compute total LCC for each alternative.
- ✓ Identify alternative with lowest LCC.
- ✓ Consider uncertainty in input values.
- ✓ Compute supplementary measures of relative economic performance, if necessary.
- ✓ Select the best alternative.

To use the LCC method, you need to compute the LCC of a project alternative (sometimes called the base case) against which to compare the LCCs of your proposed design alternative(s). Usually the base case is the current situation or alternative with the lowest initial cost.

For each alternative you consider, you must use the same discount rate and the same study period (i.e., time over which you compare the alternatives). Only then can you determine which alternative is more cost-effective. To come up with a common study period, you will sometimes have to include replacement equipment in short-lived projects and account for salvage value in long-lived projects.

An implicit assumption in LCC analysis is that all the alternatives that you are considering for a particular project are capable of satisfying the minimum performance requirements for that project (e.g., safety, reliability, regulatory compliance). Consider the extent to which any alternative exceeds such minimum performance requirements as additional benefits attributable to that alternative. If the additional benefits can be quantified in dollar terms, treat these benefits as negative costs in the years in which the benefits are realized. If the additional benefits cannot be quantified in dollar terms, include a description of these benefits in narrative form with the LCC analysis. Then use your own judgment to determine the extent to which the LCC penalty (if any) for a particular alternative is offset by such benefits.

Long-lived investments are characterized by uncertainties regarding project life, operation and maintenance costs, and other factors that affect project economics. Because the true values of these variable factors are generally unknown, it is difficult to make economic evaluations with a high degree of certainty. One approach to this uncertainty problem is to use sensitivity analysis. Sensitivity analysis measures the impact on project outcomes of changing one or more key input values about which there is uncertainty. For example, a conservative value, expected value, and liberal value might be chosen for an uncertain variable. Then an analysis could be performed to see how the outcome changes as each of these values is considered. This analysis reveals how profitable or unprofitable the project might be if input values to the analysis turn out to be different from what is assumed in a single-answer approach to measuring project worth.

Sensitivity analysis also can be performed on different combinations of input values. That is, several variables are altered at once and then a measure of worth is computed. For example, one scenario might include a combination of all conservative values; another, all expected values; and a third, all liberal values. Sensitivity analysis can be performed for any measure of worth. The Office of Management and Budget (OMB) in Circular A-94 recommends sensitivity analysis to federal agencies as one technique for treating uncertainty in input variables.[1]

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[1] Office of Management and Budget, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," Circular A-94, revised, October 29, 1992.

There are several advantages to using sensitivity analysis in project economics. First, it shows how significant any given input variable is in determining a project's economic worth. It does this by displaying the range of possible project outcomes for a range of input values. This shows decision-makers the input values that would make the project successful or unsuccessful. Sensitivity analysis also helps you to identify critical inputs so that you can choose where to spend extra resources in data collection and in improving data estimates. Second, sensitivity analysis is an excellent technique for anticipating and preparing for the "what-if" questions that will be asked when presenting and defending a project. Generating answers to what-if questions can help you assess how well your decision will withstand scrutiny. Third, sensitivity analysis does not require the use of probabilities as do many techniques for treating uncertainty. Fourth, sensitivity analysis can be used on any measure of project worth. The major disadvantage of sensitivity analysis is that there is no explicit probabilistic measure of risk exposure.

# Glossary

**Ambient Air Quality Standards:** Standards established on a state or federal level that define the limits for airborne concentrations of designated "criteria" pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, total suspended particulate, ozone, and lead), to protect public health with an adequate margin of safety (primary standards) and to protect public welfare, including plant and animal life, visibility, and materials (secondary standards).

**Archaeology:** A scientific approach to the study of human ecology, cultural history, and cultural process.

**Attainment Areas:** A region that meets the U.S. EPA National Ambient Air Quality Standards (NAAQS) for a criteria pollutant under the Clean Air Act.

**Carbon Monoxide (CO):** a colorless, odorless, poisonous gas produced by incomplete carbon (e.g., from fossil fuel) combustion. One of the six pollutants for which there is a national ambient standard.

**Chlorofluorocarbons (CFCs):** A family of inert, non-toxic, easily liquefied chemicals used in refrigeration, air conditioning, packaging, and insulation, or as solvents or aerosol propellants.

**Compliance:** Operating within the conditions established by all environmental laws, including statutes, regulations, executive orders, and permits.

**Criteria Pollutant:** A pollutant determined to be hazardous to human health and regulated under EPA's National Ambient Air Quality Standards. The 1970 amendments to the Clean Air Act require EPA to describe the health and welfare impacts of a pollutant as the "criteria" for inclusion in the regulatory regime.

**Emission:** The release or discharge of any solid, liquid, or gaseous material to the ambient environment.

**Endangered Species:** A plant or animal that is in danger of extinction throughout all or a significant portion of its range.

**Environmental Audit:** An on-the-ground assessment of compliance status at a particular location.

**Environmental Media:** One or more of the following: air, soils, ground water, or surface water.

**Floodplain:** The relatively smooth valley floors adjacent to and formed by alluviating rivers, which are subject to overflow.

**Greenhouse Effect:** A thermodynamic effect whereby energy absorbed at the earth's surface and normally radiated back out to space in the form of long-wave infrared radiation, is retained due to gases in the atmosphere, causing a rise in global temperature.

**Greenhouse Gases:** Those gases that are transparent to solar radiation but opaque to longwave radiation. Their action is similar to that of glass in a greenhouse. The greenhouse gas effect, or global warming, results when the re-radiated energy is trapped by these gases in the atmosphere and warms the Earth's surface and atmosphere. Greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorinated carbons.

**Groundwater:** Water within the earth that supplies wells and springs.

**Habitat:** The physical environment in which a plant or animal lives.

**Hazardous Chemical:** Any chemical that poses a physical or health hazard. There is no specific list of these chemicals, so the term can cover many thousands of chemicals.

**Hazardous Material:** Any useful product that is potentially dangerous to human health and safety or the environment when improperly handled, stored, or transported.

**Hazardous Substance:** Any element, compound, mixture, or solution subject to cleanup liabilities under Superfund. This includes substances specifically listed under CERCLA section 102 as well as all RCRA hazardous wastes and hazardous chemicals listed under some other statues. It does not include petroleum.

**Hazardous Waste:** A solid waste which EPA or state agencies have determined to be ignitable, corrosive, reactive, or toxic.

**Impacts:** An assessment of the meaning of changes in all attributes being studied for a given resource, an aggregation of all of the adverse effects, usually measured using a qualitative and nominally subjective technique.

**Leach:** The separation or dissolving out of soluble constituents from a rock or ore body by percolation of water.

**Native Americans:** Used in a collective sense to refer to individuals, bands, or tribes who trace their ancestry to indigenous populations of North America prior to Euro-American contact.

**Nitrogen Dioxide ($NO_2$):** Gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperature. $NO_2$ emissions contribute to acid deposition and formation of atmospheric ozone. One of the six pollutants for which there is a national ambient standard.

**Nitrogen oxides ($NO_x$):** Compounds of nitrogen and oxygen produced by the burning of fossil fuels and other combustion processes.

**Noise:** Sound that is unwanted, either because of its effect on humans, its effect on fatigue or malfunction of physical equipment, or its interference with the perception or detection of other sounds. (Dictionary of Scientific and Technical Terms)

**Organic:** Relating to, or derived from, living organisms.

**Non-attainment Area:** An area that has been designated by the Environmental Protection Agency or the appropriate state air quality agency, as exceeding one or more national or state Ambient Air Quality Standards.

**Ozone ($O_3$):** A molecule made up of three atoms of oxygen. An unstable blue gas with pungent odor ; an allotropic form of oxygen; a powerful oxidant boiling at -112 °C; used as an oxidant, bleach, and water purifier, and to treat industrial wastes. Ozone also occurs naturally in the stratosphere and provides a protective layer shielding the Earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant and major component of photochemical smog.

**Ozone Depletion:** Accelerated chemical destruction of the stratospheric ozone layer. Chlorine and bromine free radicals liberated from relatively stable chlorinated, fluorinated, and brominated products by ultraviolet radiation in the ozone layer are the most depleting species.

**Ozone Layer:** A layer in the stratosphere, at an altitude of approximately 10-50 km, where a relatively high concentration of ozone filters harmful ultraviolet radiation from the earth.

**Particulate Matter:** Matter in the form of small liquid or solid particles.

**Permit:** A written entitlement granted by an authorized regulatory body allowing emissions or waste management activities under prescribed conditions.

**pH:** A term used to describe the hydrogen-ion activity of a system. A solution of 0 to 7 is acid, pH of 7 is neutral, and a pH from 7 to 14 is alkaline.

**POTW:** Publicly Owned Treatment Works.

**Potable Water:** Water suitable for human consumption by drinking.

**Release:** An unplanned, generally episodic, flow of material to the environment.

**Solid Waste:** Any solid, liquid, semi-solid, or contained gaseous material that is discarded or abandoned; in some cases, recycled and reclaimed materials are considered wastes under prevailing environmental law. (The full legal definition of solid waste is more substantial and complex and can be found at 40 CFR §261.2.)

**Solvent:** An aqueous or organic product designed to clean a component or assembly by dissolving and/or displacing the contaminants present on its surface.

**Sound:** An alteration of properties of an elastic medium, such as pressure, particle displacement, or density, that propagates through a medium, or a superposition of such alterations; sound waves having frequencies above the audible (sonic) range are termed ultrasonic waves; those with frequencies below the sonic ranges are called infrasonic waves. Also known as acoustic wave, sound wave.

**Spill/discharge:** A flow of material, generally either to water or land.

**Sulfur Dioxide ($SO_2$):** A toxic gas that is produced when fossil fuels, such as coal and oil, are burned. SO2 is the main pollutant involved in the formation of acid rain. SO2 also can irritate the upper respiratory tract and cause lung damage.

**Threatened Species:** Plant and wildlife species likely to become endangered in the foreseeable future.

**Transfer:** A movement of material from a site to another location, such as a shipment of hazardous waste to a recycling facility.

**Ultraviolet (UV) Radiation:** Light with a wavelength shorter than the wavelengths of visible light and longer than X-rays. Associated with the light from the sun.

**Violations:** An event or condition in which compliance has ceased.

**Volatile Organic Compounds (VOCs):** Organic compounds that easily volatilize or evaporate and can break down through photodestructive mechanisms.

**Wetlands:** Land or areas exhibiting the following characteristics: hydric soil conditions; saturated or inundated soil during some part of the year and plant species tolerant of such conditions; also, areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, under normal circumstances, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

# Appendix A
# NASA's Environmental Management Contact Information

**HEADQUARTERS**
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# Appendix B
# Overview of APPL Training Course

Introductory Environmental Management Program (IEMP) is a four-day program offered through NASA's Academy of Program and Project Leadership (APPL), and managed through the NASA Training and Development Division of the Office of Human Resources and Education. The program provides basic instruction to assist with the integration of environmental initiatives into NASA's primary mission by raising environmental awareness among program and project managers. The course is designed to equip participants with management methods to limit environmental risks to their programs. The APPL forum, made up of members from NASA's program management, program control, and environmental disciplines, oversees the course content. Curriculum changes are made by assessing needs of the target audience, professional development objectives, and alignment with NASA Strategic and Policy directions, and approved by the project management forum. IEMP has a permanent program manager who is responsible for monitoring course presenters, delivery and achievement of course objectives, scheduling courses, maintenance of curriculum, and working to improve courses on a continuous basis.

The goals and anticipated results from the implementation of this interactive training course are to:

- Educate NASA program and project managers on their environmental responsibilities and methods to limit environmental risks to their programs.
- Engage trainees in best practice scenarios and realistic, scenario-based exercises to ensure the transfer of training.
- Provide sufficient training with minimal disruption to the user's work pattern.
- Assist with the integration of environmental initiatives into NASA's core mission by raising environmental awareness among program and project managers.

# Appendix C
# Environmental Web Sites and Additional Information Resources

| Title | Web Address |
|---|---|
| U.S. Environmental Protection Agency (EPA) | www.epa.gov |
| EPA/Office of Water | www.epa.gov/OW |
| EPA/Office of Water/Office of Wastewater Management | www.epa.gov/owm |
| EPA/Office of Water/Office of Ground Water and Drinking Water | www.epa.gov/safewater/ |
| EPA/Office of Underground Storage Tanks | www.epa.gov/oust |
| EPA/Office of Pollution Prevention and Toxics | www.epa.gov/wastemin |
| EPA/Office of Solid Waste and Emergency Response | www.epa.gov/swerrims |
| EPA/Office of International Activities Home Page | www.epa.gov/oiamount/egei4.htm |
| EPA Ozone Depletion Web Site | www.epa.gov/docs/ozone/ |
| EPA/Technology Transfer Network | www.epa.gov/ttn/ |
| Army Corps of Engineers | www.usace.army.mil |
| Department of Defense/pollution prevention and waste minimization resources | www.afcee.brooks.af.mil/AFCEEfrm.htm |
| Department of Energy | www.doe.gov |
| Department of Transportation | www.dot.gov |
| Nuclear Regulatory Commission | www.nrc.gov |
| Occupational Safety and Health Administration | www.osha.gov |
| World Wildlife Fund Home Page | www.worldwildlife.org/toxics/progareas/pop/index.htm |
| United Nations Environment Program (UNEP)-Chemicals | http://irptc.unep.ch/pops/ |
| United Nations Framework Convention on Climate Change (UNFCCC) | www.unfccc.de. |
| United Nations Environment Program Ozone Secretariat | www.unep.org/unep/secretar/ozone/home.htm |

## Helpful Phone Numbers

| | |
|---|---|
| Council on Environmental Quality; NEPA | (202) 395-5750 |
| EPA Ozone Protection Hotline | (800) 296-1996 |
| Hazardous Materials Information Line | (800) 467-4922 |
| Lead Information Clearinghouse | (800) 424-5323 |
| National Pesticides Telecommunications Network<br>Federal Insecticide, Fungicide, and Rodenticide Act | (800) 490-9198 |
| National Response Center | (800) 424-8802 |
| RCRA, Superfund & EPRCA Hotline | (800) 424-9346 |
| Safe Drinking Water Act Hotline | (800) 426-4791 |
| Toxic Substances Control Act Hotline | (202) 554-1404 |
| UNEP- Chemicals | Tel: 011-41-22-979-9193<br>Fax: 011-41-22-797-3460 |

## Relevant Publications

**NASA Directives**

- NPG 8800.17 Energy Metrics for NASA Facilities
- NPG 8850.1 Environmental Investigation and Remediation - Potentially Responsible Party Identification and Analysis
- NPG 8820.1 Pollution Prevention
- NPG 8830.3 Affirmative Procurement Plan for Environmentally Preferable Products
- NPG 8840 NASA Procedures and Guidelines for Implementation of the National Environmental Policy Act and Executive Order 12114 (DRAFT)
- NPG 8860 NASA Procedures and Guidelines for Energy and Water Management Technologies and Practices (DRAFT)
- NHB 8800.11 Implementing the Provisions of the National Environmental Policy Act
- NPD 8800.16A NASA Environmental Policy
- NPG 7120.4A Program/Project Management
- NPC 1158.1 NASA Environmental Management Board

**Radon**

- The Indoor Radon Abatement Act
- Interim Protocols for Screening and Follow-up Radon and Radon Decay Product Measurement (EPA)
- Removal of Radon from Household Water (EPA) (OPA 87-011)

**Underground Storage Tanks**

- Must for USTs: A Summary of Federal Regulations for UST Systems; EPA 510-K-95-002; OUST web
- Regional/State UST/LUST Program Contacts; EPA 510-F-96-003; OUST web
- Underground Storage Tanks: Requirements and Options; EPA 510-F-97-005; OUST web
- UST Program Facts: Implementing Federal Requirements for USTs; EPA 510-B-96-007; OUST web

# Appendix D
# Applicable Executive Orders

Environmental Executive Orders affecting NASA include but are not limited to the following:

1. Executive Order 11514 (Amended by Executive Order 11991): Protection and Enhancement of Environmental Quality.
2. Executive Order 11593: Protection and Enhancement of the Cultural Environment.
3. Executive Order 11988: Floodplain Management.
4. Executive Order 11990: Protection of Wetlands.
5. Executive Order 12088 (Amended by Executive Order 12580): Federal Compliance With Pollution Control Measures.
6. Executive Order 12114: Environmental Effects Abroad of Major Federal Actions.
7. Executive Order 12372: Intergovernmental Review of Federal Programs.
8. Executive Order 12843: Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances.
9. Executive Order 12856: Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements.
10. Executive Order 12898: Federal Actions Address Environmental Justice in Minority Populations and Low-Income Populations.
11. Executive Order 13006: Locating Federal Facilities on Historic Properties in Our Nation's Central Cities.
12. Executive Order 13007: Indian Sacred Sites.
13. Executive Order 13031: Federal Alternative Fueled Vehicle Leadership.
14. Executive Order 13061: Federal Support of Community Efforts Along American Heritage Rivers.
15. Executive Order 13089: Coral Reef Protection.
16. Executive Order 13101: Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition.
17. Executive Order 13123: Greening the Government Through Efficient Energy Management

# Appendix E
# Index of Federal Environmental Regulations

Environmental regulations affecting NASA include, but are not limited to:

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|---|---|
| **TITLE 10** | **ENERGY** |
| 10 PART 436 | FEDERAL ENERGY MANAGEMENT AND PLANNING PROGRAMS |
| **TITLE 14** | **AERONAUTICS AND SPACE** |
| 14 CFR 1216 | ENVIRONMENTAL QUALITY |
| **TITLE 29** | **LABOR** |
| 29 CFR 1910 | OCCUPATIONAL SAFETY AND HEALTH STANDARDS |
| 29 CFR 1925 | SAFETY AND HEALTH STANDARDS FOR FEDERAL SERVICE CONTRACTS |
| **TITLE 40** | **PROTECTION OF ENVIRONMENT** |
| CHAPTER I | ENVIRONMENTAL PROTECTION AGENCY |
| SUBCHAPTER A | GENERAL |
| SUBCHAPTER B | GRANTS AND OTHER FEDERAL ASSISTANCE |
| SUBCHAPTER C | AIR PROGRAMS |
| 40 CFR 50 | NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS |
| 40 CFR 60 | STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES |
| 40 CFR 61 | NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS |
| 40 CFR 63 | NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR SOURCE |
| 40 CFR 81 | DESIGNATION OF AREAS FOR AIR QUALITY PLANNING PURPOSES |
| 40 CFR 82 | PROTECTION OF STRATOSPHERIC OZONE |
| 40 CFR 87 | CONTROL OF AIR POLLUTION FROM AIRCRAFT AND AIRCRAFT ENGINES |
| SUBCHAPTER D | WATER PROGRAMS |
| 40 CFR 116 | DESIGNATION OF HAZARDOUS SUBSTANCES |
| 40 CFR 117 | DETERMINATION OF REPORTABLE QUANTITIES FOR HAZARDOUS SUBSTANCES |
| 40 CFR 122 | EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| 40 CFR 125 | CRITERIA AND STANDARDS FOR THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM |
| 40 CFR 129 | TOXIC POLLUTANT EFFLUENT STANDARDS |
| 40 CFR 141 | NATIONAL PRIMARY DRINKING WATER REGULATIONS |
| SUBCHAPTER E | PESTICIDE PROGRAMS |
| 40 CFR 152 | PESTICIDE REGISTRATION AND CLASSIFICATION PROCEDURES |
| SUBCHAPTER F | RADIATION PROTECTION PROGRAMS |
| 40 CFR 190 | ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR NUCLEAR POWER OPERATIONS |

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| 40 CFR 191 | ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL, HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTES |
| 40 CFR 192 | HEALTH AND ENVIRONMENTAL PROTECTION STANDARDS FOR URANIUM AND THORIUM MILL TAILINGS |
| 40 CFR 194 | CRITERIA FOR THE CERTIFICATION AND RE-CERTIFICATION OF THE WASTE ISOLATION PILOT PLANT'S COMPLIANCE WITH THE 40 CFR PART 191 DISPOSAL REGULATIONS |
| 40 CFR 195 | RADON PROFICIENCY PROGRAMS |
| SUBCHAPTER G | NOISE ABATEMENT PROGRAMS |
| SUBCHAPTER H | OCEAN DUMPING |
| SUBCHAPTER I | SOLID WASTES |
| 40 CFR 256 | GUIDELINES FOR DEVELOPMENT AND IMPLEMENTATION OF STATE SOLID WASTE MANAGEMENT PLANS |
| 40 CFR 260 | HAZARDOUS WASTE MANAGEMENT SYSTEM: GENERAL |
| 40 CFR 261 | IDENTIFICATION AND LISTING OF HAZARDOUS WASTE |
| 40 CFR 262 | STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE |
| 40 CFR 263 | STANDARDS APPLICABLE TO TRANSPORTERS OF HAZARDOUS WASTE |
| 40 CFR 264 | STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES |
| 40 CFR 266 | STANDARDS FOR THE MANAGEMENT OF SPECIFIC HAZARDOUS WASTES AND SPECIFIC TYPES OF HAZARDOUS WASTE MANAGEMENT FACILITIES |
| 40 CFR 270 | EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM |
| 40 CFR 280 | TECHNICAL STANDARDS AND CORRECTIVE ACTION REQUIREMENTS FOR OWNERS AND OPERATORS OF UNDERGROUND STORAGE TANKS (UST) |
| 40 CFR 281 | APPROVAL OF STATE UNDERGROUND STORAGE TANK PROGRAMS |
| SUBCHAPTER J | SUPERFUND, EMERGENCY PLANNING, AND COMMUNITY RIGHT-TO-KNOW PROGRAMS |
| 40 CFR 310 | REIMBURSEMENT TO LOCAL GOVERNMENTS FOR EMERGENCY RESPONSE TO HAZARDOUS SUBSTANCE RELEASES |
| 40 CFR 355 | EMERGENCY PLANNING AND NOTIFICATION |
| 40 CFR 370 | HAZARDOUS CHEMICAL REPORTING: COMMUNITY RIGHT-TO- KNOW |
| 40 CFR 372 | TOXIC CHEMICAL RELEASE REPORTING; COMMUNITY RIGHT-TO-KNOW |
| SUBCHAPTER N | EFFLUENT GUIDELINES AND STANDARDS |
| SUBCHAPTER O | SEWAGE SLUDGE |
| SUBCHAPTER P | [RESERVED] |
| SUBCHAPTER Q | ENERGY POLICY |
| SUBCHAPTER R | TOXIC SUBSTANCES CONTROL ACT |
| 40 CFR 700 | GENERAL |
| 40 CFR 745 | LEAD-BASED PAINT POISIONING PREVENTION IN CERTAIN RESIDENTIAL STRUCTURES |
| 40 CFR 760 | POLYCHLORINATED BIPHENYLS |
| CHAPTER V | COUNCIL ON ENVIRONMENTAL QUALITY |
| 40 CFR 1500 | PURPOSE, POLICY, AND MANDATE |
| 40 CFR 1501 | NEPA AND AGENCY PLANNING |

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| 40 CFR 1502 | ENVIRONMENTAL IMPACT STATEMENT |
| 40 CFR 1505 | NEPA AND AGENCY DECISIONMAKING |
| 40 CFR 1507 | AGENCY COMPLIANCE |
| | |
| **TITLE 49** | **TRANSPORTATION** |
| 49 CFR 107 | HAZARDOUS MATERIALS PROGRAM PROCEDURES |
| 49 CFR 110 | HAZARDOUS MATERIALS PUBLIC SECTOR TRAINING AND PLANNING GRANTS |
| 49 CFR 172 | HAZARDOUS MATERIALS TABLE, SPECIAL PROVISIONS, HAZARDOUS MATERIAL COMMUNICATIONS, EMERGENCY RESPONSE INFORMATION, AND TRAINING REQUIREMENTS |
| 49 CFR 173 | SHIPPERS — GENERAL REQUIREMENTS FOR SHIPMENTS AND PACKAGINGS |
| 49 CFR 178 | SPECIFICATIONS FOR PACKAGINGS |
| 49 CFR 179 | SPECIFICATIONS FOR TANK CARS |
| 49 CFR 397 | TRANSPORTATION OF HAZARDOUS MATERIALS; DRIVING AND PARKING RULES |
| | |
| **TITLE 50** | **WILDLIFE AND FISHERIES** |
| 50 PART 81 | CONSERVATION OF ENDANGERED AND THREATENED SPECIES OF FISH, WILDLIFE, AND PLANTS. COOPERATION WITH THE STATES. |
| 50 PART 217 | GENERAL PROVISIONS |
| 50 PART 222 | ENDANGERED FISH OR WILDLIFE |
| 50 PART 225 | FEDERAL/STATE COOPERATION IN THE CONSERVATION OF ENDANGERED AND THREATENED SPECIES |

# Appendix F
# Example Pollution Prevention Opportunity Assessment Checklist

❑ **Water Use/Reuse**

A. flow control valves?
B. identifying water inflow and outflow from each unit process?
C. evaluating reuse of clean or contaminated water?
D. using timers or foot pedals to control water usage?
E. using conductivity cells in plating rinse system?
F. reactive rinsing?

❑ **Material Handling**

A. segregating raw and waste material containers?
B. segregating different waste materials in separate containers?
C. purchasing materials in bulk or larger containers?
D. controlling inventory to reduce waste(e.g., "just-in-time" ordering system)?
E. labeling all containers properly?
F. labeling process tanks?
G. centralized purchasing system?
H. reagent chemicals ordered in exact amounts?
I. is less hazardous raw material available?
J. using rinsable/recyclable drums?

❑ **Raw Material & Product Storage**

A. SPCC plans in place?
B. overflow alarms?
C. loading and unloading procedures?
D. secondary containment?
E. document all spillage?
F. floating roofs for VOC storage?
G. vapor recovery systems?
H. containers stacked properly?
I. proper distance between incompatible chemicals?
J. proper distance to prevent cross-contamination?
K. drums and containers emptied thoroughly before cleaning or disposal?

❑ **Plating/Etching/Metal Finishing**

A. using low temperature baths to reduce evaporation?
B. prolonging plating solution bath life through filtration, reducing drag-out, avoiding contamination, etc?
C. using lower concentration plating bath?
D. redesigning part racks to reduce drag-out before the rinse, possibly with air blow off?
E. using trivalent chromium instead of hexavalent chromium?
F. using noncyanide plating solution such as chloride or sulfate solutions?
G. using in-line recovery techniques?
H. regenerating spent bath solutions?
I. segregating all waste streams?
J. using spray or fog nozzle rinse to reduce drag-out?
K. reusing rinse water?
L. recovering chrome and plating solutions by an evaporation unit?

❑ **Water**

A. using multiple rinse tanks?
B. using countercurrent rinsing?
C. installing drainboards and tanks?
D. installing racks above plating tanks to reduce drag-out?
E. using fog nozzles and spray units?
F. agitating rinse bath (air or solution agitation)?
G. recycling and reusing spent rinse water through such metal recovery techniques as ion exchange, reverse osmosis, and electro-chemical recovery?
H. segregating all waste streams?
I. using an evaporator for material recovery from rinse tanks and reuse in plating bath?

❑ **Alkaline/Acid Cleaners**

A. removing sludge more frequently?
B. avoiding cross-contamination of solvent?
C. reusing cleaners by filtering and rejuvenating?

❑ **Application**

A. using equipment with high transfer efficiency such as electrostatic applicators?
B. using high-solids coatings such as powder coatings?

❑ **Solvent Cleaners**

A. avoiding cross-contamination of solvent?
B. avoiding water contamination of solvent?
C. removing sludge continuously?
D. using a tank cover or air knife to reduce surface evaporation?
E. monitoring solvent composition?
F. consolidating cold cleaning operations?
G. recycling spent solvent?
H. using cryogenic or plastic media blasting for paint stripping instead of solvent stripping?
I. using nonchlorinated solvents instead of chlorinated solvents?
J. installing on-site distillation units?
K. evaluating work removal rate?
L. segregating all waste streams?
M. using cheesecloth over filters to reduce spent filter generation?
N. recycling over spray, for instance, from powder coatings?
O. evaluating the use of different types of paint arrestors such as water wash and filters?
P. arranging formal training for spray operators?
Q. optimizing spray conditions in terms of speed, distance, angle, pressure, etc.?
R. using booth coatings for easy booth cleaning?
S. inspecting all parts, such as racks, for cleanliness?
T. using a charged screen with electrostatic system to reduce edge buildup and to capture and reuse over spray paint?