ENVIRONMENTAL RESOURCES DOCUMENT

for the

NASA LEWIS RESEARCH CENTER

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LIST OF ACRONYMS

ACTS Advanced Communications Technology Satellite
CAA Clean Air Act
CAAA Clean Air Act Amendments
CEQ Council on Environmental Quality
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFC Chlorofluorocarbon
CFR Code of Federal Regulations
CSU Cleveland State University
CWA Clean Water Act
dB Decibel
dB(A) Decibel, A-scale
EIS Environmental Impact Statement
EMO Environmental Management Office, Lewis Research Center
EPCB Environmental Pollution Control Board, Lewis Research Center
EPCRA Emergency Planning and Community Right-to-Know Act
ERD Environmental Resources Document
FIFRA Federal Insecticide, Fungicide, and Rodenticide Act
FS Feasibility Study
FY Fiscal Year
HAP Hazardous Air Pollutant
HCFC Hydrochlorofluorocarbon
HTF Hypersonic Tunnel Facility
IWS Industrial Waste Sewer
LeRC Lewis Research Center
LIFT Lewis Incubator For Technology
MCF A measure equaling 1,000 cubic feet

NAAQS National Ambient Air Quality Standards
NACA National Advisory Committee for Aeronautics
NASA National Aeronautics and Space Administration
NEORSD Northeast Ohio Regional Sewer District
NEPA National Environmental Policy Act
NESHAPS National Emissions Standards for Hazardous Air Pollutants
NHPA National Historic Preservation Act
NOx Nitrogen Oxides
NPDES National Pollutant Discharge Elimination System
NRC Nuclear Regulatory Commission
OAC Ohio Administrative Code
OAI Ohio Aerospace Institute
ODC Ozone-Depleting Chemical
ODNR Ohio Department of Natural Resources
Ohio EPA Ohio Environmental Protection Agency
OSEMA Office of Safety, Environment, and Mission Assurance, Lewis Research Center
OSHA Occupational Safety and Health Administration or Act
PBMO Plum Brook Management Office
PBRF Plum Brook Reactor Facility
PBS Plum Brook Station
PCBs Polychlorinated Byphenyls
POTW Publicly Owned Treatment Works
PPM Parts Per Million
PTI Permit To Install
PTO Permit To Operate
R&D Research and Development
RCRA Resource Conservation and Recovery Act
RETF Rocket Engine Test Facility
RI Remedial Investigation
SAIC Science Applications International Corporation
SHPO State Historic Preservation Officer
SPF Space Power Facility
TRI Toxics Release Inventory
USC United States Code
USEPA United States Environmental Protection Agency
USGS United States Geological Survey
UST Underground Storage Tank

CONVERSION FACTORS

Distance

1 centimeter (cm) = 0.3937 inches 1 inch = 2.540 cm

1 meter (m) = 3.281 feet 1 foot = 0.3048 m

1 kilometer (km) = 0.6214 miles (mi.) 1 mi = 1.609 km

1 kilometer = 0.5396 nautical miles (NM) 1 NM = 1.853 km

Area

1 square cm = 0.1550 square inches 1 in^2 = 6.452 cm^2

1 square m = 10.76 square feet 1 ft^2 = 0.09290 m^2

1 square km = 0.3861 square miles 1 mi^2 = 2.590 km^2

1 hectare (ha) = 2.471 acres 1 acre = 0.4047 ha

Volume

1 cubic cm = 0.06102 cubic inches 1 in^3 = 16.39 cm^3

1 cubic m = 35.31 cubic feet 1 ft^3 = 0.02832 m^3

1 liter (l) = 1.057 quarts 1 quart = 0.9464 l

1 liter = 0.2642 gallons 1 gallon = 3.785 l

Weight

1 gram (g) = 0.03527 ounces 1 oz = 28.35 g

1 kilogram (kg) = 2.205 pounds (lbs) 1 lb = 0.4536 kg

1 metric ton (mt) = 1.102 short tons 1 short ton= 0.9072 mt

Thrust, Energy, Pressure

1 pound = 4.448 Newtons (N) 1 N = 0.2248 lb

1 joule (j) = 9.480E-4 British Thermal Units (BTU) 1 BTU = 1055 j

1 kg/m^2 = 0.2048 $pounds/ft^2$ 1 lb/ft^2 = 4.882 kg/m^2

Temperature

° C = (5/9) (° F-32) ° F = 1.8 ° C + 32.

Source: Derived primarily from the Merck Index, Eleventh Edition, Merck & Co., Inc. 1989.

The Lewis Research Center of the National Aeronautics and Space Administration has prepared this Environmental Resources Document which presents information on the Center's facilities and operations for use in assessing the potential environmental effects of Center actions on the environment.

Purpose

The National Environmental Policy Act (NEPA) of 1969, Public Law 91-190, requires Federal agencies to develop

environmental documentation for all major Federal actions. Regulations that Federal agencies must follow when implementing NEPA are prepared by the Council on Environmental Quality (CEQ) and published at 40 Code of Federal Regulations (CFR) Parts 1500-1508.

In accordance with the CEQ regulations, the National Aeronautics and Space Administration (NASA) has developed agency-specific NEPA guidance. These policies and procedures are published at 14 CFR Part 1216. The procedures mandate the preparation of certain reports, as follows:

> Each Field Installation Director shall ensure that there exists an environmental resources document which describes the current environment at that field installation, including current information on the effects of NASA operations on the local environment. This document shall include information on the same environmental effects as included in an environmental impact statement. [14 CFR 1216.319]

The Environmental Resources Document (ERD) is not required by NEPA or the CEQ regulations, but is specific to NASA. Additional guidance on NASA NEPA policy can be found in NASA Management Instruction 8800.7D, *Procedures for Implementing the Provisions of the National Environmental Policy Act*, and NASA Handbook 8800.11, *Implementing the Provisions of the National Environmental Policy Act.*

The ERD serves as a succinct baseline description of all environmental aspects of the operations of the installation and, in effect, forms a baseline environment description against which the effects of subsequent proposed actions may be judged to determine significance. Previous NASA procedures provided for a class of NEPA Environmental Impact Statements (EIS's) called "Institutional Environmental Impact Statements" defining the continuing operation of each NASA field installation as a major Federal action significantly affecting the environment. Institutional EIS's are no longer required.

The last EIS prepared by the Lewis Research Center was in fact an Institutional EIS (LeRC 1978). That document concluded that Center operations had negligible effects on the environment and that there were no appropriate alternatives to the operation of the NASA facilities at their present locations. It might also be noted that a 1996 report concluded that "No recent action at the Center [either Lewis or PBS] has produced sufficient likelihood of significant environmental impacts to require an EIS....[and] the two facilities can be judged to produce no cumulative substantial environmental impacts beyond their boundaries" (Jones 1996).

This document has been prepared by the Lewis Research Center to fulfill the requirement to have an ERD which is reviewed and updated at "appropriate intervals." The first Lewis Research Center ERD was prepared in 1980 (Polytech 1980). That document was updated in 1990 (Warner/Osborne/Pardee 1990). This document revises the ERD with updated information on environmental requirements and Lewis Research Center operations.

This Document was prepared for the NASA Lewis Research Center by the Science Applications International Corporation (SAIC). The work was performed under the direction of the Environmental Management Office as part of Task 19100 to Contract NAS3-26518.

Lewis Research Center Overview

The Lewis Research Center (LeRC) is one of ten major NASA field installations in the United States. LeRC was established over 50 years ago to support the Nation's technical and scientific enterprise, particularly in the areas of aeronautics and propulsion research. Topics explored at LeRC over the years have included:

Aeronautics and air-breathing engines

Spacecraft power and propulsion

Microgravity, fluids, and combustion research

Expendable launch vehicles

Satellite communications

Space station technology

Nuclear and solar energy conversion systems

Terrestrial energy technology

Technology transfer.

In the mid-1990's, NASA began a process of reassessment to examine the Agency's goals for the future and find ways of achieving greater effectiveness and efficiency. This process began with a Zero Base Review and culminated in a strategic plan which streamlines management and delegates greater program control to the field centers. The *Lewis Strategic Plan* (LeRC, July 1996) defines the Center's mission as follows:

> The mission of the Lewis Research Center is to work as a team to develop and transfer critical technologies to aerospace and non-aerospace industries, universities, and government institutions. To fulfill this mission, the Center is committed to maximizing the return on the taxpayers' investment, to improving management and business practices, and to striving for diversity and value in the work force.

This mission will encompass the following technical roles:

Lead Center for Aeropropulsion. This involves the development of technically and environmentally advanced civil and military aircraft; associated materials, controls, and technologies; and the development of new engine technologies for the NASA General Aviation Propulsion Program.

Lead Center for Commercial Communications and Commercial Technology. LeRC operates the Advanced Communications Technology Satellite (ACTS).

Lead Center for Workgroup Hardware and Software, as well as for Spectrum Management and advanced computing research.

Center of Excellence for Turbomachinery. This includes primary and auxiliary propulsion and power systems and rotating machinery for the pumping of fuels.

Lead role for Fluid Physics and Combustion Microgravity Research.

Continued support for space power and onboard propulsion.

Potential roles in advanced propulsion and onboard technologies for the Advanced Space Transpor-tation system (the next generation Space Shuttle), the power and propulsion technology plan for a return to the Moon and a voyage to Mars, and integrating space and aeronautics technologies into mainstream NASA programs.

Among the changes effected by the realignment of missions is the transfer of the Expendable Launch Vehicle program to another NASA location. Some aspects of this program will be transitioned to the private sector (NASA LeRC procurement synopsis dated November 11, 1996). On-site aircraft may also be relocated or excessed.

The Lewis Research Center includes two major physical facilities. The primary facility is generally referred to as the "Lewis Research Center" and is located in the greater Cleveland, Ohio area. A satellite facility or component installation is located 80 kilometers (50 miles) to the west near Sandusky, Ohio and is known as the Plum Brook Station (PBS) (Figure A-1). To distinguish the two sites, the following naming convention will be used in this document:

"LeRC" will indicate both the Cleveland and Sandusky facilities

"Lewis" will indicate the Cleveland facility only

"PBS" will indicate the Sandusky facility only.

Lewis Research Center Environmental Organization

The Environmental Pollution Control Board (EPCB) serves as LeRC's executive environmental policy-making board. It is responsible for overseeing environmental policy and implementation issues. The EPCB assures that all aspects of environmental quality are properly addressed and is responsible to the Center Director.

LeRC environmental policy is contained in the *Lewis Environmental Programs Manual* (LeRC, May 1994) which describes the policies, responsibilities, procedures, and standards for implementation of the environmental program. The Manual is organized into chapters according to major program areas. Chapter 1 of the Manual presents overall environmental policy and responsibilities as specified in Lewis Management Instruction 8800.4E, *Lewis Environmental Quality Program.* LeRC NEPA procedures are contained in Chapter 2, *National Environmental Policy Act.*

The Environmental Management Office (EMO) (formerly known as the Office of Environmental Programs) manages environmental programs and environmental compliance at NASA LeRC. The office is located in Building 6 at the Lewis facility. The EMO is a component office within the Office of Safety, Environmental, and Mission Assurance (OSEMA) (Figure A-2). The head of OSEMA reports to the Center Director's office.

The mission of the EMO is to "support NASA Lewis Research Center in the pursuit of its charter by ensuring that the Center provides a safe and healthful work place for its employees and operates in a manner that is protective of the community and the environment." The EMO is responsible for the recognition, measurement, and control of hazardous conditions in the work environment which can cause illness, disease, impaired well being, significant discomfort and inefficiency, or environmental harm. The EMO also serves as consultant to LeRC staff on matters of environmental quality, industrial hygiene, and health physics, as well as verify Center compliance with regulations regarding air, water, and waste management.

In 1995, the EMO was reorganized into functional Teams to more effectively carry out its responsibilities. These Teams are:

Chemical Management Team

Chemical Sampling and Analysis Team

Environmental Compliance Team

Health Physics Team

Industrial Hygiene Team

Noise Exposure Management Team

Project Management Team

Research Team

Waste Management Team.

Due to its separate location, PBS has its own environmental coordinator. This person reports administratively to the chief of the Plum Brook Management Office, and receives technical direction and support from the Lewis EMO. The Plum

Brook environmental coordinator handles day to day issues and routine contacts with regulatory agencies. For State regulatory purposes, the Cleveland site is under the jurisdiction of the Ohio EPA Northeast District Office in Twinsburg, Ohio. The Plum Brook site is under the jurisdiction of the Northwest District Office in Bowling Green, Ohio.

Figure -1 Lewis Research Center Locations

Environmental Resources Document Organization

This document is organized into four major parts. Part A contains an Introduction to the ERD and information common to both the Cleveland and Sandusky sites. Part B contains information specific to the Lewis Cleveland site. Part C contains information specific to the Plum Brook Station site near Sandusky. Part D contains document References.

To facilitate understanding, Parts B and C have a parallel chapter organization. For example, "Description of the Installation" is Chapter 1 for Lewis in Part B and Chapter 1 for PBS in Part C. "Air Resources" is Chapter 2 for Lewis in Part B and Chapter 2 for PBS in Part C, "Water Resources" is Chapter 3 in Part B and Part C, and so forth.

Most chapters have a typical structure as follows:

> Regulatory Background. This reviews applicable statutes, regulations, Executive Orders, and other guidance, with emphasis upon rules most relevant to LeRC. In most cases, the same requirements apply to both Lewis and PBS, so Part C refers back to Part B.
>
> Environmental Setting. This reviews the physical setting and ambient conditions with respect to the subject of the chapter (e.g., air, water, biotic resources).
>
> LeRC Operations. This reviews the ways in which LeRC operations potentially affect the medium of interest, and reviews regulatory compliance.

This structure is used as appropriate, and is modified as needed to best fit each individual chapter.

Environmental Resources Document Availability

This ERD is available without restriction to the scientific and professional community and the general public. Paper copies of the Document are maintained at the Environmental Management Office and the Library (Building 60) of the NASA Lewis Research Center. In addition, NASA plans to post this ERD on the World Wide Web, where it can be accessed from the NASA LeRC home page at http:\\www.lerc.nasa.gov. Other environmental documentation can be accessed from this location including several of the references cited herein.

Figure -2 Lewis Research Center Organization Chart

(Fold-out)

PART B CLEVELAND SITE

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DESCRIPTION OF THE INSTALLATION

The Lewis Research Center in Cleveland was established in 1941 as the Aircraft Engine Research Laboratory of the National Advisory Committee for Aeronautics (NACA). In 1958, NACA was reorganized into NASA and the laboratory became part of the new organization. On-site technical and support facilities have expanded continuously throughout the years and the campus-like setting now includes a diverse array of laboratories, office buildings, research and test stations, and support facilities.

Size and Location

At its Cleveland site, NASA owns or leases 147.62 hectares (364.49 acres) (LeRC, November 1995). The site is located in western Cuyahoga County, Ohio and is predominantly within the city limits of Cleveland, approximately twenty miles

southwest of downtown. A small part of the site to the north is located in the City of Fairview Park, and a parcel of land to the west is in the City of Brook Park. The site borders the Cleveland Hopkins International Airport to the east. To the north and west is the Rocky River Reservation, a part of the Cleveland Metropolitan Park District (Metroparks). The southern boundary of the site is adjacent to residential and business districts of the City of Brook Park, including the Tech Park office development (Figure B-1).

The site lies between latitudes 41°24' and 41°25'30"N, and longitudes 81°51' and 81°53"W. The location can be found on the United States Geological Survey (USGS) 7.5 minute-series topographic map for the Lakewood Quadrangle (41081-D7-TF-024).

Site Facilities

The Lewis site is organized administratively into four geographic areas. The North Area is the land north of Brookpark Road. This contains two administrative buildings and a parking lot. The Central Area is the largest portion and contains the greatest concentration of buildings and many of the major test facilities. The Central Area contains specialized facilities which supply altitude exhaust, compressed air, and cooling water. These systems are essential to a number of test operations and therefore combustion-related experiments are normally clustered here. The Central Area is bordered by Brookpark Road to the north, the Airport to the east, and Cedar Point Road to the south.

The South Area contains the Rocket Engine Test Facility, the Central Chemical Storage Facility, bulk storage areas, and other facilities requiring a buffer zone. The South Area is the portion of the site south of Cedar Point Road. The West Area is separated from the Central Area by Abram Creek and includes the Management Conference Building, recreational areas, the day care center, and other facilities.

The 1995 *Real Property Report* (LeRC, November 1995) lists 176 buildings, structures, and other entities at Lewis including many specialized Research and Development (R&D) facilities (Table B-1). There are 29 buildings over 2,787 square meters (30,000 square feet) in size. The capital cost of all Lewis facilities is given as $371 million, with a replacement cost of $1.391 billion. The total facility gross square footage (measured from outside wall to outside wall) is 231,788 square meters (2,495,024 square feet). The *Facilities Utilization Report* (LeRC, December 1995) gives the "allocated net usable area" as approximately 141,000 square meters (1.5 million square feet). The largest percentages of this space are used for offices (26.4%), laboratories (18.5%), and technical facilities (18.2%).

Lewis boasts many unique test facilities for conducting wind tunnel, aeronautics, propulsion, space power, and advanced research. More detailed information on the technical capabilities of these facilities can be found in *Aeropropulsion Facilities at the NASA Lewis Research Center* (LeRC, January 1995) and *Lewis Research Center R & D Facilities* (LeRC 1991). Highlights among these facilities include the following (building numbers are given for general reference only; a test complex may include several buildings):

Figure -1 Map of Lewis Site

(Fold-Out)

Table -1 Buildings and Structures at Lewis

Table B-1 Buildings and Structures at Lewis (cont'd)

Table B-1 Buildings and Structures at Lewis (cont'd)

Source: LeRC, November 1995

10' X 10' Supersonic Wind Tunnel (Building 85)

8' X 6' / 9' X 15' Supersonic/Transonic Wind Tunnel (Building 39) (NASA's only transonic propulsion wind tunnel)

Icing Research Tunnel (Building 11) (world's largest refrigerated icing wind tunnel)

Propulsion Systems Laboratory (Building 125)

Engine Research Building (Building 5)

Engine Components Research Laboratory (Building 102)

Electric Propulsion Research Building (Building 16)

Aeroacoustic Propulsion Laboratory (Building 90-1)

Rocket Laboratory (Building 35)

Microgravity Research Laboratory (Building 110)

Drop Tower (Building 45)

Electric Power Laboratory (Building 301)

Energy Conversion Laboratory (Building 302)

Space Power Research Laboratory (Building 309)

Research Analysis (Computer) Center (Building 142)

Central Air Equipment Building (Building 64)

Flight Research Building (Hangar) (Building 4).

Lewis houses aircraft which are used for microgravity, aeronautics, and icing research. These include a LearJet 25, DC-9 Microgravity Testing Aircraft, an OV-10D, 2 T-34 aircraft, and a DeHavilland Twin Otter-6. The planes are housed in the Flight Research Building from which they can taxi directly to runways at the adjacent Cleveland Hopkins International Airport. NASA LeRC is also a major supporter of the Ohio Aerospace Institute (OAI). OAI was founded in 1989 as a not-for-profit consortium of Federal laboratories in Ohio (LeRC and Wright-Patterson Air Force Base), nine Ohio universities, and high-technology aerospace companies. OAI's mission is to facilitate collaboration among the university, industry, and government sectors to enhance local and national economic competitiveness. The Institute's 6,500 square meter (70,000 square foot) building opened in 1992 and is located on 3.8 hectares (9.5 acres) of land leased from LeRC outside the security fence southwest of the main site.

Facilities and structures at Lewis are constantly changing. Recent changes include the removal of Building 415, the Barrel and Cylinder Storage Site, in the early 1990's. Building 212, the Central Chemical Storage Facility, was constructed in the South Area to take its place. The Aeroacoustic Propulsion Laboratory and an associated Control Building were constructed during the 1990's. The Rocket Engine Test Facility (Building 202) is no longer used and was placed in "inactive-mothballed" status in government Fiscal Year (FY) 1996. The Cryogenic Components Laboratory (Building 203) is scheduled to be mothballed during FY 1997. Building 49, the former Materials and Structures Laboratory, is being refurbished into a new Composite Technology Center for the study of advanced polymer, metallic, and ceramic materials. The Composite Technology Center is scheduled to open in 1997.

Site Access

Site access is controlled by gate houses at specific entrance points. There are two entrances, the Main Gate and the West Gate. A small guard station is located at the Main Gate. In 1996, Lewis closed the South Gate and consolidated it with the West Gate. This was done to enhance employee and public safety by improving traffic flow, improve security control of the West and South areas, and restrict public access to no-through-way streets in buffer areas. Public travel on Cedar Point Road now essentially ends at the West Gate.

Badges must be displayed by personnel on site at all times. Short-term visitors sign in and receive a temporary badge. The Visitor Center (Building 8) is the only building intended for general public admittance.

AIR RESOURCES

Regulatory Background

The major Federal statute regulating air emissions is the Clean Air Act (CAA) of 1970, Public Law 91-604. The Act provides for controls on stationary and mobile sources of air pollution to protect and enhance the Nation's air resources and promote the public health and welfare. In 1990, the Clean Air Act Amendments (CAAA, Public Law 101-549) were passed which strengthened the law considerably. The new Amendments impose stricter controls on sources in non-attainment areas and regulate many smaller air emissions sources for the first time. Among the provisions of the CAA are:

National Ambient Air Quality Standards

New Source Review/Prevention of Significant Deterioration

Hazardous Air Pollutants

Operating Permits

Stratospheric Ozone Protection

State Implementation Plans.

National Ambient Air Quality Standards (NAAQS) are issued for the so-called "criteria" pollutants (40 CFR Part 50). Primary standards are designed to protect the public health, and secondary standards to protect the public welfare. Standards have been established for sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, ozone, and lead (Table B-2). Areas meeting the NAAQS are called "attainment areas" and areas not in compliance are called "non-attainment areas." The standards apply to ambient conditions, not individual emissions sources. An area can be attainment for some criteria pollutants and non-attainment for others. Pollution controls on emissions sources in non-attainment areas can be made more stringent in order to bring the area into compliance.

Table -2 National Ambient Air Quality Standards

Parameter (units)	Determined As	Primary Standard	Secondary Standard
SO_2 (μ g/m^3)	Annual arithmetic mean	80[a]	- -
	24 Hour average	365[b]	- -
	3 Hour average	- -	1300
Particulate matter (PM-10) (μ g/m^3)	Annual arithmetic mean	50[a]	50
	24 Hour average	150[b]	150
Carbon monoxide (ppm)	8 Hour average	9[b]	- -
	1 Hour average	35[b]	- -
Ozone (ppm)	1 Hour average	0.12[b]	0.12[b]
Nitrogen oxides (ppm)	Annual arithmetic mean	0.053[a]	0.053[a]
Lead (μ g/m^3)	90 Day arithmetic mean	1.5[a]	1.5[a]

a. Cannot be exceeded.
b. Cannot be exceeded more than once per year.
Source: 40 CFR Part 50.

The New Source Review program requires owners and operators to conduct analyses evaluating potential impacts prior to the construction of a major new source or the major modification of an existing source. The determination of major is based on the maximum potential of the source to emit air pollutants. The Prevention of Significant Deterioration program protects air quality in attainment areas which already meets the NAAQS. Starting in 1994, the General Conformity Rule required Federal facilities to conform to state rules regarding emissions of criteria pollutants for which an area is non-attainment (58 FR 63214).

Title III of the CAAA authorized the establishment of regulations on emissions of 189 listed hazardous air pollutants (HAP's) (the list is subject to change). These rules are in addition to the older National Emission Standards for Hazardous Air Pollutants regulations for asbestos, inorganic arsenic, benzene, beryllium, mercury, radionuclides, radon, vinyl chloride, and fugitive emissions. Many facilities must also prepare Risk Management Plans for extremely hazardous air pollutants which are present in more than threshold quantities. These plans must be completed by June 1999.

Title V of the CAAA established a new operating permit program. Previously, facilities applied for and obtained Permits to Install (PTI's) and Permits to Operate (PTO's) for individual stationary sources. The new Title V permits incorporate the PTI's, PTO's, and applicable requirements into a single operating permit for an entire facility. Title V permits are required for major sources, defined as a facility with the potential to emit annually 100 tons or more of a criteria pollutant, 10 tons or more of a single HAP, 25 tons or more of any combination of HAP's, or otherwise subject to a Federally-enforceable emissions limitation.

Title VI of the CAAA addresses stratospheric ozone. These regulations call for the elimination of Ozone Depleting Chemicals (ODC's), including chlorofluorocarbons (CFC's), hydrochlorofluorocarbons (HCFC's), halons, carbon tetrachloride, methyl chloroform (1,1,1-trichloroethane or NA-500), methyl bromide, and hydrobromofluorocarbons (40 CFR Part 82). CFC's and HCFC's are inert, non-toxic chemicals which were widely used as the heat transfer fluid in refrigeration and cooling equipment, for degreasing, and other applications. Different targeted chemicals are on different phase-out schedules. Several CFC's were phased out as of the end of 1995. Phase out of most HCFC's will take place from 2010 to 2030. Executive Order 12843 (1993), Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances, directed Federal agencies to comply with CAA requirements regarding stratospheric ozone protection and use safe alternatives to the extent possible. These actions support United States participation in the international Montreal Protocol on Substances that Deplete the Ozone Layer.

States which develop air pollution control programs which meet or exceed Federal standards may be delegated the authority to administer CAA programs by the United States Environmental Protection Agency (USEPA). State programs are detailed in a State Implementation Plan which must provide the means for bringing non-attainment areas into compliance and protecting areas which are already in compliance. The Ohio EPA was delegated full authority to administer the Title V permitting program in Ohio in August of 1995. The Ohio EPA has contracted with the City of Cleveland, Bureau of Air Pollution Control of the Department of Public Health, to administer the program in Cuyahoga County. In 1993, Ohio EPA initiated an Emission Fee program. Facilities subject to Title V must pay annual fees based on estimated actual emissions of particulate matter, sulfur dioxide, organic compounds, nitrogen oxides, and lead.

OAC rules on air emissions include the following:

OAC 3745-17, Particulate Standards

OAC 3745-18, Sulfur Dioxide Standards

OAC 3745-19, Open Burning Rules

OAC 3745-21, Carbon Monoxide, Ozone, and Hydrocarbon Standards

OAC 3745-23, Nitrogen Oxide Standards

OAC 3745-25, Emergency Episode Standards

OAC 3745-78, Fee Emission Reporting.

Asbestos is also addressed by the CAA. Asbestos issues are discussed in Chapter 9 of the ERD (Parts B and C).

Environmental Setting

Climate

The climate at the Lewis site is continental in character, but strongly influenced by Lake Erie which is 8 kilometers (5 miles) to the north. Lake Erie tends to moderate temperature extremes and increase overall precipitation. Summers are warm and humid, with average temperatures of 21° C (70° F) (ODNR 1996), occasionally exceeding 32° C but rarely 38° C (90° and 100° F, respectively). The first frost typically occurs in October. Winters are relatively cold and cloudy, with an average temperature of -2° C (29° F) and 5 sub-zero (Fahrenheit) days per year.

Precipitation varies substantially from year to year. Between 1961 and 1990, precipitation averaged 89 centimeters (35 inches) per year. Some 60 percent of this precipitation falls between April and September (ODNR 1996). Thunderstorms can occur from April through August. Snowfall averages 114 centimeters (45 inches) in the vicinity of Lewis (Warner/Osborn/Pardee 1990), but can be double that amount in the "snow belt" areas at the eastern end of the County. Winter storms can be severe and make driving treacherous. Average annual free water surface evaporation for the region is 82.65 centimeters (32.54 inches) (ODNR 1972).

Prevailing winds are from the south to southwest (National Oceanic and Atmospheric Administration 1990). A wind rose is presented in Figure B-2. Westerly winds blowing across the lake can produce a lake effect near the shore. The cooling winds can delay spring in these areas. Winds are more westerly during the winter months. Some storms originating over the Lake can be violent and result in downed trees and damaged power lines. Tornadoes are rare in the Cleveland area. Atlantic coast hurricanes generally dissipate in strength before their effects are felt in northern Ohio. The National Weather Service maintains Weather Station Number 14820 at the adjoining Cleveland Hopkins International Airport. More detailed climatological data for Lewis can be obtained from the most recent *Local Climatological Data Report* for this station, available from the National Climatological Data Center in Asheville, North Carolina.

Local Air Quality

The City of Cleveland operates 21 ambient monitoring stations around Cuyahoga County which measure carbon monoxide, nitrogen oxide, nitrogen dioxide, sulfur dioxide, particulate matter (PM-10), total suspended particulates, ozone, and toxic air pollutants. Cuyahoga County is designated as attainment for carbon monoxide and nitrogen oxides. Lewis itself is in an attainment area for sulfur dioxide, but there are pockets of non-attainment elsewhere in the County. The County is officially unclassifiable for lead, which is administratively equivalent to attainment. Only recently, ozone levels had exceeded standards during the summer months, particularly during temperature inversions. Air quality has improved and the County was upgraded from non-attainment to attainment for ozone in 1996 (61 FR 20458). The County is non-attainment for particulate matter.

Lewis Operations

Stationary Sources

Lewis is assigned Ohio EPA air program facility identification number 1318001169. Stationary on-site emission sources include boilers, heaters, research test cells, paint booths, storage tanks, degreasers, and maintenance equipment. The incinerator reported in the previous ERD is no longer present. In addition, many solvent and vapor degreasers have been eliminated or now use alternative cleaning fluids.

The Lewis facility is classified as a major source under Title V of the CAAA. Accordingly, Lewis prepared a Title V permit application using the Ohio EPA-mandated Starship computer software. This was submitted to the regulatory authorities on September 24, 1996. As of this writing, the permit application was undergoing regulatory review. Title V permits are good for a period not to exceed five years.

Source: SAIC, June 1991a

Figure -2 Wind Rose for Lewis Site

The permit application includes a database with the most complete inventory of air pollution sources on site. Title V distinguishes between the most important potential air emission sources (called "non-insignificant") and less important smaller sources. The classification of emissions units at Lewis is detailed in the *Reference Document for Title V Air Permit* (SAIC 1996). Lewis's permit application listed 33 non-insignificant emission sources including 6 boilers, 7 heaters, and 20 research test cells. Emissions from these sources result from the combustion of fuels including natural gas, fuel oil, and jet fuel. Two of these sources have control devices, one a flare and one a thermal incinerator.

The estimated potential-to-emit from all non-insignificant sources at Lewis is presented in Table B-3. The potential-to-emit is the maximum theoretical limit (usually based on around-the-clock operation) and is normally much higher than estimated actual emissions. Estimated actual annual air emissions, based on the Emission Fee Report for 1996, are given below. Other pollutants were either not reported or were negligible.

Particulates: 0.81 metric tons (0.89 tons)

Sulfur Dioxide: 5.28 metric tons (5.82 tons)

Nitrogen Oxides: 36.71 metric tons (40.47 tons)

Organic Carbon: 0.77 metric tons (0.85 tons).

For almost all on-site facilities, operation is theoretically unlimited, that is, they may operate 8760 hours per year. To avoid certain regulatory thresholds, however, Lewis' Title V permit application proposed voluntary limits on the annual operating hours of five emissions units (Table B-4). Because these emissions units operate only intermittently, none of the limits was felt to impose any practical limitation on research activities.

Table -3 Emissions Units With Voluntary Limits on Operations

Emissions Unit	Ohio EPA ID	Maximum Hours Per Year
10 X 10 Air Heater	Z103	120
ASCR Preheater	Z312	2080
ASCR Combustor	Z313	1560
10 X 10 Engine Testing	Z322	1560
AAPL Engine Testing	P018 (was Z326)	832

The Title V permit application also contains the applicable requirements for the facility. All of these requirements apply at the emissions unit level; there were no facility-level or group-level applicable requirements. All of the applicable requirements applied to either particulate matter or sulfur dioxide emissions. For each applicable requirement, information was provided on the reporting, monitoring, and recordkeeping which Lewis proposed in order to verify compliance. No stack testing or other quantitative sampling was proposed.

Prior to completion of the Title V permit application, Lewis prepared several PTI/PTO applications and submitted them to the regulatory authorities. With these submittals in 1996, Lewis was current with all known permits/permit applications required for air emissions sources on site.

The CAAA contain requirements regarding vapor recovery equipment at fuel dispensing operations in ozone non-attainment areas. The requirements apply to facilities which dispense more than 37,850 liters (10,000 gallons) per month. Lewis dispenses less than this amount. Even so, the motor vehicle gasoline pump and tank are equipped with Stage II and Stage I vapor recovery systems, respectively (Foster Wheeler, Draft, 1996a).

Table -4 Maximum Potential Air Emissions from Lewis Facilities

(Non-Insignificant Emissions Units Only)

An environmental audit conducted in 1996 found Lewis to be in substantial compliance with air regulations (Foster Wheeler, Draft, 1996a). The *Environmental Justice Implementation Plan* (Jones 1996) concluded there was "...no reasonable likelihood of substantial off-site air quality impacts from normal operations and only moderate likelihood of substantial off-site air quality impacts from emergency operations or reasonably foreseeable accidents."

Mobile and Off-Site Sources

On-site vehicles are classified as mobile sources and are also a source of emissions. Lewis vehicles include construction and other heavy vehicles, fleet vehicles owned or operated by LeRC, and two on-site loop buses. As of 1995, Lewis owned approximately 200 vehicles (mostly cars and light trucks, with some heavy vehicles), leased 26 vehicles for the motor pool, and maintained approximately 70 contractor vehicles on site (SAIC 1995).

Other air emissions are not generated by LeRC directly but are attributable to its operations. Two such off-site sources are electrical generation and the use of personal vehicles for commuting. Estimated annual emissions associated with the consumption of electricity by Lewis are 9868 metric tons (10,877 tons) of ash, 233,701 metric tons (257,607 tons) of carbon dioxide, 2977 metric tons (3282 tons) of sulfur dioxide, and 1002 metric tons (1104 tons) of nitrogen oxides (SAIC 1995).

Most commuting is by private automobile, usually with a single occupant per vehicle. Estimated annual releases associated with commuting by on-site employees are 54.2 metric tons (58.5 tons) of hydrocarbons; 403 metric tons (435 tons) of carbon monoxide; 6518 metric tons (7030 tons) of CO_2; 28.1 metric tons (30.3 tons) of nitrogen oxides; and the consumption of 2,714,000 liters (717,000 gallons) of gasoline (SAIC 1995).

Ozone-Depleting Chemicals

NASA and LeRC have established ODC management policies and plan to eliminate the use of these chemicals in all but critical applications. A CFC Committee was established in 1990. LeRC CFC policy was issued in 1992 and is contained in Chapter 26 of the *Lewis Environmental Programs Manual.* There is a separate refrigerant policy which was issued in 1994. All CFC's are controlled substances at LeRC and require special approval before they may be purchased. Larger equipment containing CFC's is monitored and tracked. New refrigeration equipment must be CFC-free.

Means used to control consumption and releases of CFC's at LeRC include:

Replacing CFC equipment with non-CFC equipment

Converting CFC equipment to non-CFC alternatives

Maintaining existing equipment and repairing any leaks detected

Cleaning and reusing CFC's directly back in equipment

Ensuring only certified technicians work on CFC equipment

Prohibiting acquisition of most new CFC equipment

Restricting purchases and use of CFC supplies.

Lewis has developed specific reduction goals for three chlorofluorocarbon chemicals in compliance with Executive Order 12856 (1993), *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements.* Dichlorodifluoromethane (CFC-12), chlorodifluoromethane (HCFC-22), and dichlorotetrafluoro-ethane (CFC-114) have all been used on site in refrigeration and air conditioning equipment. Releases of these chemicals will be reduced by a minimum of fifty percent by the year 2000, relative to the NASA base year of 1994.

Other ozone-depleting chemicals are found at Lewis in lesser quantities. Trichlorofluoromethane (CFC-11) is found in a few larger cooling systems and its use is gradually being eliminated. The compound 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113 or Freon 113) is used in significant quantities NASA-wide, however Lewis' consumption is only approximately 1588 kilograms (3500 pounds) per year. There are also limited uses of HCFC-123, R-500 (a mixture of HCFC-22 and HFC-152a), R-502 (a mixture of HCFC-22 and CFC-115), and carbon tetrachloride. Halons, another class of ozone-depleters, are in limited use at Lewis for fire suppression purposes. Methyl chloroform (1,1,1-trichloroethane) was once widely used for cleaning and degreasing, but has been virtually eliminated from Center operations.

WATER RESOURCES

Regulatory Background

The primary Federal statute for the protection of water resources is the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500. This law and subsequent amendments are often collectively referred to as the Clean Water Act (CWA) and regulate discharges to the surface waters of the United States to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The laws seek the achievement of water quality which "provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water." Responsibility for administering the CWA is delegated primarily to the USEPA.

Control of "direct" point source dischargers is exercised through the National Pollutant Discharge Elimination System (NPDES) permit program (40 CFR Part 122). NPDES permits specify concentration limits for various pollutants and associated sampling, monitoring, and reporting requirements. Pollutants can be the "conventional" ones such as biochemical oxygen demand, total suspended solids, pH, fecal coliform, nutrients, and oil and grease, or the over 100 "priority" toxic pollutants. National, technology-based effluent limitations have been developed for direct discharges from approximately three dozen industrial categories. Regulations have also been developed for the control of stormwater discharges associated with industrial and construction activities.

"Indirect" point source discharges are those that go to a Publicly Owned Treatment Works (POTW). Indirect discharges do not require an NPDES permit, however, they must conform to applicable pretreatment technologies and standards. The POTW may specify additional standards to protect the quality of treated water or sewage sludges or safety and treatment processes within the plant.

Ohio has its own Water Pollution Control Act (ORC 6111) which is modeled after the CWA. The Ohio EPA has been delegated state authority to administer the NPDES program. Ohio has established water quality standards for its rivers and lakes, which may be more stringent than Federal standards. Ohio is unique among the states in its use of biological criteria to assess the attainment of water quality goals. These criteria establish performance standards for biological communities and indices by which fish, macroinvertibrates, and habitat are evaluated.

The Safe Drinking Water Act of 1974, Public Law 93-523, was enacted to ensure the safety of public water supply systems in the United States. The Act authorized the establishment of national drinking water quality standards (40 CFR Parts 141-149). "Primary" standards are issued as Maximum Contaminant Level Goals and are based on human health considerations. Regulations have been established for turbidity, coliform bacteria, asbestos, radioactivity, inorganic chemicals, organic chemicals, and other parameters. Action levels have been established for lead and copper. "Secondary" standards are intended to protect the public welfare, considering such matters as aesthetics and disagreeable tastes and odors. The Act also provides for controls on activities which may contaminate groundwater. The Underground Injection Control Program regulates the injection of liquids into storage and disposal wells.

The Wild and Scenic Rivers Act of 1968, Public Law 90-542, protects the beauty and natural qualities of designated rivers. The Act would have to be considered if construction would impact any designated wilderness area or protected river. Guidance on Wild and Scenic Rivers can be found in CEQ Memoranda at 45 FR 59189.

Wetlands (the subject of Section 404 of the CWA) are addressed in Chapter 7 of the ERD (Parts B and C). Spill prevention and control are discussed in Chapter 8.

Environmental Setting

Surface Water Hydrology

The primary surface water features at the Lewis site are the Rocky River and its tributary, Abram Creek (see Figure B-1). The Rocky River flows along the western edge of the Cleveland site, separating it from the Rocky River Reservation of the Cleveland Metropolitan Park District. The Ohio EPA lists the drainage area of the Rocky River at 761 square kilometers (294 square miles). The Rocky River is a third-order stream with an average daily discharge rate of 7.8 cubic meters (276 cubic feet) per second, as measured at a USGS gaging station 2.6 kilometers (1.6 miles) upstream from Lewis. The 7-day, 10-year low flow is estimated by the USGS to be 0.04 cubic meters (1.4 cubic feet) per second. Wastewater discharges and removals within the basin are significant and result in an effective 7-day, 10-year low flow of 0.87 cubic meters (30.6 cubic feet) per second. After passing Lewis, the river flows north approximately 18 kilometers (11 miles) and discharges into Lake Erie. There is no commercial fishing in the Rocky River or its tributaries although there is recreational fishing.

Abram Creek begins in a low-lying area south of Cleveland Hopkins International Airport and flows through a heavily industrialized area, crossing the Lewis property. It travels approximately 6 kilometers (4 miles) to its confluence with the Rocky River. Detailed hydrologic data for Abram Creek are not available. Near Lewis, both Abram Creek and Rocky River are in narrow, steep valleys, 15 to 30 meters (50 to 100 feet) below the elevation of the main Lewis site. No subsistence populations using the Rocky River or Abram Creek have been identified (Jones 1996).

Lake Erie, 8 kilometers (5 miles) to the north, is one of the five Great Lakes. Lake Erie has a surface area of approximately 25,700 square kilometers (9919 square miles) and an estimated volume of 471 cubic kilometers (113 cubic miles) (SAIC 1991a). The Lake is an important fresh water fishery, with a combined commercial and sport catch estimated to exceed 20 million fish. Lake Erie is also a popular recreational resource for boating and its many beaches.

Most surface water runoff from Lewis flows through the storm sewer system and natural swales to Abram Creek and Rocky River. Although most precipitation is believed to flow overland, several low-volume seeps have been observed on the Abram Creek Valley walls after periods of heavy rainfall (SAIC, July 1993b).

Surface Water Quality

The Ohio EPA monitors water quality in the Rocky River at several locations. The closest station upstream of Lewis is at Cedar Point Road (Station 501800) and downstream at Rockcliff Road in Lakewood (Station 501790). Both the Rocky River and Abram Creek are classified as Warmwater Habitats by the Ohio EPA and portions of Rocky River are designated as "Seasonal Salmonid." Other use designations for portions of Abram Creek and Rocky River include Primary Contact Recreation (swimming) and Agricultural and Industrial Water Supply. The Ohio Department of Natural Resources (ODNR) Division of Wildlife stocks the Rocky River with juvenile steelhead salmon each spring. Because the river flows through the Cleveland Metroparks, it is designated as a State Resource Water in the vicinity of Lewis. The designation affords special protection under the State's antidegradation policy.

Water quality in Rocky River and Abram Creek has improved in the last two decades. Many POTW's have been upgraded. Some have been eliminated in favor of centralized treatment by the North East Ohio Regional Sewer District (NEORSD). Several industries discharging to Abram Creek and Rocky River upstream of Lewis have also improved the quality of their discharges. The Ohio EPA Division of Surface Water conducted an intensive survey of Rocky River and its tributaries in 1992 (Ohio EPA 1993). Although the survey identified few exceedances of acute or chronic water quality criteria, only 3% of the surveyed sections of the river main stem were in full attainment of the warmwater habitat aquatic life use designation. The remaining sections failed one or more of the three biological index criteria. In past years, sporadic exceedences of iron, zinc, and total phosphorous limits have been observed.

A qualitative biotic survey was conducted in 1994 (ACRT 1994). The survey examined water quality, fish, macroinvertebrates, vertebrates, and plants, at Abram Creek and Rocky River in the vicinity of Lewis. Both streams displayed signs of environmental degradation, as indicated by the number of taxa, the types of organisms, and the density of organisms found. Conditions worsened on moving upstream. Abram Creek was in worse condition than Rocky River, and the unnamed tributary to Abram Creek more impacted still.

A more quantitative survey of Rocky River and Abram Creek was commissioned in 1995 by the Cleveland Hopkins International Airport (Malcolm Pirnie 1996). This confirmed earlier studies which concluded that neither stream met the warmwater habitat criteria. The study indicated that chemical pollutants in the water and sediments were not significant contributors to the degraded condition of the biological communities. Rather, stream flow patterns indicative of highly urbanized storm flow drainage may be important factors in explaining the degradation of stream biota. High peak flows and rapid changes in flow lead to unstable stream beds, resulting in periodic disturbance of the habitat.

Groundwater

Groundwater is little used in the vicinity of the Lewis site. Consequently, less information is available for groundwater than surface water. Groundwater is said to occur in two distinct lithologic zones, in the shale bedrock and in perched lenses in the overlying unconsolidated materials. Of 77 borings advanced during the Remedial Investigation (RI), only 11 had wet or saturated zones in the overlying soil. These zones were approximately 15 to 76 centimeters (0.5 to 2.5 feet) thick. The zones are thought to be isolated and not to contain significant amounts of groundwater.

The water table generally mimics the surface topography, so groundwater in the unconsolidated zone is expected to discharge to Abram Creek and Rocky River. The groundwater zone within the bedrock is under artesian pressure due to the low hydraulic conductivity of the overlying soils. Even so, the recharge rate is very slow and the shale bedrock has very low permeability (R&R International 1995). Indications are that the bedrock aquifer can be expected to yield no better than approximately 3.8 liters (1 gallon) per minute.

Only seven permitted drinking water wells are within 6 kilometers (4 miles) of Lewis, according to City and County records (SAIC, June 1991a). An earlier 1969 survey found 220 individuals in the Rocky River Basin who used groundwater for drinking water.

Lewis Operations

Wastewater Discharges

Wastewater generated by Lewis includes sanitary, stormwater, non-contact and contact cooling, cooling tower blowdown, and miscellaneous process discharges. There are three distinct wastewater collection systems at Lewis: the sanitary system, the stormwater system, and the Industrial Waste Sewer system. There was once a package sewage treatment plant at Building 415, but it was taken out of service in the 1960's.

Sanitary Sewer System: The sanitary sewer system receives wastes from lavatories, food preparation areas, and some process discharges. A 12-inch gravity sewer line enters the NASA property from the southeast carrying wastes from the nearby I-X (Exposition) Center and portions of the Airport. Near the NASA main gate, the line reaches a pump station and continues as a forced main (Warner/Osborn/Pardee 1990). Advanced tertiary treat-ment is provided by the Southerly Wastewater Treatment Plant of the NEORSD. Sanitary wastewater discharges were 22,422 MCF (1 MCF = 1,000 cubic feet = 28,319 liters = 7,481 gallons) in FY 1994. These discharges must meet effluent limitations specified in the NEORSD general sewer use ordinance. Compliance is confirmed through occasional sampling by NEORSD. The only water quality parameter monitored by Lewis on a regular basis is pH, and data from the past five years indicate that the facility is generally in compliance with pH limits.

Lewis has limited plating, printing, and machining operations. These waste streams have largely been eliminated through process substitution or recycling, or they are being containerized for off-site disposal. The only routine wastewater discharged to the sanitary sewer system that requires pretreatement is photo-processing wastes from Building 5. This wastewater is processed through specialized filters prior to discharge.

LeRC obtains temporary permits from NEORSD for short-term discharges as needed. These are for such things as temporary discharges from construction activities or underground storage tank removal projects. Water quality parameters and monitoring requirements for these permits vary based upon the nature of the discharge.

Storm Sewer System: Stormwater is discharged separately from sanitary wastewater. Stormwater discharges are regulated under the Lewis NPDES permit from Ohio EPA, Number OH 3IO00001*DD. The current permit expires January 31, 1999 and covers 13 discharge points. Discharge monitoring reports are submitted monthly. A separate stormwater permit is expected to be issued in 1997 which will authorize discharges from approximately 50 other stormwater outfalls to Abram Creek and Rocky River. Many of the larger outfalls receive stormwater from the Airport, which complicates monitoring and control of these discharges. A summary of Lewis NPDES permit requirements is shown in Table B-5.

An environmental audit found that the "discharges from the 13 monitored locations are in compliance with the current NPDES permit discharge monitoring requirements with some minor exceptions" (Foster Wheeler, Draft, 1996a). Some exceedances of pH were noted. All violations were reported to have been resolved satisfactorily and no enforcement actions were taken by Ohio EPA.

Facilities which discharge stormwater associated with industrial activity must develop management plans to identify and eliminate sources of stormwater contamination. Lewis has prepared a Stormwater Pollution Prevention Plan (Bionetics 1995). The implementation of the first phase of the Plan was completed in November 1996. As part of this effort, a map was prepared indicating drainage areas and areas of potential concern regarding stormwater.

Based on historical data, NPDES-permitted discharges from Lewis appear to have minimal impact on the water quality of the Rocky River. This was confirmed by a study which found no significant differences in the biological communities upstream and downstream from the Airport (Malcolm Pirnie 1996). Lewis' stormwater

Table -5 Summary of Lewis NPDES Permit Requirements

Outfall	Parameter (units)	Discharge Limitation-- 30-Day Average	Discharge Limitation-- Daily Maximum	Monitoring Frequency
001	Oil and grease (mg/l)	10	15	1/week
	Flow, benzene, ethylbenzene, toluene, xylene, total mercury	Monitor only	Monitor only	1/month; flow biweekly
003, 004, 006, 007, 008, 009	Flow, conductivity	Monitor only	Monitor only	1/week
010	Total suspended solids (mg/l)	50	- -	1/month
	Flow, conductivity, oil and grease	Monitor only	Monitor only	1/month; flow biweekly
059, 060	Temperature, flow	Monitor only	Monitor only	1/month
601, 602, 603	Total suspended solids (mg/l)	10	30	1/week
	Oil and grease (mg/l)	- -	10	1/week
	Total iron (μ g/l)	- -	1000	1/week
	Total zinc (μ g/l)	320	320	1/week

	Flow	Monitor only	Monitor only	1/week
All monitored outfalls	pH (Standard Units)	Not less than 6.5 and not greater than 9.0	Not less than 6.5 and not greater than 9.0	Varies

discharges are bracketed by and often mingled with those from the Airport. Despite this finding, urban runoff and potential flooding problems may have impacted water quality such that additional management practices may become necessary in the future (Warner/Osborn/Pardee 1990). The *Environmental Justice Implementation Plan* (Jones 1996) concluded there was "...no reasonable likelihood of substantial off-site water quality impacts from normal operations and only moderate likelihood of substantial off-site water quality impacts from emergency operations or reasonably foreseeable accidents ... [and there is] ... no reasonable likelihood of significant impacts to water quality from present or past actions [of solid and hazardous waste programs]."

Industrial Waste Sewer System: The Industrial Waste Sewer (IWS) system began operation in 1958 to collect and treat various oily and process wastes from around the Center. The system includes 26 spill containment devices which trap oil and grease and remove floatables and settleable solids. The IWS is currently used as a central collection system for cooling tower blowdown and wastewater/stormwater from fueling areas and some floor drains, roof drains, and sumps. Although the IWS still receives some wastewater, its chief value today is as an oil spill control system. Flows to the IWS are accumulated in retention basins where further oil removal and settling occurs. These basins may be discharged to either the sanitary or storm sewer system (Outfall 001). The discharge of IWS effluent to the sanitary sewer system was approved in 1992 and since 1994, the basins are discharged only to the sanitary sewer.

There have been several instances uncovered of inappropriate connections or broken piping which allow wastewater to travel from one system to another, such as from the sanitary system to the storm sewer system. Pollutants may thus be discharged undetected and untreated. Efforts have been made by the environmental and engineering offices to identify and eliminate these problems. All known problem have been corrected and diagnostic efforts are continuing.

Cooling tower water was once treated with chromium-based biocides. During the 1980's Lewis switched to alternative treatment chemicals which are generally non-toxic. Lewis has requested permission from the Ohio EPA to discharge cooling tower water to the storm sewer system but had not received final approval as of this writing. Non-contact cooling water is generally discharged to the storm sewer system.

Water Use and Supply

All water used by Lewis is obtained from the City of Cleveland municipal water supply system. The Division of Water draws its raw water supply from Lake Erie through four intakes and serves a total user population of more than 1.5 million people. Three of the four intakes are within 24 kilometers (15 miles) of the Lewis site. Lewis consumption in FY 1994 was 1.58 billion liters (55,954 MCF).

The majority of water is used for institutional proposes with the balance for research. An overall water budget for Lewis is illustrated in Figure B-3. Institutional water uses include sanitary, food preparation, lawn sprinkling, and hydrant flushing. The most significant research use of water is for cooling, especially for the wind tunnels. There are four large cooling systems with a combined capacity of 15.2 million liters (535 MCF). Efforts have been made to conserve water such as converting once-through cooling systems to closed-loop or recirculating systems and repairing cracked or broken pipes. Since 1992, major repair work has been performed on the Lewis Central Water Distribution System, which necessitates extensive flushing of the water mains and associated hydrants. All drinking water fountains on site are tested for contaminants and free chlorine content at least once every two years.

Groundwater

No groundwater is used for water supply at Lewis. The Phase I RI/FS did not find evidence of groundwater contamination at the Lewis site (see Chapter B.8.2.5). No aquifer at Lewis has been designated as a sole or principal drinking water source under the Safe Drinking Water Act. There are no underground injection wells at the Lewis site.

Figure -3 Generalized Water Budget for Lewis

LAND RESOURCES

Regulatory Background

Federal laws typically do not regulate land development directly, although they can indirectly restrict development which may impact sensitive areas. The Farmland Protection Policy Act (U.S.C. 4201 et seq.), for example, requires Federal agencies to minimize the extent to which they contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses, and instructs that Federal programs be administered in a manner compatible with state, local, and private programs which protect farmland. Related guidance can be found in CEQ Memoranda at 45 FR 59189.

Federal statutes regarding the coastal zone include the Coastal Zone Management Act of 1972, Public Law 92-583, and the Coastal Zone Act Reauthorization Amendments of 1990, Public Law 101-508. These laws promote the effective management, beneficial use, protection, and development of the Nation's coastal zone. Implementation of these laws is delegated to the Department of Commerce and the National Oceanic and Atmospheric Administration. Relevant regulations are found at 15 CFR Part 930. Any Federal action which directly affects a coastal zone must be consistent, to the maximum extent practical, with the applicable state coastal zone management program.

Ohio has developed a Coastal Zone Management Plan which has not yet received Federal approval. The Lewis facility is not located in the Ohio coastal zone.

Environmental and Physical Setting

Topography

The topography near the Lewis site consists of gently rolling uplands created by glacial outwash. Lewis itself is generally level due to extensive cut-and-fill operations that reclaimed much of the area from steep drainage swales that once crossed the site. These drainage features were filled in with a variety of undifferentiated soils and gravels, construction debris, and industrial and domestic waste (Figure B-4). This overall topography contrasts sharply with the deeply eroded valleys and sloping banks of Abram Creek and Rocky River. These ravines are 15 to 30 meters (50 to 100 feet) deep, with an estimated maximum sidewall slope of 75 degrees.

The Central Area and most of the site is between 229 to 235 meters (750 and 770 feet) above sea level. Elevations in the South Area are similar to those in the Central Area but drop sharply to about 201 meters (660 feet) at Abram Creek. The West Area is relatively flat and its natural relief has been generally undisturbed by earth fill or removal. The northern edge of the North Area is wooded, and the Rocky River traverses its northwest boundary. Most of this area is flat with the natural contour only slightly changed by the construction of buildings.

Geology and Soils

During the Pleistocene Epoch, northern Ohio was modified by the Nebraskan, Kansan, Illinoian, and Wisconsian continental glaciation events. Advancing and retreating ice fronts deposited till and glacial outwash over much of northern Ohio. As the Wisconsian ice front advanced and retreated across northern Ohio, it occupied several positions within the Lake Erie basin and acted as a temporary dam (SAIC, June 1991a). These ice dams formed several different lakes including what is now known as Lake Erie.

Cleveland is located on the western flank of the undeformed portion of the Appalachian Basin, which extends northeastward from Alabama across portions of Tennessee, Kentucky, Virginia, West Virginia, Ohio, Pennsylvania, and New York. The basin contains a southeastward-thickening prism of sandstones, carbonates,

Figure -4 Locations of Fill in Central Area at Lewis

shales, and salts that aggregate to a thickness of 1981 to 7010 meters (6500 to 23,000 feet). Sedimentation in the basin occurred throughout the Paleozoic Era (600 to 246 million years ago) and culminated at the end of the last Appalachian Orogeny (White 1984 as cited in SAIC, June 1991a).

Bedrock in the immediate vicinity of Lewis is composed of the Cleveland Shale Member of the Ohio Shale (Ebasco 1989). The Cleveland Shale member is dark gray to black, thin bedded, and weathers to thin slatey fragments that are stained brown. This is exposed in the bed and valley walls of the tributaries to Abram Creek, Abram Creek itself, and Rocky River.

In northwestern Cuyahoga County, the surface is primarily covered by a thin layer (several inches to a few feet) of lacustrine clay and silt deposits that are underlain by Wisconsian aged glacial tills (White 1984 as cited in SAIC, June 1991a). Naturally occurring soils include the Mahoning Association, the Brecksville silt loam, the Chagrin silt loam, and the Jimtown loam. The Brecksville silt loam is found in the stream valley of Abram Creek, the Chagrin silt loam in the flood plain of Abram Creek, and the Jimtown loam in the West Area. The parent materials of these soils consist of unconsolidated Lavery glacial till and alluvium. The Lavery Till is primarily silty-sandy to silty clayey and is transected by closely spaced joints which are steeply inclined to near vertical. The Lavery Till overlies bedrock or unnamed deposits of sand and silt which range in thickness from 0.3 to 3.4 meters (1 to 11 feet) (Ford 1987). Soils of the Mahoning Association cover most of the Central Area. These soils generally have low to very low permeability and are classified as a silty clay loam, although they often grade to a clay loam glacial till. The natural soils and parent materials in many cases have been removed or covered with fill. Geology in the area is illustrated in Figure B-5.

Seismology

The State of Ohio, including the Lewis site, is located in Seismic Zone 1 (Ohio Building Code 1990). The probability of an earthquake causing structural damage is minimal. The Ohio Shale is fissile, however, and offers differential resistance to applied stresses depending upon the inclination to the direction of stratification.

Lewis Operations

Land Acquisition and Land Use

The Lewis Research Center owns or leases 147.62 hectares (364.49 acres) of land at the Cleveland Site (see Section B.1.1). The original property was acquired in 1940 and measured approximately 81 hectares (200 acres). The land had been owned by the City of Cleveland as part of an expansive airport property and used at the time to provide parking and spectator areas for the National Air Races held at the municipal airport. The West Area was acquired between 1958 and 1962, bringing the site close to its current size.

Most of the Lewis site, particularly in the Central Area, is considered fully developed with offices, test facilities, and support facilities. All site structures must conform to Federal Aviation Administration restrictions due to proximity to the Airport. Only approximately 69 hectares (170 acres) are considered undeveloped. The recreational facilities in the West Area provide some open space.

Most of the land is owned outright by the United States Government. Some 5.3 hectares (13 acres) in the North Area are leased from the City of Cleveland for use as a parking lot. A large portion of this lot is in an area where the Airport is creating a "clear zone" at the end of one of the runways. While this use was once acceptable, the Federal Aviation Administration now believes that parking lots in clear zones represent a hazard to aircraft safety and should be removed. Accordingly, the City has not permanently renewed the lease and is currently extending it on a short-term basis. If the lot is eliminated, the lost parking spaces will need to be replaced.

Figure -5 Generalized Geology of Lewis Site

The City of Cleveland has also developed plans to expand the Hopkins International Airport. This may require portions of the South Area for additional and extended runways. This tract now includes the Rocket Engine Test Facility (Building 202), the Cryogenic Components Laboratory (Building 203), the High-Load Tensile Test Facility (Building 204), the Central Chemical Storage Facility (Building 212), and other structures, some of which may have to be removed. The Director of the Cleveland Department of Port Control (which manages the Airport) has stated that if the airport needs to acquire the South Area property, the City will relocate affected facilities to a suitable alternative location (LeRC, December 1995).

The "present use of Lewis Research Center properties and major facilities is compatible with all state, regional, and local development plans and programs with the possible exception of potential airport expansion..." (LeRC, December 1995). In addition to the Airport, the surrounding area contains several industrial complexes, business districts, highways, and a residential area of moderate density (two to six dwellings per acre). The area is highly urbanized and developed. Strict safety precautions are maintained to protect the public health and safety. Lewis is also adjacent to a large recreational park, the Rocky River Reservation. This is a protected environment and includes the entire course of the Rocky River from Lewis to Lake Erie.

BIOTIC RESOURCES

Regulatory Background

The Fish and Wildlife Coordination Act of 1958, Public Law 85-624, and the Fish and Wildlife Conservation Act of 1980, Public Law 96-366, ensure that fish and wildlife resources receive proper consideration during the planning of water resource projects larger than 4 hectares (10 acres). Consultations are required when a Federal agency plans an activity involving the impoundment, diversion, deepening, control, or modification of a water body. Federal agencies must consult with the U.S. Fish and Wildlife Service and state wildlife agencies to assess impacts on wildlife resources and modify plans by "justifiable means and measures" to prevent loss or damage to such resources.

The Migratory Bird Treaty Act of 1972 and the Migratory Bird Conservation Act protect most wildlife species native to the United States including migratory waterfowl and seabirds. The Marine Mammal Protection Act of 1972, Public Law 92-522, prohibits the taking or harassment of marine mammals except incidental take during commercial fishing, capture under scientific research or public display permits, harvest by Native Americans for subsistence purposes, or other take as authorized on a case-by-case basis (see also Chapter B.6 on Endangered Species).

A 1994 White House Memorandum on *Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds*, encourages the use of techniques that complement and enhance the local environment and minimize any adverse effects of landscaping. The Memorandum directs Federal agencies to use regionally native plants for landscaping, minimize adverse effects on natural habitats, conserve water in landscaping, and prevent pollution through such techniques as reducing the need for fertilizer and pesticides, minimizing runoff, using integrated pest management, and recycling.

Related to biotic resources is concern for threatened and endangered species, which is the subject of Chapter B.6.

Lewis Operations

Much of the information for this section was taken from a biological survey conducted by personnel from the Ohio Department of Natural Resources (ODNR 1996).

Flora

The Ohio vascular flora has been estimated at 2350 species (Cooperrider 1992 as cited in ODNR 1996). About 24% of these species are not indigenous to the state (Stuckey 1992 as cited in ODNR 1996). Alien species have spread into Ohio from many sources. A few were purposely introduced as ornamentals (Norway maple, *Acer platanoides*) or as crop plants (white sweet-clover, *Melilotus alba*). Others were inadvertently introduced, including significant weed species such as Canada thistle (*Cirsium arvense*) and redtop (*Agrostis gigantea*). Non-native species at Lewis include dotted St. John's-wort (*Hypericum perforatum*), garlic-mustard (*Alliaria petiolata*), Japanese barberry (*Berberis thunbergii*), and Toringo crab-apple (*Pyrus sieboldii*).

No significant plant communities were discovered at Lewis during the ODNR survey. Sixty-one species of non-native flora were found, nearly 30% of the total flora. This number is typical for a highly disturbed area like Lewis. (An annotated list of vascular plant species at Lewis can be found in ODNR 1996.) Non-indigenous plants which were cited as major competitors with native species include garlic-mustard and Asiatic honeysuckle (*Lonicera morrowii*).

The composition of the original vegetation at the Lewis site is unknown, but its nature can be inferred. Oak-hickory forest probably dominated the uplands with mixed mesophytic or oak-maple-hemlock forests along the gorge of Abram Creek. The terrace of Abram Creek is too narrow to support swamp forests or riverine woodlands. The original forest cover was removed probably during the early 1800's, destroying the natural vegetation. The denuded uplands likely were cultivated and/or grazed and subsequent continuing development has prevented the land from reverting to a natural state. Most of the site is too highly disturbed to support significant numbers of indigenous Ohio plant species.

Approximately 69 hectares (170 acres) at Lewis are considered undeveloped. The gorge of Abram Creek and the tops of the bluffs above the valley are the only areas which retain natural qualities. The outline of an oak-hickory forest community can still be found on the bluff tops on the northwest side of the Abram Creek gorge (Figure B-6). Many oaks in this area probably represent trees which began growing soon after the original deforestation of the area. These trees are primarily red oak and white oak with a few scattered individuals of other species. During the survey, twelve red oaks measured between 60 and 90 centimeters (24 and 35 inches) diameter breast height and six white oaks measured between 50 and 100 centimeters (20 and 39 inches) diameter breast height. Other large trees included wild black cherry, scarlet oak, bitternut hickory, and sugar maple.

Fauna

Animals censused at Lewis during the ODNR surveys included birds, amphibians, reptiles, and moths. The surveys found species common in urban/suburban/open areas in this part of Ohio. Forty species of birds were identified as nesting or potentially nesting at Lewis. Species found most often included the European starling, house sparrow, American robin, chimney swift, and house finch, which together accounted for more than half of all sitings. The "wooded, successional, and grassland habitats" in this area were judged to be too small and fragmented to support other species.

All amphibians and reptiles found were in the Abram Creek gorge. Species identified included the redback salamander, American toad, green frog, snapping turtle, and eastern garter snake, all of which are common statewide. Two species not found but thought likely to be present include the dusky salamander and ringneck snake. Some 129 species of moths were identified in the Abram Creek ravine, but the small number of specimens collected suggests that the moth population is generally limited. Although not surveyed, mammals on the Lewis site likely include squirrels, chipmunks, rabbits, deer, and groundhogs common to urban neighborhoods.

Management Planning

Areas at Lewis recommended for special attention include the wooded area behind Building 309 where there are large oaks and other trees (*Endangered Species Management Plan*, Bionetics 1996). ODNR recommended that conservation strategies here include not altering the ground surface to protect tree roots, and not mowing, using herbicides, or introducing non-native vascular species under the trees. Other areas identified for protection include the wooded riparian corridor along Abram Creek and the grassy fields adjacent to the airport. Recommendations were not to disturb these areas and to not mow the grassy fields until late summer to preserve potential bird habitat.

The Plan also recommends that the planting and propagation of alien species be minimized. The EMO will supply the Lewis community with lists of approved species as needed. Another suggestion was to allow some lawn areas to revert to grass meadows to provide additional habitat for wildlife. To implement this recommen-dation and in keeping with the White House Memorandum on landscaping, 10.5 hectares (26 acres) in the West Area will be converted from lawns to an unmaintained, meadow-type habitat beginning in 1997.

Figure -6 Plant Communities of Concern at Lewis

THREATENED, ENDANGERED, AND PROTECTED SPECIES

Regulatory Background

The primary Federal statute for the protection of threatened and endangered species is the Endangered Species Act of 1973, Public Law 93-205. This law and later amendments established a National policy that the activities of Federal agencies should not harm proposed or listed threatened and endangered species or critical habitats. Section 7 of the Act requires Federal agencies to ensure that their actions within the United States do not have adverse impacts on the continued existence of threatened or endangered species or critical habitats important in conserving these species. The Act includes flora and fauna and prohibits the taking, destruction, import, export, trafficking, sale, possession, or capture of endangered species.

Implementation of the Act is delegated primarily to the U.S. Fish and Wildlife Service of the Department of the Interior, which maintains lists of protected species (50 CFR Part 17). Some responsibilities for plant species are delegated to the Department of Agriculture. Federal agencies must consult with the Fish and Wildlife Service regarding proposed actions through either formal or informal consultation procedures. If a threatened or endangered species may be affected, a detailed endangered species assessment (Biological Assessment) may be required.

The Marine Mammal Protection Act of 1972, Public Law 92-522, provides protection for designated marine mammals analogous to the Endangered Species Act. Authority for this law is delegated to the National Marine Fisheries Service of the Department of Commerce.

Ohio passed the Ohio Endangered and Threatened Species Act in 1977. The State maintains lists of endangered, threatened, special interest, extirpated, and other protected native animal and plant species (ORC 1517 and 1518). Up-to-date lists are maintained by the Division of Natural Areas and Preserves (vascular plants) and the Division of Wildlife (animals) of the ODNR. According to an opinion cited in ODNR (1995), state regulations apply only on state-owned land, and NASA is not required by state law to preserve critical habitat for state-only listed species.

LeRC policy regarding endangered and threatened species is contained in Chapter 19 of the *Lewis Environmental Programs Manual.*

Lewis Operations

The ODNR conducted a biological survey of the Lewis facility in 1995, focusing on plant species, breeding birds, reptiles and amphibians, and moths (ODNR 1996). The survey did not identify any Federally-listed species or any State-listed

animals at Lewis. Three State-listed plant species were documented, all of which are listed as Ohio rarities and ranked as Potentially Threatened. State law does not require the conservation of Potentially Threatened species. These species are:

American Chestnut (*Castanea dentata*)

Blunt Mountain-mint (*Pycnanthemum muticum*)

Pigeon Grape (*Vitis cinerea*).

The chestnut was represented by a single small tree near Building 500 that was infected with the chestnut blight that has severely restricted this species over the last few decades. The American Chestnut will likely not survive no matter what action is taken (ODNR 1996). The Blunt Mountain-mint is represented by 40-45 flowering plants on the west side of Abram Creek northeast of Building 319. ODNR recommended that there be no mowing or clearing of the brushy edges of the slopes in the vicinity of these plants. Three vines of pigeon grape were found on tress on the blufftop on the east side of the Abram Creek gorge south of Building 142. This species is similar to common summer grape. ODNR recommends that the vines not be disturbed and allowed to continue to grow (Figure B-6).

Based on the ODNR survey, Lewis prepared an *Endangered Species Management Plan* (Bionetics 1996). The Plan recommends that the areas which contain the three species be posted with signs indicating that threatened species are present. Any use of pesticides or herbicides in these areas must be approved by the EMO. The EMO will monitor the areas twice each year to assess the status of the target species. Photographs and inspection logs will be maintained for documentation. Any declining trends in population will be brought to the attention of the ODNR for consultation to determine what actions can be taken to facilitate recovery.

WETLANDS AND FLOODPLAINS

Regulatory Background

Wetlands

Wetlands are important for migratory birds, waterfowl, flood control, erosion protection, and other reasons. Wetlands development is regulated under Section 404 of the Clean Water Act. Discharges of dredged or fill material into the navigable waters of the United States may be performed only as authorized by permit. The Secretary of the Army and the U.S. Army Corps of Engineers have been delegated the authority for issuing these permits (33 CFR Parts 320-330). The USEPA also has review responsibility in the process (40 CFR Part 230). In Ohio, a Section 401 water quality certification must be obtained from the Ohio EPA prior to the discharge of dredged or fill material into waterways including wetlands.

The Water Resources Development Act of 1990, Public Law 101-640, contains provisions for achieving no net loss of the Nation's remaining wetlands base. The older Rivers and Harbors Act of 1899 regulates development in or over navigable waters, including bridges, dams, piers, booms, and jetties by requiring permits for such actions. Court decisions have extended this protection to estuaries and wetlands.

Executive Order 11990, *Protection of Wetlands,* establishes wetlands protection as the official policy of the Federal Government. The Order directs Federal agencies "to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands." Federal activities should not cause new construction in wetlands unless there is no feasible alternative and all practicable measures have been taken to minimize damage to wetlands. Agencies must provide for public review of proposals which call for new construction in wetlands.

NASA policy on floodplain and wetlands management is contained in NASA Management Instruction 8800.10b. LeRC policy is addressed in Chapter 18 of the *Lewis Environmental Programs Manual.*

Floodplains

Floodplain statutes include the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Floodplains are regulated by the Federal Emergency Management Agency and the Environmental Protection Agency. These agencies limit the construction of buildings in the 100-year floodplain. The Federal Emergency Management Agency's objective is to limit or prevent losses associated with the Federal Flood Insurance Program.

Executive Order 11988, *Floodplain Management,* requires Federal agencies to minimize long- and short-term adverse impacts from occupying or modifying floodplains. The Order requires agencies to determine whether an action could occur in a floodplain, and if so, ensure that all practicable alternatives are considered. The Order emphasizes reducing the risk of flood loss and minimizing the impact of floods on human health, safety, and welfare. Actions must be taken "to restore and preserve the natural and beneficial values served by floodplains in conducting Federal activities and programs affecting land use."

Lewis Operations

Wetlands

A 1994 survey found the only jurisdictional wetland near the Lewis facility to be a small meadow on the site of an old girl scout camp south of Cedar Point Road (ACRT 1994). Development at this location is unlikely. The stream valleys here are narrow and deep and generally unsuitable for development. Dredge and fill activities are similarly unlikely. Any future development of a large wetlands area, attracting birds and waterfowl, could also conflict with activity at the neighboring Airport.

Floodplains

Floodplains in the area of Lewis are limited to small strips of land proximate to Rocky River and Abram Creek (Figure B-7). Development here is unlikely due to the steep topography. The greatest floods on the west branch of the Rocky River are said to have occurred in 1959, with other severe floods in 1913 and 1924 (Larson 1984).

Two facilities at Lewis had been in the Abram Creek floodplain, namely, the Drum and Cylinder Storage Facility (Building 415) and the Firing Range. Building 415 was taken out of service in the early 1990's, the site underwent RCRA closure, and the building was demolished. The firing range was taken out of service at approximately the same time. No Lewis facilities remain in the 100-year floodplain.

Figure -7 100-Year Floodplain at Lewis

WASTE GENERATION AND MANAGEMENT

Regulatory Background

Solid Waste

The primary Federal statute regulating solid waste is the Resource Conservation and Recovery Act (RCRA) of 1976, Public Law 94-580. Amendments to the Act include the Used Oil Recycling Act of 1980, Public Law 96-463, the Solid Waste Disposal Act of 1980, Public Law 96-482, and the Hazardous and Solid Waste Amendments of 1984, Public Law 98-616. The goals of RCRA are to protect human health and the environment from unsound waste disposal practices, reduce waste generation, and reduce the volume and toxicity of hazardous wastes. Most rules regarding solid (i.e., non-

hazardous) waste are found in Subtitle D of RCRA (40 CFR Parts 240-258). The regulations focus primarily on the operation of solid waste disposal facilities and the development of state solid waste management plans.

Ohio House Bill 592 led to the development of the 1989 State Solid Waste Management Plan. The goals of the Plan are to reduce reliance on landfills for solid waste disposal; extend the useful life of existing landfills; eliminate disposal of inappropriate items in landfills, resource recovery facilities, and incinerators; and encourage waste reduction. The Plan sets a goal of reducing solid waste generation by 25% per person, either through prevention, waste minimization, reuse, or recycling. Rules were enacted to discourage the disposal of yard waste in landfills. Other types of waste for which disposal restrictions may be imposed include whole waste tires, shredded tires, lead-acid batteries, and used oil.

LeRC solid waste policy is addressed in Chapter 17 of the *Lewis Environmental Programs Manual.* Policy regarding bloodborne pathogens (e.g., medical waste) is contained in Chapter 33 of the *Manual.*

Hazardous Waste

RCRA is also the primary law regulating hazardous waste management and disposal. Rules regarding hazardous waste are found primarily in Subtitle C of the Act. RCRA provides for "cradle to grave" management of hazardous wastes by regulating generation, handling, transportation, treatment, storage, and disposal (40 CFR Parts 240-279). RCRA transportation rules are coordinated with the Hazardous Materials Transportation Act, which is delegated to the Department of Transportation. Some types of hazardous waste are subject to "land ban" provisions which can prohibit their land disposal entirely. RCRA also requires waste generators to implement a waste minimization program to reduce the volume and toxicity of their hazardous wastes. LeRC waste minimization policy is contained in Chapter 6 of the *Lewis Environmental Programs Manual.* Related guidance is contained in Lewis Management Instruction 1701.2, *Disposal of Hazardous Materials and Waste.*

Storage Tanks

Underground storage tanks are regulated under Subtitle I of RCRA (40 CFR Parts 280-281). New underground storage tanks must meet stringent performance standards, including corrosion protection, proper installation, overflow protection, and leak detection. In Ohio, underground storage tanks containing petroleum products are regulated by the Bureau of Underground Storage Tank Regulation of the Office of the State Fire Marshall. Tanks containing other products such as hazardous chemicals are regulated by the Ohio EPA. LeRC policies regarding underground storage tanks are contained in Chapter 27 of the *Lewis Environmental Programs Manual.*

Spills

Oil spill prevention and reporting are regulated under Section 311 of the Clean Water Act (see also ERD Chapter B.3.1). Implementing regulations are found at 40 CFR Parts 109-117. The CWA also requires facilities to develop spill prevention, control, and countermeasure plans for preparedness in the event of an unplanned release. The Oil Pollution Act of 1990, Public Law 101-380, increased the liability of owners and operators of facilities who are responsible for spills. Administration of the Act is delegated to the U.S. Coast Guard and implementing regulations are found at 33 CFR Parts 153-158. Spill control is addressed in Chapter 8 of the *Lewis Environmental Programs Manual.*

Lewis Operations

Solid Waste

Types of solid waste generated at Lewis include waste paper, construction/demolition debris, building and equipment maintenance wastes, soils, office waste, and cafeteria wastes. Solid waste disposal is handled by a contractor. There are no active waste landfills on site. An environmental audit conducted in 1996 (Foster Wheeler, Draft, 1996a) found Lewis to be in "substantial compliance" with solid waste regulations.

The quantities of solid waste generated by Lewis have been estimated by weighing garbage trucks. Data from 1994 revealed an average solid waste generation rate of 4.49 metric tons (4.95 tons) per day (SAIC 1995). This represents a slight decrease from 1991 which showed an average rate of 4.70 metric tons (5.18 tons) per day. The figures, however, do not account for an increase in recycling during this period, and so in general solid waste generation rates should be

considered stable.

The 1991 study also assessed the composition of routine solid wastes generated (Resource Management International 1991). Paper goods accounted for over one-half of total wastes. Categories of paper included miscellaneous paper (23.0%), cardboard (13.9%), fine grade paper (9.2%), hand towels (6.6%), and newsprint (1.4%). Other types of solid waste generated included food waste, metals, yard waste, plastics, and glass.

Infectious wastes are generated by Medical Services in Building 15. Infectious waste generation rates are reported to be less than 23 kilograms (50 pounds) per month (Foster Wheeler, Draft, 1996a). These wastes are collected by a contractor and disposed of at an infectious waste treatment facility.

Recycling

Recycling is mandated by several directives including the Pollution Prevention Act of 1990, Public Law 101-508, and Executive Order 12873 (1993), *Federal Acquisition, Recycling, and Waste Prevention.* Lewis has a voluntary recycling program which collected over 454,000 kilograms (1,000,000 pounds) of materials in 1994 (SAIC 1995). The program includes office paper, telephone books, laser printer toner cartridges, scrap metals, and aluminum beverage cans. The largest collections in 1994 were for mixed scrap metals (277,000 kilograms or 611,000 pounds) and office paper (173,000 kilograms or 382,000 pounds). Telephone books are collected through a separate program run by the local telephone company and Cuyahoga County. Also recycled are lubricating oils, solvents, antifreeze, etc., which are reprocessed, reclaimed, or used for energy recovery. Starting in 1995, Lewis' solid waste disposal contract was modified to specify that the contractor must separate out and recycle plastic, cardboard, glass, wood, newsprint, aluminum, and ferrous metals from the waste stream.

Hazardous Waste

Lewis has been issued Ohio EPA hazardous waste generator identification number OH 0800005035. Lewis is classified as a large-quantity generator. Hazardous wastes are stored on site for less than 90 days. There are 20 locations where hazardous wastes or used oil are temporarily stored and 22 satellite accumulation points; these locations are inspected annually. Pick-up logs are used to ensure that storage deadlines are not exceeded. Wastes are brought to Building 212 (Central Chemical Storage Facility) for staging, consolidation, and storage before removal and disposal or reclamation at a certified Treatment, Storage, and Disposal Facility. Many temporary storage areas were eliminated during the last few years to streamline waste management.

Information on the quantities and types of hazardous waste generated by Lewis can be obtained from the Generator Annual Hazardous Waste Reports which are submitted to the Ohio EPA. Hazardous waste generation rates have been declining steadily (Table B-6). In 1994 slightly over 454,000 kilograms (1,000,000 pounds) of hazardous waste were generated, of which over 80% was contaminated soil from remediation projects. Excluding contaminated soil, waste generation decreased by 11% from 1993 to 1994, and by 86% from 1991 to 1994. Spent solvents and contaminated water and liquids declined by approximately one-half. Solvent wastes decreased from 24,000 to 5170 kilograms (53,000 to 11,402 pounds) from 1989 to 1994.

Waste contaminated soil generally results from construction or remediation projects, and is a large-volume, non-routine class of hazardous waste. The amount of contaminated soil generated varies from year to year. In 1995, approximately 1088 metric tons (1200 tons) of contaminated soil were generated, of which 816 metric tons (900 tons) required no pretreatment and 272 metric tons (300 tons) were incinerated. In 1994, 367 metric tons (404 tons) of contaminated soil were generated. Approximately 855 metric tons (943 tons) of contaminated soil were generated in 1993 and accounted for 90% of all hazardous waste generated in that year. The most common soil contaminants have been 1,1,1-trichloroethane, methylene chloride, lead, mercury, and solvents. It is generally believed that such contamination resulted from incidents that took place before the advent of modern environmental regulations and controls. LeRC policy for the handling and disposal of soil is contained in Chapter 34 of the *Lewis Environmental Programs Manual,* as well as in the LeRC *Policy on Soil Sampling, Excavation, and Removal* dated October 11, 1996.

Lewis is committed to waste reduction through prevention and other means. Lewis has prepared a *Pollution Prevention Plan* (SAIC 1995) pursuant to Executive Order 12856 and the Pollution Prevention Act of 1990. The Plan is in the process of implementation.

At one time, Building 415 (the Barrel and Cylinder Storage Facility) was used for hazardous waste management. This was a rocket combustion research facility from 1960 to 1975, and a hazardous waste and chemical storage facility from 1975 to 1992. The building was located in the floodplain which was a cause of environmental concern. In 1992 the facility was taken out of service, demolished, and a clean closure of the site completed under Ohio EPA generator closure rules. Hazardous waste management functions were transferred to the new Building 212 in the South Area.

Storage Tanks

Underground storage tanks (UST's) are used for the storage of fuel oil, diesel fuel, gasoline, and jet fuel (for research). No liquid wastes are stored in UST's. Lewis had 16 active UST's as of 1996. All new tank installations have automatic leak detection systems and are either double-wall fiberglass-reinforced plastic or single-wall steel. New installations are also equipped with automatic level recorders which send information to a centralized data logger. There were 24 UST's in 1988 (Warner/Osborn/Pardee 1990). Tank removal sites were remediated as necessary. Ohio rules require that contaminated soil from a UST cavity be taken to a landfill approved for petroleum-contaminated soil.

Lewis has approximately 40 above ground storage tanks in use on site. All new above ground tanks must have modern protection and leak-detection systems. No new permanent above ground tanks have been installed for several years, although there have been temporary ones.

Remediation Actions

Remediation actions may be governed by RCRA or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund). Lewis is conducting investigations to determine the extent of site contamination which may have been caused by past activities. These studies are based on guidance established by the Ohio EPA and the USEPA, including procedures pursuant to CERCLA. A Preliminary Assessment of the Lewis site was completed in 1991 (SAIC, June 1991a). This was followed by detailed plans for a facility-wide investigation including extensive sampling and analysis, as described in the Lewis Research Center Site Inspec-tion Plans (SAIC, July 1993a and 1993b). These efforts identified 73 potential areas of concern based upon a

Table -6 Hazardous Waste Generation at Lewis

review of past activities and available data. A Remedial Investigation/Feasibility Study (RI/FS) and field investigation then followed to carry out the plan. The field investigation included sampling of surface water, seeps, groundwater, surface soil, sediments, soil gas, mercury, and low-level radiation.

Phase I of the RI/FS began in 1994. Some 1500 samples were collected and these confirmed the presence of organic and inorganic contamination in soils in the South Area, the Firing Range, and the northern portion of the Central Area (R&R International 1995). Other small, isolated instances of soil contamination were found with concentrations in the 1 to 15 parts per billion range. Based on the sampling data, the site score according to the CERCLA Hazard Ranking System was below that normally required to be placed on the National Priorities List for site cleanup. No groundwater contamination was found and no emergency cleanup actions were warranted.

Phase II of the RI/FS will determine the level of risk to human health and the environment from site contamination, eliminate areas which do not present a risk, and design appropriate remedial strategies for the remaining areas. Phase II will begin in 1997 with the cooperation of the Ohio EPA under the terms of Director's Final Findings and Orders dated September 20, 1996. The Ohio EPA will have an oversight role and will take the lead for public information activities.

Several other remediation/closure actions have occurred at Lewis in addition to the RI/FS. Recent RCRA closures are summarized in Table B-7.

Spills

Lewis' Spill Prevention, Control, and Countermeasure Plan (LeRC, February 1994) describes procedures for the prevention and control of oil spills, including PCB-containing oil spills, which may enter any of the on-site sewer systems. The Plan contains sections on regulatory compliance, program responsibilities, training, spill reporting, location of

response equipment, and emergency response procedures. The Plan is written as an appendix to the Lewis Contingency Plan for Hazardous Waste Management. An amendment and update of the Plan is scheduled to be issued in 1997.

No spill incidents have occurred at Lewis which have required reporting under Section 304 of the Emergency Planning and Community Right-to-Know Act (EPCRA) regarding emergency release notification. Fuel tank trailers are kept in areas where the IWS would help keep spills from reaching waterways. An assessment of spill containment provisions for oil-insulated electrical equipment in the high voltage power system was conducted in 1995 (Raytheon 1995; see Chapter 9.2). An audit conducted in 1996 (Foster Wheeler, Draft, 1996a) noted some spill control and fire equipment was missing or damaged at some hazardous waste accumulation sites.

Table -7 Recent RCRA Closure Actions at Lewis

Site	Description	Date of Closure/ Date of Closure Report/ Comment
Closures Completed and Ohio Concurrence Received		
Building 5, Site A	Interior room of building	1992
Building 6	Interior room of building	1992
Building 9	Interior room of building	1992
Building 16	Covered exterior pad	1992
Building 37	Interior room of building	1992
Building 50, Site A	Exterior pad	1992
Building 55	Interior room of building	1992
Building 64	Interior room of building	1992
Building 90, Site B	Interior room of building	1992
Building 102	Exterior pad	1992
Building 107, Site A	Exterior shed	1992
Building 114, Site A	Interior room of building	1992
Closures Completed; Ohio Concurrence Not Yet Received		
Building 24	- -	1992
Building 35	- -	1992

Building 66	- -	1992
Building 49	- -	1992
Building 12	- -	1994
Building 50, Site B	- -	1994
Buildings 109 and 136	- -	1996
Building 209	- -	1994
Building 104	- -	1995
Building 415	- -	1995
Building 11	- -	To be determined
Building 77	- -	In progress
Building 106	- -	In progress
Building 202	- -	In progress
Building 203	- -	In progress
Building 4 (Hangar)	- -	To be determined

Source: Adapted from Foster Wheeler, November 1996a

HAZARDOUS AND TOXIC SUBSTANCES

This chapter is organized according to the substance(s) of interest.

Hazardous Materials and Reporting

The Emergency Planning and Community Right-to-Know Act (EPCRA) was passed as part of Title III of the Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499. EPCRA required facility owners and operators to report the hazardous and toxic chemicals at their facilities and to conduct emergency response planning. Initially, Federal installations were exempted from EPCRA, however, Executive Order 12856 (1993) instructed Federal agencies to comply with most provisions of the law. LeRC policy regarding emergency planning and community right-to-know is presented in Chapter 20 of the *Lewis Environmental Programs Manual*. Hazardous chemical safety and hazardous chemical acquisition are addressed in Chapters 21 and 22 of the *Manual*, respectively.

Each Federal facility must prepare an Annual Emergency and Hazardous Chemical Inventory Report (EPCRA Section 312). Lewis submits such reports each year; the February 1995 Tier II report listed approximately 15 substances including oils, fuels, jet fuels, CFC's, and research gases which were present in more than the threshold quantity. In August of 1995, Lewis informed the State that there were no longer any "extremely hazardous substances" (as defined by EPCRA at 40 CFR Part 355) on site in quantities which exceeded the applicable thresholds. Federal agencies are also directed to provide technical assistance to State and Local Emergency Planning Commissions in the development of emergency response plans. Lewis has offered assistance to the Local Emergency Planning Commission and submits an annual Facility Data Sheet to that organization. More detailed information on Lewis EPCRA compliance can be found in the Lewis *Pollution Prevention Plan* (SAIC 1995).

EPCRA Section 313 requires facilities to report annually their environmental releases of listed toxic chemicals, as part of the national Toxics Release Inventory (TRI). Lewis has submitted these reports since 1990, before it became mandatory for Federal agencies. A summary of Lewis reports for the TRI is provided as Table B-8.

Lewis procures some bulk materials which are potentially hazardous such as fuels, gases, and oils. Most other hazardous materials are obtained in small, laboratory-size quantities. These materials are tracked through a chemical inventory initiated in 1994. Chemical containers are bar coded and chemical and location information are entered into a computerized data base. As of 1995, the inventory included over 45,000 containers of 7000 different chemicals. Locations where hazardous materials are stored are inspected annually. All requests for non-stock chemicals are first reviewed by the Chemical Management Team of the EMO.

PCBs

Polychlorinated biphenyls (PCB's) are chemicals which were once widely used as dielectric fluids in electrical transformers and in solvents, oils, heat transfer fluids, hydraulic fluids, inks, and other products. PCB's can present a risk to human health and are regulated under the Toxic Substances Control Act of 1976, Public Law 99-519 (40 CFR Part 761). These regulations ban the further manufacture of PCB's and establish strict rules for the handling and disposal of PCB's still in use. Items are classified as "PCB" ("PCB transformers," "PCB capacitors," etc.) if they contain >500 parts per million (ppm) PCB's. Items are classified as "PCB contaminated" if they contain ≤ 500 ppm but >50 ppm, and "non-PCB" if they contain ≤ 50 ppm PCB's. PCB management is addressed in Chapter 7 of the *Lewis Environmental Programs Manual.*

Lewis has an ongoing PCB abatement program that includes transformers, capacitors, and hydraulic oil systems. Many pieces of equipment once containing PCB fluids have been removed or remediated. As of 1994, no PCB transformers remained on site. In 1995, several PCB items were shipped for disposal including capacitors, capacitor cabinets, contaminated soil, and debris (LeRC, January 1996a). Building 136 is used for secure PCB

Table -8 Summary of Lewis TRI Reports

storage when needed. As of the beginning of 1997, PCB-contaminated transformers were still in service at outdoor locations at Buildings 6, 8, 105, and 201. The Cleveland Electric Illuminating Company also has transformers on site which may be PCB-contaminated.

An assessment of spill containment provisions for oil-insulated electrical equipment in the high voltage power system was completed in 1995 (Raytheon 1995). The study recommended upgraded spill containment at several locations. The highest priority was at Substation F (Structure 41). Plans have been developed to correct this situation. The study also recommended that several pieces of equipment be tested to determine their PCB status.

Four PCB transformer spills have been recorded since 1992. Three were small leaks of PCB oil or mineral oil with PCB concentrations greater than 50 ppm. The fourth incident occurred in June of 1994 due to the over-filling of a transformer at Substation A. This resulted in the loss of 132 liters (35 gallons) of mineral oil with PCB concentrations of 10 ppm. The site was subsequently remediated.

Asbestos and Synthetic Inorganic Fibers

Asbestos refers to a variety of naturally occurring mineral silicates once widely used for heat and acoustical insulation, fireproofing, friction products, reinforcing material, and other applications. Asbestos can present a potential hazard to health and its use, removal, and disposal are regulated under the Toxic Substances Control Act and the Occupational Safety and Health Act (OSHA), Public Law 91-596. Asbestos is also regulated as an air pollutant under the National Emissions Standards for Hazardous Air Pollutants provisions of the Clean Air Act (40 CFR Part 61). The Ohio Department of Health issues rules for asbestos abatement contractors and workers at OAC 3701-34. Asbestos control at LeRC is addressed in Chapter 9 of the *Lewis Environmental Programs Manual.*

Asbestos maintenance and abatement are ongoing activities at Lewis. A visual asbestos survey of the facility was conducted in 1994. A more detailed survey is planned beginning in 1997. New uses of asbestos-containing materials are prohibited except where there is no acceptable substitute. An environmental audit conducted in 1996 (Foster Wheeler, Draft, 1996a) found some gaps in recordkeeping procedures and recommended strengthening in this area.

Synthetic inorganic fibers include materials such as fiberglass, mineral wool, and refractory ceramic fibers. Due to health concerns regarding these substances, LeRC has established operational procedures and maximum exposure limits and action levels for these substances. A description of this program can be found in Chapter 9 of the *Lewis Environmental Programs Manual.*

Lead

Lead inhalation or ingestion can impair health and interfere with normal bodily functions. Exposure to lead at LeRC can occur from lead paint, welding, soldering, or other activities involving lead-bearing materials. LeRC policies for the handling, use, disposal, and removal of lead-containing materials are presented in Chapter 13 of the *Lewis Environmental Programs Manual.* Permissible Exposure Limits and Action Levels have been established for airborne lead.

The major source of environmental lead at Lewis is old paint. Only lead-free paint is purchased today. An abatement program is underway to remove existing lead paint that poses an immediate risk to human health or the environment. Abatement is also conducted when existing structures are modified through renovation or construction. Standard practice is to partially remove the old paint using scraping and/or blasting methods and recoat the surface. Full removal is performed only when necessary. In 1994, lead-contaminated hazardous wastes totaled 16,579 kilograms (36,549 pounds).

Mercury

Mercury inhalation and chronic mercury exposure can impair health and interfere with normal bodily functions. Exposures at LeRC can occur from mercury spilled from such devices as thermometers, manometers, barometers, and electrical switches. Past uses of mercury have also resulted in contaminated tanks, pumps, and other equipment. LeRC policies regarding the handling, use, and disposal of mercury-containing materials are presented in Chapter 14 of the *Lewis Environmental Programs Manual.* Substitutes for mercury-containing devices are to be made whenever possible.

Cadmium

Cadmium exposure can impair health and interfere with normal bodily functions. Exposures to cadmium at LeRC can occur from inhalation of fumes and dust or ingestion of dust, which may be created through brazing using cadmium-containing alloys. An OSHA standard for cadmium exposure was issued in 1992 (29 CFR Part 1910.1027). LeRC policies for the handling, use, and disposal of cadmium-containing materials are presented in Chapter 15 of the *Lewis Environmental Programs Manual.* Permissible Exposure Limits and Action Levels have been established for airborne cadmium compounds.

PESTICIDES AND HERBICIDES

Regulatory Background

The primary Federal statute regulating pesticides and herbicides is the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1972, Public Law 92-516. The Act controls the manufacture, storage, transportation, and application of pesticides to ensure that these chemicals are used safely (40 CFR Parts 150-189). The authority for administering FIFRA is delegated to the USEPA. There are also OSHA occupational pesticide standards at 29 CFR Part 1910.

A 1994 White House Memorandum, *Environmentally and Economically Beneficial Practices on Federal Landscaped Grounds*, promotes practices that minimize the adverse effects of landscaping on the local environment (see also Chapter B.5). Federal agencies are encouraged to reduce their need for fertilizer and pesticides and adopt integrated pest

management practices.

At a State level, pesticide policy is delegated primarily to the Department of Agriculture. The Ohio Pesticide Law is found in Chapter 921 of the Ohio Revised Code.

LeRC pest control policy is contained in Chapter 31 of the *Lewis Environmental Programs Manual*. This policy calls for the use of integrated pest management practices wherever possible.

Lewis Operations

Non-selective herbicides are used at Lewis in small quantities for vegetation control. Herbicides are applied seasonally and only to the extent needed. Pesticides are used to control crawling insects in buildings and near ornamental trees. No restricted pesticides are used. Fertilizer is applied only to newly seeded areas. Chemicals are stored in Building 107 and equipment is stored in Building 208.

Pesticide and herbicide activities are carried out by a contractor. The facility landscaping budget has been reduced in recent years, which is a factor in the decreased use of pesticides and herbicides. For example, chemicals are no longer applied to ornamental trees, many of which are nearing the end of their normal life span. An environmental audit conducted in 1996 (Foster Wheeler, Draft, 1996a) noted that the contractor's applicators were adequately trained but there did not appear to be an adequate health monitoring system in place, and corrective action was recommended.

RADIATION

Regulatory Background

Most rules regarding radioactive materials are issued by the Nuclear Regulatory Commission (NRC) in Title 10 of the CFR. LeRC policies regarding ionizing radiation, x-ray diffraction equipment, and non-ionizing radiation are contained in Chapters 28, 29, and 30 of the *Lewis Environmental Programs Manual*, respectively. Radiation policies are also presented in the LeRC *Radiation Protection Program Manual* (LeRC 1980).

Lewis Operations

Oversight for ionizing and non-ionizing radioactive sources at Lewis is exercised by the LeRC Radiation Safety Committee. Radiation safety programs are coordinated by the Health Physics Team of the EMO, which has a Radiation Safety Officer (for ionizing sources) and a Laser Safety Officer (for non-ionizing sources). An environmental audit conducted in 1996 (Foster Wheeler, Draft, 1996a) found Lewis to be in "substantial compliance" with radiation-related requirements.

Ionizing Radiation

The largest radioactive source at Lewis was the cyclotron at Building 49. This facility had been used for research and medical purposes and was closed in 1990. In 1995-1996 the laboratory and work areas surrounding the cyclotron were decontaminated and decommissioned. The cyclotron itself is in the "machine room" that has not yet been decontaminated. Radioactive materials in the cyclotron include ^{60}Cobalt, ^{137}Cesium, ^{22}Sodium, and ^{54}Manganese. These are relatively short-lived isotopes, and the current intent is to allow these sources to decay in place. Levels of radiation within 50 years will be low enough to allow relatively simple final decontamination and decommissioning.

LeRC holds NRC Material License No. 34-00507-16. This is a Specific Byproduct Materials License and is for small sealed sources only. The license was renewed in 1996 in Amendment No. 22 and extended until June 30, 2004. There are no reporting requirements under the license. About 20 Lewis and contractor staff are monitored with personal dosimeter devices. Exposures have been consistently maintained "As Low As Reasonably Achievable" with no exposures exceeding the NRC-allowable dose for radiation workers of 1000 millirem per year.

There is a 54-curie ^{241}Americium-Beryllium neutron source on site. This source is no longer used and is stored in a shielded container. Three ^{241}Americium sources (300 millicuries each) and a variety of other smaller sources are stored in

the same area. LeRC plans to ship the 54-curie source to Europe for reuse. There are no immediate plans for removal of the smaller sources.

Other sources on site are widely distributed in laboratories and other facilities. They are used primarily for x-ray diffraction analysis, instrument calibration, and radiographic analysis. Workers who routinely use these sources are badged, and none has received appreciable doses from these sources. No exposures have exceeded allowable limits.

Some low-level radioactive waste disposal has taken place, particularly as a result of the cyclotron project. Shipments occurred in 1994 and 1996. As of the 1996 shipment, there was no radioactive waste remaining on site.

Non-ionizing Radiation

Lewis manages non-ionizing radiation sources according to guidance from the American Conference of Government Industrial Hygienists, American National Standards Institute, and OSHA regulations. There are no licenses or permits associated with non-ionizing radiation sources at Lewis.

Non-ionizing radiation sources at Lewis were inventoried in 1996. These include electromagnetic field producing equipment, radio frequency antennae, and lasers. The largest electromagnetic field sources are induction heaters. There are twelve such heaters on site, about half of which are sufficiently large to induce currents in workers. Other sources include devices used in nuclear magnetic resonance studies and a few experimental devices using large direct current magnets. Smaller sources include microwave transmitter antennae as well as transformers and power supplies. The primary concern with these sources is interference with emergency radio bands (fire, police, etc.), but except for interference with some on site computers and electronic equipment, no interference has been detected. All such sources must be registered with the site radio frequency manager. A 1991 survey of electromagnetic radiation fields at Lewis found existing levels did not represent a potential hazard in occupied areas.

About 200 lasers are in use at Lewis, about half of which are Class IIIB and IV lasers which require significant controls to prevent accidental harm. All laser users must receive training and a baseline eye examination. There are also ultraviolet sources including solar simulators, which are essentially arrays of light sources. These produce high levels of ultraviolet radiation and are capable of causing skin burns without adequate protection. Infrared sources include lasers and ignition or flame propagation sources. Ignition and flame propagation infrared sources are generally small and do not require controls.

NOISE AND VIBRATION

Regulatory Background

The Noise Control Act of 1972, Public Law 92-574, was passed to control environmental noise because "inadequately controlled noise presents a growing danger to the health and welfare of the Nation's population, particularly in urban areas." Implementation of the Act was delegated to the USEPA, which investigated noise emissions from selected products. The Noise Pollution and Abatement Act directed Federal agencies to comply with Federal, state, and local requirements regarding the control and abatement of environmental noise. The Quiet Communities Act of 1978, Public Law 95-609, established a grants program to offer technical assistance for state and local noise abatement efforts. Environmental noise regulation remains primarily a state and local matter.

Occupational exposure to noise is regulated by OSHA at 29 CFR Part 1910.95. The noise exposure limit for workers is 90 dB(A) as a maximum daily time-weighted average. (The "decibel-A" scale, written as dB(A), is a frequency weighting network representative of the response of the human ear.) NASA has set a more conservative worker exposure limit of 85 dB(A) or, if this is not possible, a time-weighted average of 85 dB(A).

Some communities adjacent to Lewis have local noise ordinances. These are generally in the form of zoning restrictions for noise levels at residences and commercial facilities and for the operation of noise-emitting devices during certain times of the day.

Environmental Setting

Several noise sources exist in the general vicinity of the Lewis site. Foremost among these is the Cleveland Hopkins International Airport which is adjacent to Lewis. Other, lesser noise sources nearby include a Ford Motor Company factory and sources of traffic noise such as two major Interstate highways and a large exhibition hall (the I-X Center).

Lewis Operations

Noise generated at Lewis can be attributed to such sources as research operations (e.g., wind tunnels and engine test cells), transient noises such as releases from valves, NASA aircraft, construction activities, and traffic noise. Research sources such as the wind tunnels generate noise from the movement of rushing air. The central process air system in Building 64 can generate high noise levels from its compressors, exhausters, heaters, chillers, and other equipment. Recent surveys indicate that, with the exception of transient noise spikes, the highest on-lab noise levels measured near operating systems are in the 90-95 dB(A) range, with a maximum of 102 dB(A). Transient peaks in noise levels may occur due to the action of relief valves, vent noise, etc. Aircraft housed in the Flight Research Building (Building 4, the hangar) can taxi directly to runways at Cleveland Hopkins International Airport. Aircraft operations can generate maximum environmental noise levels between 80 and 90 dB(A) in nearby pedestrian areas on the Lewis site. Construction generates noise from machinery and vehicular traffic.

Responsibility for noise issues is delegated to the Noise Exposure Management Team of the EMO. The Team manages programs in hearing conservation, acoustical and noise control engineering, and community noise control. The hearing conservation program focuses on compliance with OSHA occupational noise standards and is summarized in Chapter 11 of the *Lewis Environmental Programs Manual.* Annual hearing conservation training and an audiogram are required for designated employees. Hearing protection is provided to all employees exposed to noise levels above 80 dB(A) and is required in areas where noise levels are above 85 dB(A). When hearing protection cannot reduce noise levels to less than 85 dB(A), the time a worker is allowed in high-noise areas is restricted to meet a time-weighted average exposure limit of 85 dB(A).

As an example of a noise control study, Building 64 was surveyed in 1995. This resulted in the development of a hearing protection policy tailored to that facility. A guide for purchasing low and lower noise equipment has also been prepared.

The community noise control program focuses on resolving local noise complaints and instituting appropriate measures as needed. All complaints are addressed personally by the noise program manager. The general noise level of Lewis is well below the average day/night sound level of the Cleveland Hopkins International Airport. Noise levels at the Lewis fence line are generally below 70 dB(A), with much of this noise attributable to off-site sources. Wind tunnel noise at the fence line is less than 55 dB. Tree stands along the western edge of the site also provide some sound buffering capability. "The large majority of complaints received are the result of maintenance run-up operations [i.e., required engine testing] at neighboring Cleveland Hopkins International Airport" (Cooper 1995).

HISTORIC AND ARCHAEOLOGICAL RESOURCES

Regulatory Background

The National Historic Preservation Act (NHPA) of 1966, Public Law 89-665, requires Federal agencies to consider the effects of their actions on historic and cultural resources. Section 106 of the Act requires agencies to identify and evaluate historic sites on their properties, assess the effects of their actions on these sites, solicit comments from the Advisory Council on Historic Preservation, and consult with the State Historic Preservation Officer (SHPO) (36 CFR Part 800). Implementation of the Act is delegated to the Department of the Interior and the National Park Service.

The NHPA protects sites that are listed or eligible for listing on the National Register of Historic Places (National Register). Listed places can include buildings, districts, historical sites, archaeological sites, structures, or significant historical objects of architecture, archaeology, engineering, or culture. The National Park Service establishes the criteria for evaluating significance and eligibility for the National Register. Some places on the National Register are also

designated as National Historic Landmarks which are places of exceptional historical value. These sites must have national significance and receive an enhanced level of protection under the NHPA.

The Archaeological and Historic Preservation Act of 1974, Public Law 93-291, extends protection to scientific, prehistoric, and archaeological data resulting from Federal undertakings. The Archeological Resources Protection Act of 1979, Public Law 96-95, protects archeological sites on Federal land. The law requires that permits be obtained before cultural resource investigations begin at sites on Federal land. The American Indian Religious Freedom Act of 1978, Public Law 95-341, protects the traditional practices and religions of Native American Indians, Eskimos, and Native Hawaiians. Protections include access to traditional sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rites. The Native American Graves Protection and Repatriation Act of 1990 requires Federal land owners to identify Native American artifacts or human remains and provide the opportunity for their repatriation.

Executive Order 11593 (1971), *Protection and Enhancement of the Cultural Environment*, directs Federal agencies to identify cultural resources on their properties, nominate qualifying resources to the National Register, avoid damaging resources that may be eligible for listing, and to strictly comply with the NHPA.

Lewis Operations

The LeRC Chief Architect serves as the Facilities Preservation Officer.

In 1989, a Programmatic Agreement was signed between NASA, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation regarding the management of NASA's National Historic Landmarks. The Agreement stipulates that NASA will consult with and obtain approval from the SHPO prior to dismantling or significantly affecting designated National Historic Landmarks. Should NASA and the SHPO disagree, the Advisory Council on Historic Preservation is consulted.

Attachment 1 to the Programmatic Agreement lists National Historic Landmarks at NASA facilities. Lewis also undertook a cultural reconnaissance survey in 1996 to inventory National Register eligible resources in its possession (Gray and Pape 1996). These sources cite two Lewis facilities which have been designated as National Historic Landmarks: the Rocket Engine Test Facility (RETF) and the Zero Gravity Facility.

The RETF (Building 202) was constructed in 1956. It was listed as a National Historic Landmark as part of the 1984 Man In Space thematic nomination. The RETF and the former Rocket Operations Building (Building 100) were listed as an integrated test facility significant for their contribution to the development of lightweight, regeneratively-cooled hydrogen engines. The facility was used for the development of the Centaur and Saturn rocket engines (which brought the Apollo astronauts to the moon) as well as the main engines for the Space Shuttle.

In April 1996, the NASA Zero Base Review identified the RETF for closure. The facility is currently in "inactive-mothballed" status. The managing division for the facility has determined that "relatively small and portable components and items such as valves, transducers, spare parts, instrumentation, etc., will be made available to LeRC facilities and programs." Larger items will be retained in place under the current facility status.

The Zero Gravity Facility (Building 110) was constructed in 1966. It was listed as a National Historic Landmark as part of the same Man In Space thematic nomination as the RETF. The facility is used to study the behavior of aerospace components, liquids, gases, and combustion in a simulated microgravity environment and has supported all aspects of the United States space program. The key component is a 6.1 meter (20 foot) diameter drop chamber which is 143 meters (470 feet) deep. The chamber can be brought to near vacuum to lower drag on the falling test vehicle. A weightless state can be achieved for up to 10 seconds and the test vehicle retrieved without damage. This is the only known facility of its size capable of performing tests in a reduced gravity environment.

In 1987, the Icing Research Tunnel (Building 11) was named an International Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers. This facility has a unique heat exchanger and a spray system that simulate natural icing clouds. The facility is the world's largest refrigerated icing tunnel and has been the site of groundbreaking research in aircraft icing phenomena.

One archaeological site has been reported in the vicinity of Building 501 (Jones 1996). The "Dean Site" (State Number 33 Cu 133) is known from anecdotal reports and is said to have contained relics from the Archaic and Woodland periods. The site is probably no longer extant.

SOCIOECONOMIC RESOURCES

Employee Population

The Lewis on-site population was 3718 as of December 1995 (Table B-9). Of this total, 62% were civil servant employees. The Greater Cleveland Growth Association ranked Lewis as the area's 22nd largest employer (Austrian 1996). Another source reported Lewis to be the 36th largest employer in the Cleveland Consolidated Metropolitan Statistical Area (Jones 1996).

Table -9 Personnel Levels at Lewis

Personnel[1] Classification	May 1992	May 1993	May 1994	Dec. 1994	Dec. 1995
Civil servant	2,871	2,786	2,536	2,454	2,312
On-site contractor	1,575	1,549	1,548	1,460	1,202
Other	218	245	229	237	204
Total	4,664	4,580	4,313	4,151	3,718

1. Defined as "Center population, including personnel not requiring housing and second shifts."
Source: LeRC Facilities Utilization Reports.

There is significant concern regarding Federal budget cutbacks which have led to a decline in the Lewis population. Employment levels have declined 20% in the past five years. By FY 2000, the employee population is expected to decline even further, perhaps to less than 3,000. Thus far, decreases have been spread relatively evenly across personnel classifications. In the future, decreases are expected to fall more heavily upon on-site and near-site contractor personnel.

Employees are classified as either administrative professional (management), clerical, scientist and engineer, technician, or trades personnel. Numbers of personnel by category and trends are shown in Table B-10. Ten percent of civil servant employees hold a Ph.D. degree, 21% a master's degree, and another 35% a bachelor's degree. Lewis has a skilled and educated work force which is a critical component of the science and technology base of the region.

Local Demographics

The Lewis site is located in Cuyahoga County in the greater Cleveland metropolitan area. The 1990 Census gives the population of Cuyahoga County as 1.9 million and the Cleveland Metropolitan Statistical Area as 2.8 million people. Seventy percent of Lewis civil servant employees live in Cuyahoga County, and 95% in the Cleveland metropolitan area (Austrian 1996). The most common cities of residence are, in order, North Olmsted, Cleveland, Strongsville, Westlake, Parma, Fairview Park, Berea, Lakewood, Brunswick, and Medina.

Executive Order 12898 (1994), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to integrate the achievement of environmental justice into their missions. Agencies must ensure that their policies, programs, and activities do not exclude or subject persons or populations to discrimination because of race, color, or national origin.

Table -10 LeRC Personnel by Occupational Category

Source: Austrian 1996

In response to the Order, LeRC has developed an *Environmental Justice Implementation Plan* (Jones 1996). Five Census tracts were identified within an 8 kilometer (5 mile) "region of influence" which are likely to meet Federal environmental justice criteria for minority or low-income communities (Figure B-8). The Plan concluded that "...no substantial or disproportionate environmental impacts are currently experienced by any community at either location [i.e., Lewis or PBS]." The Plan is being implemented to identify and mitigate potential environmental justice problems and will be revised periodically as needed.

In close proximity to the Lewis site are a full range of cultural facilities. The downtown area is twenty miles away and boasts several theaters, the Rock and Roll Hall of Fame and Museum (opened 1995), the Great Lakes Science Center (opened 1996), Jacob's Field (home of the Cleveland Indians baseball team), and the Gund Arena (home of the Cleveland Cavaliers basketball team). In the University Circle area are clustered many museums including the Cleveland Museum of Art, Cleveland Museum of Natural History, the Garden Center, the Crawford Auto-Aviation Museum, Western Reserve Historical Society, and the Cleveland Children's Museum. The extensive Cleveland Metropolitan Park system provides green space for local residents. There are numerous houses of worship in the area of all denominations.

Local Economic Impacts

Other employers in the vicinity of Lewis include the Centerior Energy Corporation, Ford Motor Company, General Motors, Finast Supermarkets, Case Western Reserve University, the University of Akron, and medical facilities such as the Cleveland Clinic and University Hospitals.

The Cleveland State University (CSU) was commissioned by LeRC to study the potential impact of NASA budget cuts on the Cleveland economy and what actions the Center might take in response (Austrian 1996). The study found that cutbacks at Lewis could have a significant adverse economic impact on local communities. Total wages and payroll for civil servant employees amounted to $145 million in FY 1994, plus an additional $29 million in benefits. The average civil servant salary was over $50,000 (over $63,000 with all benefits included). Taxes paid by civil servant employees in FY 1994 in Ohio amounted to almost $6 million. The above figures do not include the many contract employees also at LeRC.

The study found $372 million in direct spending by LeRC in northeast Ohio in FY 1994, which resulted in a total economic output impact to the area of over $1 billion. LeRC spending resulted in a total employment impact of 12,781 jobs. The total local earnings impact was $375 million. Virtually all of LeRC's budget is derived from Federal sources outside of Northeast Ohio, so the Center represents an important conduit for the flow of Federal dollars into the region.

LeRC paid $667 million to contractors in FY 1994, primarily for engineering, business, and construction services. Of this amount, 38% was spent in Ohio, and 31% in northeast Ohio. Small businesses accounted for 60% of the spending in northeast Ohio. Almost three quarters of small businesses spending went to minority-owned firms. LeRC awarded over $43 million in grants to educational institutions (49% in Ohio). The largest grant recipients were, in order, the Ohio Aerospace Institute, Case Western Reserve University, Cleveland State University, and the University of Toledo. In the last four years, LeRC has awarded 32 research grants totaling $19 million to 16 Historically Black Colleges and Universities.

Among the recommendations of the CSU study was the development of strategies to retain skilled technical people in the area since, "...highly skilled employees enrich the area's labor market. They should be strategically redeployed where possible." Partly as a result, LeRC has been intensifying its activities in the area of Technology Transfer. For example, during FY 1994-1995, LeRC offered technical assistance to 1490 companies in the United States, two thirds of which were in Ohio. In July 1996, LeRC and the State of Ohio announced the Lewis Incubator for Technology (LIFT) program. The goal of LIFT is to create new products, services, companies, high-quality jobs, and promote economic growth in Ohio through access to NASA technologies. A major Business and Industry Summit was held at the Lewis site in September of 1996. In December of 1996, NASA

Source: Jones Technologies 1996

Figure -8 Possible Minority and Low-Income Areas Near Lewis

Lewis Research Center, the Great Lakes Industrial Technology Center, and the Youngstown Business Incubator announced an agreement to "engage in mutually beneficial cooperative activities that will encourage development and implementation of new technologies to develop new companies" (NASA LeRC Press Release 96-61).

Transportation

The transportation network in the vicinity of Lewis is well developed. Two major highways, Interstate-480 and Interstate-71, provide automobile access and serve as major feeders to the airport. These are heavily-traveled roads which are often congested during rush hour. There are many secondary roads also serving the area. Most commuting to Lewis is by automobile. Past studies have shown occupancy factors of 1.1 persons per vehicle.

The Regional Transit Authority provides public transportation to Lewis. The level of service is limited. A public transportation subsidy program is available to civil servant employees. Participation averages 30-35 people per month.

Lewis is adjacent to the Cleveland Hopkins International Airport, which provides national and some international air service. Cleveland serves as a hub for Continental Airlines, a major domestic carrier. NASA aircraft can taxi directly from the Flight Research Building to runways at the Airport.

Electric and Gas Utilities

Lewis obtains its electricity from the Cleveland Electric Illuminating Company, a subsidiary of the Centerior Energy Corporation. Electrical consumption was 286,230 MWh in FY 1994. This electricity cost $13.9 million, representing 83% of total utility costs. Rates are based on a time-of-day schedule, and when feasible, energy-intensive uses such as the wind tunnels are scheduled to run during off-peak hours. There are four incoming 138-KV overhead lines connecting at Substation A in the South Area. Electric capacity has been reported as 400 MVA (Warner/Osborn/Pardee 1990).

Qualitative data suggest that approximately one-half of the electricity used is for the major research facilities (SAIC 1995). These include the wind tunnels and engine and propulsion test facilities. The remainder is used for the smaller research facilities, support facilities, and for institutional purposes. No routine power is generated on site and there are no co-generation facilities. There are approximately 12 emergency electrical generators for back-up power.

Projects implemented to reduce electrical consumption include the upgrading of interior lighting systems with high-efficiency T-8 fluorescent lamps, electronic ballasts, and occupancy sensors. Energy-efficient lighting systems are the standard for all new construction (see LeRC Operating Instruction LVEPS-OI-005, effective September 15, 1995). Sophisticated energy and HVAC control systems have also been installed in many buildings. New computer equipment must meet USEPA Energy Star standards. LeRC has also utilized energy savings performance contracts, demand side management programs, and utility rebates as additional tools to improve energy management.

Natural gas supplies much of the heating needs of the facility. Total consumption was 496,035 MCF in FY 1994. It has been estimated that 80% of the heat and steam produced is used for institutional purposes. The remaining 20% is used for research purposes including the wind tunnels, test cells, and other activities.

Health and Emergency Services

Lewis has an Emergency Preparedness Plan which describes response actions to be taken in the event of an emergency (LeRC 1993). The Plan meets various requirements of the USEPA, OSHA, the Federal Response Plan, and the NASA Emergency Preparedness Plan (QS-EPP-92-001), and is revised periodically.

The NASA Lewis fire station was closed in April 1996 after an assessment determined that the Center could effectively rely on local emergency response resources. Fire, medical, and hazardous material emergency response are now provided by the adjacent communities of Cleveland, Brook Park, and Fairview Park. Under the current plan, reported incidents are first investigated by former fire fighters who were reassigned to first responder positions. If deemed necessary, NASA dispatchers call for outside assistance. In an obvious emergency, outside assistance is requested immediately. There is also coordination of emergency services with the Airport Fire Department.

EPCRA and Executive Order 12856 directed Federal agencies to provide technical assistance to the Local Emergency Planning Commission in the development of emergency response plans and the fulfillment of community right-to-know responsibilities, if requested and to the extent practical. Lewis has responded to all requests for information from the State and Local Emergency Response Commission. Lewis has also supplied the Local Emergency Response Commission with a list of resources and equipment which can be made available in the event of an emergency.

RT C PLUM BROOK SITE

DESCRIPTION OF THE INSTALLATION

The Plum Brook Station is operated as a satellite facility (component installation) of the NASA Lewis Research Center. Use of this site by the Federal Government began in 1941 when the U.S. Army established the Plum Brook Ordnance Works for the manufacture of munitions. Munitions production took place from 1941 to 1945, after which buildings and production lines were decontaminated and decommissioned. There were then several changes in ownership and eventual transfer of portions of the site to NACA (later NASA) in 1955.

NACA's original interest in the site was as a testing location for high-energy rocket engines and nuclear power systems. Other activities at PBS over the years have included the development of special pumps for space applications, rocket engine research, space vehicle testing, cryogenic testing, wind tunnel testing, and related aerospace research.

Size and Location

The NASA portion of the PBS site is 2614 hectares (6454 acres) in size (LeRC, November 1995). The site is located in a rural area in west central Erie County, Ohio, approximately 80 kilometers (50 miles) west of the Lewis facility in Cleveland (see Figure A-1). The nearest big city is Sandusky, 6 kilometers (4 miles) to the north. Most of the PBS site is in Perkins and Oxford townships, with some land in Huron and Milan townships to the east. The site boundaries are Bogart Road to the north, Mason Road to the south, U.S. Highway 250 to the east, and County Road 43 to the west (Figure C-1).

The northernmost point is at latitude 41°23'39"N; and the southernmost point at 41°20'04"N. The westernmost point is at longitude 82°43'12"W; and the easternmost point is at 82°38'39"W. The location can be found on the USGS 7.5 minute-series topographic maps for the Kimball and Sandusky Quadrangles (N4115-W8237.5/7.5 and 41082-D6-TF-024, respectively).

Site Facilities

The 1995 *Real Property Report* (LeRC, November 1995) lists 179 buildings, structures, and other entities at PBS (Table C-1). These include offices, mechanical and process equipment areas, test facilities, substations, and wastewater treatment facilities. The capital cost of PBS facilities is given as $104 million, with a replacement cost of $594 million. The total gross square footage (measured from outside wall to outside wall) is 91,282 square meters (982,584 square feet). The *Facilities Utilization Report* (LeRC, December 1995) states the "allocated net useable area" at approximately 89,000 square meters (961,000 square feet). The largest percentages of this space are devoted to storage (42%), technical facilities (35%), "miscellaneous" (13%), and office space (5%).

The PBS was placed on standby status in 1974. Some site facilities were preserved for future use and in 1987 were made available to government and commercial users on a full-cost reimbursable basis. This included four major space testing facilities, as described below.

Space Power Facility

The Space Power Facility (SPF) is the largest controlled environmental test chamber in the world. It also has nuclear capabilities, although these have never been used and therefore the facility is free of radioactive contamination. The facility consists of an aluminum test chamber surrounded by a heavy concrete enclosure. The chamber is 30 meters (100 feet) in. The facility can test space power generation and propulsion systems and space hardware under simulated diameter and 37 meters (122 feet) high, enclosing some 23,000 cubic meters (800,000 cubic feet) of unobstructed volume conditions including a vacuum environment and temperatures ranging from -157 ° C to +124 ° C (-250 ° F to +255 ° F).

Figure -1 Map of PBS Site

(Fold-out)

Table -1 Buildings and Structures at PBS

Table C-1 Buildings and Structures at PBS (cont'd)

Table C-1 Buildings and Structures at PBS (cont'd)

Source: LeRC, November 1995

The SPF will be used for a test of the photovoltaic radiator and central thermal control radiator for the electrical power system of the International Space Station. Other uses of the SPF include:

> A third series of Ariane 5 Payload Fairing Separation Tests for the European Space Agency was performed between September 1994 and January 1995 in the SPF. From January 1995 through the present, the SPF has been configured to support development testing of the landing gear system for the NASA Mars Pathfinder program. Mars Pathfinder testing will continue through the second quarter of FY 1996....In May 1996, the SPF [will be] configured to support Space Station Freedom Radiator Deployment Tests. Space Station testing is scheduled to continue through the third quarter of FY 1997 (LeRC, December 1995).

Spacecraft Propulsion Research Facility

The Spacecraft Propulsion Research Facility (B-2 Facility) is used for research, development, and validation testing of spacecraft and space propulsion systems. It is the world's only space environment chamber that can perform full-mission profile simulation testing for large upper stage rocket engines and complete launch vehicles. The facility can simulate vacuum, cryogenic background temperatures, and solar heating conditions found in near-earth orbit. Systems can be subjected to long-term conditions of cold, vacuum, and solar heating. The facility includes a large vacuum chamber; a "cold wall" using liquid nitrogen coolant; and radiant heating for solar thermal simulation using quartz infrared lamps. Liquid oxygen-liquid hydrogen rocket engines can be fired for up to six minutes. A test rocket can be installed vertically and fire its engines into a water-cooled diffuser and spray chamber containing 6.62 million liters (1.75 million gallons) of chilled water. This water is contained and can be treated later if contaminated by the rocket exhaust.

In 1996, the B-2 Facility was used in a live rocket firing test of densified cryogenic hydrogen fuel. Other uses of the B-2 Facility include:

> The B-2 Facility was used from January 1995 through September 1995 to perform thermal vacuum testing on the Mars Pathfinder Air Bag Landing System....In September of 1995, critical facility systems were reactivated to perform RL10 engine turbopump chilldown testing in support of the Atlas Reliability Enhancement Program. The program will continue into March 1996....B-2 is scheduled to perform risk mitigation testing in May of 1996 in support of McDonnell Douglas's Delta III upper stage development program....Integrated System Testing of the complete Delta III upper stage is scheduled to begin in April of 1997 (LeRC, December 1995).

Cryogenic Propellant Tank Research Facility

The Cryogenic Propellant Tank Research Facility (K-Site) performs testing of a variety of rocket propellant tank systems. These include cryogenic fluid slush tests, tank fill and expulsion tests, and performance testing of tank insulation systems. Boundary conditions, from ground hold to deep space, can be controlled utilizing a heated or cooled shroud enclosing the test package in a vacuum chamber. The facility includes a 7.6 meter (25 foot) diameter test chamber with a volume of 269 cubic meters (9500 cubic feet). Propellant types which can be tested include liquid hydrogen, liquid nitrogen, gaseous hydrogen, gaseous nitrogen, and gaseous helium. According to the *Facilities Utilization Report* (LeRC, December 1995), the K-Site continues to be used intermittently for densified hydrogen research programs for advanced engine

development.

Hypersonic Tunnel Facility

The Hypersonic Tunnel Facility (HTF) was once a heat transfer facility and later converted to support the development of air-breathing engines suitable for use in hypersonic aircraft. The HTF can provide true aero-thermodynamic simulation of the flight environment. It can test propulsion systems and components with synthetic air at speeds up to Mach 7 (approximately 8700 kph [5,400 mph]). Models up to 0.6 meters (2 feet) in diameter and 3 meters (10 feet) in length can be tested. The facility includes storage of approximately 20,000 cubic meters (700,000 cubic feet) of gaseous nitrogen and a smaller quantity of gaseous oxygen which are used to create the desired atmospheric test conditions. The HTF is the Nation's only large, non-vitiated (clean air) hypersonic wind tunnel.

The HTF was renovated in the early 1990's. Testing programs will focus on scram jet engines and use the steam boilers in Building 5231 to pull a vacuum on the test chamber. In 1996, a mechanical failure occurred in the HTF which damaged a shutter valve beyond repair. This put the facility temporarily out of commission; it is expected to be repaired and back on line during 1997.

Other Facilities

The Plum Brook Reactor Facility (PBRF) began operation in the early 1960's. After approximately ten years of operation, the facility was shut down. In 1979 NASA determined there was no further need for this facility and it could be removed. Funding limitations have prohibited dismantling and decommissioning to date (see also Chapter C.11).

Other facilities at PBS include the Engineering Building (Building 7141) which provides office space. There are 99 storage bunkers (originally used for storing munitions) in the southeast area, nearly all of which are now used for warehousing and storage of records and chemical supplies. The Ohio Air National Guard stores munitions in one bunker. Two raw water pumping stations are located off-site and supply water for fire protection and cooling equipment. There is also a small airstrip, as well as buildings for mechanical and process equipment, shipping and receiving areas, substations, and cooling towers.

Site Access

The site is surrounded by an 2.4 meter (8 foot) security fence. Access is controlled by a security guard house located on Columbus Avenue. The guard house is staffed 24 hours a day.

AIR RESOURCES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

Environmental Setting

Climate

At PBS the climate is continental in character and influenced by proximity to Lake Erie. Summers are moderately warm and humid, with temperatures occasionally exceeding 32° C (90° F). Winters are cold and cloudy, with temperatures falling below -18° C (0° F) an average of five days per year. Annual temperature extremes typically occur after late June and in December. First frost typically occurs in October.

Average annual precipitation is 86 centimeters (34 inches) (1951-1980 data). The 2-year, 24-hour rain event is 6.2 centimeters (2.45 inches). Average annual water loss is estimated at 57 centimeters (22.5 inches). The National Weather Service maintains a volunteer Cooperative Data Station in Sandusky (Data Station Index Number 7447). Daily high and low temperatures and precipitation data are published in a *Cooperative Data Report* for this location. The nearest full-

scale National Weather Service stations are in Cleveland (Station Number 14820) and Toledo (Station Number 94830).

The most recent available wind rose for the area was prepared in 1956 (Figure C-2). The predominant wind direction is southwest throughout the year. In spring and summer, there are also northerly and northeasterly breezes from the lake (Morrison Knudsen Corporation 1994).

Local Air Quality

Erie County, in which the PBS is located, is attainment for all NAAQS. There is one Ohio EPA monitoring station in the County which monitors total suspended particulate levels. In addition to NASA, other emission sources in the area include the Ford Motor Company in Sandusky, several greenhouses, and some large coal-fired institutional boilers.

PBS Operations

PBS is assigned Ohio EPA air program facility identification number 1322020172. A recent air emissions inventory (Ebasco 1994) identified 43 point sources of air emissions, which were grouped into seven categories:

Boilers and space heaters

Degreasers

Paint/coating booths

Combustion process equipment (e.g., the HTF)

Fuel storage tanks

Laboratory exhaust hoods

Internal combustion engines, including electric generators.

There are fifteen boilers with a heat input rate greater than 1 million BTU per hour. Boilers are located in Buildings 1121, 1411, 2831, 3232, 3431, 5231, and 7141. These boilers typically burn natural gas, with fuel oil as a backup fuel. Eight degreaser units were reported. Solvents used include 1,1,1-trichloroethane, Varsol, Super Agitene, phosphoric acid, and isopropyl alcohol (Table C-2). One active paint booth in Building 7131 (the Maintenance Garage) was reported in 1994, using an estimated 34 liters (9 gallons) of paint per year.

Source: SAIC, June 1991b

Figure -2 Wind Rose for Sandusky

Table -2 Solvent Use in Degreasers at PBS

Solvent	Composition	Estimated Annual Use
1,1,1-Trichloroethane (TCA)	- -	15 gallons (Building 3411)
Varsol	Paraffins 55% Napthenes 40% Aromatics 5%	20 gallons (Building 1411, 2 units)
Super Agitine	Paraffins-napthenes 98% Dipropylene glycol methyl ether <0.5%	30 gallons (Building 7131)
Phosphoric acid, Isopropyl alcohol, or TCA	- -	330 gallons, starting in 1996 (Building 1491, 3 units)

Source: Ebasco 1994.

Bulk storage tanks at PBS contain gasoline, diesel fuel, and fuel oil. Building 7143 contains laboratory fume hoods used during chemical analyses of water samples. Of the internal combustion engines on site, the two largest are a 200 horsepower backup pump in Building 8133 and a 1.25 mW electric generator set in Building 1411. Open burning is practiced for vegetation control and is an additional source of emissions. An on-site incinerator has not been used for 20 years or more.

Potential emissions are shown in Table C-3; estimated actual emissions are given in Table C-4. The highest actual emissions are projected to be from the boilers. In general, actual emissions are much less than potential emissions because of the limited operation of PBS facilities.

Some ODCs are still in use at PBS. These include CFC-11, CFC-12, CFC-113, and HCFC-22, which are used in refrigeration and air conditioning equipment and for cleaning. Plans are to continue using chemicals in cooling equipment as long as it continues to function properly. Some 1,1,1-trichloroethane is used in a vapor degreaser because this is the solvent specified for cleaning cryogenic oxygen systems for space flight hardware. The used solvent is captured with an estimated 96% recovery rate.

Due to its limited emissions, the PBS is not classified as a major source under the Clean Air Act Title V permitting program. PBS has applied for and received PTIs and PTOs for various on-site air emission sources. An environmental audit (Foster Wheeler, Draft, 1996b) found PBS to be in general compliance with air regulations. The *Environmental Justice Implementation Plan* (Jones 1996) concluded there was "...no reasonable likelihood of substantial off-site air quality impacts from normal operations and only moderate likelihood of substantial off-site air quality impacts from emergency operations or reasonably foreseeable accidents."

Table -3 Maximum Potential Air Emissions from PBS Facilities

Table -4 Estimated Actual Air Emissions from PBS Boilers

WATER RESOURCES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

Environmental Setting

Surface Water Hydrology

The PBS is located in the Lake Erie watershed. The Huron River and its branches constitute the major surface water system. Eleven streams cross the site, the largest of which are Pipe Creek, Kuebler Ditch, Ransom Brook, and Plum Brook. Streams generally flow northward and converge into Ransom Brook, Storrs Ditch, Plum Brook, and Sawmill Creek and eventually flow into Lake Erie. The drainage areas of streams at PBS are shown in Figure C-3. The streams could receive some of their volume from groundwater. Seventeen isolated ponds and reservoirs and three red water ponds are also located on the PBS site (SAIC, June 1991b). There are no catch basins specifically intended to collect runoff. No subsistence populations have been identified as users of the streams at PBS (Jones 1996).

The largest surface water body near PBS is Sandusky Bay on Lake Erie, approximately 6 kilometers (4 miles) to the north. Lake Erie is one of the five Great Lakes and has a surface area of approximately 25,700 square kilometers (9,919 square miles) and an estimated volume of 471 cubic kilometers (113 cubic miles) (SAIC, June 1991b). The Lake is an important fresh water fishery with a combined commercial and sport fishery catch estimated to exceed 20 million fish. Most commercial fishing takes place near Sandusky Bay. Lake Erie is also a popular recreational resource for boating and beaches. Other surface water features include Bellevue Reservoir Number 5 which is 23 kilometers (14 miles) to the south-southwest. There are numerous other ponds and streams within a 24 kilometer (15 mile) radius. The Erie County Health Department does not permit surface water to be used for private drinking water supply.

Surface Water Quality

All surface waters at PBS are classified as Warmwater Habitat by the Ohio EPA. Other use designations applicable to PBS streams include Primary Contact Recreation (swimming) and Agricultural and Industrial Water Supply. Ohio EPA does not routinely monitor the streams which drain the PBS site. The only known ambient monitoring data from the area were taken in Pipe Creek (upstream of PBS) in 1984. While monitoring data are limited, water quality in the streams that originate or flow through PBS is believed to be generally good. Hemming Ditch and Plum Brook ultimately discharge to Lake Erie within the Sheldon Marsh State Nature Preserve, and are afforded special protection by ODNR.

Groundwater

There are two principal bedrock aquifers in the PBS area (Morrison Knudsen 1994). A limestone aquifer is found in the western portion of Erie County. Groundwater in this aquifer occurs in a network of interconnected fractures, bedding planes, and solution channels, and flows to the north. A shale aquifer to the east is a poor producer due to the fine grained texture of the shale. The ODNR has delineated three groundwater zones based on well yield as illustrated in Figure C-4.

Some 179 private drinking water wells within a 6 kilometer (4 mile) radius of PBS are recorded by the Erie County Health Department (Morrison Knudsen 1994). No groundwater wells downgradient of PBS are known to be used for industrial or agricultural purposes. The nearest recorded downgradient well is at 6115 Schenk Road, but it is not known if this is used for drinking water.

Source: SAIC, June 1991b

Figure -3 Surface Streams at PBS

Source: SAIC, June 1991b, modified from Walker 1986

Figure -4 Water Bearing Zones at PBS

PBS Operations

Wastewater Discharges

Wastewater discharges at PBS include stormwater, non-contact cooling water, cooling tower and boiler blowdown, and sanitary discharges. There are currently no significant sources of process wastewater. The largest sewage treatment facility had been the Taylor Road plant (outfall 004), but this was taken out of service and its discharges were routed to the Erie County Sewage Treatment Works. Smaller tertiary treatment facilities are located at the SPF (outfall 005), the B-2 Facility (outfall 006), and the B Control Building (outfall 008). A treatment plant at the J-Site (outfall 007) is currently inactive.

Surface discharges are authorized by NPDES Permit No. OH 2IO00002*ED, effective through March 28, 2000. The permit covers eight discharge locations including three in-stream monitoring stations, two sewage treatment plant outfalls, and three non-contact cooling water outfalls. This permit is somewhat unusual in that three of the monitoring stations (Kuebler Ditch 001, Ransom Brook 002, and Plum Brook 003) are located in the stream rather than at the point of discharge. Permit limitations and monitoring requirements are shown in Table C-5. PBS is in compliance with its NPDES permit (Foster Wheeler, Draft, 1996b).

Stormwater from developed areas is collected in sumps and discharged through the industrial waste outfalls. Other stormwater is discharged to the ground or to streams. Stormwater can amount to hundreds of thousands of gallons during a major rainfall event.

PBS has two surface water areas which are believed to be affected by earlier manufacturing operations. Both contain red water ponds and are former wastewater disposal areas. "Red water" is a by-product of the manufacture of TNT. One area has reddish soils and periodic standing water and is located near Pentolite Road and drains to Plum Brook. The other area consists of two ponds which cover approximately 3 hectares (8 acres). Drainage from these ponds enters Pipe Creek,

particularly when there is significant precipitation. These discharges are reported to Ohio EPA as unauthorized discharges. The total volume and chemical characteristics of these discharges are unknown. The largest cooling tower is at the SPF. Most of the cooling towers are relatively small.

The *Environmental Justice Implementation Plan* (Jones 1996) concluded there was "...no reasonable likelihood of substantial off-site water quality impacts from normal operations and only moderate likelihood of substantial off-site water quality impacts from emergency operations or reasonably foreseeable accidents....Review of solid and hazardous waste programs indicates no reasonable likelihood of significant impacts to water quality from present actions and programs and only moderate impacts to water quality from earlier munitions manufacturing activities at the [Plum Brook] Station."

Water Use and Supply

Potable water used at PBS is purchased from the Erie County Water Division. The Division uses Lake Erie as its source of public, commercial, and industrial water supply. Water for PBS is drawn at the Big Island Pump Station and re-chlorinated at PBS. Neither local surface water nor wells are used for drinking water. Monthly monitoring is conducted for chlorine and coliform bacteria. Annual monitoring is conducted for turbidity, pH, lead, iron, copper, and zinc. Annual volume at this intake is over 10 trillion liters (3,500 million gallons) per year.

All drinking water fountains and janitorial sinks are tested for Safe Drinking Water Act parameters every six months. Analytes include free chlorine, chromium, coliform bacteria, copper, iron, lead, pH, and zinc. No drinking water fountains on site contain a lead liner.

Table -5 Summary of PBS NPDES Permit Requirements

Groundwater

No groundwater is used for drinking water. There are no injection wells on site. Therefore, routine groundwater monitoring is not required. Groundwater investigations are being conducted by the U.S. Army Corps of Engineers in connection with site remediation activities such as the red water ponds (see Section C.8.2.5). Approximately 60 wells have been installed. Ongoing groundwater investigations have found several contaminants including nitroaromatics, VOCs, SVOCs, and metals. This contamination will be remediated, but results to date do not indicate that immediate or emergency action is required.

LAND RESOURCES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

Environmental and Physical Setting

Topography

PBS is situated on land which was once lake bottom formed from glacial melt waters. The site is relatively flat and slopes gently northward. The average slope of the land is less than six percent. Elevations range from about 191 to 207 meters (625 to 680 feet) above sea level.

Geology and Soils

PBS is situated in the Ohio Lake Plain physiographic region. The soil is light-textured and often sandy with moderate to slightly acid pH. Two soil associations are present according to ODNR mapping. The Arkport-Galen association occurs in the northern and western areas of the site, and the Prout association in the southern and eastern areas. Soils are highly variable in thickness and permeability. The following information is taken from SAIC (June 1991b):

> The Arkport-Galen association is characterized by deep, nearly level to moderately sloping, well-drained to moderately well-drained soils that have a subsoil of loamy fine sand and fine sand and occur on sand hills and ridges. These soils are formed in very fine sand and deposited by wind and water as beaches, sand bars, and sand dunes. This association is made up of about 40% Arkport soils, 30% Galen soils, and 30% minor soils.
>
> The Arkport soils are gently to moderately sloping and well drained. The Galen soils are nearly level and moderately well drained. The minor soils occur in level to depressional areas and in the flat areas between the sand hills and ridges. The minor soil associations are either very poorly or somewhat poorly drained.
>
> The Prout association has moderately deep to deep, nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of heavy silt loam to silty clay loam. This association occurs on uplands such as the sides of stream valleys, shale outcrop ridges, along drainage ways, and in some steeper areas.
>
> The Prout soils are nearly level to gently sloping, dark colored, and somewhat poorly drained. These soils are underlain by shale bedrock at a depth ranging from 51 to 102 centimeters (20 to 40 inches) for the Prout soils, and 102 to 152 centimeters (40 to 60 inches) for deep variant Prout soils. The minor soils in this association include a broad spectrum from nearly level to depressional and very poorly drained to nearly level to gently sloping and well drained.

Bedrock in the area consists of carbonates and clastics (sandstones and shales). Bedrock consists of four Devonian formations: Columbus Limestone, Delaware Limestone, Plum Brook Shale/Prout Limestone, and Ohio Shale. Depth to bedrock is highly variable and can range from 0.7 to 7.6 meters (2 to 25 feet). In scattered locations, the bedrock formations are exposed.

Seismology

The State of Ohio, including the PBS site, is located in Seismic Zone 1 (Ohio Building Code 1990). The probability of an earthquake causing structural damage is minimal.

PBS Operations

Land Acquisition and Land Use

The area surrounding the PBS is largely rural and agricultural. Some food processing facilities are located in the area including dairy and meat processing operations. Tourism and recreation are important economic influences in the Sandusky area during the summer months.

The land originally leased by NACA in 1956 included 202 hectares (500 acres). NASA accepted the land in 1963 after the Ravenna Arsenal certified the land was decontaminated and suitable for unrestricted future use (Morrison Knudsen 1994). NASA acquired another parcel of approximately 2428 hectares (6000 acres) in 1963. A detailed history of site ownership

can be found in Morrison Knudsen (1994). In addition to the land NASA owns directly, it has a use permit for 244 hectares (604 acres) from the Ohio Air National Guard. Local farmers lease approximately 393 hectares (972 acres) outside the security fence.

Most of the land at the PBS consists of forest land and old fields. An estimated 75% of NASA's property at PBS is considered unused. The remaining land is used for offices, test facilities, roads, and infrastructure. Other organizations maintaining offices or utilizing space at PBS include the Department of the Interior, Department of Agriculture, the Federal Bureau of Investigation, Department of Labor, Department of Defense, Immigration and Naturalization Service, the U.S. Coast Guard, U.S. Army Reserve, and Ohio Air and Army National Guards.

NASA identified 871 hectares (2152 acres) of land as excess in 1978. Of this land, 19 hectares (46 acres) were given to the Perkins Township Board of Education for use as a bus transportation center. Approximately 243 hectares (600 acres) in the western area designated as "Parcel 59" have been excessed through the General Services Administration. However, because of special conditions disposal has not taken place and decisions regarding potential contamination are pending (LeRC, December 1995).

BIOTIC RESOURCES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

Environmental Setting

The PBS site is part of a regional ecosystem encompassing Sandusky, parts of Lake Erie, and several Lake Erie Islands. Several natural areas are found in the general vicinity. The Milan State Wildlife Area is located approximately 5 kilometers (3 miles) to the south. The Erie Sand Barrens State Nature Preserve is approximately 305 meters (1000 feet) to the south. The Sheldon Marsh State Nature Preserve is approximately 6 kilometers (4 miles) to the northwest, and the Resthaven Wildlife Area 10 kilometers (6 miles) also to the northwest. Another local natural area is Old Woman Creek, a National Estuarine Research Reserve and State Nature Preserve, which is east of the city of Huron.

PBS Operations

Flora

The PBS site contains significant areas of grassland, bushland, and woodland. A biological survey conducted in 1994 focused on plant species, breeding birds, reptiles and amphibians, fish, and moths and butterflies (ODNR 1995). While the emphasis was on protected species (see Chapter C.6), all species found were identified. The following information is adapted from the ODNR survey:

> No significant plant communities were discovered in 1994 at the Plum Brook Station. The woodlands and grasslands that probably existed in the nineteenth century have been altered by a variety of factors. The historic prairies were drained and plowed prior to the establishment of the station. Older trees are absent, reflecting the clearing of forests. Because of the loss of the prairie soils through construction and drainage, many species present in 1899 are no longer present.
>
> Some 327 vascular plant species were collected or observed at PBS during the 1994 survey, 251 of which are considered indigenous to the area. The number is rather low because of the previous history of disturbance and the predation of deer. Many common wildflowers such as lilies, trilliums, and gentians which occur elsewhere in Erie County are absent from Plum Brook because of excessive browsing. Areas of greatest plant diversity are depicted in Figure C-5.

The Ohio vascular flora has been estimated at approximately 2350 species (Cooperrider 1992). About 24% of these are not indigenous to the State (Stuckey 1992). Alien species have spread into Ohio in many ways. A few were purposely introduced as ornamentals (Norway maple, *Acer platanoides*) or as potential crop plants (white sweet-clover, *Melilotus alba*). Many more were inadvertently introduced, including some of the most significant weed species such as Canada thistle (*Cirsium arvense*). Non-native species at Plum Brook include plants originally from Europe (downy chess, *Bromus tectorum*), Asia (tatarian honeysuckle, *Lonicera tatarica*), and the southern United States (broom-sedge, *Andropogon virginicus*).

Seventy-six non-native species were found at PBS. The number is typical for large blocks of land in Ohio. Most of the alien species are innocuous plants which occur primarily on roadsides and old agricultural land. These species, such as chicory (*Cichorium intybus*) and Deptford pink (*Dianthus armeria*), pose little threat to the natural vegetation. Other non-indigenous plants are major competitors with native species. At PBS these

Figure -5 Areas of Greatest Plant Diversity at PBS

include garlic mustard (*Alliaria petiolata*), multiflora rose (*Rosa multiflora*), autumn-olive (*Eleagnus umbellata*), and crown-vetch (*Coronilla varia*). These aggressive aliens displace native species and prevent the re-establishment of the natural flora.

The PBS obtains annual authorization from the Northwest District Office of the Ohio EPA to conduct open burning to control noxious weeds and assist in the establishment of field grasses. A two-month burn campaign is conducted each spring, alternating every year between one of three portions of the site. The campaign is timed to be completed prior to the nesting season of local wildlife.

The mowing of grasslands at PBS may be limiting the distribution of the threatened Least St. John's-wort (see Chapter C.6) and two other species (prairie-dock and northern blazing-star). Mowing in late August prevents these species from shedding seeds, restricting their spread into new areas. Early spring or late autumn burning of the grasslands may be a more appropriate management technique that would restrict the invasion of the native grasslands by woodlands and allow native species to re-establish themselves in this area. At the same time, burning in the woodlands is apparently contributing to loss of the natural understory that would exist in these areas.

Fauna

Wildlife at PBS includes such species as white tailed deer, raccoons, woodchucks, moles, starlings, pigeons, coyotes, hawks, Canada geese, and turkey vultures. A listing of wildlife typical of the northeastern United States can be found in Warner/Osborn/Pardee (1990). NASA utilizes the Fish and Wildlife Service of the U.S. Department of the Interior to cooperate with the ODNR Division of Wildlife in addressing wildlife management issues at PBS. The Fish and Wildlife Service maintains an office at PBS.

Controlled hunting is periodically undertaken to manage wildlife populations and control overgrazing. On September 26, 1975, the Fish and Wildlife Service issued a "Negative Declaration of Environmental Impact on White Tailed Deer Hunting on NASA Plum Brook Station." Based on this report, controlled white tailed deer hunts overseen by ODNR were conducted in 1976, 1984, and 1987. By 1989, herds throughout Ohio had increased substantially and ODNR raised the quotas. Alternative management techniques such as trapping have been tried but were not successful. Since 1989, hunts have been conducted approximately two out of every three years. A recent opinion recommended that the deer population at PBS be reduced as it was "decimating the herbaceous flora...destroying the natural diversity of the area" (ODNR 1995).

A total of 116 bird species was identified at PBS (ODNR 1995). Of these, 92 species were either confirmed or likely nesters. Five species were considered to be late migrants, and nine species visitors only. Commonly encountered birds include the American robin, song sparrow, field sparrow, indigo bunting, common yellowthroat, blue jay, and house wren. Nineteen reptile species were identified. These included two salamander, seven frog, six snake, and four turtle species.

Regarding fish, 13 species and 1 hybrid were captured and identified. With the exception of the brook stickleback, all of the species are common statewide and tolerant of water quality and habitat degradation. A total of 41 species of butterflies and 385 species of moths were recorded. Five of the butterfly species and approximately half of the moth species had not been recorded previously in Erie County.

Another wildlife management issue of concern is Zebra mussels in Lake Erie. These mollusks have infested the lake and reproduce at such high rates that they can clog water intakes. PBS continues to monitor this situation at its raw water intakes.

THREATENED, ENDANGERED, AND PROTECTED SPECIES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

A single-season biological survey was conducted at PBS in 1994 (ODNR 1995). The survey identified one Federally-listed species, the bald eagle (*Haliaeetus leucocephalus*). There was no evidence that any mating pairs were present on site.

Among State-listed species, three endangered, four threatened, six potentially threatened, and three species of special concern were found during the survey (Table C-6). Grooved flax and twisted yellow-eyed-grass (potentially threatened and threatened, respectively) were found on the site in 1982 but not in 1994. While there is suitable habitat for these species, deer may have browsed the twisted yellow-eyed-grass, making the plants difficult to recognize. Since deer would not tend to graze the wiry grooved flax, it should have been detected if present.

Table -6 Ohio-Listed Protected Species at PBS

Status	Species	Common Name
Endangered	*Hypericum gymnanthum*	Least St. John's-wort
	Cistothorus platensis	Sedge wren
	Carex cephaloidea	Thin-leaf sedge
Threatened	*Arenaria laterifolia*	Grove sandwort
	Carex conoidea	Field sedge
	Helianthus mollis	Ashy sunflower
	Bartramia longicauda	Upland sandpiper
Potentially Threatened (plants)	*Baptisia lactea*	Prairie false indigo
	Carex alata	Broad-winged sedge
	Gratiola virginiana	Round-fruited hedge-hyssop
	Hypericum majus	Tall St. John's-wort

	Rhexia virginiana	Virginia meadow-beauty
	Viola lanceolata	Lance-leaved violet
Special Concern (animals)	*Emydoidea blandingii*	Blanding's turtle
	Elaphe vulpina gloydi	Eastern fox snake
	Opheodrys vernalis	Smooth green snake

Source: ODNR 1995.

Other rare bird species identified at PBS (ODNR 1995) include:

Cooper's hawk

Alder flycatcher

Least flycatcher

Marsh wren

Brewster's warbler

Black-throated green warbler

Henslow's sparrow.

The Indiana bat (*Myotis sodalis*) is a Federally-listed endangered species which has been reported in Erie County. Other State protected species reported in the County include the western banded killifish (*Fundulus diaphanous menona*), least bittern (*Ixobrychus exilis*), eastern pondmussel (*Ligumia nasuta*), and the common tern (*Sterna hirundo*) (Morrison Knudsen 1994).

WETLANDS AND FLOODPLAINS

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

Past site modifications at PBS have included the construction of drainage ditches to prevent the accumulation of standing water. These activities have affected wetlands in the past, but do not appear likely to do so in the future (Jones 1996).

Data on peak discharges from surface water bodies are available from the National Flood Insurance Program and are summarized in Table C-7. Floodplains exist at each of the surface water bodies on site. A "Special Flood Hazard Evaluation Report for Plum Brook, Pipe Creek, and Tributary Streams in Erie County, Ohio, April 1984" was prepared by the Buffalo District of the U.S. Army Corps of Engineers.

No buildings at PBS are within the 500 year floodplain. There is concern regarding possible sources of contamination within the floodplain. The West Area Red Water Pond A-2 is entirely within the 100-year and 500-year floodplain. Red Water Pond A-1 is in the 500-year floodplain, and Disposal Area 2A is partially within the 100-year and 500-year floodplains (Morrison Knudsen 1994).

Table -7 Peak Discharges in the PBS Area

(Discharge data in cubic feet per second)

Flooding Source and Location	Drainage Area (sq. mi.)	10-Year	100-Year	500-Year
Pipe Creek above Taylor Ditch	23.6	2110	2525	2790
Storrs-Hemminger at Route 2	0.4	93	164	200
Plum Brook at Perkins Avenue	7.1	901	1603	1955

Source: Morrison Knudsen 1994.

WASTE GENERATION AND MANAGEMENT

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

Solid Waste

Solid wastes generated by PBS include office waste, paper, used equipment, construction and demolition debris, and wastes from routine maintenance. There are 19 collection containers for solid waste on site which are emptied on a weekly or bi-weekly basis. Waste generation rates were reported at 5 to 24 cubic meters (6 to 32 cubic yards) per week (Warner/Osborn/Perdee 1990). Waste is disposed of at the Erie County Sanitary Landfill. There are no solid waste disposal locations on site.

Recycling

White bond and computer paper are collected for recycling. Scrap metals such as steel, copper, brass, and aluminum are collected in separate containers and are also recycled.

Hazardous Waste

The PBS has been assigned Ohio EPA RCRA identification number OH 3800015379. PBS is a classified as a large-quantity generator due to high-volume wastes from past underground storage tank removals. Hazardous wastes are collected from four satellite accumulation points (Buildings 1441, 3211, 3411, and 7131) and brought to Building 9206 for consolidation and storage for less than 90 days. All areas where hazardous wastes are stored have secondary

containment. No treatment or disposal takes place on site so no RCRA Part A or Part B permit is required. Hazardous waste management is addressed locally by PBS staff, with guidance and support from EMO staff at Lewis.

Typical hazardous wastes from PBS consist of used solvents (chlorinated and non-chlorinated), oils, laboratory chemicals, fuels, lab packs, and wastes from maintenance operations. There is no segregation or reclamation of used solvents because the quantities involved are relatively small. When not contaminated, used oils may be recycled or used for fuel blending.

In the early 1990's, many unwanted chemicals were identified and removed in a large "lab-pack" disposal effort. Other changes made in the last few years regarding hazardous wastes at PBS include improved housekeeping practices, such as placing greater emphasis on putting wastes in the proper receptacles.

Storage Tanks

There are 2 UST's and 10 above ground storage tanks at PBS which are used to store gasoline, diesel fuel, and lubricating oils. All new underground storage tanks have double wall fiberglass-reinforced plastic for tanks and piping. All above ground tanks greater than 600 gallons have secondary containment (Foster Wheeler, Draft, 1996b).

From 1989 to 1994, PBS carried out an aggressive UST removal and replacement program. Some 21 UST's were removed from nine locations. Any visibly-contaminated soil was removed from the excavation cavity for proper disposal. Three of the UST sites are undergoing RCRA corrective action. Tanks which were at the Space Power Facility, Maintenance Garage, and the Research Reactor Building stored materials considered hazardous wastes. These tanks were removed and closure plans submitted to the Ohio EPA in 1995 for comment (Foster Wheeler, Draft, 1996b).

Remediation Actions

Several investigations of possible contamination at PBS have taken place over the years. These are summarized in Table C-8. One such study was a CERCLA Preliminary Assessment of potential locations and sources of hazardous substance contamination (SAIC, June 1991b). This study identified 14 operable units for which there was evidence of possible contamination. A CERCLA Site Inspection then evaluated these locations through soil, sediment, surface water, and groundwater sampling (Morrison Knudsen 1994). The sampling and other data were used to derive a Hazard Ranking System score for the PBS site. The score for the entire study area was 7.99, less than the minimum of 28.50 typically required to be placed on the CERCLA National Priorities List. Scores for the five individual subareas (or Project Management Units) were also less than 28.50. The Site Inspection recommended no further remedial action under CERCLA. PBS received a No Further Remedial Action Planned letter from the USEPA in October 1994.

As a result of past Army activities at PBS, the U.S. Army Corps of Engineers is also conducting remedial activities under the Defense Environmental Restoration Program for Formerly Used Defense Sites. Thus far, areas of concern have been identified and prioritized based on historical information and available field data. A Site Investigation is evaluating these areas to determine their environmental significance, after which remediation will be carried out as needed. Particular areas of concern are the red water ponds and the former rifle range. "Red water" is a by-product of the manufacture of TNT, one of the activities of the old Plum Brook Ordnance Works. Seepage from the red water ponds has been observed or suspected over the years. The firing range may be contaminated with various heavy metals. Corps of Engineer activities at PBS are being conducted in coordination with NASA and the Ohio EPA.

Spills

PBS has a Spill Prevention, Control, and Countermeasure Plan (LeRC, March 1994). The Plan describes procedures for the prevention and control of oil spills, including PCB-containing oil spills, and specifies program responsibilities, training, spill reporting, location of response equipment, and emergency response procedures.

In 1980, several thousand gallons of diesel oil were released from a UST at the SPF and flowed to one of the PBS sewage treatment plants. As much oil as possible was recovered and contaminated media were disposed of at a county landfill. The Coast Guard was involved and was satisfied that the pollution had not spread (Morrison Knudsen 1994).

In 1978, approximately 6056 liters (1600 gallons) of raw coal tar naphtha were released from a fuel storage trailer. The spill was contained in an earthen retention basin and recovered for off-site disposal. It is believed that none of the spilled

material was released to surface waters.

In 1976, 189 to 284 liters (50 to 75 gallons) of No. 2 fuel oil were released from an above ground storage tank. The spill was contained in a catch basin and recovered to the extent possible. Contaminated plants and soil were removed and the site was monitored to ensure clean-up efforts were effective.

PCB incidents are addressed in Section C.9.2.

Table -8 Summary of Recent Remedial Studies at PBS

Source: Morrison Knudsen 1994

HAZARDOUS AND TOXIC SUBSTANCES

Hazardous Materials and Reporting

General background for the PBS is the same as for the Lewis site.

The Plum Brook Management Office is responsible for the management of hazardous materials at PBS, coordinating in this task with the EMO. An environmental audit reported that PBS uses approximately 250 different hazardous materials including fuels, gasoline, laboratory chemicals, propellants, gases, paints and coatings, lubricants, herbicides, and heating oil (Foster Wheeler, Draft, 1996b). Aside from bulk materials such as fuels, most hazardous substances are used in small quantities.

PBS maintains an on-site chemical inventory and copies of Material Safety Data Sheets. PBS submits Tier I/Tier II reports, TRI reports, and emergency preparedness plans in compliance with the Emergency Planning and Community Right-To-Know Act. PBS does not currently have a Pollution Prevention Plan in accordance with Executive Order 12856.

PCBs

PCB wastes at PBS are stored in a separate area of Building 9206 (the hazardous waste storage building). An annual assessment of PCBs indicated that there were four PCB transformers and 255 high-voltage PCB capacitors in service as of the end of 1995 (LeRC, January 1996b). These units contained 6323 kilograms (13,940 lbs) of PCB oils. A disposal shipment of PCB-contaminated items in April 1995 consisted of 6662 kilograms (14,690 lbs) of PCB oil, 45 kilograms (99 lbs) of PCB-contaminated solid debris, and 23,154 kilograms (51,055 lbs) of transformers. The shipment included all PCB wastes in storage at that time. It is anticipated that by the end of 1997 all four remaining PCB transformers will be remediated to less than 50 ppm.

In 1981, there was a spill of approximately 643 liters (170 gallons) of PCB-contaminated oil onto the concrete floor of Building 9206. Recovery operations captured approximately 70% of the spilled material. The remaining oil leaked under the floor and resulted in soil contamination. Remediation actions included removal of the contaminated soil and free liquids. Four groundwater monitoring wells were installed and revealed no groundwater contamination. Total decontamination was performed in 1989 and groundwater monitoring discontinued a year later after consultation with USEPA.

Asbestos

No major asbestos abatement projects were active at PBS during an audit conducted in 1996 (Foster Wheeler, Draft, 1996). Some areas at the PBRF are scheduled for abatement and there is an ongoing operation and maintenance program. Small abatement tasks may be conducted by on-site personnel. After a 1986 environmental audit revealed degradation of asbestos insulation, a program was implemented which prioritized abatement actions and undertook removal and disposal actions.

PESTICIDES AND HERBICIDES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

The Plum Brook Management Office manages the pest control program at PBS and develops an annual Pest Control Plan. The Plan is submitted to the EMO for approval and is implemented by a contractor. The use of pesticides and herbicides at PBS is limited. Building 9103 is used for pesticide storage and mixing. Less than 189 liters (50 gallons) of chemicals are in storage at any given time.

Non-selective herbicides such as PUP-1, Roundup, Spike, and Hyvar are applied along the fence line for vegetation control. Approximately 50 gallons are used each spring with additional applications if needed. No fertilizers are used on lawn or forest areas, nor are any restricted pesticides used. Pesticides are not normally used in buildings (Foster Wheeler, Draft, 1996b).

RADIATION

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

Teledyne Isotopes conducted a comprehensive radiological survey of the PBS in 1986-1987. That study determined that over half of the site is underlain by Huron shale which often exhibits elevated levels of background radioactivity. In a more recent study, samples of surface water and sediments showed low levels of radioactivity, not inconsistent with what might be expected given the underlying geology (Morrison Knudsen 1994).

There are two nuclear reactors in the Plum Brook Reactor Facility, the Research Reactor and the Mock-Up Reactor. This facility was closed in 1973. The reactors are covered by NRC licenses R-93 and TR-3, respectively, for Safe Protective Storage. Under these licenses, three radiation workers are required to report doses received annually. The license agreements expired in January 1997 and an application for renewal was submitted as of this writing.

The Plum Brook Reactor Facility contains no fuel, spent fuel, or special nuclear material. There is significant contamination of the reactor vessels and piping, much of which is associated with long-lived radioisotopes with half lives greater than 1000 years. There are no current plans for decontaminating and decommissioning of the reactor building, however, this will eventually be required.

Smaller radioactive sources on site are covered under a separate NRC Material License No. 34-00507-16. This license is for small sealed sources only. This license was renewed in 1996 in Amendment No. 22 and was extended until June 30, 2004.

There are no non-ionizing radiation sources at PBS except for low-level electromagnetic field sources associated with transformers and power supplies.

NOISE AND VIBRATION

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

Sources of noise at PBS include an airstrip, transient noise blasts from test facilities, construction activities, and traffic noise. The Army Reserves and the Ohio Air National Guard also discharge pyrotechnic devices at PBS (Jones 1996).

None of these activities is believed to be a significant source of noise impacts. Any potential offsite impacts are mitigated by large distances to offsite receptors. No noise complaints against the PBS were noted. The *Environmental Justice Implementation Plan* (Jones 1996) concluded there was "...no reasonable likelihood of substantial sustained off-site noise impacts from normal operations and only moderate likelihood of substantial off-site noise impacts from emergency operations or reasonably foreseeable accidents such as explosions or fires."

HISTORIC AND ARCHAEOLOGICAL RESOURCES

Regulatory Background

Regulatory Background for the PBS is the same as for the Lewis site.

PBS Operations

Attachment 1 to the Programmatic Agreement between NASA, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation lists NASA National Historic Landmarks (see Chapter B.13.2). The Spacecraft Propulsion Research Facility (B-2 Facility) at PBS has been designated a National Historic Landmark by the National Park Service as part of the 1984 Man In Space thematic nomination. The facility was used for "hot fire" testing of full-scale Centaur rockets under simulated space conditions (see also Chapter C.1.2.2.)

Native Americans once occupied this area. There are approximately 133 Native American archaeological sites outside the PBS fence line that have been placed on the Ohio Historic Society Register (Warner/Osborn/Pardee 1990). Given this number of sites nearby, there may be similar sites on the Plum Brook grounds as well.

SOCIOECONOMIC RESOURCES

Employee Population

Peak NASA employment at the PBS was approximately 600 people. Today total NASA employment is approximately 120. Of these, approximately 12 are civil servants and the remainder are contractor employees. Other government agencies have 20-30 personnel stationed on site.

Local Demographics

The 1990 Census lists the population of Erie County at 76,779, with 32,827 total housing units. The summer population at Sandusky increases by approximately 50 percent due to tourism.

The *Environmental Justice Implementation Plan* found "no substantial or disproportionate environmental impacts are currently experienced by any community at either [Lewis or PBS]." The Plan identified six Census tracts within an 8 kilometer (5 mile) "region of influence" from PBS which are likely to meet Federal environmental justice criteria for minority or low-income communities. The locations of these tracts are shown in Figure C-6. The Plan is being

implemented to identify and mitigate potential environmental justice problems and will be revised periodically as needed.

Local Economic Impacts

The PBS is not as significant an employer in its region as is the Lewis site. Other large employers in the area include the Ford Motor Company, Delco-Chassis NDH, Imperial Clevite, Sandusky Plastics, and Sandusky Foundry and Machine. NASA's presence in the area provides local economic impacts and benefits nonetheless. A 1996 study found overall economic benefit to the regional economy from LeRC to be: total output of $1 billion, employment impact of 12,800, and household earnings impact of $375 million (Austrian 1996). Most of these benefits are associated with the Cleveland facility (the study did not disaggregate results by NASA site), however LeRC actions are felt throughout Ohio. Some 40% of LeRC's annual $600-$700 million in consumption of goods and services is spent in Ohio. LeRC awards $43 million in grants to schools and universities of which $6 million is spent in Ohio.

Transportation

The PBS includes a 101 kilometer (62.5 mile) internal paved road system. There is also a 25 kilometer (15.7 mile) rail line which is currently unused (Morrison Knudsen 1994). Several State roads service the area, and the Ohio Turnpike (Interstate 80 and 90) is just to the south. In addition, there is a small airstrip at PBS.

Electric and Gas Utilities

Electric power for the PBS is supplied by the Ohio Edison Company. Backup generators are available for emergency power. Natural gas is supplied by Columbia Gas of Ohio and is used for space heating and testing purposes.

Health and Emergency Services

Health, emergency, and fire services are provided by Perkins Township under an informal cooperative agreement. This may be formalized in the future in a written agreement. The nearest hospitals are Firelands Community and Providence Hospital in Sandusky. Staff at the PBS Plant Protection Office can administer emergency first aid and CPR.

SOURCE: Jones Technologies 1996

Figure -6 Possible Minority and Low-Income Areas Near PBS

ART D REFERENCES

D. REFERENCES

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Glenn Environmental Programs Manual

GLENN ENVIRONMENTAL PROGRAMS MANUAL

ENVIRONMENTAL POLICY

Regulations governing protection of our work environment, including various aspects of occupational health, are constantly changing. An equally large and dynamic body of rules and regulations governs the environment comprising the natural surroundings. To stay current with these changing regulations, Glenn Research Center (GRC) implements or modifies policies and procedures protecting the work environment and surroundings encompassing the entire Glenn and Plum Brook Station (PBS) facilities. GRC employees must be aware of the current policies and procedures, the impact these policies and procedures have on GRC activities and operations, the individual responsibility each employee has to comply with these policies and procedures, and the personal liability one accepts when not complying with these policies and procedures. To promote this awareness, the Environmental Management Office (EMO) has developed the "GRC Environmental Programs Manual."

This manual sets forth policies, responsibilities, procedures, and standards for implementation of the occupational health and environmental programs at GRC. This manual is applicable to all Glenn and PBS personnel, operations, and off-site facilities under GRC jurisdiction.

Questions concerning this manual or the policies and procedures relating to any aspect of the environment at Glenn or PBS are to be directed to the Chief of EMO. It must be noted that the policies and procedures of this manual represent minimum standards and practices. Proposed deviations from the policies and procedures of this manual are to be examined critically and shall be brought to the attention of EMO for detailed review and concurrence prior to implementation.

Users of this manual should be cognizant of other documents such as the Glenn Safety Manual.

Donald J. Campbell Director, Glenn Research Center, Julian Earls Chairman, Environmental Pollution Control Board

Michael Blotzer Chief, Environmental Management Office

Curator: Sandra Jacobson{sandra.e.jacobson@grc.nasa.gov}
Last Update: 11-August-1997

GLENN
POLICY
DIRECTIVE

Directive: GLPD 8870.
Effective Date: November 4, 1998
Expiration Date: November 4, 2003

Responsible Organization: 0540/Environmental Management Office

Subject: The Glenn Research Center Environmental Quality Program

1. POLICY

The Glenn Research Center will provide a safe and healthful workplace by seeking to prevent occupational injuries, illnesses, and fatalities; by complying with all applicable laws and regulations pertaining to health and the environment; and by taking a proactive approach to environmental issues. The Center's leadership in protecting the environment will enhance the quality of life in the surrounding communities.

2. APPLICABILITY

The provisions of this directive are applicable to all organizational elements at the Glenn Research Center and the Plum Brook Station.

3. AUTHORITY

a. Executive Order 12088, Federal Compliance With Pollution Control Standards

b. Executive Order 12856, Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements

4. REFERENCES

Glenn Environmental Programs Manual (contains specific programs and requirements and has the same force and effect as this GLPD)

5. RESPONSIBILITY

a. Environmental Pollution Control Board (EPCB)*

(1) Establishes environmental policies for the Center

(2) Serves as an appeal for unresolved questions pertaining to the environmental quality of Glenn

operations, reviews, evaluates, and resolves disputes

(3) Ensures that information about existing or potential environmental problems be made available to all appropriate Glenn employees and levels of Glenn management

(4) Meets quarterly, or as is necessary, and submits to the Director the minutes of the meetings

*See attachment for members.

(5) Establishes and reviews environmental objectives and identifies targets

b. Environmental Management Office (EMO)

(1) Implements policies formulated by the Environmental Pollution Control Board

(2) Assists the Glenn Procurement Officer in reviewing the environmental quality programs and practices of contractors

(3) Reviews and approves requests for safety permits to determine whether they fall under the cognizance of the EMO; coordinates with Area Safety Committees and the Safety Assurance Office in third-party reviews of proposed activities

(4) Verifies compliance with all pertinent regulations applicable to the management of wastes and the prevention, control, and abatement of air, water, and land pollution

(5) Maintains appropriate safeguards over the acquisition of chemicals and hazardous material, including the evaluation of the hazard potential for each; issues a Material Safety Data Sheet as necessary

(6) Serves as the focal point for Center contacts with regulatory agencies regarding environmental quality issues

(7) Serves as the focal point for planning the Glenn Environmental Quality Program, including the development of funding plans

(8) Identifies significant environmental impacts of Glenn operations and uses the data to define Center's environmental objectives

(9) Provides technical support and oversight to Plum Brook Station operations

c. The Chief of the Environmental Management Office

(1) Establishes, implements, and maintains environmental management systems in accordance with good environmental management practices

(2) Reports the performance of the environmental management system to senior management for review

(3) Promotes continual improvement in environmental management systems

d. Radiation Safety Committee

(1) Recommends to the EPCB policies for controlling the acquisition, use, accountability, and disposal of radiation sources, radioactive materials, and radiation-producing equipment

(2) Supports the Radiation Safety Officer by reviewing safety permit requests involving radiation sources, radioactive materials, an radiation-producing equipment

(3) Annually reviews Glenn compliance with NRC license and regulatory requirements

e. Plum Brook Management Office (PBMO)

(1) Manages and oversees all activities associated with operations and issues of environmental protection, industrial hygiene, and health physics

(2) Receives technical direction and oversight from the EMO on issues under its cognizance

f. All other Glenn organizations

(1) Ensures that their operations be conducted in accordance with this policy directive

(2) Seek assistance from EMO to implement and comply with environmental programs

6. DELEGATION OF AUTHORITY

The Chief of EMO is delegated the authority to sign monthly reports on wastewater discharges, hazardous waste management permit applications and reports, permit applications for air contaminant sources, license and license modification requests for the use of radioactive materials, and other official correspondence with regulatory agencies for matters under its cognizance.

7. MEASUREMENTS

Measures of the effectiveness of the Glenn environmental program will include compliance with permit limitations and regulatory requirements; reduction of hazardous waste generation and hazardous chemical releases; and proficiency ratings for laboratory analysis conducted by EMO.

8. CANCELLATION

This GLPD cancels LMI 8800.4E, Lewis Environmental Quality Program, dated April 2, 1993.

Julian M. Earls
Deputy Director for Operations

ATTACHMENT
Attachment A

Attachment A
GLPD 8870.
September 30, 1998

EPCB Membership

Chairman	Deputy Director for Operations
Executive Secretary	Chief, Environmental Management Office
Members	Director, Research and Technology Directorate
	Chief Counsel
	Director, Office of Safety, Environmental and Mission Assurance
	Chief, Plum Brook Management Office
	Chief, Construction Management Branch
	Chief, Community and Media Relations Office
	Radiation Safety Officer
Advisor/Consultant	Medical Director

GRC Environmental Programs Manual

Chapter 2 - NATIONAL ENVIRONMENTAL POLICY ACT

Note: The current version to this Chapter is maintained and approved by the Environmental Management Office (EMO). The revision date for this chapter is July 10, 1998. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

GENERAL

This chapter establishes procedures at the Glenn Research Center (GRC) to identify and assess the environmental impact of proposed programs or projects. It also establishes procedures to aid in new project planning to present and forecast environmental impacts and their alternatives. It is applicable to all GRC actions that may have an impact on the environment. It is applicable to GRC employees at all levels who in any way participate in the formulation, development, and execution of qualifying NASA actions.

REGULATIONS AND REQUIREMENTS

The National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code (U.S.C.) 4321 et seq.), establishes national policy concerning the protection and the enhancement of the environment. It requires Federal agencies to prepare detailed documentation on any action undertaken that could result in a significant impact on the environment. Additional guidance directed towards NASA was published as 14 CFR Subpart 1216.3.

POLICY

It is Glenn policy to

- Use all practical means, consistent with statutory authority, available resources, and national policy, to protect and enhance the quality of the environment.
- Ensure that environmental amenities and values are given appropriate consideration in all actions, including those performed under contract, grant, lease, or permit.
- Use systematic and timely approaches that will ensure the integrated use of planning and decision making for actions that may have an impact on the environment.
- Pursue research and development, within the scope of authority or in response to authorized agencies, technologies useful in the protection and enhancement of environmental quality.
- Initiate and use ecological and other environmental information in the planning and development of resource oriented projects.
- Invite cooperation and input, when appropriate, from Federal, State, local, and regional authorities and from the public in the planning, environmental review, and decision making processes.

- Incorporate pollution prevention principles and techniques in planning and decisionmaking processes.

RESPONSIBILITIES

All Research and Support Directorates

All research and supporting directorates shall comply with regulations and requirements established by NEPA and with Glenn policy for all research and supporting functions. Researchers and supporting project managers shall submit a completed Environmental Analysis Checklist to the Environmental Compliance Team (ECT) for every proposed project or program for which there is a potential for significant environmental impact. The Research Advocate is responsible for providing the project manager with information relating to the function of proposed research. Guidance to assist project managers in determining the appropriate documentation and response during the proposal stage of a project or program is provided in the following documents:

- Environmental Analysis Checklist
- NASA Categorical Exclusions
- GRC Actions Requiring an Environmental Assessment (EA)
- GRC Actions Requiring an Environmental Impact Statement (EIS)
- NEPA Documentation Flowchart at GRC

Regardless of the determination of the needed level of NEPA documentation, the project manager is responsible for notifying the EMO if a change in scope occurs after NEPA documentation has been approved. Where mitigation is required in the execution of a project, a monitoring plan is jointly developed between EMO and the Project Manager. The project is documented in an Environmental Monitoring Report at the conclusion of the project and submitted to the ECT.

Facilities and Test Engineering Division (FTED)

For each GRC CoF project meeting the requirements, the project manager is responsible for the preparation of an Environmental Analysis (EVAL) which is submitted to the ECT. The notification should be submitted during the initial stages of project design. Any additional required documentation will also be the responsibility of the project manager.

For each new CoF project proposed for execution by FTED, the FTED project manager shall notify the FTED NEPA Coordinator. The FTED NEPA Coordinator will assist the Project Manager in preparing the EVAL Checklist and supporting documents. The FTED NEPA Coordinator will transmit the NEPA documents through the Facilities Preservation Officer to the EMO NEPA Coordinator. The EMO NEPA Coordinator will make a recommendation to the Chief of the Environmetnal Management Office, regarding the advisability of granting categorical exclusion or seeking additional levels of documentation. If it is advisable to continue the NEPA process, the FTED Project Manager or EMO is responsible for preparing the proper level of reporting. The FTED Project Manager will initiate the preparation of the required documentation.

Environmental Pollution Control Board (EPCB)

The EPCB, with the assistance of EMO, will review all NEPA documentation above the level of a

Record of Environmental Consideration (REC). These could include Environmental Assessments (EA's), Environmental Impact Statements (EIS's), Finding of No Significant Impact (FONSI's), Record of Decision (ROD's) or variations of these reports.

Environmental Management Office (EMO)

The ECT will review EVAL's prepared by the Project Managers. The ECT will determine which, if any, additional environmental review or documentation is appropriate for the proposed program or project.

The EMO NEPA Coordinator is responsible for reviewing every new safety permit that is submitted to EMO for review. The NEPA Coordinator will either provide the Safety Permit Coordinator with a REC, signed by the Chief of EMO or request, in writing, a completed EVAL Checklist. If an EVAL Checklist is required, the EMO NEPA Coordinator will notify the requester of the determination.

The ECT also reviews any completed Environmental Assessment or Environmental Impact Statement before final submission to the EPCB.

When the Center Director approves an EA or an EIS, EMO is responsible for agency and public notification.

Community and Media Relations Office

The Community Relations Program at Glenn will assist in assuring that environmentally significant activities are disclosed to the public and that public opinion is taken into consideration during the planning process.

RELATED PROGRAMS

NEPA reviews require consideration of diverse environmental and cultural issues. Issues of concern that are also specifically addressed in this Manual are rare and endangered species, water and air quality, hazardous and solid waste, occupational and environmental noise, and floodplains and wetlands. Guidance in matters related to the Environmental Justice can be found in the Environmental Justice Implemention Plan for NASA/GRC, which is available through the EMO.

RESOURCES

Much of the information necessary for fulfilling a NEPA environmental review is maintained by the EMO. The current Environmental Resource Document (ERD) contains information on the same environmental effects as included in an Environmental Assessment or an Environmental Impact Statement. The ERD does not replace an environmental assessment, but rather is an information source for the environmental assessment. By referring to specific chapters within this Manual, additional sources of information can be accessed.

DEFINITIONS

Categorical exclusion

A category of actions that does not individually or cumulatively have a significant effect on the human environment, that has no such effect in procedures adopted by a Federal agency in implementation of regulations, and for which, therefore, neither an Environmental Assessment nor an Environmental Impact Statement is required.

Description of Proposed Actions and Alternatives (DOPAA)

The most important section of the Record of Environmental Consideration. This section satisfies the NEPA requirement for a Project Manager to identify alternatives to accomplishing the project as proposed.

Environmental analysis (EVAL)

The analysis of the environmental effects of proposed actions, including alternative proposed actions. The analysis is carried out from the very earliest planning studies for the action and form the materials from which the more formal Environmental Assessments, Environmental Impact Statements, and public Records of Decisions are made. The EVAL is recorded on an EVAL Checklist, on Record of Environmental Consideration, and in supporting documents (as necessary).

Environmental Assessment (EA)

A concise public document, which a Federal Agency is responsible for preparing, that (1) briefly provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding Of No Significant Impact (FONSI); (2) is proof of an agency's compliance with the Act when no Environmental Impact Statement is necessary; and (3) facilitates preparation of a statement when one is necessary. The EA shall briefly describe the need for the proposed action, of alternatives, as required by Section 102(2)(E) and the environmental impacts of the proposed action and alternatives, and it shall list the agencies and persons consulted. It forms the basis of the decision to prepare a Finding of No Significant Impact or a Notice of Intent to Prepare an Environmental Impact Statement (EIS).

Environmental Impact Statement (EIS)

A document that is prepared for an action that may have significant impact on the quality of the human environment or that has the potential for controversy in environmental effects. The primary purpose of an EIS is to serve as a device for use by officials to plan actions and make decisions. It provides information that must be considered throughout the decision process. An EIS is filed with the Environmental Protection Agency, published, and distributed widely for public comment.

Environmental monitoring report

A document, prepared at the end of a project by the project manager, that summarizes environmental impact mitigation efforts during the project and deviations from mitigation plans.

Environmental Resources Document (ERD)

An information report required as a reference source for the preparation of environmental assessments and Environmental Impact Statements.

Finding of No Significant Impact (FONSI)

A document prepared by the project engineer that briefly presents the reasons an action will not have a significant effect on the human environment and for which an EIS will not be prepared. It is published in the Federal Register by NASA Headquarters.

Major facility project

Construction in excess of $750,000; repair, rehabilitation, and modification in excess of $1,000,000, and land acquisition and emergency repair approved under the provisions of Section 308(b) of the National Aeronautics and Space Act of 1958 (as amended) at any cost. Requires a detailed environmental assessment unless categorically excluded.

Minor facility project

Construction in excess of $200,000 and not exceeding $750,000; repair and rehabilitation in

excess of $200,000 and not exceeding $1,000,000. Requires a detailed environmental analysis.

Notice of Intent (NOI)

A notice that an Environmental Impact Statement is prepared and considered. It summarizes issues uncovered in the Environmental Assessment, if one was done. The notice shall briefly (1) describe the proposed action and possible alternatives; (2) describe the Agency's proposed scoping process including whether, when, and where any scoping meeting is held; and (3) State the name and address of a person within the Agency who can answer questions about the proposed action and the Environmental Impact Statement. This notice is required by law to allow interested parties to participate in the Environmental Impact Statement development or to review it upon completion.

Record of Environmental Consideration (REC)

A document prepared by the Environmental Management Office that outlines the level of documentation a project needs to satisfy NEPA requirements.

Record of Decision (ROD)

A document that describes how environmental considerations, and the Environmental Impact Statement itself, entered into the decision. It is not published in the Federal Register, but is made available upon request.

NASA Categorical Exclusions

NOTE: Even though an action may be categorically excluded from the need for a formal environmental assessment, or EIS, the action is not excluded from the requirement for an environmental analysis commencing with the earliest planning phases of the action. If that analysis shows that the action deviates from the criteria for exclusion and if it is concluded that there may be significant environmental effects, an environmental assessment must be completed. Based on that assessment, a determination must then be made whether or not to prepare an EIS.

The following activities are categorically excluded from the requirements for environmental assessments and EIS:

1. Research and Development (R&D) activities in space science (for example, physics and astronomy research and analysis, planetary exploration mission operations and data analysis) other than specific spacecraft development and flight projects.
2. R&D activities in space and terrestrial applications (for example, resource observations, applied research and data analysis, technology utilization) other than specific spacecraft development and flight projects.
3. R&D activities in aeronautics and space technology and energy technology applications (for example, research and technology base, systems technology programs) other than experimental projects.
4. R&D activities in space transportation systems engineering and scientific and technical support operations, routine transportation operations, and advanced studies.
5. R&D activities in space tracking and data systems.
6. Facility planning and design (funding).

The following criteria are provided to clarify the types of activities which is considered Categorically Excluded (CATEX) per NASA regulations on the National Environmental Policy Act (NEPA); 14 CFR Part 1216.305 (d)(7) and (8) and to provide direction as to when an Environmental Checklist should be completed and processed:

1. 14 CFR Part 1216.305(d)(7): Minor construction of new facilities including rehabilitation, modification, and repair.

   The activity is CATEX if it meets any one of the following criteria:

   a. The activity occurs within an existing building or facility, and is deemed to have no outside effects: (1) does not generate toxic or hazardous waste; (2) has no emissions or discharges; or (3) does not add a new function or modify an existing function performed elsewhere in the Center, or
   b. The activity occurs within an existing building or facility and does produce a waste or emission, but does not add a new function or modify an existing function performed elsewhere on the Center, where the handling and/or disposal of the waste/emission is provided for under normal and/or special Glenn operations and procedures, or
   c. The activity occurs to the exterior of a building or facility, with no changes to form, fit, or function (i.e., replacement in-kind). If a waste is produced by this activity, the handling and/or disposal of the waste/emission is provided for under normal and/or special Glenn operations and procedures.

2. 14 CFR Part 1216.305(d)(8): Continuing operations of a NASA installation at a level of effort, or altered operations, provided the alterations induce only social and/or economic effects, but no natural or physical environmental effects.

   Operations that meet this criteria are considered CATEX. In addition, the continuing operation will not require an Environmental Checklist if it meets any one of the following criteria:

   a. It is an existing operation that was covered under the 1971 Glenn Environmental Impact Statement, or
   b. Has been evaluated within another NEPA review (i.e., Glenn Checklist or Environmental Assessment).

Once a NEPA review has been completed for an operation, environmental reviews (i.e., Checklists, EA's or EIS's) do not have to be completed each time the operation is performed. Any significant change in an operations procedure will require a reevaluation of the procedure through the NEPA process using an Environmental Checklist.

Environmental Assessment

Specific GRC actions normally requiring an environmental assessment are

1. Specific spacecraft development and flight projects in space science.
2. Specific spacecraft development and flight projects in space and terrestrial applications.
3. Specific experimental projects in aeronautics and space technology and energy technology applications.
4. Development and operation of new space transportation systems and advanced development of new space transportation and spacecraft systems.
5. Reimbursable launches of NASA spacecraft or payloads.

6. Major construction of facilities projects.
7. Actions to alter ongoing operations at GRC that could lead, either directly or indirectly, to natural or physical environmental effects.

Environmental Impact Statement

Specific GRC actions that require an EIS are

1. Development and operation of new launch vehicles.
2. Development and operation of space vehicles likely to release substantial amounts of foreign materials into the Earth's atmosphere or into space.
3. Development and operation of nuclear systems, including reactors and thermal devices used for propulsion and/or power generation. Excluded are devices with millicurie quantities or less of radioactive materials used as instrument detectors and small radioisotope heaters used for local thermal control, provided they are properly contained and shielded.

General GRC actions that require an EIS are:

Actions expected to have a significant effect upon the quality of the human environment.

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GRC Environmental Programs Manual

Chapter 3 - WATER POLLUTION CONTROL

Note: The current version to this Chapter is maintained and approved by the Environmental Management Office (EMO). The revision date for this chapter is October 5, 1998. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@lerc.nasa.gov.

PURPOSE

This chapter provides the policies and requirements for design, construction, modification, and operation of GRC facilities contributing waterborne wastes to the sanitary, storm, and industrial waste systems. The provisions herein are in accordance with the national efforts to improve water quality through prevention, control, and abatement of water pollution from Federal activities in the United States.

REGULATION

The Clean Water Act (CWA) is the primary authority for water pollution control programs. The objective of the program is to restore and maintain the chemical, physical, and biological integrity of the Nation's water. Under the CWA, it is illegal for any person, including Federal agencies, to discharge pollutant from a point source without a permit.

RESPONSIBILITIES

All Employees

Each employee is responsible for assuring no release of toxic or hazardous materials or reportable quantities of other materials to the sanitary, storm, and industrial waste sewer systems.

All facilities shall comply with the local, State, and Federal regulations and codes applicable to the collection, transmission, and disposal of waterborne wastes to sanitary, storm, and industrial waste sewer systems.

Environmental Management Office (EMO)

The EMO sets Lewis environmental pollution standards based on the minimum requirements of local, State, and Federal regulations and permits. EMO updates these standards as required by changes in such regulations and permits. At the Plum Brook Station, questions concerning application of standards should be directed to the Plum Brook Management Office (PBMO), which consults with EMO.

The EMO defines a sampling and testing program to monitor wastes in the sewer systems, the purpose of which is to detect, control, and eliminate pollution. At Plum Brook, the PBMO is responsible for assuring that the appropriate sampling and testing programs are conducted.

The EMO is the focal point for the submission for applications of all water permits.

The EMO coordinates with outside agencies as appropriate.

At Cleveland EMO provides technical direction for the operation of the sewer systems and carries out the sampling and testing programs. EMO provides requesters with waste disposal technology information, analytical chemistry, and monitoring metrology for handling and disposing of wastewater.

Facilities & Test Engineering Division (FTED)

FTED maintains configuration control of the sanitary, storm, and industrial waste systems. No changes to a sewer system are to be made without the concurrence of the FTED. FTED maintains and operates the systems.

At Cleveland, FTED is responsible for the physical operation and maintenance of the process water systems and the industrial waste system. This responsibility includes maintenance of the oil separator pits, oil skimming operations, and sludge removal operations. At Plum Brook, the PBMO is responsible for the physical operation and maintenance of the sanitary sewer systems and process water systems.

Lewis Fire Dispatch/Plum Brook Management Office (PBMO)

At Cleveland the Fire Dispatcher is the focal point of communications in initiating the emergency spill containment and cleanup plans. At Plum Brook the PBMO performs this function.

PERMITS

National Pollution Discharge Elimination System (NPDES)

Cleveland and Plum Brook operate under NPDES water discharge permits issued by the Ohio EPA. The permits specify the discharges that are allowed, pollutant limitations, and the monitoring and reporting requirements. Any discharge not allowed under these permits is a violation of the CWA.

Storm Water Permit

The Cleveland facility has submitted a permit application to discharge storm water runoff. Monitoring and reporting requirements will be similar to those in the NPDES permit. The EMO has written a **Storm Water Pollution Prevention Plan** and **Tables 1 through 5**

The Plan identifies sources of pollution and contamination at GRC, and determines improved actions and practices to prevent or control the pollution of storm water discharges.

APPLICABILITY

This chapter is applicable to all facilities of GRC.

AUTHORITY

- Federal Water Pollution Control Act
- Executive Order No. 12088, Federal Compliance with Pollution Control Standards, October 13, 1978
- Toxic Substances Control Act
- Title 40, Code of Federal Regulations, Part 112, Oil Pollution Prevention, December 11,1973.
- Spill Prevention Control and Countermeasure Plan for Lewis and Plum Brook
- Title 40, Code of Federal Regulation, Part 265 Subpart D, Contingency Plan and Emergency Procedures.
- Title 40, Code of Federal Regulation, Part 300.33, National Oil and Hazardous Substances Pollution Contingency Plan.
- Lewis and Plum Brook Station Contingency Plans
- Title 10, Code of Federal Regulations, Part 20
- Emergency Preparedness Plan
- Glenn Storm Water Pollution Prevention Plan

POLICY

It is Glenn policy that the design, maintenance, operation, and changes to the Cleveland and Plum Brook sewer systems be planned, controlled, and monitored in a manner that assures that environmental pollution regulations will not be violated.

REQUIREMENTS FOR DESIGN AND CONSTRUCTION

All facilities shall be designed and constructed in accordance with the criteria and standards set forth in the authorities cited above. All facilities shall comply with local, State, and Federal regulations and codes applicable to the collection, transmission, and disposal of waterborne wastes contributing to the sanitary, storm, and industrial waste systems. When the possibility of an accidental release of contaminated waste exists, adequate safeguards shall be included in such designs. Due consideration shall be given to effluent limits established for release to adjacent creeks or rivers and to municipal sewage systems.

Control or treatment facilities may be required in order to prevent such accidental or normal releases.

The environmental impact and assessment of design, construction, and modification activities shall be evaluated in the initial planning stages. Requirements governing the preparation and review of assessments of the environmental impact of GRC activities are contained in Chapter 2 National Environmental Policy Act, of this manual.

Except for domestic type sewage originating at standard plumbing fixtures, all designs for new facilities and modifications to existing facilities where connections are to be made to any GRC

waterborne waste disposal system shall be submitted for review, evaluation, and approval of the EMO and the Process Systems Safety Committee. The approval, documented by the issuance of a safety permit, must be obtained before procurement, installation, or modification are begun.

Violations of design or construction requirements or water pollution control standards should be reported to the Chief of FTED for evaluation and corrective action.

REQUIREMENTS FOR OPERATION AND MAINTENANCE

Facilities

Facilities will be operated and maintained to achieve compliance with the standards described in the paragraph under Requirements for Design and Construction; and in regulations issued by the authorities cited in the; Authority; section of the chapter.

The Cleveland sewer systems will be operated and maintained to satisfy the following intended purposes:

Storm sewer system - Surface and subsurface rainwater runoff, e.g., from roadways, parking lots, roof drains, and yard basins.

Industrial Waste Sewer (IWS) system - Waste waters containing oil and grease. GRC attempts to minimize the discharge of pollutants at each entrance to the IWS. Many of the buildings that generate wastewater containing petroleum products have oil separators that remove floating and settable materials before entering the IWS system.

The IWS is not a chemical treatment facility. It is a separate drainage system, apart from the storm and sanitary sewer systems, which contains holding basins to allow for the separation of water and oil so proper disposal can be accomplished.

Contamination of this system with solvents and other chemicals violates the proper and intended use of the IWS.

IWS wastewater discharges to a sanitary sewer system.

Sanitary sewer systems - Domestic type sewage originating at standard plumbing fixtures and laboratory sinks.

Radioactive Wastes

All contaminated wastewater that contain radioactive materials will be disposed of in accordance with applicable Ohio EPA and U.S. NRC regulations and licenses and requirements of the Midwest low-level Radioactive Waste Disposal Compact. In Cleveland, the Health Physics Team will control the disposal of radioactive wastes. At Plum Brook, radioactive waste disposal will be controlled in accordance with established Plum Brook Reactor storage license requirements and procedures approved by the GRC Radiation Safety Officer.

REPORTING EMERGENCIES

Any person who becomes aware of any spill or the inadvertent or unauthorized release of toxic or hazardous materials to any GRC sewer system shall report the incident by dialing 911, the Glenn Dispatch.

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Last Update: October '98

GRC Environmental Programs Manual

Chapter 4 - AIR POLLUTION CONTROL

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is February 9, 1999. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

This chapter sets forth GRC policies and requirements for the design, construction, and operation of new and existing facilities that contribute airborne contaminants to the atmosphere. The provisions herein are in accordance with the national effort to improve air quality through prevention, control, and abatement of air pollution resulting from Federal activities.

APPLICABILITY

This chapter is applicable to Cleveland, Plum Brook Station, and other facilities under GRC cognizance.

AUTHORITY

The Air Quality Act of 1967, Public Law 90-148, and subsequent amendments including those of 1977 and 1990.
Ohio EPA regulations, Ohio Administrative Code 3745, and Cleveland Division of Air Pollution Control Regulations.

DESIGN AND CONSTRUCTION

All GRC facilities will be designed and constructed in accordance with requirements and standards prescribed by the above Authorities. All designs for new facilities and all modifications to existing facilities that will result in the emission of wastes to the atmosphere will be reviewed and coordinated with the Environmental Management Office (EMO). Simultaneously, the designs of such facilities will be submitted to the Chief of EMO; to the Chief, Facilities and Test Engineering Division under Cleveland cognizance; to the Management Office for facilities at Plum Brook; and to the applicable project office for designs prepared for other sites under GRC cognizance. When possibility of an accidental release of a contaminating or toxic airborne waste exists, suitable safeguards and emergency response activities must be included in the design.

INTERFACING WITH REGULATORY AGENCIES

At Cleveland official contact with the Cleveland Division of Air Pollution will be through the Environmental Compliance Team (ECT). At Plum Brook contact with the Northwest District Office of the Ohio EPA will be through the Plum Brook Management Office (PBMO). The ECT is the focal point for the submission of applications of all air permits. Documentation of all contacts will be submitted to EMO.

All facilities shall have systems and equipment capable of meeting local, State, and U.S. EPA codes, standards, and requirements.

OPERATING AND MAINTENANCE POLICY

Facilities will be operated and maintained in conformance with the standards and requirements prescribed by the Clean Air Act as revised.

Where required by the area safety committee, a sampling and testing program to monitor airborne wastes will be the responsibility of the EMO at Cleveland and the Management Office at Plum Brook. Reports on test results shall be sent to the EPCB and to the area safety committee chairman.

Any questions concerning disposal of airborne waste should be referred to the ECT for appropriate direction.

There shall be no releases of radioactive materials except through established and approved procedures. Airborne waste that contains radioactive material will be monitored by the Health Physics Team and the Radiation Safety Officer in accordance with Nuclear Regulatory Commission regulations.

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Revision Date: February 9, 1999

GRC Environmental Programs Manual

Chapter 5 - MANAGEMENT OF HAZARDOUS MATERIALS AND WASTES FOR REUSE, RECYCLING, OR DISPOSAL

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is June 11, 1998. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

This chapter establishes GRC policy and procedures and assigns responsibilities for the management of hazardous materials and wastes and the handling of hazardous materials. Soil that has been designated as hazardous is discussed in Chapter 34, Handling and Disposal of Soil.

APPLICABILITY

This chapter applies to all organizational elements of Lewis and Plum Brook, particularly to employees involved with the processing and handling of hazardous materials or the disposal of hazardous wastes.

POLICY

As a requirement of our waste minimization policy, GRC's first priority is to reduce the amount of hazardous waste and hazardous material, second to reuse it, third to recycle it, and lastly to dispose of it.

It is GRC policy that special attention be given to the management of hazardous materials and wastes no longer required for ongoing institutional operations, research programs, or related activities. These materials and wastes are to be managed in a safe and proper manner following the requirements and standards prescribed in the following authorities and GRC procedures.

AUTHORITIES

- Title 40 CFR, Parts 260-265, Protection of the Environment
- Title 49 CFR, Department of Transportation, Parts 100-177, Hazardous Materials Definitions
- NSS/FS 1740.7, August 1977, Safety Standard for Handlers of Hazardous Materials
- Public Law 94-580, Resource Conservation and Recovery Act

- Title 40 CFR, Part 61, Subpart M (Asbestos - NESHAPS)
- Title 41, CFR, Part 101-42, Utilization and Disposal of Hazardous Material
- and Certain Categories of Property.
- NASA Handbook, NHB 4300.1, NASA Personal Property Disposal Manual

RESPONSIBILITIES

User

- The user cannot simply dispose of the material by indiscriminately throwing the material or waste into the trash container or dumping it down the drain.
- Ensures that each hazardous material or waste to be turned in is properly identified and labeled as to its contents and its potential hazard. The Waste Management Team (WMT) should be contacted at 3-2124 to assist in the identification and labeling of materials and wastes to be turned in.
- Prepares and submits a Lewis Property Disposal Turn-in Document, NASA C-260, and submits it to the Logistics and Technical Information Division (LTID), Property Disposal Officer, or the WMT for determination of proper disposal.

Logistics and Technical Information Division (LTID) Property Disposal Officer

Forwards the Lewis Property Disposal Turn-in Document, NASA C-260, as required, either to the WMT or the Environmental Compliance Team (ECT) to determine the ultimate disposition of the material.

Environmental Compliance Team (ECT)

- Provides technical input to the Property Disposal Officer via the NASA C-260 for managing hazardous materials and disposing of equipment containing hazardous material.
- Provides technical direction, methodology, and consultation to any user for turn in of hazardous materials, equipment containing hazardous material, and soils containing hazardous materials.
- Provides analytical chemistry support for identifying unknown materials for identified for turn in for disposal.
- Assures that hazardous waste disposal contractors under contract to GRC conduct their activities at a licensed/permitted waste disposal facility.
- Maintains responsibility for signing all hazardous waste manifests. ECT shall investigate and inquire, as necessary, regarding shipments prior to signing the manifests. At Plum Brook, the Plum Brook Management Office (PBMO) maintains responsibility for signing all hazardous waste manifests.
- Performs a quarterly compliance audit on the Hazardous Waste Management function. Provides an audit report to the Chief of the Environmental Management Office (EMO). EMO issues orders to address audit deficiencies.
- Educates personnel on hazardous material and hazardous waste handling and waste reduction.

Waste Management Team (WMT)

- Develop and implements a program for managing hazardous material and disposing of

hazardous wastes.
- Provides documentation to the Property Disposal Officer records of shipment for disposal of hazardous wastes and materials.
- Recommends and educates to the user the proper procedures to be followed when turning in a hazardous material or disposing of hazardous waste. Also, educates all staff at GRC on hazardous material and hazardous waste handling and waste reduction/minimization.
- Coordinates the transfer of the hazardous materials and wastes to Building 212, the Central Chemical Storage Facility, for temporary storage (90-day maximum for materials determined to be a hazardous waste) while a means of reuse, recycling or disposal is determined.
- Determines whether hazardous material can be reused, recycled, or needs to be disposed of as hazardous waste.
- Coordinates the method of disposal being used with ECT.
- Arranges for a waste disposal contractor to pick up and deliver the hazardous waste to a disposal facility, as required.
- Reviews all supporting documentation for compliance with the provisions of Title 49 CFR, Department of Transportation, for the shipment of hazardous materials and Title 40 CFR, EPA, for the disposal of hazardous wastes.
- Prepares, packages, marks, labels, and certifies the packaging and crating of materials and wastes for shipment.
- Prepares Uniform Hazardous Waste Manifests for items such as oils, solvents, chemicals, and hazardous soils not covered by other FTED contracts in accordance with EPA and DOT specifications.
- Tracks all manifests to ensure they are accounted for and properly signed.
- Maintains original files on all hazardous and non-hazardous waste shipments for regulating agency review.
- Provides and maintains all records on required hazardous waste management and DOT training for GRC.
- Coordinates and provides required annual training updates.
- Prepares regulatory required and NASA reports.

Plum Brook Management Office

- Coordinates the transfer of the hazardous materials and wastes to Building 9206 for temporary storage (90-day maximum for materials determined to be a hazardous waste) while a means of reuse, recycling or disposal is determined.
- Maintains original files on all hazardous and non-hazardous waste shipments for regulating agency review.
- Maintains all records on required hazardous waste management and DOT training for PBS staff..
- Notifies WMT to arrange a waste disposal contractor to pick up and dispose the hazardous waste.

NOTE: At Plum Brook, the PBMO shares the responsibilities with the WMT.

DEFINITIONS

Hazardous material

A substance, government property, or material that has been determined by the Secretary

of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated. Title 49 CFR, Part 171.8.

Hazardous waste

Any substance or combination of wastes in solid, liquid, semisolid, or gaseous form which, because of its quantity, concentration, or physical, chemical, or infectious characteristics may (1) cause or significantly contribute to any increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness or (2) pose a substantial present or potential hazard to human health, safety, or environment when improperly stored, treated, transported, disposed of, or otherwise managed. This includes wastes that singly, or in combination, require special handling, treatment, or disposal because they are, or may be, ignitable, radioactive, corrosive, reactive, toxic infectious, an irritant, or a strong sensitizer. For the purpose of this chapter it means any material that is subject to the Uniform Hazardous Waste Manifest requirements of the U.S. Environmental Protection Agency (U.S. EPA) as specified in Title 40 CFR, Part 262.

Uniform Hazardous Waste Manifest

A document used when transporting hazardous waste for offsite treatment, storage, or disposal.

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GRC Environmental Program Manual

Chapter 6 - HAZARDOUS WASTE MINIMIZATION

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GENERAL

This chapter establishes policies and procedures for dealing with projects and programs at GRC that generate hazardous waste. The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who in any way participate in the development and execution of GRC actions.

REGULATIONS

Minimization of hazardous waste is addressed in the Resource Conservation and Recovery Act of 1976, as amended. It requires that generators of hazardous waste certify that they have established a program to reduce the volume or quantity and toxicity of such waste to the degree practicable. Executive Order 12780, "Federal Agency Recycling and the Council on Federal Recycling and Procurement Policy", addresses the broader issues of waste reduction and recycling. This Order requires that Federal agencies promote cost-effective waste reduction and recycling of reusable materials from wastes generated by Federal Government activities.

POLICY

It is the policy of GRC to minimize the volume and toxicity of wastes generated by GRC operations to the extent technically possible and economically practicable. Recycling, recovery, and reuse shall be used whenever feasible.

RESPONSIBILITIES

Chemical Management Team (CMT)

- Reviews purchase to verify that the quantities of hazardous materials ordered are consistent with expected usage and to determine whether a less hazardous or less toxic material can be used.

Environmental Compliance Team (ECT)

- Reviews, at the beginning of each calendar year, the hazardous waste records for waste generated the previous year. Waste streams, quantities, and disposal costs shall be broken down by division. This information shall then be sent to the respective divisions as part of the Hazardous Waste Minimization Progress Report.
- Advises GRC divisions on hazardous waste minimization.
- Reviews operations to assure that they are conducted efficiently and result in the reduced use of hazardous material whenever possible.
- Reviews all hazardous wastes generated for possible reuse. Degreasing solvents, in particular, should be considered for recycling.

Users and line management

- Minimize the volume and toxicity of waste generated by their tests to the extent techni- cally possible and economically practicable.
- Must obtain written approval from the EPA when it is necessary to bring hazardous materials or hazardous waste onsite without subjecting the material to a purchase requisition review.
- Use proper waste segregation practices so that nonhazardous wastes do not become contaminated.

Contractors

- Must obtain written approval from Environmental Management Office (EMO) before bringing hazardous materials or hazardous waste onsite.
- Shall dispose of hazardous waste generated at GRC through the ECT at Plum Brook. Contractors must receive written approval from PBMO.

GRC Divisions

- Review, upon receipt of the Hazardous Waste Minimization Progress Report, the data presented and specify waste reduction plans for the coming year. The completed form shall be returned to EMO within 30 days of receipt. Each division should strive to achieve a reduction in waste generated. Although consideration of waste minimization is a legal requirement and should be considered an integral part of any operation, suggestions considered from employees may be eligible for appropriate recognition awards.

RELATED PROGRAMS

Aspects of solid waste management at GRC are addressed in chapters 5, 6, 9, and 34, entitled "Disposal of Hazardous Material and Hazardous Waste", "Hazardous Waste Minimization", "Asbestos," and "Handling and Disposal of Soil."

DEFINITIONS

Hazardous material

Hazardous material is any material defined as hazardous under 29 CFR 1910.120(c) and includes material presenting health and/or physical hazard. Such material has one or more toxic, flammable, corrosive, or reactive properties. All materials listed under Title M of the

Superfund Amendments and Reauthorization Act of 1986 (SARA) are included.

Hazardous waste

By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special U.S. EPA lists.

Recycling

The diversion of materials from the solid waste stream and the beneficial reuse of such materials.

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GRC Environment Program Manual

Chapter 7 POLYCHLORINATED BIPHENYLS POLICY

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GENERAL

This chapter establishes policies pertaining to the handling and disposal of polychlorinated biphenyls (PCB's) at GRC. The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who are in any way involved in the handling, storage, transportation, and/or disposal of PCB's.

REGULATIONS

40 CFR 761 - Polychlorinated Biphenyls Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 112 - Oil Pollution Prevention
29 CFR 1910 - Occupational Safety and Health Standards

POLICY

It is GRC policy to maintain information such as inspection logs, annual document logs, and disposal records in a readily accessible manner and to dispose of PCB articles in compliance with Federal and State regulations.

RESPONSIBILITIES

Facilities & Test Engineering Division (FTED)

- Disposes of PCB transformers, capacitors, and other PCB articles.
- Conducts quarterly inspections of PCB transformers.
- Assists Plum Brook with disposal of PCB items.

ENVIRONMENTAL MANAGEMENT OFFICE

Chemical Management Team (CMT)

- Writes and maintains PCB annual document log for GRC.
- Conducts internal audits of the GRC PCB program.
- Keeps PCB-related records in a readily accessible location.

Waste Management Team (WMT)

- Assists FTED with disposal of PCB items
- Assists Plum Brook with disposal of PCB items

Plum Brook Station

- Manages its own PCB disposal, inspection, and record keeping system independently with technical advice from FOD and ECT. Records of interest include such things as disposal records and annual document logs.

DEFINITIONS

Annual document log
: A record of waste handling at a facility.

Quarterly inspection
: A visual inspection for leaks from PCB transformers conducted once every three months.

PCB transformer (PCB item)
: A transformer with a PCB concentration above 500 ppm.

PCB contaminated transformer (PCB item)
: A transformer with a PCB concentration between 50 and 500 ppm.

PCB article
: Any manufactured article, other than a PCB container, that contains PCB's and PCB items.

PCB article container
: A device containing PCB's or PCB articles whose surfaces have not been in direct contact with PCB's (example: a drum containing a nonleaking capacitor).

PCB container
: A device containing PCB's or PCB articles whose surfaces have been in direct contact with PCB's (example: a drum containing a leaking capacitor).

PCB item
: A PCB article, PCB container, PCB article container or PCB equipment container that contains PCB's.

PCB equipment
: A manufactured item other than a PCB container, PCB article container, or which contains, a PCB Article (example: fluorescent light ballast).

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GRC Environmental Programs Manual

Chapter 8 - SPILL CONTROL

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GENERAL

This chapter establishes policies and procedures for dealing with projects and programs at Cleveland and Plum Brook Station that have the potential to contaminate indoor or outdoor environments with spilled material (i.e., oil, chemicals, asbestos, etc.). The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who in any way participate in the formulation, development, and execution of qualifying NASA actions.

REGULATIONS

Contingency plans are required by 40 CFR 300, which was authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Contingency plans call for planning the response to and cleanup of a spill. The GRC Emergency Preparedness Plan is used to fill the needs of the GRC Hazardous Waste Operations and Emergency Response (HAZWOPER), as required by OSHA/29 CFR 1910, and the contingency plan.

Spill Prevention Control and Countermeasure (SPCC) plans are required by 40 CFR 112, which was authorized by the Clean Water Act. The SPCC Plan describes spill prevention structures, procedures, and equipment that are already in place and recommends the construction of any additional spill containment structures. The plan should describe the measures being taken at facilities with petroleum products to prevent spills from occurring. It should also specify the actions to be taken should an oil spill occur.

POLICY

It is GRC policy to minimize spill potential through engineering and administrative controls. Should a spill occur, containment and cleanup procedures shall be promptly implemented to assure compliance with all applicable Federal, State, and local regulations and to minimize the effect on the environment.

RESPONSIBILITIES

When the responsible entity at Plum Brook differs from its Glenn (Cleveland) counterpart, the name of the responsible entity at Plum Brook is given in parentheses.

Users

The primary responsibility for spill prevention lies with the user. The Environmental Management Office (EMO) is available to advise users on prevention methods. Reaction to a spill shall be preplanned and incorporated into use procedures. Specific responsibilities include:

- Reporting any spill by calling Glenn Dispatcher (911) or Plum Brook Communications Center. If possible, identifying the material and estimating the volume released.
- For small spills and in the absence of a safety permit, by calling Glenn Dispatcher (911) or Plum Brook Communications Center, then attempting to contain and clean up the spill.
- For larger spills, taking immediate emergency response actions as required under the safety permit/ or, in the absence of a safety permit, calling Glenn Dispatcher (911) or Plum Brook Communications Center, then attempting to contain the spill, if possible or practical. If there are any questions with regard to safety, evacuate the area.
- Maintaining containment and cleanup supplies necessary for small spills. Additional supplies may be requested from the Waste Management Team at 3-2124 or, at Plum Brook, from the support service contractor environmental staff.
- Completing a Mishap Report (Form 1627).

The cost of cleaning up a spill will be charged to the directorate responsible for the spill.

Discoverer of a Spill

- Reports the spill to the Glenn Dispatcher (911) or at Plum Brook to the Communications Center (911).

Environmental Management Office (EMO)

- Notifies Federal and local regulatory agencies of spills as required in the SPCC Plan (PBMO Environmental Manager).
- Maintains the SPCC Plan and updates it as necessary (Plum Brook support service contract environmental staff).
- Maintains current lists of reportable quantities and provides technical advice to responders (Plum Brook support service contract environmental staff).
- Provides technical advice to the spiller (Plum Brook support service contract environmental staff).
- Assists Safety Office in investigations (Plum Brook support service environmental staff).
- Assists in determining exposure limits, personal protective equipment, and containment measures (Plum Brook support service contract environmental staff).
- Directs remedial efforts (PBMO Environmental Manager).
- Maintains spill containment and clean up supplies. (Plum Brook support service contract environmental staff.
- Provides containment and cleanup at spill sites whenever possible, usually through an independent contractor. (The support service contract environmental staff at Plum Brook.)
- Maintains complete documentation for initial reports on all reportable quantity spills and for

nonreportable quantity spills. These reports will be copied to EMO and the Safety Office at Glenn. (At Plum Brook, the reports will be maintained by the PBS support service contractors environmental staff and the PBMO Environmental Manager.)
- Notifies the GRC Office of Public Affairs (PBMO Environmental Manager).

Glenn Security Management Office and Plum Brook Station Plant Protection

- Provides area control and security at spill sites.

Glenn Safety Office

- Advises GRC and NASA Headquarters senior management of the event as necessary (PBMO Environmental Manager).
- Serves as Emergency Preparedness Coordinator (PBMO Environmental Manager).
- Investigates the causes of the spills and recommends procedures or policies to prevent a reoccurrence (Plum Brook support service contract environmental staff).
- Develops and maintains the GRC and Plum Brook Emergency Preparedness Plan.

DEFINITIONS

Nonreportable quantity (NRQ) spills
: Spills that present low hazard potential to workers or to the environment. Nonreportable quantity spills can be contained and cleaned up with only minor difficulty. Cleanup of nonreportable spills is the responsibility of the GRC directorate managing the material. Outside support may not be necessary for nonreportable quantity spills.

Reportable quantity (RQ) spills
: Spills that often involve large volumes of material and present significant hazards to workers or to the environment. Any spill reportable under EPA Regulations, 40 CFR 302 shall be considered a reportable quantity spill. Reportable quantity spills include, but are not limited to, the materials and volumes given in appendix B under extremely hazardous substances (EHS) reportable quantities or CERCLA reportable quantities. All expenses incurred as a result of a reportable quantity release will be charged to the organization responsible for the spill.

Hazardous material
: Any material defined as hazardous under 29 CFR 1910.120(c) including material presenting health and/or physical hazard. Such material has one or more toxic, flammable, corrosive, or reactive properties. All materials listed under Title M of the Superfund Amendments and Reauthorization Act of 1986 (SARA) are included.

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GRC Environmental Programs Manual

Chapter 9 ASBESTOS

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PURPOSE

This chapter establishes minimum requirements for handling, maintenance, use, removal and disposal of all asbestos containing materials and debris (ACM), friable and nonfriable at GRC.

APPLICABILITY

This chapter applies to all personnel at Glenn and Plum Brook Station, including, but not limited to, civil servants, contractors, and students.

BACKGROUND

Asbestos is a generic term applying to a number of naturally occurring mineral silicates that, when crushed or processed, separate into fibers. The most common type of asbestos is chrysotile, amosite, and crocidolite. All forms of asbestos have a tendency to break into dust of tiny particles that suspend in the air and can be inhaled or swallowed.

Asbestos may be found in valve packing, gaskets, boiler laggings, pipe coverings, brake linings, shielding materials, insulating boards, and protective clothing. In the building industry it is used in the manufacture of asbestos cement products, heat insulating and fireproofing materials, patching and taping compounds, and floor and ceiling tiles.

Asbestos is not believed to pose a health hazard unless it gets into the air and is breathed or swallowed. Breathing asbestos fibers increases the risks of developing lung cancer (especially in active smokers), mesothelioma (a cancer of the lung lining) and chronic lung disease (asbestosis). Gastrointestinal cancers have been reported more frequently in asbestos workers, but a direct relationship between ingestion of asbestos and the development of these cancers has not been established.

Asbestos related activities are strictly regulated. Worker protection is regulated by the Occupational Safety and Health Administration (OSHA) asbestos standards, 29 CFR 1910.1001 and 1926.1101. These standards include requirements for regulated areas, employee exposure monitoring, personal

protective equipment (including full body coveralls and respirators), work practices and engineering controls, competent persons, employee training, hygiene facilities, housekeeping, and medical monitoring.

Environmental protection is covered by the U.S. Environmental Protection Agency's National Emission Standards for Asbestos, 40 CFR 61.140 - 61-157. Enforced by the U.S. EPA and the Cleveland Division of Air Pollution Control (CDAPC), these regulations include requirements for regulated areas, negative pressure enclosures, worker training, and material disposal. The regulations also require notification of the EPA and the CDAPC at least 10 days before any asbestos removal work begins. For continuing removal projects, such as asbestos-related maintenance work, a blanket notification may be used. The EPA and the CDAPC may require that they approve all work performed under the blanket notification before the work can be done. In addition, Ohio Department of Health regulations cover training and licensing requirements of asbestos abatement contractors, supervisors, and workers and include a notification requirement as part of the license.

POLICY

It is the policy of Glenn Research Center to comply with all applicable regulations regarding asbestos management and to prevent illness to employees and damage to the environment from the use, removal, and disposal of asbestos.

The policy of Glenn Research Center with regard to asbestos is to

- Restrict contact with asbestos-containing materials to only those staff who have been properly trained and properly licensed, in accordance with Table 9-1.
- Provide sufficient training and communications so that this policy is effectively implemented.
- Ensure that contact with asbestos-containing materials, whether in restricted or non-restricted areas, is conducted in accordance with GRC specifications and OSHA requirements for such work.
- Ensure that any job that may involve disturbing ACM is coordinated with Environmental Management Office (EMO).
- Prohibit the new use of asbestos-containing materials (ACM) except in applications where there is no suitable non-asbestos material.
- Ensure that existing asbestos-containing building materials are maintained, abated, osolated from routine contact by the establishment of regulated areas.
- Ensure that staff engaged in asbestos activities, who are properly trained, equipped, and medically monitored, are not continuously exposed to asbestos fibers in excess of ½ of the OSHA exposure limits, (0.05 fibers per cubic meter of air), without personal protective equipment.
- Staff who are outside of the regulated areas of asbestos activities, whether trained or not, shall not be exposed to airborne concentrations of asbestos fibers in excess of 0.01 fibers per cubic meter (f/cc).

There are five categories of asbestos activity at Glenn: three involving asbestos abatement, maintenance activities, and spill response and cleanup (Appendix 9-A); housekeeping (Appendix 9-B); and motor vehicle brake and clutch maintenance and repair activities (Appendix 9-C). Each category has special regulatory controls and work practice requirements given in the appropriate Appendices.

RESPONSIBILITIES

It is the responsibility of all civil servant and support service contractor employees to ensure that ACM is removed or handled only by employees who are properly trained and equipped to minimize exposure to asbestos. Specific responsibilities are listed below.

Chief, Environmental Management Office (EMO)

- Tracks ongoing asbestos abatements and oversees compliance with regulatory requirements.
- Assures through program design and implementation that the health of non-asbestos workers, and the environment, are protected from the asbestos containing materials present at the Glenn Research Center.

Environmental Compliance Team (ECT)

- Provides guidance on the requirements of Federal, State, and local environmental regulations.
- Obtains and manages center wide blanket notifications.
- Maintains a tracking system of asbestos abatement projects.
- Provides guidance and oversight on the disposal of ACM and any air, water, or soil pollution issues.
- Upon request, arranges for the temporary storage and proper disposal of asbestos-containing wastes.

Industrial Hygiene Team (IHT)

- Maintains results of asbestos building surveys and bulk and air monitoring.
- Provides guidance on the requirements of Federal, State, and local occupational health regulations.
- Audits COTR and contractor performance in asbestos abatement projects.
- Evaluates employee exposure and recommends employees for inclusion in a medical surveillance program.
- Manages the Asbestos Program.
- Reviews control measures in operations involving ACM.
- Manages worker exposure issues in spills of ACM.

Chemical Management Team (CMT)

- Reviews and approves purchase requests of ACM in cases where no suitable substitute can be found. Non-asbestos containing products will be used as substitutes for asbestos containing products, whenever possible.

Occupational Medical Services

- Manages and administers a medical surveillance program for civil servant employees identified by the IHT as having been significantly exposed to ACM.

Motor Pool Supervision

- Create, maintain and update an inventory of all asbestos-containing materials used during automotive brake and clutch maintenance and repair activities, done in accordance with Appendix B.
- Create and maintain a log of all brake and clutch maintenance and repair activities which require the employee to use, replace or otherwise come in contact with known or suspected asbestos containing materials, done in accordance with Appendix B.

Plum Brook Management Office (PBMO)

- Ensures that Plum Brook operations comply with this chapter and develops and implements an Asbestos Maintenance Program for Plum Brook Station Operations.

Users and Facility Personnel

Project managers, facility management engineers, and facility operations personnel must

- Ensure that ACM which may be disturbed in any renovation and maintenance activities is identified in the scope of work and removed only by qualified asbestos abatement or maintenance workers, in accordance with Appendix A of this chapter.
- Ensure that survey protocols are conducted in accordance with the requirements of Appendix D

Contracting Officer's Technical Representative (COTR)

The COTR's overseeing projects involving ACM must

- Notify the ECT, in advance, of the date of each step in an asbestos abatement project for tracking and monitoring purposes.
- Identify suspect asbestos containing materials not identified in the scope of work during renovation and construction activities, arrange testing of the suspect ACM for asbestos content, and ensure its removal by a qualified asbestos abatement contractor if it contains 1% or more asbestos and may be disturbed during the project.
- Ensure that asbestos related work is performed in accordance with all applicable appendices, regulations and EMO guidance.
- Provide a copy of survey results to EMO, as specified in Appendix D.
- Provide a final report to EMO detailing all ACM removed during abatement and/or repair activities, to allow EMO to update the inventory.
- Assure that building occupants and employers are properly notified in advance of, during, and following the completion of asbestos work.
- Provide the results of air samples taken during Class I, II, and III work to employers of employees in contiguous areas within 10 days, (including IHT).

Researchers

- Identify the use of ACM on safety permit applications and contact the IHT for operations involving ACM not subject to a safety permit.

Managers

- Ensure that COTR's and others in their organization with responsibility for projects involving asbestos abatement activities are accountable for compliance with this policy via performance appraisals and/or other means.
- Notify the IHT of operations involving ACM.
- Ensure that employees working with ACM receive the training specified in table 9-1 and use the engineering and work practice controls and personal protective equipment specified for their operations.

Employees are responsible for properly using engineering and work practice controls and personal protective equipment specified for their operations.

Table 9-1 Training Requirements 1

Training (Initial with Annual Refresher)	COTR	EMO 2	Competent Person 1910.1001	Competent Person 1926.11101	Asbestos Workers4	Air Monitoring Tech 3	Custodial Staff	Other Site Employees
Abatement Specialis	yes	yes	-	yes	-	-	-	-
Evaluation Specialist	yes	yes	yes	yes	-	-	-	-
Project Designer	yes	-	-	yes	-	-	-	-
Asbestos Worker	-	-	-	-	yes	-	-	-
Air Monitoring	-	-	-	-	-	yes	-	-
1 to 2 hours (Custodial)	-	-	-	-	-	-	yes (Class IV worker)	Brake & Clutch Repair
1 hour (Awareness) (Awareness)	-	-	-	-	-	-	-	offered

1. All training courses must comply with the State of Ohio Department of Health regulations and the U.S. EPA AHERA regulations.
2. Training for EMO personnel with asbestos abatement or asbestos maintenance program responsibilities.
3. Clearance air sampling and environmental monitoring can also be performed by persons with American Board of Industrial Hygiene certification as a Industrial Hygienist in Training (IHIT), or Certified Industrial Hygienist (CIH), or persons with an Ohio Department of Health (ODH) certification as an Asbestos Hazard Evaluation Specialist. Persons with ODH certification as an Asbestos Hazard Abatement Specialist may only take personal samples as required by OSHA.
4. Training for Asbestos Workers

Class I Workers -

EPA Asbestos Abatement Worker Training or equivalent (32 hours), with annual refresher training (8 hours).

Class II Workers-

EPA Asbestos Abatement Worker Training or equivalent (32 hours), with 8 hours annual refresher training. The curriculum must include a hands on training session applicable to the type of asbestos abatement activities the worker will be performing on the job. If the worker is to abate only one type of Class II material, (example - floor tile) the 32 hour worker training may be waved in favor of an 8 hour course. This training must include a hands on session for the specific abatement activity which the worker will perform. For each additional type of Class II material which the worker is expected to abate, individual 8 hour training sessions are required.

Class III Workers-

EPA Operations and Maintenance Training or equivalent (16 hours), with 4 hours annual refresher training. A Competent Person (as defined by EPA and OSHA) musts review the curriculum and confirm that it properly prepares the workers for their expected duties. If the course does not meet the criteria, a separate 4 hour course which adequately covers specific methods of operation and controls for each Class II activity is required.

Class IV Workers-

1 to 2 hours of awareness training annually.

AUTHORITIES AND REGULATIONS

U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1926.1101 and 29 CFR 1910.1001, Asbestos.

U.S. Environmental Protection Agency, 40 CFR 61.140 - 61.157, National Emission Standards for Hazardous Air Pollutants; National Emission Standards for Asbestos.

Ohio Department of Health, chapter 3701-34 Ohio Administrative Code, Asbestos Abatement Hazard Rules.

USEPA, National Emission Standards for Hazardous Air Pollutants; Amendments to Asbestos Standard; Final Rule (49FR13661; April 5, 1984).

USEPA, Toxic Substances; Asbestos Abatement Projects; Final Rule (51FR62044A; April 25,1986.

APPENDIX 9-A - ASBESTOS ABATEMENT and MAINTENANCE PROGRAMS

NASA GLENN RESEARCH CENTER

CLEVELAND FACILITY

Environmental Management Office (EMO)

Introduction

The Occupational Safety and Health Administration's Asbestos Construction Standard requires that each facility engaging in asbestos abatement work perform that work in accordance with OSHA's requirements. This document describes the NASA GRC Asbestos Abatement and Maintenance Program. It describes the OSHA asbestos work classifications that apply to abatement and maintenance activities, the implementation of requirements for workers in restricted areas (whether performing abatement or not), and for employers and employees adjacent to restricted areas.

OSHA Asbestos Work Classifications for Abatement and Maintenance Activities

There are three OSHA categories of asbestos activity performed at Glenn which apply to abatement and maintenance activity. Below is a brief explanation of each.

1. Asbestos abatement is the removal, enclosure, or encapsulation of ACM to minimize the risk of asbestos-related illness. Abatements are classified by OSHA as Class I and Class II asbestos activities.
2. Asbestos-related maintenance tasks involving the likely or intentional disturbance of ACM meets the OSHA definition of a Class III asbestos activity. All asbestos-related maintenance activities at Glenn must be performed in accordance with this Appendix A. Asbestos-related maintenance at Plum Brook will be performed in accordance with the Plum Brook Station Asbestos Maintenance Program.
3. Asbestos spill response and cleanup is the act of responding to and cleaning up releases of ACM. This work must be performed in accordance with the spill response and cleanup procedures described in this appendix A, as well as with the requirements of an OSHA Class IV asbestos activity.

Inventory of Asbestos Containing Building Materials (ACBM)

An inventory of asbestos-containing building materials is maintained by the EMO. The inventory has been provided to each building manager, and is available on computer disks. The inventory is upgraded by reports from FED and FOD following their actions to further identify and remove asbestos-containing materials.

Handling of Asbestos-Containing Materials(ACM)

This appendix regulates asbestos exposure in all work as defined in 29 CFR 1910.12(b), including but not limited to the following:

- Demolition or salvage of structures where asbestos is present;
- Removal or encapsulation of materials containing asbestos;
- Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos;

- Installation of products containing asbestos;

Asbestos spill/emergency cleanup; and

- Transportation, disposal, storage, containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed.

Responsibility of the NASA Responsible Person

The individual planning asbestos abatement tasks (typically, the COTR) must develop OSHA-compliant written procedures specific for the tasks and submit them to IHT for review. The Industrial Hygiene Team may be consulted for assistance in developing the procedures. The Industrial Hygiene Team shall approve the procedures prior to initiating work. IHT's review will include:

- Compliance with applicable OSHA requirements.
- The initial exposure assessment.
- Provisions for notifying affected employers of employees in adjacent areas of the asbestos related work.
- Details of control methods that will be used to minimize the release of asbestos fibers into the air and that will be used to decontaminate equipment and workers.
- Procedures for proper disposal of all ACM.

A copy of the written procedures will be maintained in the IHT along with a copy of the initial exposure assessment, and the Asbestos Abatement and Maintenance Program.

The competent person and COTR are accountable for ensuring that the work is performed in accordance with established procedures and OSHA standards.

If using a control method modified from OSHA requirements, ensure that the control method is approved by a Professional Engineer or Certified Industrial Hygienist.

EMO has developed a review check list which may be used as guidance.

Provide copies of plans for renovation and maintenance to EMO for review, prior to conducting the activity.

The individual planning asbestos abatement tasks (typically, the COTR) must also notify ECT of all asbestos abatement activities at least 30 days in advance so that the activity may be tracked. This period is also needed to review control procedures and notify the appropriate government agencies where applicable. If the project does not permit 30-day advance notice (i.e., in an emergency) the ECT must be notified as soon as possible, but no later than the filing of the EPA/OSHA notifications. The ECT will:

- If using a control method modified from OSHA requirements for Class I work, notify OSHA in writing, on the required NESHAPS reporting form, 10 days in advance of project start-up.
- If performing Class III work for which OSHA has specified a negative pressure work practice, and for which an alternate control method is contemplated, notify OSHA, on the required NESHAPS reporting form, 10 days in advance of project start-up.

Provide information on the location and quantity of ACM/PACM present in a work area to potential bidders on construction work in the area.

Responsibility of Others

Employers of employees adjacent to construction activities in restricted areas shall be responsible for notifying and protecting their employees under the requirements of the OSHA standard (29 CFR 1926.1101).

Notification

The COTR shall be responsible to inform building staff and their employers of asbestos-related activities covered by this rule.

The COTR shall post warning signs at each regulated area.

Employers of employees working in and contiguous to regulated areas shall ensure that the employees comprehend the warning signs. Glenn Research Center shall assist employers by providing annual training for site employees (see Additional Information below).

Additional Information

Any questions concerning asbestos or this asbestos abatement program should be directed to the Environmental Management Office at 3-3105.

References

Glenn Environmental Programs Manual, Chapter 9, "Asbestos."

U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1926.58 and 29 CFR 1910.1001, Asbestos.

U.S. Environmental Protection Agency, 40 CFR 61.140 - 61.157, National Emission Standards for Hazardous Air Pollutants; National Emission Standards for Asbestos.Ohio Department of Health, chapter 3701-34 Ohio Administrative Code, Asbestos Abatement Hazard Rules.

APPENDIX 9-B - ASBESTOS HOUSEKEEPING PROGRAM

NASA GLENN RESEARCH CENTER

CLEVELAND FACILITY

Environmental Management Office

Introduction

The Occupational Safety and Health Administration's General Industry Asbestos Standard (29 CFR 1910.1001) places certain notification and action requirements on employers and their employees who work in areas where ACM and/or PACM is present. The applicable requirements for workers in nonrestricted areas are the subject of this program.

Acting under the requirements of the regulations, selected areas in each building may be restricted. These are areas in which GRC has not determined that exposure to airborne asbestos can be maintained below applicable standards.

Housekeeping activities in areas where damaged ACM or damaged suspect ACM is present may be conducted under the procedures outlined in this Appendix B of the Glenn Asbestos Housekeeping Program. If not conducted in accordance with this Appendix B, they shall be conducted in accordance with the stricter standards of Appendix A.

Inventory of Asbestos-Containing Building Materials (ACBM)

An inventory of asbestos-containing materials is maintained by the EMO. The inventory has been provided to each building manager, and is available from EMO. The inventory is upgraded by reports from FED and FOD following their actions to further identify and remove asbestos-containing materials.

Housekeeping of Asbestos-Containing Materials (ACM)

- Reporting and Management of Asbestos Spills

Asbestos spill prevention is key to preventing unnecessary employee exposure to asbestos. There are two primary strategies for effective spill prevention: periodic inspection of ACM with prompt repair of any ACM in a deteriorated condition and careful planning to prevent damage to ACM.

An inspection of the condition of suspect ACM should be included in an organization's periodic safety inspections. Anyone seeing deteriorated suspect ACM should report the damage. Housekeeping staff are especially encouraged to report such deterioration.

Anyone seeing spilled material from deteriorated suspect material should Immediately leave the area, close any doors to prevent others from entering the area and dial 911 to report the spill. Please tell the person answering your call that you are reporting an asbestos spill and give the location of the spill and your name and telephone number.

Areas involved in an asbestos spill will be barricaded and isolated by the spill responders in accordance with the Glenn Safety Manual to prevent employee exposure and the spread of asbestos contamination to other areas. The spill will then be cleaned up in accordance with applicable standards. Do not enter a barricaded area!

These barricaded areas are restricted areas, as defined by OSHA. If essential work must be done inside a barricaded area, contact EMO at 3-3105 so that procedures can be implemented to ensure the

work is done safely.

Asbestos Spill Cleanup and Disposal

Any spill response work proposed to be done by support service contractor, outside contractor, NASA employees, or any other group or organization must be approved by the ENMO.

The individual planning spill cleanup tasks (typically, the COTR) must develop OSHA-compliant specific written procedures for the tasks and submit them to IHT for review. The IHT may be consulted for assistance in developing the procedures. The IHT shall approve the procedures prior to initiating work. IHT's review will include:

- Compliance with applicable OSHA requirements.
- The initial exposure assessment. IHT requires an initial exposure assessment be completed and submitted for work practice and control approval before the activity starts.
- Provisions for notifying affected employers of employees of the asbestos related work.
- Details of control methods that will be used to minimize the release of asbestos fibers into the air and that will be used to decontaminate equipment and workers.
- Procedures for proper disposal of all ACM.

A copy of the written procedures will be maintained by the IHT.

The competent person and COTR are accountable for ensuring that the work is performed in accordance with established procedures and OSHA standards.

EMO has developed a review check list which is available for preparation guidance.

Spill response tasks will be performed only by adequately trained personnel. The work must be supervised by an individual meeting the competent person requirements of the OSHA Asbestos Stan dard. Workers must be provided training, exposure monitoring, respiratory protection, and medical surveillance programs that meet OSHA Asbestos Construction Standard requirements.

While the EMO will provide oversight, the competent person and COTR are accountable for ensuring that the work is performed in accordance with established procedures and OSHA

standards.

Housekeeping in Areas with Asbestos-Containing Spills

By definition, dust and debris in areas that have damaged materials that are OSHA-presumed asbestos must be treated as asbestos containing. For this reason, areas with significant damage have been made inaccessible.

Accessible areas that have been and are routinely maintained present an opportunity for management by housekeeping staff who have received two to four hours of specialized training, and who have appropriate equipment. Specifically, the EMO has determined that:

- Housekeeping in areas where no damage is present is not an asbestos-related task.

- Housekeeping in areas with damaged ACM or PACM shall not be allowed. House-keeping staff shall report the damage and cease housekeeping in the area until the damage is assessed, repaired, and cleaned up, or until the material is determined to be asbestos free.

Notification

Building managers shall inform building staff and their employers, and COTR's shall notify housekeeping staff and their employers, of the presence and location of ACM and PACM. The EMO shall provide the inventory (see Housekeeping in Areas with Asbestos-Containing Spills).

Building managers shall post warning signs at each regulated area. EMO shall provide such signs for posting.

Employers of employees working in and contiguous to regulated areas shall ensure that the employees comprehend the warning signs.

Additional Information

Any questions concerning asbestos or this asbestos maintenance program should be directed to the Environmental Management Office, at 3-3105.

APPENDIX 9-C - ASBESTOS BRAKE AND CLUTCH REPAIR PROGRAMS

NASA GLENN RESEARCH CENTER

CLEVELAND FACILITY

Environmental Management Office

Introduction

The Occupational Safety and Health Administration's General Industry Asbestos Standard mandates specific preferred or equivalent work practices and engineering control methods which must be implemented during automotive brake and clutch activities where employees may be exposed to elevated levels of airborne asbestos fibers.

While the continued use of asbestos in brake pads and linings has been reduced over the last decade there are still circumstances where no adequate substitute is available. Therefore, during automotive maintenance and repair work on brake and clutch systems exposure to airborne asbestos is still possible.

Policy

This Appendix C of Chapter 9, details work practices and control methods which must be implemented by automotive maintenance and repair management and staff to protect against an eight

hour time weighted average personal exposures to airborne asbestos in excess of 0.05 fibers/cubic centimeter of air.

Inventory of Asbestos Containing Automotive Maintenance and Repair Materials

This inventory of all asbestos containing materials, as specified in Chapter 9 under Motor pool supervision responsibilities, must be updated when, new materials are received or identified which contain asbestos, parts in which asbestos content has been eliminated, or when the use of a asbestos containing part has been discontinued. For assistance in obtaining information about a products asbestos content contact the Chemical Management Team (CMT) at 3-6735 or the IHT at 3-8822.

The log of brake and clutch maintenance and repair activities, as specified in Chapter 9 under Motor pool supervision responsibilities, will be used to determine the required asbestos control methods which will be employed for these activities (see Control Method for Brake and Clutch Activities). If asbestos content in any suspect part can not be positively confirmed it must be assumed to be present until a through evaluation is completed. In cases where the presence of asbestos in parts cannot be assured, control methods as specified in Control Method for Brake and Clutch Activities must be followed.

Control Method for Brake and Clutch Activities

For facilities which can prove, through documented repair and maintenance records, that there are never more than five pairs of brakes or five clutches which are inspected, disassembled, reassembled and/or repaired per week, a Wet Method control procedure as specified by OSHA is acceptable. Requirements are:

1. A spray bottle, hose nozzle, or other implement capable of delivering a fine mist of water or amended water or other delivery system capable of delivering water at low pressure, shall be used to first thoroughly wet the brake and clutch parts. Brake and clutch components shall be wiped clean with a cloth.
2. The cloth shall be placed in an impermeable container and properly marked or labeled as asbestos containing waste. After this is accomplished, notify the Waste Management Team (WMT) at 3-2124 for proper disposal.
3. If a vacuum is to be used during this operation it must be equipped with HEPA filters. The filters, when full, shall be first wetted with a fine mist of water, then removed and placed immediately in an impermeable container. The container must be properly marked or labeled as an asbestos containing waste and WMT must be notified for proper disposal, at 3-2124.
4. Any spills of aqueous solutions or any asbestos containing waste mater shall be cleaned up immediately and put in a properly labeled container. After this is accomplished, notify WMT at 3-2124 for proper disposal.
5. The use of dry brushing during the wet method operations is prohibited.
6. The use of compressed air to clean dust and debris from surfaces during brake and clutch repair is prohibited.
7. Before attempts are made to dislodge a frozen brake drum, the drum must be thoroughly wetted.

For shops which perform more than five brake or clutch repair or maintenance activities per week,

OSHA specifies, and GRC adopts, a Low Pressure/Wet Cleaning Method" to control airborne levels of asbestos during automotive brake and clutch repair and maintenance activities. Requirements for this type of control method includes:

1. A catch basin must be placed under the brake assembly, positioned to avoid splashes and spills.
2. The reservoir shall contain water containing a wetting agent. The flow of liquid shall be controlled such that the brake assembly is gently flooded to prevent the asbestos containing brake dust from becoming airborne.
3. The aqueous solution shall be allowed to flow between the brake drum and brake support before the drum is removed.
4. After removing the brake drum, the wheel hub and back of the brake assembly shall be thoroughly wetted to suppress dust.
5. The brake support plate, brake shoes and brake components used to attach the brake plate shall be thoroughly washed before removing the old shoes.
6. If a vacuum is to be used during this operation it must be equipped with HEPA filters. The filters, when full, shall be first wetted with a fine mist of water, then removed and placed immediately in an impermeable container.
7. The container must be properly marked or labeled as an asbestos containing waste and WMT must be notified for proper disposal, at 3-2124.
8. Any spill of aqueous solutions or any asbestos containing waste material shall be cleaned up immediately and put in a properly labeled impermeable container. After this is accomplished, notify WMT at 3-2124 for proper disposal.
9. The use of dry brushing during low pressure/wet cleaning operations is prohibited.
10. The use of compressed air to clean dust from surfaces during brake and clutch repair is prohibited.
11. Before attempts are made to dislodge a frozen brake drum, the drum must be thoroughly wetted.

Training

All persons who may be required to handle asbestos containing materials will receive initial training as required by OSHA and EPA regulations. See the section on Training and Licensing requirements in Chapter 9.

Additional Information

Any questions concerning asbestos or this asbestos maintenance program should be directed to the IHT, at 3-3105.

APPENDIX 9-D - ASBESTOS RECORDS PROGRAM

NASA GLENN RESEARCH CENTER

CLEVELAND FACILITY

Environmental Management Office

Introduction

The Occupational Safety and Health Administration's Asbestos Standards require NASA to know the presence, extent, and condition of asbestos containing materials in the workplace. Significant efforts have gone into developing an inventory of asbestos containing building materials. This document describes the steps to be taken to maintain a coordinated asbestos inventory.

Inventory of Asbestos Containing Building Materials (ACBM)

An inventory of asbestos-containing materials is maintained by the EMO. The inventory has been provided to each building manager, and is available from EMO. The inventory is updated by EMO using reports from FED and FOD following their actions to further identify and remove asbestos-containing materials.

Bulk Sampling Requirements

The existing inventory of bulk samples, air samples, and building materials is maintained by IHT, and will be made available on hard copy and electronically. Maintenance of the inventory requires cooperation and support by everyone who samples and/or abates asbestos-containing materials.

In support of this need, those conducting sampling are required to consult the inventory prior to sampling, to ascertain the known condition of the homogeneous area(s) to be sampled, and the extent of the homogeneous areas, in order to plan a sampling program that is cost effective for attainment of long-term goals.

- All bulk sampling results of building materials collected for analysis of asbestos shall be reported to EMO on the attached form.
- Samples collected to document a negative finding of asbestos shall, at a minimum, include three samples of randomly selected locations of the homogenous area. The bulk sample submittal shall note the homogeneous area, sample location, analysis method and results.
- Sample locations shall be marked, photographed, and the material tagged as Asbestos should the results show a positive finding in at least one sample.
- All analysis must be done by a NVLAP accredited laboratory.

Approval of Asbestos Sampling Plan

Before the commencement of any remediation or abatement activities, the COTR shall submit a copy of the contractors asbestos sampling plan, (bulk and air) for approval by EMO/IHT.

Coordination of Abatement Results

The COTR of any abatement activity shall forward a copy of the final abatement report to EMO/IHT. This report will document the location and extent of abatement work. The report shall be sufficiently detailed to allow update of the asbestos inventory.

GRC Office of Safety and Assurance Technologies (OSAT)
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Last Update: 27 - November - 1996

GRC Environmental Program Manual

Chapter 10 - SYNTHETIC INORGANIC FIBER PROGRAM

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is November 27, 1996. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

This chapter describes the GRC Synthetic Inorganic Fiber Program and establishes the minimum requirements to reduce the risk of occupational illness resulting from exposure to respirable airborne synthetic fibers. To provide an environment free from excess fibers, priority will be given to the use of engineering controls such as, local exhaust ventilation for employees working with synthetic fibers.

BACKGROUND

Synthetic inorganic fibers (SIF), which include fiberglass, mineral wool, and refractory ceramic fibers (RCF), have been under review by the scientific community to determine health effects of these fibers. Based on animal toxicology and on some human epidemiological studies, the International Agency for Research on Cancer classified these materials as "possibly carcinogenic to humans". Of particular concern among industry health and safety professionals is the animal toxicology studies of refractory ceramic fibers, which have indicated the development of lung cancers and mesothelioma, a rare cancer of the pleura. For this reason, the GRC permissible exposure limit for RCF has been set to a lower level than either fiberglass or mineral wool. Refractory ceramic fiber that has been exposed to temperatures above 1800 F may form crystalline silica, a suspect human carcinogen. Synthetic inorganic fiber materials are available in various forms, including loose fill bulk insulation, blanket insulation, paper type wrap insulation, and compressed products such as gaskets.

While the Occupational Safety and Health Administration (OSHA) does not currently set permissible exposure limits for synthetic inorganic fibers, exposure limits have been recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and by the manufacturers of these materials. It is prudent that these limits be adhered to at Glenn Research Center to ensure worker protection.

APPLICABILITY

The Synthetic Inorganic Fiber Program is applicable to all personnel (civil servants and contractor) at Glenn Research Center and Plum Brook Station who may be exposed to SIF including but not limited

to fiberglass, mineral wool, and refractory ceramic fibers.

RESPONSIBILITIES

All employees and their supervisors shall be cognizant of the Synthetic Inorganic Fiber Program and conform to the requirements of the program. Specific responsibilities are as follows:

Industrial Hygiene Team (IHT)

- The IHT is responsible for the administration, maintenance, and surveillance of this program including
- Conducting baseline and routine surveys of operations, jobs, or procedures that require the use of SIF.
- Recommending appropriate controls.
- Maintaining a record of all air or wipe sampling data.
- Providing employee access to exposure data.
- Notifying employee supervisors and the Occupational Occupational Medical Services Office of employees who require medical surveillance based on exposure assessments.

Occupational Medical Services

- Maintains records of persons included in the medical surveillance program.
- Provides medical evaluations.
- Notifies employees of medical surveillance results.
- Notifies IHT of employees who may require exposure evaluation based on clinical findings.

Project Managers and Facilities Engineers and Operators

- Notifies IHT of facility renovations, modifications, and operations that require the use of SIF.
- Ensures that bid requests identify any SIF involved in the project.
- Implements appropriate controls and work practices for the control of excess fiber exposure

Plum Brook Management Office (PMBO)

- Manages and oversees the proper use of SIF's at Plum Brook in accordance with the guidelines of this chapter.

Researchers

- Must note on safety permit applications the use of synthetic fibers and, for operations for which a safety permit is not required, must notify IHT of the use of SIF.

Supervisors

- Ensure their employee Hazard Communication Training includes specific training on the hazards of SIF and how to minimize exposures.
- Request SIF hazard evaluations.
- Enforce the use of engineering and administrative controls including personal protective

equipment.

Chemicals Management Team (CMT)

- Includes SIF's used in research applications in the Center's hazardous chemical inventory.
- Provides updated copies of MSDS to the users.
- Ensures that labeling requirements under the GRC Hazard Communication Program are met.
- Conducts hazard communication training specific for SIF.

Environmental Compliance Team (ECT)

- Provides information on the disposal of the various SIF's.
- Provides information on any air, water, or soil pollution issues.

PROCEDURES

This document specifies the procedures to reduce and control exposure to SIF. Copies of this program are maintained by IHT and are available on request.

Permissible Exposure Limits

The following table lists the GRC maximum exposure limits and action levels for SIF:

Fiber Type	Maximum airborne exposure limit, MEL(a) fibers/cm3	Action level, AL(b), fibers/cm3	Excursion limit' EL (c), fibers/cm3
Refractory ceramic fiber	0.1	0.05	1
Fiberglass	1.0	0.5	-
Rock wool (mineral)	1.0	0.5	-
SIF not otherwise classified	Consult IHT		

Notes:
a - Limit for an 8-hr workday.
b - Level that triggers employee inclusion in a medical surveillance program.
c - Over a 30-min time period.

Engineering/Administrative Controls

To the extent feasible, priority shall be given to reducing employee exposure by the use of engineering controls such as using local exhaust ventilation for activities involving SIF such as cutting, grinding, sawing, etc., which generate airborne dust.

Where SIF materials are in place, they should be enclosed, and/or encapsulated so as to prevent the release of airborne fibers that may result from physical disturbance or air moving across the exposed

SIF surface. Where possible, alternative materials shall be considered for RCF.

Personal Protective Equipment

Where engineering controls cannot be used to control exposures below the action level, the following personal protective equipment shall be used to prevent occupational exposure to SIF.

- Disposable protective coveralls and head coverings
- Protective booties
- Respiratory protection - an air purifying respirator equipped with high-eficiency particulate air (HEPA) filters. NOTE: Contact the IHT for advice on the selection of an appropriate respirator.
- Cotton gloves may be worn
- Safety eyewear.

Air monitoring

Air sampling shall be conducted by IHT or contractor representative as a result of a preliminary hazard assessment, recommendation from Occupational Medical Services Office, employee request, safety permit review, facility renovation or maintenance activity, or emergency response such as a spill of SIF. Requests for assistance shall be directed to IHT using a Work Request Form (C-709) through EMO.

The NIOSH 7400 method for fibers will be used to assess worker exposures. Area monitoring shall be conducted using either the NIOSH method or a real time fibrous aerosol monitor.

Where possible, sampling should be conducted before, during, and after operations. Sampling conducted during a particular work activity should reflect worst-case exposures for the employee. Supervisors, employees, and, when necessary, Occupational Medical Services Office shall be notified of the sample results.

Occupational Medical Surveillance

Employees who may be exposed at the action level for 30 or more days per year, shall be recommended for inclusion in a medical surveillance program.

Safe Work Practices

Work involving SIF should be planned to control and prevent employee exposure and the contamination of work surfaces and equipment. The plans should include IHT review to determine the required air sampling and ventilation controls. For operations that cannot be accomplished using local exhaust ventilation, workers must use personal protective equipment, as listed in the "Personal Protective Equipment" section (above).

Facility and equipment work surfaces will be protected from contamination by the use of plastic sheeting. The area in which work is to be done shall be secured by the use of warning signs and tape to prevent entry the of unprotected persons in accordance with the Glenn Safety Manual.

A HEPA vacuum cleaner will be used to clean any debris once a task is completed. Wet wiping will

follow the vacuuming.

Disposal

Substances containing SIF will be handled and disposed of using the same procedures that are currently being used by GRC for the disposal of asbestos containing materials (ACM). Although SIF's are not now regulated by the U.S. EPA, they are currently under study. It is prudent for GRC to follow the most conservative methods for disposing of these materials in anticipation of their becoming regulated.

Training

As required by the with the OSHA Hazard Communication Standard, employees working with SIF shall be trained regarding the health hazards, routes of exposure, exposure limits, safe work practices, air sampling requirements, the proper use of personal protective equipment, engineering controls, first aid, emergency response procedures for spills, and disposal requirements. Employees shall also be made aware of the contents and location of the written program.

Recordkeeping

In accordance with the requirements of the 29 CFR 1910.20 OSHA Employee Access to Medical and Exposure Records Standard, both medical and industrial hygiene sampling records will be made available to affected employees or their representatives. Copies of these records will be maintained by the Occupational Medical Services Office and IHT.

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Approved by: Environmental Management Office Chief: Michael Blotzer *michael.blotzer@grc.nasa.gov}*
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Revision Date: November 27, 1996

GRC Environmental Programs Manual

Chapter 11 - Hearing Conservation Program

Records and Forms

Noise Exposure Management Process Flowchart (Micrografx format)

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is October 14, 1999. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

This Chapter establishes minimum requirements for GRC Hearing Conservation Program (HCP). The program's purpose is to prevent noise-induced hearing loss among GRC employees, contractors, and visitors. This chapter sets forth procedures and responsibilities for the effective control of occupational noise exposures at GRC, for the early identification of noise induced hearing loss, and for ensuring compliance with applicable regulations and standards.

APPLICABILITY

This chapter is applicable to all civil servant and contractor employees assigned to GRC sites and to any NASA-controlled, government-owned facilities associated with GRC. The full intent of this chapter shall be incorporated in any support service contract under which contractor employees will be assigned to work in areas or conditions on NASA sites where noise levels are or have the potential to be greater than 80 dBA.

Employees of other contractors (e.g., construction) and all other visitors shall abide by the personal hearing protection requirements and default maximum permissible noise exposure limits specified in this chapter by observing and complying with all posted hearing protection requirements.

AUTHORITY

OSHA Standard on Occupational Noise Exposure 29CFR 1910.95

NASA Headquarters Health Standard on Hearing Conservation NHS/IH 1845.4

BACKGROUND

Repeated unprotected exposure to high sound levels is the most direct and common cause of noise-induced hearing loss. Hearing loss due to noise exposure is always irreversible and almost entirely preventable. Implementation of a proactive hearing loss prevention program will minimize noise-induced hearing loss and result in improvements in the safety, productivity, comfort, and regulatory compliance of the work environment. Elements of a successful program include the implementation of engineered noise controls, responsible operation and maintenance of noise sources, consideration of noise emission criteria in equipment purchase and facility design decisions, specific and personalized employee education, and early detection (and follow-up) of hearing loss via accurate medical monitoring.

POLICY

It is GRC policy to conduct research and support operations in such a manner as to minimize unprotected exposure to noise levels above 85 dBA and to proactively support the HCP's primary goal of preventing noise induced hearing loss among employees, contractors, and visitors.

RESPONSIBILITIES

The Chief of the Environmental Management Office (EMO) is responsible for:

The GRC HCP. The responsibility for the management for this program is delegated to the HCP Manager.

The Director of the Engineering and Technical Services Directorate is responsible for:

Ensuring that noise control and reduction considerations are integral to the site selection and design of new or modified GRC facilities.

The Director of the Glenn Research Center is responsible for:

Ensuring that the HCP, as specified by the NASA Headquarters Health Standard on Hearing Conservation, is in place at GRC.

Employees of the Engineering and Technical Services Directorate are responsible for:

Ensuring that the design and development, or selection and purchase, of aeronautical and space hardware, tools, support equipment, engineering controls, and associated procedures (where feasible) will minimize unprotected exposure to noise levels above 85 dBA.

Planning, scheduling and conducting research, maintenance and construction operations in a manner that minimizes unprotected exposure to noise levels above 85 dBA.

Selecting building and research support equipment with the lowest noise emissions, where feasible.

Notifying the Hearing Conservation Program Manager of noisy areas/operations.

Designing and applying engineering controls necessary to reduce noise exposures below 85 dBA or to

the maximum extent feasible.

Giving necessary consideration to acoustics in the design and modifications of buildings.

Providing copies of applicable engineering drawings and operational plans to the HCP Manager for review of any precautions planned to limit noise emissions and control noise exposures.

Maintaining noise producing equipment and controls to preclude noise increases. Vibrations, worn gears, bad bearing, unbalanced fans, corroded mufflers, nonubricated fittings, and vibrating pipes can all contribute to high noise levels.

Contracting Officers (CO) and Contracting Officers' Technical Representatives (COTR's) are responsible for:

Ensuring that the full intent of this chapter is incorporated into all support service contracts and that other (e.g., construction) contracts require compliance with posted personal hearing protection requirements. CO's and COTR's are also responsible for ensuring that all contracted activities are planned, scheduled and conducted in a manner that minimizes unprotected exposure to noise levels above 85 dBA.

The GRC Medical Director, Occupational Medicine Services (OMS) is responsible for:

Maintaining a registry of all personnel enrolled in the GRC HCP, scheduling those persons for audiometric examinations, and notifying employees of the need to avoid exposure to high noise levels preceding audiometric tests.

Providing medical evaluations, obtaining an occupational history of participants in the Medical Monitoring Program, supervising on-site audiometric testing, and evaluating test results.

Notifying employees of significant hearing loss or other medical pathology of the ear, and explaining the need and plans for further testing and/or referrals.

Notifying the employee (in writing), the employee's supervisor, and the HCP Manager within 21 days if further testing establishes that a permanent Standard Threshold Shift (STS) has occurred. (If the shift is 25 dB or greater, the HCP Manager shall be notified within 48 hours.)

Forwarding audiometric monitoring results (names, dates, and specific information about any STS's identified) to the HCP Manager on a monthly basis.

Consulting with the HCP Manager regarding any employee with hearing loss so that the workplace can be evaluated/re-evaluated to assure that no excess exposures occur.

Recommending to the supervisor the reassignment of employees to work in low noise areas when such is necessary to prevent further significant hearing loss or the aggravation of other medical conditions. Any reassignments should be in accordance with applicable personnel management requirements.

Referring employees to an audiologist or physician specialist, as appropriate.

Ensuring that the physicians who conduct or supervise the audiometric testing of employees have reviewed the requirements of this chapter.

Ensuring that personnel who conduct audiometric testing be responsible to a physician/audiologist.

Ensuring that audiometric test equipment is properly calibrated and that ambient noise levels in audiometric test rooms meet the requirements specified in the NASA Headquarters Health Standard on Hearing Conservation. Background noise levels can be measured by the HCP Manager.

Maintaining audiometric test records and other records as required by the NASA Headquarters Health Standard on Hearing Conservation.

Providing employee access to medical records in accordance with the requirements of the NASA Headquarters Health Standard on Hearing Conservation.

The Hearing Conservation Program Manager is responsible for:

Conducting baseline surveys of each new operation, job, procedure having the potential of creating noise levels above 80 dBA. These surveys should be pre-operational, where possible.

Conducting annual walk-through surveys of all worksites to evaluate the potential for excess noise exposures and to develop sampling strategies as appropriate.

Monitoring and evaluating noise hazard areas or operations through noise surveys and personal noise dosimetry.

Recommending appropriate means of controlling noise exposures.

Designating noise hazard areas and notifying appropriate managers/supervisors of such areas.

Maintaining a current inventory of all noise hazard areas and noise levels recorded in these areas.

Providing employee access to noise survey/dosimetry records.

Notifying supervisors of affected employees and the GRC Medical Director of the requirements for employees to participate in the HCP. Participation is required when noise monitoring data shows that noise exposures exceed the action level of 80 dBA TWA as specified in this chapter.

Notifying supervisors of affected employees of the requirements for employees to wear appropriate hearing protection.

Reviewing facility and operational plans to assess the adequacy of precautions planned/taken to control noise exposures.

Recommending the selection of hearing protection devices (in collaboration with OMS, as necessary) and specifying performance (attenuation) requirements.

Coordinating with supervisors, personnel officers, OMS, and others as necessary to carry out all

aspects of the HCP.

Providing guidance in the development of training programs for personnel enrolled in the HCP and their immediate managers, and assuring that the training provided is adequate and meets regulatory requirements.

Coordinating with OMS in determining if the cause of a permanent STS is work-related.

Notifying the Glenn Safety Office of any employees who have demonstrated a persistent STS of 25 dB or greater so that the appropriate information may be entered on the OSHA 200 Log.

Assisting OMS in measuring background noise levels in audiometric booths.

The Chief of the Glenn Safety Office is responsible for:

Entering the appropriate information on the OSHA 200 Log when notified by the HCP Manager that an employee has demonstrated a persistent STS of 25 dB or greater.

Supervisors are responsible for:

Reporting suspected hazardous noise in all of their areas of jurisdiction to the HCP Manager.

Maintaining a roster (name and job titles) of personnel working in designated high-noise areas (or otherwise exposed to hazardous noise) and informing the HCP Manager of changes (new employees, employees transferred, employees terminated, etc.).

Referring personnel who complain of hearing loss or other hearing or ear problems to OMS for examination.

Enforcing the wearing of hearing protection devices and ensuring that administrative controls are followed where required.

Notifying the HCP Manager of any changes in operations requiring noise determinations or evaluations.

Ensuring that hearing protective devices that have been approved by the HCP Manager are available for use by employees.

Ensuring that employees who are enrolled in the HCP receive annual (calendar year basis) training.

Ensuring that employees who are enrolled in the HCP participate in annual (calendar year basis) audiometric testing.

Attending Hearing Conservation Training as required for supervisors.

Assuring that caution signs are posted in designated noise hazard areas and that appropriate labels, decals, or placards are placed on tools and equipment as specified by the HCP Manager.

Notifying each affected employee of the results of noise monitoring when the employee's noise

exposure meets or exceeds the action level of 80 dBA TWA.

Individual employees are responsible for:

Participating in annual Hearing Conservation Training (on a calendar year basis), if enrolled in the HCP.

Receiving an annual (calendar year basis) audiometric test, if enrolled in the HCP.

Utilizing control procedures established for maintaining effective noise exposure control, including wearing and maintaining hearing protective devices furnished for their protection.

Observing posted hearing protection signs, decals and labels and complying with the specific NRR requirements at all times.

Cooperating with supervisors, OMS personnel and the HCP Manager in activities/actions undertaken to evaluate hazardous noise and to prevent hearing loss caused by excessive exposure to workplace noise.

Notifying supervisors or the HCP Manager of areas, operations, or equipment which may produce hazardous noise.

Program Requirements

Written Program

This chapter incorporates the requirements of the OSHA Standard on Occupational Noise Exposure and the NASA Headquarters Health Standard on Hearing Conservation. These requirements shall be incorporated into all support service contractor written programs.

Employee Access

Copies of this chapter, 29 CFR 1910.95 and any appropriate records required by this chapter shall be provided, upon request, to employees, former employees, representatives of employees, and representatives of the U.S. Department of Labor, the national Institute for Occupational Safety and Health (NIOSH), and NASA Occupational Health Division personnel. Privacy Act provisions shall be adhered to where applicable.

Default Maximum Noise Exposure Limits (With Hearing Protection)

Where highest rated personal hearing protective devices (plugs plus muffs) are insufficient to attenuate employee noise exposure to a level of 85 dBA or below, administrative controls shall be implemented to ensure that the employee's exposure does not exceed the default exposure limit of 85 dBA Time-Weighted-Average (TWA) shown in Table 1 below, computed using a 5 dB exchange rate. This default exposure limit also applies to cases where the requirement for personal hearing protection with a specific Noise Reduction Rating (NRR) has been waived by the HCP Manager for operational or safety reasons.

Table 1
85 dBA TWA Default Maximum Permissible Noise Exposure Limits*

Noise duration, hr.....	Sound level*, dB(A)
16	80
8	85
4	90
2	95
1	100
0.5	105
0.25	110
0.125 or less	115

*These limits apply to noise exposure with (after accounting for) hearing protection and are applicable only when highest-rated hearing protector(s) (plugs plus muffs) are insufficient to attenuate noise exposure to 85 dBA. Exposure (after accounting for hearing protection) to sound levels above 115 is not permitted, regardless of duration of exposure.

Engineering Controls

Where feasible, facilities and equipment shall be procured, designed, operated, and/or modified in such a manner as to minimize exposure to noise levels above 85 dBA. Any reduction in noise level, even if it is not reduced below 85 dBA, is beneficial. If engineering controls fail to reduce sound levels below 85 dBA, hearing protective equipment and/or administrative methods of noise exposure protection must be used.

Personal Hearing Protection

Personal protective equipment is to be used only temporarily or where engineering controls are not feasible or practical.

Earmuffs and/or plugs shall be provided to employees assigned to work in areas where they will be exposed to continuous, intermittent, or impact noise (without regard to duration of exposure) in excess of 80 dBA. Disposable earplugs shall be available for employee use where noise exposures are less than 80 dBA (for protection against nuisance noise), if they so desire. Earmuffs and/or earplugs shall be worn by employees exposed continuous, intermittent, or impact noise in excess of 85 dBA, without regard for duration of exposure or character of the noise source. Earplugs and earmuffs shall be for the exclusive use of each employee and shall not be traded or shared. Use of ear protectors shall be mandatory where requirements are posted, and their use shall be enforced by supervisors as specified in this chapter.

Hearing protectors must attenuate noise exposure (at the ear) to a level of 85 dBA or below, based on the NRR of the protector. Estimation of the adequacy of hearing protector attenuation shall be performed according to OSHA-specified methods.

The adequacy of hearing protector attenuation shall be re-evaluated whenever employee

noise exposures increase to the extent that the hearing protector currently in use may no longer provide adequate attenuation. More effective hearing protectors shall be provided when necessary.

Employees shall be able to choose either earmuffs or earplugs from a variety styles. Any protector (or combination of protectors) that provides the required NRR, as specified by the HCP Manager, shall be acceptable.

Special hearing protection equipment, such as sound-attenuating communication headsets, may be used in high-noise areas. These devices should be regularly inspected. Sound-attenuating headsets which have been damaged, altered, or modified in any way which affects the attenuation characteristics may not be used. Where replacement parts, such as earcup seals are available, the headsets may be repaired and reused. Where sound attenuating headsets are not permanently issued to individuals, such equipment must be cleaned before being reissued.

Requirements for specific NRR performance in Section 3 may be waived on a case-by-case basis by the HCP Manager where warranted for technical or safety considerations. The default maximum noise exposure limit of 85 dBA TWA shall apply in those cases.

Administrative Control

Where highest rated hearing protective equipment (plugs plus muffs) or engineering controls are not sufficient to attenuate noise exposure to less than 85 dBA, the duration of time spent in the noise hazard area shall be limited so as not to exceed the default maximum exposure limit (with hearing protection) of 85 dBA TWA. This default limit is 80 dBA TWA for employees who have demonstrated a persistent Standard Threshold Shift.

Noise Monitoring

Measurement of potentially hazardous sound levels shall be conducted when any information, observation or calculation shows that an employee could be exposed to a noise level in excess of 80 dBA. This includes, but is not limited to times where there is a need to document representative noise exposures, where employees complain of excessive noise, or where it is difficult to understand a normal conversation when the speaker and listener face each other at a distance of two feet. Any new equipment, operation, job or procedure with the potential for creating noise levels above 80 dBA should be evaluated with regard to noise emissions prior to start-up. All continuous, intermittent and impulsive sound levels from 80 dB to 130 dB shall be integrated into the noise measurements. Noise exposure computation is shown in Appendix A of 29CFR 1910.95. Noise monitoring should be repeated at least biannually, or whenever any changes to facilities, equipment, work practices, procedures, or noise control measures alter potential noise exposures.

Noise monitoring shall be conducted in accordance with the OSHA Standard on Occupational Noise Exposure and the NASA Headquarters Health Standard on Hearing Conservation. Requirements of these standards are hereby incorporated by reference.

Employee Participation in the HCP

All personnel who are routinely exposed to noise (30 or more days per year) at or above the action level of 80 dBA TWA as shown in Table 2 below shall be identified and placed in the HCP. [Program enrollment is based on employee noise exposure independent of hearing protector usage or selection.] Other personnel, including those in maintenance, custodial, emergency response, safety, security, and environmental management positions who have a reasonable potential for periodic exposure to noise levels above 85 dBA should also be enrolled in the HCP.

Table 2
80 dBA TWA Action Level for Employee Enrollment in the HCP

Noise duration, hr.....	Sound level*, dB(A)
8	80
4	85
2	90
1	95
0.5	100
0.25	105
0.125	110 or above

*These sound levels apply to measured or estimated TWA exposures, without accounting for any reduction provided by hearing protection. They are to be used only as a threshold for Program enrollment and are not to be construed as exposure limits.

All employees who are enrolled in the HCP shall receive an annual audiogram (every calendar year).

All employees who are enrolled in the HCP shall participate in annual hearing conservation training activities (every calendar year), as specified by the HCP Manager.

Medical Monitoring Program

Audiometric testing shall be conducted in accordance with the OSHA Standard on Occupational Noise Exposure and the NASA Headquarters Health Standard on Hearing Conservation. All medical monitoring requirements specified in these standards are hereby incorporated by reference.

Posting of Personal Hearing Protection Requirements

Caution signs which clearly indicate the hazard of high noise levels and state the requirements to wear hearing protection shall be posted at the entrance(s) to, or the periphery of, noise hazard areas. Decals or placards with similar statements shall be affixed to power tools and machines that produce noise levels above 85 dBA. Signs and decals shall have working in black letters on a yellow or orange background.

Employee Training

Hearing conservation training shall be provided to each employee on annual (calendar year) basis and shall include, at a minimum, an overview of the GRC HCP, a review of the effects of noise on hearing (including permanent hearing loss); noise control principles; the purpose of hearing protectors; the advantages, disadvantages, and attenuation characteristics of various types of ear protectors; instructions on selections, fitting, use, and care of hearing protectors; and explanation of the audiometric testing procedure; and the purpose of audiometric testing.

An education program shall be provided for supervisory and managerial personnel whose employees are exposed above the action level of 80 dBA, emphasizing their responsibility in the HCP.

Personnel shall be encouraged to use hearing protectors whenever they are exposed to noise levels above 80 dBA during off-duty activities (e.g., from lawn mowers, firearms, etc.).

Recordkeeping Requirements

Audiometric test data, noise exposure records and instrument calibration records shall be established and maintained in accordance with the OSHA Standard on Occupational Noise Exposure and the NASA Headquarters Health Standard on Hearing Conservation. Recordkeeping requirements of these standards are hereby incorporated by reference.

DEFINITIONS

Action Level - an exposure to an 8-hour TWA of 8- decibels measured with a dosimeter or sound level meter on the A-scale, slow response. The time-weighted average computation should be made using a 5 dB exchange rate.

Audiogram - a chart, graph, or table resulting from an audiometric test. An audiogram shows an individual's hearing threshold level as a function of frequency.

Standard Threshold Shift (STS) - an average hearing threshold shift of 10 dB or more at 2000, 3000, and 4000 Hz in either ear. A Standard Threshold Shift that is demonstrated on a retest audiogram is determined to be a permanent or persistent Standard Threshold Shift.

Time-Weighted-Average (TWA) sound level - the sound level that, if constant over an 8-hour workday exposure, would result in the same noise dose as is measured.

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GRC Environmental Program Manual

Chapter 12 - Respiratory Protection Program

Records and Forms

Respiratory Protection Program Flowchart (Micrografx format)

Note: The current versions to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is October 10, 1999. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

Purpose

This chapter establishes minimum requirements for the NASA Glenn Research Center (GRC) Respiratory Protection Program. It is intended to ensure employee protection from hazardous airborne materials through the implementation of engineering, work practice, and administrative controls to minimize employee exposure or, when these controls are not effective, to reduce employee exposures to safe levels.

Applicability

The Respiratory Protection Program is applicable to all personnel (civil servants and contractors) who use respirators for protection of health or who may, on an emergency response basis, need to use respirators at the GRC and Plum Brook Station. The Respiratory Protection Program procedures described in this chapter will be followed except where substance-specific OSHA regulations contain more stringent or additional requirements.

Background

The Glenn Research Center (GRC), as part of its effort to provide a safe and healthful work environment, is committed to protect all employees from exposure to harmful concentrations of hazardous or toxic dust, fumes, mists, vapors, gases, or oxygen-deficient atmospheres. Where effective engineering controls are not feasible or while they are being instituted, respiratory protection measures described herein shall be used to protect workers. The Respiratory Protection Program encompasses all aspects of respiratory protection, from the initial hazard assessment, where the need for a respirator is determined, to the program evaluation, where the effectiveness of the program is assessed. The flow chart in Appendix A provides an outline of the Respiratory Protection Program.

Authority

- NASA 1800.2 NASA Occupational Health Program
- Respiratory Protection, 29 CFR 1910.134.
- Basic Program Elements for Federal Employee Occupational Safety and Health Programs, 29 CFR 1960, as revised
- Executive Order 12196 of February 26, 1980, Occupational Safety and Health Administration (OSHA)
- Programs for Federal Employees

Responsibilities

All employees and their respective supervisors shall be cognizant of and conform to the requirements of the program.

Specific responsibilities are:

Environmental Management Office (EMO)
Industrial Hygiene Team (IHT)

- Designate a Program Administrator
- Implement this written Respiratory Protection Program.
- Perform Hazard Evaluations.
- Develop worksite-specific procedures and elements for respirator use.
- Conduct user training for SCBA.
- Conduct training for supervisors on the GRC Respiratory Protection Program
- Provide information on the specific use of the respirator to the Physician or Other License Health Care Professional (PLHCP)
- Maintain air compressor and components for compressed air cylinders.
- Provides guidance on the selection, use, and fitting of respiratory protection.
- Perform periodic program evaluation.

Medical Services

- Administer medical questionnaire and conduct spirometry test annually.
- Conduct annual fit test.
- Show respiratory protection program training video.
- Administer short quiz after employee completes training video.
- Confirm demonstration of employee proper use of respirator (donning, removing, and cleaning).
- Provide a written opinion regarding the employee's physical ability to use a respirator, any limitations of use, and the need for any follow-up evaluations.
- Provide information to the IHT on the appropriate respirator (make, model, and size) chosen for each employee and a confirmation of training.
- Enter employee information into database.

Plum Brook Management Office (PBMO)

Administer this Respiratory Protection Program for Plum Brook Station.

Supervisors

- Be familiar with the Program requirements and ensure their employees comply with them.
- Support the Respiratory Protection Program as it relates to the needs of their employees.
- Participate in Respiratory Protection Program training for supervisors.
- Support the IHT in identifying needed hazard evaluations.

Employees

- Comply with all aspects of the program including but not limited to annual respirator fit
- testing, annual respirator training, and annual medical spirometry tests.
- Comply with the proper procedures for using, cleaning, maintaining, and storing the respirator
- Support the IHT in identifying needed hazard evaluations.
- Notify the IHT when using the respirator for materials other than those in the most recent hazard assessment.

Contractors

- Provide, manage, and implement their own respiratory protection programs. Contractor respiratory
- protection programs shall comply with all Occupational Safety and Health Administration (OSHA) regulations as well as with the GRC program.

Students

Co-op students are employees of GRC and are included in the GRC Respiratory Protection Program

- Student interns are employees of their respective universities and thus would not be covered by the GRC
- Respiratory Protection Program. However, since the student is working in the confines of GRC, the IHT can assist by conducting a hazard assessment of the operation.

Hazard Assessment

Before the selection and assignment of a respirator, an industrial hygienist, or a competent person under the supervision of an industrial hygienist, shall perform a hazard evaluation of the task that may require respiratory protection. The evaluation shall include the nature of the hazard, reasonable estimate or actual levels of exposure, identification of the chemical state and physical form, and the length of time the respiratory protection is required.

Where a reasonable estimation of employee exposure cannot be determined, the atmosphere must be considered immediately dangerous to life or health (IDLH).

Whenever possible, air contaminants shall be controlled by accepted engineering control measures (e.g., enclosure, ventilation, wet methods, and substitution of less toxic materials). When effective

engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used.

Medical Surveillance

Only persons found to be physically able shall be assigned a task requiring the use of a respirator. The

Physician or Other Licensed Health Care Professional (PLHCP) shall conduct a medical questionnaire that meets the requirements of 29 CFR 1910.134. The PLHCP may also include any other health and physical conditions that are pertinent, and shall perform a pre-placement medical examination. The PLHCP shall prepare a written opinion regarding the employee's physical ability to use a respirator, any limitations of use, the need for any follow-up evaluations. A copy of the written opinion shall be sent to the IHT for inclusion in the Respiratory Protection Program files.

Before the PHCLP makes a recommendation on the employee's ability to use a respirator, the Industrial Hygiene Team must provide information on the type and weight of the respirator to be used, the duration and frequency of use, the expected physical work load, additional protective clothing worn, and temperature and humidity extremes that may be encountered.

The medical evaluation must be completed before the employee is fit tested or required to use the respirator in the workplace.

The employee's medical status shall be reviewed annually by a PHLCP.

The employee's medical status shall also be reviewed whenever the employee experiences medical signs or symptoms that are related to the ability to use the respirator or information including observation during fit testing or program evaluation indicates a need for an re-evaluation.

Records of medical evaluations will be maintained and made available in accordance with 29 CFR 1910.1020.

Selection of Respirators

Proper selection of respirators shall be made according to 29 CFR 1910.134 and with the guidance of the American National Standards Institute (ANSI) "Practices for Respiratory Protection" Z88.2.

All respirators shall be approved and certified by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR Part 84. Air-purifying respirators shall not be used in oxygen deficient atmospheres, IDLH atmospheres or unknown atmospheres. Only full facepiece respirators shall be used in contaminant concentrations that produce eye irritation.

When appropriate, employees may choose to use a Powered Air Purifying Respirator (PAPR) in lieu of a negative pressure respirator. Purchase and use of a PAPR is subject to the approval of the IHT. However, if the PLHCP determines that an employee's health is at increased risk if a negative pressure respirator is used, the employee will be provided a PAPR if the PLHCP determines that such a respirator can be used.

Disposable filtering facepieces may be used for nuisance particulate levels. Use of disposable

respirators does not require a medical spirometry test or fit test but does require training and compliance with all other aspects of the Respiratory Protection Program, the written approval of an industrial hygienist, and the information provided in Appendix B.

Respirators must first be chosen based on the identification and evaluation of workplace hazards. Assigned protection factors, using NIOSH recommend protection factors and the professional judgment of an industrial hygienist (whichever is more conservative), shall be used for determining the appropriate respirator. OSHA assigned protection factors will replace the NIOSH recommended protection factors after the data is reviewed and published in 29 CFR 1910.134.

For protection against gases and vapors GRC will provide an atmosphere supplying respirator or an air-purifying respirator with an end of service life indicator certified by NIOSH for the contaminant. Where no end of service life indicator is available, a change out schedule based on objective information or data must be established. Objective data may be obtained through the manufacturer or through testing breakthrough times for a chemical under the specific conditions in which it will be used.

For protection against particulates GRC will provide an atmosphere supplying respirator or an air-purifying respirator equipped with a filter certified by NIOSH under 42 CFR 84.

Voluntary Use of Respirators

Use of respirators voluntarily requires that employees receive their annual medical examination and are provided the information in Appendix B which addresses the safe use of a respirator.

Voluntary use of a filtering facepiece does not require inclusion in the Respiratory Protection Program, it does however, require that the employee receive and understand the information in Appendix B.

Fit Testing Procedures

The employee shall be fitted with a respirator from a selection that includes at least three sizes of each type of facepiece from at least two different manufacturers. The appropriate respirator shall be chosen by an industrial hygienist or a designated competent person based on the hazard assessment, fit testing, and comfort.

Employees required to wear tight-fitting air-purifying respirators (that is, respirators dependent on a facepiece-to-face seal) and tight-fitting atmosphere-supplying respirators shall be fit tested to ensure that the respirator selected fits the employee well enough to provide the adequate protection.

The employee shall be fit tested after the initial medical surveillance but prior to the first use of the respirator and annually thereafter.

The fit test's) used shall be in accordance with OSHA standard 29 CFR 1910.134 and shall be approved by the IHT.

A qualitative fit test may only be used to fit test a negative pressure air-purifying respirator that must achieve a fit factor of 100 or less. If a qualitative fit test is used, the air-purifying respirators may only

be used in atmospheres that do not exceed 10 times the established permissible exposure limit.

A quantitative fit test may be used in lieu of a qualitative fit test but for fit factors equal or greater than 100, a quantitative fit test must be passed.

The half-mask air-purifying respirator may only be used in atmospheres that do not exceed 10 times the established permissible exposure limit. The full facepiece air-purifying respirators may only be used in atmospheres that do not exceed 50 times the established permissible exposure limit.

For tight-fitting atmosphere-supplying respirators, a quantitative fit test must be used. The facepiece shall be tested as a negative pressure respirator, without the air-supplying equipment or attachments. If the respirator facepiece passes the test, the assigned protection factor shall be in accordance with those established by OSHA.

Respirator fit testing records shall be kept for the duration of employment.

Training Program

The IHT shall provide training for each employee who is required to wear a respirator. Training shall be conducted by an industrial hygienist or a competent person designated by an industrial hygienist prior to use and annually thereafter. Written records shall be kept for the duration of employment and shall include names, training dates, and subject areas covered. The subjects covered by the training are outlined in Appendix C.

Use of Respirators

Before a respirator is used, work site specific information must be established by an industrial hygienist or a competent person designated by an industrial hygienist. Detailed information should include a description of the task for which the respirator will be used, frequency of use, average duration of use at any one time, chemical hazards involved, other necessary protective clothing, measured or estimated exposures, and the appropriate respiratory protection for the task. Respirators shall be used only for the chemicals and tasks for which they have been assigned.

If the user intends to use the respirators in unknown atmospheres or in the presence of hazardous materials other than those in the hazard assessment, the user shall request a new hazard assessment.

Respirators may not be worn under conditions that would interfere with the facepiece-to-face seal or good fit. Examples of such conditions include facial hair, facial scars, eyeglasses with sidebars, and headgear that interferes with the seal. Any facial hair that interferes with the facepiece-to-face seal or the operation of the inhalation or exhalation valves must be completely shaved for tasks requiring respirator use. If glasses must be worn, they must not interfere with the seal of the facepiece. A respirator spectacle kit will be issued when a full-facepiece respirator is required.

Before entering the work area, employees shall perform a user seal check for all tight fitting facepieces. Details on how to perform a user fit and seal check may be found in Appendix D.

Should an emergency situation develop in an area where respirator usage is required, such as a spill, fire, explosion or an IDLH atmosphere, leave the area and call 911 Glenn Dispatcher.

Emergency use of respirators required for GRC employees shall first require the approval of the IHT. All emergency use respirators shall be administered and controlled by the IHT. See the section on "Emergency Use of Respirators".

Maintenance of Respirators

Workers are responsible for the maintenance of their personal respirators. Oversight shall be provided by the IHT.

Respirators shall be cleaned and disinfected after each use. If the respirator is used periodically throughout the day it should be cleaned at the end of the day. The respirator shall be cleaned according to the recommendations provided by the manufacturer or by using the following procedures:

- Disassemble respirator completely.
- Wash in warm water with mild detergent (with a disinfecting agent).
- Rinse all components in clean, warm water.
- Allow components to air dry or hand dry with a lint free cloth.
- Reassemble facepiece.

Respirators shall be stored in a manner that protects them from damage, dust, sunlight, extreme temperatures, excessive moisture, or damaging chemicals. They shall be stored to prevent deformation of the facepiece or the exhalation valve.

Respirators for emergency use must be clearly marked and stored where they are always accessible.

Respirator shall be inspected before each use and during cleaning. Inspections shall include respirator function, tightness of connections, and the condition of the facepiece, head straps, valves, connecting tube, and cartridges, canisters, or filters and the pliability of rubber/silicone parts for signs of deterioration. Replacement parts must be NIOSH certified.

Emergency use respirators shall be inspected and tagged at least monthly as well as being inspected before and after each use. The SCBA inspection must be documented including the date of inspection, person doing inspection, required remedial action, and identification number for the SCBA. The documentation must be on a tag or label attached to the storage compartment for the SCBA.

All respirators issued by the IHT that fail to pass inspection shall be removed from service and returned to the IHT for repair or disposal.

Replacement of respirator filters or cartridges shall be in accordance with a schedule established by an industrial hygienist or designated competent person. Replacement filters or cartridges shall be obtained from Stores Stock. If the necessary cartridges are not available from stock they may be purchased from an outside vendor.

Program Evaluation

The IHT shall evaluate the effectiveness of the respirator program as part of the GRC Facility Inspection Program described in the Glenn Safety Manual. During the evaluation, respirator program participants and their immediate supervisors will be interviewed. The interviews will be used to evaluate wearer acceptance of the respirator program (as to respirator selection, training, donning and fit, maintenance, storage, medical aspects) and to appraise the protection afforded based on monitoring data. This annual evaluation shall be documented. In addition, random inspections shall be conducted to ensure compliance with the program.

Confined Spaces

All respirator use in confined spaces will also comply with the requirements of the Glenn Safety Manual Chapter "Confined Spaces."

Respirator Use in Immediately Dangerous to Life or Health Atmospheres

When emergency use of respiratory protection is required, call 911 Glenn Dispatcher. Examples of such situations include unknown atmospheres, rescue of workers from a confined space, oxygen deficient atmospheres, IDLH atmospheres, or a situation where an employee may be overcome by toxic vapors.

Only full-facepiece pressure-demand supplied-air respirators (SAR) with an auxiliary self-contained air supply or self-contained breathing apparatus (SCBA) may be used in an unknown, oxygen deficient, or IDLH atmosphere. Each SCBA used in IDLH atmospheres or for emergency entry or fire fighting shall be certified for a minimum service life of 30 minutes.

SAR's and SCBA's shall only be used by personnel trained in the their use and limitations. Users of SCBA will receive training specific to their SCBA equipment on an annual basis.

The buddy system shall be used where at least one standby person shall be present in a safe area and equipped with the same level of protection as the employee in the IDLH area. Communication (visual, voice, or signal) shall be maintained at all times between the standby person and the individual in the IDLH atmosphere. The employee outside of the IDLH atmosphere must be trained and equipped to provide effective emergency rescue.

Respirator wearers in IDLH atmospheres shall be equipped with retrieval equipment for lifting or removing them from the area or equivalent provisions for rescue shall be in place.

Breathing Air Quality and Use

Breathing air used for respiration shall be of high quality purity. At a minimum, it must meet the specifications outlined in 29 CFR 1910.134(i) which are the minimum requirements for Type1-Grade D breathing air as described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

Cylinders of breathing air must be tested and maintained as prescribed in 49 CFR Part 173 and 178.

They must come with a certificate of analysis from the supplier that the breathing air meets the requirements for Type 1- Grade D breathing air.

Compressors used to supply breathing air must be constructed and situated as to prevent entry of contaminated air in the air-supply stream, minimize moisture content. They must be equipped with suitable in-line sorbent beds and filters and an in line carbon monoxide monitor. The filters and sorbent beds must be tagged with information including the most recent change date and a signature of the person who performed the change.

Identification of Filters, Cartridges, and Canisters

All filters, cartridges, and canisters used in the workplace shall be properly labeled and color coded with a NIOSH approved label as required by 42 CFR Part 84 before and during their service life.

Respirator users are categorized as either Active or Inactive. Active respirator users are those GRC employees and students who are presently using a respirator. Inactive respirator users are those employees who no longer use their respirator and those who are no longer employed by GRC.

Definitions

Definitions to terms found in the GRC Respiratory Protection Program may be found in Appendix E.

Appendix B: Information for Employees Using Respirators When Not Required Under the Standard (Appendix D of 29 CFR 1910.134)

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, of if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

Appendix C: Elements of a Respiratory Protection Training Program

- Respiratory hazards to which an employee may be exposed.
- Operation and proper fit of the respirator.
- Limitations and capabilities of the selected respirator.
- Inspection, donning, and removal of the respirator, including checking the fit and seals in the wearing of the respirator.
- Maintenance and storage of the respirator.
- Respirator malfunctions.
- Respirator use in emergency situations.
- Recognition of medical signs and symptoms that may limit or prevent the effective use of respirators.
- Aspects of the written Respiratory Protection Program.
- The training will also include sufficient practice to enable the employee to become confident in the use of the respirator.
- All supervisors of employees required to wear respirators shall also be trained in respirator selection, use, and maintenance.
- Demonstrate knowledge of training elements.

Appendix D: Procedures for Performing a User Fit and Seal Check when Donning a Tight Fitting Respirator

Positive Pressure Test: A positive pressure test is performed by closing off the exhalation valve and exhaling gently into the facepiece. If a slight positive pressure is built up in the facepiece then the fit is satisfactory.

Negative Pressure Test: A negative pressure check is performed by closing off the inlet openings with the palm of the hands and inhaling gently so the facepiece collapses slightly. The user should hold their breath for 10 seconds and feel for any leaks around the perimeter of the facepiece.

Appendix E: Definitions to Terms Found in the GRC Respiratory Protection Program

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element. Assigned protection factor (APF) [Reserved]. This definition will be updated in a subsequent phase of OSHA's rulemaking.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

Competent person A person within the Industrial Hygiene Team who has demonstrated the knowledge and skills necessary to administer certain GRC Respiratory Protection Program procedures such as fit testing, training, hazard assessments, etc.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Dust Solid particles mechanically generated by handling, crushing, grinding, sawing, rapid impact or detonation of organic or inorganic materials such as metal, coal, wood, and dirt.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Emergency situation means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

Engineering controls Methods of controlling employee exposures to toxic materials by modifying the source or reducing the quantity of contaminants released into the workroom environment.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air purifying element means a component used in respirators to remove solid or liquid aerosols from the inspired air.

Filtering facepiece (dust mask) means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

Fume Airborne particulate formed by the evaporation of solid materials, e.g., metal fume emitted during welding. Usually less than 1 m in diameter

Hazard assessment An industrial hygiene evaluation of the health hazards posed by a specific operation or task.

Helmet means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

High efficiency particulate air (HEPA) filter means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

Hood means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Interior structural firefighting means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See29 CFR 1910.155)

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Maximum use concentration (MUC) [Reserved]. This definition will be updated in a subsequent phase of OSHA's rulemaking.

Mist Suspended liquid droplets generated by condensation or by breaking up of a liquid into a dispersed state, such as by splashing, foaming or atomizing. Mist is formed when finely divided liquid is suspended in air.

Negative pressure respirator (tight fitting) means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Permissible Exposure Limit (PEL) The airborne concentration of a substance that, even on repeated daily exposure, will pose no adverse health effects to nearly all workers. PEL's are published and enforced by the Occupational Safety and Health Administration as a legal standard.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

Qualitative fit test (QLFT) means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent. QLFT provides only a pass/fail result.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit by numerically

measuring the amount of leakage into the respirator.

Respiratory inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

Threshold limit value (TLV) The airborne concentration of a substance to which nearly all workers may be repeatedly exposed without adverse health effects. TLV's are guidelines used in the practice of industrial hygiene. TLV's are published by the American Conference of Governmental Industrial Hygienists and are not legal standards.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

Vapor A gaseous form of a substance that is normally in the solid or liquid state at standard temperature and pressure.

GRC Office of Safety and Assurance Technologies (OSAT)
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GRC Environmental Programs Manual

Chapter 13 - LEAD

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PURPOSE

This chapter establishes minimum requirements for handling, use, removal and disposal of all lead-containing materials at the NASA Glenn Research Center.

AUTHORITIES

This chapter is issued under the authority of the Environmental Pollution Control Board of the Glenn Environmental Quality Organization, LMI 8800.4D.

APPLICABILITY

This instruction is applicable to all personnel at Glenn Research Center and Plum Brook Station including, but not limited to, civil servants, contractor personnel, and students.

BACKGROUND

Lead exposure is one of the oldest known occupational hazards. 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 systems range from mild behavioral symptom changes to fatal brain damage. Lead exposure can also result in impotence and sterility in men and decreased fertility in women. Without proper workplace hygiene practices, the lead on workers' clothing may expose their families at home. There have been instances of lead poisoning among children whose parents work in an environment with excessive amounts of lead.

Employees at Glenn may be exposed to lead in construction and maintenance activities that disturb lead-bearing paint or other lead-containing materials. Exposures may also occur where lead-containing products are used, including, soldering and brazing operations and certain research operations. Airborne lead exposures are not a problem during soldering operations when the temperature remains below 500 C (932 F), as lead fume production is not significant below this temperature. Good housekeeping and personal hygiene practices must still be used in these operations to minimize the ingestion of lead. Local exhaust ventilation may still be needed to control exposure to

other contaminants generated by these operations and to minimize lead exposures during grinding and polishing operations.

Extremely high exposures to lead occur during welding, cutting, and brazing of materials with lead-bearing paint and when lead-bearing paint is removed by abrasive blasting or grinding. Strict controls must be used during these operations to protect workers and to prevent lead contamination of the workarea.

Strict occupational and environmental regulations govern the use, handling, and disposal of lead containing materials. The occupational airborne exposure limit is 50 micro-grams/m3 of air as an 8-hr time weighted average. At an action level of 30 micro-grams/m3 employers must establish a program that includes a lead compliance plan, employee training, exposure monitoring, and medical monitoring. Occupational health and safety regulations also require exposure monitoring, employee training, engineering and work practice controls, personal protective equipment, housekeeping, hygiene practices, and medical monitoring. Workers must be protected as if they were exposed above the permissible exposure limit unless exposure monitoring proves otherwise.

Environmental regulations include controlling and permitting releases of lead to the air and water, testing of lead-containing materials before disposal, and proper disposal of any lead-containing materials meeting the definition of hazardous waste.

POLICY

It is the policy of Glenn Research Center to comply with all applicable regulations regarding lead and to prevent illness to workers and damage to the environment from the use, removal, and disposal of lead. To accomplish this, all personnel must comply with the requirements of this chapter.

Lead-related work in construction and maintenance activities ranges from large lead remediation projects to small maintenance operations. In all cases, lead-related operations must be done within a controlled area using engineering and work practice controls that minimize worker exposure and prevent contamination of surrounding areas. The area will be posted with signs meeting OSHA requirements to restrict access to workers with the required personal protective equipment. Regulations governing worker protection must be strictly followed, including requirements for

- A competent person, defined by OSHA as someone capable of identifying existing and potential lead hazards in the surroundings or working conditions, who has authority to take prompt corrective measures
- A written lead compliance program that describes each lead activity; the engineering, work practice, and administrative controls; the air monitoring to procedures; and inspection schedules.

RESPONSIBILITIES

Environmental Compliance Team (ECT)

- Provides guidance on the requirements of Federal, State, and local environmental regulations; on any air, water, or soil pollution issues; and guidance and oversight on the disposal of lead-containing materials.

Industrial Hygiene Office (IHT)

- Provides guidance on the requirements of Federal, State and Local occupational health regulations.
- Maintains the Lead Compliance Program for civil servant operations.
- Evaluates civil servant employee exposures, recommends procedures to minimize exposures, and recommends employees for inclusion in a medical surveillance program.
- Maintains the lead task and exposure database for all lead-related operations.

Medical Services

- Manages and administers the medical surveillance program for civil servant employees exposed to lead.

Plum Brook Management Office (PBMO)

- Develops and manages the Lead Compliance Program according to OSHA 29 CFR 1926.62(e) for Plum Brook.

Project Managers, Facilities Engineers, and Facilities Operations Personnel

- Identify lead-bearing paints and materials that may be disturbed in any renovation and maintenance activities.
- Ensure that bid specifications identify lead that may be disturbed in any renovation or maintenance activities and include requirements that the contractor comply with all applicable regulations and this instruction.
- Ensure that the contractor submittals include a site-specific health and safety plan which provides for an OSHA competent person, includes a Lead Compliance Plan, and meets all requirements of the OSHA lead standard.

Contracting Officer's Technical Representatives (COTR's)

- Attend training necessary to meet the OSHA and EPA competent person requirements.
- Identify suspected lead-containing materials not identified in the scope of work during renovation and construction activities; arrange for testing of the suspect material; and, if the material does contain lead and will be disturbed during the project, ensure its removal by a qualified lead abatement contractor.
- Ensure that lead-related work is performed in accordance with the contractor's site-specific health and safety plan, all applicable regulations, and EMO guidance.
- Ensure that contractor exposure monitoring data meets the information requirements of the EMO lead task and exposure database and is submitted to the IHT.

Support Service Contractors

- Developing a health and safety plan that includes a lead compliance program for contractor operations.
- Providing copies of air monitoring results and task data to the IHT. (Note: Lead air monitoring

data sheets are available from the IHT and may be used as a data sheet for adequate documentation.)

Research Personnel

- Must note the use of lead on safety permit applications and contact the IHT when lead is to be used in projects that do not require a safety permit.

Supervisors

- Notify the IHT of operations involving exposure to lead and enforce the use of engineering and work practice controls and personal protective equipment prescribed for the job.

Employees

- Must properly use engineering and work practice controls and personal protective equipment specified for their operations.

LEAD COMPLIANCE PLAN PROCEDURES

This applies to civil servant operations. Contractors must develop their own lead compliance plan.

This document provides the general procedures to reduce and control exposure to lead. Task information for procedures and controls for specific lead-related tasks must be developed by the supervisor using a lead task form that is available from the IHT. The procedures and controls are then reviewed by the IHT.

Employee Access

Copies of this program are maintained by IHT and are available on request.

Exposure Limits

The following table lists the maximum exposure limit and action level for airborne lead:

Action level (AL)	30 micro-grams/m3, 8 hr, TWA
Permissible exposure limit (PEL)	50 micro-grams/m3, 8 hr, TWA

Exposure Assessment

IHT air monitor monitoring must be in accordance with the NIOSH methods. Initial air monitoring must be done to determine if any employee may be exposed to lead above the PEL.

Monitoring frequency

- None if initial monitoring demonstrates exposures is less than the action level.

- Quarterly in exposures greater than the PEL.
- Every 6 months if exposures are greater than the action level but less that the PEL. That frequency may be reduced if two consecutive samples, 7 days apart are below the action level.

Additional monitoring is required if there has been a change of equipment, process, control, or personnel or if a new task may result in more employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL.

Presumed Exposure

Until sampling shows otherwise, employees performing certain tasks will be presumed to be exposed above the PEL and must be protected.

Personal Protective Equipment

Where engineering controls and work practices are not sufficient (or not yet implemented) to reduce exposures to or below the PEL or where employees are exposed to irritating lead compounds, the following personal protective equipment is required.

- Respiratory protection - The selection of the respirator is based on the IHT hazard assessment of a specific task.
  (Note: A respirator will be provided whenever an employee requests one, but anyone who wears a respirator must be included in the GRC Respiratory Protective Program.)
- Disposable protective coverall and head covering
- Gloves, hats, and shoes
- Safety eyewear.

Housekeeping

All surfaces shall be maintained as free of lead accumulation as practicable.

- Use a high-efficiency particulate air (HEPA) vacuum or wet wipe where possible.
- The use of compressed air to remove lead from dusty surfaces is strictly prohibited.

Hygiene Facilities

Employees who are exposed to lead levels above the PEL will be provided with hygiene facilities, including a change area and shower, where feasible, lunchroom facilities, and hand-washing facilities.

Hygiene Practices

No food or beverages, tobacco products, or cosmetic application shall be used or present in areas above the PEL.

Hands must be washed immediately at end of shift and before eating, drinking, using tobacco, or applying cosmetics.

No protective clothing must leave regulated areas.

When showers are not provided, workers must wash their hands and face at the end of the workshift.

Administrative Controls

If administrative controls are used as a means to reduce an employees exposure time to lead, a job-rotation schedule will be established and implemented.

Medical Surveillance

Employees who are or who may be exposed to lead at or above the action level for more than 30 days in any 12 consecutive months will be included in the medical surveillance program. Also, employees who are occupationally exposed on any day above the action level may be included, upon request, in the program Monitored employees may request multiple physician review if they feel it is necessary. Employees will be notified of the results of tests and examinations made as part of the surveillance.

Medical surveillance includes but is not limited to

- Annual medical examination blood test to establish lead level Physician written opinion

The first medical examination under the surveillance program consists of biological monitoring and includes blood lead level and zinc protoporphyrin level.

A worker will be removed from lead exposure when blood lead level is greater than 50 micrograms/dl and will not be returned to exposure until blood lead level is less than 40 micrograms/dl.

Signs

Warning signs will be posted in each work area where employees are being exposed to lead levels above the PEL. The wording on the signs should include

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

TRAINING

Employees who work with lead but are exposed to less than PEL require general lead training that meets the requirements of the GRC Hazard Communication Program.

Employees exposed to lead at or above the action level on any day require further training on the following subjects:

- Content of the lead in construction standard
- Nature of operations that may result in lead exposure

- Purpose and description of the medical surveillance program
- Awareness of medical removal program and protection
- Routes of exposure
- Toxicity, health effects, chelation therapy
- Possible engineering controls and work practices for tasks in which employees are involved
- Proper disposal methods

All employees who are required to use a respirator must be enrolled in the GRC Respiratory Protection Program.

RECORDKEEPING

A database of task descriptions, control techniques, and associated exposure levels will be maintained by the IHT. This database ensures worker protection by identifying procedures that minimize worker exposures, minimizes costs by identifying tasks and procedures that do not result in employee exposure to lead, and helps identify lead abatement methods that provide high-production levels without jeopardizing worker health and safety.

Medical surveillance and removal records will be maintained by Medical Services. All records involving an employee are available, on request, to that employee.

DISPOSAL

All lead-containing materials will be collected and disposed of in accordance with environmental regulations. The Environmental Compliance Team (ECT) may be contacted for assistance on proper disposal.

REFERENCES, GUIDANCE DOCUMENTS, AND REGULATIONS

U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.252, Welding cutting and brazing; 1910.1025, Lead; 1926 Subpart C, General Safety and Health Provisions; 1926. 62 Lead; 1926.353, Ventilation and protection in welding, cutting and brazing; and 1926.354, Welding, cutting and heating in way of preservative coatings.

Housing and Community Development Act of 1992, Title 10.

U.S. Environmental Protection Agency, 40 CFR 261, Identification and Listing of Clean Air Act Amendments of 1990, Title III, Toxic Air Pollutants.

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GRC Environmental Programs Manual

Chapter 14 - ELEMENTAL MERCURY

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PURPOSE

This chapter establishes minimum requirements for mercury use, contamination cleanup, and disposal at Cleveland and Plum Brook Station.

APPLICABILITY

This chapter is applicable to all personnel at Cleveland and Plum Brook Station.

BACKGROUND

Elemental mercury is a silvery, odorless, heavy liquid used at GRC in thermometers, manometers, barometers, and as a propellant in ion propulsion systems. It is also commonly found in mercoid electrical switches and mercury vapor and fluorescent lamps. Elemental mercury, which is also know as quicksilver, is not highly toxic as an acute poison, although inhalation of high concentrations of mercury vapor for relatively brief periods can cause severe problems with the lungs and digestive systems. Chronic exposure to mercury affects the nervous system causing tremors and neuropsychiatric disturbances, loss of appetite, and weight loss.

The current American Conference of Governmental Industrial Hygienists (ACGIH and GRC 8-hr time weighted average exposure limit for elemental mercury is 0.025 milligrams per cubic meter (mg/m3). The Occupational Safety and Health Administration (OSHA) and GRC also has a ceiling concentration limit of 0.1 mg/m3 which may not be exceeded for any time period.

POLICY

It is the policy of GRC to comply with all applicable regulations regarding mercury and to prevent illness to workers and damage to the environment from its use and disposal. To accomplish this, all personnel must comply with the requirements of this chapter.

Whenever possible, a substitute for mercury-containing devices, such as mercoid switches, thermometers, and gauges, should be made. All unnecessary mercury sources including mercury

manometers and thermometers should be removed from the Cleveland and Plum Brook Station. Contaminated areas should be identified and cleaned up.

It is GRC policy that mercury spill cleanups within areas controlled by research organizations must be funded by the research organization. Funding for cleanups outside of the research area will be advocated by the Environmental Management Office (EMO)

RESPONSIBILITIES

Environmental Compliance Team (ECT)

- Provides guidance on the requirements of Federal, State, and local environmental regulations.
- Provides guidance and oversight on the disposal of mercury through the Waste Management Team.
- Assesses and makes recommendations on air, water, or soil pollution issues.
- Oversees spill cleanup and soil and water remediation projects

Waste Management Team (WMT)

- Provides guidance and oversight on the disposal of mercury.
- Insures that mercury is property packaged and stored prior to disposal.
- Coordinates mercury spill cleanups and decontamination by contractors.
- Provides guidance on the requirements of Federal, State, local, GRC transportation and environmental disposal requirements.

Industrial Hygiene Team (IHT)

- Maintains an inventory of mercury-contaminated and potentially contaminated areas.
- Maintains a calibration station for the Jerome mercury air monitoring equipment.
- Provides support to Center personnel to identify mercury contaminated areas.
- Provides industrial hygiene support in mercury spill cleanup and remediation projects.
- Measures employee exposure levels, recommends procedures to minimize exposures, and recommends employees for inclusion in a medical surveillance program.
- Maintains records of equipment and facility assessments and air monitoring results.
- Provides guidance on the requirements of Federal, State, and local occupational health regulations.

Chemical Sampling and Analysis Team (CS&AT)

- Provides sampling and analysis support to identify mercury contamination of vacuum pumps.
- Provides some types of analysis of mercury contamination in various mediums.

Chemical Management Team (CMT)

GRC Mercury Coordinator (Manuel Dominguez 3-6735)

- Approves usage of mercury.
- Appoints a Mercury Monitor when needed.

- Provides audit results on usage, disposal, and inventory of mercury at Cleveland and Plum Brook Station to Logistics Management, for the annual report filed with the Bureau of Mines.

Mercury Monitor (appointed by the Mercury Coordinator)

- Maintains and reports usage, purchases, and returns or disposal of mercury, to the Mercury Coordinator in December of each year.
- Determines labeling and MSDS requirements for shipment of mercury and mercury-contaminated equipment.

Plum Brook Mercury Coordinator (Keith Peecook 419-621-3234)

- Approves usage of mercury in coordination with the Cleveland Mercury Coordinator.
- Reports usage, disposition, and available quantities of mercury at Plum Brook to the Cleveland Mercury Coordinator in December of each year.

Facilities and Test Engineering Division (FTED)

- Coordinates mercury spill cleanups and decontamination by contractors, when initiated by EMO.

Logistics Management Division

- Procures, stocks, and issues liquid mercury.
- Reports annual usage and available quantities of mercury at Cleveland and Plum Brook Station to the Bureau of Mines.

Occupational Medical Services

- Manages and administers the medical surveillance program for civil servant employees exposed to mercury.
- Project Managers, Facilities Engineers, and Facilities Operations Personnel
- Ensure that areas contaminated or potentially contaminated with mercury are managed to minimize employee exposure to mercury.
- Ensure that renovation projects plans identify mercury-contaminated areas and provide for cleanup.
- Contracting Officer's Technical Representative (COTR)
- Identifies areas with suspected mercury contamination not listed in the original scope of work that surface during construction activities.
- Arranges for testing to determine the level of mercury contamination.
- Ensures cleanup of any contamination by a qualified contractor.
- Ensures that mercury-related work is performed in accordance with all applicable regulations and EMO guidance.

Research Personnel

- Report quantities of mercury stored in vials, bottles, or equipment to the Mercury Coordinator.
- Notify IHT for unpermitted operations involving mercury.

- Follow the requirements for handling, storing, and reporting mercury use specified on the safety permit.

Supervisors

- Notify the IHT of operations involving exposure to mercury.
- Enforce rules requiring the use of engineering and work practice controls and personal protective equipment.

Employees

- Report quantities of mercury stored in vials, bottles, or equipment to the Mercury Monitor.
- Identify the use of mercury on safety permit applications.
- Properly use engineering controls, work practice controls, and personal protective equipment specified for their operations.
- Properly dispose of all mercury containing devices (i.e., thermometers, mercoid switches, etc.) through the Waste Management Team.

PROCEDURES

Hazard Identification

Anyone who is concerned about mercury exposure or mercury contamination should contact the IHT. IHT will evaluate the degree of exposure or contamination and recommend any corrective action

Contaminated Facility and Equipment Assessment

A written work order can be submitted directly to EMO or, in an emergency, verbally. In addition, the Management and Project Support Office of FTED, may require EMO to sign off on any activity for which mercury contamination is suspected.

Any evaluation performed by any office of EMO will be reported in writing with findings and recommendations. In addition, the equipment will be tagged with the results of the survey.

Vacuum Pump Contamination Assessment

Prior to the disposition of vacuum pumps for either rebuilding or disposal, a work order should be submitted to CS&AT for testing to determine if the pump is mercury contaminated. After the analysis CS&AT submits the results to ECT for interpretation. ECT will then prepare a written report with recommendations and send it to the requester and the WMT. The requester will then attach a copy of the report to the pump. If the pump is contaminated the requester also must submit a work order requesting decontamination of equipment or facilities to the WMT. The WMT will forward the mercury remediation contractors site specific health and safety plan to IHT for review and approval before work begins.

Disposal of Mercury-Contaminated Equipment

All mercury-containing equipment that is to be disposed of must be drained and the mercury reclaimed. To dispose of mercury-containing or -contaminated equipment, submit a NASA C-260

Form to property disposal. If you have any questions contact the WMT (3-2124).

Mercury spills or discovery of visible mercury must be reported immediately (911). When the operator answers state your name, phone number where you can be contacted, the department, building, and room number where the mercury is located. Dispatch will then relay the information to EMO who will contact the originator for further details. This information will be used to insure a timely and efficient response.

Air Sampling Support Activities

The IHT maintains a calibration station for the Jerome real time mercury analyzers. All parties, including the support service contractors, calibrate their instrument before each use or at regularly scheduled intervals.

The IHT has developed a screening procedure and aggressive sampling technique to find residual mercury that has become "hidden" over time in grime and other substrate. IHT should be contacted for guidance on using the technique.

Purchasing Mercury

To acquire mercury, write a short memo to the GRC Mercury Coordinator, explaining your project, the amount you need to keep on-hand, and why no substitute materials are acceptable. The GRC Mercury Monitor will then check the chemical inventory to see if any mercury is available, prior to purchase.

Annually, the usage, disposition, and on-hand quantity of each mercury user is audited by the GRC Mercury Coordinator or by the GRC Mercury Monitor.

REFERENCES, GUIDANCE DOCUMENTS, AND REGULATIONS

U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.1000, Air Contaminants.

Memo dated November 8, 1989, from Director of Technical Services and Chairman of the Environmental Pollution Control Board regarding "Use of Mercury Manometers for Pressure Measurement."

Memo dated June 2, 1993, from Director of Technical Services and Chairman of the Environmental Pollution Control Board, regarding "Use of Mercury Manometers for Pressure Measurement."

Memo dated August 12, 1991, from GRC Mercury Coordinator regarding "Recall of All Mercury."

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GRC Environmental Programs Manual

Chapter 15 - CADMIUM

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PURPOSE

The purpose of the cadmium compliance program is to protect all employees who may be exposed to cadmium dust or fumes from any adverse health effects. A further goal is to reduce airborne concentrations of cadmium to the lowest possible level. This program establishes minimum requirements for handling, use, and disposal of all cadmium-containing materials at NASA Glenn Research Center.

AUTHORITIES

This policy is issued under the authority of the Environmental Pollution Control Board of the Glenn Environmental Quality Organization, GLPD 8800.4D, and the Occupational Safety and Health Administration standard 29 CFR 1910.1027.

APPLICABILITY

This policy is applicable to all personnel at NASA Glenn Research Center and Plum Brook Station, including, but not limited to, civil servants, contractor personnel and students.

BACKGROUND

In September 1992 the Occupational Safety and Health Administration (OSHA) promul gated a new standard for cadmium, which became effective December 14, 1992. The standard, 29 CFR 1910.1027, establishes a single 8-hour, time-weighted-average, permissible exposure limit (TWA PEL) of 5 micrograms of cadmium per cubic meter (ug/m^3) of air for all cadmium compounds, including dust and fumes and an action limit of 2.5 ug/m^3. This regulation is based on the determination that employees exposed to cadmium face a significant risk to their health from lung cancer and serious kidney damage. Compliance with this limit is primarily through engineering and work practice con trols combined with personal protective equipment. The standard has requirements for air monitoring, biological monitoring, medical examinations, written programs, good hygiene practices, training, and recordkeeping.

Occupational exposure to cadmium occurs through inhalation of fumes and dust or ingestion through contact with cadmium dust. The major source of employee exposure at GRC is through fumes emitted from brazing with cadmium-containing alloys. The program described herein outlines how GRC will comply with the cadmium standard.

POLICY

It is the policy of the Glenn Research Center to comply with all applicable regulationsregarding cadmium and to prevent illness to workers and damage to the environment from the use, removal, and disposal of cadmium. To accomplish this, all personnel must comply with the requirements of this chapter.

Cadmium-related tasks at GRC are restricted to silver brazing, welding of cadmium-plated bolts, and nickel-cadmium battery research. Cadmium-related tasks must be done within a controlled area using engineering and work practice controls that minimize worker exposure and prevents contamination of surrounding areas. The areas will be posted with signs meeting OSHA requirements to restrict access to employees with the required personal protective equipment. Regulations governing worker protection must be strictly followed. This includes the development of a written cadmium compliance program meeting OSHA regulations. This written program is contained in this chapter.

RESPONSIBILITIES

Environmental Compliance Team (ECT)

- Provides guidance on the requirements of Federal, State, and local environmental regulations and for collection and disposal of cadmium-contaminated waste products.

Industrial Hygiene Team (IHT)

- Provides guidance on the requirements of Federal, State, and local occupational health regulations.
- Maintains the Cadmium Compliance Program.
- Evaluates worker exposure and recommends procedures to minimize exposure.
- Recommends employees for inclusion in a medical surveillance program.
- Maintains the cadmium task and exposure database for all cadmium-related operations.

Chemicals Management Team (CMT)

- Controls and issues cadmium-containing brazing alloys.

Occupational Medical Services

- Manages the medical surveillance program for civil servant and contractor employees exposed to cadmium.

Plum Brook Station Management Office (PBMO)

- Develops a cadmium compliance program according to OSHA 29 CFR 1910.1027 for their facility.

Supervisors

- Identify tasks requiring cadmium-containing brazing alloys and ensure that these tasks are performed whenever possible within regulated areas and following the guidelines for those areas.
- Notify the IHT when tasks will be performed outside of regulated areas.

CADMIUM COMPLIANCE PROGRAM PROCEDURES

This section describes the general procedures to reduce and control exposure to cadmium.

Air Monitoring

An air monitoring program shall be established to assess employee exposures to cadmium during brazing operations, during welding of cadmium-plated bolts, and during other minor tasks involving cadmium-containing products.

A personal and area sample shall be collected on a mixed cellulose ester filter and sampled for the duration of the task or the entire workshift, whichever is more feasible. The samples will be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory.

Frequency

Initial monitoring shall be performed whenever there is a potential for exposure to cadmium or whenever process changes occur that could increase employee exposure.

If initial monitoring of a task or regulated area indicates that airborne concentrations of cadmium are less than the action level of 2.5 ug/m^3 and if this is confirmed upon repeated testing, no further routine monitoring shall be scheduled unless otherwise specified.

If initial monitoring determines that the exposure level for a task or regulated area is at or above the action level, air monitoring shall be conducted every 6 months or whenever necessary if more than 6 months has transpired since the last cadmium task. Monitoring shall continue until such time as two consecutive monitoring episodes result in levels below the action level. Thereafter the task or area will then be monitored on an annual basis unless otherwise specified.

Employee Notification

The IHT shall notify all affected parties of the results of any monitoring within 15 working days of receipt of results. The results shall be in the form of a written report detailing the sampling scheme, the results, and the recommendations. A copy of the results shall be posted by the area supervisor in a conspicuous place accessible to all employees. If the PEL is exceeded, the report shall include a statement concerning this and give a description of the corrective actions being taken to reduce employee exposure.

EXPOSURE CONTROLS

Whenever air monitoring indicates that employees are exposed to airborne cadmium above the action level, controls shall be instituted to reduce the exposure to or below 2.5 ug/m^3.

Engineering Controls

The supervisors shall be responsible for implementing engineering controls recommended by the IHT. Engineering controls may consist of various types of mechanical ventilation, substitution of cadmium-free alloys, or removal of cadmium-containing materials such as the stripping of cadmium-pigmented paints before brazing or welding activities. Whenever possible, substitution of cadmium-free alloys should be the first engineering control considered.

Work Practices

Supervisors shall be responsible for ensuring that all employees follow good hygiene practices while performing tasks involving cadmium. This includes, but is not limited to, working only in regulated areas such as fume hoods and welding booths designated for cadmium use, wet wiping hoods and equipment upon completion of a task, disposing of rags properly, not eating, drinking, or smoking while performing a task, and washing hands and face thoroughly upon completion of a task. Clothes worn while working with cadmium shall remain at the worksite. Welding aprons and other water proof equipment should be wet wiped at the end of a task.

Respiratory Protection

The use of respiratory protection shall be in accordance with the GRC Respiratory Protection Program. All employees required to wear respirators for tasks involving cadmium shall be active in the program, have current medical approval, and have had their respirators qualitatively fit tested. Respirators shall only be used until effective engineering and work practice controls can reduce employee exposures to below the action level or whenever an employee requests a respirator. Respirators shall be worn at all times when work is performed outside of a regulated area such as in a test cell.

Protective Clothing

GRC shall provide to any employee exposed above the action level, regardless of respiratory protection, work clothing, and equipment that prevents contamination of the employee's garments. This includes uniforms or coveralls, gloves, disposable shoe covers, face shields, and goggles or safety glasses.

The protective clothing will be provided in a clean and dry condition on an as needed basis. Protective clothing shall be repaired or replaced as necessary.

All contaminated protective clothing shall be placed in a covered container properly labeled as cadmium contaminated. The label shall indicate that laundering should be done in a manner that prevents the release of airborne cadmium. No employees or laundering personnel shall remove cadmium from clothing by blowing, shaking, or any other means which disperses cadmium into the

air.

MEDICAL SURVEILLANCE

Air monitoring cannot adequately assess the amount of cadmium that will enter an employee's body. Therefore, a medical surveillance program has been established by to determine if employees may be showing the affects of cadmium exposure. Any employee, civil servant or contractor, who may have been exposed or who is currently being exposed to airborne levels of cadmium above the action level of 2.5 ug/m^3 (as an 8-hour time weighted average), as identified by the IHT will be included in the Medical Monitoring Program.

Biological Monitoring

Biological monitoring consists of testing an employee's blood and urine for cadmium levels and levels of Beta 2-microglobulin, a protein found in the urine.

Biological monitoring shall be scheduled and performed by Glenn Occupational Medical Services in accordance with the Cadmium Medical Monitoring Program .

Medical Examinations

Complete medical examinations will be provided by Glenn Occupational Medical Services if results of the biological monitoring as outlined in the Cadmium Medical Monitoring Program indicate a need. Included in the medical examination will be a detailed medical and work history, a smoking history and current smoking status, complete physical examination, baseline chest x-ray, spirometry, additional biological monitoring tests, and any additional tests deemed appropriate by the examining physician.

Multiple Physician Review

Employee may request a second opinion if not satisfied with the care given by Glenn Occupational Medicine Services. The second physician may review any findings, determinations, or recommendations of the initial physician and may conduct such examinations, consultations, or laboratory tests as the second physician deems necessary to facilitate the review.

MEDICAL REMOVAL PROTECTION

GRC shall remove an employee from tasks involving cadmium if medical monitoring results indicate unacceptable levels of cadmium and beta 2-microglobulin as outlined in the Cadmium Medical Monitoring Program or whenever a physician's written medical opinion states that an employee should be removed. The employee shall be reassigned to a job where cadmium exposure levels are below the action level.

During medical removal GRC shall provide follow-up biological monitoring and medical examinations. The employee shall not be returned to his or her former job until a physician determines in a written medical opinion that continued medical removal is no longer necessary.

HOUSEKEEPING

All surfaces shall be kept free of accumulations of cadmium or other dusts. Floors or other surfaces shall not be cleaned with compressed air. Wet wiping of areas or vacuuming with vacuums equipped with an high efficiency particulate air (HEPA) filter shall be performed at the completion of a task. Rags shall be disposed of properly in containers marked clearly "cadmium-containing, hazardous waste". Emptying of vacuums shall be in an appropriate manner so as to minimize reentry of cadmium dusts into the workplace.

HYGIENE AREAS AND PRACTICES

Employees shall not consume food or beverages, use tobacco products or apply cosmetics in any areas where employees are exposed to cadmium above the action level without regard to respiratory protection.

EMPLOYEE TRAINING

All employees who are potentially exposed to cadmium at any level shall be informed of the contents of the cadmium standard. The training shall be conducted before assignment to an area above the action level. The training shall be repeated annually. The training shall include the following information:

- The content of 29 CFR 1910.1027 and appendices.
- The specific nature of the operations that could result in exposure to cadmium above the action level.
- The purpose, proper selection, fitting, use, and limitations of respirators.
- The purpose and a description of the medical surveillance program and the medical removal protection program, including information concerning the adverse effects associated with excessive exposure to cadmium.
- The contents of any compliance plan in effect.
- The employee's rights of access to records under 1910.20.

REGULATED AREAS

All regulated areas shall be posted with the following information: Caution, Cadmium, Cancer Hazard, Can cause lung and kidney disease, Authorized personnel only, Respirators may be required in this area.

Supervisors of the area are responsible for the posting the signs.

Only properly trained personnel may enter a regulated area.

- Two regulated areas have been identified and established at GRC. Guidelines for each area may be found in the "Task Evaluations and Controls" section.

RECORDKEEPING

GRC shall maintain all employee exposure records, training records, medical removal records, and all medical records in accordance with the cadmium standard and 1910.20 or other applicable

regulations. All records will be maintained for at least 30 years.

Exposure Monitoring

Accurate records shall be maintained for all air monitoring results obtained for cadmium. These records shall include, at least, the following information:

- The date, number, duration, location, and results of each of the samples taken.
- The name, social security or badge number, and job classification of the employees monitored.
- A description of the sampling and analytical techniques used.
- Type of respiratory protection, if any, used by the employee monitored.

Medical Surveillance

Accurate records for each employee covered by medical surveillance shall be maintained. These records shall include, at least, the following information:

- Name, social security number, and description of duties.
- A copy of the physician's written opinions and an explanation sheet for biological monitoring results.
- A copy of the complete medical examination if applicable.
- The employees medical symptoms that might be related to exposure to cadmium.

Training Records

A certification record that includes the identity of the person trained, the signature of the employer or the person who conducted the training, and the date the training was completed shall be maintained on file for one year beyond the date of training of that employee.

Availability of Records

Access to these records shall be made available to OSHA, the employees, or employee representatives upon request and in accordance to 29 CFR 1910.20.

Transfer of Records

GRC shall provide records to NASA headquarters upon cessation of activities. If NASA headquarters is not available, the records shall be sent to the National Institute for Occupational Safety and Health.

EMERGENCY PROCEDURES

In the event of a power failure during a brazing operation using cadmium-containing silver braze, all work will come to a stop and the area will be wet wiped. Workers should practice good hygiene and good housekeeping procedures.

All other emergencies will be addressed on a case by case basis. The supervisor must be notified immediately of any extraordinary circumstances and the IHT must be contacted to evaluate any health concerns.

TASK EVALUATIONS AND CONTROLS

Cadmium tasks at GRC are restricted to brazing operations, new and reworking of old brazed materials, nickel-cadmium battery research miscellaneous laboratory research, and possible welding of cadmium-plated bolts and possible use of cadmium-pigmented paint.

Brazing Operations - Regulated Areas

Brazing operations performed in regulated areas will abide by the following guidelines:

Building 14, instrument shop, brazing fume hood

- All brazing shall be performed within the fume hood.
- Before brazing, the fume hood shall be checked for current validation tag and proper draw.
- The hood shall be wet wiped upon completion of a task and the wipes disposed of properly.
- Employees shall follow proper hygiene practices.
- Items too large for the fume hood shall be taken to another regulated area. Brazing activities using cadmium shall be monitored by the IHT on an annual basis.

Building 50, shop, welding booth

- Respirators equipped with HEPA filters shall be worn whenever brazing with cadmium.
- A HEPA equipped air filtering system shall be acquired and used whenever brazing with cadmium.
- Protective clothing shall be worn. The area shall be wet wiped upon completion of a cadmium task and the wipes disposed of properly.
- Employees shall follow proper hygiene practices.
- Brazing activities utilizing cadmium shall be monitored by the IHT semi-annually or whenever necessary if more than six months has transpired since the previous brazing activity.

Brazing Operations - Nonregulated Areas

Brazing operations performed in nonregulated areas such as test cells will abide by the following guidelines:

- The HCT or supervisor must be contacted to obtain the cadmium-containing brazes and notified of it's intended use.
- The IHT must be contacted for task evaluation and possible monitoring for personnel exposures.
- Respirators, coveralls, and gloves must be worn.
- The area must be posted with signs indicating the use of cadmium and its hazards.
- All unnecessary personnel must be removed from the area.
- A portable smog hog equipped with a HEPA filter will be used unless approval from the IHT has been granted to proceed without local ventilation.
- The entire area within a 5-ft radius must be wet-wiped upon completion of the task and the rags disposed of properly.

Nickel-Cadmium Batteries

Maintenance and servicing of the nickel-cadmium (Ni-Cd) batteries does not involve contact with the cadmium plates. Batteries are not dismantled. Should standard procedures change, the IHT must be contacted for evaluation.

Initial exposure monitoring in the area of Ni-Cd battery research has determined that the exposures are below the action level during activities that included separating and reassembling the battery plates. Verification of these results will be performed. The IHT must be contacted for assessment.

Exposure monitoring during the cutting of cadmium plates must be performed. The IHT must be contacted for assessment.

When handling the cadmium plates, employees will wear protective gloves and lab coats. The area will be wet wiped thoroughly before and after separation of plates and cutting of plates. Gloves and wipes will be disposed of as hazardous waste. Employees will follow proper hygiene practices.

Welding of Cadmium-Plated Bolts

Welding of cadmium-plated bolts will only be performed with approval and guidance from the IHT.

Research Use of Cadmium

Individual research tasks requiring the use of cadmium or it's compounds shall be evaluated. The IHT must be contacted prior to the next scheduled use for evaluation and recommendations.

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GRC Environmental Programs Manual

Chapter 16 - LOCAL EXHAUST VENTILATION

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PURPOSE

This chapter establishes minimum requirements for local exhaust ventilation (LEV) for controlling occupational exposure to air contaminants at GRC.

APPLICABILITY

This chapter is applicable to all personnel at Glenn and Plum Brook Station, including, but not limited to, civil servants, contractor personnel, and students.

BACKGROUND

A variety of materials, ranging from inert gases to highly toxic, carcinogenic materials are used by GRC personnel. Local exhaust ventilation (LEV) is a common engineering control used to minimize worker exposure to airborne hazardous substances.

A LEV system typically consists of a hood to capture or contain the contaminants, ducts to transport the air containing the contaminants, and a fan to provide the exhaust or discharge the air outside the building. Depending on the system and the level of contami nant generation, the LEV may be equipped with filters, such as high-efficiency particulate air (HEPA) filters or an air-pollution control device.

Examples of LEV at GRC include laboratory fume hoods, welding snorkels, and paint booths. Local exhaust ventilation for toxic materials may require an air-pollution permit for operation. Please refer to Chapter 4, "Air Pollution Control," For additional information.

POLICY

Construction, installation, inspection, and maintenance of LEV shall comply with OSHA standards, as well as with standard industry references, such as the American National Standards Institute (ANSI) and the American Conference of Governmental Industrial Hygienists (ACGIH).

REQUIREMENTS

Newly purchased laboratory fume hoods shall include, at a minimum, a continuous face velocity monitor to monitor hood performance.

All LEV systems are inspected and tested annually by the IHT. Continuous face velocity monitors shall be tested and calibrated annually. Each LEV hood is tagged with the LEV Identification #, date of the test, and the person doing the test. When the sash for a laboratory fume hood is not in the closed or nearly closed position, it shall be adjusted such that the hood provides a face velocity at 100 fpm+20%.

RESPONSIBILITIES

Industrial Hygiene Team (IHT)

- Provides guidance on the requirements of Federal, State, and Local ventilation regulations as well as standard industry practice guidelines.
- Maintains a registry of all LEV at GRC.
- Performs an annual survey of all LEV's in the registry.
- Maintains a reference library on industrial ventilation and should be consulted for guidance.

Plum Brook Management Office (PBMO)

- Maintains a registry of all LEV at Plum Brook Station.
- Performs an annual survey of all LEV's in the registry.

Project Engineers

- Facilities and Test Engineering Division (FTED) project engineers involved in the purchase or modification of LEV systems
- Take training in ventilation design for contaminant control
- Ensure LEV design specifications comply with the requirements of this program.
- Inform the IHT of all newly installed or modified LEV systems and request a ventilation survey before releasing the system for use.

Operations and Maintenance Personnel

- Inform the IHT of all modifications or repairs of LEV systems and request a ventilation survey before releasing the system for use.

Supervisors

- Ensure that LEV is operated in accordance with the requirements of this program.
- Stop operations, tag the LEV "out of service," and contact the IHT if, a LEV system is suspected of being deficient.
- Inform the IHT of all newly installed LEV systems and all modifications or repairs of LEV

systems and request a ventilation survey before releasing the system for use.

Employees

- Operate LEV in accordance with this program
- Conduct operations in laboratory hoods so that the hood sash is raised no higher than the point where the face velocity is within the appropriate operating specifications (80-120 fpm) and the face velocity monitor is not in alarm.
- Report any LEV that does not appear to adequately control employee exposure to air contaminants.
- When a laboratory hood is in alarm immediately lower the sash to a level at which the alarm ceases and notify the IHT of the alarm.
- Area Safety Committees in their review of new or modified installations shall ensure compliance with this program.

REFERENCES, GUIDANCE DOCUMENTS AND REGULATIONS

U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.95, Ventilation.

American Conference of Governmental Industrial Hygienists, Industrial Ventilation: A Manual of Recommended Practice, Cincinnati, Ohio, 1990.

American National Standards Institute, American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1060 and Z33.1-1961.

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GRC Environmental Programs Manual

Chapter 17 - SOLID WASTE

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GENERAL

This chapter establishes policies and procedures for the disposal of solid waste at GRC. The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who in any way participate in the development and execution of NASA actions.

This guidance replaces the document "GRC Waste Disposal Guidelines", first edition, November 1990.

REGULATIONS AND REQUIREMENTS

The attached guidance is designed to conform to U.S. EPA and Ohio EPA waste disposal regulations and draws heavily on the following U.S. Department of Defense guidance documents:

- U.S. Government Disposal Methods Guidelines - DOD 6050.5
- Environmental Compliance for the DRMS Hazardous Property Program, June 1990 edition (newest version of DRMS-M 6050.1)
- Federal Agency Recycling and the Council on Federal Recycling and Procurement Policy - Executive Order 12780 The Resource Conservation and Recovery Act (RCRA) of 1976, P.L. 94-580 as amended
- Ohio Solid and Hazardous Waste Disposal Law, ORC Title 37 chapter 3734.

POLICY

It is the policy of GRC to reduce solid waste by finding and using methods of reuse and recycling for all discarded materials; to comply with all Federal, State, and local regulations governing the generation, storage, shipment, and disposal of solid waste; and to conserve resources.

RESPONSIBILITIES

Waste Management Team

- Achieves waste minimization goals at GRC.

Property Disposal Officer

- Prepares and awards contracts for precious and nonprecious metal recycling and paper recycling.

Recycling Coordinator

- Plans and administers cost effective recycling programs at GRC.

Logistics and Technical Information Division (LTID)

- Provides storage/shipping containers.
- Prepares the solid waste management plan.

Environmental Management Office (EMO)

- Reviews the solid waste management plan.
- Audits landfills and recycling facilities.
- Provides regulatory advice to FTED on solid waste disposal and to LTID on recycling matters.

RELATED PROGRAMS

Aspects of solid waste management at GRC are addressed in the chapters "'Disposal of Hazardous Material and Hazardous Waste," "Hazardous Waste Minimization," "Asbestos", and "Handling and Disposal of Soil" of this manual.

DEFINITION

Solid waste
: Any waste, scrap, abandoned, or discarded materials that is not Regulated under Resource Conservation Recovery Act, National Pollutant Discharge Elimination System, or the Nuclear Regulatory Commission

Amenable to recycling
: Subject to regulation under the GRC Property Disposal and Reutilization Program.

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GRC Environmental Programs Manual

Chapter 18 - FLOODPLAIN AND WETLANDS MANAGEMENT

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GENERAL

This chapter establishes policies and procedures for dealing with GRC projects and programs that could impact floodplains or wetlands. The guidance provided here is applicable to GRC employees and contractors at all levels who in any way participate in the formulation, development, and execution of qualifying NASA actions.

REGULATIONS AND REQUIREMENTS

The primary mechanism through which the Federal government protects wetlands is Section 404 of the 1972 Clean Water Act. Section 404 has an established legal history of broad interpretation that requires that any actions that disturb or eliminate wetlands be approved by the Army Corps of Engineers. In conjunction with this law is a related set of laws governing the management of floodplains. These laws include the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Authority for floodplain management is included in Executive Orders 11988 and 11990. These Orders require that each Agency evaluate the potential effects of its actions on flood plains. Agencies should not undertake actions that directly or indirectly induce growth in the floodplain unless there is no practical alternative. Agency regulations and operating procedures for licenses and permits should include provisions for the evaluation and consideration of flood hazards. NMI 8800.10b provides NASA instructions on floodplain and wetlands management.

POLICY

It is GRC policy to restore, preserve, and protect the natural and beneficial values provided by floodplains and wetlands. In carrying out this policy, GRC will avoid adverse impacts associated with the occupancy and modification of floodplains and wetlands.

- Avoid direct or indirect support of floodplains and wetlands development wherever there is a practicable alternative.
- Reduce the risk of flood loss and minimize the impact of floods on human health, safety, and welfare.
- Develop an integrated process to involve the public in the floodplain and wetlands management

decision-making process.
- Incorporate into the GRC Master Facilities Plan the requirements of the Unified National Program for Floodplain Management.
- Establish internal management controls to monitor NASA actions to assure compliance with the Executive Orders.

RESPONSIBILITIES

Environmental Compliance Team (ECT)

- Maintains an accurate inventory of all GRC floodplain and wetlands
- Validates the need for permit applications
- Reviews all floodplain and wetlands permit applications
- Maintains copies of all existing floodplain and wetlands permits
- Coordinates with technical management of Facilities Test and Engineering Division for inclusion of wetlands and floodplains inventories into the Master Facilities Plan.

Facilities and Test Engineering Division (FTED)

- Review all proposed projects to identify activities in floodplain and wetlands
- Coordinate with ECT for floodplain or wetlands permits applications
- Directorates Initiating Projects
- Coordinate proposed actions affecting floodplains and wetlands with ECT and the External Affairs Office.

Project Engineers

Prepare permit applications and submit them to ECT for review.

RELATED PROGRAMS

Floodplain and wetlands actions are addressed in the National Environmental Policy Act on the subject of water pollution (see chapter 2 of this manual). Also, the Ohio Coastal Zone Management (CZM) Plan has regulatory impact on Plum Brook Station's water intake structure.

RESOURCES

Copies of the official floodplain and wetlands maps for GRC are maintained in ECT.

DEFINITIONS

Action

Activity including, but not limited to, the acquisition, construction, modification, change in land use, issuance of facilities use permits, and disposition of Federal lands and facilities.

Floodplain

The lowland and relatively flat areas adjoining inland and coastal waters, including the flood-prone areas of offshore islands and including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year. The base floodplain shall be used to designate the 100-year floodplain (1 percent chance floodplain). The critical action floodplain is defined as the 500-year floodplain (0.2 percent chance floodplain). A large portion of GRC floodplains also encompasses wetlands.

Wetlands

Those areas that are frequently inundated by surface or ground water and normally support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, river overflows, wet meadow, and natural ponds.

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GRC Environmental Programs Manual

Chapter 19 - ENDANGERED AND THREATENED SPECIES

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GENERAL

Many species of animals and plants have become endangered or threatened within Ohio due to habitat destruction, harvesting and hunting, and pollution. Congress has recognized these species as having aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people. It is the policy of Congress that all Federal departments and agencies seek to conserve, to the extent practicable, the various species of fish or wildlife and plants facing extinction. Federal agencies must insure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat.

REGULATIONS

The Endangered Species Act of 1973 established the purposes and policies of the United States with respect to endangered species. 50 CFR 17.11 and 17.12, implemented in 1983, address endangered and threatened species and list the species that fall into these categories. The State of Ohio maintains its own Endangered and Threatened Species programs (ORC 1517 and 1518).

ENDANGERED SPECIES LISTS

Both the Federal and State governments periodically release updated lists of species that have been recognized as threatened or endangered. Local park authorities and natural history museums are also sources of information regarding species for which there may be special concerns. Several endangered and threatened species are known suspected of inhabiting or frequenting GRC.

POLICY

It is the policy of the Lewis Research Center, both at Cleveland and at Plum Brook, to comply with all applicable Federal and State regulations with regards to endangered and threatened species.

RESPONSIBILITIES

Environmental Management Office (EMO)

- Arranges for surveys of biological habitats and communities under GRC jurisdiction.
- Arranges for endangered and threatened species management plans for land under GRC jurisdiction.
- Monitors actions in critical habitats for compliance with policy.
- Maintains threatened and endangered species lists from information provided by offered by Federal and State governments.

Facilities and Test Engineering Division (FTED)

- Identifies those habitats known to harbor endangered or threatened species in the Master Facilities Plan.

RELATED PROGRAMS

The National Environmental Policy Act program (chapter 2 herein) provides for the consideration of endangered and threatened species during the planning phase of any significant construction of facilities projects.

RESOURCES

EMO has commissioned and completed biological surveys of both Lewis and Plum Brook Station. *The Biological Inventory of Plum Brook Station* (Ohio Department of Natural Resources, 1994) and the *Biological Inventory of the NASA Lewis Research Center* (Ohio Department of Natural Resources, 1995) are available through EMO.

The *Endangered Species Management Plan for the NASA Lewis Research Center* (The Bionetics Corporation, 1996) is available through EMO.

The U.S. Fish and Wildlife Service, Department of the Interior, is responsible for defining endangered and threatened species. It is required to update its list at least once every 5 years. Its findings are recorded in 50 CFR 17.11 and 17.12.

The Ohio Department of Natural Resources, Division of Natural Areas and Preserves, publishes the official state list of rare native Ohio vascular plants. The Division of Wildlife, ODNR, is responsible for developing and maintaining a list of Ohio Endangered Wildlife Species. The Ohio Natural Heritage Data Services, ODNR, maintains a database of the endangered and threatened species for all of Ohio. Information on species known to inhabit GRC, both at Cleveland and Plum Brook Station, can be obtained from the database for a fee.

DEFINITIONS

Endangered species

Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insect that has been determined to be a pest whose protection

under the provisions of this Act would present an overwhelming and overriding risk to humans.

Threatened species

Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

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GRC Environmental Programs Manual

Chapter 20 - EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is November 27, 1996. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

GENERAL

The Emergency Planning and Community Right-To-Know Act (EPCRA) was enacted in October 1986 in response to growing concern about the effect of chemical releases on communities. Although enacted as part of the Superfund Amendments and Reauthori- zation Act of 1986 (SARA title III), EPCRA is a free-standing law. It is intended to encourage and support emergency planning efforts at the State and local level and to provide citizens and local governments with information concerning potential chemical hazards present in their communities.

REGULATIONS

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980

Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986

Superfund Amendments and Reauthorization Act (SARA), Title III, Sections 311, 312, and 313

Title 29 Code of Federal Regulation (CFR) 1910.1200, Hazard Communication Standard

Title 40 CFR 350, Trade Secrecy Claims for Emergency Planning and Community Right-To-Know Information; and Trade Secret disclosures to Health Professionals

Title 40 CFR 355, Emergency Planning and Notification

Title 40 CFR 370, Hazardous Chemical Reporting; Community Right-To-Know

Title 40 CFR 372, Toxic Chemical Release Reporting; Community Right-To-Know.

REQUIREMENTS

Inventory Reporting

The EPCRA requires that the owner or operator of any facility that prepares or has available Material Safety Data Sheets (MSDS's) for hazardous chemicals under OSHA prepare and submit an emergency and hazardous chemical inventory form to the Ohio EPA State Emergency Response Commission (SERC), the local emergency planning committee, and the local fire department with jurisdiction over the facility. Facility owners and operators subject to this reporting requirement include both manufacturing and nonmanufacturing facilities that maintain hazardous chemicals in amounts above established reporting thresholds.

The U.S. EPA has published a list of 366 extremely hazardous substances in 40 CFR Part 355 and has established a permanent threshold planning quantity for each substance on the list. The reporting thresholds currently apply to hazardous chemicals present at a facility in quantities equal to or greater than 10,000 lb or to extremely hazardous substances present in quantities equal to or greater than 500 lb (nominally 55 gal), or the threshold planning quantity (TPQ), whichever is less.

Facilities that do not produce, store, or use hazardous chemicals or extremely hazardous substances at or above the threshold planning quantity are exempt from the reporting requirement. Facility owners and operators subject to this reporting requirement must submit the inventory form annually by March 1st. In compliance with EPCRA requirements, GRC reports on those hazardous chemicals or extremely hazardous substances that are present at any time during the year in quantities equal to or greater than the threshold planning quantities.

Ohio State Emergency Response Forms (Ohio EPA forms 0316 and 0317) are used by GRC to fulfill the reporting requirement.

Emissions Reporting

The EPCRA also requires a report of emissions of toxic chemicals from manufacturing facilities (Standard Industrial Classification Codes 20 through 39) that manufacture, process, import, or otherwise use a listed toxic chemical above the threshold quantities. The U.S. EPA Toxic Chemical Release Inventory Reporting Form (Form R) is used by GRC for reporting this information annually to the EPA by July 1.

RESPONSIBILITIES

Environmental Management Office (EMO)

- Submits the Emergency and Hazardous Chemical Inventory Forms to the Ohio State Emergency Response Commission, the Cuyahoga County Department of Community Services, The Cleveland Fire Department, and the Erie County Emergency Manage- ment Agency, and the Perkins Township Fire Department (Plum Brook Station Inventory)
- Submits the U.S. EPA Toxic Chemical Release Inventory Form (Form R) to the U.S. EPA Region 5.

Chemicals Management Team (CMT)

- Maintains the chemical inventory and the MSDS files.
- Prepares the Ohio SERC forms and the EPA Form R.

Security Branch

- Provides area control and security at spill sites and supports the Lewis Fire Department.

Glenn Safety Office (GSO)

- Conducts investigations into the causes of the spill incidents and recommends prevention measures.
- Develops and maintains the GRC Contingency Plan.
- Maintains the GRC Emergency Response Plan.
- Coordinates with the Area Safety Committee Chairs on safety permits requiring the use of reportable quantities of toxic materials.
- Provides the CMT with information on all toxic material spills for reportable quantities assessment.

DEFINITIONS

Hazardous chemical
: Any chemical that is a physical or health hazard as defined by OSHA 29 CFR 1910.1200, Hazard Communication Standard

Hazardous material
: Any material defined as hazardous under 40 CFR 171.8 which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated. Such material has one or more toxic, flammable, corrosive, or reactive properties. All materials listed under Title M of the Superfund Amendments and Reauthorization Act of 1986 (SARA) are included.

Nonreportable quantity (NRQ) spills
: A spill that is relatively small in volume and presents low hazard potential to personnel or the environment. Containment and cleanup of trace quantities of NRQ spills are the responsibility of the user (custodian) of the material. Nonreportable quantity spills can be contained and cleaned up with only minor difficulty. Outside support is not necessary for NRQ spills.

Release
: Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, dumping or disposing into the environment (including abandonment or discarding of barrels, containers, and other closed receptacles) of any toxic chemical.

Reportable quantity (RQ) spills
: Spills involving large volumes of material and may present significant hazard to personnel or the environment. Any spill reportable under EPA regulations 40 CFR 302, 355, or 372 shall be considered a RQ spill. Reportable quantity spills include, but are not limited to, the materials and volumes given in appendix B under Extremely Hazardous Substances (EHS) RQ or CERCLA reportable quantities.

Threshold planning quantity (TPQ)
: The quantity for an extremely hazardous substance as defined in Title 40 CFR 355.

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GRC Environmental Programs Manual

Chapter 21 HAZARDOUS CHEMICALS SAFETY AND HEALTH

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PURPOSE

This chapter contains general information about and establishes minimum requirements for the safe handling and use of hazardous materials.

APPLICABILITY

The part he provisions of this part of this chapter are applicable to all employees at Cleveland and Plum Brook who use hazardous materials.

POLICY

It is Glenn Research Center policy that an employee's health and safety is the highest priority. Therefore, all Glenn, tenant, and resident support services contractor employees involved in the handling, storage, transportation, use, production or disposal of hazardous materials must be informed of the hazards of the chemicals with which they work, the appropriate measures to take to protect themselves from the hazards, how to minimize exposures to the chemicals, and how to work with materials in a safe and healthful manner.

RESPONSIBILITIES

Environmental Management Office (EMO)

- Manages, directs, and ensures the implementation of Hazard Communication and Chemical Hygiene programs at Cleveland and Plum Brook Station.

GRC Employees

- Must follow all proper procedures for purchasing and disposing of hazardous chemicals. Employees are reminded not to buy more chemicals than they can possibly use in their project

or to stockpile material. Employees are to include in their budget the cost of disposing of their chemicals and hazardous wastes.

Chemicals Management Team (CMT)

- Implements the Glenn Hazard Communication Program and ensures that appropriate hazard awareness training is provided to Center employees; maintains inventory control of hazardous chemicals purchased by the Center as stock items and program chemicals; provides technical support on the hazards of materials, their handling, storage, and use and the safety measures to protect the employee from the hazards of the materials; and provides Material Safety Data Sheets (MSDS) to employees who work with or may be exposed to hazardous chemicals
- Maintains and implements the Chemical Hygiene Program
- Coordinates the Hazard Communication and Chemical Hygiene Programs with the Plum Brook Station.

Plum Brook Station Management Office (PBMO)

- Performs the same function as CMT at the Plum Brook Station and coordinates all efforts with CMT.

DEFINITIONS

Carcinogen
: A chemical is considered to be a carcinogen if it has been evaluated by the International Agency for Research on Cancer (IARC) and found to be a carcinogen or potential carcinogen; or if it is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or if it is regulated by OSHA as carcinogen.

Hazardous chemical
: Any chemical that is a physical or health hazard as defined by OSHA 29 Code of Federal Regulations 1910.1200, Hazard Communication Standard

Health hazard
: A chemical for which there is scientifically established evidence that acute or chronic health effects may occur in exposed employees.

Physical hazard
: A chemical or product for which there is scientifically established evidence that the chemical is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or is water reactive.

Hazardous material
: Any material defined as hazardous under 40 Code of Federal Regulations 171.8 which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated. Such material has one or more toxic, flammable, corrosive, or reactive properties. All materials listed under Title M of the Superfund Amendments and Reauthorization Act of 1986 (SARA) are included.

Highly toxic
: A chemical falling within any of the following categories:
- A chemical that has a median lethal dose (LD50) of 50 mg, or less, per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 g each.

- A chemical that has a median lethal dose (LD50) of 200 mg or less per kilogram of body weight when administered by continuous contact for 24 hr (or less if death occurs with 24 hr) with the bare skin of albino rabbits weighing between 2 and 3 kg each.
- A chemical that has a median lethal concentration (LC50) in air of 200 ppm by volume or less of gas or vapor, or 2 mg/l or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within 1 hr) to albino rats weighing between 200 and 300 g each.

Material Safety Data Sheet (MSDS)

A document, provided by the manufacturer or importer of a hazardous chemical or prepared by Glenn researchers, that identifies a hazardous material and provides information about the physical and health hazards associated with it (See samples of MSDS's in appendix A.). Although MSDS vary in both format and content all must contain this: product identification, manufacturer's name and address, hazardous ingredients information, physical and chemical characteristics, fire and explosion hazard data, reactivity data, health hazard data, precautions for safe handling and use, and control measures.

Additional information on MSDS's can be found in the Dictionary (See Reference I.) which will assist users of MSDS's with over 300 terms commonly found in MSDS's. Included are abbreviations, acronyms, and synonyms along with explanations of the various sections found in an MSDS.

GENERAL INFORMATION

It is prudent practice to consider all chemicals as hazardous until proven otherwise. Chemicals occur in all three physical states, solid, liquid, or gaseous and can be dangerous in any or all states. Information on the physical and chemical characteristics of any chemical can be obtained from the manufacturer's Material safety data sheet (MSDS) and also from the label found on the container. All hazardous chemicals must be appropriately labelled. If, during use, the labels become damaged or defaced, the containers should be relabelled with information from the appropriate MSDS. Material safety data sheet binders are located in every building at the Center. Employees are required to know where they are located and to become familiar with its contents. Employees who work with chemicals that are not stock items are required to obtain MSDS's for those chemicals and maintain a file of those MSDS's in their work area. Copies of MSDS's may be obtained from the CMT by calling 3-8824.

In general, hazardous chemicals should be used only in well ventilated fume hoods (see chapter 16) and using appropriate protective clothing, goggles or face shields, impervious gloves, and respirators (see chapter 12) when required. Eating and smoking in the workplace is not permitted, and one should follow good personal hygiene practices by washing thoroughly after handling any chemicals.

FLAMMABLE LIQUIDS AND GASES

Flammable materials shall be kept away from ignition sources, open flames, or heat. Containers shall be bonded to the building grounding system when transferring flammable materials to a secondary container or another system, such as a test facility. Flammables may be stored only in properly labeled metal safety cans that are equipped with flame arresters, and placed into flammables storage cabinets. At no time should flammables be stored in a basement area or a below-grade location. (This policy is in compliance with the National Fire Protection Association Codes.) Explosion-proof electrical fixtures shall be used in areas where flammables are stored or handled. (See NFPA Code 70

National Electrical Code for specific requirements.)

TOXIC AND CARCINOGENIC CHEMICALS

Only minimum quantities of toxic materials, an amount sufficient for one workshift, should be present in the work area. Consult the Chemical Hygiene Officer 3-8689 for advice on determining quantities permitted in the work area.

Storage container labels for toxic and carcinogenic chemicals should also list the appropriate warning, such as "high chronic toxicity or cancer-suspect agent." Highly toxic or carcinogenic chemicals (see Definitions) should be stored in well-ventilated areas and in unbreakable, chemically resistant secondary containers.

Storage areas for highly acute or chronic toxicity materials should be marked with a proper hazard warning sign, have limited access, and be adequately ventilated. An inventory of the toxic chemicals and those regulated as carcinogens should be maintained and posted at the site.

The MSDS for material being used will describe the necessary precautions to protect yourself and others from unnecessary exposure. These precautions should be followed carefully. Documents referred to in the References section provide explanations of the information in the MSDS's.

REPORTING EMERGENCIES

Any person who becomes aware of any spill or the inadvertent or unauthorized release of hazardous materials to the environment must call 911 to report the incident. At no time should anyone try to cleanup a spill by themselves.

HAZARD COMMUNICATION (HAZCOM) TRAINING

All Center employees, including resident support service contractors are required to attend Hazard Communication Awareness Training. Employees who work in chemical laboratories are required to attend Chemical Hygiene Awareness Training as well as HAZCOM Training. This training is conducted by the CMT and coordinated by the Office of Human Resources Development.

REFERENCES

The references listed below can be found in the Glenn Library.

The Merck Index. Eleventh Edition. Merck & Co., Inc. Rahway,N.J. 1989.

Patty's Industrial Hygiene and Toxicology. Third Revised Edition. John Wiley & Sons. New York, N.Y. Volumes I, II,& III. 1978.

Best's Safety Directory. Volume II. A.M. Best Company. Oldwick,N.J. 1990. pg. 1289-1307.

Prudent Practices for Handling Hazardous Chemicals in Laboratories. National Academy Press. Washington, D.C. 1981.

Prudent Practices for Disposal of Chemicals from Laboratories. National Academy Press. Washington,D.C. 1981.

R. E. Lenga, The SIGMA-ALDRICH Library of Chemical Safety Data, Vol. I & II, Edition 2, Sigma-Aldrich, Milwaukee, WI., 1988.

Code of Federal Regulations. 29 Code of Federal Regulations 1910.1000. Appendix B, Subpart Z "Toxic and Hazardous Substances," Air Contaminants., as revised.

DATA BASES

In addition to the reference texts listed above and MSDS data bases supplied by a number of chemical manufacturers, two are available on the STN International Network, which can be accessed by the GRC Library.

Chemlist

Produced by the American Petroleum Institute, this data base contains information about chemical substances currently listed in the EPA's Toxic Substances Control Act (TSCA) inventory or those compounds that are subject to TSCA or similar legislation. There are approximately 76,000 records in this file, which was created in 1979. Included in the file is a listing of references and abstracts for these records.

Chemical Safety News Base (CSNB)

CSNB created in 1981 by the Royal Society of Chemistry in London, contains about 21,000 records on the environmental, health, and safety aspects of a variety of chemical substances. Specific information includes data on fires and explosions, storage, toxic substances, laboratory toxicology studies and waste removal. Like the CHEMLIST data base, the information contained in CSNB is in the form of a bibliography that contains a reference and an abstract of that reference.

Material Safety Data Sheet Dictionary, Glenn Research Center

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Chapter 22 - ACQUISITION OF HAZARDOUS CHEMICALS AND MATERIALS

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PURPOSE

This chapter sets forth the policy and procedures for the acquisition of chemicals and hazardous materials and describes the functions, responsibilities and authority for the purchasing, processing, receiving, controlling and shipping of hazardous materials. These procedures are intended to provide for the acquisition of toxic, radioactive, flammable, corrosive, or otherwise hazardous materials and for the initiation of proper review and approval considerations for their safe use.

APPLICABILITY

The provisions of this part are applicable to all operations at Cleveland and Plum Brook Station.

POLICY

It is Glenn policy to assure the safe handling, receipt, control, and shipment of chemicals and hazardous materials, in order to protect the requester, user, transporter, shipper, and the environment from an accidental exposure to a hazardous material.

AUTHORITIES

Title 40 Code of Federal Regulations, Protection of the Environment, Parts 260-265
Title 49 Code of Federal Regulations, Transportation, Parts 100-177, Hazardous Materials Regulations
Public Law 94-469, Toxic Substances Control Act
Federal Standard 313A, Material Safety Data Sheets, Preparation and Submission of
NSS 1740.7, Safety Standard for Handlers of Hazardous Materials
LHB 5120.15, Preparing and Processing Purchase Requests, as revised
Title 29 Code of Federal Regulations, 1910.1200, Hazard Communication Standard, as revised
Title 29 Code of Federal Regulations, 1960 Basic Program Elements for Federal Occupational Safety and Health

SARA - Title III, Section 311-312.

RESPONSIBILITIES

Requester

- Checks the availability from the Center's inventories, such as Stock or Chemical Management System, before requesting the purchase of chemicals or hazardous materials.
- Consults with safety, environment, industrial hygiene, health, chemical services, security, specialists to ensure that the request contains necessary supporting information. This information may include Safe Handling and Use Guides, MSDS's, and special handling precautions as directed by the Safety Assurance and Chemical Management Team (CMT).
- Prepares a complete, legible, and accurate technical package in accordance with LHB 5120.15, with special attention to block 11 of the Purchase Request (PR) form (NASA C-100) where the hazard assessment must be recorded. The hazardous properties considered are toxicity, flammability, corrosivity, radioactivity, reactivity (oxidizing and reducing potential), and explosive characteristics as well as etiological properties.

Division Procurement Coordinator

- Reviews purchase requests, paying particular attention to block 11 on the PR form. At Glenn, routes the PR for hazardous materials to the Safety Assurance Office and the CMT for concurrence and approval (Part 9 blocks F and G). At Plum Brook, routes the PR to PBMO for concurrence and approval.
- Submits a copy of the PR to the building manager and area safety committee chair where hazardous materials will be delivered, used, and stored.

Glenn Safety Office

- Reviews all PR's for chemicals and hazardous materials and evaluates the hazard potential.
- Administers a program and, in consort with the area safety committee, assures the safe use, handling, storage, and disposal of chemical and hazardous materials.
- Coordinates any difficult or unusual circumstances that may arise in the handling of hazardous materials with all appropriate parties.
- Reviews hazardous chemical use work areas to ensure that all appropriate safety procedures and equipment are in place to minimize employee and property risk and that the hazardous chemicals can be used safely in the designated area.

Chemical Management Team

- Reviews all PR's for hazardous chemicals and materials and evaluates the hazard potential of each hazardous chemical or material being purchased. Identifies the proper hazard clause to be incorporated in the contract/purchase order. And designates on the PR that an MSDS be supplied by the vendor for each hazardous material being purchased.
- Provides a Safe Handling and Use Guideline or MSDS for each hazardous material identified on the PR form.
- Maintains a file on the hazardous properties of chemicals and other substances.
- Distributes copies or a list of newly acquired MSDS's to the Occupational Medicial Services,

the chair of the appropriate safety committee, and, on request, to NASA Headquarters, Occupational Health Office.
- Provides technical advice for the safe use, handling, storage, and disposal of chemicals and hazardous materials.
- Notifies the appropriate organization of any unusual circumstances.

Logistics and Technical Information Division

- Reviews purchase requests for accuracy, justification, and proper approvals and executes contracts or purchase orders for acquisition of hazardous materials. Identifies the purchase of hazardous materials by placing a suffix "H" to the contract/purchase order number. Incorporates the appropriate hazard clause in the contract/purchase order in all contracts requiring the use of hazardous chemicals.
- Ensures that vendors furnish MSDS's on all chemicals identified as hazardous.
- Ensures that vendors properly describe, package, mark, and label the items being purchased in accordance with Title 49 CFR, Department of Transportation.
- Inspects all packages containing hazardous chemicals and materials for breakage or leakage and reports any leaking packages to the Glenn Dispatcher at 911 and to the CMT 3-6735 or, at Plum Brook, to the Station Communications Center at 911.
- Ensures that required MSDS's have been submitted by the vendor for each item identified as a hazardous material and holds all hazardous materials in temporary storage when MSDS's have not been received or are not on file with CMT. If an MSDS is not received after several requests to the supplier, the material will be returned to the supplier.
- Sends Material Safety Data Sheet(s) to the CMT as received.

Building Managers

Maintain awareness of all potentially hazardous activities within their assigned facilities that require the safe use, handling, storage, and disposal of hazardous materials and hazardous wastes.

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Chapter 23 - HAZARD COMMUNICATION POLICY

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PURPOSE

The Glenn Hazard Communication (HAZCOM) Policy was established to formalize the methods of communicating information on hazardous materials and to ensure that correct and complete information is available to employees.

APPLICABILITY

The Glenn HAZCOM Policy is applicable to all organizational elements of the Cleveland Center and the Plum Brook Station, all tenant organizations, and all resident support services contractors.

AUTHORITIES

OSHA 29 Code of Federal Regulations 1910.1200, Hazard Communication Standard, as revised

OSHA 29 Code of Federal Regulations 1926.59, Hazard Communication Standard, as revised

Executive Order 12196, Occupational Safety and Health Provisions for Federal Employees

NHS 1845.3, NASA Health Standard on Hazard Communication

NMI 8710.2, NASA Safety and Health Programs

BACKGROUND

On July 25, 1986, the Occupational Safety and Health Administration (OSHA) ruled that, pursuant to Executive Order 12196, all Federal agency heads were required to comply, by May 23, 1988, with the OSHA Hazard Communication Standard as set forth in OSHA 29 CFR 1910.1200. As a result, NASA Headquarters established the NASA Health Standard on Hazard Communication, NHS 1845.3, requiring agency-wide compliance with the applicable provisions of OSHA 29 CFR 1910.1200. This chapter prescribes the Center's implementation of the directives.

SCOPE

The Glenn HAZCOM Policy applies to any hazardous chemical to which GRC employees, tenant employees, and resident support services contractor personnel may be exposed or may expose others under normal conditions of use or in a foreseeable emergency at the Cleveland Center, the Plum Brook Station, or any associated off-site facility. A HAZCOM Program has been established to assure Center compliance with regulation. The HAZCOM Program is administered by the Environmental Management Office (EMO). Implementation of the program is the responsibility of each supervisor.

POLICY

It is Glenn policy that employee health and safety are the highest priority. Therefore, all GRC, tenant, and resident support services contractor employees involved in handling, storage, transportation, use, production or disposal of chemicals will be informed that their lives or health may depend on their knowledge of the chemicals they work with and on their taking appropriate measures to protect themselves and minimize exposure to hazardous chemicals.

DEFINITIONS

For the purpose of the hazard communication policy, the following significant terms are defined:

Employee

A GRC, tenant, or resident support services contractor employee who may be exposed to hazardous chemicals in his or her assigned work area under normal operating conditions or in foreseeable emergencies.

Work Area

A room, laboratory, warehouse, or other defined area within the Cleveland Center, the Plum Brook Station, or an associated off-site facility wherein hazardous chemicals are used, stored, or transported, and where employees are present.

RESPONSIBILITIES

The Center Director, who has ultimate responsibility for hazard communication within Glenn, provides, with other administrators, continuing support for institutional hazard communication.

Director of Office of Safety, Environmental, and Mission Assurance

- Appoints, after consultation with the Chief, of the EMO, a technically qualified management official as the HAZCOM Officer to carry out the responsibilities set forth in the HAZCOM Program.
- Assures the availability of resources necessary for the establishment, execution, and maintenance of the HAZCOM Program.

Office of the Chief Counsel

- Provides legal assistance and counsel pertinent to all areas of OSHA 29 CFR 1910.1200 and OSHA 29 CFR 1926.59 and provides assistance and advice relative to the official compliance inspections conducted at the Cleveland Center and the Plum Brook Station by OSHA Compliance Officers.

Chief, Environmental Management Office

- Assigns organization responsibility and allocates resources to ensure that all parts of OSHA 29 CFR 1910.1200 are implemented and maintained.

Hazard Communication Officer - Chemical Management Team (CMT)

- Establishes, administers and maintains the Glenn HAZCOM Program in coordination with all appropriate Glenn Research Center personnel.
- Ensures that the Glenn training, inventory, Material Safety Data Sheets (MSDS's) and labeling requirements as specified in OSHA 29 CFR 1910.1200 are in place and maintained.
- Ensures that recordkeeping requirements are established and maintained as required by OSHA 29 CFR 1910.1200 and 1926.59.

Chief, Office of Human Resources Development

In conjunction with the HAZCOM Officer

- Implements the training requirements of OSHA 29 CFR 1910.1200, in conjunction with the HAZCOM Officer. Provides suitable certificates to employees upon completion of scheduled training by such employees.
- Establishes and maintains the official training records as required in OSHA 29 CFR 1910.1200.

Supervisors

Whose functional operations and work areas involve the use and/or storage of hazardous chemicals where employees are present

- Ensure that their employees are appropriately trained to handle all hazardous chemicals in their work areas.
- Ensure that all of the information as specified in OSHA 29 CFR 1910.1200 is available to each employee.
- Ensure that all the information as specified in OSHA 29 CFR 1926.59 is available to each construction contract employee when in the work area..

Safety Officer

- Ensures that appropriate warning placards and/or signs and labels are provided or arranged for and in place at designated areas as necessary.

Resident Contract COTR's

- Ensure that each resident support service contractor has a Hazard Communication Program and that all elements are in place and followed.

Construction Contract COTR's

- Ensure construction contractor has a Hazard Communication Program and that all elements are in place and followed.
- Provide Glenn chemical information as required.
- Ensure MSDS and inventory lists are available on site in the work area.

Plum Brook Management Office (Aeropropulsion Facilities and Experiments Division)

- Ensures compliance with the Plum Brook operational support services contractor's HAZCOM Program and the applicable provisions of this chapter by the contractor, the Plum Brook staff, all tenant organizations, and other resident and nonresident contractors.
- Coordinates with the HAZCOM Officer on matters pertaining to OSHA 29 CFR 1910.1200 and OSHA 29 CFR 1926.59.

REQUIREMENTS

All aspects of Glenn HAZCOM will assure compliance as specified in OSHA 29 CFR 1910.1200 and OSHA 29 CFR 1926.59. The scope shall include but is not limited to:

- A written HAZCOM Program to be maintained and reviewed annually by the Glenn HAZCOM Officer. The requirements of OSHA 29 CFR 1910.1200 and OSHA 29 CFR 1926.59 and the programs in place at GRC to meet the requirements are defined in the written HAZCOM Program.
- A MSDS Plan which specifies that the master MSDS files are kept, maintained, and distributed by CMT and MSDS binders are available in all work areas. MSDS's can be requested through CMT and MSDS binders are available in all work areas. MSDS's can be requested through CMT or through a menu pick on GRC Internal Web applications.
- A Hazardous Chemical Labeling Plan which includes the chemical name and appropriate hazard warning, including target organs to ensure that containers of hazardous chemicals are labeled properly. Labels can be requested through the CMT.
- A Glenn training plan to ensure that employees that use hazardous chemicals are aware of the OSHA Standards, the hazards of the chemicals that they work with and the ways to protect themselves from those hazards. CMT provides general training classes at least six times a year, and training of supervisors once a year. Specific chemical training is available through the CMT.
- A Chemical Inventory Plan which includes the tracking of chemicals at GRC, bar coding, and the maintenance of the inventory. Employees who use chemicals must submit a Chemical Inventory Usage Form NASA-C-3032 to CMT whenever the inventory is changed.
- A construction contractor HAZCOM Plan which includes the COTR's gathering information on the construction contractor's HAZCOM program and submitting the information to CMT, and the transfer of Glenn specific chemical information to the construction contractor.

- A hazard assessment plan which includes how the hazards of chemicals are determined, what measures are to be taken to protect Glenn employees from those hazards, and how Glenn will be working to reduce the hazards in each work area.

FUNCTIONAL MANAGEMENT REVIEWS

Periodic internal functional management reviews of the Glenn HAZCOM Program must be conducted, at least annually, to ensure that the objectives and requirements of the program are effectively accomplished and to assess both strengths and weaknesses within the program.

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GRC Environmental Programs Manual

Chapter 24 - CHEMICAL HYGIENE POLICY

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PURPOSE

This chapter establishes Glenn policy and assigns responsibilities for the laboratory scale use and handling of hazardous chemicals. All Glenn, tenant, and resident support services contractor employees involved in the laboratory scale use of hazardous chemicals are to be informed that their lives or health may depend on their knowledge of the chemicals they use or work with, on their following proper handling procedures, and on wearing appropriate protective apparel and equipment.

APPLICABILITY

This part is applicable to all organizational elements of the Glenn Research Center at the Cleveland Center and the Plum Brook Station, all tenant organizations, and all resident support services contractors.

AUTHORITIES

OSHA 29 Code of Federal Regulations 1910.1450, Occupational Exposures to Hazardous Chemicals in Laboratories, as revised

Executive Order 12196, Occupational Safety and Health Provisions for Federal Employees

BACKGROUND

On January 31, 1990, the Occupational Safety and Health Administration (OSHA) issued the final rule 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories. This chapter prescribes the Center's policy with regard to that directive.

SCOPE

This chapter applies to all Glenn and tenant employees and resident support services contractor personnel engaged in the laboratory use of hazardous chemicals. A Chemical Hygiene Plan has been

established as part of this policy to assure Center compliance with the Occupational Safety and Health Administration Regulation 29 (CFR 1910.1450), Occupational Exposure to chemicals in Laboratories. The Chemical Hygiene Plan is administered by the EMO. Implementation of the plan is the responsibility of each laboratory line manager/supervisor.

POLICY

It is Glenn policy to protect the lives and health of employees who work with hazardous chemicals in laboratories by providing adequate laboratory facilities, equipment, training, personal protection, and environmental surveillance of their workplace.

RESPONSIBILITIES

The Center Director has ultimate responsibility for chemical hygiene within Glenn and must, with other administrators, provide continuing support for institutional chemical hygiene.

The Director Office of Safety and Assurance Technologies (OSAT)

- Appoints, after consultation with the Chief, Environmental Management Office (EMO), a technically qualified management official as the Chemical Hygiene Officer to carry out the responsibilities set forth in the Chemical Hygiene Plan
- Assures the availability of resources necessary for establishing, executing, and maintaining the Chemical Hygiene Plan.

The Office of the Chief Counsel provides legal assistance and counsel to the Center Director, the Director of OSAT, the Chief, EMO, the Glenn Environmental Pollution Control Board, the Chemical Hygiene Officer, and the Chief, Logistics Technical Information Division, on the interpretation, implementation of, and compliance with the provisions of OSHA 29 CFR 1910.1450 and other related authorities.

The Chief, EMO ensures that appropriate technical support and review is provided by the Glenn EMO to support the Chemical Hygiene Officer and maintain compliance with OSHA 29 CFR 1910.1450.

The Chemical Management Team Leader establishes, administers, and maintains the Chemical Hygiene Plan in coordination with all appropriate Glenn Research Center personnel (such as Glenn Safety Office).

The Chemical Hygiene Officer implements the Chemical Hygiene Plan and coordinates with the laboratory line manager/supervisor and employees the required training, environmental monitoring, personal protective equipment, signs and labels, hazard identification, spill control plans, waste disposal, and recordkeeping.

Each laboratory line manager/supervisor of employees who work with laboratory-scale use amounts of hazardous chemicals is responsible for chemical hygiene in the laboratory, which includes but is not limited to

- Ensuring that workers know and follow the chemical hygiene rules, that protective equipment

is available and in working order, and that appropriate training has been provided
- Providing regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment
- Knowing the current legal requirements concerning regulated substances
- Determining the required protective apparel and equipment
- Ensuring that facilities and training for use of any material being ordered are adequate.

The Institutional Safety Office, in conjunction with the Chemical Hygiene Officer, ensures that appropriate warning placards and signs are provided or arranged for and in place at designated laboratory areas as necessary.

The Training Officer, in conjunction with the Chemical Hygiene Officer,

- Determines the types and levels of training requirements and provides appropriate programs for training all Glenn, tenant, and resident support services contractor employees involved in the laboratory use of hazardous chemical at the Glenn, the Plum Brook Station, or an off-site facility
- Establishes and maintains the official training records and periodically provides the Chemical Hygiene Officer with an updated listing of all trained employees, the type and date of training, and the sponsor.

The Medical Officer, in conjunction with the Industrial Hygiene Team

- Provides information on medical testing available to the laboratory worker
- Performs selected employee testing and monitoring as required
- Maintains records as required.

Plum Brook Management Office, in conjunction with the Chemical Hygiene Officer, will ensure compliance with the laboratory standard at the laboratories at the Plum Brook Station.

REQUIREMENTS

All aspects of the Glenn Chemical Hygiene Plan assure compliance with OSHA 29 Code of Federal Regulations 1910.1450. Its scope, as it applies to laboratory use, includes, but is not limited to

- Basic rules and procedures
- Chemical procurement, distribution and storage
- Environmental monitoring
- Housekeeping, maintenance, and inspections
- Medical programs
- Personal protective apparel and equipment
- Records
- Signs and labels
- Spills and accidents
- Information and training
- Waste disposal
- Laboratory design
- Standard laboratory operating procedures.

FUNCTIONAL MANAGEMENT REVIEW

Internal functional management reviews of the Glenn Chemical Hygiene Plan are to be conducted by the Chief of the EMO, at least annually to ensure that the objectives and requirements of the plan are effectively accomplished by the responsible organizational elements and individuals and to assess both the strengths and weakness within the plan.

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GRC Environmental Programs Manual

Chapter 26 OZONE DEPLETING CHEMICALS

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is November 27, 1996. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

GENERAL

The stratospheric ozone layer that protects us from harmful ultraviolet radiation is in danger of being depleted by ozone depleting chemicals. This chapter establishes policies and procedures pertaining to the use and disposal of ozone depleting chemicals (ODC's) at GRC. This guidance provided in the chapter is applicable to GRC employees and contractors at all levels who in any way participate in the use, handling, storage, transportation, or disposal of ODC's.

REGULATIONS

The "Montreal Protocol on Substances that Deplete the Ozone Layer" requires the elimination of all ODC's from production and eventual phase out of specific compounds by the year 2000. Ozone depleting chemicals are those compounds identified by the Montreal Protocol (as revised) as responsible for the depletion of the stratospheric ozone layer. In 1990, the Copenhagen Agreement changed the phaseout of ozone-depleting materials to 1996. In addition, the Clean Air Act Amendments of 1990 require the phase out of the use of these chemicals.

The Clean Air Act of 1990 (PL 101-549) as amended, included among its provisions Title VI, Stratospheric Ozone Protection. Title VI includes regulations on the listing of ODC's, monitoring and reporting requirements, recycling and emission reduction, phaseout scheduling, safe alternatives, Federal procurement, and related topics.

POLICY

It is GRC policy to phase out the use of ozone-depleting chemicals in all but critical applications by 1997. For the purpose of this policy, critical applications are those that are essential to the mission and have no proven or available market alternatives. A committee has been formed to develop the phase-out plan to carry out this policy. This committee is composed of representatives from Facilities Operations Division, Facilities Engineering Division, Technical Installations Division, Office of Mission Safety and Assurance, Plum Brook Management Office (PBMO), and the Environmental Management Office (EMO).

RESPONSIBILITIES

All Users

- It is the responsibility of each employee at GRC, civil service or support service contractor, to ensure the protection of the environment and act to limit the use of ozone-depleting chemicals at GRC.

Chemicals Management Team (CMT)

- Evaluates all procurement of ozone-depleting chemicals, like chlorofluorocarbons (CFC's), hydrochlorofluorocarbons (HCFC's), Halon, and halogenated hydrocarbons, for mission criticality. Requests for chemicals that are not mission critical will not be approved.
- Coordinates the development of education programs in the following areas: technician certifications in ODC applications and employee ODC awareness.

Chlorofluorocarbon Committee

- Makes the final decision on whether an application is critical.
- Coordinates and approves phaseout plans developed by user divisions for existing systems at GRC and Plum Brook Station.
- Will develop a Refrigerant Conservation Program to establish a tracking system for the purchase, use, and disposal of refrigerants and by-products; establish a leak testing and repair program; evaluate equipment upgrades to meet current standards; and use of proper recovery and recycling equipment.

Procurement

- Verifies that new equipment purchases will not contain or require the use of ODC's.

Facilities Operations Division

- Reviews all equipment containing or using ODC's for age and condition, type and mount of refrigerant, and feasibility of converting equipment to non-ODC refrigerants .
- Develops and implements a plan and budget to establish an engineered conversion program for systems containing CFC's to alternative refrigerants, where applicable.
- Obtains and monitors certified contractors to service HVAC and refrigerant systems containing more than 100 pounds of refrigerant.
- Notifies vendors of required compliance with this policy
- Verifies that a refrigerant containment-recovery system is used on all refrigeration systems during service, repair, or disposal to prevent the release of any Class I or Class II ODC's to the environment.

DEFINITIONS

CFC's (Chlorofluorocarbons)

A family of inert, nontoxic, and easily-liquefied chemicals used in refrigeration, air conditioning, packaging, insulation, or as solvents or aerosol propellants. Because CFC's are not destroyed in the lower atmosphere, they drift into the upper atmosphere where the ozone-destroying chlorine is released.

Class I Substances

Chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform.

Class II Substances

Hydrochlorofluorocarbons.

Halons

A family of bromine-containing compounds used in fighting fires. The breakdown of halons in the atmosphere depletes stratospheric ozone.

HCFC's

Chlorofluorocarbons that have been chemically altered by the addition of hydrogen and that are significantly less damaging to stratospheric ozone than other CFC's.

Montreal Protocol

An international environmental agreement to control chemicals that deplete the ozone layer. The protocol, which was renegotiated in June 1990, calls for a phaseout of CFC's, halons, and carbon tetrachloride by the year 2000, a phaseout of chloroform by 2005, and provides financial assistance to help developing countries make the transition from ozone-depleting substances.

Ozone

A compound, consisting of three oxygen atoms, that is the primary constituent of smog. It is formed through complex chemical reactions in the atmosphere involving volatile organic compounds, nitrogen oxides, and sunlight. Ozone can cause damage to the lungs as well as to trees, crops, and materials. The natural layer of ozone in the upper atmosphere shields the Earth from harmful ultraviolet radiation.

Reclaim

To reprocess refrigerant to at least the purity specified in the ARI Standard 700 1988 Specifications for Fluorocarbon Refrigerants and to verify this purity using the analytical methodology prescribed in the Standard.

Recover

To remove refrigerant in any condition from an appliance and store it in an external container without necessarily testing or processing it in any way.

Recycle

To extract refrigerant from an appliance and clean refrigerant for reuse without meeting all of the requirements for reclamation.

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GRC Ozone Protection Policy

January 19, 1994

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INTRODUCTION

This policy establishes policies and procedures pertaining to the use and disposal of Chlorofluorocarbons (CFC's) at GRC. The guidance provided in this policy is applicable to GRC employees and contractors at all levels who in any way participate in the development and execution of GRC actions involving the procurement, use, handling, storage, transportation, and/or disposal of CFC'S.

GENERAL

NASA policy is to phase-out CFC's by eliminating their consumption in all but critical applications by 1996. For the purpose of this policy, critical applications are defined as those that are mission essential and have no currently proven and available market alternatives.

It is NASA Lewis Research Center's policy to protect the environment in which we live and work, on Earth as well as in outer space. To accomplish this policy, a committee, the CFC Committee, was formed to develop phase-out plans to meet or dxceed the abovementioned requirements depending upon the availability of substitute materials. This committee consists of representatives from Facilities and Test Engineering Division (FTED), Aeropropulsion Facilities and Experiments Division, Office of Safety, Environmental, and Mission Assurance (OSE&MA) , Plum Brook Management Office (PBMO), and Environmental Management Office (EMO).

POLICY

All CFC's are considered controlled items. Their procurement, use, storage, transportation and disposal shall be reviewed and coordinated by the CFC Committee and the Chemicals Management Team (CMT).

Users are required to seek replacements for these materials. Current stocks of CFC's will be conserved, recycled, reclaimed and contained until systems are upgraded or modified to use environmentally friendly substitutes.

Every system or piece of equipment that uses an CFC will be properly maintained to prevent any release of these materials to the environment.

All personnel whose duties include the use, handling, storage or disposal of CFC's will be properly trained and certified in accordance with current regulatory guidelines.

REGULATIONS

The "Montreal Protocol on Substances that Deplete the Ozone Layer" requires the elimination of all Chlorofluorocarbons (CFC's) from production and eventual phase-out of specific compounds by the year 2000. ozone-depleting chemicals are defined as those compounds identified by the Montreal Protocol (as revised) as responsible for the depletion of the stratospheric ozone layer. In 1990, the Copenhagen Agreement changed the phase-out of CFC's to 1996. In addition, the Clean Air Act Amendments of 1990 also require the phase-out of these materials.

The Clean Air Act (CAA), 1990 (PL 101-549) as amended included among its provisions Title VI, Stratospheric Ozone Protection. Title VI includes regulations on the listing of ODCS, monitoring and reporting requirements, recycling and emission reduction, phaseout scheduling, safe alternatives, Federal procurement, and other related topics.

RESPONSIBILITIES

ALL USERS

It is the responsibility of each employee at GRC, civil service or support service contractor, to ensure the protection of the environment and act to limit the use of chlorofluorocarbons at GRC. Users of CFC's should contact CMT to determine if substitute materials are available.

Chemical Management Team(CMT)

1. All procurement of CFC'S, Halon and halogenated hydrocarbons will be evaluated by the CMT/PBMO, in coordination with the CFC Committee, in order to meet the critical applications criteria mentioned above. Requests that do not meet this criteria will not be approved.

2. The CMT will coordinate with appropriate divisions the development of a personnel education program that addresses the following issues:

a. Technician certifications

b. GRC and PBS personnel awareness

3. CMT shall establish a tracking system for the purchase, use and disposal of CFC'S.

4. CMT will maintain information on available CFC substitutes.

5. CMT will inform the CFC Committee of any new regulations regarding CFC'S.

6. The CMT will prepare a semiannual summary report, which will provide a current status of CFC's used at the Center and various phase-out plans.

CHLOROFLUOROCARBON COMMITTEE

1. The CFC Committee will make the ultimate decision oi-. whether an application is critical.

2. The CFC Committee will coordinate and approve phaseout plans being developed by different divisions for the existing systems at GRC and Plum Brook Station.

3. A Refrigerant Conservation Policy will be developed by the committee to:

a) Establish a leak testing and maintenance program.

b) Establish a program to repair leaks when found.

c) Evaluate equipment upgrades to meet current standards.

d) Ensure proper use of proper recovery and recycling equipment.

e) Ensure proper use of detection equipment.

f) Ensure use of certified technicians.

PROCUREMENT

1. Verify that new equipment purchased is specified to be CFC free.

2. Notify vendors and contractors of the requirements of this policy.

FACILITIES AND TEST ENGINEERING DIVISION AND PLUM BROOK MANAGEMENT OFFICE

1) Review all equipment for:

a. Age and condition

b. Type and amount of refrigerant

c. Convertability of equipment to alternative refrigerants

2) Establish a phase-out plan and budget to establish an engineered conversion program for systems containing CFC's to alternative refrigerants.

3) Review the phase-out plan with CFC Committee for approval.

4) Use Certified tochnicians-to service HVAC and Refrigerant systems containing more than 100

pounds of Refrigerant.

5) Verify that a refrigerant containment/recovery system is employed on-all refrigeration systems during service, repair or disposal of such equipment to prevent the release of any Class I or Class II substances to the environment.

DEFINITIONS

CFCs (Chlorofluorocarbons).
: A family of inert, nontoxic, and easily-liquefied chemicals used in refrigeration, air conditioning, packaging, insulation, or as solvents or aerosol propellants. Because CFCs are not destroyed in the lower atmosphere they drift into the upper atmosphere where the chlorine is released and destroys ozone.

Class I Substances
: Chlorofluorocarbons, halons, carbon tetrachloride, azeotropic mixtures, and methyl chloroform.

Class II Substances
: Hydrochlorofluorocarbons.

Halons
: A family of compounds containing bromine used in fighting fires, whose breakdown in the atmosphere depletes stratospheric ozone.

HCFCs (Hydrochlorofluorc>carbons)
: Chlorofluorocarbons that have been chemically altered by the addition of hydrogen, and which are significantly less damaging to stratospheric ozone than other CFCs.

Ozone
: A compound consisting of three oxygen atoms, that is the primary constituent of smog. It is formed through chemical reactions in the atmosphere involving volatile organic compounds, nitrogen oxides, and sunlight. Ozone can initiate damage to the lungs as well as damage to,trees, crops, and materials. There is a natural layer of ozone in the upper atmosphere which shields the earth from harmful ultraviolet radiation.

Reclaim
: To reprocess refrigerant to at least the purity specified in the ARI Standard 700-1988, "Specifications for Fluorocarbon Refrigerants", and to verify thispurity using the analytical methodology prescribed in the Standard.

Recover
: To remove refrigerant in any condition from an appliance and store it in an external container without necessarily testing or processing it in any way.

Recycle
: To extract refrigerant from an appliance and clean refrigerant for reuse without meeting all of the requirements for reclamation.

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GRC REFRIGERANT POLICY

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is November 27, 1996. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

GENERAL

In order to meet the provisions outlined in section 608 of the Clean Air Act Amendments of 1990, this policy was developed to address the conservation, containment, reclamation, and recovery of all CFC and HCFC refrigerants.

This policy applies to all employees and contractors at NASA Glenn Research Center (GRC) and Plum Brook Station (PBS).

REFRIGERANT CONSERVATION AND CONTAINMENT

1. The Chemicals Management Team (CMT) will develop and maintain a tracking system for the purchase, use, and disposal of refrigerants and by-products.

2. Facilities and Test Engineering Division (FTED) will develop a leaktesting program as part of routine checks of all refrigeration systems with capacities of 1,000 pounds or more.

3. If a leak is detected, it will be repaired as soon as possible by a certified technician (as defined in this policy).

REFRIGERANT RECLAMATION AND RECOVERY

1. Requests for reclamation and recovery of institutional equipment must be made on a FORM 709 and mailed to the Institutional Support Branch.

2. Requests for reclamation and recovery of central research equipment will be handled through the Research Systems Operations Office.

3. The requesters must include the following information:

a. Type of refrigerant
b. Type of system
c. Amount of refrigerant present in the system
d. MSDS for the refrigerant (MSDS Request Form)

4. Only certified equipment and technicians will be used for the recovery and reclamation of refrigerants. All equipment will be certified in accordance with EPA guidance on the certification of recovery and reclamation equipment.

REFRIGERANT DISPOSAL

1. A protocol will be developed by FOD/FED, in coordination with the GRC Environmental Compliance Team (ECT), for the proper disposal of refrigerants at GRC and Plum Brook Station (PBS).

2. For refrigeration units with capacities of 50 pounds or more, an account number will be required. The requester will be responsible for any expenses incurred in the safe disposal of the refrigerant.

CERTIFIED TECHNICIAN TRAINING

1. All technicians who service, repair, and dispose of regulated refrigerants during the course of their duties must be certified.

2. The certification must be provided by an EPA-approved training and certification program.

3. Training must be provided for the proper use of the recovery, recycling operation equipment used at GRC.

REFRIGERANT PROCUREMENT

1. Only certified technicians will be allowed to obtain refrigerants at GRC and PBS through the Stock Room.

2. Each request will require a signature from an authorized supervisor at GRC or PBS for the refrigerant to be issued to a certified technician.

3. All procurement of refrigerants will be reviewed and approved by the Chemical Management Team Leader, at GRC or the PBS Safety Officer at PBS.

NEW EQUIPMENT

1. All new refrigeration equipment purchases will contain CFC-free alternatives.

CONVERSION OF EXISTING EQUIPMENT

1. Facilities Operations Division will coordinate the conversion of existing refrigeration equipment that contain CFC's as the refrigerant. Plans and budgets will be established to develop a program to meet this goal.

2. Only certified technicians will be used to remove, modify, or dispose of CFC-containing

equipment. For outside contractors, proof of certification will be required by the COTR, and reviewed by CMT before work begins.

PERSONNEL PROTECTION

1. Personal protection for all personnel working with refrigerants will be selected based on the exposure guidelines outlined in the Material Safety Data Sheet (MSDS) or provided by the Industrial Hygiene Team.

2. Also, each technician must receive training on emergency response actions for an accidental release of refrigerants in accordance with the GRC Emergency Preparedness Plan.

40 CFR Part 82 - Protection of Stratospheric Ozone; Refrigerant Recycling; Final Rule and Proposed Rule

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GRC Environmental Programs Manual

Chapter 27 UNDERGROUND STORAGE TANKS

Note: The current versions to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is February 9, 1999. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

This chapter sets forth Glenn policies and requirements for the design, construction, operation and maintenance, monitoring and reporting for underground petroleum storage tanks. The provisions herein are in accord with the national effort to comply with federally mandated regulations.

APPLICABILITY

This chapter is applicable to Cleveland and Plum Brook Station.

AUTHORITY

40 Code of Federal Regulation Part 280, Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST).

Ohio UST's Law as found in Ohio Revised Code, Title 37 - Health, Safety, and Morales, excerpt from chapter 3737 - Fire Marshall, Fire Safety, Petroleum UST's, as amended.

Ohio Department of Commerce, Fire Marshal Bureau of Underground Storage Regulations (BUSTR), chapter 1301-7-28 and 1301-9-01 through 1301-9-15.

RESPONSIBILITIES

Facilities and Test Engineering Division (FTED)

- Designs and constructs underground storage facilities in accordance with requirements and standards prescribed by the Ohio State Fire Marshall.
- Forwards all designs for new or modified facilities to the Environmental Pollution Control Board (EPCB) for information purposes and to the Environmental Management Office (EMO) in Cleveland or the Plum Brook Management Office (PBMO).
- Obtains any permits necessary for the removal, installation, and operation of these tanks
- Maintains the official file of any permits and forwards copies of any correspondence and

permits to EMO and PBMO, as appropriate.
- Operates and maintains underground storage tanks facilities in conformance with the standards and requirements prescribed by the authorities listed above.
- Reports known or suspected leaks immediately to the Glenn Dispatcher at 911 and then to EMO as specified in the GRC Emergency Preparedness Plan.

Waste Management Team (WMT)

- Maintains daily usage records of inputs and withdrawals.

Environmental Compliance Team (ECT)

- Daily monitors the tank integrity and reports any leaks to the State agency,
- Records from FTED and ECT will be used for reports required by the regulations.
- Prepares and submits an annual report of the GRC underground storage tank inventory to BUSTR (by July 1).
- Responds to any requests for information concerning the environmental aspects of the UST program at GRC.

Plum Brook Management Office (PBMO)

- At Plum Brook the annual report is prepared and the inventory maintained by PBMO.
- Implements, maintains, and monitors the UST inventory program at Plum Brook.
- Assures the proper and accurate auditing of inventory and monitoring of tank conditions performed by PBMO staff or its contractors.
- Reports suspected leaks to the SSC Enviornmental Specialist Office and Glenn Environmental Management Office.
- Following verification, reports leaks to ECT, local fire officials, and the Ohio Fire Marshal.

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GRC Environmental Programs Manual

Chapter 28 - IONIZING RADIATION

Note: The current versions to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is November 8, 1996. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

SCOPE

This chapter describes the policies and responsibilities of the Glenn Radiation Protection Program and the general radiation protection procedures for the operation, handling and use of radioactive materials and ionizing radiation producing equipment. Specific details of radiation protection programs can be found in the Glenn Radiation Protection Program Manual the U. S. Nuclear Regulatory Commission Regulations, and recommendations of the National Council on Radiation Protection and Measurements.

APPLICABILITY

The provisions of this chapter are applicable to all the Glenn and PBS facilities except the Reactor Facility.

RESPONSIBILITIES

Radiation Workers

All personnel located at GRC who use radioactive materials or who operate radiation-producing equipment are responsible for understanding and complying with the policies and procedures of this chapter.

Executive Safety Board

The Executive Safety Board is responsible for the overall safety program.

Environmental Pollution Control Board (EPCB)

The EPCB is responsible for issues dealing with environmental policy, radiation protection, and providing support for organizations, committees, and individuals with specific radiation safety responsibilities.

Radiation Safety Committee (RSC)

The RSC is responsible for reviewing and approving all ionizing radiation operations. This committee also has the responsibility for ensuring that all operations are in strict compliance with the Nuclear Regulatory Commission's (NRC) license requirements.

Health Physics Team (HPT)

The HPT is a team of the Environmental Management Office (EMO) and is responsible for continuous monitoring of all facilities and personnel using ionizing radiation sources and equipment. In addition, this team ensures that the safety procedures and personnel practices sustain compliance with NRC regulations.

Radiation Safety Officer (RSO)

The RSO is appointed by the Center Director and approved by the Chief of the Environmental Management Office, to implement the Radiation Protection Program at GRC. The specific responsibilities of the RSO are described in the "Radiation Protection Program Manual."

Area Safety Committees

Area Safety Committees are responsible for ensuring that all requests for radiation operations in their respective safety areas are reviewed by the HPT. The Area Safety Committees retain the authority to issue Safety Permits after HPT approves the request.

Supervisors and Authorized Users

Supervisors and authorized users of radioactive materials or radiation-producing equipment are responsible for maintaining their radiation operations in accordance with the requirements of this chapter and the Glenn Radiation Protection Program. If an operation is suspected of being deficient or hazardous, the supervisor shall stop the operation and notify the RSO.

Environmental Management Office (EMO)

EMO is responsible for managing, directing, and implementing the environmental programs of Glenn and has responsibility for functional management of the Glenn Radiation Protection Program.

RADIATION PROTECTION PROCEDURES

Authorization of Users

Only those persons who have been authorized by the RSC or its designee shall work with radioactive materials or radiation-producing equipment. To become an authorized user a form NASA-C 197 "Users Radiological Training and Experience Record" must be filed with the RSO.

Protective Apparel and Equipment

The individual user and the user's supervisor must ensure that the user wears appropriate protective clothing whenever contamination of personnel or personal clothing is possible.

Each individual working with radioactive materials must maintain contamination levels as low as reasonably achievable (ALARA) and must ensure that contamination is not carried beyond restricted areas. The Glenn "Radiation Protection Program Manual" details specific procedures regarding personnel contamination, area contamination, and specifies maximum permissible contamination levels for the following: skin surfaces and personal clothing; laundered protective clothing; unrestricted areas; and restricted areas.

Emergency Procedures

The authorized user or any person who observes any incident where personnel may be overexposed to radiation due to a spill or loss of control of radioactive material shall report the incident to the RSO. Fires or injuries to personnel in areas where radioactive materials are used shall be reported by Dialing 911. Specific reporting requirements are described in the Radiation Protection Program Manual Chapter 30.

Restricted Area Controls

Restricted radiation, high-radiation, and very-high-radiation areas, shall be designated by the RSO, and marked clearly with signs. Where personnel monitoring equipment is required, the signs shall include a statement to this effect. Standard signs, prescribed in 10 CFR Part 20, shall be available from the HPT.

Control of Radioactive Material and Radiation-Producing Equipment

Procurement

All purchases of radioactive material and radiation-producing equipment shall be approved by the RSO **before** the order is placed. Glenn Research Center operates under a "specific" NRC license that is more restrictive than the previous "broad scope" license. The specific license limits Glenn to exact quantities of radioactive materials. Any addition to these quantities must be approved by the Glenn Radiation Safety Committee and the U.S. Nuclear Regulatory Commission, by obtaining a license amendment **prior to purchase and delivery to Glenn**. The amendment process takes 90 - 120 days.

Provisions for some sources and quantities of radioactive materials are covered by the general license regulations, which shall be determined by the RSO after reviewing NASA Form C-100b "Radioactive Material and Hazards Assessment". The user/requester is required to complete this form and submit it to the RSO as part of the approval process.

This form can be obtained by sending a Work Request (C-709) to Margarita Aponte, Forms Management Office, Mail Stop 21-9.

Receiving

When a package of radioactive materials is received, the RSO or designated HPT personnel shall be

contacted immediately for a survey to confirm radiation levels, and that no contamination is present from leakage of the contents. The notification and survey shall be completed within 3 hours of the time it is received.

Utilization and Storage

All storage and use areas for radioactive material shall be approved by the RSO. Each room or area in which radioactive material is used or stored shall be properly posted, and each container of radioactive material shall be properly labeled.

Handling Sources with High Radiation Levels

Some radio nuclides, because of a combination of activity and particle or photon energy, present a significant hazard to personnel in the immediate vicinity of an unshielded source. The sources of concern are those that produce radiation levels from which a major portion of the body could receive a dose in excess of 100 millirem in any 1 hour. Specific procedures must be followed in order to keep personnel exposures as low as reasonably achievable.

Transfers

Internal transfers of licensed material shall be properly documented, the material properly identified, and radiation levels properly controlled. Off site transfers shall receive the same considerations. In addition, the RSO or designee shall approve and maintain a record of all radioactive material shipments and shall certify that materials are properly classified, described, packaged, marked, and labeled in accordance with applicable regulations (both NRC and DOT). Specific procedures are described in the Radiation Protection Program Manual."

Radioactive Waste Disposal

Requests for disposal shall be made to the RSO. The disposal of radioactive wastes shall be coordinated by HPT personnel.

Liquid waste must be disposed of in accordance with the provisions of 10 CFR 20. Such disposal must be approved by the RSO.

Release of radioactive gases or particulate radioactive material into the air must be done in accordance with the provisions of 10 CFR 20.

Personnel-Monitoring Equipment and Bioassay

Personnel-monitoring equipment is issued to all personnel who work in radiation areas. In addition, bioassays can be performed for appropriate personnel designated by the RSO. Monitoring results shall be available to the user and the RSC.

REFERENCES, GUIDANCE DOCUMENTS, AND REGULATIONS

Radiation Protection Program Manual, 1996, NASA Glenn Research Center, Cleveland, Ohio

Title 10, Code of Federal Regulations, Chapter 1, Nuclear Regulatory Commission

Part 19. Notices, Instructions, and Reports to Workers: Inspection and Investigations.

Part 20. Standards for Protection Against Radiation.

Part 33. Specific Domestic Licenses of Broad Scope for Byproduct Material.

Part 40. Domestic Licensing of Source Material.

Part 70. Domestic Licensing of Special Nuclear Material.

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GRC Environmental Programs Manual

Chapter 29 - X-RAY DIFFRACTION EQUIPMENT

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PURPOSE

This chapter sets forth the policies, responsibilities, procedures, standards and limitations for establishing and maintaining safe x-ray diffraction equipment operations.

APPLICABILITY

This chapter applies to all Glenn Research Center (GRC) facilities and technical operations involving the use of x-ray diffraction equipment.

POLICY

It is the policy of the Glenn Research Center to control the use of x-ray diffraction equipment in such a manner as to avoid unnecessary exposures, minimize necessary exposures, and ensure that no individual radiation dose exceeds the recommended dose limits. All this should be accomplished with a minimum of restrictions on operations.

LIMITATIONS

This chapter applies specifically to x-ray diffraction equipment designed within the scope of the definition in section 6. However, any electronic tube operating at potentials above 5000 volts may produce nonuseful x-rays. Examples are cathode ray tubes, electron microscopes, and particle accelerators. Safeguard requirements for sources of such nonuseful x-rays are established by the Health Physics Team (HPT) of the Environmental Management Office (EMO). Questions and problems relative to such devices should be referred to the Radiation Safety Officer (RSO) in this office.

RESPONSIBILITIES

Supervisors

- Ensure that only x-ray diffraction equipment with approved safety features is procured and used.
- Ensure that each installation of or modification to such equipment is inspected and surveyed by health physics personnel of the HPT before it is placed into use.
- Consult with HPT regarding changes to the equipment, to operating procedures, or relocation of equipment that could affect the radiation safety of its operation.
- Ensure that the facilities, equipment, and working environment are periodically inspected and evaluated for radiation and other hazards.
- Ensure that faulty equipment is promptly repaired and that unsafe equipment is not operated.
- Designate and train specific individuals to operate the equipment and ensure that only qualified personnel operate and service the equipment.
- Provide for necessary physical interlocks, shields, barriers, enclosures, warning devices, and install monitoring equipment and signs.
- Provide safe operating procedures and ensure that they are followed.
- Initiate safety permit requests and renewals for each unit. If more than one unit is in the same room, the RSO may recommend to the Safety Committee Chairman that one permit will suffice.
- See that all individuals subject to possible radiation exposure in the vicinity of the x-ray facilities are informed of the nature and degree of radiation exposure potential and that they wear required personnel monitoring equipment.
- Ensure that appropriate medical examinations and/or evaluations of the operators are performed.

Operators

- Obtain training in radiation safety and in the safe operation of x-ray diffraction equipment assigned; demonstrate competence in these areas. A Qualified Equipment Operators list should be maintained and coordinated with the Office of Safety Assurance.
- Operate the equipment in a safe manner and in accordance with the approved operating procedures and safety permit.
- Maintain radiation exposures to all personnel as low as practicable.
- Wear required personnel monitoring devices and use other protective devices provided.
- Immediately notify the RSO of known or suspected abnormal radiation exposures to self or others.
- Report any defects or deficiencies in radiation protection devices, procedures or equipment.

Health Physics Team (HPT)

- Reviews and approves the design of new facilities and changes to existing facilities and equipment and notifies the Safety Committee Chairman of its findings. A memo will be submitted to the Safety Committee Chairman providing the review and approval requirements for issuance of the Safety Permit.
- Assists in the development of practices that prevent unnecessary exposure to x-rays, control exposures within recommended limits, and in the planning and design of new programs and facilities.
- Provides training in basic radiation protection.
- Conducts periodic inspections, takes inventory, and monitors functioning of x-ray diffraction equipment at GRC. Promptly reports unsafe conditions and practices to responsible

supervisors.
- Investigates abnormal radiation exposures to personnel and recommends actions to prevent recurrences.
- Administers the personnel monitoring program.
- Establishes and posts radiation control areas.
- Compiles and maintains a record of all radiation surveys, inspections, and reports and a register of x-ray diffraction equipment.

BIOLOGICAL EFFECTS OF OVEREXPOSURE

X-ray diffraction equipment generates extremely high-intensity ionizing radiation that, if not controlled, can cause severe and permit injury if any part of the body is exposed for even brief periods of time. Radiation levels as high as 400,000 r/minute at the tube port are possible at 50 kV and 20 mA; the dose rate from a diffracted beam may be as high as 80 r/hr; scattered radiation can reach levels of 1 r/hr.

Because of the low energy of the x-rays, the skin or eyes are usually the critical organs. Severe burns to the upper extremities are the most frequently reported injuries. These injuries can be slow to heal and in high-dose incidents can lead to ulcerations that do not heal and may result in amputation. Exposure of the lens of the eye to large doses can result in formation of cataracts or other opacities.

RADIATION HAZARDS

An x-ray diffraction unit may simultaneously radiate as many as four very small beams. The beams are frequently in a horizontal plane, about 4 or 5 ft above the floor. The following are some of the most common causes of unnecessary radiation exposure:

- Placing fingers in the primary beam while changing samples because of failure to either block primary beam or stop x-ray production.
- Aligning beams visually without using a leaded glass shield or leaded eyeglasses. This may result in the primary beam directly striking the eye for prolonged periods.
- Failing to realize when x-ray beams are being emitted from exit ports other than the one of immediate concern.
- Unattended operation of the unit in an unrestricted area.
- Altering or removing shielding in order to perform a specialized analysis.
- Installing or modifying equipment and making final adjustments with the unit partially disassembled.

RADIATION DOSE LIMITS

Standards for maximum recommended doses of ionizing radiation are established by the National Council on Radiation Protection and Measurements (NCRP) and by the International Commission on Radiological Protection (ICRP). The current recommendations of the NCRP are the basis for the dose rate limits set forth in the Nuclear Regulatory Commission regulations (10 CFR Part 20) and the Occupational Safety and Health Standards (29 CFR 1910). The GRC Radiation Safety Committee has adopted these dose limits for exposure to all ionizing radiation from all sources at the Glenn Research Center.

The dose to the whole body, head and trunk and active blood forming organs shall not exceed 5 rem/yr. In addition, the dose in any calendar quarter shall not exceed 1.25 rems.

The dose to the lens of the eye shall not exceed 15 rem/yr, or 3.75 rems in any calendar quarter.

Although there is no specific limit on the weekly dose, it is convenient to evaluate and control exposures on the basis of weekly values; there corresponding weekly averages are shown for each maximum permissible dose.

Portion of body	Maximum dose per calendar quarter, rem	Corresponding average per week, mrem
Whole body, head &trunk, active blood forming organs	1.25	100
Hands and forearms	3.12	250
Skin of whole body	3.12	250
Lens of the eye	3.75	300

PERSONNEL MONITORING EQUIPMENT

The following x-ray sensitive monitoring devices are available from the HPT for use in measuring personnel exposure. The need for and use of these devices will be determined by the RSO after evaluating the workings.

- TLD body badges
- TLD wrist badges
- Self-reading pocket dosimeters

A preplacement medical examination should be given to all personnel new to radiation work. The examination should be directed toward determining the baseline condition of the worker before the onset of exposure.

Medical examinations should also be administered to persons receiving known or suspected overexposure to radiation when the HPT. An exit examination should be performed of radiation workers upon termination of employment. The nature of all examinations is determined by the Medical Officer.

X-Ray Restricted Area

Each x-ray facility shall be located within an x-ray restricted area that is separated from the adjacent unrestricted area by a suitable barrier or installation enclosure.

Radiation dose rate within the x-ray restricted area may exceed 500 mrem/yr but will not exceed 5 mrem in any one hour or 100 mrem in any five consecutive days.

Unrestricted Area

Dose rates in unrestricted areas shall not exceed 2 mrem in any hour, 100 mrem in any seven consecutive days or 500 mrem per year.

Radiation Area

When radiation levels exceed restricted area limits, the affected area is classified as a radiation area. The radiation area shall be delineated by use of barriers or ropes and posted with a sign or signs bearing the radiation caution symbol the words, "CAUTION, RADIATION AREA."

X-RAY SYSTEM CLASSIFICATION

X-ray systems for certain specific applications can be designed so that all possible x-ray beam paths are fully enclosed. However, operation requirements such as (a) frequent changes of attachments and configuration, (b) a need for making adjustments with the x-ray beam on, and (c) motion of specimen and detector over wide angular limits often make the use of a fully enclosed system impractical. Also, a unit may be either an open beam or enclosed beam system depending upon its mode of operation.

The appropriate requirements in following two sections must be complied with.

Enclosed Beam X-Ray System

An enclosed beam x-ray system is one in which all possible x-ray paths are fully enclosed according to the following:

- The radiation source, sample, detector and analyzing crystal (if used) shall be enclosed in a chamber or coupled chambers that cannot be entered by any part of the body during normal operation.
- The inherent shielding of the chamber walls shall be sufficient limit the dose rate in all regions 5 cm from its outer surface to 0.25 mrem/hr during normal operation.
- The sample chamber closure shall be interlocked with the x-ray tube high-voltage supply or a shutter in the primary beam so that no x-ray beam can enter the sample chamber while it is open unless the interlock has been consciously and deliberately defeated. This interlock shall be an automatic protective device.
- If there is more than port in the radiation source housing or more than one radiation source, all these requirements must be satisfied for each port in every source housing associated with the system.

Open Beam X-Ray System

An x-ray system that does not comply with all of the requirements above shall be classified as on open beam x-ray system.

DESIGN REQUIREMENTS

Both enclosed beam and open beam x-ray systems must fulfill the following requirements:

The dose due to unwanted radiation from components such as high-voltage rectifiers shall not exceed

10 mrem in a week in any accessible region 5 cm from the outside surface of the generator cabinet. Assuming that an individual may be in the vicinity of the equipment while it is operating for as long as 40 hours per week, the dose rate should not exceed 0.25 mrem/hr.

The x-ray accessory apparatus shall include a beam trap or other barrier with sufficient shielding so that the dose rate due to the transmitted primary beam does not exceed 0.25 mrem/hr under normal operating conditions.

The dose rate may be difficult to evaluate in the presence of scattered radiation, and in the case of x-ray tube sources, this requirement shall be considered met if the inherent shielding of the trap or barrier is at least equivalent to the thickness of lead specified in the table for the maximum rated anode current and potential. In the case of radionuclide sources, the required barrier thickness should be determined by the RSO.

Thickness of lead required for a primary beam barrier located 5 cm from the focal spot:

Anode current, mA	**Thickness of lead (mm)**		
	50 kvp	70 kvp	100 kvp
20	1.5	5.6	7.7
40	1.6	5.8	7.9
80	1.6	5.9	----
160	1.7	----	----

A distinctive warning label bearing the words "CAUTION, X-RAYS. THIS EQUIPMENT PRODUCES X-RAYS WHEN ENERGIZED" or other words having similar meaning shall be located near any switch that energizes an x-ray tube.

An automatic protective device, light, or illuminated sign in a conspicuous location near the radiation source housing shall be used to indicate when the x-ray tube is on or the port of the radioactive source is open.

A key-actuated switch shall be installed on the controls providing power to the unit. This key shall have the approved operator's name tag on it. The key must be removed when not operating and unattended unless the room containing the unit is locked by the operator.

X-ray diffraction equipment should be placed in a room separate from other work areas whenever possible.

A flashing red sign with words indicating x-ray hazard shall be placed at the entrance to the installation enclosure, which is automatically energized when the x-ray generator is on.

Open Beam X-Ray System Requirements

In addition to the general requirements above, the open beam system must fulfill the following requirements:

- All shutters shall be provided with an automatic protective device adjacent to the tube housing.

This device shall indicate "SHUTTER OPEN."

- Radiation levels external to the x-ray tube housing with all shutters closed shall not exceed 2.5 mrem/hr, as measured at 5 cm from the surface of the housing within which an x-ray tube is operating at full rated power at maximum rated accelerating potential.
- Each port of the radiation source housing shall be provided with a beam shutter interlocked with the x-ray accessory apparatus coupling, or collimator, in such a way that (a) the port will be open only when the collimator or coupling is in place; or (b) the x-ray tube can be energized only when the collimating system is in place. Shutters at unused ports shall be secured to prevent casual opening.
- A guard or interlock that prevents entry of any part of the body into the primary beam path shall be used.
- The sample position must not be accessible to the operator when the beam is on. The sample changing port shall have a cover interlocked with the shutter or power source that shuts off the primary beam.
- Radiation exposure levels in the vicinity of controls and adjustments of the x-ray accessory apparatus used during normal operation shall not exceed 37.5 mrem/hr to the hands or 2.5 mrem/hr to the whole body, gonads, or blood forming organs.
- The coupling between the x-ray tube and the collimator of the accessory equipment shall prevent stray radiation from escaping the coupling.
- If an interlock system functions to turn off the primary beam, it shall not be possible to resume operation without resetting the beam "ON" switch at the control panel.

OPERATING CRITERIA

Operating criteria and procedures in themselves are not sufficient safeguards to guarantee personnel protection. The expert knowledge of all persons concerned and their cooperation and desire in following the procedures is required.

- Only those procedures approved jointly by the RSO and cognizant supervisors should be used.
- No operation involving the removal of covers, shutters, shielding materials or tube housings, or modifications to shutters, collimators, or beam stops shall be performed with the shutter open without ensuring that the tube is turned off.
- Personnel shall not expose any part of their body to the primary beam.
- Only trained, approved personnel shall operate x-ray diffraction equipment.
- Only trained personnel shall install, repair or make other than routine maintenance to the equipment.
- The operator shall be in immediate attendance at all times when the, equipment is in operation unless the doors to the room are locked.
- Deviations from this practice must be approved through the safety permit with the approval of the RRO.
- No x-ray tube shall be operated without a suitable housing to restrict the radiation to a well defined beam.
- Because of the extremely intense radiation levels in the primary beam, open beam operating techniques should be used only after all other possibilities have been exhausted. The RSO must be consulted.

REPAIR AND ALIGNMENT CRITERIA

Most severe injuries due to radiation exposure occur during non-routine operations such as repair and alignment of the beam. Extreme care should be taken during these activities.

- Alignment procedures recommended by the manufacturer should be used available. Alignment procedures must be approved by the RSO.
- When alignment involves working near the open primary radiation beam, the beam current should be reduced to lower exposure rates.
- If an alignment procedure may result in increasing the dose rate such that the usual boundaries of the controlled area no longer apply, the RSO must be notified and new boundaries and postings erected until normal operations are restored.
- Repairs should be carried out on an uncluttered surface so that pieces left out during reassembly will be conspicuous.
- After reassembly, the x-ray system must be checked by the RSO.
- Particular attention should be given to the alignment of shielding, shutters, and collimators. Lead parts should be inspected for damage or distortion that could result in radiation leakage, and should be mounted in such a way that they will not cold-flow because of their own weight.

USE OF NONSTANDARD ACCESSORIES

Any device for use with an x-ray tube shall be regarded as a nonstandard accessory unless it is a compatible component manufactured specifically to fit the equipment used.

Nonstandard accessories shall not be used until procedures have been approved and a radiation survey performed by the RSO.

OTHER PROTECTIVE MEASURES

- When not in operation, the x-ray equipment shall be secured in such a way as to be accessible to, or operable by, authorized personnel only.
- All safety devices (interlocks, shutters, warning lights, automatic protective devices, et cetera) shall be tested at least annually to ensure their proper operation. Records of such tests shall be maintained.
- Equipment should be located out of heavily trafficked areas.
- Unused tube head ports shall be secured in the closed position.
- The use of safety glasses with lead-containing lenses is required when exposure to the radiation beam is likely, e.g., in alignment procedures.
- Before operating the equipment, the operator shall always check that shutters for unused tube ports are closed and that collimator tubes, slits, or adapters are well seated in ports being used.

EXCEPTIONS TO THIS CHAPTER

Exceptions to this chapter may be made with the approval of the EMO in specific instances when a unit is judged to be safe with these exceptions.

DEFINITIONS

Automatic protective device
: A device that is designed such that failures of indicators or safety components cause the equipment to fail in such a mode that personnel are safe from exposure to radiation. For example, if a light indicating "ON" fails, the production of x-rays shall terminate or attenuate automatically.

Dose rate
: The absorbed radiation dose per unit time, e.g., roentgen absorbed dose per hour (rad/hr).

Exposure
: A measure of the ionization produced in air by x or gamma radiation. The special unit of exposure is the roentgen.

Exposure rate
: The exposure per unit time (R/hr).

Interlock
: A device for precluding access to an area in which radiation is present, by automatically reducing the exposure rate upon entry by personnel or parts of their body.

Leakage Radiation
: All radiation coming from within the x-ray tube housing except the primary radiation beam.

Primary radiation beam
: Ionizing radiation coming by a direct path from an x-ray tube anode or radionuclide through an aperture in the radiation source housing.

Radiation Safety Officer
: The person appointed by the Director to implement the Radiation Protection Program at GRC. A designee who has the knowledge and responsibility to apply appropriate radiation protection regulations and controls may be assigned by the Office of Environmental programs.

Radiation survey
: An evaluation of the radiation hazard potential associated with a specified set of conditions incident to the production and use of radiation sources.

Scattered radiation
: Radiation that, during passage through matter, has been deviated in direction.

Stray radiation
: The sum of leakage and scattered radiation

X-ray accessory apparatus
: Any portion of an x-ray installation that is external to the x-ray tube housing and into which an x-ray beam is directed for the purpose of conducting x-ray measurements.

X-ray diffraction equipment
: An analytical x-ray device in which an x-ray beam is made to strike a specimen, causing a portion of the beam to be diffracted. Measurements of certain parameters of the diffracted beam may provide information about the specimen.

X-ray spectrographic (fluorescence) equipment
: An analytical x-ray device in which a polychromatic x-ray beam is made to strike a specimen, producing x-ray fluorescence that is characteristic of the specimen. A portion of the fluorescent radiation is directed into an analyzing crystal where it is diffracted. The wavelength of interest may then be monitored by a properly positioned detector to provide qualitative and/or quantitative analysis of the specimen.

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GRC Environmental Programs Manual

Chapter 30 - NON-IONIZING RADIATION

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PURPOSE

This chapter summarizes the cause, effect, and methods of controlling exposure to harmful levels of non-ionizing radiation at the NASA Glenn Research Center.

APPLICABILITY

The guidelines apply to all NASA Glenn Research Center personnel, which includes contractors, civil servants, students, and in some instances, members of the general public.

BACKGROUND

Non-ionizing radiation sources at GRC can be characterized by three primary areas: (1) electromagnetic fields, (2) lasers, and (3) ultraviolet radiation.

High-intensity exposure to any source of non-ionizing radiation can produce a variety of health effects. The American National Standards Institute (ANSI), the International Radiation Protection Association (IRPA), the National Council on Radiation Protection (NCRP), and the American Conference of Governmental Industrial Hygienists (ACGIH), have developed standards to protect individuals against these health effects.

The evidence gathered to date for the health effects of electromagnetic field exposure is fragmentary and inconclusive. Therefore, these effects are discussed herein as possible, rather than as defined, effects. Because these fields are so pervasive, it is necessary to evaluate work practices in these environments. Controls and methods have been established to minimize or eliminate the hazards associated with the use of devices that generate non-ionizing radiation.

POLICY

NASA Glenn Research Center uses the standards developed by organizations such as ANSI or the NCRP as a reference for recommending and enforcing compliance with requirements that promote health and safety in non-ionizing radiation environments.

The Health Physics Team (HPT) provides guidelines stating the specific controls for authorized use of devices that produce non-ionizing radiation. Authorized use is obtained through the safety permit process. The safety permit request should include a standard operating procedure for the test activity, equipment specifications, location sketches, and any other pertinent information such as the use of chemicals, gases, or dyes. This information will help determine the most effective method of hazard protection.

ELECTROMAGNETIC FIELDS (EMF)

Electromagnetic radiation includes the entire energy spectrum, from the 60-cycle-per-secon (60-Hz) fields produced by power lines to gamma rays. The entire electromagnetic spectrum exhibits the following particle wave characteristics:

Photons - Quantity of electromagnetic energy
Form waves - Described in terms of wavelength

This composition oscillates with a frequency described as cycles per second or hertz (Hz).

Electromagnetic fields have an electric field and a magnetic field. The electric field strength is measured in volts per meter (V/m). The magnetic field strength is measured in gauss, milligauss, tesla, amperes per meter (A/m), and milliamperes per meter (mA/m). The relationship of these units is

Milliampere per square meter	0.001 m/A
Gauss	80 A/m
Milligauss	80 mA/m

The radiofrequency radiation band is subdivided into smaller frequency ranges of the spectrum. Microwaves occupy a portion of the high-energy end of the radiofrequency band and have a short wavelength and high frequency.

Electromagnetic fields are produced by all devices that use or carry an electric current. These may be devices as common as telephones and the electric wiring in a room or as specialized as induction heaters, high-voltage power supplies, transformers, and electro- magnets. The fields produced by such devices are characterized as having wavelength, frequency, and energy. Concerns about such field may be interference with other equipment, such as computer terminals and possible health effects.

The occupationally exposed group consists of adults exposed under controlled conditions. These persons are normally trained to be aware of potential risks, to be familiar with the equipment they are using, and to take appropriate precautions. The duration of occupational exposure is limited to the duration of the work shift and the individual's working lifetime. Persons who are occupationally exposed to EMF may also receive some nonoccupational exposure from sources outside of their workplace, such as electric power lines, etc. The occupational exposure limits for this group does not include these other environmental exposures.

Persons with particular medical conditions, such as cardiac pacemakers have very specific limits for

EMF exposure. Electromagnetic fields have been known to turn off such devices, resulting in serious medical conditions. Persons with these devices must be restricted from fields of sufficient magnitude to create damage. These considerations produced the rationale for adopting lower exposure limits for the general public than for occupationally exposed persons.

EMF EXPOSURE LIMITS

Occupational exposure to EMF should not exceed the levels of unperturbed electric and magnetic field strengths recommended in ANSI Standard C95.1-1990, provided that induced body-to-ground current does not exceed 200 milliamperes (mA) and that any hazards of radiofrequency radiation burns are eliminated.

Because the ANSI recommendations are based on thermal effects, e.g., heat generation in the body, ANSI recommends averaging field strengths over 6-minute intervals. Compliance may be achieved by limiting work time in electromagnetic fields during these 6-minute intervals as well as by altering the EMF environment to which workers are exposed.

Exposure to such fields should be controlled by restricting or prohibiting access. In addition, a restricted area should be established and marked around equipment that generates very high magnetic fields to eliminate damage to such devices as cardiac pacemakers. This boundary should be established at or below the 1-gauss (80-A/m) level.

It may be desirable to minimized EMF exposure to levels below those recommended by the ANSI standard. This can usually be accomplished by limiting time in the fields or by increasing distance from the source generating an EMF. Electromagnetic field strength decreases with increased distance from the source. Fields with very short wavelengths decrease rapidly.

Video display terminals are located in most offices and laboratories at Glenn and are used by most Glenn personnel. Since these are frequently an item of concern, the following recommendations may be followed to minimize exposure:

- EMF from a monitor decreases rapidly with increased distance. Sitting an arm's length from the monitor greatly reduces exposure.
- EMF is emitted by devices located in back of the monitor, not by the screen. Therefore, monitors emit stronger fields at the sides and back. Positioning monitors in an office so that users are not working at the side or back of another monitor should reduce their exposure.
- Turning off a monitor when it is not being used will reduce exposure.

Electromagnetic fields have both magnitude and direction and can be difficult to characterize properly. In some instances it may be necessary to evaluate an EMF with an oscilloscope to assure that the correct EMF frequency is being monitored. The HPT maintains monitoring equipment and can assist anyone with a problem or concern.

LASER RADIATION

Laser Environments

Lasers produce a variety of emissions across the electromagnetic spectrum, from infrared to

ultraviolet radiation. They are of concern because of the intense energy that may be produced and focused on a very small area. Some lasers have enough energy to severely damage eyes and skin. Laser environments also create a number of nonbeam hazards, some of which can cause death.

Special consideration must be given to ancillary problems, which cover a broad range of potential hazards. In some instances, additional safety controls are required. Laser fuels, dyes, chemicals, exhaust products and other contaminants produced by laser-target interactions require industrial hygiene considerations. Laser facility personnel may be aware of these potential hazards, but the hazards are not always apparent. The Industrial Hygiene Team (IHT) provides guidance in this area.

Laser Classification and Control Levels

Lasers and laser systems are assigned hazard classifications according to the maximum permissible exposure (MPR) levels of accessible laser radiation during operations. The classification ranges are

Class I	0.4 microwatt (uW)
Class II	Does not exceed 1 milliwatt (mW)
Class IIIA, continuous wave	1 to 5 mW
Class IIIB: Continuous wave	5 to 500 mW
Class IIIB: Pulsed	10 joules per square centimeter (J/cm2)
Class IV: Continuous wave	greater than 500 mW
Class IV: Pulsed	greater than 10 J/cm2

For embedded or enclosed laser systems, class II, III, or IV lasers are contained in a protective housing that lowers the classification during operation (usually to class I).

Controls for laser environments are determined by evaluating the ability of the emitted laser radiation to do biological damage. General descriptions of laser controls for each classification are

Class I	Exempt from controls
Class II	Minimal controls
Class IIIA	Limited controls
Class IIIB	Significant controls are required
Class IV	Significant controls are required.

Controls and restrictions are defined in detail when documented for area safety committee inspections and for safety permit requests describing test activities engaging the use of lasers.

Warning Signs and Labels

The warning signs recommended by the ANSI standard are

- DANGER sign - Black lettering on white background with red laser symbol

- CAUTION sign - Black lettering on yellow background
- LASER CONTROLLED AREA sign - Black lettering on yellow background
- LASER ON - DO NOT ENTER - Flashing red sign with black lettering.

The CAUTION and DANGER labels are used for laser enclosures in the same format. DANGER signs are posted at facilities operating class IIIB and class IV lasers. CAUTION signs are used for class II laser environments and some class IIIA facilities. LASER CONTROLLED AREA signs are posted at the entrances to all areas where lasers are in use, regardless of the classification. Signs and labels include significant information, such as type and wavelength of the laser being operated.

Medical Surveillance

A baseline eye examination is recommended for all laser users before and upon termination of laser operation. Baseline eye examinations are required for class III and IV laser users. Other medical surveillance will be determined by the Medical Officer, and the respective individuals will be notified by the Occupational Medical Services staff.

Eye Examination requirements are determined by the following risk assessment categories:

- INCIDENTAL PERSONNEL - Minimal risk. These individuals are transient to laser controlled areas and could be exposed to laser radiation, but it is highly unlikely.
- LASER PERSONNEL - Moderate risk. Applies to laser operators and others who routinely work directly with Class III & IV laser devices or systems. They are fully protected by engineering controls and administrative procedures.
- LASER PERSONNEL - High risk. Laser operators who routinely work with exposed beam paths and may use test procedures that put them at high risk while using protective eyewear and equipment.

Written instructions and information to assist in preparing for laser operation can be obtained from the HPT.

Training

Computer-based laser training can be scheduled at the Learning Center. On-Site training classes will be scheduled by the Laser Safety Officer. Experienced laser researchers are available for arranged training sessions.

ULTRAVIOLET RADIATION

Ultraviolet (UV) light is produced by a variety of sources, including welding and etching operations, xenon flash lamps, and ultraviolet light irradiation devices. Ultraviolet light is the component of sunlight that causes sunburn and eye damage. The same effects may occur through the use of industrial devices such as those listed, particularly since some of the operations may result in more intense exposure. In addition, ultraviolet light has been produced by intense heating of components such as metal alloys and sometimes by a laser (blackbody effect).

The range of wavelengths constituting ultraviolet radiation is 100 to 400 nanometers (nm). The ultraviolet spectrum can be divided into three regions:

400 to 315 nm	UV-A region, frequently referred to as the "black light" region
315 to 280 nm	UV-B region, causes skin erythema (reddening)
0 to 280 nm	UV-C region, commonly used for its germicidal effects

Sources of UV Radiation

The spectrum of ultraviolet radiation emitted varies from one source to another. Most artificial sources of ultraviolet radiation can be grouped together as follows:

Gas discharges
- Mercury lamps
- Noble gas lamps
- Flash tubes
- Welding arcs

Incandescent sources
Fluorescent lamps
Mixed sources
- Carbon arc
- UV lasers

Biological Effects of UV Radiation

Ultraviolet radiation, either direct or reflected can cause damage to the eyes and the skin. Eyes become inflamed, painful, with the pressure sensation of a foreign body. Skin damage is similar to sunburn, with erythema and blisters.

The eyes can be protected against UV radiation by the use of protective glasses or shields between the viewer and the UV source. Safety glasses with a minimum thickness of 0.040 inch will filter 85 to 90 percent of UV radiation. This same criteria can be applied to viewing shields. Side shields on safety glasses are necessary to protect against reflected UV radiation. If viewing shields are large enough, they can also protect against skin damage, provided that reflective materials and surfaces do not negate shield effectiveness. If shielding is unavailable or ineffective, two layers of clothing will prevent skin damage.

RESPONSIBILITIES

Health Physics Team

- Provides guidelines and recommendations for minimizing exposure to non-ionizing radiation fields and sources.
- Maintains monitoring equipment for use in evaluating the hazards associated with non-ionizing radiation fields.

Occupational Medical Services

- Determines and administers the necessary medical surveillance for civil servants engaged in

work with sources of non-ionizing radiation.

Industrial Hygiene Team

- Provides guidance on the requirements of occupational health regulations with regard to industrial hygiene considerations.

Procurement Personnel

- Ensures that all purchases of non-ionizing radiation devices are approved by the HPT.

Area Safety Committees

- Ensure that safety permit requests for test activities involving the use of non-ionizing radiation sources have been evaluated and approved by the HPT.
- Alert the HPT to any changes observed during inspections that may alter the safety status of personnel and facilities.

Research Personnel

- Use the safety permit process for planned test activities.
- Obtain the proper evaluations, approvals, protective equipment, etc. before engaging in the use of non-ionizing radiation devices.

Supervisors

- Ensure that the safety permit process is used.
- Support the enforcement of controls, methods, and work practices that will reduce or eliminate harmful exposures.
- Provide the recommended protective equipment for test facilities under your supervision.

Laser Safety Officer

- Administers the overall laser safety program.

STANDARD REFERENCES

American National Standard C95.1-1990.

American National Standard ANSI A136.1-1993.

American National Standard ANSI Z136.2-1988.

International Radiation Protection Association.

National Council on Radiation Protection.

American Conference of Governmental Industrial Hygienists.

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GRC Environmental Programs Manual

Chapter 31 PEST CONTROL

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GENERAL

This chapter establishes policies and procedures for dealing with the chemical and biological control of pests. The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who in any way participate in the development and execution of NASA actions.

REGULATIONS

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), officially cited in 61 Stat. 163 (1947), 7 U.S.C.A. 136, as amended, is the basis for federal pesticide legislation. The intent of FIFRA is to regulate the manufacture, transport, application, storage, and disposal of pesticides. The federal law is administered by the U.S. EPA.

Chapter 921 of the Ohio Revised Code defines the Ohio Pesticide Law. It is enforced within the State by the Ohio Department of Agriculture.

The Occupational Safety and Health Act (OSHA) Safety and Health Standards pertaining to FIFRA are contained in 29 Code of Federal Regulation 1910.

POLICY

It is a goal of GRC to exercise integrated pest management practices whenever pest control is necessary. GRC will store, apply, transport, and dispose of pest control materials according to all applicable Federal, State, and local statutes. It is a goal of GRC to minimize the storage, use, and disposal of pesticides onsite. Pesticide use at GRC will be exercised with a goal of minimizing both human exposure and adverse environmental impacts.

RESPONSIBILITIES

Logistics and Technical Information Division (LTID)

- Manages the pest control program for the at Lewis.

Plum Brook Management Offices (PBMO)

- Manages the pest control program at Plum Brook.

Environmental Management Office (EMO)

- Recommends and advises actions that will lead to achieving goals and regulatory compliance.

DEFINITIONS

Integrated pest management

A coordinated approach to pest control intended to prevent unacceptable levels of pests, while causing the least possible hazard to people, property, and the environment and using the most cost-effective means.

Pest

A harmful, destructive, or nuisance insect, fungus, rodent, nematode, bird, snail, weed, or parasitic plant or a harmful animal species that the State Director of Agriculture, or his authorized representatives, declares to be a pest, except viruses, bacteria, or other microorganisms on or in living animals, including man.

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GRC Environmental Programs Manual

Chapter 32 - DRINKING WATER

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GENERAL

The quality of the drinking water at GRC is of great importance to the work force. Potable water is supplied to the Cleveland and Plum Brook Station (PBS) facilities from different sources. The facilities have different chemical analysis capabilities, and, consequently, the approaches taken to ensure that quality drinking water differ considerably.

REGULATIONS

Water quality is determined by comparing the concentration of contaminants in the water with specifications set forth in the Safe Drinking Water Act (SDWA) and its 1986 and 1991 amendments.

POLICY AND RESPONSIBILITY

Cleveland Facility

Drinking water is supplied to the facility by the city of Cleveland and is assumed to meet SDWA specification. Consequently, the only potential sources for introduction of contamination are assumed to be at the facility. The Chemical Sampling and Analysis Team (CS&AT) responds to calls and work requests for assessing the quality of drinking water by checking the suspect source for likely contaminants.

The drinking water program at Cleveland consists of periodic testing of all drinking water fountains. Every fountain is tested at least once every 2 years for contaminants and naturally occurring species designated with an asterisk (*) in tables 32-1 plus free chlorine content.

To have a suspect water source tested, submit a work order to the CS&AT for analysis of the water. The CS&AT staff will tag the source (e.g., a water fountain) "Under Testing - Temporarily Out of Service." The water will be collected by a CS&AT technician the following morning and processed immediately.

Results of tests are usually available within 24 hours, and a verbal report will be made to the

requester after review by the CS&AT. CS&AT issues a formal report to the requester along with a recommendation for either closing down the source, pending further testing and investigation, or returning it to service. A source returned to service will be tagged with a notice stating the date and results of testing. A source that is closed down will continue to be tested until the condition dissipates (for those conditions best remedied by flushing the system) or until the cause of the contamination is identified and corrected.

The tests performed depend on known or suspected conditions of the source and availability of test methodology. A table of the recommended concentrations of various contaminants and naturally occurring species is given below.

TABLE 32-1. - PRIMARY (p) AND SECONDARY MAXIMUM CONTAMINANT LEVELS FOR PUBLIC WATER SYSTEMS

```
Aluminum . . . . . . . . . . . . . . . . . . . 0.05 to 0.2 mg/L
Chloride . . . . . . . . . . . . . . . . . . . . . . . . 250 mg/L
Chromium - total (p) . . . . . . . . . . . . . . . . .0.05 mg/L
*Coliform - total (p). . . . . . . . . . . . . . . . .<1/100 mL
Color. . . . . . . . . . . . . . . . . . . . . . 15 color units
*Copper. . . . . . . . . . . . . . . . . . . . . . . . . 1.3 mg/L
Corrosivity. . . . . . . . . . . . . . . . . . . . Noncorrosive
Fluoride . . . . . . . . . . . . . . . . . . . . . . . . 2.0 mg/L
Foaming Agents . . . . . . . . . . . . . . . . . . . . 0.5 mg/L
*Iron. . . . . . . . . . . . . . . . . . . . . . . . . . 0.3 mg/L
*Lead. . . . . . . . . . . . . . . . . . . . . . . . . 0.015 mg/L
Manganese. . . . . . . . . . . . . . . . . . . . . . .0.05 mg/L
Odor . . . . . . . . . . . . . . . . .3 Threshold odor number
*pH. . . . . . . . . . . . . . . . . . . . . . . . . . .6.5-8.5
Silver . . . . . . . . . . . . . . . . . . . . . . . . 0.1 mg/L
Sulfate. . . . . . . . . . . . . . . . . . . . . . . . 250 mg/L
Total Dissolved Solid (TDS). . . . . . . . . . . . . . 500 mg/L
*Turbidity (p) . . . . . . < 5 ntu (nephelometric turbidity units)
*Zinc. . . . . . . . . . . . . . . . . . . . . . . . . . 5 mg/L
```

These levels are recommended in the 1992 National Primary Drinking Water Regulations. The State may establish higher or lower levels that may be appropriate dependent upon local conditions such as unavailability of alternate sources of waters or other compelling factors, provided that public health and welfare are not adversely affected.

There is no established upper limit on free chlorine content. The value that CS&AT considers normal is 1.0 mg/L, which coincides with the level of chlorine added to the potable water by the City of Cleveland. The lower limit is set at 0.2 mg/L by Federal regulation.

Plum Brook Station

PBS receives potable water from the Erie County Water Division. PBS takes a proactive stance to ensure the domestic water distributed to employees meets the Safe Drinking Water Act specifications.

Once every 6 months a water sample from all active drinking water fountains and janitorial sinks is collected and analyzed as appropriate for compliance with Primary and Secondary Drinking Water Standards. Each sample is to be analyzed for free chlorine, chromium (total), coliform (total), copper, iron, lead, pH, and zinc (see table 32-1 for further details). Based on analytical results, the source remains in service or is tagged out-of-service pending further analysis. Corrective action is taken as

necessary; that is, lines are flushed and the source repeatedly analyzed until the source is able to maintain compliance with the drinking water standards. If a source is unable to meet the drinking water standards an alternative water supply is used until the cause of the contamination is identified and corrected.

Upon notification of employee concern with the water quality at a specified location, the source is tagged out-of-service until appropriate analysis is performed. After the determination that the source is safe for employee consumption the source is so identified and appropriate personnel notified of analytical results.

All drinking fountains have been surveyed to ensure that the fountain does not contain a lead liner. There are no drinking fountains on-site that contain a lead liner.

The environmental personnel ensure water samples are collected on a routine basis, appropriate analysis is performed, corresponding data is recorded, and corrective action is taken as necessary to ensure safe drinking water.

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Chapter 33 BLOODBORNE PATHOGENS

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PURPOSE

This chapter establishes minimum requirements to limit occupational exposure to blood and other potentially infectious materials that could result in transmission of bloodborne pathogens that could lead to disease or death.

APPLICABILITY

This program is applicable to all personnel (civil servant and contractor) at GRC.

BACKGROUND

The purpose of this program is to eliminate or minimize employee exposure to bloodborne pathogens from blood and other potentially infectious materials (OPIM) through a combination of engineering and work practice controls, personal protective clothing and equipment, medical surveillance, hepatitis B vaccination, signs, labels, and training. The two most significant bloodborne pathogens are hepatitis B Virus (HBV) which causes hepatitis B, a serious liver disease, and human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS).

REGULATION

Occupational Safety and Health Administration (OSHA) standard 29 Code of Federal Regulation 1910.1030, Occupational Exposure to Bloodborne Pathogens.

POLICY

Any organization, civil servant or contractor, with employees who could be reasonably anticipated to face contact with blood and other potentially infectious materials as the result of performing their job duties, must comply with the OSHA requirements. Appendix 26-A provides an overview of the requirements of this OSHA standard.

Job categories where occupational exposures to blood and OPIM is reasonably anticipated are medical services personnel, first responders, security personnel, custodial workers responsible for cleaning a medical clinic or first aid station, and similar operations. "Good Samaritan" acts, such as assisting a coworker with a nosebleed, would not be considered occupational exposure and do not require establishment of a program.

Civil servant organizations must follow the requirements of GRC Bloodborne Pathogen Program maintained by the Industrial Hygiene Team (IHT). The organization must prepare an infection control plan for their operations involving potential exposure to bloodborne pathogens. The infection control plan must be submitted to the IHT for review and comment and will be included as part of the GRC program.

Contractors must establish and implement a bloodborne pathogen program meeting the requirements of the regulation. A copy of the contractor's program must be submitted to the IHT for review and comment.

RESPONSIBILITIES

Environmental Management Office (EMO)

- Maintains file copies of contractor bloodborne pathogen programs.

Industrial Hygiene Team (IHT)

- Advises and assists, on request, organizations in the development of their bloodborne pathogens programs.
- Reviews bloodborne pathogen programs for compliance with 29 C.F.R. 1910.1030, recommends appropriate changes, and submits approved programs to the EMO.

Managers

- Ensure that infection control procedures are developed to cover all job categories in their operations where exposure to blood and OPIM is reasonably anticipated. Managers must ensure that the procedures are submitted to the IHT.

Contracting Officer Technical Representatives (COTR)

- Ensure that contractors have a bloodborne pathogen program and that it is submitted to the IHT for review.

Supervisors

- Implement all aspects of any bloodborne pathogen program covering their operations.

Employees

- Must comply with the requirements of any bloodborne pathogen program covering their

operations.

REFERENCES, GUIDANCE DOCUMENTS, AND REGULATIONS

U. S. Department of Labor, Occupational Safety and Health Administration, 29 Code of Federal Regulation 1910.1030, Occupational Exposure to Bloodborne Pathogens.

APPENDIX 33-A. - OSHA FACT SHEET 92-46

UNITED STATES DEPARTMENT OF LABOR

Occupational Safety and Health Administration

Fact Sheet No. OSHA 92-46

BLOODBORNE PATHOGENS FINAL STANDARD: SUMMARY OF KEY PROVISIONS

PURPOSE

Limits occupational exposure to blood and other potentially infectious materials since any exposure could result in transmission of bloodborne pathogens which could lead to disease or death.

SCOPE

Covers all employees who could be "reasonably anticipated" as the result of performing their job duties to face contact with blood and other potentially infectious materials. OSHA has not attempted to list all occupations where exposures could occur. "Good Samaritan" acts such as assisting a coworker with a nosebleed would not be considered occupational exposure.

Infectious materials include semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid visibly contaminated with blood and all body fluids in situations where it is difficult or impossible to differentiate between body fluids. They also include any unfixed tissue or organ other than intact skin from a human (living or dead) and human immunodeficiency virus (HIV)-containing cell or tissue cultures, organ cultures and HIV or Hepatitis B (HBV)-containing culture medium or other solutions as well as blood, organs, or other tissues from experimental animals infected with HIV or HBV.

EXPOSURE CONTROL PLAN

Requires employers to identify, in writing, tasks and procedures as well as job classifications where

occupational exposure to blood occurs -- without regard to personal protective clothing and equipment. It must also set forth the schedule for implementing other provisions of the standard and specify the procedure for evaluating circumstances surrounding exposure incidents. The plan must be accessible to employees and available to OSHA. Employers must review and update it at least annually -- more often if necessary to accommodate workplace changes.

METHODS OF COMPLIANCE

Mandates universal precautions, (treating body fluids/materials as if infectious) emphasizing engineering and work practice controls. The standard stresses handwashing and requires employers to provide facilities and ensure that employees use them following exposure to blood. It sets forth procedures to minimize needlesticks, minimize splashing and spraying of blood, ensure appropriate packaging of specimens and regulated wastes and decontaminate equipment or label it as contaminated before shipping to servicing facilities.

Employers must provide, at no cost, and require employees to use appropriate personal protective equipment such as gloves, gowns, masks, mouthpieces and resuscitation bags and must clean, repair and replace these when necessary. Gloves are not necessarily required for routine phlebotomies in volunteer blood donation centers but must be made available to employees who want them.

The standard requires a written schedule for cleaning, identifying the method of decontamination to be used, in addition to cleaning following contact with blood or other potentially infectious materials. It specifies methods for disposing of contaminated sharps and sets forth standards for containers for these items and other regulated waste. Further, the standard includes provisions for handling contaminated laundry to minimize exposures.

HIV AND HBV RESEARCH LABORATORIES AND PRODUCTION FACILITIES

Calls for these facilities to follow standard microbiological practices and specifies additional practices intended to minimize exposures of employees working with concentrated viruses and reduce the risk of accidental exposure for other employees at the facility. These facilities must include required containment equipment and an autoclave for decontamination of regulated waste and must be constructed to limit risks and enable easy clean up. Additional training and experience requirements apply to workers in these facilities.

HEPATITIS B VACCINATION

Requires vaccinations to be made available to all employees who have occupational exposure to blood within 10 working days of assignment, at no cost, at a reasonable time and place, under the supervision of licensed physician/licensed healthcare professional and according to the latest recommendations of the U.S. Public Health Service (USPHS). Prescreening may not be required as a condition of receiving the vaccine. Employees must sign a declination form if they choose not to be vaccinated, but may later opt to receive the vaccine at no cost to the employee. Should booster doses later be recommended by the USPHS, employees must be offered them.

POST-EXPOSURE EVALUATION AND FOLLOW-UP

Specifies procedures to be made available to all employees who have had an exposure incident plus any laboratory tests must be conducted by an accredited laboratory at no cost to the employee. Follow-up must include a confidential medical evaluation documenting the circumstances of exposure, identifying and testing the source individual if feasible, testing the exposed employee's blood if he/she consents, post-exposure prophylaxis, counseling and evaluation of reported illnesses. Healthcare professionals must be provided specified information to facilitate the evaluation and their written opinion on the need for hepatitis B vaccination following the exposure. Information such as the employee's ability to receive the hepatitis B vaccine must be supplied to the employer. All diagnoses must remain confidential.

HAZARD COMMUNICATION

Requires warning labels including the orange or orange- red biohazard symbol affixed to containers of regulated waste, refrigerators and freezers and other containers that are used to store or transport blood or other potentially infectious materials. Red bags or containers may be used instead of labeling.

When a facility uses universal precautions in its handling of all specimens, labeling is not required within the facility. Likewise, when all laundry is handled with universal precautions, the laundry need not be labelled.

Blood that has been tested and found free of HIV or HBV and released for clinical use, and regulated waste that has been decontaminated, need not be labeled.

Signs must be used to identify restricted areas in HIV and HBV research laboratories and production facilities.

INFORMATION AND TRAINING

Mandates training within 90 days of effective date, initially upon assignment and annually -- employees who have received appropriate training within the past year need only receive additional training in items not previously covered. Training must include making accessible a copy of the regulatory text of the standard and explanation of its contents, general discussion on bloodborne diseases and their transmission, exposure control plan, engineering and work practice controls, personal protective equipment, hepatitis B vaccine, response to emergencies involving blood, how to handle exposure incidents, the post-exposure evaluation and follow-up program, signs/labels/color-coding. There must be opportunity for questions and answers, and the trainer must be knowledgeable in the subject matter. Laboratory and production facility workers must receive additional specialized initial training.

RECORDKEEPING

Calls for medical records to be kept for each employee with occupational exposure for the duration of employment plus 30 years, must be confidential and must include name and social security number; hepatitis B vaccination status (including dates); results of any examinations, medical testing and follow-up procedures; a copy of the healthcare professional's written opinion; and a copy of information provided to the healthcare professional. Training records must be maintained for three years and must include dates, contents of the training program or a summary, trainer's name and

qualifications, names and job titles of all persons attending the sessions. Medical records must be made available to the subject employee, anyone with written consent of the employee, OSHA and NIOSH--they are not available to the employer. Disposal of records must be in accord with OSHA's standard covering access to records.

DATES

Effective date: March 6, 1992. Exposure control plan: May 5, 1992. Information and training requirements and recordkeeping: June 4, 1992. And the following other provisions take effect on July 6, 1992: engineering and work practice controls, personal protective equipment, housekeeping, special provisions covering HIV and HBV research laboratories and production facilities, hepatitis B vaccination and post-exposure evaluation and follow-up and labels and signs.

This is one of a series of fact sheets highlighting U.S. Department of Labor Programs. It is intended as a general description only and does not carry the force of legal opinion.

APPENDIX 33-B. - BLOODBORNE PATHOGENS EXPOSURE CONTROL PROGRAM

PURPOSE

This appendix explains the program that is designed to minimize occupational exposure to blood and other potentially infectious materials that could result in transmission of bloodborne pathogens that could lead to disease or death. This program is designed to meet the requirements of the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.1030, Bloodborne Pathogens.

UNIVERSAL PRECAUTIONS

Universal precautions is an approach to infection control in which all human blood and OPIM are treated as if known to be infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV) and other bloodborne pathogens. Universal precautions are a requirement of the OSHA standard and must be followed.

EXPOSURE DETERMINATION

The following jobs have been identified as having tasks involving employee exposure to bloodborne pathogens and are covered by this program:

- Glenn First Responders

A list of the tasks and procedures involving exposure to blood and OPIM is enclosed.

Other job categories with occupational exposure to bloodborne pathogens are security personnel, medical services personnel, custodial personnel, whose tasks include the health clinic and cleaning up blood or OPIM after an occupational accident, and the employees of the Lewis Little Folks Day Care Center. These jobs are performed by support service contractors who are required to have their own exposure control program.

HEPATITIS B VACCINATION

Hepatitis B vaccination is recognized as a safe and effective means of protecting against HBV infection. Hepatitis B vaccination must be provided, free of charge, to covered employees within 10 working days of initial assignment to every employee who has occupational exposure to bloodborne pathogens. Vaccinations are not necessary for employees who have previously completed the HBV vaccination series, where antibody testing confirms the employee is already immune to HBV, or if vaccination is contraindicated for medical reasons. Vaccinations are available by contacting the Office of Health Services at 3-5841.

Employees who decline vaccination must sign a declination form indicating they were offered the vaccination, but refused it. The employee may begin the vaccination series at a later date at their request and if they are still occupationally exposed to bloodborne pathogens.

EXPOSURE CONTROL PROCEDURES

Specific procedures have been developed for tasks involving exposure to blood and OPIM and are described in the attachment. These procedures include engineering and work practice controls, housekeeping and decontamination procedures, personal protective equipment, laundering of contaminated clothing, and the handling potentially infectious waste. These procedures must be followed.

EDUCATION AND TRAINING

Employees must be trained upon initial assignment to a job involving exposure to bloodborne pathogens, and annually thereafter. This training will include

- The requirements of the OSHA standard.
- The epidemiology and symptoms of bloodborne diseases.
- The modes of transmission of bloodborne pathogens.
- An explanation of the exposure control plan, including the use and limitations of safe work practices and engineering controls and how to select, use, remove, handle, decontaminate, and dispose of personal protective clothing and equipment.
- Methods to control transmission of HIV and HBV.
- How to recognize occupational exposure.
- The availability of free HBV vaccination.
- Labels, signs, and color coding for bloodborne pathogens.
- Procedures for reporting exposure incidents and postexposure followup.

Additional training must be provided when existing tasks are modified or new tasks are added that may affect employee exposure to bloodborne pathogens. This training may be limited to the new or

modified tasks.

Arrangements may be made to have the training provided by the Occupational Health Services 3-5841 with support by IHT at 3-3032. The documentation of the training content and individuals trained must be provided to the Technical and Administrative Training Branch 3-3768.

LABELS

All containers with blood or OPIM, contaminated waste and clothing, must be labeled as a biohazard. Standard biohazard labels are acceptable, however, red bags or red containers may be used instead of labels.

POSTEXPOSURE FOLLOWUP

Any employee involved in an incident exposing them to blood or OPIM must immediately report the incident to their supervisor and the Office of Health Services at 3-5841. The Occpuational Health Services will provide postexposure evaluation and followup services to the employee.

RECORDKEEPING

The Occpuational Health Services will establish and maintain employee medical records under this program. The Technical and Administrative Training Branch will maintain employee training records.

IMPLEMENTATION DATES

This program is currently implemented.

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GRC Environmental Programs Manual

Chapter 34 HANDLING AND DISPOSAL OF SOIL

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INTRODUCTION

This chapter establishes policies and procedures for the handling and disposal of soils at GRC. The guidance provided in this chapter is applicable to GRC employees and contractors at all levels who in any way participate in the development and execution of GRC actions involving the handling, excavation, storage, transportation, and/or disposal of soils. It sets forth guidelines to ensure that such operations do not result in solid or hazardous wastes being disposed of improperly and to ensure that areas of contamination are promptly addressed.

POLICY

It is GRC Policy To:

- Evaluate the need for analysis on all soils prior to excavation;
- Minimize the volume and toxicity of waste soil generated by GRC operations to the extent technically, and legally possible and economically practicable;
- Reuse clean soil as fill material at GRC whenever possible;
- Fulfill the requirements of landfills.

SITE ASSESSMENT

Site Assessments are a requirement of both the Environmental Management Office (EMO) and disposal facilities for any project at GRC that involves the excavation and off-site shipment of soils.

- Small scale excavations at which the soil is to be put back at its original location do not require any sampling for contamination unless contamination is suspected or contaminates are found in the process of excavating. Determination of what constitutes small scale excavations will be left to the discretion of EMO. In general, preconsturction sampling is not required in projects where no contamination is suspected and where no excavated material will leave the Center.
- For preconstruction sampling on sites that are not suspected of having significant contamination and where the excavation will not occur within a year of sampling, the following parameters shall be run, as required, on each sample:

Total metals plus nickel
F001 - F005 solvents
Total PCB's - (in and near electrical substations only)

Nickel is an analysis required by many disposal facilities because it is a condition of their operating permit.

- For preconstruction sampling on sites known to have or suspected of having significant contamination and where excavation is scheduled within a year, full disposal parameters shall be run on appropriate samples. EMO will maintain the list of disposal parameters.

The testing described above will be conducted prior to the start of construction and, in most cases, will require soil borings to obtain samples from appropriate depths. On a case-by-case basis, EMO will develop site-specific sampling recommendations as part of the preconstuction planning process. These recommendations will be used by EMO or an outside party to develop a site-specific sampling plan. Specific factors should be considered in each sampling plan.

To the greatest extent possible, existing analytical data shall be utilized in the development of a sampling plan. Existing analytical data is filed in both the Facilities and Test Engineering Division (FTED) and EMO.

The sampling plan shall, at a minimum, include the following:

1. A summary of existing information on the location to be sampled.
2. A description of the sampling objectives and the ultimate use of the data.
3. The number, location, and type of samples to be collected including rationale for choosing the same.
4. A detailed description of the sampling protocols and analytical methods to be used.

At such time as a sufficient database is developed, testing of soils may be discontinued for locations where soil contamination levels have been adequately characterized.

SOIL STORAGE

Clean excavated soil or other natural substrate material may be stored in stock piles at GRC or placed in other locations as agreed upon by EMO and FTED. Provisions to prevent erosion of storage piles and subsequent water pollution are the responsibility of FTED.

SOIL DISPOSAL

Where the soils exhibit no more than background levels of contaminants, the excavated soil may be reused for fill on site. Additionally, clean soil may be used off site at landfills as cover material. This activity must be closely coordinated with EMO to ensure regulatory requirements are followed. Where it has been shown that there is some contamination, but not enough for the soils to be considered a hazardous waste, the soils will be disposed of as solid waste. Soil which has been determined to be hazardous shall be handled as hazardous waste and disposed of as required by law.

RESPONSIBILITIES

Facilities Test Engineering Division (FTED)

- Have environmental site assessment analyses performed, if required, for all construction or facility maintenance projects early in the planning phase. For FTED this is done through the site assessment coordinator.
- Coordinate all projects requiring site assessment analyses with the Environmental Management Office (EMO).
- For emergency or unplanned projects requiring excavation, contact the Environmental Compliance Team (ECT) for guidance and recommendations concerning the appropriate environmental requirements.
- Arrange for the disposal of excavated soil as recommended by ECT.
- Ensure that contractors under their control fill out hazardous and solid waste manifests with coordination and guidance from ECT and the Waste Management Team.

Other GRC Organizations

- All GRC organizations planning projects where soil is to be excavated must contact ECT for guidance. Site assessments may be required to determine the potential hazard of the soil if previous environmental data are unavailable.

Environmental Management Office (EMO)

- Provides site assessment funding for all planned major CoF construction and facility maintenance projects and emergency or unplanned projects as required.

Environmental Compliance Team (ECT)

- Reviews site assessment reports and recommends proper disposal or soil placement procedures.
- Provides guidance to FTED and designated contractors on a daily basis.
- Maintains an inventory on all previous environmental assessments and pertinent environmental analysis.
- Obtains authorization from the Director of the Ohio EPA for any construction on previous or existing solid or hazardous waste sites. This must be coordinated through ECT.
- Coordinates with outside agencies as appropriate.

DEFINITIONS

Clean fill

Soil that has been analyzed and found to be free of contamination above natural occurring background concentrations and that is to be reused at GRC at the job site or other locations at GRC or off site.. Usage must be coordinated with EMO.

Solid waste

Soil that has been analyzed and found to be free of hazardous contaminants or other nonhazardous contaminants above natural occurring background concentrations, but that is not reused on site. Solid waste must be disposed of at a permitted solid waste landfill.

Hazardous soil

Soil that upon analysis is found to contain hazardous contaminants as defined in 40 CFR 261.3. Such soil must be disposed of at a hazardous waste landfill.

REGULATIONS AND REQUIREMENTS

The following regulatory documents and GRC guidance documents are to be followed:

40 Code of Federal Regulation (CFR) 243 - (as amended) Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste

40 CFR 260, 263 - (as amended) Hazardous Waste Management System

Ohio Solid Waste Disposal Regulations OAC 3745-27

Ohio Hazardous Waste Regulations OAC 3747-51

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GRC Environmental Programs Manual

Chapter 35 - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REGULATED MATERIALS PROGRAM

Note: The current version to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is February 27, 1998. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

PURPOSE

The purpose of the OSHA Regulated Materials compliance program is to protect all employees who may be exposed to regulated chemicals from any adverse health effects. This program establishes minimum requirements for handling, use, and disposal of all regulated materials at the Lewis Research Center, with the exception of asbestos, cadmium, mercury and lead which have separate programs.

AUTHORITIES

This policy is issued under the authority of the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910 Occupational Safety and Health Standards. Executive order 12196 of February 26, 1980, Occupational Safety and Health Programs for federal employees.

APPLICABILITY

This policy is applicable to all personnel at the Lewis Research Center and Plum Brook Station, including, but not limited to civil servants, contractor personnel and students.

BACKGROUND

The Occupational Safety and Health Administration has issued compliance standards for a number of chemicals. Each standard has specific requirements for assessing and controlling the exposures to employees when used for a given task. These may or may not include exposure monitoring of employees for each job classification, establishment of regulated areas with specific warning signs and handling procedures, engineering controls, work practices, respiratory protection, written programs and written standard operating procedures. In addition, GRC may determine additional requirements based upon the chemical, its hazards, and the results of a hazard assessment and exposure monitoring.

The Environmental Management Office (EMO) recognizes that generally OSHA regulated materials are used in small quantities and on an infrequent basis at NASA GRC. Therefore, in order to comply with the OSHA standards, EMO has developed the following guidelines for current and future use of all OSHA regulated materials.

POLICY

It is Lewis policy to comply with all applicable regulations regarding chemical use and to prevent illness to workers and damage to the environment from the use, removal and disposal of the chemicals. To accomplish this, all personnel must comply with the requirements of this chapter.

This chapter applies to use of chemicals currently at GRC, future use of current chemicals and acquisition of chemicals regulated by OSHA that have not previously been assessed.

Regulated materials currently used at GRC

OSHA regulated materials currently in use at GRC included in this program are the following:

- Benzene
- Formaldehyde
- Inorganic Arsenic
- 4,4 -Methylenedianiline **(Appendix A)**
- Methylene Chloride

All regulated materials currently in use at GRC must have a hazard assessment performed by a member of the Industrial Hygiene Team (IHT) of EMO.

This assessment shall be performed during the next scheduled use of the material. The user or area supervisor must contact the IHT prior to use and arrange for a member of the team to observe the handling of the material, assess the hazards and perform exposure monitoring if necessary.

Luz Jeziorowski at 3-3030 are the contacts for users of regulated materials.

Results of the hazard assessments for all current users of a given material will determine if a written program must be established or revised. **Written programs will be included in this chapter as appendices.**

Future use of current materials

The IHT must be notified whenever new users of current materials are identified by the area supervisor, when a process which uses a regulated material changes or when new tasks not previously assessed require the use of a regulated material.

The above information shall be provided in a timely manner in order to arrange for hazard assessments and not delay the users work.

This information shall be provided by the area supervisor to Luz Jeziorowski at 3-3030.

Upon receipt of the information, a hazard assessment will be performed.

The results of the new assessment will determine if the material requires a written program or if a current program requires revision.

Acquisition of regulated materials not previously assessed

The IHT shall be notified whenever OSHA regulated materials not previously assessed are requested for purchase. These include the following material:

- 2-Acetylaminofluorene
- Acrylonitrile
- alpha-Napthylamine
- 4-Aminodiphenyl
- Benzidine
- beta-Naphthylamine
- beta-Propiolactone
- bis-Chloromethyl ether
- 1,2,-dibromo-3-chloropropane
- 3,3 -Dichlorobenzidine(and its salts)
- 4-Dimethylaminoazobenzene
- Ethyleneimine
- Ethylene Oxide
- Methyl chloromethyl ether
- 4-Nitrobiphenyl
- N-Nitrosodimethylamine
- Vinyl Chloride

The above information shall be provided in a timely manner in order to arrange for hazard assessments and not delay the users work.

The Chemical Management Team of EMO will provide this information to the IHT OSHA Regulated Materials Program manager.

Upon receipt of the information, the program manager or a member of the team will contact the requester and arrange a hazard assessment of the material. The assessment will consist of the following:

- A review of related standards to determine regulatory requirements.
- A meeting with the requester shall be arranged to discuss handling procedures, engineering controls, personal protective equipment and scheduling of exposure monitoring.
- Results of the hazard assessment and exposure monitoring will determine the need for a written program and future requirements.

RESPONSIBILITY

Environmental Compliance Team

- Provides guidance on the requirements of Federal, State and local environmental regulations and for collection and disposal of regulated materials and waste products containing regulated materials.

Industrial Hygiene Team

- Provides guidance on the requirements of Federal, State and local occupational health regulations.
- Maintains the OSHA Regulated Materials Program.
- Evaluates worker exposure and recommends procedures to minimize exposure.
- Recommends employees for inclusion in a medical surveillance program, if required.
- Maintains the task and exposure database for all related operations.

Chemical Management Team

- Maintains chemical inventory and notifies the IHT when new users or new chemicals are identified.

Occupational Medical Services

- Maintains medical surveillance programs for civil servant and contractor employees exposed to chemicals which require medical monitoring.

Plum Brook Station Management Office (PBMO)

- Identifies OSHA Regulated Materials at Plum Brook Station and develops an OSHA Regulated Materials compliance program based upon the Occupational Health and Safety Standards in 29 CFR Part 1910.

Supervisors

- Identify users of regulated materials within the guidelines of this policy and notify the Industrial Hygiene Team of the user and the particular material prior to its use.

Employees

- Use the regulated materials in accordance with procedures established for safe use of the materials.
- Use personal protective equipment as specified in established work procedures.
- Notify their supervisors of any operational changes or new uses of the regulated materials.

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GRC Environmental Programs Manual

Chapter 36 - Environmental Document Management System

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GENERAL

This chapter establishes the Environmental Document Management System (EDMS) at Glenn Research Center (GRC). The EDMS is intended to ensure compliance with regulatory requirements, to conform to ISO 9000 standards, to make it easier to retrieve information quickly, and to make reference material more readily available. It is applicable to GRC employees at all levels who in any way participate in the formulation, development, and management of environmental documentation.

REFERENCES

a. NPG 1441.1c - NASA Records Retention Schedules - Procedures Governing the Retention, Retirement, and Destruction of Agency Records
b. Chapter 29, Code of Federal Regulations, Part 1910 - Occupational Health and Safety Standards
c. Chapter 40, Code of Federal Regulations - Protection of the Environment
d. Ohio Administrative Code Section 3745 - Protection of the Environment

DEFINITIONS

a. Document - an original or official writing, book, or other instrument that exists before an activity takes place and that provides guidelines and instructions. Examples include regulations, GRC Environmental Programs Manual chapters, and licenses.
b. Record - a form, writing, or other instrument that exists after the performance of an activity and that provides objective evidence of accomplishment. Examples include discharge monitoring reports, training records, and databases.

PROCEDURES

a. GRC Environmental Programs Manual - the Environmental Manual is considered the primary document in the EDMS. The Environmental Manual defines policies, program scopes, and responsibilities.
b. Changes - the EMO Team Leaders are responsible for initiating needed changes to chapters in

the Environmental Manual to ensure the chapter is kept up-to-date.

c. Approval - new and revised chapters in the Environmental Manual must be approved by the Chief, Environmental Management Office. Significant new policies must be approved by the Environmental Pollution Control Board, per GLPD 8800.4E.
d. Distribution - chapters in the Environmental Manual will be distributed by making them available at the GRC Environmental Programs Manual Home Page.
e. Tracking - a note will be placed on each chapter of the Manual stating,

> **Note: The current versions to this Chapter will be maintained and approved by the Environmental Management Office (EMO). The revision date is shown at the end of each chapter. If you are referencing paper copies, please verify that it is the most current version before use.**

In this way, it will be made clear that the current version of the chapter is that on the GRC Environmental Programs Manual Home Page.

f. Review - each chapter in the Environmental Manual will be reviewed annually to ensure it is up-to-date. This is the responsibility of the EMO Team Leader. Each chapter will note the date of the most recent revision.

RESPONSIBILITIES

EMO Team Leaders

The Team Leader is responsible for ensuring the documents and records applicable to the Team's functions are maintained according to this instruction.

EMO Resource Management Team (RMT)

The RMT will provide oversight and coordination of the overall EDMS and will update this instruction as needed.

Plum Brook Management Office

The Plum Brook Management Office is responsible for ensuring the documents and records applicable to its' operations are maintained according to this instruction.

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GRC Environmental Program Manual

Chapter 37 - Indoor Air Quality

Records and Forms

Indoor Air Quality Investigation Process Flowchart (Micrografx format)

Note: The current versions to this Chapter will be maintained and approved by the Environmental Management Office. The revision date for this chapter is October 10, 1999. If you are referencing paper copies, please verify that it is the most current version before use. Approved by: Environmental Management Office Chief: Michael Blotzer michael.blotzer@grc.nasa.gov.

Purpose

The objective of the Indoor Air Quality (IAQ) Program is to provide healthful and comfortable indoor environments through proper facility design, operation, and maintenance. The program also provides a mechanism for solving problems involving IAQ.

Please note that policies regarding the safe use of and regulatory requirements for hazardous chemicals (e.g. lead, asbestos and carcinogens) are covered in other chapters of this Manual.

Applicability

This chapter is applicable to all personnel at Glenn and Plum Brook Station, including, but not limited to, civil servants, contractor personnel, and students.

Background

Good IAQ is important to ensure a healthy and productive work environment. IAQ is affected by a variety of factors, including building design, occupancy loading, and the work being performed. IAQ issues are commonly associated with non-industrial, non-laboratory office buildings where typical office operations (use of copy machines, laser printers, and retail chemical products), building products (carpets, furniture, etc.), or smoking, combined with improperly designed, used or maintained heating, ventilation and air conditioning (HVAC) systems create an irritating or unhealthful environment.

The variety of work performed at NASA Glenn Research Center poses special problems for IAQ. Few buildings are dedicated office-only space. Instead it is common to have office space co-located in buildings with research laboratories or shop areas. IAQ is also affected by maintenance and renovation activities in Center facilities. As a result, unusual odors may indicate a loss of control in

laboratory or shop operations or poorly controlled construction and maintenance activities.

Due to employee concerns over chemical hazards, complaints of unusual odors in the workplace are the most common IAQ issue at the Center and these complaints deserve a high level of concern and response.

Combustion exhaust products from various facilities are another contributor to poor IAQ at the Center. Stack heights are limited at the Center due to the proximity to Cleveland Hopkins Airport so that combustion exhaust is released near to the ground and may enter air intakes of nearby buildings resulting in a strong odor of jet exhaust indoors. Exhaust from motor vehicles idling near building fresh air intakes are another source of combustion products.

Construction and maintenance activities in occupied buildings are another source of indoor air pollution which can adversely affect building occupants. Such work must be planned and managed to minimize the release of dust, vapors, and other air contaminants to protect workers and building occupants.

Proper carpet maintenance, regular vacuuming using a vacuum equipped with high-efficiency filters and deep cleaning every 12 - 18 months, increases the life of a carpet and helps ensure carpets do not become a source of dust, mold, bacteria, and other indoor air contaminants. Selecting low-emission carpets, cushions, and adhesives will minimize indoor air quality problems with new carpet installations.

Integrated pest management techniques are more effective in controlling insects and rodents and also reduce indoor air quality problems created during pesticide applications.

Policy

It is Glenn Research Center policy to provide a healthful indoor environment which complies with federal, state, and local regulations and applicable national consensus standards. This will be achieved through proper design, operation, and maintenance of building systems.

Good IAQ will also be achieved through compliance with Executive Order 13058 which prohibits the smoking of tobacco products in all interior space and in any outdoor areas in front of air intake ducts.

Responsibilities

Industrial Hygiene Team (IHT)

- Provides guidance on the requirements of Federal, State, and Local ventilation regulations as well as standard industry guidelines.
- Provides technical guidance and support on minimizing the impact of construction, renovation, and maintenance activities on indoor air quality.
- Serves as the focal point for receiving and investigating IAQ complaints at Cleveland facilities.
- Recommends corrective actions to resolve IAQ problems.
- Maintains a log of IAQ complaints.
- Utilizes approved funding for projects to correct high priority problems.

Plum Brook Management Office (PBMO)

Serves as the focal point for receiving and investigating IAQ complaints at Plum Brook Station facilities.

Facilities and Test Engineering Division (FTED)

- Ensures building and HVAC system designs and modifications meet the requirements of ANSI/ASHRAE standards 55 (12) and 62 (13) and do not adversely affect local exhaust ventilation systems.
- Designs and implement construction and maintenance projects to minimize their impact on indoor air quality.
- Ensures that architects and engineers involved in the purchase or modification of local exhaust ventilation systems are trained in ventilation design for contaminant control.
- Maintains building systems in good working order to reduce the potential for indoor air quality problems.
- Assists the Industrial Hygiene Team (IHT) in identifying and correcting indoor air quality problems.

Logistics and Technical Information Division

Provides house keeping services that maintain carpets in accordance with recommendations by the Carpet and Rug Institute (2, 5) with the exception that frequency of vacuuming may be in accordance with recommendations of the Association of Specialists in Cleaning and Restoration (7).

Selects carpets, cushions, and adhesives labeled under the Carpet and Rug Institute IAQ testing program (4) and installs carpets in accordance with the Carpet and Rug Institute (3). (Note: carpet should not be installed under water coolers or other areas where chronic moisture promotes the growth of mold and fungi.)

Provides pest control services in accordance with the General Services Administration publication *Integrated Pest Management (IPM) for Buildings; Desk Guide for Facilities Managers*.

Supervisors (Research, Laboratory, and Shop Areas)

- Ensure that Local Exhaust Ventilation (LEV) is operated in accordance with the requirements of this program
- Stop operations, tag LEV "out of service," and contact the IHT if, for any reason, a LEV system is suspected of being deficient
- Inform the IHT of all newly installed LEV systems and all modifications of LEV systems.

Employees (Research, Laboratory, and Shop Areas)

- Operate LEV in accordance with this Chapter and **Chapter 16, Local Exhaust Ventilation**.
- Conduct operations using capture or receiving hoods within the distance indicated on the annual ventilation survey sticker

- Use laboratory hoods with the sash adjusted to maintain airflow within normal operating range of 80 - 120 fps
- Report any LEV that does not appear to adequately control employee exposure to air contaminants or has been modified in a way that may adversely affect airflow.

Employees (Office Areas)

Facilitate maintenance activities by maintaining unobstructed access to HVAC systems.

References, Guidance Documents, and Regulations

1. *IAQ Guidelines for Occupied Buildings Under Construction, Sheet Metal and Air Conditioning Contractors' National Association.*
2. *Commercial Carpet Maintenance Manual, Carpet and Rug Institute.*
3. *Standard for Installation of Commercial Carpet, CRI 104 - 1996, Carpet and Rug Institute.*
4. *Standard Industry Reference Guide for Installation of Residential Textile Floor Covering Materials, CRI 105 - 1995, Carpet and Rug Institute.*
5. *Floor Covering Maintenance for School Facilities, Carpet and Rug Institute.*
6. *Guidelines for Operating Bitumen Roofing Kettles, Construction Safety Association of Ontario.*
7. *Guide to Carpet Cleaning Methods and Selecting a Carpet Cleaner, Association of Specialists in Cleaning and Restoration, http://www.ascr.org/guide.htm.*
8. *Indoor Air Quality (proposed rule), Occupational Safety and Health Administration.*
9. *Integrated Pest Management (IPM) for Buildings: Desk Guide for Facilities Managers, General Services Administration.*
10. *Integrated Pest Management Program Contract Guide Specification, General Services Administration.*
11. *Protecting Federal Employees and the Public From Exposure to Tobacco Smoke in the Federal Workplace. Federal Register: October 20, 1997, Volume 62, Number 202, Page 54461*
12. *Thermal Environmental Conditions for Human Occupancy (ANSI/ASHRAE 55-1992) American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.*
13. *Ventilation for Acceptable Indoor Air Quality (ANSI/ASHRAE 62-1989), American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.*

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MANUAL ACRONYMS

ACM - Asbestos Containing Material
ACT - Asbestos Containing Tile
ACGIH - American Conference of Governmental Industrial Hygienist
AEL - Accessible Emission Limit
AL - Action Level
AMP - Asbestos Management Plan
ANSI - American National Standards Institute
APF - Air-purifying Respirator
AST - Aboveground Storage Tanks
BUSTR - Bureau of Underground Storage Regulations
CAA - Clean Air Act
CDAPC - Cleveland Division of Air Pollution Control
CERCLA - Comprehensive Environmental Response, Compensation & Liability Act of 1980 (Superfund)
CFR - Code of Federal Regulations
CIH - Certified Industrial Hygienist
CMT- Chemical Management Team
CoF - Construction of Facilities (funds to construct buildings)
CO - Contracting Officer
COTR - Contracting Officers Technical Representative
CSAT- Chemical Sampling and Analysis Team
CWA - Clean Water Act
CZM - Coastal Zone Management
DOD - Department of Defense
DOE - Department of Energy
DOPAA - Description of Proposed Actions & Alternatives
DOR - Directorate Ordering Representative
DRMS - Defense Reutilization and Marketing Service
DSHWM - Division of Solid and Hazardous Waste Management
EA - Environmental Assessment
ECT - Environmental Compliance Team

EDMS - Environmental Document Management System
EDO - Eastern District Office
EEO - Equal Employment Opportunity Office
EES - Environmental Emergency Section
EHS- External Hazardous Substance
EIS - Environmental Impact Statement
ELF - Extremely Low Frequency
EM - Electromagnetic Radiation
EMO - Environmental Management Office
EPA - Environmental Protection Agency
EPCB - Environmental Pollution Control Board
ERD - Environmental Resource Document
ESLI - End-of-service-life Indicator
ESO - Engineering Support Office (within FTED)
EVAL - Environmental Analysis
FDAA - Federal Disaster Assistance Administration
FTED - Facilities and Test Engineering Division
FIFRA - The Federal Insecticide, Fungicide, and Rodenticide
FONSI - Finding of No Significant Impact
FWPCA - Federal Water Pollution Control Act
HAZCOM - Hazard Communication
GLPD - Glenn Policy Directive (**GLPD 8870** The GRC Environmental Quality Program)
GRC - Glenn Research Center
GSO - Glenn Safety Office
HAZWOPER - Hazardous Waste Operations and Emergency Response
HCP - Hearing Conservation Program
HEPA - High Efficiency Particulate Air (filter)
HHE - Health Hazard Evaluation
HPT - Health Physics Team
HVAC - Heating, Ventilation, and Air Conditioning
ICAP - Inductively Coupled Argon Plasma
ICRP - International Commission on Radiological Protection
IDLH - Immediately Dangerous to Life and Health
IG - Inspector General

IHIT - Industrial Hygienist In Training
IHT - Industrial Hygiene Team
IRAP - Interagency Radiological Assistance Plan
IRPA - International Radiation Protection Association
IWS - Industrial Waste System
LASER - Light Amplification by Stimulated Emission of Radiation
LEL - Lower Explosive Limit
LEV - Local Exhaust Ventilation
LSO - Laser Safety Officer
LTID - Logistics & Technical Information Division
MPE - Maximum Permissible Exposure
MSDS - Material Safety Data Sheet
MSHA - Mine Safety and Health Administration
MUC - Maximum Use Concentration
NASA - National Aeronautics and Space Administration
NCRP - National Council on Radiation Protection and Measurements
NEPA - National Environmental Policy Act
NESHAP - National Emission Standard for Hazardous Air Pollutants
NHS - NASA Health Standard
NHZ - Nominal Hazard Zone
NI - National Institute
NODIS - NASA Online Directive Information System (Library)
NOHD - Nominal Ocular Hazard Distance
NOI - Notice of Intent
NIOSH - National Institute of Occupational Safety & Health
NOV - Notice of Violation
NPDES - National Pollutant Discharge Elimination System
NRC - National Response Center (Coast Guard)
NRC - Nuclear Regulatory Commission
NRPP - National Resource Protection Program
NQ - Nonreportable Quantity
NTU - Nephelometric Turbidity Unit
NVLAP - National Voluntary Laboratory Accreditation Program
ODH - Ohio Department of Health