



Goddard Procedural Requirements (GPR)

DIRECTIVE NO. GPR 1840.2C **APPROVED BY Signature:** Original Signed By
EFFECTIVE DATE: April 14, 2016 **NAME:** Judith N. Bruner
EXPIRATION DATE: April 14, 2021 **TITLE:** Director, Safety and Mission Assurance

COMPLIANCE IS MANDATORY

Responsible Office: 360/Safety Division

Title: Industrial Hygiene Program

PREFACE

P.1 PURPOSE

This directive defines the requirements for the implementation and management of the Industrial Hygiene (IH) Program at the Goddard Space Flight Center (GSFC). The IH Program supports NASA Policy Directive (NPD) 1800.2 and NASA Procedural Requirement (NPR) 1800.1 by anticipating, recognizing, evaluating, and controlling actual and potential occupational health and safety hazards and environmental factors that may affect the health, comfort, or productivity of GSFC's community.

P.2 APPLICABILITY

This directive applies to all GSFC personnel, facilities, and activities, including all permanent and temporary sites. This directive shall also apply to all GSFC tenant organizations, contractors, grantees, clubs and other persons operating under the auspices of GSFC, or on GSFC property, as required by law, and as directed by contractual, grant, and agreement documents. The IH Program refers to IH functions at both Greenbelt (Code 360) and Wallops Flight Facility (WFF) (Code 803).

P.3 AUTHORITY

- a. NPD 1800.2, NASA Occupational Health Program; and
- b. NPR 1800.1, NASA Occupational Health Program Procedures.

P.4 APPLICABLE DOCUMENTS AND FORMS

- a. U.S. Department of Labor (DOL), Occupational Safety and Health Administration (OSHA), 29 Code of Federal Regulations (CFR) 1910.132, Personal Protective Equipment (PPE) General Requirements;
- b. U.S. DOL, OSHA, 29 CFR 1910.95, Occupational Noise Exposure;
- c. U.S. DOL, OSHA, 29 CFR 1910.134, Respiratory Protection;
- d. U.S. DOL, OSHA, 29 CFR 1910.1000, Air Contaminants;
- e. U.S. DOL, OSHA, 29 CFR 1910.1200, Hazard Communication;
- f. U.S. DOL, OSHA, 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories;
- g. NRRS 1441.1, (NASA Record Retention Schedules);

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- h. NASA Form 1707, Special Approvals and Affirmations of Requisitions;
- i. GPR 1410.1 Directives Management;
- j. GPR 1700.1, Occupational Safety Program at Goddard Space Flight Center;
- k. GPR 1700.2, Chemical Hygiene Plan;
- l. GPR 1700.8, GSFC Hazard Communication Program;
- m. GPR 1800.1, GSFC Smoking and Other Tobacco Use Requirements;
- n. GPR 1800.7, Ergonomics Program;
- o. GPR 1820.1, Hearing Conservation Program;
- p. GPR 1820.2, Respiratory Protection Program;
- q. GPR 1840.1, Asbestos Management Program;
- r. GPR 1870.1, Food Service Sanitation, Inspection, and Foodborne Illness Prevention Program;
- s. GPR 8500.1, Environmental Planning and Impact Assessment;
- t. GPR 8500.3, Waste Management;
- u. GPR 8621.4, GSFC Mishap Preparedness and Contingency Plan;
- v. GPR 8730.7, Laboratory Management Program;
- w. GPR 8800.2, Local Exhaust Ventilation (LEV) System Maintenance and Repair Management;
- x. GPR 8830.1, Facility Operations Managers;
- y. GSFC Form 17-26, Exit Clearance Record;
- z. GSFC Form 17-26W, Exit Clearance Record/WFF;
- aa. GSFC Form 23-59, Initiator's Acquisition Checklist;
- bb. GSFC Form 23-60, Job Hazard Analysis (JHA) Worksheet;
- cc. GSFC Form 23-73, Facilities Environmental and Safety Checklist for New Construction, Modifications, Demolition, and Maintenance of Facilities;
- dd. GSFC Form 23-75, GSFC Environmental Checklist R&D and Other Projects;
- ee. Code 300 Form 360-IH-030 Indoor Air Quality Assessment Checklist;
- ff. Code 300 Form 360-IH-IAQ Industrial Hygiene Survey Data Sheet – Indoor Air Quality;
- gg. American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs[®]) and Biological Exposure Indices (BEIs[®]).
- hh. U.S. Environmental Protection Agency (EPA)/National Institute for Occupational Safety and Health (NIOSH). Building Air Quality - A Guide for Building Owners and Facility Managers. Department of Health and Human Services (DHHS) Centers for Disease Control (CDC) (NIOSH) Pub 91-114, Washington, DC, GPO, 1991.
- ii. U.S. EPA. An Office Building Occupant's Guide to Indoor Air Quality. Washington DC, GPO, 1997.
- jj. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and American National Standards Institute (ANSI). Ventilation for Acceptable Indoor Air Quality. ASHRAE 62.1-2013, Atlanta, GA, 2013.
- kk. ASHRAE. Thermal Environmental Conditions for Human Occupancy. ANSI/ASHRAE Standard 55-2013, Atlanta, GA, 2013.
- ll. OSHA Technical Manual. Section III, Chapter 2, Indoor Air Quality Investigation, 1999.
- mm. ACGIH. Bioaerosols: Assessment and Control. Cincinnati, OH, ACGIH. 2007.
- nn. ACGIH. Industrial Ventilation: A Manual of Recommended Practice for Design. 28th Ed., Cincinnati, OH, 2013.

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- oo. ACGIH. Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance. 28th Ed., Cincinnati, OH, 2013.
- pp. OSHA. A Brief Guide to Mold in the Workplace. Washington DC, DOL, 2013.
- qq. General Services Administration: Integrated Pest Management (IPM) for Buildings: Desk Guide for Facilities Managers.
- rr. Approaches to Safe Nanotechnology: Managing the Health and Safety Concerns Associated with Engineered Nanomaterials. DHHS CDC NIOSH Publication No. 2009-125.
- ss. General Safe Practices for Working with Engineered Nanomaterials in Research Laboratories. DHHS CDC NIOSH Publication No. 2012-147.
- tt. Centers for Disease Control (CDC). Biosafety in Microbiological and Biomedical Laboratories (BMBL), 5th edition.
- uu. EPA 100/B-07/001 U.S. Environmental Protection Agency (EPA) Nanotechnology White Paper. Science Policy Council, February 2007.
- vv. ANSI /American Industrial Hygiene Association (AIHA) Z9.5-2012 Laboratory Ventilation.
- ww. ANSI / NFPA 70 - 2014, National Electrical Code (NEC), Article 500.
- xx. CDC NIOSH Occupational Cancer Carcinogen List.
- yy. U.S. DHHS CDC NIOSH Pocket Guide to Chemical Hazards, 2005-149.
- zz. U.S. DHHS NIOSH /The Effects of Workplace Hazards on Female Reproductive Health, No. 99–104, 1999.
- aaa. U.S. DHHS NIOSH /The Effects of Workplace Hazards on Male Reproductive Health, No. 96–132, 1996.
- bbb. U.S. DHHS, National Institutes of Health (NIH), National Institute of Environmental Health Sciences (NIEHS) National Toxicology Program, Report on Carcinogens, 2014.
- ccc. International Agency for Research on Cancer (IARC) Monographs on the Evaluation of Carcinogenic Risks to Humans.

P.5 CANCELLATION

GPR 1840.2B, Industrial Hygiene Program

P.6 SAFETY

All personnel who perform surveys in conjunction with this document will comply with all worksite safety and health requirements, including procedures and hazard controls required for use by workers.

P.7 TRAINING

IH civil service employees and contractors shall receive information and training on the hazards to which they may be exposed and the means of protection during the performance of surveys.

- a. Training for IH support contractors will be determined and provided by the IH contractor's Team Leader; and

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- b. IH civil service employees will have demonstrated competence in recognizing potential health hazards and shall have certification in subprogram areas and any relevant experience, in fulfillment of the position description.

See also Section 3.

P.8 RECORDS

Record Title	Record Custodian	Retention
Medical Evaluations required as part of IH Programs	Medical and Environmental Management Division (MEMD), (Health Unit)	<u>NRRS 1/127A*</u> Thirty days after separation, transfer to National Personnel Records Center (NPRC), St. Louis, MO. NPRC will destroy 75 years after birth date, 60 years after date of the earliest document in the folder if the date of birth cannot be ascertained, or 30 years after latest separation, whichever is later.
Employee Exposure Summaries Civil service employee exposure summaries from personal monitoring shall be maintained in conjunction with the employee's medical records.	MEMD Health Unit	<u>NRRS 1/129.5A*</u> Cut off upon employment termination. Destroy 30 years after cut off.
Similar Exposure Group (SEG) Potential Exposure Records Records of groups of persons who experience similar exposures, so that an exposure to any member of the group is representative of that of all members of the group.	Safety Division, Industrial Hygiene Office (IHO) or WFF Code 803 Safety Office	<u>NRRS 1/129.5A*</u>
Employee Personal Air Monitoring Results, Exposure Assessment Reports	Safety Division, IHO or WFF Code 803 Safety Office	<u>NRRS 1/129.5A*</u>

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IH Baseline and Follow-up Survey Reports	Safety Division, IHO or WFF Code 803 Safety Office	<u>NRRS 1/129.5A*</u>
IH Request-based Survey Reports IH survey reports will be maintained for all IH activities performed at GSFC (e.g. facility walk through inspections, ergonomic, noise, heat stress, and local/general ventilation surveys, employee complaint and exposure incident investigations and emergency response reports.)	Safety Division, IHO or WFF Code 803 Safety Office	<u>NRRS 1/129.5A*</u>
Area Air Monitoring Results and Reports	Safety Division, IHO or WFF Code 803 Safety Office	<u>NRRS 1/129.5A*</u>
Training Records	Managers and Supervisors	<u>NRRS 3/33C*</u> - Destroy or delete 5 years after separation of employee or when no longer needed, whichever comes first.
Calibration Certificates of Air Monitoring Instrumentation	Organization Owning Instrumentation	<u>NRRS 8/41.5B*</u> Cut off upon audit, analysis or quality check. Delete 5 years after cut off.

*NRRS – NASA Record Retention Schedules

P.9 MEASUREMENT/VERIFICATION

The IHO shall maintain statistics on the performance of the IH program. The statistics are compiled, reviewed, and reported annually to the Safety Division Chief. These statistics include, but are not limited to:

- a. Number of comprehensive baseline and follow up surveys conducted;
- b. Number of request-based surveys (indoor air quality, ergonomics, noise, PPE, consultative/chemical exposure) conducted;
- c. Number of samples (asbestos, lead, mold, metals, dusts, organic vapors, etc.) analyzed;
- d. Number of comprehensive and request-based (indoor air quality, ergonomics, noise, PPE, consultative/chemical exposure) surveys performed in relation to the number of surveys scheduled or requested;
- e. Percentage of high hazard operations or areas receiving annual follow up surveys;

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- f. Number of local exhaust ventilation (LEV) surveys conducted in relation to the number scheduled;
- g. Number of civil service employees receiving training (respiratory protection, hearing conservation, asbestos awareness) in relation to the number of civil service employees required to receive training;
- h. Average response time from survey request to evaluation and from survey request to verbal/written report;
- i. Average report time from onsite evaluation or sample collection (asbestos, mold, organic vapor) to written report;
- j. Percentage of asbestos and lead abatement submittals that are either approved or rejected within 3 working days;
- k. Percentage of customer satisfaction evaluations for training classes presented and surveys performed ranking above average to excellent in relation to total number of evaluations;
- l. Number of personnel who are nanomaterial users or whose job functions have exposure to nanomaterials; and
- m. Number of personnel who have received nanomaterial safety training.

PROCEDURES

In this document, a requirement is identified by “shall,” a good practice by “should,” permission by “may” or “can,” expectation by “will,” and descriptive material by “is.”

1. RESPONSIBILITIES

1.1 The Center Director will ensure that:

- a. A safe and healthful workplace is provided for all GSFC personnel; and
- b. All recognized hazards are controlled to the greatest possible extent.

1.2 Directors of shall:

- a. Ensure that job hazard analyses (JHAs) and process hazard analyses (PHAs) are developed for all operations with potential occupational health hazards, and reviewed annually and updated as needed; in accordance with GPR 1700.1 Occupational Safety Program at Goddard Space Flight Center and GPR 1700.2 Chemical Hygiene Program;
- b. Ensure that written directives (e.g. Work Instructions) and procedures implemented for controlling potential occupational health hazards are reviewed and updated every five years in accordance with GPR 1410.1 Directives Management;
- c. Ensure that directorate requirements governing the maintenance of safety data sheets (SDS) in the GSFC SDS database system are in place; and
- d. Ensure that directorate procedures are in place for reviewing design and modification packages for systems involving the use, storage, or processing of hazardous materials or which have the potential to expose civil service employees and contractors to chemical, biological, or physical agents.

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1.3 The Safety Division shall:

- a. Maintain and provide management oversight of the IH program in accordance with NPD 1800.2 and NPR 1800.1;
- b. Develop and implement methods (support agreements, contracts, etc.) to augment the IH program where required or where necessary personnel are not assigned;
- c. Assist requirements initiators in ensuring that acquisition package documents provided to the Procurement Operations Division include the appropriate safety and health requirements from NPR 1800.1 and other applicable Agency/Center documents; and
- d. Systems Safety personnel will advise Project Managers/Supervisors on hazardous chemical and physical agent exposure or contact the IHO for support.

1.4 The MEMD Health Unit shall:

- a. Perform medical evaluations and surveillance for civil service employees exposed to certain chemical, biological, or physical agents and those enrolled in medical surveillance or PPE programs in accordance with NPD 1800.2 and NPR 1800.1.
- b. Evaluate the medical condition of employees referred to the Health Unit for potential health effects from exposure to indoor contaminants.
- c. Provide medical treatment or referral to a specialist for an occupational illness.
- d. Notify the Safety Division IHO or WFF Code 803 Safety Office if there is a suspected occupational illness associated with a workplace exposure, if there are employees undergoing medical surveillance, and if there are individuals who may require exposure evaluation based on clinical findings.
- e. Provide consultation and examination to pregnant employees who work with reproductive and developmental health hazards, if deemed appropriate.
- f. Provide a written statement indicating any specific work limitations if it is determined through medical consultation or examination that an employee is restricted from work activities.
- g. Identify examination elements following an exposure incident and share that information with other medical providers providing services to exposed employees.
- h. Inquire about employees' exposure to nanomaterials and determine whether medical evaluations and surveillance are warranted for civil service employees who use or are exposed to nanomaterials as part of their job functions.

1.5 The Safety Division IHO shall:

- a. Manage all IH programs and GPRs identified in section 3.1, identify civil service employees required to participate in IH programs, and provide related training to civil service employees;
- b. Perform routine comprehensive baseline and follow-up IH surveys of GSFC organizations and facilities in order to identify potential occupational health hazards;

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- c. Perform request-based surveys to evaluate potential occupational health hazards due to chemical, physical, and biological agents, including concerns related to asbestos, lead, noise, thermal stressors, indoor air quality, and ergonomics;
- d. Conduct health hazard evaluations (HHE) of operations and evaluate personal exposure levels of civil service employees to chemical, physical, and biological agents, as necessary, and provide employee exposure summaries to the MEMD Health Unit;
- e. Conduct hazard assessments to determine recommended and required PPE for operations and processes associated with potential occupational health hazards in each code, laboratory, or shop, in accordance with OSHA 29 CFR 1910.132;
- f. Interpret regulations and guidelines related to chemical, physical, and biological exposures;
- g. Identify contractor support organization compliance with GSFC IH programs, and assist contractors in identifying personnel required to participate in IH programs;
- h. Provide managers and supervisors, building managers, facility operations managers (FOMs), requestors and other affected employees or responsible safety organizations with the results of IH surveys, HHEs, and assessments, including findings, recommended methods for the control of occupational health hazards, requirements to participate in medical monitoring programs upon consent, and requirements for compliance with applicable OSHA, State, NASA, and GSFC regulations and requirements;
- i. Investigate incidents involving occupational exposure to health hazards and referrals from other functions such as the Health Unit, Occupational Safety, and Systems Safety;
- j. Review proposed facility plans and designs for processes, procedures, construction, renovation, and modifications to assess the adequacy of hazard controls, and provide recommendations on mitigating risks;
- k. Provide technical assistance in the design and implementation of engineering controls, work practices, and selection of PPE when requested;
- l. Survey and certify the effectiveness of LEV systems;
- m. Participate in Directorate and Center Safety Council meetings, contractor safety forums, and other safety meetings; presenting on the status of IH programs and matters as necessary;
- n. Provide periodic reports to the Safety Division Chief. These reports include, but are not limited to, monthly and annual program status reports, and annual program audit and metrics reports;
- o. Provide IH program policy and Headquarters audit support to the WFF Safety Office;
- p. Provide IH support to the WFF Safety Office during emergency exercises, launch activities, and specific projects, as resources permit;
- q. Loan equipment and arrange for analytical support services for samples collected at WFF up to 10% of the sample analysis budget;
- r. Perform indoor air quality (IAQ) assessments with reference to current OSHA, EPA, ACGIH Ventilation Manual, and ASHRAE 55 and 62 recommended guidelines, and recommend corrective actions to resolve IAQ concerns;
- s. Provide technical guidance on minimizing the impact of construction, renovation, and maintenance activities on IAQ to FOMs and Facilities Management Division (FMD);
- t. Coordinate IAQ assessments with FMD;
- u. Provide consultation and assistance to supervisors and managers in reviewing and assessing chemical, biological, and physical agents for their potential to cause reproductive or developmental

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harm, especially related to individuals with a declared pregnancy, and determining preventive controls;

- v. Restrict the use of reproductive and developmental hazardous agents if they cannot be used without undue risk to health;
- w. Provide training on chemical, physical, and biological reproductive and developmental hazards upon request, including the proper use of engineering controls, work practices, and PPE; and
- x. Report nanomaterial assessment findings to the Nanotechnology Safety Committee Chairperson and supervisors, laboratory managers, contractor representatives, and other affected employees or responsible safety organizations, as necessary.

1.6 The WFF Safety Office Industrial Hygienists shall:

- a. Perform all IH functions required in this and other applicable IH GPRs at WFF, except where otherwise stated;
- b. Provide representation for various functional groups such as the GSFC Occupational Health Working Group and GSFC Asbestos Working Group;
- c. Maintain annual metrics for elements P.9 a, f., and k.;
- d. Communicate IH concerns to the Safety Division as necessary; and
- e. Obtain technical assistance, equipment, and analytical services through the Safety Division as necessary.

1.7 The Procurement Operations Division shall:

- a. Verify that services contracts include provisions for safety and health programs and training; and
- b. Verify that NASA Form 1707 and supporting documents are completed; and can assist the requiring organization and the Safety Division in completing the Initiator's Acquisition Checklist, GSFC Form 23-59 and other supporting documents as needed.

1.8 Office of Human Capital Management shall:

- a. Ensure that reasonable accommodation, alternative duties, and sick leave are considered when indicated by medical opinion.
- b. Serve as a facilitator or consultant to the employee and employee's supervisor regarding reasonable accommodation, alternative duties, and sick leave.
- c. Ensure that civil service employees complete GSFC Form 17-26 or 17-26W, Exit Clearance Record, prior to termination of employment. GSFC Form 17-26 and 17-26W require an exit medical evaluation clearance from the MEMD Division Health Unit (Greenbelt or Wallops) if the employee indicates workplace exposure to nanomaterials or certain other chemical or physical hazards.

1.9 Organization and Project Managers/Supervisors shall:

- a. Conduct periodic workplace inspections, review operations/procedures, and ensure JHAs (Form 23-60) and PHAs are developed and updated in accordance with GPR 1700.1 and GPR 1700.2;

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- b. Ensure that any mishap, close call, injury, or illness resulting from an occupational health hazard is reported to the NASA Mishap Information System (NMIS), in accordance with GPR 8621.4;
- c. Ensure that any SDSs for chemical substances not procured through GSFC's hazardous material management system are submitted to the Information and Logistics Management Division for inclusion in the hazardous material management system, and maintained in hard copy form until such inclusion, to comply with OSHA 29 CFR 1910.1200 and GPR 1700.8;
- d. Ensure that all civil service employees and contractors are aware of the chemical, physical, and biological hazards in their work area; are provided the required information and training, e.g. hazard communication, PPE, respiratory protection, hearing conservation, lead hazards, biological safety, and nanomaterial safety; are aware of protective engineering, work practice, administrative, and other control measures, and know what actions to take in an emergency, e.g. chemical spill or release;
- e. Ensure the proper operation of protective engineering controls in accordance with GPR 8800.2 LEV System Maintenance and Repair Management, GPR 1700.2 Chemical Hygiene Program, CDC BMBL, ACGIH Industrial Ventilation Manual, and other applicable standard operating procedures (SOPs);
- f. Provide appropriate PPE;
- g. Coordinate with the Safety Division IHO and MEMD using the Safety and Environmental Checklist (GSFC Form 23-73) during the planning process for any new construction, modification, or demolition of any facility and for any new process or operation or any change to an existing process or operation, including those that may interfere with the proper function of the heating, ventilation, and air-conditioning (HVAC) system and projects in which suspected asbestos-containing materials or lead-containing paints may be present. Coordination with FMD and the FOM should also take place;
- h. Coordinate with the Safety Division to ensure that safety and health requirements are included in requirements documents provided to the Procurement Operations Division for incorporation into contracts.
- i. Coordinate the scheduling of IH surveys with the IHO;
- j. Ensure that the results of HHEs are provided to affected civil service employees;
- k. Ensure that corrective actions or controls are implemented for nonconformances identified during IH surveys;
- l. Integrate IAQ concerns into purchasing decisions by avoiding procedures and products that generate pollutants, whenever possible;
- m. Provide reasonable accommodation, alternative duty, temporary reassignment, or restricted duty if it is determined by MEMD or the Safety Division that an employee's condition or exposure is such that work limitations are necessary;
- n. Consider employee sensitivities to chemical or biological substances with respect to space utilization decisions;
- o. Encourage civil service employees and contractors with signs or symptoms of exposure to occupational health hazards report to their responsible occupational health service provider;
- p. Contact the IHO or WFF Code 803 Safety Office for determining proper procedures or requirements related to the following:

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- (1) New processes with potential exposure to chemical, physical, or biological agents, or changes to existing processes that correspond to changes in exposure to chemical, physical or biological agents;
- (2) Work in confined spaces;
- (3) Operations involving excessive exposure to chemical, physical, and biological agents;
- (4) Operations involving carcinogens, reproductive and developmental hazards, and nanomaterials;
- (5) LEVs that do not appear to adequately control employee exposure to air contaminants or that have been modified in a way that may adversely affect airflow; and
- (6) Significant changes in the work environment of pregnant employees.

1.10 FMD Operations and Maintenance Branch shall:

- a. Ensure that operations and maintenance for building and HVAC systems meet applicable FMD requirements including GPR 8800.2 LEV System Maintenance and Repair Management, and that maintenance to HVAC systems does not adversely affect LEV;
- b. Assist in the investigation and remediation of IAQ concerns when requested by the Safety Division or WFF Code 803 Safety Office;
- c. Notify the Safety Division IHO or WFF Code 803 Safety Office and the Building Manager or FOM at least three days prior to conducting any activities within fifteen feet of the building's air intake;
- d. Notify the IHO or WFF Code 803 Safety Office, and FOM at least three days prior to conducting any roofing applications greater than 100 ft² or other operations that would significantly impact IAQ;
- e. Maintain the capability to mitigate hazards in a timely manner, including those related to water damage / intrusion in buildings; and
- f. Provide pest control services in accordance with the General Services Administration (GSA) publication Integrated Pest Management (IPM) for Buildings.

1.11 FMD Engineering and Planning shall:

- a. Plan, design and construct new facilities or facility modifications in accordance with current ANSI and ASHRAE 55 and 62 standards, and GSFC Forms 23-59 and 23-73;
- b. Coordinate the design, construction, and modification of facilities, including design reviews, with the FOM and either the Safety Division or WFF Code 803 Safety Office; and
- c. Design and implement construction and maintenance projects in a manner that minimize their impact on IAQ.

1.12 Building Managers shall:

- a. Assist the Safety Division IHO in conducting IAQ and other occupational health assessments by providing pertinent information on building layout and activities and by providing access to areas within the building;
- b. Notify the IHO and FOM at least three days prior to conducting any activities within 15 ft of the building's air intake, roofing applications greater than 100 ft² or other operations that would significantly impact IAQ;

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- c. Ensure corrective action is taken regarding maintenance or repairs to building systems as they pertain to occupational health issues such as IAQ; and
- d. Building Managers may consult EPA/NIOSH document, Building Air Quality - A Guide for Building Owners and Facility Managers and OSHA, A Brief Guide to Mold in the Workplace.

1.13 Facility Operations Managers (FOMs) shall:

- a. Communicate plans for maintenance, renovation, construction and pest control activities to building occupants, and be the central point of contact in accordance with the requirements in GPR 8830.1;
- b. Manage adherence to GPR 1800.1, GSFC Smoking and Other Tobacco Use Requirements;
- c. Assist the Safety Division IH or WFF Code 803 Safety Office in conducting IAQ assessments by providing pertinent information on building layout and activities and by providing access to areas within the building;
- d. At WFF, ensure corrective action is taken regarding maintenance or repairs to building systems as they pertain to occupational health issues such as IAQ;
- e. FOMs will ensure vehicles and other sources of combustion are not operating in the vicinity of building air intakes; and
- f. FOMs should consult EPA/NIOSH document, Building Air Quality - A Guide for Building Owners and Facility Managers and OSHA, A Brief Guide to Mold in the Workplace, as necessary.

1.14 Employees shall:

- a. Perform work in a safe manner consistent with the guidance provided to them;
- b. Notify supervisors of areas, operations, or equipment that may be a source of chemical, biological, or physical hazards;
- c. Report signs or symptoms of exposure to a health hazard to the supervisor and the responsible occupational health service provider;
- d. Use, maintain, and store PPE as required;
- e. Participate in workplace audits, hazard evaluations, and the development of written procedures and analyses;
- f. Complete all safety and health training requirements;
- g. Have the right to decline participation in medical surveillance programs, however such a declination may result in exclusion from performing certain work functions;
- h. Follow healthful work practices, including the use of engineering controls, work practices, SOPs, and JHAs to limit exposure to chemical, biological, and physical hazards, including reproductive and developmental hazards;
- i. Report any LEV or other controls that do not appear to adequately control exposure to air contaminants;
- j. Complete Forms 23-59, 23-73, and 23-75 if applicable, and IAQ forms when requested;
- k. Adhere to GPR 1800.1, GSFC Smoking and Other Tobacco Use Requirements;
- l. Limit the use of products with odors or that otherwise emit chemicals that may be bothersome or cause health symptoms to other occupants; and

- m. Employees may consult EPA guidance document, An Office Building Occupant's Guide to Indoor Air Quality, as necessary.

1.15 The Nanotechnology Safety Committee Chairperson shall:

- a. Coordinate representatives from each directorate and compliance function to meet and review nanotechnology processes and associated JHAs; and
- b. Coordinate the development, provision, and maintenance of a nanomaterial safety training course.

1.16 The MEMD, Environmental Management shall:

- a. Provide environmental compliance guidance to supervisors, managers, Contracting Officer's Representatives (CORs), Safety Division or WFF Code 803 Safety Office, Nanotechnology Safety Committee Chairperson and other affected employees or responsible safety organizations, as necessary; and
- b. Review and provide comments on submitted Safety and Environmental Checklists (GSFC Form 23-73).

2. GENERAL PROVISIONS

2.1 Applicable Exposure Limits

Occupational exposure limits (OEL) set by OSHA in 29 CFR 1910.1000, the ACGIH or NASA, whichever is most stringent, shall be used to evaluate occupational hazards. Other sources of OELs may include NIOSH, AIHA, or chemical manufacturers.

2.2 Comprehensive Baseline and Follow-up Surveys

Comprehensive baseline and follow-up IH surveys shall be conducted by the IHO or WFF Code 803 Safety Office for all codes at GSFC to establish baseline exposure levels to occupational health hazards; identify hazardous operations; characterize operations, processes and related employee exposure; evaluate health hazards; identify health hazard controls; form SEGs; and track operations for changes in processes and exposures.

- a. Surveys of new or modified operations should be conducted within 30 days of receiving notification from managers or supervisors.
- b. The frequency of follow-up surveys shall correspond to the health risk assessment rating assigned by the IHO as follow:
 - (1) Operations assigned a high risk assessment rating will receive an annual follow-up survey;
 - (2) Operations assigned a medium risk assessment rating will receive a follow-up survey every 2 years; and
 - (3) Operations assigned a low risk assessment rating will receive a follow-up survey every 3 years.

2.3. Health Hazard Evaluations (HHEs)

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HHEs (i.e., exposure assessments to chemical, physical, or biological agents) are performed to evaluate, monitor, and document civil service employee exposures.

- a. HHEs will be performed for the following chemical, physical, and biological agents:
 - (1) Those that have specific OSHA standards;
 - (2) Confirmed and probable carcinogens (according to recognized authorities such as the IARC, National Toxicology Program, EPA, OSHA, ACGIH) if contents are greater than 0.1% of the product;
 - (3) Possible human carcinogens based on animal studies if contents are greater than 50%;
 - (4) Reproductive/developmental hazards indicated on NIOSH list and Navy list of developmental and reproductive hazards;
 - (5) Extreme toxicants that have low immediately dangerous to life and health (IDLH) values (<10 parts per million (ppm)), low exposure limits (<1 ppm as an 8-hr TWA), are allergic sensitizers, or upon the judgment of the Industrial Hygienist.
- b. HHE sampling strategy shall incorporate appropriate sampling and analytical methods and be developed to measure civil service employee exposure levels against applicable OELs defined in Section 2.1;
- c. Civil service employee exposure monitoring shall characterize exposure for the SEG. This representative exposure data for similarly exposed personnel will be provided to the Health Unit;
- d. Affected civil service employees shall be notified of all monitoring results, in writing, within 15 working days of the IHO receiving the results;
- e. If civil service employee exposure is above the applicable OEL or action level, the IHO shall inform the employee of the corrective actions being taken (i.e., changes to engineering controls, work practices, etc.);
- f. Civil service employees with exposures at or greater than the action level shall be identified and arrangements made for periodic medical surveillance with the Health Unit, upon employee consent (declined participation may result in exclusion from performing certain work functions);
- g. HHEs shall reflect civil service employee exposure during operations as they are normally performed; and
- h. Follow-up HHEs will be performed to assess exposure conditions after any modifications that may increase employee exposure, and after the implementation of hazard control measures.

2.4. Hazard Assessments and Request-based Surveys

- a. A hazard assessment or request-based survey will be initiated by the IHO or WFF Code 803 Safety Office as a result of:
 - (1) Surveys of workplaces by the Safety Division or WFF Code 803 Safety Office that identify potential health hazards;
 - (2) Reviews of the hazardous material management system or chemical purchase reviews;
 - (3) IHO or WFF Code 803 Safety Office reviews of procedures or operations to identify hazardous agents; and
 - (4) Employee requests or complaints related to work-related health hazards, illness or injury.

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- b. The hazard assessment or request-based survey shall be aimed at collecting information related to evaluating workplace exposures and conditions; the frequency and duration of exposure; the severity of possible health outcomes; and the elimination of hazards. Interim hazard control measures will be recommended along with those more permanent.
- c. HHEs shall be conducted where there is a reasonable potential for civil service employee exposure to the hazardous material or condition. Supervisors will consult the IHO or WFF Code 803 Safety Office to determine the need for the evaluation.

2.5. Health Hazard Controls

Health hazard controls should be implemented, to the extent feasible, to eliminate or reduce exposure to occupational hazards. Engineering, work practice, and administrative controls are the primary means of reducing exposure to occupational hazards. PPE shall be used if it has been determined that engineering, work practice, and administrative controls are not sufficient to achieve acceptable limits of exposure, if such controls are not feasible, or while such controls are being instituted.

- a. Engineering controls include those controls that remove or isolate the hazard from the work environment. Engineering controls include eliminating the use of hazardous chemicals; substituting chemicals, materials, equipment, and processes with less hazardous ones; isolating the worker from the operation; enclosing or confining work processes; and installing general and LEV systems.
- b. Work practice controls include:
 - (1) Implementing procedures that minimize exposure to hazards by altering the manner in which an operation is performed;
 - (2) Inspecting and maintaining process and control equipment on a regular basis;
 - (3) Implementing good housekeeping procedures;
 - (4) Prohibiting eating, drinking, smoking, chewing tobacco, and applying cosmetics in regulated areas.
- c. Administrative controls include scheduling operations and setting work schedules in a manner that minimizes the number of workers and the duration of worker exposure to occupational health hazards, e.g. job rotation or scheduling high hazard operations for periods when the fewest employees are present.
- d. Examples of PPE include gloves, safety glasses, chemical splash goggles, face shields, ear plugs, helmets, safety shoes, protective suits, and respirators. To be effective, PPE must be individually selected, properly fitted, properly worn, regularly cleaned and maintained, stored in a sanitary manner, and replaced as necessary.

3. PROVISIONS FOR SPECIFIC IH FUNCTIONS

3.1 IH Programs and Training

- a. Civil service employees shall participate in certain IH programs and training if during a survey, the IHO or WFF Code 803 Safety Office identifies employees required for inclusion.
- b. Supervisors and civil service employees shall be notified by the IHO or WFF Code 803 Safety Office if they are required to participate in these programs.

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- c. IH programs and training with specific GPRs include, but are not limited to, the Respiratory Protection Program (GPR 1820.2, NPR 1800.1, 29 CFR 1910.134), Hearing Conservation Program (GPR 1820.1, NPR 1800.1, 29 CFR 1910.95), Hazard Communication Program (GPR 1700.8, 29 CFR 1910.1200), Chemical Hygiene Program (GPR 1700.2, 29 CFR 1910.1450), Food Service Sanitation, Inspection, and Foodborne Illness Prevention Program (GPR 1870.1), Asbestos Management Program (GPR1840.1), Ergonomics Program (GPR 1800.7), and a yet to be named lead management program.

3.2 Indoor Air Quality (IAQ)

The objective of this section is to ensure the provision of healthful IAQ through proper response to building-related conditions and concerns. IAQ concerns may be related to office, laboratory and shop processes and facility systems that are operating as intended, or may be related to ventilation and building envelope inadequacies and failures. Changes in building space use and facility systems in addition to renovation and maintenance activities may also affect IAQ. GPR 1800.1, GSFC Smoking and Other Tobacco Use Requirements covers requirements for smoking and tobacco use as they relate to IAQ.

- a. Building ventilation systems shall be maintained in accordance with ACGIH, ASHRAE and ANSI standards.
- b. Maintenance of building systems shall be conducted in accordance with FMD directives for the additional purpose of minimizing IAQ concerns.
- c. Sources of building leaks, moisture intrusion, and mold should be reported to the FMD, Building Manager, or FOM, and mitigated to the extent feasible to prevent mold and other microbial growth.
- d. Factors that adversely affect the comfort of occupants, such as inadequate air flow, high humidity, irritating odors, and temperature extremes should be reported to the responsible supervisor, FOM, or building manager.
- e. Construction and maintenance activities in occupied buildings should be planned and managed to minimize the release of dusts and other contaminants in accordance with OSHA Technical Manual Section III, Chapter 2 (V)(B)(2)(h).
- f. Sources of contaminants from construction and renovation activities near building entrance doors and building air intakes should be controlled to the extent practical by covering air intakes, temporarily shutting off the ventilation system, or other methods.
- g. IAQ assessments shall be conducted by the IHO function or WFF Code 803 Safety Office upon request or referral with the intention of evaluating the potential hazard and recommending mitigation controls.
- h. IAQ assessments shall be based on comparison of existing conditions with applicable OSHA, ACGIH, ASHRAE, and EPA standards and guidelines for exposure to chemicals and indoor environmental control and comfort.
- i. IAQ assessments will include the following general steps:
 - (1) Characterization of IAQ concern;
 - (2) Evaluation of building and indoor environment conditions;
 - (3) Coordination of assistance from FMD, MEMD, FOM, building managers, employees, and other applicable organizations for further evaluation;

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- (4) Completion of Form 360-IH-030, Indoor Air Quality Assessment Checklist or 360-IH-IAQ, Industrial Hygiene Survey Data Sheet – Indoor Air Quality (available from the Safety and Mission Assurance Configuration Management System: <https://ossmacm.gsfc.nasa.gov>) or similar form; and
- (5) HHE procedures.
- j. Carpets should be periodically vacuumed and cleaned to minimize it as a reservoir for dust, mold, bacteria, and other indoor air contaminants.
 - k. Procurement of new furniture and carpet, and building materials used will be specified to be low volatile organic compound (VOC) emitting products.
 - l. Vehicles should not be allowed to remain running near building entrance doors and building air intakes.
 - m. Supply air diffusers and exhaust air vents should be maintained in a manner free from obstruction.
 - n. Garbage should be disposed of in containers designated by the type of waste, e.g. containers for food waste; mixed use waste, recyclable materials.
 - o. Food and food waste should be stored or disposed of in containers in such a way that it does not attract pests, e.g. sealable containers and bags, designated waste containers, refrigerators.
 - p. Refrigerators, microwaves, and kitchenettes should be cleaned on a periodic basis.
 - q. IPM techniques shall be used to control insects and rodents.
 - r. Plants will be maintained properly, taking care to clean up water spills and not to have them placed on window fan coil units or other areas where leaves could decay in difficult to reach areas or interfere with building systems.

3.3 Ventilation

This section provides requirements for the design, use, and testing of LEV systems for controlling airborne contaminants.

- a. Design specifications of LEV systems shall be in accordance with OSHA regulations, the ACGIH Industrial Ventilation Manual, and ANSI standards.
- b. Repair and maintenance shall be conducted in accordance with GPR 8800.2 LEV System Maintenance and Repair Management.
- c. Moveable exhaust hoods should be positioned as close to the point of air contaminant generation as possible without interfering with the work and pulling air through the operator's breathing zone.
- d. LEVs shall be evaluated on initial installation and annually thereafter by the IHO or WFF Code 803 Safety Office to ensure proper airflow and operation.
- e. LEV systems evaluated to meet the appropriate airflow criteria specified by OSHA, the ACGIH Industrial Ventilation Manual, or ANSI Z9.5, shall receive a label indicating approval.
- f. LEV systems that do not to meet appropriate airflow criteria shall be tagged out of service.

3.4 Reproductive and Developmental Hazards

The objective of this section is to ensure protections for the reproductive health of all individuals at the Center from occupational exposures to substances known or suspected of being able to pose a hazard to human reproduction, and also for the development of unborn children of individuals at the Center.

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- a. Because short-term exposures to reproductive and developmental hazards can result in long-term health effects and because a developing embryo or fetus may be adversely affected by exposures lower than those generally considered to be safe for adults, keep exposures as low as reasonably achievable; that is, below published regulatory and recommended limits.
- b. Use of reproductive and developmental hazardous materials shall be controlled with the hierarchy of controls using in order of preference: engineering controls when feasible, administrative controls, and PPE. Use of materials can be denied by the IHO or WFF Code 803 Safety Office if they cannot be used without undue risk to health.
- c. Known reproductive hazards specific to an operation shall be included in the JHA for that operation.
- d. Personnel shall be informed by organization or project supervisors regarding the hazards and control methods associated with any reproductive and developmental hazards to which they may be exposed during their work operations.
- e. Medical surveillance requirements are based on the specific chemical or physical hazard present and the degree of potential exposure. Medical surveillance shall be provided according to NASA occupational health guidelines developed for chemical and physical exposure hazards. Personnel working with reproductive and developmental health hazards may undergo additional occupational health consultation, if pregnant, as well as an examination, if deemed appropriate by the MEMD.
- f. A review of chemical, biological, and physical agents in the workplace and associated exposure conditions shall be performed since only a small percentage of chemical, biological, or physical agents have OELs based on adverse reproductive effects.
- g. For workplaces with individuals with a declared pregnancy, an assessment of the chemical, biological, and physical agents present shall be performed to determine whether any are reproductive or developmental hazards, and what preventive steps to implement. Developmental disorders have been associated with maternal exposures to radiation, lead, carbon monoxide, polychlorinated biphenyls (PCBs), and organic mercury compounds, among others. Even though OELs have been established for many hazardous agents, many materials have not been studied extensively, and a developing embryo or fetus may be adversely affected by lower doses than those considered to be safe for adults.

3.5 Nanomaterial Hazards

This section defines the requirements and guidelines for operations involving exposure to nanomaterials and extraterrestrial reference materials. The requirements and guidelines are intended to prevent safety and health risk associated with the handling of and exposure to these materials. Nanomaterials include, but are not limited to, single-walled carbon nanotubes, multi-walled carbon nanotubes, graphene sheets, fullerenes, quantum dots, and catalysts; and particles may be liberated through cutting or abrading nanostructured materials. Nanoparticles have chemical and physical properties, including size, shape, surface area, aspect ratio, charge, and solubility, that are different from larger particles. Extraterrestrial reference materials may include lunar or planetary regolith dust or simulant.

- a. Since experimental studies have shown the toxicity of nanoparticles to be greater than the toxicity of same mass of larger particles of similar composition, exposures shall be kept as low as reasonably

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achievable and not exceed NIOSH recommended levels for nanomaterials or their chemical-specific exposure limits.

- b. Risk assessment and exposure prevention procedures referenced in NIOSH Publications No. 2009-125 and No. 2012-147, and EPA's Nanotechnology White Paper should be followed.
- c. JHAs shall be developed to document the process steps, hazards, and controls prior to commencing nanomaterial operations.
- d. An Environmental Checklist for Research and Development Project (GSFC form 23-75) shall be completed prior to working with the materials and provided to the Nanotechnology Safety Committee Chairperson.
- e. The handling or manipulation of nanomaterials and associated JHAs shall be reviewed by the Nanomaterial Safety Committee or IHO prior to the start of the activity.
- f. Work with dry, loose nanomaterials in quantities greater than 10 grams shall be performed in a low flow hood or glove box. Work with lesser quantities should be performed in a low flow hood or glove box.
- g. Low flow hoods for containing nanomaterials shall be operated with a face velocity of 60 to 80 feet per minute.
- h. Dry, loose nanomaterials shall be stored in sealed containers and double bagged or contained to prevent dispersion into the air and fire hazard. Metal containers minimize electrostatic discharge.
- i. Containers or bags of nanomaterials shall be properly labeled as containing nanomaterials.
- j. Working with nanomaterials in a liquid suspension, solution, or attached to substrate will require fewer controls.
- k. Initial and periodic medical monitoring as determined by the MEMD shall be instituted prior to working with nanomaterials.
- l. PPE hazard assessments shall be conducted by the IHO or WFF Code 803 Safety Office to identify appropriate PPE to prevent exposure.
- m. Minimum required PPE during the handling or manipulation of dry, loose nanomaterials shall include safety glasses, gloves, nonporous coveralls, shoe covers, and respirators, filtering face-piece or elastomeric with N100 or P100 filters, unless review by the IHO has downgraded these requirements. Gloves will be nitrile, neoprene or rubber and allow for being rinsed off once they are exposed to nanomaterials.
- n. High-efficiency particulate air (HEPA) filters shall be installed in exhaust systems used to control nanomaterial operations.
- o. A schedule for replacing HEPA filters shall be developed and followed.
- p. Exhaust systems for nanomaterials shall be labeled so that facilities personnel are aware of their potential exposure before maintenance or repair.
- q. Nanomaterial laboratories shall be designed so that the room has negative pressure in relation to adjacent halls and rooms;
- r. Personnel with exposure to dry, loose nanomaterials, including facilities personnel who may work on the exhaust system or replace filters, shall complete nanomaterial safety training through a GSFC instructor-led training course or through SATERN Course GSFC-003-08, GSFC Nanotechnology Safety Training, prior to the start of operations.
- s. Maintenance, modification and/or calibration of nanoparticle related equipment shall be conducted by personnel who are aware of the particular nanomaterial's hazards.

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- t. A preventative and general maintenance plan should be developed by the Laboratory Owner and approved by the Nanotechnology Safety Council for maintenance personnel to ensure hazards are mitigated.
- u. Laboratory equipment and facilities systems such as exhaust hoods should be cleaned prior to transfer or renovation.
- v. Work surfaces around nanomaterial operations should be cleaned periodically, such as weekly.
- w. Spills shall be cleaned immediately preferably using wet methods.
- x. Dry sweeping, vacuuming without a HEPA filter, and using compressed air shall be prohibited.
- y. If materials are deemed to present a fire explosion hazard, electrical equipment shall meet National Electrical Code (NEC), Article 500, Class III locations (dust-tight).
- z. Processes using nanomaterials will be evaluated by MEMD to identify waste streams prior to waste generation in accordance with GPR 8500.3;
- aa. The use of any manufactured nanomaterials that are defined as "chemical substances" under the Toxic Substances Control Act (TSCA) and which are not on the TSCA Inventory shall be reported to the EPA.
- bb. A pre-manufacture notice shall be submitted to the EPA by anyone intending to manufacture or import a chemical substance that is not on the TSCA Inventory of Chemical Substances.
- cc. Transportation, storage, use, and disposal of manufactured nanomaterials shall be conducted in accordance with all Federal, state, and local requirements.
- dd. The handling or manipulation of extraterrestrial reference materials shall be conducted in accordance with requirements for dry, loose nanomaterials as stated in previous paragraphs.

3.6 Biosafety Hazards

This section defines the requirements and guidelines for operations involving biological agents. The requirements and guidelines are intended to prevent safety and health risk associated with non-medical biological laboratory work. The use of BSL-3 and BSL-4 agents shall be prohibited.

- a. The use of genetically-modified agents, recombinant DNA molecules, or Biosafety Level 2 (BSL-2) or higher agents, and proposed facility designs and equipment purchases relating to these agents, shall be reviewed and approved of by the IHO prior to use.
- b. Biological agents shall be classified, used, and controlled in accordance with CDC BMBL recommended criteria. This includes identifying the appropriate BSL, using the hierarchy of controls, and completing the appropriate level of training.
- c. A JHA shall be completed by the organization using biological agents prior to start of operations involving biological agents.
- d. Biological safety cabinets and other containment devices shall be inspected and certified by the IHO prior to use and annually thereafter.

Appendix A – Definitions

- A.1 Action level** - the exposure level at which OSHA or other occupational exposure regulations take effect. This is generally one half of the occupational exposure limit (OEL) or OSHA permissible exposure limit (PEL) for a specific substance;
- A.2 Biological agent / hazard** – a biological pathogen that may cause illness. Examples include bacteria (foodborne pathogens), viruses (bloodborne pathogens), and fungi (mold);
- A.3 Biosafety level** – designation that defines the principal hazardous characteristics of agents that may be present as stated in Appendix B of NIH Guidelines.
- A.3 Chemical agent / hazard** - a chemical substance that may cause illness or injury;
- A.4 Contractor** - any entity that performs services at or on behalf of GSFC, including prime contractors and subcontractors;
- A.5 Hazardous material** – any chemical or biological substance that may cause health hazards as a result of exposure. A hazardous material may be radioactive, flammable, explosive, toxic, corrosive, biohazardous, an oxidizer, an asphyxiant, an allergen, or may have other characteristics that make it hazardous in specific circumstances;
- A.6 Health hazard evaluation (HHE)** – an evaluation of an individual’s or a group of individuals’ exposure to a chemical, physical, or biological agent, to characterize and assess the health risk of that agent;
- A.7 High risk assessment rating** – a health risk rating given to an operation when potential exposure to chemical, biological, or physical agents used or generated will likely result in a high score of combined severity and probability of health effects or produce an exposure that is:
- (1) greater than the action level under normal use;
 - (2) greater than one-half of the action level for confirmed or probable human carcinogens, under normal use;
 - (3) greater than one-half of the action level for extreme toxicants and sensitizers, under normal use;
 - (4) greater than 50% of the immediately dangerous to life and health threshold in the event of a release or spill;
 - (5) greater than 50% of the lower explosive limit in the event of a release or spill; or
 - (6) less than 16% oxygen in the event of a release or spill, and the oxygen deficiency hazard (ODH) classification is “1”.
- A.8 Immediately dangerous to life and health** - an atmospheric concentration of any toxic, corrosive or asphyxiates substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere;
- A.9 Low risk assessment rating** – a health risk rating given to an operation when potential exposure to chemical, biological, or physical agents used or generated will likely result in a low score of combined severity and probability of health effects or produce an exposure that is:
- (1) less than 10% of exposure limits under normal use;
 - (2) less than the detection limit for confirmed or probable human carcinogens, under normal use;
 - (3) less than the detection limit for extreme toxicants and sensitizers, under normal use;
 - (4) less than one-half of the immediately dangerous to life and health threshold in the event of a release or spill;

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- (5) less than 10% of the lower explosive limit in the event of a release or spill; and
- (6) greater than 19.5% oxygen in the event of a release or spill.

A.10 Medium risk assessment rating – a health risk rating given to an operation when potential exposure to chemical, biological, or physical agents used or generated will likely result in a medium score of combined severity and probability of health effects or produce an exposure that is:

- (1) greater than 10% of the exposure limit and less than the action level under normal use;
- (2) greater than the detection limit but less than one-half of the action level for confirmed or probable human carcinogens, under normal use;
- (3) greater than the detection limit but less than one-half of the action level for extreme toxicants and sensitizers, under normal use;
- (4) between 10% to 50% of the immediately dangerous to life and health threshold in the event of a release or spill;
- (5) between 10% to 50% of the lower explosive limit in the event of a release or spill; or
- (6) greater than 16% but less than 19.5% oxygen in the event of a release or spill, and the ODH classification is either “0” or “none”.

A.11 Occupational exposure limit (OEL) - the airborne concentration of a substance that a worker may be exposed to, as determined by recognized authorities, including OSHA PELs; American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLV), specific NASA or GSFC Standards, National Institute for Occupational Safety & Health (NIOSH) recommended exposure limits (REL), and others referenced in NPR 1800.1;

A.12 Oxygen deficiency hazard (ODH) classification – rating given to a cryogenic or other operation with the potential of creating an oxygen deficient atmosphere. The ratings of 1, 0, and none are arrived at using a calculation worksheet available on the safety1st website.

A.13 Permissible exposure limit (PEL) - the airborne concentration of a substance that a worker may be exposed to under OSHA regulations, 29 CFR 1910.1000. PELs are based on an 8-hour time-weighted average (TWA) exposure;

A.14 Physical agent – a source of energy that may cause injury or disease. Examples include noise, vibration, radiation, and extremes in temperature and pressure; and

A.15 Similar exposure group (SEG) - a group of individuals having similar exposures to chemical, physical, or biological agents for a given work process, and for which medical surveillance may be required.

Appendix B – Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-conditioning Engineers
BEI	Biological Exposure Index
BMBL	Biosafety in Microbiological and Biomedical Laboratories
BSL	Biosafety Level
CDC	Centers for Disease Control
CFR	Code of Federal Regulations
COR	Contracting Officer’s Representative
DHHS	Department of Health and Human Services
DNA	Deoxyribonucleic Acid
DOL	Department of Labor
EPA	Environmental Protection Agency
FMD	Facilities Management Division
FOM	Facility Operations Manager
FRC	Federal Records Center
GPR	Goddard Procedural Requirements
GSA	General Services Administration
GSFC	Goddard Space Flight Center
HEPA	High-efficiency Particulate Air
HHE	Health Hazard Evaluations
HVAC	Heating, Ventilation, and Air-conditioning
IAQ	Indoor Air Quality
IARC	International Agency for Research on Cancer
IDLH	Immediately Dangerous to Life and Health
IH	Industrial Hygiene
IHO	Industrial Hygiene Office
IPM	Integrated Pest Management
JHA	Job Hazard Analysis
LEV	Local Exhaust Ventilation
MEMD	Medical and Environmental Management Division
NASA	National Aeronautics and Space Administration
NEC	National Electric Code
NIH	National Institutes of Health
NIEHS	National Institute of Environmental Health Sciences
NIOSH	National Institute for Occupational Safety and Health
NMIS	NASA Mishap Information System
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
NPRC	National Personnel Records Center
NRRS	NASA Records Retention Schedules

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ODH Oxygen Deficiency Hazard
OEL Occupational Exposure Limit
OSHA Occupational Safety and Health Administration
PCB Polychlorinated biphenyls
PEL Permissible Exposure Limit
PHA Process Hazard Analyses
PPE Personal Protective Equipment
PPM Parts per million
REL Recommended Exposure Limit
SDS Safety Data Sheet
SEG Similar Exposure Group
SOP Standard Operating Procedure
TLV Threshold Limit Value
TSCA Toxic Substances and Control Act
TWA Time-Weighted Average
VOC Volatile Organic Compound
WFF Wallops Flight Facility

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CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	03/30/2007	Initial Release
A	11/10/2010	Administratively Revised to update the Responsible Office Code, Organization Title and organization name within the document.
B	02/27/2012	Revised with minor updates to referenced forms and directives.
C	04/14/2016	Revised with major updates to add sections for Indoor Air Quality, Reproductive and Developmental Hazards, and Nanomaterial Hazards, in accordance with NPR 1800.1 requirements.