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Approval

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Table of Contents

1.0 INTRODUCTION 1
1.1 Purpose 1
1.2 Scope 1
1.3 Applicability 1
2.0 SAFETY PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES 2
2.1 Specific References 2
2.2 Safety Meetings 2
2.2.1 John C. Stennis Space Center (SSC) Safety and Health Council 2
2.2.2 NASA Safety Awareness Day Meetings 3
2.2.3 Supervisor/Worker Safety Meetings 4
2.3 Safety & Health Inspections 4
2.3.1 General Requirements 4
2.3.2 Safety Inspection Reporting 5
2.4 Safety & Health Training, Education, Certification and Technical Skills 5
2.4.1 Safety and Certification Training Instruction 5
2.4.2 Responsibilities 6
2.4.3 Certification Program Requirements 6
2.5 Danger Tag 10
2.5.1 Danger Tag Definition and Use 10
2.5.2 Operational Requirements and Procedures 11
2.6 Maximum Worktime Policy 12
2.6.1 General Requirements 13
2.7 Variances from Safety Requirements 13
2.8 Imminent Danger Situations 14
2.8.1 Responsibilities/Requirements 14
2.9 Safety of Motor Vehicles and Mechanized Equipment Used on SSC 14
2.9.1 General Equipment Requirements 15
2.9.2 Additional SSC Requirement(s) 15
2.9.3 Specific Motor Vehicles Requirements 15
2.9.4 Safety Requirements for All Terrain Vehicles (ATVs) 16
2.9.6 Material Handling Equipment Requirements 17
2.9.7 Site Clearing Equipment 17
2.9.8 Rollover Protective Structures (ROPS) 17
2.10 SSC Aviation Safety Program 17
2.10.1 SSC Aviation Safety Program Applicability 17
2.10.2 General Policy/Requirements 18
2.10.3 Responsibilities 18
2.10.4 Requirements for Non-NASA Aircraft 18
2.10.5 Use of Non-NASA Aircraft 19

2.10.6 Requirements for Aircraft Operations at SSC 20
2.10.7 Operating Conditions Acceptance and Approval 21
2.10.8 Required Documentation for SSC Aircraft Operations 22
2.10.9 Aircraft Management Office (AMO) Responsibilities 22
2.10.10 Remotely Piloted Vehicles (RPV) 22
2.11 SAFETY CRITICAL Procedures 23
2.12 System Safety and Risk Assessment.... 24
2.12.1 System Safety and Risk Assessment General Requirements....24
2.12.2 System Safety and Risk Assessment Responsibilities....25
2.12.3 System Safety and Risk Assessment Facility Risk Indicator (FRI)....25
2.12.4 Hazard Analysis....28
3.0 INDUSTRIAL SAFETY OPERATING REQUIREMENTS 30
3.1 Specific References.... 30
3.2 Responsibilities.... 30
3.3 Stennis Space Center Fundamental Safety Rules and Procedures.... 30
3.4 Fundamental Safety Rules and Procedures - Lightning Protection 33
3.4.1 Lightning Protection Responsibilities....33
3.4.2 Lightning Protection Operations during Lightning and Electrical Storms33
3.5 Fundamental Safety Rules and Procedures - Personal Protective Equipment..... 34
3.6 Fundamental Safety Rules and Procedures - Fall Protection in Industrial & Construction Activities 34
3.7 Fundamental Safety Rules and Procedures - Buddy System 34
3.8 Fundamental Safety Rules and Procedures Safe Use of Powered/Non-powered Handheld Tools at SSC.... 35
3.9 Fundamental Safety Rules and Procedures - Safety Requirements for Machine/Machinery Guarding.... 36
3.9.1 Machine/Machinery Guarding General Requirements 36
3.9.2 Machine/Machinery Guarding Specific Equipment Requirements 36
3.9.3 Machine/Machinery Guarding General Operational Requirements 36
3.10 Fundamental Safety Rules, Procedures, and Requirements for Control of Hazardous Energy (Lockout/Tagout & Non-Service/Maintenance Hazardous Energy Isolation).... 37
3.10.1 General Safety Requirements for Control of Hazardous Energy (LO/TO)38
3.11 Fundamental Safety Rules and Procedures General Safety Requirements in Welding/Cutting Operations 45
3.12 Fundamental Safety Rules and Procedures - General Safety Requirements for Recreational Safety at SSC 46
3.12.1 Recreational Safety Responsibilities....46
3.12.2 Recreational Safety Requirements....47
3.13 Fundamental Safety Rules and Procedures - Safe Transport, Storage, and Use of Compressed Gases in Portable Cylinders 47
3.13.1 Safety of Storing, Transporting, and Using Compressed Gases in Portable Cylinders General Requirements....48

3.14 Fundamental Safety Rules and Procedures - Electrostatic Discharge Control 48
3.15 Fundamentals of Safety Rules and Procedures - Electrical Safety Requirements 50
3.15.1 Electrical Safety Responsibilities 50
3.15.2 Electrical Safety Small Appliances for Personal Use 51
3.16 Fundamentals of Safety Rules and Procedures – Scaffold Safety 51
3.16.1 Applicability 51
3.16.2 General Safety Requirements 51
4.0 INDUSTRIAL HEALTH PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES 54
4.1 Specific References 54
4.2 Respiratory Protection Program 54
4.3 Chemical Hygiene Policy for Laboratory Facilities 54
4.3.1 Responsibilities 54
4.3.2 Requirements 55
4.4 Ionizing Radiation Protection 55
4.5 Non-Ionizing Radiation 55
4.6 Safety and Health Requirements for Hazardous Noise Exposures 56
4.7 Safety and Health Requirements for Asbestos Management and Awareness 56
4.8 Chemicals/Hazardous Materials Safety 56
4.9 Bloodborne Pathogen Health Program 56
4.10 Automated External Defibrillator (AED) Program 56
4.10.1 Purpose 56
4.10.2 Scope 56
4.10.3 Responsibility 56
4.10.4 Process 57
4.11 Ergonomics Program 60
4.12 Smoke-Free Workplace 60
4.12.1 Requirements 60
4.12.2 Responsibility 60
5.0 HAZARDS SAFETY AND HEALTH OPERATING PROCEDURES 62
5.1 Specific References 62
5.2 Confined Space Entry Program for SSC 62
5.2.1 Responsibility 62
5.2.2 General Requirements 64
5.2.3 Specific Requirements (The following requirements are additions to those required by OSHA) 64
5.2.4 Definitions 65
5.3 General Hydrogen Entry 67
5.3.1 Responsibilities 67
5.3.2 General Entry Requirements 67
5.3.3 General Safety Requirements 68
5.3.4 Specific Purging/Inerting/Purification Methods 69
5.4 Oxygen and Combustible Gas Meter Operations 71

5.4.1 Responsibilities 71
5.4.2 General Safety Requirements 71
5.4.3 Safety Requirements 72
5.4.4 Safety Requirements for Specific O_2/Toxic Atmosphere/Combustible Gas Meters 72
5.5 Safe Handling of Triethylaluminum/Triethylborane (TEAL/TEB) 73
5.5.1 General Safety Requirements 73
5.5.2 Environmental Requirements 76
5.5.3 Emergency Procedures 77
5.6 Safety Requirements for Gaseous and Liquid Hydrogen 79
5.6.2 General Requirements 80
5.6.3 Environmental Requirements 80
5.7 Safety Requirements for Liquid/Gaseous Oxygen Systems 81
5.8 Cryogenics Safety 81
5.8.1 Management/Supervision Responsibilities 81
5.8.2 Requirements 81
5.9 Safety Requirements Pressure Systems 83
5.9.1 Requirements 83
5.10 Explosive Safety 90
5.10.1 Responsibilities 90
5.10.2 Requirements 90
5.11 Process Safety Management (PSM) 92
5.11.1 Responsibilities 92
5.11.2 General Requirements 92
5.13 Safe Handling of Hydrocarbon Based Propellants 93
5.13.1 General Safety Requirements 93
5.13.2 Emergency Procedure 93
5.13.3 Environmental Requirements 93
5.13.4 Materials and Equipment Compatibility 93
5.13.5 Transportation 94
5.14 Safe Handling of Hydrogen Peroxide Propellants 94
5.14.1 Safety Requirements 94
5.13.3 Environmental Requirements 97
5.14.3 Emergency Procedures 98
5.15 Critical Lifting Operations 98
5.15.1 Requirements 98
6.0 FIRE SAFETY AND HEALTH OPERATING PROCEDURES 102
6.1 Specific References 102
6.2 Flame Permits Procedure 102
6.3 Selection, Use, and Inspections of Fire Extinguishers 102
6.3.1 Responsibilities 102
6.3.2 Requirements 103
6.4 Emergency Response/Employee Evacuation of Personnel in the Event of Fire 103

6.4.1 Responsibilities 103
6.4.2 General Requirements 103
6.4.3 Emergency Fire Evacuation Plan 104
6.5 Fire Symbols 106
6.5.1 Responsibilities 107
6.5.2 Requirements 107
6.6 Safety Requirements for Using/Storing/Dispensing Gasoline 107
6.6.1 General Requirements 107
6.7 Natural Gas Systems 108
6.7.1 General Requirements 108
6.7.2 Operational Requirements 108
7.0 CONSTRUCTION SAFETY AND HEALTH OPERATING PROCEDURES 108
7.1 Specific References 108
7.2 Construction Safety Program Plans 109
7.2.1 Requirements 109
7.3 Excavations and Trenching Safety 109
7.3.1 General Requirements 109
7.4 Pile Driving 111
7.4.1 Responsibilities 111
7.4.2 Requirements 111
7.5 Safety in Concrete and Masonry Construction 113
7.5.1 General Requirements 114
7.5.2 Specific Requirements for Concrete Finishing Equipment 114
7.5.3 Specific Requirements for Cast-in-place Concrete 114
7.6 Diving/Underwater Work 115
7.6.1 General Requirements 115
7.6.2 Specific Requirements 115
7.7 Building Modifications within Occupied Facilities 116
7.7.1 General Requirements 116
7.7.2 Specific Requirements 116
7.8 Steel Erection 118
7.8.1 Responsibilities 118
7.8.2 Requirements 119
7.9 Safety Requirements Related to Roofing Jobs at SSC 120
8.0 RECORDS AND FORMS OR QUALITY RECORDS AND FORMS 121
9.0 ACRONYMS, ABBREVIATIONS, AND DEFINITIONS 121
9.1 Acronyms 121
9.2 Definitions 125
APPENDIX A – SAFETY RULES FOR DRILL PRESSES 130
APPENDIX B – REQUIREMENT FOR OFFSITE CONTRACTOR LOCKOUT/TAGOUT (LO/TO) 131
APPENDIX C – RECREATIONAL FACILITIES 133
APPENDIX D – AED PROTOCOL AND CHECKLISTS 140

APPENDIX E – CONFINED SPACE ENTRY PROGRAM REQUIREMENTS FOR CONSTRUCTION ACTIVITIES AT SSC 146
APPENDIX F – EXPLOSIVE SAFETY SUBMISSION/SITE PLANNING 149
APPENDIX G – OUTLINE OF CONTRACTOR'S SAFETY PROGRAM PLAN 151
APPENDIX H – STENNIS SPACE CENTER (SSC) SCAFFOLD INSPECTION CHECKLIST 155
APPENDIX I- STENNIS SPACE CENTER CONSTRUCTION SITE INSPECTION CHECKLIST 160

FIGURES

Figure 1. Danger Tag 12

TABLES

Table 1. SSC Occupational Safety and Health Administration (OSHA) Standard Training Requirements 8
Table 2. Facility Risk Indicator 26
Table 3. Facility Categorization Worksheet NASA Facility Risk Index 27
Table 4. Summary Hazard Risk Index 29
Table 5. Hazard Risk Index Actions 29
Table 6. Dives Less than 33 Feet in Depth 115
Table 7. Dives Over 33 Feet in Depth 116

1.0 INTRODUCTION

1.1 Purpose

All National Aeronautics and Space Administration (NASA) and NASA contractor employees share in the responsibility of:

- creating and maintaining a workplace environment free from recognized health and safety hazards;
- conducting operations in a safe and responsible manner; and,
- ensuring full compliance with applicable regulatory requirements.

Fulfilling this responsibility requires a conscious, continued effort to promote safe work practices for all employees at John C. Stennis Space Center (SSC). The success of these health and safety efforts will be reflected in how well these practices are implemented throughout SSC's operations.

1.2 Scope

Figures, illustrations, tables, charts, etc., are included in the text of the procedures. Lengthy or more detailed instructional materials and other attachments that supplement the requirements of the procedures are provided in the Appendices.

1.3 Applicability

SSC agencies/organizations and their respective contractors are responsible for complying with the procedures and requirements listed herein to the extent specified by their contractual documents.

2.0 SAFETY PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES

2.1 Specific References

29 CFR 1960, *Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters*
14 CFR Parts 1 - 198, *Federal Aviation Regulations* (FARs)
FAA Form 337, *Major Repair and Alteration (Airframe, Powerplant, Propeller, or Appliance)*
MIL-STD-882D, *System Safety Program Requirements*
NASA-STD-8719.9, NASA Technical Standard, *Facility System Safety Guidebook*
NPD 7900.4, *NASA Aircraft Operations Management*
NPR 3600.1, *NASA Procedural Requirement Attendance and Leave*
NPR 7900.3, *NASA Procedural Requirement (NPR), Aircraft Operations Management Manual*
NPR 8621.1, *NASA Procedural Requirement for Mishap, Reporting, Investigating and Recordkeeping*
SSTD-8070-0007-CONFIG, *John C. Stennis Space Center Standard (SSTD) Variance and Alternate Standard Requests*
SCWI 8700-0001, *John C. Stennis Space Center Common Work Instruction (SCWI) Hazard Analysis Preparation*
SPR 8715.1, *SSC Safety and Health Procedural Requirements*
SPR 1600.1, *SSC Security Requirements Handbook*
SSC Form 405, *Safety Inspection Report*
SSC Form 517, *Variance Request*
SSC Form 602, *Request for Physical / Surveillance Examination for Certification*
SSC Form 727, *Employee Certification Card*
Title 63, Mississippi Motor Vehicle and Traffic Regulations

2.2 Safety Meetings

2.2.1 John C. Stennis Space Center (SSC) Safety and Health Council

Responsibilities:

a. NASA Safety & Mission Assurance (S&MA) Office. The S&MA will serve as the chair of the SSC Safety Management Council. Responsibilities shall include:
   1) Choosing a major theme/topic for the meeting.
   2) Arranging for guest speakers to be present at the meeting.
   3) Facilitating the meeting.

b. Facility Operating Services Contractor (FOSC). The FOSC is responsible for assisting the current chair of the SSC Safety Management Council in the following:

1) Notifying concerned parties of the Safety Management Council Meetings.
2) Maintaining an up-to-date list of Council members.
3) Arranging for the meeting room/area in which to host the meeting.
4) Keeping minutes of the meeting and forwarding copies of the minutes to all concerned parties.
5) Procuring (i.e., preparing the paperwork) guest speakers and/or special videos to be used during Council meetings.
6) Preparing a short synopsis of changes to federal/state regulations in the areas of safety; industrial hygiene/environmental health; radiation protection; transportation safety; and informing the Council.

c. Resident Agencies. Resident agencies and their contractors are responsible for designating a representative to attend and participate in the quarterly SSC Safety Management Council meetings.

d. NASA Contractors. The manager of safety for each NASA contractor and his/her safety and health personnel will attend quarterly Council meetings and provide professional support on an as-needed basis to fulfill the purpose of the meeting.

e. NASA Managers. NASA's mid-level managers or their designated representatives are strongly encouraged to attend the quarterly meetings to keep abreast of changing regulations.

Typical SSC Safety Management Council meeting formats/agenda will include:

a. Welcoming/Introduction of new members.
b. Addressing SSC unique safety problems/concerns.
c. Highlighting unique SSC Safety and Health Operating Procedures.
d. Updating members on recent or near term changes to federal/state safety and health regulations.
e. Viewing a safety video available for checkout.

2.2.2 NASA Safety Awareness Day Meetings

Typical formats/agenda for NASA Safety Awareness Day Meetings will include:

a. All Hands: An all hands (all individuals are strongly encouraged to attend) meeting for NASA employees and the top-level managers of NASA's contractors involving a short safety program.
b. Field Visits: Field visits by managers of NASA and NASA contractors of work sites to discuss safety with personnel.
c. Special Event: A special safety event.

2.2.3 Supervisor/Worker Safety Meetings

Objectives of the meetings are to:

a. Promote Safety: Promote safety (both on the job and off the job).
b. Supplement Instruction: Supplement instruction and training.
c. Address Concerns: Address any new safety concerns arising during the month.

The time frame of the meeting will vary according to the subject matter, but normally meetings should last 30 to 60 minutes.

2.3 Safety & Health Inspections

2.3.1 General Requirements

a. Construction Site Inspections (Frequency-Weekly). Due to the inherent hazards involved in construction, each construction site shall be inspected on a weekly basis at a minimum or more frequently as accident potential requires. Appendix J shall be used when conducting construction site inspections.
b. Building Inspections (Frequency-Annual). Inspections of all SSC buildings shall be conducted by the FOSC on an annual basis. The purpose of these inspections is to determine the general safety status of the building. SSC Form 405 located on the SSC Electronic Forms Index shall be used to document this inspection. For inspection reports containing unabated hazards with a status of +30 days, the Facility Manager or Area Manager shall prepare a Corrective Action Delinquency Report and forward it to NASA/SSC S&MA with copies to the manager or the custodian of the facility.
c. Process/Shop Inspections (Frequency-Bimonthly). Each operational area shall be subjected to process or shop inspections intended to identify unsafe work practices and conditions in the area.
d. General Inspections (Frequency-Administrative Areas Quarterly). The overall success of a safety program depends on continuous inspections by supervisors and others responsible for activities and operations.
e. Environmental/Health Audits/Inspections (Frequency-Quarterly/Biannual). Environmental Health audits will be performed for NASA and NASA contractor operational areas on either a quarterly or semi-annual rotation. The audit frequency is determined by past audit results (i.e., consistently high-scoring work areas are audited less frequently than areas receiving low audit scores). A team comprised of representatives from NASA and onsite contractors' industrial hygiene and environmental professionals will perform the audits.
f. Resident Agencies Inspection. Inspection of Resident Agency facilities and operations will be conducted to assure compliance with 29 CFR 1960.
g. Crane/Pile Driving Equipment Inspections. All crane or pile driving equipment to be used at SSC must be inspected by NASA and FOSC field engineers prior to their setup and use.

h. Special Inspections. New equipment and procedures, relocation and revisions of operations, and system modifications occur on a frequent basis. In each situation, the prevention of accidents is better served if the change is inspected prior to "start-up." Therefore, inspections of this type shall be conducted as occasions develop to determine if controls are adequate or if new hazards have been created in an operation.

2.3.2 Safety Inspection Reporting

The cognizant safety engineer/specialist shall document hazards and/or non-compliant conditions observed. Reports of inspections shall be submitted to NASA S&MA. Each Safety Inspection Report shall include:

a. Identification of the area and shop/agency inspected.
b. The date of the inspection.
c. A description of the hazardous and/or non-compliant condition.
d. Status. The status will be listed as OPEN, In Process (IP), +30, (or >30), No Response (NR) or CLOSED based on the following descriptions:

- **OPEN** – First time a hazardous condition is recorded.
- **IP (In Process) –** Corrective action has been assigned or risk has been accepted by the agency responsible for corrective action.
- **+30 –** Item open > 30 days beyond its respective Risk Assessment Code (RAC) determined corrective action completion date.
- **NR (No Response) –** If the supervisor or building custodian fails to reply by the reply due date on the inspection cover letter, enter NR.
- **CLOSED –** If corrective action has been completed and the Safety Engineer/Specialist has verified its completion; or when a Risk Acceptance Document (RAD) has been approved.

e. The Risk Assessment Code (RAC). The RAC will be assigned to each hazardous/non-compliant condition. See Section 2.12 Table 2, “Facility Risk Indicator,” for the basic RACs in use at SSC.
f. Hazard Group.
g. Item number.

2.4 Safety & Health Training, Education, Certification and Technical Skills

2.4.1 Safety and Certification Training Instruction

Instructor-based courses are available through the onsite FOSC and Test Operations Contractor (TOC). Supplemental training is available through the NASA Safety Training Center (NSTC) and on the Internet through the System for Administration, Training, and Educational Resources for NASA (SATERN) at: https://satern.nasa.gov/elms/learner/login.jsp.

SSC safety and health training is available to SSC resident agencies and commercial customers.

2.4.2 Responsibilities

a. FOSC shall:
   1) Provide Regulatory safety and health training for NASA/SSC, NASA contractors and resident agencies, as outlined in Table 1 of this procedure.
   2) Maintain SSC Safety and Health consolidated training schedule.
   3) Provide Hazardous Operational Training, as outlined in Table 1.
   4) Provide development or procurement training services as required.

b. TOC shall:
   1) Provide specialized Safety Training associated with rocket propulsion testing, as outlined in Table 1.
   2) Provide Hazardous Operational Certification, as outlined in Table 1.
   3) Avoid duplicating FOSC-provided safety and health courses.

c. NASA S&MA shall: develop, maintain and ensure a comprehensive SSC Safety and Health Training Program.

d. Responsible Organizations shall:
   1) Provide a member to serve on the SSC Training and Certification Board.
   2) Implement a thorough and complete safety and health training program and develop implementing procedures, detailing the training certifications and re-certification program. This program shall be submitted to and approved by the SSC Training and Certification Board.
   3) Analyze, assess and define which process or skill requires certification.
   4) Identify personnel requiring certification and be responsible for ensuring training and qualification of their employees.
   5) Provide instructors to train and certify personnel in critical process elements.
   6) Maintain a file for each employee's certification containing the original SSC Form 602, *Request for Physical / Surveillance Examination for Certification,* copies of all test documents and any other documents utilized to establish the employee's certification status.

2.4.3 Certification Program Requirements

a. Demonstration of Skills. Personnel who perform or control hazardous operations shall demonstrate that they possess the necessary knowledge, skill, judgment, and physical ability to do the job in a safe, healthful and qualified manner.

b. SSC personnel working in the occupational categories listed below shall have current Hazardous Operation Safety certification:
   - Firefighters.
   - Propellant or explosives users per NSS 1740.12.
   - Propellant or explosives handlers.
   - Rescue personnel.
   - Self-contained breathing apparatus (SCBA) users.
   - High-voltage electricians.
   - High-pressure liquid/vapor/gas system operators.
   - Welders.
   - Laser operators/maintenance personnel.
   - Crane operators.
   - Riggers for hoisting operations.
   - Heavy equipment operators.
   - Confined space entry personnel.
   - Lockout/tagout personnel.
   - Hazardous materials handlers.
   - Personnel (technicians, engineers) performing hazardous operations.
   - Environmental personnel.

c. Restrictions of Duty. No employee shall operate equipment or perform critical processes when the SSC Medical Director or the NASA/SSC S&MA Office determines such operations may create a hazard to the employee, property, and/or other individuals. This restriction shall include limited duty assignments due to temporary or permanent medical reasons.

d. Certification Requirements. Certification requirements will include, but are not limited to, the following:
   1) Physical Examination (documented).
   2) On-the-Job Training (documented).
   3) Classroom Safety Training (documented).
   4) Written Testing (if applicable).
   5) Performance/Operational Qualification Testing (if applicable).

e. Requesting and Documenting Certification Training. Each organization shall utilize SSC Form 602, *Request for Physical / Surveillance Examination for Certification*, for documenting the certification of their employees. It shall contain the following:
   1) Name of the person who is to be certified.
   2) Operation that requires certification.
   3) Signature and date of appropriate management.
   4) Signature and date of instructor.

f. Physical Examinations. The SSC Medical Director will determine the scope of the physical examination. Such determinations shall establish baseline or occupational exposure limits and/or the health requirements.

g. Employee Certification Card. Upon successful completion and documentation of the requirements established for the operations requested, a certification card (SSC Form 727, *Employee Certification Card*) will be issued to the employee. The card shall indicate (at a minimum) the employee's name, company, skill certified in, and date of expiration. A current certification card must be carried on the person performing the specific operation for which he/she is certified.

h. Recertification Requirements. Specific recertification requirements shall be established for each operation, activity, or process that requires certified employees. The criteria for determining a candidate's need for recertification will be based on the following:
   1) The specific skill.
   2) Employee proficiency.
   3) Change in certification requirements.

i. Certification Process Validation: Training, testing and physical examination activities to assure reliability and accuracy of the certification process will be monitored and validated on a yearly basis.

j. Instructor Qualifications Validation: The list of operational qualifications for instructors responsible for operational qualification testing will be monitored and validated.

Table 1. SSC Occupational Safety and Health Administration (OSHA) Standard Training Requirements

Required Training	OSHA Standard	Applicable Organization	Employees/Skills
Hazardous Operations			
Liquid Hydrogen (LH)	1910.119	TOC	Handling/Transfer of LH, maintenance of systems
Hydrogen Peroxide	1910.119	TOC	Handling/Transfer
Triethylaluminum (TEAL) TEB	1910.106	TOC	Handling/Transfer/Transportation
Explosives	1910.109		Handling/Installation
Electrical Safety	1910.332	TOC	Electrical techs, electricians
Electrical Generation	1910.269	TOC	Electrical Generator Operators
Laboratory Safety	1910.1450	TOC	Gas Material Analysis Lab (GMAL), Measurements, Standards & Calibration Lab (MS&CL), Environmental Lab workers/scientist
Radiation Worker	1910.96	TOC	Non-destructive examination (NDE), GMAL, MS&CL, Environmental Lab

Required Training	OSHA Standard	Applicable Organization	Employees/Skills
Laser Safety/Operator	ANSI	TOC	LASER operators
Hazard Communication	1910.1200	FOSC	All exposed to chemicals in work area
Hearing Conservation	1910.95	FOSC	All exposed to noise (time weighted average (TWA) 85dB)
Personal Protective Equipment (PPE)	1910.132	FOSC	All required to use PPE
Bloodborne Pathogens	1910.1030	FOSC	All having occupational exposure to blood; Clinic and Rescue personnel
Control of Hazardous Energy	1910.147	FOSC	All performing work involving hazardous energy sources, those affected, and engineers writing work documents
Permit-Required Confined Space Entry	1910.146	FOSC	All who enter, monitor or perform rescue operations associated w/permit-required confined space entries
O_2/Lower Explosive Limit (LEL) Meter	1910.146	FOSC	Safety, Environmental Health (EH) and Rescue personnel who are required to operate O_2/LEL monitoring equipment
Respiratory Protection	1910.134	FOSC	All required to use respiratory protection, based on hazard
Asbestos	1910.1001	FOSC	Maintenance/Supv/Eng personnel who might come in contact with asbestos-containing materials (ACM). Abatement/maintenance
Hazardous Waste Operations (HAZWOPER)	1910.120	FOSC	Hazardous waste storage/handling
Hazardous Materials (HAZMAT)	1910.120	FOSC	Hazardous material handling, storage, and emergency response
Welding/Cutting Safety	1910.252, 253 1926.350-351	FOSC	All welders/welders' helpers
Powered Industrial Truck (Forklift)	1910.178	FOSC	All persons who operate a powered industrial truck
O/H Crane/Hoisting Equip	1910.179 1926.552-554	FOSC	All persons who operate an overhead bridge crane or other hoisting device
Powered Platforms/Manlifts	1910.66	FOSC	All persons who operate any vehicle-mounted powered platform or manlift.
Lead Awareness	1910.1025 1926.62	FOSC	All exposed to lead such as Welders, Painters, etc.
Electrical Safe Work Practices	1910.147, 301,302,303, 331-335	FOSC	All working w/exposed/energized lines or equipment >50 volts
Electrical Generation/Distribution	1910.269	FOSC	All working w/exposed/energized lines or equipment >50 volts in an electrical generation/distribution area
Radiation Worker	1910.96/ANSI Z136.1-193	FOSC	Non-Destructive Evaluation Technicians
First Aid	1910.151	FOSC	Clinic, Rescue personnel or those required to administer first aid
Fire Protection	1910.155	FOSC	Fire Department personnel

Required Training	OSHA Standard	Applicable Organization	Employees/Skills
Cardiopulmonary Resuscitation	1910.269 1910.146	FOSC	All working w/exposed/energized lines or equipment >50 volts; Certified Confined Space Attendants and rescue personnel
Rigging	1910.179-181, 184 1926.251, 550, 552	FOSC	Riggers involving hoisting/lifting operations
Mobile Crane	1910.180 1926.550	FOSC	Mobile Crane Operators
Scaffolding	1926.454	FOSC	All working from scaffolding
Fall Protection/Personal Fall Arrest Systems	1926.503	FOSC	All exposed to fall hazards over 6 feet
Ladders	1926.1060	FOSC	All working from ladders
Employee Emergency Plans	1910.38	FOSC	All building occupants to assist in safe and orderly emergency evacuation
Portable Fire Extinguishers	1910.157	FOSC	Employees who have access to portable fire extinguishers
Excavation, Trenching, Shoring	1926.651	FOSC	Professional Engineers in charge of excavation, trenching, shoring operations
Safety & Health Inspectors	1960.26 & 57	Each responsible organization	Safety & Health Personnel
Supervisors	1960.55	Each responsible organization	All supervisory personnel who are responsible for providing & maintaining safe and healthful work conditions for their employees
Train the Trainer		TOC	All instructors/trainers

2.5 Danger Tag

IMPORTANT: This procedure and sample tag DO NOT apply to the lockout/tagout of hazardous energy/operations during maintenance, rework, reconfiguration, examination and construction activities.

2.5.1 Danger Tag Definition and Use

DANGER tag shall be interpreted to mean a tag used to provide an immediate alert to personnel of a hazardous or unsafe condition or process that might result in personnel injury or property damage in the event a component, system, or process is activated or utilized prior to corrective action being accomplished. As soon as it is concluded a danger exists which could reasonably be expected to cause physical harm or property damage, affected employees will be notified of the danger. Immediate action shall be taken to notify and abate the danger.

2.5.2 Operational Requirements and Procedures

a. The Danger Tag. The DANGER tag, illustrated in Figure 1, will be used by all organizations at SSC.

b. Use. DANGER tags shall be used as temporary warnings only and will not be used for purposes other than to identify hazardous or unsafe conditions.

c. Attachment of Danger Tags. DANGER tags will be attached as required by safety representatives, managers, engineering field representatives or employees within their assigned areas of responsibilities. Anyone identifying unsafe equipment, processes or systems will immediately notify their cognizant safety office after affixing the DANGER tag.

d. Danger Identification. In the event DANGER tag situations are noted outside an area of assigned responsibility, the person noting the situation will immediately notify the cognizant supervisor and/or safety representative in order to assure a DANGER tag is affixed and an investigation of the dangerous situation is made.

e. Danger Tag Log. Each safety office or responsible manager will maintain a DANGER tag log for their assigned area(s) of responsibility. This log will include date emplaced, exact location, reason, corrective action required, and date corrective action was completed and tag removed.

f. Danger Tag Notifications. Safety representatives placing DANGER tags will notify the cognizant supervisor of the tag emplacement and provide details of the situation.

g. Danger Tag Visibility. The DANGER tag will be clearly visible and securely affixed to the system, component, tools, equipment, processes, facilities, systems, materials, processes, or tests which are considered unsafe.

h. Unsafe Conditions. Unsafe conditions where DANGER tags shall be used to identify a hazardous condition(s) include, but are not limited to: (DANGER tags shall only be applied by persons cognizant of the associated hazards; this minimizes the likelihood of an incident occurring during the process of applying the tag.)
   1) Defective or malfunctioning equipment which would create a physical hazard.
   2) Defective tools and power/extension cords.
   3) Tools or equipment altered to circumvent the manufacturer-installed safety guards.
   4) Chemical and radioactive materials that present hazards.
   5) Confined spaces or other areas containing hazardous atmospheres.
   6) Articles involved in mishaps.
   7) Lack of process controls.

i. Removal of Danger Tags. Upon completion of the required corrective action or as approved by the cognizant safety office, **only the person who placed the tag has the authority to remove it**. In situations where a second or third shift is worked, the relieving safety representative or the supervisor in charge will have authority to remove a DANGER tag if corrective action has been implemented.

j. Unauthorized Removal. If a DANGER tag is removed in an unauthorized manner, the cognizant safety representative will investigate to determine the responsibility for such action and notify proper management for corrective action including appropriate administrative action. This will be documented in a memorandum for record forwarded to the cognizant safety office.

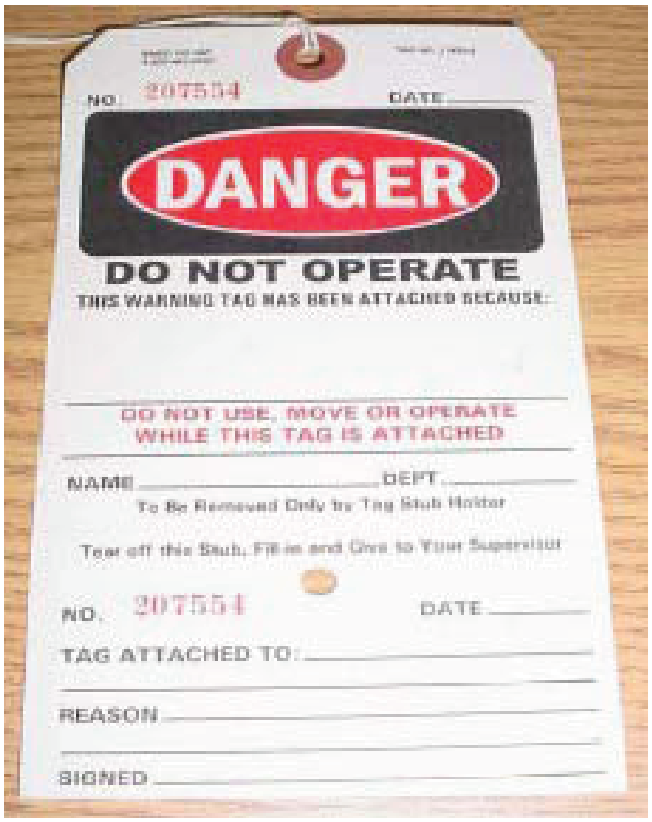


Figure 1. Danger Tag

2.6 Maximum Worktime Policy

NASA and NASA contractors working at SSC shall abide by maximum allowable work time requirements per NPR 3600.1, NASA Procedural Requirement Attendance and Leave. The following policy defines the maximum work time allowable for critical personnel assigned to projects and programs involving SAFETY CRITICAL activities. It provides the necessary

guidance to supervisors for making decisions about the length of time that workers will be asked to work on projects and programs involving SAFETY CRITICAL tasks.

2.6.1 General Requirements

a. Maximum Shift Lengths. A critical employee should not work in excess of 12 consecutive hours without approval. The hours worked over the individual's standard shift, bringing the total to 12 consecutive hours, must be approved by the applicable immediate supervisor or contractor counterpart (or higher). A maximum of 16 consecutive hours may be authorized when a one-time job circumstance exists. These additional 4 hours (to bring the total to 16) must be approved by the applicable director or contractor counterpart (or higher).

b. Maximum Hours/Working Days. A critical employee must not work in excess of 72 hours in 6 consecutive days, or work more than 6 consecutive days without 1 full day off. The approval of the applicable first-level director or contractor counterpart (or higher) will be required for exceptions to this restriction.

c. Rest Time Between Shifts. A minimum of 8 hours must be taken off between work shifts.

d. Identification of Critical Jobs and Personnel. Organizations will prepare and maintain a list that identifies and documents critical jobs and critical persons.

e. Extension of Worktime. Extension of worktime under this policy will be subject to advance written approval. When necessary, oral approval may be obtained, provided it is followed by written verification, submitted within one (1) week by the applicable authority. Documented approval will be maintained by the approving organization and will be available to NASA for review.

f. Worktime Policy Violations. Violations of this maximum worktime policy for critical persons must be reported immediately to the director of the appropriate primary organization who will inform the Manager of the S&MA Office.

2.7 Variances from Safety Requirements

This section establishes general requirements for requesting variances or alternate standards for the safety requirements set forth by this manual or any other NASA/SSC requirement document or procedure.

Under certain circumstances, strict compliance with established safety criteria may unduly delay or prohibit the accomplishment of a task, operation, or test. When it is necessary to deviate from a specific requirement, a written request using SSC Form-517, *Variance Request*, will be submitted per SSTD-8070-0007-CONFIG, *Variance and Alternate Standard Requests*.

Additional submittal of the written request to NASA Headquarters, S&MA is required for variances of NASA Headquarters regulations.

2.8 Imminent Danger Situations

This procedure provides the general safety requirements for stopping operations or practices which, if allowed to continue, could reasonably be expected to result in the death or serious physical harm of personnel, cause major damage to system/facilities, or to endanger the ability of SSC to accomplish its mission. These situations will be referred to as imminent danger situations at SSC.

2.8.1 Responsibilities/Requirements

a. Authority to Stop Work. Anyone has authority to immediately stop unsafe work practices at SSC that can lead to an imminent danger situation.

b. Notifications of Operations Stoppage. Any individual, who stops an unsafe operation where "Imminent Danger" is involved, will immediately notify the cognizant manager and the cognizant safety manager for the particular agency, organization, or contractor.

c. Resuming Operations. Operations in which work has been shut-down due to an "Imminent Danger" situation will not resume until corrective actions have been completed.

d. Defective Equipment Tagging. Any equipment/tools identified as defective and being involved in an "Imminent Danger" situation shall be tagged in accordance with Section 2.4 "DANGER Tags" of this Handbook.

e. Worker "Safety Time Out". SSC has adopted a policy of open communication with respect to safety concerns among its employees and its contractor's employees. Any time that a safety concern is raised by any employee working on a joint program, that employee has the right to call a "Safety Time Out" to voice his/her concern. Work activities can resume after the parties involved have reached agreement on corrective action or understanding of the situation.

f. Company Safety Policies and Procedures for Work Stoppage. Nothing written in this procedure shall be implied to interfere with any company's policies/procedures that allows its own employees to stop work activities given their concern for their or their fellow workers safety.

2.9 Safety of Motor Vehicles and Mechanized Equipment Used on SSC

This procedure provides the general safety requirements for using motor vehicles and mechanized equipment at SSC.

2.9.1 General Equipment Requirements

a. Removal of Debris. Contractors shall be responsible for removing material such as mud tracked onto existing roadways, walkways, etc.

b. Unattended Vehicles. Do not leave motor vehicles unattended while engines are running. The vehicle is considered unattended when the operator is 25 feet or more away from the vehicle, which remains in his/her view or whenever the operator leaves the vehicle and it is not in his view.

c. Motor Vehicle Requirements. Conveyances designed or modified to operate at speeds greater than 25 miles per hour (mph) must meet all Federal Motor Vehicle Safety Standards which apply to passenger carrying vehicles.

2.9.2 Additional SSC Requirement(s)

a. Inflating and Mounting Tires. A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

b. Working Underneath Heavy Equipment. Before employees are permitted to work under or between heavy equipment, substantially block or crib heavy machinery, equipment, or parts thereof, which are suspended or held aloft by use of slings, hoists, or jacks to prevent falling or shifting.

c. Heavy Equipment Controls. When being repaired or when not in use, bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment shall be either fully lowered or blocked. Leave all controls in a neutral position with the motors stopped and brakes set, unless work being performed requires otherwise.

d. Parking Brake. Set the parking brake whenever the equipment is parked. Equipment parked on inclines shall have the wheels chocked and the parking brake set.

e. Power Lines. All equipment covered by this part shall comply with the electrical safety requirements of Stennis Procedural Requirement, SPR 8715.1, *SSC Safety and Health Procedural Requirements*, when working or being moved in the vicinity of power lines or energized transmitters.

2.9.3 Specific Motor Vehicles Requirements

Employees will not be transported in the bed of pickup trucks without approved seats and seat belts.

2.9.4 Safety Requirements for All Terrain Vehicles (ATVs)

a. Payload Limitation. Do not exceed the manufacturer's recommended payload for ATVs. Passengers shall not be carried on ATVs.

b. Number of Wheels. SSC agencies/organizations and their respective contractors shall not use three-wheeled ATVs.

c. Fire Protection. All ATVs shall have a portable fire extinguisher of the proper type mounted on the equipment.

d. Vehicle Signage. ATVs traveling at less than 25 mph on public roads will display a standard "SLOW MOVING" vehicle sign.

e. Training Requirements. All NASA and its contractors shall develop training outlines and plans detailing the training that will be accomplished prior to employees utilizing ATVs in the performance of work on SSC.

f. Personal Protective Equipment. All appropriate safety equipment shall be worn when operating an ATV on SSC, as outlined in Title 63, Mississippi Motor Vehicle and Traffic Regulations. When work is being accomplished from ATVs on SSC roadways, proper helmet and reflective vest shall be worn.

2.9.5 Safety Requirements for Low Speed Vehicles and Golf Carts

a. Golf carts: are small utility conveyances that are incapable of exceeding 20 mph. They are only subject to state and local requirements regarding safety equipment for use at SSC. If golf carts are modified from original manufacturer specifications to obtain speeds in excess of 20 mph, they are classified as motor vehicles and must meet federal safety standards. Golf carts are NOT to be used on main SSC public use roads unless they meet all specific Federal Motor Vehicle Safety Standards for motor vehicles. Golf carts operated at night must be equipped with forward and rear lamps.

b. Low Speed Vehicles: are any four-wheeled conveyances with top speed greater than 20 mph, but less than 25 mph. Low speed vehicles are classified as motor vehicles and must meet specific Federal Motor Vehicle Safety Standards for low speed vehicles (49 CFR 571.500) to operate on SSC roads. Low speed vehicles must be equipped with specified headlamps, stop lamps, turn signal lamps, reflex reflectors, parking brakes, rear view mirrors, windshields, seat belts, and vehicle identification numbers. Low speed vehicles traveling on SSC public roads will display a standard "SLOW MOVING" vehicle sign.

c. Golf Cart and Low Speed Vehicle Safety Procedures:
   1) No golf cart or low speed vehicle is to be operated with more passengers than seating is provided.
   2) All occupants of golf carts and low speed vehicles shall keep hands, arms, legs and feet within the confines of the vehicle at all times when in motion.

Operators are to possess a valid driver's license, and use and movement of these type vehicles shall comply with vehicular requirements in SPR 1600.1, *SSC Security Requirements Handbook.*

2.9.6 Material Handling Equipment Requirements

All Material Handling Equipment will be equipped with a portable fire extinguisher of the proper type.

2.9.7 Site Clearing Equipment

All rider-operated equipment used in site clearing operations shall be equipped with rollover guards.

2.9.8 Rollover Protective Structures (ROPS)

Requirements: SCC agencies/organizations and their respective contractors shall provide ROPS on all of the following types of material handling and similar equipment:
a. All rubber-tired, self-propelled scrapers.
b. Rubber-tired front-end loaders.
c. Rubber-tired dozers.
d. Wheel-type agricultural and industrial tractors.
e. Crawler tractors.
f. Crawler-type loaders.
g. Motor graders, with or without attachments used in construction work.

Note: This requirement does not apply to side boom pipe laying tractors.

2.10 SSC Aviation Safety Program

2.10.1 SSC Aviation Safety Program Applicability

This procedure is applicable to any aircraft being used in direct support of the SSC mission, including government and contracted civilian aircraft support.

2.10.2 General Policy/Requirements

Conflicting Requirements: In the event of conflicting requirements between NASA and the Federal Aviation Administration (FAA), the most stringent requirement shall be adhered to for aircraft operations at SSC.

a. FAA Airworthiness Certification. Aircraft provider shall maintain FAA Airworthiness Certification per standards set forth in the Federal Aviation Regulations.

b. Airworthiness Program. An established and documented Airworthiness Program shall be maintained utilizing standards of quality of workmanship, materials, and support equipment that will ensure "Safety of Flight."

c. Flight Readiness Review Board. A Flight Readiness Review (FRR) Board shall be held for each mission, functional check flight, and major maintenance action. The purpose of the FRR shall be to minimize risk, enhance mission success, and ensure adequate justification for all risks associated with the missions or operations.

d. Flight Crew Training and Certification. The flight crew shall be trained and certified in accordance with 14 CFR Parts 61 and 67 and NPR 7900.3, *Aircraft Operations Management*.

2.10.3 Responsibilities

a. Aviation Safety Officer (ASO). The SSC Director shall appoint, in writing, an ASO for SSC. This individual shall be knowledgeable regarding aircraft safety and have the skills required of a Safety Professional, including maintaining an Aviation Safety Certificate from an accredited institution. The ASO may be a civil servant or a contractor employee.

b. Aviation Safety Program. The NASA S&MA Office shall develop an Aviation Safety Program. It shall address, as a minimum, the responsibilities of the ASO and Pilot in Command, organizational structure of the flight crew, provisions for hazard analyses as necessary and emergency response. This office will utilize a surveillance and audit program to verify compliance with requirements.

2.10.4 Requirements for Non-NASA Aircraft

a. Non-NASA Aircraft Definition. Non-NASA Aircraft is defined as any aircraft not owned, maintained, and operated by NASA personnel and NASA flight crew, including NASA contractor personnel, with the exception of scheduled and chartered air carriers not modifying aircraft for research data collection but providing transportation services.

b. General Safety and Oversight Requirements. Any non-NASA aircraft conducting flight operations for SSC must meet the safety and oversight requirements of NPD 7900.4. Among

other requirements, NPD 7900.4 states all NASA programs engaged in aircraft operations will use airworthy aircraft, qualified flight crew, and approved operational procedures.

c. Requesting Use of Non-NASA Aircraft. Program managers desiring to use non-NASA aircraft for research program support should request a non-NASA aircraft risk analysis from the SSC Office of S&MA. This request should be made as early as possible in the program planning process, as some may take an extended amount of time and effort to complete.

d. Non-NASA Aircraft Program Risk Analysis. Once aircraft operators are selected to conduct aviation operations for SSC programs, the SSC Office of S&MA will ensure a sufficiently detailed risk analysis of the flight program is conducted, as required.

e. Risk Analysis Report. This report will include a summary statement, action items, and an overall recommendation. Flight operations will not be conducted until all action items from the risk analysis report are closed.

f. Flight Readiness Review. Program managers shall hold a FRR prior to flight operations using non-NASA aircraft. Flight operations will not be conducted until all action items from the FRR are closed.

2.10.5 Use of Non-NASA Aircraft

Non-NASA aircraft operations are approved for use by SSC programs under the following conditions, depending upon the ownership and operation of the aircraft.

a. NASA-owned, military operated. If an SSC obtained aircraft is operated for SSC by the U.S. military, the SSC Office of S&MA will determine whether NASA or military standards for airworthiness, operations, maintenance, and safety should apply. Responsibilities will be established by written agreement between the military unit operating the aircraft and SSC.

b. Military or military contractor-owned and military or military contractor-operated. If SSC personnel or high value equipment are required to be aboard a military operated research or research support aircraft, responsibilities and tasks will be established by written agreement between the military or military contractor unit with operational responsibility for the aircraft and the SSC Program/Project Manager, with approval of the SSC Office of S&MA. The written agreement will cover a period for not more than three years.

c. Contractor-owned and contractor-operated. If SSC personnel or high value equipment are required to be aboard an aircraft owned by a contractor and operated under an FAA operating certificate as a civil aircraft, the aircraft will be operated in accordance with the applicable Federal Aviation Regulations (FARs) and within the limitations imposed by the operating certificate. If the aircraft has an experimental or provisional operating certificate, the

configuration and airworthiness must be reviewed and approved by the SSC Office of S&MA. At no time will a contractor be utilized under public aircraft status.

d. Contractor-owned aircraft with no FAA certificate. NASA projects will not be flown on contractor owned and operated aircraft that do not have a FAA airworthiness certificate, or equivalent.

2.10.6 Requirements for Aircraft Operations at SSC

The Aviation Safety Officer shall ensure that aircraft:

- have radio capability with a ground station at all times for flight following;
- be outfitted for over-water operations if so required by mission requirements; and,
- must be able to maintain a positive climb rate at the mission-required weight with one engine shut down.

Operations Requirements

a. Pilot in Charge must hold a current Airline Transport Pilot (ATP) Certificate.
b. Co-pilot must hold a current Commercial Pilots Certificate with an instrument rating.
c. All pilots must have 100 hours total time and have passed an annual proficiency flight check within the last year in the type aircraft flown.
d. All pilots must have three take-offs and landings within the previous 90 days.
e. Aircraft must have radio capability with a ground station at all times for flight following.
f. Aircraft must be outfitted for over-water operations if so required by mission requirements.
g. Aircraft must be able to maintain a positive climb rate at the mission-required weight with one engine shut down.
h. Operators must have an alcohol use policy that addresses alcohol use at least 10 hours prior to flight and flying under the influence of alcohol.
i. Flight plans must always be filed with appropriate Air Traffic Controller (ATC).

Maintenance Requirements

a. Aircraft must have a complete history including date of manufacture, registration number, and total time of airframe and engines.
b. A copy of the aircraft registration and Airworthiness Certificate must be provided to the SSC Office of S&MA.
c. A current copy of the aircraft weight and balance must be kept on the aircraft at all times.
d. Current copies of the aircraft Airframe and Powerplant Inspections must be provided to the SSC Office of S&MA.
e. All FAA Form 337s regarding the aircraft must be available for review. Copies of all FAA Form 337s related to installations performed for NASA must be maintained in the NASA Office of S&MA.

f. All Airworthiness Directives must be complied with.
g. Maintenance personnel must be qualified/certified in performing maintenance, preventive maintenance (including required inspections), rebuilding, and alterations.
h. Aircraft provider shall have an inspection program and a program covering other maintenance, preventive maintenance, rebuilding, and alterations which comply with FAA approved Original Equipment Manufacturer (OEM) standards, Department of Defense (DoD) technical standards, or NASA standards, as required.
i. The aircraft maintenance/inspection program should address provisions for inspections and certification procedures of specific maintenance actions.
j. Serviceability, authenticity, traceability, and airworthiness of parts, components, accessories, and assemblies shall by determined by inspections, tests, or operational checks as per applicable directives, rules, standards, and regulations.
k. The aircraft provider's configuration control process shall ensure compliance with applicable airworthiness, service, and safety bulletins, or other pertinent directives.
l. A list of maintenance personnel and their individual qualifications must be available for review.

2.10.7 Operating Conditions Acceptance and Approval

The following conditions will be accepted with Center Director's approval:

a. Non-turbine aircraft operations.
b. Single pilot operations.
c. Single engine aircraft operations.
d. Pilot in Charge with less than 200 hours in type aircraft.
e. Pilot in Charge with less than an ATP rating, 2500 hours total time, 100 hours instrument time, 3 instrument approaches and 3 instrument landings in the past 90 days, and 50 night hours.
f. Co-pilot with less than a commercial pilot certificate, 700 hours total time, 100 hours instrument time, 3 instrument approaches and 3 instrument landings in the past 90 days, and 50 night hours.
g. Utilizing aircraft without a Ground Proximity Warning System or radar altimeter for flight below 2000 feet (not to include take-off and landing).
h. Utilizing aircraft without an Emergency Locator Transmitter for remote operations (outside VHF range from ground station).
i. Crew Duty Day or Crew Rest Cycle of less than 12 hours.
j. Flight Crew flight limits greater than 8 hours a day or 35 hours a week.
k. Flights within 25 nautical miles of thunderstorms or in known or forecast severe weather.
l. No filed alternate landing site with destination weather below 5000 feet and visibility under 5 miles.
m. No operating weather radar for any flight other than visual flight rules (VFR).
n. Any deviations from manufacturer's overhaul and replacement schedule.

2.10.8 Required Documentation for SSC Aircraft Operations

a. Operational Requirements. The following information must be current and made available for government review at all times.
   1) Initial and recurrent aircraft training for all crew members.
   2) Medical certificates for all crew members.
   3) Radio, navigation, and survival equipment.
   4) Minimum runway requirements and minimum fuel requirements.
   5) Weather minimums for takeoff, landing and alternate landing sites.
   6) Written policy for impounding and releasing aircraft.
   7) Drug and alcohol testing policy.
   8) Description of company and contact information for key personnel.
   9) Description of personnel by position.
   10) Company organizational chart.
   11) Policy for manifesting personnel and information regarding next of kin notification.
   12) All maintenance and inspection records required by FAA/NASA rules and regulations.
   13) Reports/documentation regarding mishaps, incidents, and/or accidents.

b. Quarterly Reports. All operators must submit a quarterly written report listing the following:
   1) Any class A, B, or C mishap or "close call" as defined by NPR 8621.1, *NASA Procedural Requirement for Mishap, Reporting, Investigating and Recordkeeping*.
   2) Any violation that was required to be reported to any regulatory agency.
   3) Any scheduled flight related to NASA operations that was canceled or postponed due to any reason other than weather.

This report should be routed to: SSC Office of Safety and Mission Assurance, Code QA00, Stennis Space Center, MS 39529-6000.

2.10.9 Aircraft Management Office (AMO) Responsibilities

Information on File Requirements. The following information will be kept on file with the SSC Office of S&MA:

a. NASA program manager name and contact information.
b. Copy of contract or signed letter of agreement, Space Act, etc.
c. Program description that includes key objectives.
d. Safety analysis for any aircraft modifications.
e. Readiness Review information and board minutes.

2.10.10 Remotely Piloted Vehicles (RPV)

In the event NASA programs require the use of remotely piloted vehicles (RPVs), all applicable requirements that are listed for aircraft operations will apply. In addition, any use of RPVs will

require a hazard analysis for the operation, and a hardware analysis that addresses the use of the vehicle. As a minimum, the analysis will address redundant control systems, loss of communication, and flight termination criteria and systems.

Non-NASA programs utilizing RPVs within SSC must coordinate operations with the NASA Office of S&MA.

2.11 SAFETY CRITICAL Procedures

SAFETY CRITICAL includes any operation, process or procedure involving materials, equipment or tasks which have a high potential to result in loss of life, serious injury to personnel, and/or damage to high value or mission essential systems, equipment, or facilities. These include but are not limited to laboratory operations, high-pressure gas operations in excess of 150 pounds per square inch gauge (psig), low-pressure high volume gas operations, voltages above 550 volts, storage and handling of liquid or solid propellants, storage and handling of explosives, use of "heavy lift" material handling equipment, extreme temperature environments, oxygen-deficient or -enriched environments, permit-required confined space entries, lockout/tagout required operations. The following situations are also classified as SAFETY CRITICAL procedures:

1) Experience has shown that the task has a complexity beyond that of routine or requires more than brief training or experience to accomplish.
2) A task contains steps that must be satisfactorily completed in a specific sequence.
3) Preparation for the task has been specified as the corrective action by an investigation.
4) The process is one that must be controlled due to the hardware involved such as flight hardware or test article hardware in which the customer has imposed requirements.

a. Deviations from SAFETY CRITICAL procedures will normally require the prior approval of the cognizant safety representative. Changes occurring during off shifts when safety support is not onsite will only be allowed under the following conditions:
   1) Operating personnel affected by the change are apprised of the change. Safety personnel are notified. The risks associated with the change are discussed in a meeting between the author of the change, safety personnel, and the operating personnel affected by the change.
   2) It has been determined in the meeting that the level of risk to operating personnel is not increased.
   3) The change is processed as soon as the cognizant safety representative returns to work.
   4) In the event the change is not approved by the cognizant safety representative, rationale will be provided to the author and operating personnel as to why the change was not approved.

b. The responsible engineer or supervisor shall determine the need for a procedure to address SAFETY CRITICAL operations [e.g., Detailed Operating Procedures (DOPs); Test Preparation Sheets (TPSs)].

1) Preparation of Procedures: The SSC organization performing the work shall write procedures (e.g., DOPs, TPSs) in a manner that provides maximum protection to personnel, precludes procedural error, and minimizes misinterpretation. Procedures shall include steps to:
    a) Ensure the safety of personnel.
    b) Specify actions to bring an emergency situation under control.
    c) Return the system(s) to nearest possible safe condition.
2) Cautionary Notes: Procedures shall use one of the following cautionary notes to precede specific steps in which a malfunction or error produces a reaction that causes system degradation, personnel injury, or death.

    a) **WARNING**: Maintenance or operating procedures, techniques, restrictions, etc. that may result in severe personnel injury, loss of life, or major equipment damage if not followed exactly.
    b) **CAUTION**: Maintenance or operating procedures, techniques, restrictions, etc, that may result in some damage to equipment or system, or minor injuries to personnel if not followed exactly.
    c) **NOTE**: Maintenance or operating procedures, techniques, restrictions, etc. that require emphasis for safe operation.
3) SAFETY CRITICAL Marking: The title page of hazardous procedures (e.g., DOPs, TPSs) shall be marked "SAFETY CRITICAL."
4) Approvals: All SAFETY CRITICAL procedures shall require approval from:
    a) The cognizant safety representative to certify that they have performed a review of the procedures.
    b) The cognizant engineer.

c. Change Approval: Changes to procedures shall be approved from the cognizant safety office representative.

d. SSC Variances shall be processed in accordance with John C. Stennis Space Center SSTD-8070-0007-CONFIG, *SSC Variance and Alternate Standard Requests*.

2.12 System Safety and Risk Assessment

2.12.1 System Safety and Risk Assessment General Requirements

Control Mitigation. System safety is a process that assures adequate steps have been taken to ensure the design, processes, and materials used do not impose a risk to human life, equipment or the environment. When a risk cannot be avoided, system safety will ensure adequate steps have been taken to control or mitigate the risk.

System Safety and Risk Assessment. System safety and risk assessment is a vital part of the SSC risk management program. It is dependent upon two analytical techniques: Facility Risk

Indicators (FRI) and Hazard Analysis. Hazard Analyses are program specific (although they can be used on a facility) and FRIs assess the severity of potential hazard inherent in the facility.

Risk Management. Knowledge of risk permits the responsible person to decide whether a danger can be accepted, or must be reduced or eliminated by application of additional protective measures, or whether the operation must be cancelled.

Operational Readiness Assessments. Operational Readiness Assessments (ORAs) shall utilize the FRI and/or hazard analysis to assess readiness of the facility a program to proceed to the next phase (activation/test). By considering the size and complexity of the project and the safety risks associated with the project, this assessment will help identify the system safety activities, which should be accomplished early in the acquisition process and how resources should be allocated.

Configuration Control. System safety and risk assessment at SSC is heavily dependent on accurate and approved drawings under Configuration Management (CM) control. The Operating Instruction (OI) for CM shall be the governing document for CM.

2.12.2 System Safety and Risk Assessment Responsibilities

Risk Assumption. The decision to assume a risk is the responsibility of SSC Senior Management and the applicable Project/Program Manager and should be based on all relevant data. Management must not allocate resources to correct specific hazards without first obtaining sufficient information to determine whether more hazardous conditions are being neglected, or whether the corrective costs are justified by the benefit of, or a reduction in, risk. Risk assessment is the responsibility of the appropriate S&MA organization. NASA S&MA shall ensure risk assessments are properly conducted.

2.12.3 System Safety and Risk Assessment Facility Risk Indicator (FRI)

Performance of FRI Assessment. The FRI is a first step to estimating the combined level of risk associated with a facility. The FRI assessment classifies the severity of potential hazards inherent to the facility itself; its operations, processes, environment, equipment, potential interfaces, and personnel. Although the FRI can be performed at any time during the Facility Life Cycle, the FRI is generally performed early in the acquisition program during the conceptual phase to ensure potential hazards are identified. The FRI is the initial safety assessment used to help determine the level of system safety effort required to meet NASA safety requirements. This process begins by identifying hazards that may exist at any given point throughout the life of the facility. The FRI evaluation alerts the facility project manager and other acquisition managers of the potential safety concerns within a facility.

FRI Scale. The extent to which system safety analysis is applied to facility acquisition is initially based upon the FRI assessment. The FRI process is defined in NASA-STD-8719.7, *NASA Technical Standard, Facility System Safety Guidebook*. SSC uses unique facility risk indicators

ranging from an FRI of 1A (High Risk) to an FRI of 4 (Minimal Risk). These unique indicators are shown in Table 2. An FRI of 1 signifies major risk associated with personnel safety, operational productivity, design effectiveness, environmental impact, and/or other user interfaces. An FRI of 4 indicates negligible or low risk. A review of a checklist, in Table 3 assists in determining the FRI for the facility or project, particularly if the Center Safety Department helps with the evaluation.

Hazards Evaluation Criteria. The potential hazards inherent to the facility are evaluated using the following criteria as evaluation factors:

1) Life Safety – Hazard which could potentially cause death or serious injury to personnel;
2) Mission Continuity – Failures which could have serious impact on mission capability and/or operability;
3) Facilities Protection – Failures which could cause serious damage to facilities or equipment resulting in significant financial loss; and
4) Environmental Impact – Hazards that could have serious impact to the adjacent facilities or operations or to the surrounding community.

Table 2. Facility Risk Indicator

FRI	Criteria
1A	Facility contains Fuel, and Oxidizer and at least one of which is used under ultra high pressure.
1B	Facility contains Fuel, and Oxidizer and at least one of which is used under high pressure.
1C	Facility contains Fuel, and Oxidizer and at least one of which is used under medium ultra high pressure.
1D	Facility contains an Oxidizer and at least one of which is used under ultra high pressure.
2A	Facility contains Fuel, and Oxidizer, but is only used for distribution of those as commodities, or the facility contains explosives or solid propellants.
2B	Facility houses high voltage electrical distribution and switching gear.
2C	Total number of "yes" responses is >38, but does not have any of the criteria called out above for a higher category.
2D	Total number of "yes" responses is >18 and ≤ 38, but does not have any of the criteria called out above for a higher category.
3	Total number of "yes" responses is >3 and ≤ 18, but does not have any of the criteria called out above for a higher category.
4	Total number of "yes" responses is >3, but does not have any of the criteria called out above for a higher category.

Table 3. Facility Categorization Worksheet NASA Facility Risk Index

		Yes	No
Facility Protection			
1)	Is the facility critical to NASA Missions?		
2)	Are there unique characteristics that must be designed into this facility to accommodate proposed hazardous operations?		
3)	In the worst-case operational mishap, could the facility, modifications/repair cause $500,000 or more in damage?		
4)	Is the facility valued at $500,000 or more?		
5)	Is the facility protected by a fire protection system?		
6)	Does the facility have pressurized systems >5 psig?		
7)	Does the facility have pressurized systems >500 psig?		
8)	Does the facility have pressurized systems >1,000 psig?		
9)	Does the facility have pressurized systems >5,000 psig?		
10)	Does the facility have pressurized systems >10,000 psig?		
11)	Does the facility have mechanical equipment such as rotating machinery, actuating mechanisms, or other pinch points which could injure workers?		
12)	Does the facility have cryogenic materials stored in or around the facility?		
13)	Does the facility have toxic and/or flammable materials stored in or around the facility?		
14)	Does the facility have explosive or propellant materials stored in or around the facility?		
15)	Does the facility have radiation hazards present? (magnetic, ionizing, lasers, ultraviolet (UV), RF, etc.)		
16)	Does the facility have an electrical substation in close proximity to the facility?		
Operational Purpose of the Facility			
1)	Are hazardous operations conducted in this facility?		
2)	Are hazardous chemical or materials stored in this facility?		
3)	Are hazardous chemical or materials used in this facility?		
4)	Are the operations conducted in this facility of critical importance to NASA operations and/or mission success?		
5)	Is there lifting equipment used in the facility?		
6)	Will unacceptable delays result if the operations of this facility are interrupted?		
7)	Is the facility a manufacturing facility?		
8)	Is the facility a test facility?		
9)	Are there laboratories located in the facility?		
10)	Do the labs handle toxic and/or flammable materials?		
11)	Does the facility produce electrical power?		
12)	Is the power to the facility >50 volts?		
13)	Is the power to the facility >600 volts?		
14)	Are there material handling operations occurring in the facility?		
15)	Does the facility handle cryogenic propellants?		
16)	Does the facility handle hypergolic propellants?		

		Yes	No
17)	Does the facility have high pressure systems?		
18)	Does the facility have fuels present?		
19)	Does the facility have oxidizers present?		
Life Safety and Environmental Impact			
1)	Can personnel be killed or severely injured as a result of an operational mishap in this facility?		
2)	Can personnel or the environment be exposed to hazardous materials in the facility?		
3)	Are personnel involved in hazardous operations in this facility?		
4)	Will any people requiring special considerations (i.e., non-ambulatory disabled people, pregnant, etc.) be exposed to potential risk due to an operational mishap?		
5)	Does the facility have more than one story?		
6)	Is there limited access to the facility?		
7)	Is the facility manned during hazardous operations?		
8)	Are safe havens required to protect personnel in the event of an emergency?		
9)	Are there areas that have noise levels >80 dBA?		
10)	Is there machinery that requires guards or other protective measures to prevent personnel from coming in contact with the point of operations?		
11)	Does the facility have areas that contain stored energy?		
12)	Does the facility have areas where quantity-distance requirements (QD) apply?		
13)	Are there facilities that fall within the QD for the facility?		
14)	Is the facility located inside the QD for another hazardous facility?		
15)	Does the facility require a chemical hygiene plan?		
16)	Does the facility have highly hazardous materials, as defined by 29 CFR 1910.119?		
17)	Are there known uncontrolled hazards in the facility?		
18)	Are there accepted hazards in the facility?		
19)	Does any proposed equipment change the risk associated with the facility or personnel?		
20)	Do any proposed modifications/repairs to the facility change the risk associated with facility or personnel?		
21)	Does any proposed test articles change the risk associated with the facility or personnel?		
22)	Were there special requirements for design to limit damage from accidental explosions?		

2.12.4 Hazard Analysis

a. Standards. All hazard analyses shall meet the guidance of MIL-STD-882D and SCWI-8700-0001.

b. Hazard Risk Index (HRI). A HRI is an expression of the level of urgency in the application of risk suppression countermeasures. SSC uses a 20-level risk index; the level is determined by the combination of hazard severity and probability of identified hazards, as shown and summarized in Table 4. Action required for HRIs shown in Table 5 is then indicated by the HRI shown in Table 4.

c. Hazard Reduction Precedence Sequence (HRPS). Upon completion of the hazard analysis, a means of controlling each hazard must be developed to eliminate or reduce the risk to an acceptable level. Hazard reduction shall be approached through the use of the following sequence of steps:

1) Design - Every possible attempt shall be made to eliminate/reduce the risk associated with each hazard through the incorporation of controls in the design phase.
2) Safety Devices - Safety devices shall be considered to protect against undesired events when the elimination of the hazard through design controls is not possible.
3) Warning Devices - If design or safety devices are not possible, warning devices may be utilized to inform personnel of impending harm. Warning devices will not prevent the harm without personnel action.
4) Procedures - If all else fails, procedures may be established as a means of control. It is necessary that personnel be trained to comply with the procedure(s) as a part of this step. Control of hazards through procedures and training is the least preferred means of control.

Table 4. Summary Hazard Risk Index

		Probability				
		A	B	C	D	E
Category	Descriptive Work	Frequent	Reasonably Probable	Occasional	Remote	Improbable
I	Catastrophic	1	2	4	8	12
II	Critical	3	5	6	10	15
III	Marginal	7	9	11	14	17
IV	Negligible	13	16	18	19	20

Table 5. Hazard Risk Index Actions

Index	Criteria
1 - 5	Unacceptable operation is not permitted.
6 - 9	Undesirable Senior Management decision/Waiver required (ORAB)
10 - 17	Acceptable with Safety Review Team (SRT) review and disposition
18 - 20	Acceptable without review

3.0 INDUSTRIAL SAFETY OPERATING REQUIREMENTS

3.1 Specific References

NPR 8715.3, *NASA Safety Manual*
NFPA 70, *National Electrical Code*
NFPA (V4) 780, *Standard for the Installation of Lightning Protection Systems*
NFPA 102, *Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures*
Safety in Hydrogen and Oxygen Systems, a text presented via a short course by CRYOCO
29 CFR 1910, *Occupational Safety and Health Standards*
29 CFR 1910.28, *Safety Requirements for Scaffolding*
29 CFR 1910.29, *Safety Requirements for Manually Propelled Mobile Ladder Stands and Scaffolds*
29 CFR 1926, *Safety and Health Regulations for Construction*
29 CFR 1926, *Safety and Health Regulations for Construction Subpart L, Scaffolds*
SCWI-8715-0001, *Lightning Warning System*
SCWI-8715-0002, *SSC Personal Protective Equipment*
SCWI-8715-0003, *SSC Fall Protection Program*
SPR 8715.3, *SSC Hot Work Permit Program*
SSC Form 222, *Permit for Use of Small Appliances*

3.2 Responsibilities

Managers are responsible for enforcing all Safety and Health Operating Procedures within their assigned areas of responsibility. They must also assure all physical activity restrictions governing their personnel are applied.

3.3 Stennis Space Center Fundamental Safety Rules and Procedures

a. Safe Job Performance. Employees are to ask questions and remove any doubt that may exist regarding the safe way to perform job tasks.

b. Alterations or Repairs to Safety Equipment. Employees shall not alter or attempt to repair any item of safety or safety related equipment unless specifically authorized by job classification.

c. Substituting and Improvising. Substitutions or improvising should be minimized and not attempted by technicians without authorization from the responsible engineer. Deviations from written procedures will be approved by the Stand Engineer/Test Director and documented in a timely manner.

d. Makeshift Tools and Shortcut Methods. Locally manufactured tools or short-cut methods shall not be used without written authorization from engineering.

e. Employee Illness. Employees should not work if ill. The illness may cause the employee to have an accident and/or injury to themselves or others. The employee's doctor should be seen, or the employee should report to the SSC Medical Clinic.

f. Blocking or Altering Safety Devices. Safety switches or devices shall not be blocked or altered in any manner.

g. Lifting Heavy or Bulky Objects. An employee must not attempt to lift heavy or bulky objects beyond their capacity. The load should be sized up and help obtained when needed. The back should be kept straight, the knees bent, and the lift made with the legs, not the back.

h. Carrying Sharp Objects. Employees must not carry sharp objects in pockets without proper covers.

i. Transport Containers and Devices. Employees shall use approved containers or devices for transporting material or equipment.

j. Paths of Access. Aisles and walkways are to be used at all times. Shortcuts through roped-off areas, across ditches, or over rough ground are prohibited.

k. Cautions and Warnings. All "**CAUTION**," "**WARNING**," and "**DANGER**" signs, sirens, bells, and other safety warnings shall be adhered to at all times.

l. Makeshift Climbing Devices. Makeshift devices (including chairs) shall not be used in place of approved ladders, stands, or lifts for reaching heights.

m. Walking on Roadways. Walking shall be permitted only on the side of the road facing traffic when personnel are walking along roads shared with vehicular traffic.

n. Operation of Machines and Equipment. Machines and equipment shall be operated only by qualified, authorized (certified) personnel.

o. Equipment Test and Inspection. Equipment subject to periodic inspection, test, and/or calibration shall not be used until the inspection, test, or calibration has been accomplished.

p. Use of Air Driven or Electrical Tools. All air or electrically driven machine or tools must be completely stopped and deactivated when leaving the equipment unattended, inspecting it, or when changing parts or accessories.

q. Repairing Equipment. Only authorized personnel shall repair electrical or mechanical equipment.

r. Unusable/Damaged Fire Extinguishers. Report unserviceable or damaged fire extinguishers to the Fire Department (ext. 8-3639).

s. Chemical Labeling. Labels shall not be removed from chemical or solvent containers unless the containers are empty and have been thoroughly cleaned. All reused containers must be properly labeled.

t. Skin Cleansing Agents. The use of volatile or flammable chemicals as a skin-cleaning agent is prohibited.

u. Written Safety Procedures. Written operating procedures with safety guidance and sufficient warnings, must be prepared, approved, and made available to operators or technicians before production or research and development work is undertaken.

v. Tripping and Blocking Hazards. Avoid flexible cords, hoses, etc., across work floors. Never block routes of exit with cords or hoses. In cases where it is absolutely necessary, fix to avoid tripping. Flexible electrical cords should not be used in place of permanent wiring.

w. Blocking of Fire Lanes. Parking shall be prohibited within 15 feet (5 meters) of any fire hydrant, fire department connection, any fire suppression systems, or within any fire lane (marked in red). These areas shall also be labeled or marked as no parking zones.

x. Wearing of Jewelry. Due to the snagging hazard, rings should not be worn around moving equipment or operating/construction areas in which personnel have to climb, handle heavy objects, or operate moving machinery. Jewelry must not hang loose to the point where it may be caught. Due to the electrocution hazard, rings and jewelry shall not be worn by personnel working on electrical systems of any voltage level.

y. Personal Clothing. Clothing shall not hang loose to the point where it may be caught in moving machinery or snag onto dangerous objects (i.e., shirts should be tucked in to the slacks when working around rotating/moving equipment).
   1) Tank tops, net shirts, cut-off shirts, sleeveless shirts, etc., shall not be worn. As a minimum, employees are required to wear a shirt or top that is comparable to a t-shirt with sleeves.
   2) Pants shall be full length for activities performed in construction areas and industrial shops. Cut-offs, shorts, and other such apparel are not permitted in these areas.

3.4 Fundamental Safety Rules and Procedures - Lightning Protection

This procedure contains the practices for safeguarding of persons and property from hazards associated with lightning.

3.4.1 Lightning Protection Responsibilities

a. Responsible Organizations. Each responsible organization shall assure that the necessary lightning protection systems exist on all structures in their areas of responsibility where hazards may exist due to the possibility of lightning.

b. Construction Organizations. Construction organizations shall insure that proper lightning protection systems and materials are implemented during the construction phase of all structures.

c. Design Organizations. Design organizations shall insure that proper lightning protection systems and materials are included in the design of all structures.

d. Facilities Review Board (FRB) Chair. The Chair of the Facilities Review Board (FRB) has been designated as the Authority Having Jurisdiction (AHJ) for interpretations of all technical matters relating to National Fire Protection Association (NFPA) 780 and lightning protection. An engineer specializing in electrical safety and lightning protection shall provide technical advice on these matters to the FRB.

3.4.2 Lightning Protection Operations during Lightning and Electrical Storms

Lightning Advisories and Warnings. Lightning Advisories and Warnings will be issued based on the SSC Lightning Detection System. Advisories and Warnings will be transmitted over the SSC radio system, the SSC Video System and the SSC Internal Homepage Website. All personnel on SSC must comply with these advisories and warnings.

a. Lightning Advisories and Warnings shall be issued in accordance with SCWI-8715-0001, Lightning Warning System.

b. Lightning Advisory- A Lightning Advisory will be issued when lightning is detected within 10 miles of SSC. An advisory indicates the potential for lightning exists in the area and management should monitor the situation via the video feed or Internet to ensure operations that may be impacted are properly warned and secured in a timely manner if the situation warrants.

c. Lightning Warning- A Lightning Warning will be issued when lightning has been detected, or the potential for lightning has been detected by the SSC Lightning Detection System. Once a Lightning Warning has been issued, all personnel must seek shelter in approved

locations. Operations under way at the time of the warning will be secured and personnel will seek shelter.

d. Self Protection- Individuals have the right to remove themselves from exposure to lightning or lightning effects consistent with this procedure and contractor safety program planning.

e. An onsite safety representative observing an actual lightning event has the right to implement this procedure.

f. Construction Monitors will ensure contractors performing outdoor construction activities are notified of Lightning Advisories and Warnings.

g. Lightning protection systems shall be installed on all structures where hazards exist due to the possibility of a lightning strike.

h. Proper lightning protection systems and materials shall be implemented during the construction phase of all structures per NFPA and LPI requirements.

3.5 Fundamental Safety Rules and Procedures - Personal Protective Equipment

Personal Protective Equipment procedures are contained in SCWI-8715-0002, John C. Stennis Space Center Personal Protective Equipment.

3.6 Fundamental Safety Rules and Procedures - Fall Protection in Industrial & Construction Activities

Fall Protection Safety Requirements are contained in SCWI-8715-0003, John C. Stennis Space Center Fall Protection Program.

3.7 Fundamental Safety Rules and Procedures - Buddy System

This procedure provides the general operating requirements for use of the buddy system in an effort to minimize personnel injury and/or limit property damage given an accident or emergency situation.

Buddy System operations: The “Buddies” are expected to monitor each other, to stay close enough to be able to help in an emergency, to behave safely, and to follow prescribed safety procedures as applicable. The “Buddy System” shall be used whenever hazardous operations are being conducted. Such operations include, but are not limited to:

a. Remote and isolated work operations.
b. Operations and maintenance activities of pressure systems.

c. Welding/cutting/spark producing operations conducted within 100 feet of propellant, flammable liquid/gas/ vapor and oxygen systems.
d. High voltage (greater than 550 volts) operations.
e. Heavy hoisting/lifting operations.
f. Marine and rail operations.
g. Energized low voltage system operations (i.e., 50 volts or more in which the work has to be performed "hot" and the work involves working within enclosures or on circuits). Work involving properly de-energized equipment that has been properly locked and tagged out does not necessarily require use of the buddy system unless there is some other requirement for its use.
h. Explosive/ordinance/pyrotechnics handling/testing operations.
i. Cryogenic transfer and venting operations.
j. Confined space entries. Confined space entries call for specific requirements of standby personnel. Refer to Confined Space Entry Program section of this document for these requirements.
k. Personnel lift operations.
l. Radiological operations.
m. Diving operations.
n. Excavation activities. Refer to the Safety in Excavations Section of this document for specific requirements for use of the buddy system when excavations are being made.

3.8 Fundamental Safety Rules and Procedures Safe Use of Powered/Non-powered Handheld Tools at SSC

This procedure provides basic safety guidelines for the use of hand and portable powered tools. It is also intended to assist workers in recognizing the hazards associated with the most common types of tools and the safety precautions necessary to prevent those hazards.

a. Spark Resistant Tools: Employees are required to use only spark-resistant tools made from brass, plastic, aluminum, or wood around flammable substances. Iron and steel hand tools can be a dangerous ignition source.

b. Powder-Actuated Tools
   1) The tool must not be able to operate until it is pressed against the work surface with a force of at least five (5) pounds greater than the total weight of the tool.
   2) The muzzle end of the tool must have a protective shield or guard centered perpendicularly on the barrel to confine any flying fragments or particles that might otherwise create a hazard when the tool is fired. The tool must be designed so that it will not fire unless it has this kind of safety device.
   3) All powder-actuated tools must be designed for varying powder charges so that the user can select a powder level necessary to do the work without excessive force.

c. Fasteners
   1) Must not be driven into materials like brick or concrete any closer than three (3) inches to an edge or corner.
   2) In steel, the fastener must not come any closer than one-half inch from a corner or edge.
   3) Must not be driven into very hard or brittle materials, which might chip or spatter, or make the fastener ricochet.
   4) An alignment guide must be used when shooting a fastener into an existing hole.

3.9 Fundamental Safety Rules and Procedures - Safety Requirements for Machine/Machinery Guarding

This procedure outlines the basic safety requirements for guarding of machinery and machines used at NASA worksites at SSC. This procedure does not address the safety requirements for using portable handheld tools that are covered in Section 3.8, Safe Use of Powered/Non-powered Handheld Tools at SSC.

3.9.1 Machine/Machinery Guarding General Requirements

a. Machine Guards. Removal (or interference) of machine guards and other safety devices for any reason other than during necessary maintenance is strictly prohibited.

b. Shielded Startup. Startup (i.e., on/off) switches shall be shielded located on industrial shop equipment to prevent accidental startups. A location cannot be used if it is not allowed by OSHA.

3.9.2 Machine/Machinery Guarding Specific Equipment Requirements

a. Aluminum. Aluminum shall only be used on grinders with wheels specifically formulated for use with aluminum.

b. Dressing Tool. A dressing tool shall be used periodically on bench grinders throughout their use to assure uniform wear of the grinding wheel throughout the life of the wheel.

c. Drill Presses. Appendix A of this document depicts the basic safety requirements for drill presses. This should be posted in the immediate vicinity of the drill press, and operating personnel should be trained to the requirements.

3.9.3 Machine/Machinery Guarding General Operational Requirements

a. Qualified Operators. Only fully trained and authorized operators or those under the supervision of a qualified operator will be permitted to operate shop machinery.

b. Unattended Machinery. Operators or maintenance personnel shall not leave running machinery unattended.

c. Thrown Object Protection. Work jigs/fixtures/clamps shall be used to protect the employee from the hazards of thrown objects.

3.10 Fundamental Safety Rules, Procedures, and Requirements for Control of Hazardous Energy (Lockout/Tagout & Non-Service/Maintenance Hazardous Energy Isolation)

This instruction defines Lockout (LO)/Tagout (TO) minimum requirements for positively locking and tagging out equipment to perform service or maintenance as well as systematic operations at SSC where the unexpected release of energy, or energization, could result in injury to personnel, facilities or the environment. This includes energy in the form of, but not limited to the following:

- Electrical
- Pressure
- Mechanical
- Chemical
- Hydraulic
- Stored
- Pneumatic
- Thermal

Additionally, this guideline is intended to uniformly lock and tag equipment/systems across all SSC operations. For the purpose of attempting to maintain the overall effectiveness of the LO/TO program, a separate (but equally effective) program shall be documented and properly approved for long-term isolation of equipment/systems which may contain hazardous energy, but not undergoing service or maintenance activity.

WARNING: Documented procedures shall be developed and utilized to protect persons from any condition where potentially hazardous energy may exist and contribute to personnel injury if unexpectedly released.

This safety procedure is applicable to all NASA SSC and its contractor and resident agency personnel whose tasks could potentially exposure personnel to hazardous energy or materials, if unexpectedly energized or released.

Exception: LO/TO requirements different than those described in this document for SSC controlled programs/projects being performed on property controlled by another NASA Center or government agency shall be clearly defined in a contract, grant, or written agreement between the two parties.

This document does **NOT** apply to the control of energy in the following conditions:

1) Service/maintenance activities such as minor tool changes and adjustments that are routine, repetitive, and integral to the use of the equipment and which are conducted during normal production operations are **not** regulated by 29 CFR 1910.147 if the safeguarding provisions of 29 CFR 1910 Subpart O (1910.211–219) and Subpart S (1910.301–335) or other applicable portions of 29 CFR 1910 are implemented to prevent worker exposure to the hazards created by the unexpected energization or startup of the equipment/system.

2) Service/maintenance activities performed on electric equipment connected to the energy source by a cord and the plug is under the exclusive control of the employee performing the service/maintenance. Reference Section 9.2, Definitions, for "exclusive control" as applied to this instruction.

3) Facilities under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution, including related equipment for communication or metering. The exposure of employees to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations is regulated by 29 CFR 1910.269 and 29 CFR 1910.301–335.

3.10.1 General Safety Requirements for Control of Hazardous Energy (LO/TO)

a. LO/TO Program Plan: A written LO/TO program, including procedures, shall be developed for each federal agency and their contractor located at SSC. Each respective program shall be reviewed and updated as necessary to reflect the most current applicable requirements and references. As a minimum, each program shall conform to the requirements found within the latest edition of the Stennis Safety Procedure (SSP 8715-0001), Stennis Procedural Requirements document (SPR 8715.1), and any superseding federal and state requirements. Each written program shall at least provide the following information in adequate detail:

1) Purpose
2) The program's scope, applicability and any possible exceptions
3) Program specific definitions
4) Compliance enforcement incentive(s) (general actions for violation of the program)
    a) Civil service employees discovered disturbing the controls, energy isolating devices, and/or energy sources for any equipment/system or component that has been locked or tagged out by someone else (SSC standardized LO/TO devices or configuration locks or tags) shall be subject to disciplinary action in accordance with the "Table of Disciplinary Offenses and Penalties". (This document can be viewed on the SSC Office of Human Capital web page by clicking on sitemap, then scrolling down to the Table of Disciplinary Offenses and Penalties.)

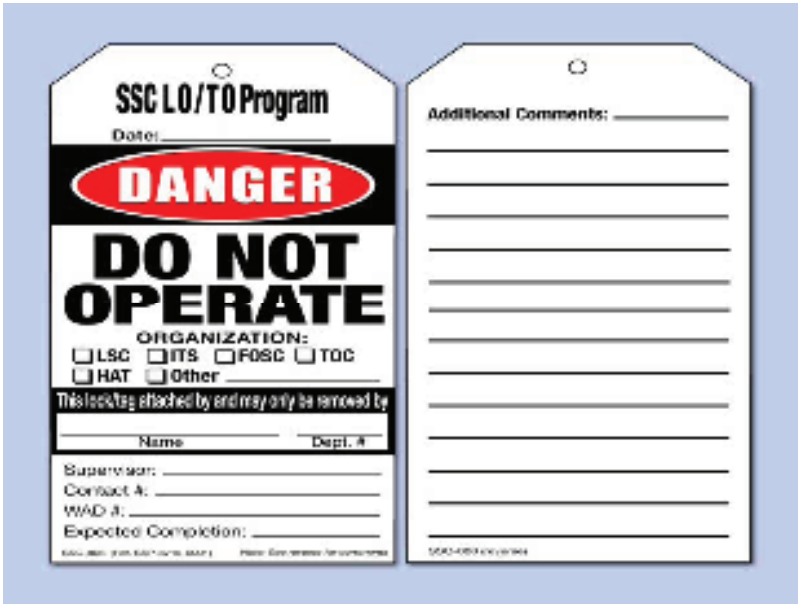
b) Onsite and offsite contractor employees shall be subject to SSC disciplinary action as determined by the Contracting Officer (CO) and/or Contracting Officer's Technical Representative (COTR), or possibly the organization requesting service.

5) Relevant definitions
6) Employee training/certification requirements – All onsite LO/TO certification programs shall be officially administered via the Facility Operating Services Contractor (FOSC). The training must demonstrate each employee understands the purpose and function of the SSC LO/TO program, and those employees possess the knowledge and skills to work safely on or in the vicinity of systems/equipment that could be impacted by the LO/TO program.
    a) Certification and Training
        i. "Control of Hazardous Energy" (LO/TO course #QG-609-FOS) and NSTC 814 are approved as designated courses for obtaining certification in the SSC LO/TO program. Each organization's safety office should coordinate LO/TO training for its respective employees.
        ii. Onsite SSC authorized employees certification records shall be maintained current in the NASA SSC Training Certification Records System (TCRS).
        iii. Offsite contractor records shall independently maintain accurate and up to date training/certification records for its respective employees.
        iv. Third party LO/TO certification is on a three-year periodicity cycle. However, authorized employees must complete an annual LO/TO refresher training to maintain proper certification. Refresher training can be provided by the FOSC or by the respective organization's safety office having employees requiring refresher training.
        v. Supervisors shall identify affected employees and assure those employees receive the necessary training relating to recognition of this program and its limitations.
        vi. Personnel certification records shall be maintained for at least five (5) years after separation of employee, and destroyed when no longer needed.
7) Written procedures to successfully implement the LO/TO program requirements will consist of:
    a) Requirement for equipment/system specific LO/TO implementation procedures. Procedures shall only be written by employees that have been properly certified via an approved means discussed in Section 3.10.1(a)(6).
    b) Notification of affected employees – Designated means of notification shall be detailed in the procedure or work authorizing documentation, as necessary.
    c) Sample of acceptable lock and tag devices.
    Notes:
        - LO/TO program locks shall be "RED" in color and used exclusively for the purpose of locking out equipment in conjunction with this program**.**

- Locks used in conjunction with the LO/TO program can be purchased from a manufacturer with a "RED" case, or a "RED" heat shrink sleeve can be installed over the lock case.
- LO/TO devices shall be replaced with configuration locks and tags if the hazardous service or maintenance activity hats for an extended period of time and the equipment/system energy remains hazardous to persons in the vicinity. This does not mean LO/TO devices must be replaced with configuration devices when the estimated completion date is slightly extended as a result of unforeseen circumstance which delays the service or maintenance less than one week.
- A pictorial of an approved SSC tag must be exhibited as an example in the program plan. SSC LO/TO tags can be ordered through the SSC warehouse via a Material Request (MR) using the SSC Service Request System (SRS). The LO/TO tag stock number is 769000N013923.

d) LO/TO equipment not permanently assigned to individual employees (e.g., Area LO/TO kits) shall be managed by the area supervisor for accurate accountability and utilization of the equipment. This must include a LO/TO equipment log requiring the equipment to be properly signed and dated in and out by the actual user upon removal from and return to the stored location.

e) Each lock must be accompanied by a "DO NOT OPERATE" tag identifying:
   i. Company/organization name
   ii. Name and department of authorized employee who installed lock
   iii. Supervisor's name and contact information
   iv. Realistic estimated removal date
   v. Tags must be legibly completed using fine or extra fine permanent marker.



Notes regarding sole use of TO devices:

- TO devices used without a lock in conjunction with this program are prohibited unless it is physically impossible to lock and tag the energy source(s) and supporting evidence proves tagging alone can eliminate potential danger that may be associated with the unexpected energization.
- The responsible safety office shall inspect all instances where tagging without lock will serve as the designated means for isolation.
- Additional safety measures, such as removing fuses or lifting wires, shall be exercised to provide added employee protection when tags are used without locks in this program.

f) Group LO/TO

i. A group LO/TO procedure shall be developed and communicated to all employees involved when the service/maintenance activity on equipment/systems involves more than one employee from a craft, crew, or department.

ii. The craft, crew, or department assigned the primary responsibility for the service/maintenance activity shall be responsible for developing the detailed group LO/TO procedure and communicating it to all employees participating in the service/maintenance activity prior to start of work.

iii. Each group LO/TO procedure shall comply with the following minimum requirements:

a. The crew or department with primary responsibility appoints an authorized employee to serve as the LO/TO coordinator for the group LO/TO activity.

b. The LO/TO coordinator informs all the group members of the type, magnitude, and hazards related to the energy to be controlled and the methods and means to be implemented to control the energy for the equipment/system.

c. The LO/TO coordinator informs the affected employees and group members of the method to be used for the group LO/TO activity. The method to ensure employee protection shall be one of the following:

1. Use of a multi-lock hasp; or
2. Use of a lock box.

d. The LO/TO coordinator coordinates the shutdown and LO/TO of the equipment/system with any affected employees.

e. The equipment/system is shutdown and "safed" per LO/TO procedure sequence and requirements complying with OSHA 1910.147(d)(1,2,3 and 4).

f. The LO/TO coordinator and each group member verify the equipment/system is shut-down, de-energized, placed in a zero-energy state, any stored or hazardous energy is released, and the equipment/system is in safe working condition.

g. Before each group member begins work, they will affix their personal LO devices to the group multi-lock hasp or group lock box.
h. When each group member finishes their work, they will remove their personal lock and tag from the group multi-lock hasp or group lock box.
i. After all work has been completed the LO/TO coordinator verifies that the LO/TO devices applied by other authorized employees in the group activity are removed by those employees. If a situation arises where the employee that placed the LO/TO devices is unable to remove them, the LO/TO devices are to be removed in accordance with "emergency removal" guidelines contained in section 3.10.1(a)(11)(a) of this document.
j. After ALL lockout devices are removed, the LO/TO coordinator removes his/her lockout devices from the multi-lock hasp or lockbox and from the energy-isolation device.
k. The equipment/system is then reenergized in the correct start-up steps sequence.

8) Description of acceptable/unacceptable types of energy isolation devices
9) Dissipation or restraining of stored energy (if necessary)
10) Means for verifying successful equipment isolation
11) Requirement for a written procedure for restoring equipment to service consisting of:
    a) Limit removal of LO/TO devices to the employee who applied the devices. When the authorized employee who applied the LO/TO device is not available to remove, the device may be removed under the direction of the employer. The level of safety must not be jeopardized in any way by this process. The applicable procedure shall include the following elements:
        i. Verification by the employer that the authorized employee who applied the device is not at work.
        ii. Making a reasonable effort to contact the authorized employee to inform him/her that their LO/TO devices are to be removed.
        iii. Ensure the authorized employee has this knowledge before returning and resuming work.
    b) Capture provisions for emergency removal, in the event the responsible employee is not available.
    c) Check the machine or equipment and the adjacent area to assure all items that could create a hazard, if left in place, are removed and equipment is ready for reactivation.
    d) All employees shall be safety positioned or removed from the impact area before system reactivation.
    e) Confirm equipment controls are in the neutral position.
    f) Once lock and tag (and possibly blocking) devices are removed, the equipment/system is ready for reactivation.
    g) Notify affected personnel and facility managers that lock and tag process is complete and equipment/system is again functional.

b. Shift or Personnel Changes
   1) Each organization shall develop and implement a specific procedure for shift or personnel changes to ensure the continuity of LO/TO protection, when required.
   2) The procedure shall include provisions for the orderly transfer of LO/TO devices protection between on-coming and off-going employees. Only two options are allowed at SSC.
      a) A physical transfer between off-going and on-coming employees. Both employees shall be present at the worksite at the same time to replace the off-going employee's lock and tag with the on-coming employee's lock and tag; or,
      b) When there is a gap between shifts and a physical transfer procedure is not possible, the responsible supervisory personnel shall use the Transfer Lock Procedure. A configuration lock and tag shall be used to maintain the system's zero energy state. This procedure does not require both authorized employees to be present at the worksite at the same time. This options is only acceptable under the following conditions:
         i. Keys for the configuration lock(s) must be controlled in a designated location only accessible to supervisory personnel.
         ii. Each employee must verify the equipment/system remains in a safe state before applying their respective LO/TO devices and initiating/resuming work.

c. Inspections
   1) An annual internal inspection of each approved lockout/tagout program shall be lead or performed by the organization's safety office.
   2) Members of the inspection team must be independent of the daily hands-on LO/TO implementation process. Each employee participating on the inspection team and employees who may be interviewed during the inspection shall be identified within the final inspection report.
   3) The inspection shall verify enough of the program's elements to positively determine the program's overall effectiveness.
   4) Objective evidence of LO/TO program inspection results and corrective action plans shall be maintained on file by the inspected organization for a minimum period of three years from the actual last finding closure date reflected in the LO/TO inspection Corrective Action Plan (CAP). CAPs must be developed by the audited organization and properly managed to reflect closure rationales, all ECDs, and actual implemented corrective actions and dates (if different from initial).
   5) LO/TO inspection CAPs shall be presented to the lead inspector for approval within 45 calendar days of the inspection report and a routine status update provided to the lead inspector until all findings have been acceptably closed.

d. Configuration Locks and Tags
   1) Configuration locks and tags are to be installed in accordance with the following**:**

a) Work has not been completed on the equipment/system and it is not in a condition permitting a safe return to service by the end of the estimated completion date and the equipment/system is not undergoing service/maintenance activity, but hazardous energy must be positively controlled.
b) Any delays that would significantly (i.e., more than a week beyond the original ECD) impact service/maintenance completion.
c) To keep the equipment/system in the "off" position if it is not safe to operate.
d) To keep the equipment/system in the "on" position to prevent some from inadvertently turning it off.
e) To keep unauthorized employees from operating the equipment/system.

2) SSC does not have a standardized configuration lock. The lock used to maintain configuration of the equipment/system can be any size, shape or color (other than RED) required to safely lock the equipment/system.
3) Configuration lock keys shall be inventoried, managed, and positively controlled by supervisory personnel. Keys must be kept in a location only accessible to the supervisor, unless installed or removed in the field.
4) All locks used to maintain configuration of equipment/system shall be accompanied by a tag appropriate for the hazard level.
5) SSC does not have a standardized configuration tag, but tags specified for use in conjunction with the LO/TO program shall not be used in a configuration lock process. All tags shall comply with the guidelines of OSHA CFR 1910.145 and shall be appropriately used in conjunction with the hazard level for which they are being placed in the configuration process.
6) Configuration tags are to include the following information:
   a) The name of the employee that placed the tag;
   b) Organization name code that placed the lock;
   c) Contact phone number; and
   d) Work authorizing document and number
7) A configuration lock shall always be installed if the energy isolation device is capable of accepting a locking device.

e. Offsite Contractors
1) Offsite contractors shall ensure that their personnel performing LO/TO activities have received acceptable training/certification and that personnel comply with all applicable LO/TO requirements of this document.
2) Appendix B details specific responsibilities assigned to SSC and contractor organizations when they request offsite contractor services, which could impact or be affected by SSC's LO/TO program requirements.

3.11 Fundamental Safety Rules and Procedures General Safety Requirements in Welding/Cutting Operations

This instruction provides the general safety requirements for welding, cutting, and brazing operations at SSC.

a. Hot Work Permits. Welding and/or cutting activities (as well as ancillary grinding operations) to be performed outside of designated areas/processes or weld/machine shops **will not be performed** unless a "Hot Work Permit" has been obtained per SPR 8715.3. In weld/machine shops, typical industrial safety practices as well as routine safety inspections will suffice to govern welding activities in these areas.

b. Safe Operations Distance. Welding, cutting, grinding, or other heat producing operations will not be performed within 100 feet of any storage vessel, transfer/vent line, or system that contains a propellant, toxic/hazardous material, or flammable atmosphere. In the event hot work activities are required to be performed within 100 feet of the above, the following precautions will be taken prior to issuance of a "Hot Work Permit" and beginning of the work activities. For more information on how to obtain a Hot Work permit, see SPR 8715.3, *John C. Stennis Space Center Hot Work Permit Program*.

c. Hazard Analysis. The Area Supervisor shall provide a written hazard analysis of the planned work process to determine the hazards present and asses the risks associated with the control measures proposed. The cognizant safety office will review this assessment and determine the appropriate level of management acceptance for approving the work.

d. Hazardous Work Area Classification. The area in which the work is to be performed will be classified as a hazardous work area and the numbers of personnel within this area will be minimized to those actually needed to safely perform the work.

e. Propellant System Configuration. The propellant system will be maintained in a static mode configuration. The amount of material present will be kept to a minimum that system features allow.

f. System Sampling and Leak Prevention. Positive integrity of the system will be maintained to assure that there are **positively** no leaks present. An atmosphere sample (using approved portable gas detectors) will be taken to verify the absence of flammable, combustible, toxic, or hazardous materials in the work area. Continuous sampling or periodic sampling will be required if the process situation warrants this or the work is performed over an extended period of time. Equipment operators must be properly trained and certified (if necessary).

g. Pressure Monitoring and Relief. System pressure relief (venting) will not be accomplished during the work activities. The system will be monitored by a qualified operator for excessive pressure buildup. In the event that emergency venting is needed, all work activities

will be discontinued until the system is returned to a static mode configuration and the work area is rechecked for presence of flammable/combustible/toxic/hazardous materials.

h. Emergency Procedures. Emergency plans will be determined and conveyed to all parties involved/affected with/by the work process.

i. Safety and Fire Equipment. Safety equipment and adequate fire fighting equipment/services will be determined and made readily available to the work crews.

j. UV/IR Sensor Shielding. Shields (preferably at the point of welding/cutting operations) shall be used to preclude the inadvertent activation of fire detection systems based on UV and IR sensors.

k. Notifications of Operations. Welding and cutting operations inside buildings/facilities equipped with fire alarms (specifically smoke and fire detectors) will not commence until the FOSC Fire Alarm Technicians have notified the SSC Fire Department and disabled the appropriate detection devices for the given work duration. When fire alarms/detection devices are disabled, the onsite "fire watch" work crew will maintain communications with the SSC Fire Department, and alternate alarm/evacuation notification procedures will be established for the building/facility occupants.

3.12 Fundamental Safety Rules and Procedures - General Safety Requirements for Recreational Safety at SSC

This instruction provides the general safety requirements for recreational/promotional activities occurring within the confines of Stennis Space Center. This safety procedure is applicable to all NASA and NASA contractor personnel, and their visitors who engage in Stennis Space Center Recreation Center (SSCRC) sponsored activities or other recreational activities approved by NASA management.

3.12.1 Recreational Safety Responsibilities

a. Responsible Managers/Supervisors. The responsible supervisor of personnel engaging in recreational activities at SSC shall ensure all:
   1) Employees are familiar with the requirement of this instruction by orientation upon their employment at SSC.
   2) Employees are kept informed of changes to this instruction.

b. NASA/SSC Safety Management Council. Because this procedure affects many different agencies at SSC, the NASA/SSC Safety Management Council shall make all final determinations and clarifications of this procedure to assure the safety of personnel involved in recreation activities at SSC.

3.12.2 Recreational Safety Requirements

a. SSC Designated Walking and Jogging Areas: Recreational walking/jogging is permitted within the boundaries of SSC provided that participants comply with applicable State of Mississippi laws and wear their SSC identification badges.

b. Use of Recreational Facilities – SSCRA Guidelines for Use of SSC Recreational Areas: SSC personnel and visitors will follow the rules for use of SSC recreational facilities established by the SSC Recreation Association (SSCRA). Appendix C, Attachment 1 of this document provides the rules and general safety requirements for use of the recreational facilities at SSC.

c. Gun and Archery Range Safety – SSCRA Gun and Archery Club Safety Requirements: Appendix C, Attachment 2 of this document provides the general safety rules established by the SSCRA Gun & Archery Club for use of the range.

d. Bicycling Safety: Although Mississippi State Law does not require the wearing of a bicycle safety helmet, cyclists are **required to wear a helmet** while riding at SSC. In addition, all cyclists shall comply with the following guidelines while riding a bicycle within the confines of SSC.
   1) Riders shall abide by all traffic signs/regulations.
   2) Riders shall always ride with the flow of traffic.

e. Use of Tents and Shelters – Fire Safety Inspection: Promotional activities requiring the use of tents and other temporary shelters shall be inspected by the SSC Fire Department to assure that such tents and structures are in compliance with NFPA 102 prior to their use.

f. Annual Facility Inspections: SSCRA recreational facilities shall be inspected at least annually by a committee comprised of representatives of the following organizations:
   1) NASA S&MA Office.
   2) SSCRA Recreational Association.
   3) FOSC Safety Office.

Typically, this inspection will be scheduled in early spring of each year.

3.13 Fundamental Safety Rules and Procedures - Safe Transport, Storage, and Use of Compressed Gases in Portable Cylinders

This instruction provides the guidelines for the identification, inspection, testing, transportation, handling, use, and storage of compressed gas cylinders located on the SSC.

3.13.1 Safety of Storing, Transporting, and Using Compressed Gases in Portable Cylinders General Requirements

a. Tube Bank Trailers Requirements
   1) Tube bank trailers will be subject to the applicable requirements for compressed gas cylinders.
   2) Tube bank trailers will be durably marked to indicate contents and operating pressure.

b. Hammer Test
   1) The hammer test is an indicator of internal corrosion and is performed on empty un-pressurized cylinders.
   2) The hammer test consists of tapping the cylinder side-wall with a light blow using a half-pound ball-peen hammer or equivalent. A good cylinder will have a clear ring. A dull ring indicates internal corrosion, liquid or foreign material in the cylinder. The cylinder shall be removed from service.

c. Hoisting: When cylinders are moved by a hoisting mechanism, a properly designed cradle shall be used. No cylinder shall be moved by a lifting magnet. Valve protection caps shall not be used for lifting cylinders from one vertical position to another.

d. Transport of Flammable Gases: Cylinders containing flammable gases shall not be transported with other flammable substances.

3.14 Fundamental Safety Rules and Procedures - Electrostatic Discharge Control

This instruction provides the general safety requirements for the development of appropriate control measures to provide protection against personal injury, property damage, and/or mission degradation due to the electrostatic discharge of energy (ESD) and subsequent initiation of solid propellants, igniter components, explosives, or flammable/combustible materials. This safety procedure establishes mandatory electrostatic discharge control requirements for NASA and NASA contractors at SSC who engage in the receiving, distributing, assembling, disassembly, handling, testing, repairing, or storing of explosive ordinance, flammable/combustible materials or propellants.

a. General Requirements
   1) Grounding Systems: Grounding systems shall be tested and retested for electrical resistance and continuity in the following conditions.
      a) When initial installation is completed.
      b) Before equipment is returned to service following any repairs.
      c) Before equipment is used after an incident which is suspected to have caused damage to power (electrical) systems in the equipment or system.
      d) At intervals not to exceed one (1) year (every six (6) months for explosive operations/facilities).

2) Ground Tests: Ground tests will be recorded, with the identification of the item/system being indicated as well as the date of test, the test equipment used and the test equipment's calibration date.
3) Ground System Inspection: The ground system shall be visually inspected and grounds tested by maintenance prior to activation and reactivation of the system if the equipment has been inactive for more than one (1) year.
   For explosive operations, the ground system shall be visually inspected by maintenance prior to activation and reactivation of the system if the equipment has been inactive for more than one (1) month. If the system has been inactive for more than six (6) months, it shall be visually inspected by maintenance and tested prior to activation and reactivation.
4) Maximum Resistance to Ground: The maximum resistance to ground permitted for different types of equipment/systems is as follows:
   a) Hazardous Locations - All conductive parts of equipment shall be grounded so that resistance does no exceed 25 ohms, except for lightning protection, which requires 10 ohms or less.
   b) Non-hazardous Locations - Non-electrical equipment in non-hazardous locations need not be grounded unless for static dissipation, but should be grounded as part of the lightning protection system if present (Reference NFPA 780).
5) Electrostatic Charging Control: Controls required for preventing electrostatic charging are dependent on many factors including the materials being processed, contacting materials, the process or operation being performed, and hardware and equipment design and materials of construction. The control measures may include the use of anti-static spray to minimize charge build-up, static dissipation and conductive plastics, metals, electrical bonding and grounding, process delays permitting charge relaxation from materials of low conductivity, and the use of leg or wrist-stats by operating personnel. The specific measures must be defined for each operation or process determined to be a significant electrostatic charge generator. Control measures shall be specified in individual operating procedures.
6) Process Procedures: Material electrical properties are primary contributors to the magnitude of the electrostatic charge build-up and rate dissipation. Process procedures shall define the materials to be permitted to contact live propellants, energetic materials, and loaded solid rocket motors. Nonconductive materials are not to be used unless specified within a procedure.

b. <u>ESD Measures for Combustibles</u>: ESD Measures/Controls for Working with Flammable/Combustible Liquids.
   1) Transfer of Flammable Solvents into Tanks: Free fall of liquid must be avoided. Liquid should be introduced below the surface of the liquid in the tank. A slowing down of this motion will reduce the rate of the generation of static electricity.
   2) Paint Spraying: Paint spray gun nozzles and pressure feed pots shall be grounded. Care must be taken to ensure ground connections remain free of paint coatings.

c. ESD Measures for Hydrogen: ESD Measures/Controls for Working with Liquid/Gaseous Hydrogen.
   1) Electrostatic Energy Ignition: Electrostatic energy can be a source of ignition with hydrogen requiring as little as 0.017 millijoules (Milliwatt-Seconds) of energy to ignite. Electrostatic energy of sufficient voltage to cause ignition can be generated by several mechanisms:
      a) Two phase fluid flow (Ref. CRYOCO text).
      b) Solid particles traveling in fluid flow (Ref. CRYOCO text).
      c) Possible fluid flow through nonconductive enclosures/piping.
      d) Generation of static electricity in garments worn by operating personnel.
   2) Conductive Piping: Facility piping shall be shown to be conductive through out its entirety. Special concern shall be paid to means of joining to assure adequate flow to the facility ground.
   3) Conductive Plastics: Conductive plastics (bonded/grounded) shall be given strong consideration for enclosures that must be used in temporary/permanent applications of testing at SSC.
   4) Prevention of Charge Buildup: To preclude possible charge build up and subsequent ignition of hydrogen in nonconductive tubing/piping, the following will be given a high consideration (listed in order of priority) when designing hydrogen systems.
      a) Substitute conductive materials and provide facility grounding of such.
      b) Substitute plastics that are designed to limit charge buildup.
      c) Limit the flow rates to a level that will not induce a charge.
      d) Preclude air/oxygen entrainment by use of facility purges.

3.15 Fundamentals of Safety Rules and Procedures - Electrical Safety Requirements

This instruction establishes the requirements to ensure an electrically safe work place, free from electrical hazards. Employees must only adhere to those portions of this document that are applicable to their specific area(s) of responsibility.

In addition to these basic requirements, each contractor/agency shall be responsible for implementing electrical safety programs that thoroughly cover those applicable portions of 29 CFR 1910, 29 CFR 1926 and the latest edition of the National Electrical Code (NFPA 70).

3.15.1 Electrical Safety Responsibilities

a. NASA/SSC S&MA Manager: The NASA/SSC S&MA Manager shall ensure an electrical safety program is integrated into an overall Safety and Health Program for all NASA/SSC personnel, Government, and Government contractors.

b. Organizations: Each organization is responsible for:
   1) Developing operating procedures concerning special electrical hazards in their work areas.

2) Providing oversight for implementing the electrical safety program.
3) Conducting periodic inspections of their work areas and electrical equipment.
4) Ensuring that permit restrictions are implemented in the manner intended.
5) Recognizing equipment adjustments in high voltage or any other high hazardous locations as being "SAFETY CRITICAL." The cognizant safety representative shall approve SAFETY CRITICAL operations.

3.15.2 Electrical Safety Small Appliances for Personal Use

a. All appliances for personal use in the workplace such as coffee pots, heaters, refrigerators, microwaves and toasters will be listed and shall exhibit the label of a national research testing laboratory. Small electric appliances such as coffee makers and microwave ovens must be accompanied by SSC Form 222, *Permit for Use of Small Appliances* only issued by the SSC Fire Department. The permit must be obtained prior to initial usage of the appliances at NASA/SSC.

b. Electric heaters for office use shall not be permitted without written authorization from the AHJ.

c. Permit for use of small appliances shall be displayed within the office area for each electrical appliance in use.

3.16 Fundamentals of Safety Rules and Procedures – Scaffold Safety

This instruction provides the general safety requirements for working with scaffolds.

3.16.1 Applicability

a. This safety instruction is applicable to all NASA and NASA contractor personnel working scaffolds at SSC. The procedure is also applicable to all Resident Agencies at SSC and Resident Agency contractors who perform work at SSC.

b. This procedure is applicable to industrial and non-industrial activities and operations, test operations, maintenance processes, and construction projects at SSC.

3.16.2 General Safety Requirements

a. Inspection: A NASA/FOSC qualified field engineer must inspect scaffolds before use. Prior to each shift, scaffolding shall be tagged, by a designated scaffold competent person, with an inspection tag verifying the inspection and approval for employee use.

b. OSHA Inspection Checklist: The field engineer will use an OSHA scaffolding inspection checklist, appropriate to the specific scaffolding type in use. For an example of this checklist, refer to Appendix I, SSC Scaffold Inspection Checklist.

c. Tagging Requirements:

1) All scaffolds erected at SSC are required to be tagged with an appropriate erectors tag, which will state the status of the scaffold and whether or not it is safe for use. Three different tags will be used to identify the safety status of the scaffold:
   a) A complete scaffold GREEN TAG will be attached to any scaffold that was built to meet Federal OSHA standards and is safe for all crafts to work from. This tag will be signed by the competent person who was in charge of erecting the scaffold and placed in a conspicuous location after the scaffold has been inspected prior to its use.
   b) For any scaffold with platform(s) which physically cannot be completely erected, (i.e., interference with equipment prevents installation of all guardrails or planks) a caution YELLOW TAG will be attached to the scaffold. This tag will indicate that scaffold has been inspected and may be used only by workers wearing a properly anchored personnel fall arrest system, including a full body harness and lanyard. This tag will be signed by the competent person who was in charge of erecting the scaffold and placed in a conspicuous location after the scaffold has been inspected prior to its use.

      TAG USAGE NOTE: **Use of Yellow Tag(s) does not permit intentional erection of incomplete scaffolds. In no case shall a scaffold that is missing members required for structural stability (i.e., bearers, runners, posts, or braces) be tagged with yellow or green scaffold tag(s).**
   c) A warning RED TAG will be attached to any scaffold which is incomplete and should not be used until complete. This tag will state, "**Warning, Do Not Use This Scaffold.**" This tag will be placed in a conspicuous location and indicates that the scaffold has not been inspected or is NOT safe for use by anyone other than qualified scaffold erectors.
2) Prior to each shift and prior to use of the built scaffold, a competent person shall inspect the scaffold and tag the scaffold with a competent person pre-shift inspection tag. This tag is in addition to the scaffold builder's tag which should be present on the scaffold. The pre-shift inspection tag shall be placed next to (not to replace or obscure) the erectors tag. If discrepancies in the scaffold are discovered during the pre-shift inspection by the competent person, the scaffold will be immediately Red Tagged as "Do not use this scaffold" and qualified scaffold erectors notified for repair and inspection of the scaffold.

   SCAFFOLD CONFIGURATION NOTE: **Under no circumstance should a scaffold be reconfigured or altered by unqualified personnel. Qualified scaffold erectors under the supervision of a competent person are the only personnel who can reconfigure or**

alter a scaffold at SSC. A competent person **as defined by OSHA is** ***one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.***

4.0 INDUSTRIAL HEALTH PROGRAM ADMINISTRATIVE REQUIREMENTS AND PROCEDURES

4.1 Specific References

29 CFR 1910.134, *Respiratory Protection*
29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*
OSHA 29 CFR 1910.95, *Occupational Noise Exposure*
ANSI Z136.1, *Safe Use of Lasers*
NPR 1800.1, *NASA Occupational Health Program Procedures*
NPR 1820.1, *Hearing Conservation*
Regulations for Control of Radiation in Mississippi, Division of Radiological Health, Bureau of Environmental Health, State Department of Health, Jackson, Mississippi
SSC Form 740, *Asbestos Maintenance Work Approval*
SCWI-1800-0001, *Ergonomics Program*
SCWI-1800-0002, *SSC Hearing Conservation*
SCWI-1800-0003, *SSC Bloodborne Pathogens Control Program*
SCWI-8500-0004-ENV, *John C. Stennis Space Center Hazardous Materials, Hazardous Waste and Solid Waste Procedures and Guidelines*
SCWI-8500-0019-ENV, *Asbestos Hazard Control Plan*
SCWI-8700-0002, *Health Physics Program*

4.2 Respiratory Protection Program

Respiratory Protection Program procedures are contained in SCWI-8715-0002, John C. Stennis Space Center Personal Protection Program.

4.3 Chemical Hygiene Policy for Laboratory Facilities

This requirement specifies the general requirements for the safe operation of laboratory facilities at SSC.

4.3.1 Responsibilities

Each responsible organization will assess all activities and operations to determine the applicability of 29 CFR 1910.1450.

Facilities and operations determined to be "Laboratory Operations" will be designated as such and their location and scope of operation reported to the NASA Safety Office. All organizations with "Laboratory" activities will designate a Chemical Hygiene Officer (CHO) and develop a written Chemical Hygiene Plan available to all employees that is in compliance with the requirements of 29 CFR 1910.1450.

4.3.2 Requirements

a. Safety and Emergency Resources and Equipment
   1) Telephone numbers of emergency personnel, chiefs and other workers as deemed appropriate will be posted in laboratory work areas.
   2) Prior to the procurement of new chemicals, the responsible organization's CHO and the purchasing party shall follow procurement and safety guidelines outlined in SCWI-8500-0004-ENV. The procurement approval process shall include a verification/confirmation that existing fire extinguishers and other emergency equipment are appropriate for such chemicals.
   3) This fire and emergency equipment will be inspected by the laboratory chief monthly, and maintained in good working order.
   4) Location signs for safety and emergency equipment will be selected by the laboratory chief who will post and maintain them.

b. Chemical Spills, Releases and Accidents: The responsible organization's CHO shall be immediately notified of all spills or releases. Report all spills immediately by calling 911 from any SSC extension or by calling 228-688-3636 from a cell phone.

c. Engineering Controls: Improperly functioning engineering controls must be reported to the responsible organization's CHO immediately. The system shall be taken out of service until proper repairs have been executed. The responsible organization's CHO shall select and implement temporary alternative measures, such as personal protective equipment, alarms, etc., until engineering controls are restored.

d. Annual Chemical Hygiene Plan Audit: The responsible organization's CHO will conduct an audit of all phases of the Chemical Hygiene Plan each year as required by 29 CFR 1910.1450 (e) (4). Results will be provided to the NASA Office of S&MA and the responsible laboratory manager or chief. Implementation of corrective actions will be verified by the responsible organization's CHO.

e. Annual Chemical Inventory: The responsible organization's CHO will prepare and submit to the NASA Office of Safety and Mission Assurance and NASA Environmental Officer a complete chemical inventory per SCWI-8500-0004-ENV.

4.4 Ionizing Radiation Protection

Ionizing Radiation Protection procedures are contained in SCWI-8700-0002, Health Physics Program.

4.5 Non-Ionizing Radiation

Non-Ionizing Radiation Protection procedures are contained in SCWI-8700-0002, Health Physics Program.

4.6 Safety and Health Requirements for Hazardous Noise Exposures

Hazardous Noise Exposures safety requirements are contained in SCWI-1800-0002, John C. Stennis Space Center Hearing Conservation.

4.7 Safety and Health Requirements for Asbestos Management and Awareness

Asbestos Management procedures are contained in SCWI-8500-0019-ENV, Asbestos Hazard Control Plan.

4.8 Chemicals/Hazardous Materials Safety

Chemical/Hazardous Material Safety procedures are contained in SCWI-1800-0005, John C. Stennis Space Center Hazard Communications.

4.9 Bloodborne Pathogen Health Program

Bloodborne pathogen procedures are contained in SCWI-1800-0003, John C. Stennis Space Center Bloodborne Pathogens Control Program.

4.10 Automated External Defibrillator (AED) Program

4.10.1 Purpose

The SSC Automated External Defibrillator (AED) Program is designed to enhance the emergency medical response capability for early recognition and correction of treatable sudden heart dysrythmia events and improve the outcome of personnel undergoing sudden cardiac arrest at Stennis Space Center.

4.10.2 Scope

This procedure applies to the availability and the use of AED by NASA and NASA contractors, specifically those AEDs used in the Occupational Health Clinic, the Wellness Center, the onsite visitor's center, the Fire Department ambulances and pumper vehicles, security vehicles, and in the Test Area. Before procuring an AED, Resident Agencies are encouraged to seek assistance through the SSC Occupational Heath Clinic and the AED Committee to assure that model selection, placement, maintenance, and general program organization is optimized. The agency may utilize the FOSC on a demand basis to manage their AED program.

4.10.3 Responsibility

a. NASA Office of Chief Health and Medical Officer, is responsible for establishing the AED Program Policy and Guidelines and providing support and consultation to the centers.

b. Medical Director, Occupational Health Services Medical Clinic - FOSC is designated the AED Program Director and is responsible for implementation and oversight of the AED Program at SSC, including developing policy for AED usage at SSC. The Medical Director is the chairperson on the AED Control Committee at SSC.
c. NASA Center Operations Clinic Coordinator is responsible for creating and revising AED Policy, reviewing program effectiveness, participating in the annual system review, and participating as a member of the AED Control Committee.
d. NASA Office of S&MA Industrial Hygiene Coordinator is responsible for creating and revising AED Policy, reviewing program effectiveness, participating in the annual system review, and participating as a member of the AED Control Committee.
e. Chief Nurse, Occupational Health Services Medical Clinic - FOSC is responsible for advising the Medical Director on AED related issues, participating in the Annual System Review, and participating as a member of the AED Control Committee.
f. Fire Chief - FOSC is responsible for advising the Medical Director on AED related issues, providing AED/Cardio Pulmonary Resuscitation (CPR) training, participating in the Annual System Review, and participating as a member of the AED Control Committee.
g. Safety & Mission Assurance Manager - FOSC is responsible for advising the Medical Director on AED related issues, participating in the Annual System Review, and participating as a member of the AED Control Committee.

4.10.4 Process

This document outlines the requirements for the SSC AED program. AED devices are located in strategic locations throughout the site to provide for the broadest coverage across the Center. Many organizations including NASA, Resident Agencies, and contractors participate in the program. A list of current AEDs is maintained by the Medical Director. A Cardiac Arrest/AED use protocol (see Appendix E) is provided to familiarize the Facility Manager and responder with general conditions for device utilization.

The AED Control Committee will meet annually to review the AED program. Their specific responsibilities include reviewing performance data and program management, performing quality control review of all AED response cases, maintaining documentation of case performance reviews, case outcome data, and annual program experience reviewing/approving training requirements for First Responders. Membership will include:

Medical Director, Medical Occupational Health Services Clinic, FOSC (Chair)
Chief Nurse, Medical Occupational Health Services Clinic, FOSC
Fire Chief, Fire Protection Services, FOSC
Safety & Mission Assurance Manager, FOSC
NASA Center Operations Health Clinic Coordinator
NASA S&MA Office Industrial Hygiene Coordinator

a. Training and Skills Competency Requirements.

1) Training requirements for Occupational Health Services (OHS) clinic nurses and physicians shall include current Basic Life Support/Advanced Cardiac Life Support (BLS/ACLS) Certification and monthly practice review of Clinic AED Resuscitation protocol.
2) Training requirements for Wellness Center and Visitor's Center personnel shall include initial and annual refresher BLS/ CPR training and monthly practice review of the SSC AED protocol, supervised by Fire/Emergency Medical Technicians (EMTs).
3) All non occupational health first responders (those designated first responders not employed by the SSC Health Clinic, Wellness Center, and Visitor Center personnel) will be provided with BLS/CPR training every two years.
4) All participating contractors (those contractors who participate) will annually notify and certify to the AED Program Medical Director that its volunteers have been trained at least every two years in compliance with the contractor's AED guidelines and federal and state law.

b. AED Responder Responsibilities Following AED Use. The AED Program Medical Director must be notified verbally immediately following an AED Response and should receive written documentation of event circumstances and response efforts prior to the close of business on the day of the incident, but no later than the beginning of the next business day. Standard SSC Emergency Response Procedures shall apply in all cases of cardiac arrest or other potential cardiac emergency. A post utilization checklist (Appendix E, Attachment 2) shall be completed following the use of an AED.

c. AED Audit and Review. Each AED use will be reviewed (see Appendix E for AED Summary Use Report) for at least the following criteria:
1) Appropriate dispatch
2) Witnessed arrest documented
3) Bystander CPR documented
4) Response time to scene
5) Appropriate use of the AED
6) Patient's consciousness, respiration, and pulse where pulse was checked according to protocol
7) Equipment properly and quickly setup according to protocol AED responder properly identified and gives report
8) First shock delivered within 90 seconds of initiation of use
9) Adequate BLS maintained
10) Reassessment adequate following every shock
11) All protocols followed
12) Time care was transferred to ALS personnel noted on audio
13) Appropriate transfer of care to ALS

d. AED Review With AED Responder. Within the next working day following the use of the AED, if the AED Responder has not reported as required in Section c. above, the Medical Director or designee will contact the AED Responder involved to arrange for an AED review. The review must be conducted within three days of the incident. The review is designed to assess Incident Response and give the AED responder feedback on performance

of the crew and the AED (see Appendix E Attachment 3 for AED Response Summary Report).

e. Corrective Action for Deficiencies. Deficiencies in personnel performance will be addressed during the AED review with the AED responder involved. The Medical Director will recommend remedial training when indicated. Any deficiencies in AED device performance shall be addressed on a case-by-case basis with the assistance of the manufacturer's representative if necessary.
   1) An inspection log shall be maintained on all AEDs (Appendix E, Attachment 4). The log and all incident reports relating to device performance will be reviewed at every AED Control Committee meeting.
   2) If at any time an AED is found to be malfunctioning, the Facility Manager shall immediately notify the OHS Clinic and the Fire Chief that the device is out of service. An incident report will be completed with appropriate request for repair or replacement and forwarded to the responsible authority.

f. Inspection and Maintenance of AED Equipment.
   1) Use manufacturer's checklist specific to each AED device.
   2) Appendix E, Attachment 5 contains a checklist of required AED accessories to use in conjunction with the Aids currently in service at SSC.

g. Annual AED System Review. Annually, the AED Control Committee will conduct a program review to include the following:
   1) Summary data on use and patient outcomes.
   2) Medical Response times for all cardiac arrests and AED uses.
   3) Procedural deficiencies in the operation or utilization of the AED.
   4) AED technical performance/deficiencies.
   5) Any trends identified through the AED Medical Control Program.
   6) Deviations from protocol.
   7) How to improve survivability and patient outcomes.
   8) Recommendations for changes to the program.

h. Administrative Functions. Each Facility Manager, or designee in the area in which an AED device is located will accomplish the following administrative functions:
   1) Maintain equipment according to the manufacturer's recommendations.
   2) Maintain an adequate inventory of supplies.
   3) Coordinate training programs, drills, and post-incident debriefings.
   4) Maintain a current list of trained responders.
   5) Ensure appropriate written documentation is completed after an incident.

i. AED Protocol.
   1) Appendix E contains AED protocol.
   2) Personnel providing the report to the Medical Director immediately after an AED response shall thoroughly document in the report any deviation from this protocol and include the explanation for the deviation.

j. Clinical and Safety Considerations. Application of an AED is indicated for use on individuals exhibiting all of the following signs of sudden cardiac arrest:
   1) Unresponsiveness

2) Absence of breathing
3) Absence of detectable pulse

Note: An AED is intended for use by personnel who have been trained in its operation. The user should be qualified by training in basic life support or advanced life support. Do not use AEDs to treat children under the age of eight (8) years. Follow standard operating procedures when treating children over eight years of age. Follow specific recommendations listed in each AED's manufacturer's operating manual.

4.11 Ergonomics Program

Ergonomic procedures are contained in SCWI-1800-0001, Ergonomics Program.

4.12 Smoke-Free Workplace

This procedure provides the general safety requirements for establishing a Smoke-Free Workplace at SSC.

4.12.1 Requirements

a. Smoking Prohibited Inside. Smoking is prohibited inside all interior space owned, rented, or leased by NASA/SSC (with the exception of designated smoking areas/entries), in any outdoor areas within 50 feet of air intake ducts, and in SSC leased General Services Administration (GSA) vehicles.

b. Outdoor Smoking. Smoking is permitted in general outdoor areas unless it is identified as a no-smoking area (i.e., LOX storage tanks, fuel storage and transfer areas, etc.).

c. Designated Smoking Entries. The Facility Manager shall designate entries as smoking or non-smoking. To the extent smoking entry areas are permitted, the facility manager shall make every effort to place these entries in areas around the structure to minimize the impact on non-smokers.

4.12.2 Responsibility

a. Smoking Prohibited Signs. Facility Managers are responsible for:
   1) posting suitable signs at or near entrances to buildings and facilities indicating smoking is prohibited inside;
   2) posting designated no-smoking areas outside buildings and facilities to ensure personnel and operational safety or fire prevention;
   3) identifying and posting building entrances where smoking is prohibited; and,
   4) identifying and posting building entrances where smoking is permitted.

b. Assessing Program Effectiveness. The FOSC Safety and Industrial Hygiene Office assess program effectiveness and development. Specifically, they assist in the decision-making process regarding where smoking in outdoor areas will be prohibited to ensure personnel and operational safety, and for fire prevention.

c. Enforcement. Each organization is responsible for the general enforcement of this policy in those areas of their management or control.

d. Compliance. SSC employees will comply with the requirements of the SSC Smoke-Free Workplace Plan as administered by the FOSC Safety and Industrial Office.

5.0 HAZARDS SAFETY AND HEALTH OPERATING PROCEDURES

5.1 Specific References

29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*
29 CFR 1910.146, *Permit-Required Confined Spaces*
29 CFR 1910.1000, *Air Contaminants*
ANSI/AIAA G-095-2004, *Guide to Safety of Hydrogen and Hydrogen Systems*
ASTM Manual 36, *Manual for Safe Use of Oxygen and Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operation, Storage, and Transportation*
AMCR 385-100, *Army Material Command, Safety Manual, latest edition*
NPR 8621.1A, *NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping*
NPD 8710.5, *NASA Safety Policy for Pressure Vessels and Pressurized Systems*
NASA-STD-8719.9, *Standard for Lifting Devices and Equipment*
SCWI-8500-0004-ENV, *Hazardous Materials, Hazardous Waste, and Solid Waste Plan*
SPR 8500.2, *John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements*
SSC-66-200, *SSC Standard for Bourdon Tube Pressure and Vacuum Gages for Use in Facility Piping or Tubing Systems*
SSTD 8070-0089-FLUIDS, *Surface Cleanliness Requirements for SSC Fluid Systems*
Hydrogen Peroxide Rocket Manual (1965) published by FMC Corporation, authored by James C. McCormick, copyright FMC
SWI-8834-0001, SSC *Lifting Devices and Equipment Management Plan*
SSC Form 559, *Report of Industrial Injury or Illness*
SSC Form 576, *SSC Confined Space Entry Permit*

5.2 Confined Space Entry Program for SSC

This procedure provides the safety requirements for entering confined spaces at SSC. This includes personnel working at SSC whose employees perform tasks that potentially expose them to occupational injuries, illnesses, or death from entering and working in a confined space.

Written Confined Space Entry Program: Each onsite resident agency and/or federal agency and/or their contractors at SSC shall develop a written Confined Space Entry program that conforms to OSHA requirements.

5.2.1 Responsibility

(The following requirements are additions to those required by OSHA)

a. Responsible Organizations shall:
   1) Develop and implement a written Confined Space Entry program, in accordance with the requirements of 29 CFR 1910.146. The program must include the necessary employee training and be approved by the NASA/SSC S&MA Office prior to implementation.
   2) Classify all confined space entry operations as SAFETY CRITICAL and require a written procedure reviewed and approved by a cognizant safety representative prior to initiation.
   3) Generate a new permit in the event of work discontinuation due to problems associated with the confined space, a change in system configuration, shift change, or work continuation from previous days.
   4) Keep the number of persons involved to a minimum.
   5) Implement the following safety precautions when working with another contractor (in the case where there are conflicts of requirements among contractors working on the same project, the most stringent requirements shall be followed):
      a) Inform of permit locations and programs.
      b) Inform of common hazards.
      c) Inform of precautions and procedures.
      d) Coordinate entry operations.
      e) Schedule debriefing.
   6) Review confined space entry program and all permits on an annual basis to correct deficiencies that may present future hazardous situations.

b. Entry Supervisor shall:
   1) Notify the SSC Fire Department at least 24 hours in advance of proposed/planned entry.
   2) Notify SSC Fire Department before entry is made in an emergency and upon completion of the entry.
   3) Notify, identify and assure certified rescue personnel are available until completion of task.

c. Cognizant Safety Offices:
   1) Prior to entry, a verification of calibration shall be performed on instruments used to perform atmospheric sampling.

d. Attendants shall:
   1) Maintain a running log of entrants and equipments entering/exiting the confined space.
   2) Assure the confined space permit remain posted at the entry point throughout the duration of the task.

e. Entrants:
   1) Continuous atmospheric monitoring shall be performed in the immediate vicinity of the work area within the confined space.

5.2.2 General Requirements

Written Confined Space Entry Program:

a. Each onsite agency and/or federal agency and/or its contractor(s) at SSC, shall develop a written confined space entry program that conforms to OSHA requirements.

b. The written program, as a minimum, should provide the following information:
Offsite contractors or organizations performing work at SSC are required to comply with OSHA requirements, the requirements of Appendix F of this document and any specific actions required by the cognizant SSC Office of S&MA representative deemed necessary to preclude the endangerment of human life or damage to SSC property.

c. This program is applicable to industrial activities/operations, test operations, maintenance processes, and construction projects at SSC.

5.2.3 Specific Requirements (The following requirements are additions to those required by OSHA)

a. Training and Certification. All personnel involved in confined space shall be certified / qualified in their respective duties.

b. Pre-Entry Briefings. The individual in charge of confined space entry shall brief all persons participating in the confined space entry operation. This briefing shall include the task to be performed during the entry, applicable safety precautions, and an explanation of communications to be used.

c. Fire Department Notification. The SSC Fire Department shall be the primary Rescue Service provider. Non-SSC Rescue Service provider may be employed only with concurrence from the primary provider.

d. Oxygen Sampling, Analysis and Verification. Personnel shall conduct oxygen sampling, analysis, and verification for all confined spaces
1) Before the first person is allowed to enter the confined space, workers shall conduct an oxygen analyzer check by sampling in four-foot increments both vertically and horizontally. The sampling shall be performed with a calibrated direct-reading instrument that will reflect the following conditions:
a) oxygen content;
b) flammable gases and vapors; and
c) potential toxic air contaminants.

Note: The sampling process must occur in sequence (i.e., a, b, and then c).

2) Once the first person has verified that there is safe breathing atmosphere in the confined space, a second person shall be allowed to enter and shall maintain a second sampling unit in close proximity throughout the duration of the confined space stay. The first person shall maintain visual contact with the second person while inspecting other areas of the confined space to verify oxygen content. The two workers shall perform this routine daily and prior to the start of each work shift.

Note: If the confined space is left unattended for any length of time, the sampling process shall be performed again

e. Safety Rope. A safety rope (lifeline) shall be properly secured to the harness of each person entering the confined space. If additional hazards are created by the use of the safety rope, the safety rope may be disconnected with concurrence from the rescue personnel and the Safety Office supervisor or designee.

f. Posting of Permits. The confined space permit shall be posted at the entry/exit point throughout the duration of the job. Where there are multiple entry/exit points, each entry/exit point shall have an original confined space entry permit (no photocopies are allowed).

g. Rescue Services. The SSC Fire Department will determine the requirement for a constant presence of rescue services and equipment at the confined space entry point for the duration of the task.

h. Valve Pit Entries. All SSC designated valve pits shall be permit required confined space.

i. Labeling Requirements. All confined spaces located within facilities of SSC shall be labeled with signage depicting the hazard.

j. Readings obtained from sampling permit required confined space atmosphere (both oxygen and combustible gas LEL) shall be recorded on the confined space permit and signed by the person taking the sample. The date the sample was taken, calibration due date of the meter and the NASA ID number of the meter shall also be recorded.

5.2.4 Definitions

1. Acceptable Entry Conditions - The conditions that must exist in a confined space to allow entry.

2. Entrant – An employee authorized to enter the confined space to perform an assigned duty as outlined in the written permit system.

3. Entry Supervisor – The person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

4. Attendant - An individual stationed outside a confined space who monitors the entrants and performs other attendant's duties assigned.

5. Confined Space - A space that is:
   a. Not normally occupied by personnel;
   b. Has limited or restricted openings for entry and exit; and
   c. Is not designed for continuous employee occupancy.

6. Entry - A term used to denote entry into a confined space as described above. An entry shall be considered initiated as soon as any part of an employee's body breaks the plane of an opening in the direction of the space.

7. Entry Permit - A NASA Confined Space Entry Permit (SSC Form 576), that allows a controlled entry into a confined space that contains or has the potential to contain hazards.

8. Hazardous Atmosphere - An atmosphere that may expose employees to the risk of death, injury or illness from one or more of the following reasons:
   a. Combustible or flammable gases and vapors at concentrations in excess of 10% of their LEL.
   b. An oxygen concentration less than 19.5% or greater than 23.5% by volume.
   c. A toxic substance present in concentrations in excess of its dose or permissible exposure limit (PEL).
   d. Any other atmospheric condition that is immediately dangerous to life of health.

9. Hot Work Permit - NASA/SSC written authorization (Flame Permit, SSC Form-68), to perform operations that requires flame producing equipment within a confined space. This form is only issued by the SSC Fire Department.

10. Non-Permit Confined Space - Any confined space where all hazards, atmospheric and physical, have been eliminated.

11. Permit-Required Confined Space - Any confined space having one or more of the following characteristics:
    a. Contains or has the potential to contain a hazardous atmosphere;
    b. Contains a material that has the potential for engulfing an entrant;
    c. Has internal configuration that could trap or asphyxiate an entrant; or
    d. Contains any other recognized serious safety or health hazard.

12. Rescue Service - The organization designated to perform rescue operations in an emergency.

13. Safety Line – Any ANSI approved line used to facilitate location of entrants.

14. Rescue Lifeline: Any ANSI approved line used to facilitate rescue.

5.3 General Hydrogen Entry

This procedure provides the general operating requirements for preparation of lines (pipes and tubes), accumulators, vessels, etc. that have contained Hydrogen (H_2) or are suspected to have contained H_2 for safe entry (opening or breaking into the system). This procedure does not address the removal of liquid hydrogen from vessels or lines. This document addresses those systems in which hydrogen existed in a gaseous form or those liquid hydrogen systems that have been emptied of liquid or warmed to the point that the liquid has become gaseous.

5.3.1 Responsibilities

a. Engineer. The responsible engineer (i.e., test, construction, project, etc.) shall determine the method of inerting the system containing hydrogen. The engineer will also assure that applicable safety requirements (e.g., aspects of this and other safety procedures, safety requirements unique to the system being worked on, etc.) are incorporated into applicable operational procedures/checklists (e.g., Engineering Work Requests (EWRs), DOPs, TPSs, etc.). The engineer shall assure that applicable procedures/checklists are labeled SAFETY CRITICAL as called for in SAFETY CRITICAL Procedures in Section 2.11 of this document, for any activity/operation that requires breaking/entering into hydrogen systems.

b. Safety Representative. The cognizant safety representative will review and approve the applicable procedure and provide support to these activities/operations as needed.

c. Supervisors/Managers. Supervisors/managers are responsible for assuring that those personnel required to break/enter hydrogen systems are trained in this procedure and apprised of the hazards associated with the breaking/entering of the specific hydrogen system being worked on.

d. Employees. Employees shall follow prepared procedures when breaking/entering hydrogen systems.

5.3.2 General Entry Requirements

WARNING: Prior to beginning work on a system that is suspected of containing or known to have contained hydrogen atmosphere workers must make that system inert.

The general order of events for hydrogen system entry and reactivation of hydrogen systems follows:

a. Pre-Entry Ambient Temperature. Prior to entry, bring all systems to ambient temperature to assure the system contains gas and not liquid.

b. Insertion of Inert Gas. Insert all systems with an inert gas, followed by verification that the system is inert. Methods of inertion are described in this document (Section 5.3.4). Verification is accomplished by sampling (using an approved and calibrated tester or by lab analysis).

c. System Entry. Break into the system and performing the work as required.

d. System Closure. Close the system and leak check all disturbed joints with an inert gas.
NOTE: Helium is preferred inert gas.

e. Re-Inerting System. Remove any atmospheric air from the system via inerting the system with an inert gas.

f. System Purification. Purify the system with hydrogen gas to remove the inert gas if required. On the first hydrogen cycle, test the system for hydrogen at all disturbed joints. To assure meeting purification levels, take samples and verify them by laboratory analysis.

g. Reactivation. Reactivate the system and perform required functional checkouts.

5.3.3 General Safety Requirements

a. Safe Hydrogen Concentration. The hydrogen concentration must be less than 0.8% (20% LEL) by volume to be considered safe for system entry.

b. Purge Gas Depressurization Sampling. Conduct sampling during the final depressurizing of the purge gas before opening of the system. Take an additional sample at the point of entry on every opening/re-opening of the system.

c. Continuous Monitoring. Systems not disconnected from active hydrogen systems require continuous monitoring with an electronic type H_2 tester.

d. Adherence to Basic Safety Guidelines. Whenever working on or in the proximity of hydrogen systems, comply with the following guidelines:
1) Eliminate all sources of ignition (such as smoking, welding, burning, grinding, open electrical outlets, heat producing equipment, heat guns, etc.) within 100 feet of the intended operation.
2) All personnel performing tasks on hydrogen systems should, as a minimum, wear flame retardant coveralls.

e. Pre-Entry GH_2 Sampling. Systems entry delayed for 30 minutes or more after completion of the inertion sampling of the system for gaseous hydrogen (GH_2) content below acceptable levels will be repeated just prior to entry.

5.3.4 Specific Purging/Inerting/Purification Methods

a. Pressure-Purge Inerting:
   1) Vent the system to 2-3 psig if the system is at a higher pressure.
   2) Pressurize the system to a chosen pressure with helium or gaseous nitrogen. This pressure depends on the type of system and determines the number of cycles required. The pressure should be held as long as possible, preferably for 30 minutes.
   3) Repeat steps a.1) and a.2). Calculate the number of cycles necessary to obtain the maximum allowable concentrations of hydrogen using formulas or obtain them from the attached chart, Purification - Inertion Map - Two-Gas System.

EXAMPLE: (CALCULATION USING FORMULAS)

Assume the initial pressure is 3 psig [17.7 pounds per square inch absolute (psia)] hydrogen. Assume a purge pressure of 38.4 psig (53.1 psia).

(**Note:** The average ambient pressure at SSC is 14.7 psia.)

The expression to calculate the number of cycles is:

$$\left(\frac{Pmin}{Pmax}\right)^n = Ratio \left(\frac{GH_2}{Inert}\right)$$

Where: n = Number of cycles
Pmin = Minimum pressure of Cycle, psia
Pmax = Hydrogen gas to inert gas

Calculation:
Assuming 0.8% by volume hydrogen is required for tank entry.

$$\left(\frac{Pmin}{Pmax}\right)^n = Ratio \left(\frac{GH_2}{Inert}\right)$$

$$\left(\frac{17.1}{53.1}\right)^n = (.00800)$$

n = 4.4 or 5 cycles required

b. Evacuation-Purge Inerting:

WARNING: If the system is suspected to have leakage, evacuation-purge inerting should not be used **because the first evacuation could suck air into the hydrogen system, resulting in a contained explosive mixture.**

1) Evacuate the system as low as possible, preferably to less than 1.5 psia.
2) Next, break the vacuum with helium or gaseous nitrogen and pressurize the system. The purge pressure depends on the type of system and influences the number of cycles required. Hold the pressure for as long as possible (preferably for 30 minutes).
3) Repeat steps b.1) and b.2). The number of cycles necessary to obtain the maximum allowable concentrations of hydrogen can be calculated or obtained from the attached chart entitled "Purification - Inertion Map - Two Gas System." **WARNING:** This method is quite effective since a higher-pressure differential can be achieved; however, the external pressure of the vessel must be known since there is a danger of implosion.

c. Flowing-Purge Inerting: This is the simplest method, but the least satisfactory because it provides no positive assurance that a completely inert atmosphere has been attained. This method requires the use of an inert purge [gaseous nitrogen (GN_2) or helium (He)] flowing into one part of the system and flowing out another part of the system. Since most systems contain traps where hydrogen may not be adequately removed by a flowing purge, use this method only where other methods cannot be used. Purging configurations should be such that turbulent flow of the purging gas is assured, and flow rates should be such that all parts of the system can be thoroughly purged.

Use the following analysis methodology to determine the length of time to flow the purge. Or determine the length of time to flow the purge by using the following analysis methodology.

Step 1. Determine the standard cubic feet in the line or system to be purged.

Step 2. Determine the standard cubic feet needed to be used to bring the line to safe limits based on calculations or obtained from the attached chart entitled "Purification - Inertion Map - Two Gas System."

Step 3. Use the following formula to determine the number of standard cubic feet per minute that can be flowed thru the system within the existing system parameters.

Step 4. Apply a safety factor of 2 or 3 to the flow duration to reduce the possibility of trapped hydrogen.

d. Purification Process: The system should be verified that purity levels are within acceptable levels of the specified service fluid prior to introducing the service fluid. Use either the pressure-purge inertion method (Section 5.3.4(a)) or the evacuation-purge inertion method (Section 5.3.4(b)) to aid in the purification process to reduce the residual gas levels to the

level desired. The number of purge cycles can be calculated or estimated by use of the attached chart. If absolute verification of the residual gas levels is required, then laboratory analysis must be utilized!

5.4 Oxygen and Combustible Gas Meter Operations

NASA/SSC and its contractors shall develop and adhere to procedures regarding the safety training and authorization required to operate oxygen, toxic atmosphere, and/or combustible/flammable gas meters. The following procedure identifies the training and authorization required to operate oxygen, toxic atmosphere, and/or combustible/flammable gas meters for assuring a safe atmosphere for work.

5.4.1 Responsibilities

a. Safety Offices. The individual Safety Offices are responsible for providing training and certifications in the use of oxygen (O_2), toxic atmosphere, and combustible gas meters for their personnel. Each office shall also provide support to their personnel in developing safe procedures for work involving sampling of hazardous atmospheres and/or confined space entry.

b. Safety Representatives. The safety representative will review and approve purchase requests for O_2, toxic atmosphere, and combustible gas meters.

c. Supervisors/Managers. Supervisors/Managers are responsible for assuring that personnel (those required to work in areas where air contamination is a concern or required to work in confined spaces) have been trained and authorized in the use of the O_2, toxic atmosphere, and combustible gas meters.

5.4.2 General Safety Requirements

Safe work atmosphere boundaries for combustible/flammable gases will be established by using gas meters as follows.

Combustible gas meters indicate the percent by volume of the LEL of the gas sampled. For example, the explosive limit for hydrogen gas is approximately 4%-75% hydrogen in air. (See Notes 1 and 2 below.). The LEL for hydrogen is 4% (4% hydrogen is the lower explosive limit in air). The combustible gas meter indicates a percent of this LEL, as follows:

Percent Hydrogen in Air	Percent LEL
1%	25%
2%	50%
3%	75%
4%	100%

Calibrate the combustible gas meter to near zero in open air (no combustible gases present). When an atmosphere is sampled, any LEL readings above 10% may indicate a combustible gas contamination problem.

Note 1: The LEL for other combustible/ flammable gases/vapors will differ from hydrogen and must be determined prior to using the meter.

Note 2: The instrument must also be evaluated to determine its ability to measure the particular gas/vapor.

5.4.3 Safety Requirements

a. Atmospheric Sampling Training and Authorization: Each respective safety office will provide training and authorization to perform atmospheric sampling that will be valid for a period not to exceed two (2) years.

b. Notification, Review and Approval: All work requiring entry into confined spaces are considered SAFETY CRITICAL and require notification and review/approval of work documents by the respective safety office.

5.4.4 Safety Requirements for Specific O_2/Toxic Atmosphere/Combustible Gas Meters

Calibration Requirements. The following calibration requirements are applicable to all personnel who use the identified meters:

a. Use manufacturers' guidance/recommendations to determine the equipment schedule of laboratory/factory calibrated checks. Oxygen/combustible gas meters will be laboratory calibrated, as a minimum, once every six (6) months. Personnel will not use meters in which the calibration has expired.

b. Personnel using a combustible gas meter shall determine whether the meter is calibrated to the gas/vapor being checked.

> **METER CALIBRATION NOTE:** Most of the portable combustible gas detection instruments in use at NASA/SSC are calibrated for hydrogen. One must remember that in the petro-chemical industry instruments are usually calibrated with pentane, and calibration with methane is required for below ground work (excavation/utilities)**.**

c. Calibrate the instrument with a known calibration gas before each day's use prior to the use of O_2/combustible gas meters in confined space environments.

d. Calibrate the meter with a known calibration gas before each day's use prior to using a toxic gas meter in a potential toxic environment.

5.5 Safe Handling of Triethylaluminum/Triethylborane (TEAL/TEB)

NASA/SSC and its contractors shall develop and adhere to safety requirements that list the hazards involved, safety equipment required, safety precautions to follow, and procedures/process requirements when working around Triethylaluminum and/or Triethylborane. The following procedure outlines the hazards involved, safety equipment required, safety precautions to be observed, and procedures/process requirements when working around Triethylaluminum (TEAL or TEA) or Triethylaluminum/Triethylborane (TEAL/TEB). TEAL and TEAL/TEB is used interchangeably through this section. The same procedures apply to both. Always ensure that a recent Material Safety Data Sheet (MSDS) is readily available and is reviewed.

5.5.1 General Safety Requirements

a. Basic Safety Requirements:
   1) All areas of operation where TEAL/TEB is used, handled, transferred, or stored are considered hazardous, and will be classified as SAFETY CRITICAL, requiring the preparation of written operational procedures.
   2) Perform all operations involving the use, handling, or transfer of TEAL/TEB using the minimum number of personnel required to perform the task, while still incorporating the buddy system to conduct the tasks.
   3) Welding or using a cutting torch on or near any containers or piping systems used for TEAL/TEB, even when empty, is **prohibited**.
   4) Personnel working with TEAL/TEB or TEAL/TEB systems shall wear PPE when there is any possibility of exposure.
   5) All TEAL/TEB handling, transfer, or storage sites require emergency eye wash stations and safety showers. The eye washes/safety showers shall be operational and located in close proximity to operations.
   6) TEAL/TEB will never be mixed with any other chemical substance/compound unless a thorough investigation has shown the materials are compatible or the resulting reaction is controllable from a design aspect.
   7) Clean equipment and piping systems contaminated with TEAL/TEB per written procedures with approved solvents prior to performing any maintenance or repair activities.
   8) Move heavy TEAL/TEB storage cylinders using hand carts.
   9) Utilize PPE as follows:

      a) PPE for Quantities Less than 5 Gallons:
         i. Full body protection - SSC Cryogenic Coveralls (Brownies) purchased to the standard SSC Specification for Flame Retardant Cryogenic Handling

Coveralls, consisting of an outer shell of 40% PBI/60% Kevlar Aramid, inner barrier of Goretex PTE, and an inner liner of either 20%PBI/80% Durvil or 100% Nomex trilaminate.

ii. Hand protection - Heavy-duty fire fighters gloves, specifically "Shelby Firewall" made with cow leather.
iii. Head/face protection - PBI "Lifesaver" pullover protective hood (long model). Hardhat with full-face shield attached.
iv. Eye protection - Safety glasses with side shields and a full face shield. Keep the face shield lowered when transferring or otherwise handling TEAL/TEB containers.
v. Foot protection - Heavy leather boots with high shafts.
vi. Clothing - The coveralls shall be closed, with sleeves extending over the gloves and securely fastened. The coveralls shall extend over the boots without cuffs that could trap spilled material. The PBI pullover hood should be tucked under the neck opening of the coveralls and the opening closed via the suits fasteners.

b) PPE for Quantities Greater than 5 Gallons:

The NASA S&MA office can be contacted to help provide specific guidance in the choice of the following PPE.

i. Full body protection - Complete aluminized protective suit, cape and leggings.
ii. Hand protection - Heavy-duty fire fighter gloves with aluminized outer layer.
iii. Head/face protection - Aluminized hood with a full-face shield built integrally to the hood.
iv. Eye protection - Safety glasses with side shields. The face shield shall be kept lowered whenever actual transfer operations occur or TEAL containers are handled.
v. Foot protection - Heavy leather boots with an outer covering of neoprene or PVC covering.
vi. Clothing - The coveralls shall be closed, with sleeves extending over the gloves and securely fastened. The coveralls shall extend over the boots without cuffs that could trap spilled material. The PBI pullover hood should be tucked under the neck opening of the coveralls and the opening closed via the suits fasteners.
vii. PPE for Sampling Operations/Laboratory Work - Currently no foreseeable requirement exists for TEAL/TEB to be handled within SSC laboratories or for samples to be taken from TEAL/TEB systems. PPE requirements for these two activities will be delayed until such time that they are needed. Personnel, offices, or projects considering these activities should contact the NASA S&MA office for guidance in choosing PPE for these operations.

b. Training and Material Safety Data: Personnel shall be trained in this procedure and familiar with the MSDS for TEAL and TEAL/TEB before handling TEAL or operating a TEAL system.

c. Transportation Safety: TEAL (Organometallic Hypergolic Igniter Compounds) **will not** be delivered to the warehouse area. The material will be directed to the approved storage site per instructions of the person or office that ordered the material.

d. Procurement/Requisition: According to SSC SPR 8500.2, *John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements*, a *Hazardous Material (HZM) Requisition Form* will be completed and the most recent MSDS attached to the form. This package will accompany the traditional Material Request (MR) form and be forwarded to the NASA Environmental Officer for approval.

e. Storage Requirements:
   1) TEAL (Organometallic Hypergolic Igniter Compounds) will not be stored in existing flammable/chemical storage facilities at SSC.
   2) Storage will be minimized as to the amount needed to support safe and efficient operations and will require justification to the NASA Safety Office prior to use/storage at SSC. All storage sites must be approved by the NASA Safety and NASA Environmental offices.

   TEAL will only be shipped in special Department of Transportation (DOT) approved containers designed specifically for the material and in compliance with DOT regulations.

   Procurement packages for TEAL will include the requirement that the transporter of the material stop at the entrance to SSC and notify the following prior to entrance of the site and delivery of the material:

FOS Contract S&MA Department	228-688 - 6578
FOS Contract Quality & NDE Services	228-688 - 1305
FOS Contract Safety & IH Services	228-688 - 1500
FOS Contract Environmental Services	228-688 - 1302
FOS Contract Fire Services	228-688 - 3439

   Procurement packages for TEAL will include the requirement that an up to date MSDS accompany the material and be provided to the user of the material.

   TEAL **will not** be delivered to the warehouse area. The material will be directed to the approved storage site per instructions of the person or office that ordered the material.

f. Laboratory Safety: Currently no foreseeable requirement exists for TEAL to be handled within SSC laboratories. Because of the detailed and unique challenges of working with

TEAL in a laboratory environment, the development of requirements will occur when they are needed. Personnel, offices, or projects considering the use of TEAL should contact the NASA S&MA Office prior to planning any laboratory activities to allow for the development of this section of the document.

g. Industrial Hygiene:
   1) Eating, drinking, smoking and carrying of tobacco products is not allowed in areas where there is a potential for exposure to TEAL.
   2) Wash hands and face before eating, drinking, or smoking.
   3) Although inhalation of TEAL is highly unlikely, the American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a Threshold Limit Value (TLV) of 2 mg/m^3 as an eight-hour time weighted average for aluminum alkyls.
   4) Train personnel in this procedure and the MSDS for the material before handling TEAL or operating a TEAL system.

5.5.2 Environmental Requirements

Procurement/Requisition - According to SSC SPR 8500.2, *John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements*, a *Hazardous Material (HZM) Requisition Form* will be completed and the most recent MSDS attached to the form. This package will accompany the traditional MR form and be forwarded to the NASA Environmental Officer for approval.

a. Storage Requirements. TEAL will not be stored in existing flammable/chemical storage facilities at SSC. TEAL storage containers must be stored in a cool, dry, well-ventilated area away from flammable materials and sources of heat or flame. Storage containers shall be stored to prevent mechanical damage to them (e.g., shelves should have lips to preclude containers falling off, large cylinders shall be secured to prevent tipping, etc.). Storage will be minimized as to the amount needed to support safe and efficient operations and will require justification from the NASA Safety Office prior to use/storage at SSC.

   All storage sites must be approved by NASA Safety and NASA Environmental. Storage facilities should conform to the requirements of the National Fire Protection Association (NFPA), latest edition. Construct storage facilities with noncombustible materials, preferably open sided, and with concrete floors that slope to the outside of the facility. Capture runoff to preclude saturation of moist soils by constructing a dike.

   Explosive pockets of hydrocarbon may result from hydrolysis of the TEAL. **Small quantities (five (5) gallons or less), may be stored in facilities without sloped floors or curbs, given that the facility design will preclude the spread of the material to other processes/storage sites**.

Buildings used for storage of TEAL shall be properly grounded against static electricity and shall have approved lighting protection. Buildings/storage sites used for storing TEAL will be appropriately marked via the NFPA hazard identification system. Conspicuously post the "no smoking in storage areas" notification.

b. Decontamination/Disposal Requirements.
   1) Decontamination: The certified operator will empty the piping systems of TEAL by using the material or by transferring fluids through a safely designed system. Then he/she will use a dry inert gas to purge all piping previously containing TEAL. The certified operators will evaluate the exhaust of the purge for placement and risks to the process. Systems undergoing routine equipment clean up/maintenance will be flushed with a hydrocarbon such as dry kerosene.
   2) Disposal: The certified operator will collect kerosene with residual amounts of TEAL or aluminum oxides and place the material(s) in a sealed drum to preclude evaporation of the kerosene. This residual will be treated as a hazardous waste and disposed of in accordance with SPR 8500.2, *John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements*. Label waste containers as such.
   3) Disposal of Shipping Containers: Certified operators shall return shipping containers to the manufacturer in compliance with DOT regulations.

5.5.3 Emergency Procedures

The following emergency procedures will be included in written operational procedures for TEAL, as well as posted at storage and use locations. Always review the MSDS for current manufacturer recommended procedures.

a. First Aid. If contact with this material occurs, immediately start the recommended procedures below. Simultaneously contact the SSC Emergency Response by dialing **911** from any SSC extension, or by calling 228-688-3636 via cell phone.

b. Ingestion. If swallowed, immediately give several glasses of water. **Do not induce vomiting. This material is corrosive.** If vomiting does occur, keep head below hips to reduce the risk of aspiration. Give fluids again. Have a physician determine if condition of patient will permit induction of vomiting or evacuation of stomach. **Do not give anything by mouth to an unconscious or convulsing person.**

c. Skin Contact. Immediately remove all contaminated clothing and shoes. Under a safety shower, flush all affected areas thoroughly with large amounts of running water for at least 15 minutes. **Do not attempt to neutralize with chemical agents.** Get medical attention immediately. Discard contaminated clothing.

d. Eye Contact. Immediately flush the eyes with large quantities of running water for at least 15 minutes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface

of the eye and lids with water. **Do not attempt to neutralize with chemical agents.** Obtain medical attention as soon as possible. Oils or ointments should not be used at this time. Continue flushing for an additional 15 minutes if a physician is not readily available.

e. Inhalation. Exposure to combustion products may cause respiratory symptoms. If inhaled, remove to fresh air. If not breathing, clear victim's airway and start mouth-to-mouth artificial respiration. Keep person warm and at rest. Get medical attention immediately.

> **NOTE:** Supplemental information for Emergency Response Personnel - Artificial respiration may be supplemented by the use of a bag mask respirator or manually, triggered oxygen supply capable of delivering one liter per second or more. If victim is breathing, supplemental oxygen may be given from a demand-type or continuous-flow inhaler, preferably with a physician's advice.

f. Fire fighting. Personnel handling TEAL will not attempt to fight a fire involving the TEAL or other materials in close proximity to a TEAL system or TEAL storage. Operating personnel may attempt to safe a system given that personnel are not exposed to risk of fire or explosion. **Emergency Response Personnel are the only personnel authorized to fight a fire involving TEAL.** The following guidance is provided to minimize the risks to the SSC Fire Department, but ultimately the Commanding Officer in charge of the Fire Department at the time of an incident holds the ultimate responsibility for deciding the appropriate measures in combating a fire involving TEAL.
   1) Fires that cannot be safely controlled with extinguishing agents should be left to burn until consumed, and adjacent property protected with personnel positioned a safe distance from the TEAL fire.
   2) Contact with air due to spillage, ruptures or leaks will result in spontaneous fires resistant to extinguishment by the more common fire fighting agents and methods. **The most effective fire extinguishing agent is dry chemical powder pressurized with nitrogen.** Vermiculite or dry sand may also be used. **CAUTION: Re-ignition may occur.**
   3) **DANGER: Due to violent reaction of water with aluminum alkyls, the use of water, water sprays, chemical and mechanical foams should be avoided.** With large fires, water may be considered for the protection of adjacent structures and equipment, but the practicability of such use can only be confirmed through large-scale tests.
   4) **DANGER: Do not use Carbon Tetrachloride or Chloro-Bromomethane extinguishing agents as either product reacts violently or liberates toxic fumes and vapors on contact with aluminum alkyls.**
   5) A standard aluminized fire-fighting suit is recommended for fighting aluminum alkyl fires. A NIOSH-approved positive pressure demand type, air supplied, full face piece respirator should be used.

g. Spill Handling. Regardless of the location (transportation, storage, or use) of a spill, the pyrophoric nature of the material presents little options in terms of controlling the material; but the following guidelines should help minimize the damage to the site and property.

Evacuate immediately all personnel from the scene of any motor vehicle accident involving the transport of TEAL or the accidental release within a storage area or from a TEAL system. The SSC Fire Department should be immediately notified by calling 911 from any SSC extension or by calling 228-688-3636 from a cell phone. If systems can be safely secured, all sources of the spill should be blocked off. After a fire has occurred and been extinguished or burned out, large amounts of water can be used to wash the affected area. **CAUTION: Water may cause re-ignition to occur. Water should be collected by diking appropriate drainage sites. This water should be disposed of properly and not allowed to enter into waterways.** The following emergency procedures will be included in written operational procedures for TEAL, as well as posted at storage and use locations.

1) First Aid - If contact with this material occurs, immediately start the recommended procedures below.
2) Immediately notify the SSC Fire Department by calling 911 from any SSC extension or by calling 228-688-3636 from a cell phone.

5.6 Safety Requirements for Gaseous and Liquid Hydrogen

This procedure outlines the hazards involved and identifies the applicable codes and procedures to provide a practical set of requirements and guidelines for the safe storage, handling and use of gaseous, liquid, or slush hydrogen. This safety procedure is applicable to all personnel engaged in the design, construction, and operation of hydrogen storage, transfer, conversion, and pressurization facilities. NASA/SSC and its contractors shall abide *Guide to Safety of Hydrogen and Hydrogen Systems*, American Institute of Aeronautics and Astronautics, ANSI/AIAA G-095-2004 for all safety issues regarding liquid and gaseous hydrogen systems. NASA/SSC and its contractors engaged in the design, construction and operation of hydrogen storage, transfer, conversion and pressurization facilities shall develop and abide by procedures respective to their operations. Procedures shall provide a practical set of requirements and guidelines for the safe storage, handling and use of gaseous, liquid, or slush hydrogen.

5.6.1 Responsibilities

a. Managers/Supervisors:

1) Managers and supervisors of all contractor, agency, and NASA organizations are responsible for compliance to and implementation of the requirements of this safety procedure.
2) Managers and supervisors of organizations engaged in hydrogen operations are responsible for developing and maintaining detailed operating, maintenance, and emergency procedures. Procedures shall include safety requirements, required safety equipment, and safety warnings and cautions necessary to carry out the operations.
3) Communications (radio, headset, intercom, or similar equipment) shall be maintained during liquid and gaseous hydrogen operations. Communications equipment used with the operations will be intrinsically safe.

b. Cognizant Safety Organizations:
   1) Safety offices shall provide qualified Safety representatives for monitoring hydrogen operations to insure compliance with the provisions of this safety procedure.
   2) Contractor and agency safety organizations shall develop safety procedures/standards specific to the type of hydrogen operations in which they are engaged, if applicable.
   3) Safety organizations shall review all design drawings and operational procedures for inclusion of appropriate safety provisions. Designate all procedures involving liquid hydrogen as SAFETY CRITICAL.
   4) An Operational Readiness Inspection (ORI) or Safety Review Team (SRT) as deemed appropriate by the NASA/SSC S&MA Office shall verify the safe design and use of newly installed or heavily modified hydrogen systems prior to first use. The ORI/SRT shall ensure the safety of personnel at or near the facility has not been compromised and that the facility has been designed and built to meet accepted standards and guidelines and comply with established regulatory codes.

5.6.2 General Requirements

a. Inerting the System: No welding, grinding, or cutting is permitted on any liquid or gaseous hydrogen systems without first inerting the system. (**Exception:** Removal of paint from the outer surface of storage vessels (paint visually removed via grinding) and buffing of welds or surface anomalies for the purposes of visual inspection and non-destructive testing for pressure vessel and pressure systems inspections under the NASA/SSC Pressure Vessel and Systems Recertification Plan.) System will be checked to ensure that hydrogen has been successfully removed during the inerting operation, prior to initiation of work.

b. Loading and Unloading: When loading or unloading liquid or gaseous hydrogen transporters, shut off engines and make sure the transporter tank is grounded prior to the hookup and keep it grounded until transfer lines/hoses have been disconnect from tank.

c. Electrical storms: If an electrical storm approaches within 5 miles of the working area, stop hydrogen transfer and/or venting operations, secure the system(s), and clear personnel from the working area.

d. Storage Vessel Inspection: Periodically inspect liquid hydrogen (LH_2) storage vessels for pressure build-ups while in transit and vent as necessary.

5.6.3 Environmental Requirements

No specific environmental constraints exist with respect to using or accidental spillage of hydrogen (gaseous or liquid). Treat any accidental spillage of a quantity (levels to be determined for each program/process) of liquid hydrogen an emergency release of flammable liquid and take emergency precautions to protect life and property.

5.7 Safety Requirements for Liquid/Gaseous Oxygen Systems

a. NASA/SSC and its contractors shall abide by Oxygen Standard (ASTM Manual 36, *Manual for Safe Use of Oxygen and Oxygen Systems: Guidelines for Oxygen System Design, Materials Selection, Operation, Storage and Transportation*) for all safety issues regarding liquid and gaseous oxygen systems.

b. Requirements shall be included in all SSC and contractor written procedures.

5.8 Cryogenics Safety

This procedure provides requirements for the safe handling of cryogenics and the safe operation of cryogenic systems at SSC. NASA/SSC and its contractors whose personnel are involved in the handling of cryogenics shall develop and adhere to procedures respective to their operations. Procedures shall provide requirements for the safe handling of cryogenics and the safe operation of cryogenic systems at SSC. The procedures include top-level requirements for cryogenic safety, including LH_2, liquid oxygen (LOX), liquid nitrogen (LN_2), and liquid helium (LHe), as well as emergency procedures and environmental concerns.

This section provides generic, top-level requirements for cryogenic safety, including liquid hydrogen (LH_2), liquid oxygen (LOX), liquid nitrogen (LN_2), and liquid helium (LHe). More detailed specific requirements for hydrogen and oxygen are provided in other subparagraphs.

5.8.1 Management/Supervision Responsibilities

Only personnel properly trained and certified for managing cryogenics by the cognizant management authority shall engage in operations involving cryogenics. Such personnel shall be familiar with the hazards associated with the particular cryogen and the appropriate safety precautions to be observed.

5.8.2 Requirements

a. <u>General:</u>
   1) Drawings shall reflect all cryogenic systems modifications immediately following completion of work.
   2) Store cryogenic liquid containers in well-ventilated areas. They must be handled carefully, not dropped, rolled or tipped on their sides. They shall be secured against overturning, including during transport. Use storage precautions appropriate to these materials in gaseous form when storing them in cryogenic liquid form.
   3) When cryogenic liquids are being used to cool an object, the object shall be inserted into the liquid slowly to minimize boiling and splashing. Use tongs to insert the object or to withdraw it after cooling. Never use cryogenic liquids to cool ordinary compressed gas cylinders made of carbon steel, which lose impact resistance at cryogenic temperatures.

b. Systems:
   1) If ice plugs do form, remove the container to a remote location and notify the cognizant Safety representative for safety instructions.
   2) Leak test all cryogenic equipment/systems at the normal operating pressure to verify system integrity.

c. Leak and Fire Detection Systems: Ventilate all working areas where cryogenic liquids are used and install monitoring/alarm systems to detect and alert personnel to hazardous concentrations of vapors and/or lack of oxygen.

d. Personal Protective Equipment (PPE):
   1) PPE shall always be worn when engaged in cryogenic operations.
      a) Eye protection shall provide top, side, and front protection; goggles and face shields are most effective.
      b) Gloves shall be leather or insulated and have a relatively loose fit; if they should accidentally contact cryogenic liquid, loose gloves can be removed easily before they become frozen to the hand.
      c) Wear a long-sleeved, lab coat, smock, coveralls or other protection as required; avoid having open pockets, trouser cuffs, or other catch points where a spill could accumulate. Do not wear watches, rings, or jewelry because they can become frozen to exposed skin.
   2) The following PPE are required for each specific cryogen, as a minimum when performing liquid nitrogen operations: coveralls or smock, face shield (with hardhat if required by the face shield) and eye protection, and cryogenic handler gloves.
   3) Where a significant splash hazard exists, wear safety shoes with soles and heels of semi-conductive rubber.

e. Liquid Nitrogen (LN_2) Equipment and Materials:
   1) Non-metal materials shall be selected to withstand the low temperatures associated with liquid nitrogen service.
   2) Use only approved materials for pipes and fittings, and hydrostatically test construction at specified pressures. Whenever possible, use welded and flanged connections.
   3) Use only hoses that are of engineering design specifically for cryogenic service.
   4) Monitor liquid nitrogen equipment with pressure gauges. In order to minimize operator-reading errors, all pressure gauges used for a common purpose should have identical scales.
   5) Large storage containers shall be vacuum-insulated tanks. Equip the insulated area between the inner and outer shells with either a rupture disc or a pressure-relief device. The storage container itself shall be of welded construction and shall be equipped with an adequate vent line and pressure-relief devices. These vents shall discharge to the outdoor atmosphere. Equip all lines and vessels in which liquid nitrogen may be trapped between

closed valves with relief valves. If there is any likelihood that the relief valve may freeze, associated vessels and lines shall also be equipped with rupture discs.

6) Liquid nitrogen may be stored and shipped in small cylinders or containers specifically designed to hold low-temperature, liquefied gases. Containers designed for low-temperature liquids should be either open or protected by a vent or other pressure-device that permits vapors to escape. When a special vented stopper or venting tube is used, check the vent at regular intervals to ensure it is not plugged with ice. Use only the stopper supplied with the container.

5.9 Safety Requirements Pressure Systems

This procedure outlines the responsibilities and requirements for the design, inspection, testing, fabrication, installation, operation and maintenance of pressure vessels and systems. NASA/SSC and its contractors shall develop and comply with procedures respective to their operations. The procedures shall outline the responsibilities and requirements for the design, inspection, testing, fabrication, installation, operation and maintenance of pressure vessels and systems.

5.9.1 Requirements

a. Engineering, Design, and Structural Analysis:

1) All components used in a pressure system shall have a rated working pressure that is consistent with its intended application. Components used in a pressure system shall be constructed of materials that are compatible with the commodity involved and labeled in accordance with applicable codes, standards and regulations.
2) Pressure systems shall have drawings or schematic diagrams approved by the responsible engineering sections.
3) Drawings are to be corrected as soon as practical to include modifications or material substitutions.
4) Aluminum, brass, or cast iron fittings should not be used on high-pressure systems unless approved and stamped by a professional engineer and specified as such on the drawings.
5) Install hand-operated valves around pressure-reducing valves only if the downstream system is designed for the maximum source pressure or it is protected from overpressure by relief devices.
6) Do not install isolation valves between positive displacement compressors and their receivers unless a pressure relief device is installed between the isolation valve and the compressor.
7) Equip bulk storage flammable/combustible liquid pressure systems with water deluge systems for fire protection.
8) Pressure Relief Devices:
    a) Pressure systems shall be protected by pressure relief devices when the source pressure can exceed the design pressure of the system, the malfunction/failure of any component can result in system pressure exceeding design pressure, or when process fluid pressure build-up can be expected.

b) Install pressure relief devices downstream of pressure regulating devices and orifices unless the downstream portion of the system is capable of accepting the maximum source pressure.
c) Overpressure protection for Pressure Vessels and systems shall be in accordance with the applicable National Consensus codes and Standards.
d) Locate or direct exhausts from relief valves, rupture/burst discs, bleed valves, vents and gauge blow-out ports so as to prevent personnel injury or equipment damage in the event of actuation. Where relief extensions are used, they shall be adequately secured to restrain the thrust developed by pressure release.
e) Arrange discharge lines from pressure relief devices to prevent the discharge of fluid into a confined space.
f) Keep discharge lines from pressure relief devices free from sharp bends, kinks, and other obstructions that could cause abnormal back-pressure.
g) Indicate the pressure setting of each relief device on an attached durable tag.

9) Pressure Gauges:
a) Pressure gauges are to be used on main pressure systems or portions of systems that can be isolated from the main system. When the pressure gauge is the sole pressure indicating instrument or has the potential to become the sole pressure indicating instrument in the isolated system, the pressure gauge shall be classified as a primary gauge. This does not apply to pressure vessels or systems that have been down-moded.
b) When practicable, pressure gauges should be selected so that the normal reading falls in the middle third of the gauge scale, but in no case is the pressure gauge range to be less than one and one-fourth times the design pressure of the system.
c) Pressure gauges must have shatter-proof fronts and blow-out back panels.
d) Do not install pressure gauges with blow-out back plugs close to a flat surface; such configuration will lessen the pressure relieving feature of the gauge.
e) Do no install pressure gauges in spaces in which leakage into the space could cause an asphyxiation hazard unless the space is continuously monitored while personnel are in the space.
f) When practicable, pulsating dampeners, orifice plates, or similar devices should be installed at each gauge location if the gauge:
   i. Undergoes frequent surge pressure.
   ii. Is installed in an inert-gas system in a closed area with inadequate ventilation.
   iii. Is used in a system with toxic, corrosive, or flammable fluids.
g) Pressure gauges are to be supported in such a manner that they do not place excessive stress on the piping system.
h) Pressure gauges with a case that can be pressurized (i.e., Wallace & Tiernan) during operation are to be provided with a relief valve sized to ensure the maximum case pressure is not exceeded.
i) Do not remove or work on gauges in any manner while under pressure. Shutoff valves between the system pressure and the gauge, with vent valves to relieve the

pressure, may be installed to allow work on the gauge while the system is under pressure.

10) Flexible Hoses:
    a) Flexible metal hoses must have end restraints and at intervals not to exceed 6 ft, in gas systems with pressures of 150 psig or greater to secure against whipping in the event of failure. Where practicable, this should also be done for systems operating at less than 150 psig.
    b) Isolation valves that pressurize flexible metal hose are to be located a safe distance from the hose or shielded from the hose to prevent injury to the valve operator in the event of hose failure.
    c) Provide armor protection for flexible metal hose when possible.
    d) Employees are to be directed away from the immediate area when flexible metal hose is being pressurized. Protect flexible lines from chafing.
11) Permanent gas-venting capability, will be provided for all workrooms where venting of gases is required or where hazardous conditions could result from venting.
12) Do not use pressure regulators designed for specific gases on other gases.
13) Do not use block valves as a way to regulate of pressure.

b. Modification
    1) Configuration changes to high pressure systems, which require approval of the SSC Facilities Review Board or the Configuration Control Board, will be classified as SAFETY CRITICAL and will require the prior concurrence of the cognizant Safety Office.
    2) Repairs, alterations, or re-rating of pressure vessels or systems shall be in accordance with NASA-STD-8719.17, "NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)".

c. Training, Qualification, and Operating Procedures
    1) Train personnel to become familiar with pressure system component locations, operation and functions, and system operational procedures or instructions before operating pressure systems.
    2) Apprise personnel of hazards associated with the process fluid and train them in the use of any escape/rescue equipment involved.
    3) Use only current procedures and instructions to operate pressure systems, to ensure functions or tasks are performed in a safe and logical sequence. Procedures for high-pressure system operations shall be classified as SAFETY CRITICAL and shall require the approval of the cognizant Safety Office.
    4) Only certified personnel familiar with the inherent hazards of the pressures, gases or liquids and established safety precautions for each shall operate pressure systems.

d. Operations
    1) All operations involving high-pressure systems shall be classified as SAFETY CRITICAL and shall be limited to essential personnel.

2) High pressure valves are not to be operated by employing excessive operator pressure or similar methods.
3) Smoking is prohibited in work areas containing flammable/combustible liquids or gases.
4) Flame permits will be required for all welding/cutting/spark/heat-producing operations.
5) During pressure vessel venting operations, follow safety controls and precautions consistent with the gas being vented, volume, and noise level expected.
6) Use the "Buddy System" during all pressure system operations. Control consoles shall not be left unattended during system operation.
7) Verify adjacent safety showers and eyewash fountains as operable prior to pressure system operations.
8) Verify water deluge systems as operable prior to pressure system operations on pressure systems containing fuels or oxidizers.
9) Monitor pressure vessels containing cryogenics periodically to detect pressure build-ups, and vent as required.
10) Maintain adequate communications at all times during pressure system operations where visual contact cannot be maintained.
11) Areas containing pressure vessels will be appropriately posted.
12) Perform initial pressurization of high pressure vessels at SSC using inert pneumatics to establish integrity of the pressure systems. Establish controls to prohibit access of personnel and vehicular traffic into areas during initial pressurization. Establish a danger area during initial pressurization of a "new" system or when 25% of the design burst pressure is to be exceeded.
13) The level of cleanliness of all components utilized in a pressure system shall be compatible with the requirements of the commodity involved

e. Installation, Maintenance and Welding

1) All maintenance on pressure systems shall be accomplished in accordance with approved maintenance plans and procedures.
2) Do not initiate maintenance, modification or repair of pressure systems until the affected portion has been:
    a) Depressurized and verified safe.
    b) Isolated from the pressure source and properly Lockout/Tagout.
3) Welding/cutting operations on vessels that contain (or have contained and are not inert) flammable/combustible liquids or gases are prohibited at all times.
4) Tightening or adjustments of hubs, flanges, or fittings under high pressure is prohibited at all times.
5) Only certified welders are to weld on pressure systems.
6) Welding, hammering, or any work which could unintentionally release pressure from vessels or piping is prohibited.
7) Pipelines and components vulnerable to damage from routine activity are to be shielded and have warning signs posted.
8) Before pressurizing a system after installation, inspect the system to ensure compliance with safety requirements and noting of material substitutions and design variances.

9) Perform periodic maintenance inspections to detect external damages; to correct improper operating procedures; and to prevent equipment failure.
10) When any part of a pressure system is an integral part of a vacuum system and the safety requirements of the two systems are conflicting, the stricter requirements shall take precedence.

f. Temporary Installations. In addition to the requirements for permanent installations, temporary installations must meet the following:
1) Kellum restraints or similar devices shall be employed at all line-to-line, line-to-manifold, or line-to-vessel connections when using a flex-hose.
2) Flex-hoses, utilized in temporary high-pressure installations, shall be secured at intervals not to exceed six feet to prevent whipping in the event of hose or hose-fitting failure. Although securing the flex-hose to the permanent structure of a heavy vehicle is preferred, weights of 100 pounds or more which incorporate a positive attachment point may be used.
3) Temporary installations shall incorporate vent valves to allow for depressurization prior to disconnection.
4) Pressure relief devices shall be incorporated into any temporary high pressure installation in which there is the possibility (due to component malfunction or human error) of exceeding the rated working pressure of any component in the temporary installation. Install pressure relief device(s) in any system having a design pressure that is lower than the source pressure.
5) Components requiring proof pressure testing which are utilized in temporary high pressure installations shall have proof pressure testing information attached.

g. Proof Testing/Calibration
1) A pressure system will be capable, without failure, of withstanding leakage or permanent deformation from a hydrostatic test at a pressure of 1.5 times the maximum operating pressure.
2) In the event a pneumatic test is used in lieu of hydrostatic test, every component of a pressure system will be capable, without failure, of withstanding leakage or permanent deformation from a pneumatic test at a pressure of 1.25 times the maximum operating pressure.
3) Hazardous fluids will not be used as test medium during proof pressure tests.
4) If the integrity of a pressure system has been disturbed, proof test the system shall be proof tested prior to operation. If proof testing is not feasible due to operational mode, operational commitments, and/or managerial decisions (based on Engineering evaluations), the system shall be leak checked to maximum operating pressure.
5) Prepare and submit operating procedures for proof testing to the cognizant Safety Office for review and approval prior to proof test to ensure adequate safety precautions are included.
6) Relief valves in gas or liquid pressure systems shall be inspected, reset and tested at in accordance with SSTD-8070-0097-TEST.

7) Primary gauges in high and low-pressure systems shall be calibrated annually. Identify pressure gauges not critical to a system as "No Calibration Required." Gauges so identified must conform to NPD 8710.5, *NASA Safety Policy for Pressure Vessels and Pressurized Systems*.
8) All pressure vessels and systems shall be proof tested and marked in accordance with applicable regulations.
9) All flex-hoses not permanently installed and not considered a permanent part of a system and subject to periodic removal, storage, and/or reinstallation require initial proof testing, visual inspection prior to use, and retested at the flexible element MAWP no less frequently than every 5 years.
10) Flex hoses whose rupture would cause unacceptable hazard to personnel or risk to mission shall be retested at the flexible element MAWP no less frequently than every five years.
11) Flex-hoses, not subject to the requirements of paragraph “9” and “10”, in a system with pressure 150 psig and below require no proof testing provided they are properly tagged "Low Pressure Use Only" and connected to a source labeled "Low Pressure, 150 psig or Less," or portable sources conspicuously labeled "Do Not Pressurize Above 150 psig."
12) Flexible hoses that are permanently installed by welding or brazing shall be included as part of the PV/S inspection and testing requirements, and the retest requirement of paragraph ”9” does not apply.
13) Perform inspections of flex hoses in accordance with number ”i” of this procedure, *Inspection Criteria for High Pressure Flex Hose*s.

h. General Criteria for Flex Hoses Flex Hoses fall into two major categories: small diameter high pressure hoses used in temporary installations to supply gas or fluid media for transfer, purging, etc., and large diameter low pressure flex hoses used to transfer cryogenic fluids (liquid nitrogen, liquid oxygen, liquid hydrogen).
1) Identification - All flex hoses shall be permanently marked with an identifying serial number and information stating: MAWP, proof pressure test and date of original proof test or retest, Quality Control (QC) mark or stamp, and Stennis Work Request (SWR) or other work document number for traceability.
2) Cleanliness Level - Flex hoses shall be cleaned for the intended service. Portable flex hoses (including portable cryogenic sampling flex hoses) shall have a Progressive Inspection Tag affixed indicating the service media and clean level. The user organization shall maintain adequate documentation that reflects that cleanliness levels are maintained for the intended service.
3) Hydraulic Service - Flex hoses used in hydraulic service, or those subject to any type of hydrocarbon contamination, shall be uniquely marked to indicate hydraulic service.
4) Storage and Use – Store portable flex hoses in clean, dry environments with the ends capped to prevent entry of contamination.
5) General Use Flex Hoses - Rubber or other similar flex hoses used for low pressure (150 psi or less) shop air, air driven tools, low pressure breathing air, etc. do not require proof

pressure testing but remove them from service when there is evidence of wear, damage, cracks, abuse, or other indications of potential failure.

6) Inspections and Recertification – Perform inspections to determine if flex hoses are suitable for continued service. See number ”i” below for inspection criteria. Perform inspections prior to use and document same at least monthly.

i. Inspection Criteria for High Pressure Flex Hoses Flex hoses failing visual inspection shall be removed from service and tagged "Do Not Use." Disposition shall be either repair or destroy (for scrap). Flex hoses that are repaired shall be proof pressures tested, identified and re-cleaned for the intended service.

1) Identification: - Any in-service hose lacking identification of safe working pressure, proof pressure test (date, test pressure and test number), QC stamp, or serial number shall be removed from service.
2) Permanent Deformation - Deformed hoses indicate possible internal damage and shall be removed from service. Deformation includes permanent set from bending too sharply (kinks), and flattened spots or "bird cages" indicate that the hose was subjected to external loads such as being rolled over by a vehicle or pinched.
3) Broken Wire Strands in Outer Braid - Any hose having more than one-half of the individual elements (strands) in any one braid (plait) of the outer reinforcing jacket broken shall be removed from service.
4) Heat Damage - The exterior stainless steel braid will turn a uniform yellow or light brown color after exposure to elevated temperatures. Hoses exposed to elevated temperatures or hoses exhibiting evidence of exposure to high temperatures shall be removed from service.
5) Abrasion of the Outer Jacket - Hoses that have been abused by dragging them over concrete or other rough surfaces will have areas on the outer jacket that are fretted. These worn and frayed areas weaken the jacket and create a hazard to personnel handling the hose due to sharp edges and raised metal on the braid. Remove from service hoses showing sign of this type of damage.
6) Damaged End Connections - Hoses having damaged, cracked, or galled attaching hardware, or have binding between the movable and non-movable parts of the attaching hardware, shall be removed from service. End connections that have raised or smeared metal, nicks or gouges are an indication that improper wrenches (such as "vise grips") were used and/or the fittings were over-torqued. These shall also be removed from service.
7) Leakage - Any leaking hose shall be removed from service. If the leakage is at the connection and the leak can be corrected by tightening the fitting or using approved-type crush washers, then the hose can remain in service.
8) Splitting or Cracking - Any non-metallic hose having splits or cracks on the outer surface shall be removed from service. This does not include non-metallic coverings that are used as chafe guards or insulation.

5.10 Explosive Safety

This procedure provides assigned personnel and customers of the Stennis Space Center the safety requirements that are required in addition to existing regulations regarding shipping, handling, using, and storing explosives within the confines of SSC. NASA/SSC and its contractors involved in the shipping, handling, using and storing of explosives within the confines of SSC shall develop and follow explosives safety procedures. The procedures shall outline the responsibilities and requirements for shipping, handling, using and storing explosives.

5.10.1 Responsibilities

a. Program/Project Managers: Program/Project managers will assure all activities involving explosives are in compliance with the applicable requirements as outlined in this document. The Program/Project manager shall assure explosive facilities are sited properly (i.e. quantity distance relationships are evaluated) and are documented in a site plan/safety submission, Appendix G. The Program/Project manager shall obtain approval of the site plan/safety submission from NASA Safety prior to bringing any explosive material on to SSC.

b. Safety Office: The Safety Office will evaluate and approve all explosive site plans/safety submissions for explosive operations/activities at SSC. NASA S&MA Office or designated representative shall annually audit (to include a site walkthrough) each explosive operation for compliance with this procedure.

c. Responsible Managers: Managers over explosive operations or personnel involved with explosive operations are responsible for assuring that personnel are trained in the hazards associated with the unique operations/equipment/explosive material and that their employees abide by the safety requirements of this document as well as that presented in training and written procedures.

d. Employees: Employees shall abide by safety requirements and follow written operating procedures.

5.10.2 Requirements

a. Explosives Safety Plan: Typically NASA-SSC does not allow the use of explosive material to be used in construction related projects/activities. In the event all other alternatives have been explored and explosives must be used on a construction project at SSC, then a detailed safety plan, Appendix G, will be developed in compliance with the "Basic Authority Requirements" above to address the unique hazards created as a result of the project specific conditions. This plan must be approved by the NASA S&MA Manager and the NASA Center Director.

b. Explosive Licensing Submission: Where limited quantities of H/D 1.4 explosives and or quantities less than 100 lbs of H/D 1.3 explosives are to be used and or stored, an explosive license shall be submitted (SSC Form 720) in place of an explosive site plan submission. The requesting organization must request the license in writing to the SSC AHJ for explosives. Quantities of explosives on the license are limited to the minimum quantities necessary to support specific explosive operations. Licenses are not to be used for convenience and each license must be signed by the requesting organization and coordinated through the SSC fire department and security prior to being approved by SSC Safety/AHJ. The license must be displayed at the licensed facility. License compatibility groups will not include groups A, K and L. Quantity distance is not a factor for any amount of H/D 1.4 explosives. A minimum separation distance of 25 feet is required between licensed locations containing H/D 1.3 explosives and adjacent explosive operations, personnel or other licensed locations containing H/D 1.3. The explosive license will be revalidated on an annual basis.

c. Explosive Materials: Explosive materials (exclusive of liquid propellants) used in conjunction with NASA and/or Resident Agencies projects and programs will be handled, stored, transported and used in accordance with the following.
   1) Comply with the requirements of the applicable "Specific Reference Requirements."
   2) For new projects/programs, prepare a site plan/safety submission (see Appendix G) detailing the explosive operations to be performed, the proposed location of facilities and supporting rationale to document quantity distance settings for the facilities.
   3) Prepare written procedures with safety precautions denoted for operations involved with explosive materials.
   4) Prepare an explosive inventory denoting the following.
      a) Explosive Materials Name
      b) Quantity of Explosive Material
      c) Storage Location
      d) Explosive Storage Compatibility Grouping ID

   The inventory shall be prepared on a bi-monthly basis and copies shall be delivered to the NASA Safety Office and the FOS Fire Chief.

d. Guidance Document: If the project/program involves the manufacture and/or assembly of explosive items, then use AMCR 385-100 as a guidance document for requirements. The intent of NASA is to enforce this regulation (i.e., AMCR 385-100) unless sound engineering logic (documented) can be used to show that alternative methods of engineering provide protection to personnel and property equal to or greater than the requirements of the regulation.

   Liquid propellants that NASA and its contractors at SSC shall comply with the explosive guidance provided in standard applicable to that commodity.

5.11 Process Safety Management (PSM)

This procedure provides guidance for compliance with OSHA, 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*. This requirement is applicable to all personnel on SSC who manage systems required to have an active PSM program per the requirements of 29 CFR 1910.119.

5.11.1 Responsibilities

a. Mangers/Supervisors:
   1) Management and supervision of all contractor, agency, and NASA organizations are responsible for the compliance to and implementation of the requirements of this safety procedure.
   2) Ensure sufficient and appropriate resources and skills are dedicated for implementing and maintaining an effective PSM Program.
   3) Implement and maintain a system of retrievable documentation of all PSM activities.

b. Operations: Identify personnel to participate in process safety reviews and in the development of operating, maintenance and emergency procedures.

c. Safety Organizations: Review contractor and subcontractor work plans for safety and health hazards and monitor their compliance.

5.11.2 General Requirements

a. Pre-Startup Safety Review: The NASA Operational Readiness Inspection (ORI) process may be used as the required safety review. On projects where an ORI is not required, a senior management safety review shall be held.

b. Management of Change: Established Configuration Management systems (NASA Change Requests, Field Change Notice, etc.) shall be used as the request, review and approval for changes.

c. Incident Investigation:
   1) Records of investigations shall be available for audit and maintained for five years.
   2) NPR 8621.1, *NASA Procedural Requirements for Mishap Reporting, Investigating, and Recordkeeping*, contains further guidance and requirements for accident/incident investigation.

d. Trade Secrets: Organizations operating at Stennis Space Center engaged in new technologies or processes that are covered by OSHA 29 CFR 1910.119 are responsible for making all information available to those assisting in the development of process safety information, the process hazard analysis, operating procedures, and emergency planning and response.

5.13 Safe Handling of Hydrocarbon Based Propellants

This procedure outlines the associated hazards, necessary safety precautions and requirements to be observed when working with RP-1 or any Hydrocarbon Fuels.

5.13.1 General Safety Requirements

a. Written Procedures: A written operating procedure shall be used for all operations involving RP-1 and all Hydrocarbon Fuels.

b. Safety Radius: All sources of ignition shall be prohibited within a fifty-foot (50 ft.) radius of areas where RP-1 or any Hydrocarbon Fuel is handled, stored and used. Any work activity performed within the radius shall be accompanied by a flame permit from the SSC Fire Department and approval from the cognizant safety representative.

c. Venting: Vapors should be vented or flared at remote locations.

d. SAFETY CRITICAL Classification: All areas of operation where RP-1 or any Hydrocarbon Fuel is used, handled, transferred, or stored are considered hazardous, and will be classified as SAFETY CRITICAL.

e. Buddy System: The "Buddy System" philosophy shall be enforced when performing any RP-1 or Hydrocarbon Fuel operations.

5.13.2 Emergency Procedure

In the event of an RP-1 or Hydrocarbon Fuel spill that extends beyond the means of retention, personnel must call 911 from an SSC phone extension or via cell phone by dialing 228-688-3636 and give the location and a brief description of the incident. In case of a fire, the nearest fire alarm shall be activated.

5.13.3 Environmental Requirements

For environmental requirements, refer to SPR 8500.2, *John C. Stennis Space Center Environmental Operation and Implementation Program Procedural Requirements*.

5.13.4 Materials and Equipment Compatibility

a. Liquid Reservoir: Permanently installed pumps in main storage systems may also be equipped with a liquid reservoir to serve as a primer for the pump used to empty vessels not equipped with bottom outlets.

b. Gages: Gages for RP-1 or Hydrocarbon Fuel service shall be selected in accordance with SSC-66-200, Bourdon Tube Pressure & Vacuum Gauges for Use in Facility Piping or Tubing Systems. In order to minimize operator errors, all pressure gages used for a common purpose should have identical scales.

5.13.5 Transportation

For specific transportation requirements, refer to the applicable section(s) of the DOT Code of Federal Regulations, Title 49.

5.14 Safe Handling of Hydrogen Peroxide Propellants

This procedure outlines the hazards involved, safety equipment required, safety precautions to be observed, and procedures/process requirements when working with and around Hydrogen Peroxide (H_2O_2) used as rocket propellant at concentrations higher than 62%.

5.14.1 Safety Requirements

a. General Safety Requirements
   1) All areas of operation where H_2O_2 is used, handled, transferred, or stored are considered hazardous and will be classified as "SAFETY CRITICAL," requiring the preparation of written operational procedures and will require PSM implementation when the OSHA quantity thresholds identified in Appendix A of 29 CFR 1910.119 are exceeded. If PSM is required, develop a detailed PSM plan to describe how the PSM elements are to be implemented.
   2) All operations involving the use, handling, or transfer of H_2O_2 shall be performed by the minimum number of certified personnel required to perform the task but the “buddy system” will be used in the performance of all tasks.
   3) Welding or using a cutting torch on or near any containers or piping systems containing H_2O_2, even when empty, is prohibited without approved written procedures ensuring that the system has been inerted and a Hot Work Permit has been acquired.
   4) H_2O_2 will never be mixed with any other chemical substance/compound unless a thorough investigation has shown the materials are compatible or the resulting reaction is controllable from a design aspect.
   5) Equipment and piping systems contaminated with H_2O_2 will be cleaned via written procedures with approved solvents prior to performing any maintenance or repair activities. Wastes resulting from these procedures should be handled in accordance with the Hydrogen Peroxide Rocket Manual (1965) published by FMC Corporation.

b. Personal Protective Equipment (PPE)
   1) PPE is required for all operations where personnel may be exposed to Hydrogen Peroxide. As a minimum, Gore-Tex coveralls, chemical goggles, Nitrile gloves and

boots with face shield and hardhat are required. (Full PPE consist of boots, full coveralls, gloves, goggles, face shield and hardhat.)

2) Safety shower and eyewash stations must be present and operational.
3) All operations that may expose personnel to Hydrogen Peroxide will require the use of a calibrated meter to monitor the area.
4) Test operations at SSC involving Hydrogen Peroxide will be in compliance with the OSHA/NIOSH Standard Permissible Exposure Limit (PEL), and 8-hour Threshold Limit Value-Time Weighted Average (TLV-TWA) of 1PPM (29 CFR 1910.1000 Table Z (7-1-99).
5) Excursion Limit will be in compliance with the ACGIH Recommendation that "Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 minutes during a work day, and under no circumstances exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded." (ACGIH: TLVs For Chemical Substances and BEIs.)
6) In event of exposure to levels exceeding Excursion Limits or the TLV-TWA during hours 8AM-4:30PM, exposed employee(s) shall report to the Occupational Health & Safety (OHS) Clinic for evaluation and treatment as appropriate. After normal working hours call 911 for evaluation, first aid and if necessary, transport to the nearest Hospital, by the SSC Emergency Medical Services/Emergency Medical Technicians (EMS/EMTs). Exposed employee(s) shall report to the OHS Clinic on the next working day before reporting for work.
7) Report all such occupational exposures on the SSC Form 559, *Report of Industrial Injury or Illness*.
8) Any operation that may exceed the exposure limits as stated in items (4, 5) requires the use of Self Contained Breathing Apparatus (SCBA).
9) Any response to emergency situations will require the use of Level A protective and SCBA.

c. E-3 Test Stand Specific Access Requirements: The following information will be used to determine the level of PPE required to access the E-3 Test Stand. During transfer operations; PPE will be the test stand and five feet from any equipment used in the transfer operation.

Personnel are not allowed on the test stand with the run system pressurized.

Situation	**PPE Required**
Static test stand (empty run tank)	None
Transfer Operations	Full
Loaded run tank -Post transfer & Pre Test (0 psig in tank)	None
Loaded run tank-After 1st test until after wash down (0 psig in tank)	Full
H_2O_2 Conditioning Operations	Full

When the E-3 H_2O_2 100,000 Gal Containment Tank receives diluted H_2O_2 discharge, FOSC Safety will determine if detectable levels of H_2O_2 are present. If so, the following guidelines will

be followed. FOS Contractor Safety will look for misting and detectable H_2O_2 readings downwind outside the fence.

Under no circumstances will unprotected personnel be exposed to atmospheres above those values in 2.(4,5), as represented by H_2O_2 detection equipment.

If the safety observations and assessment warrant (as determined by FOS Contractor/NASA Safety) then the use of a calibrated H_2O_2 meter is required when personnel are in the vicinity (~50 feet from the containment tank fence) of the containment tank.

After a 1/2 day with no recordable H_2O_2 readings downwind of misting within the containment tank, no additional measuring is required by S&MA or SSC personnel, and the area is safe for normal activity.

d. System Design Requirements

1) H_2O_2 systems shall be designed to prevent uncontrolled escape and contact with reactive materials. Advice from the H_2O_2 supplier and material reactivity lists in the reference materials identified in this document will be used to aid in material selection of components and hardware that will see H_2O_2 service.
2) Handling materials, including metals, gasket material, and lubricants shall be researched via reference material and/or material suppliers, to determine their compatibility with H_2O_2 prior to being used in H_2O_2 systems.
3) All vessels, transfer lines and equipment should be tightly sealed, free of moisture, oxygen, and other reactive materials and purged with dry nitrogen or other inert gas, cleaned and passivated (2-hour nitric acid bath) before introducing H_2O_2 into the system. The system should be nitrogen purged after use, making sure all liquid is displaced and drained in accordance with approved procedures for safing.

   WARNING: With the exception of AK225 samples taken in the Fluid Component Processing Facility (FCPF) as part of the Level 1XX cleaning process identified in SSTD 8070-0089-FLUIDS, AK225 and Vertrel shall not be used to clean components to be used in H_2O_2.

4) Be careful when procuring valves/components to assure that H_2O_2 will not be trapped within inaccessible cavities of the item. Pressure relief by means of pre-drilled passages or through design of the component will be provided. Ball valves will have a hole drilled in the upstream side of the valve to prevent pressure from building inside of the ball.

e. Transportation Safety

1) Procurement packages for H_2O_2 will include the requirement that the transporter of the material stop at the entrance to SSC and notify the following prior to entrance of the site and delivery of the material.

2) H_2O_2 will not be delivered to the warehouse area. The material will be directed to the approved storage site per instructions of the person or office that ordered the material.

f. Laboratory Safety: A process plan will be developed for any activities conducted with rocket propellant grade H_2O_2. The plan will identify safety precautions necessary for the safe handling, use, and disposal of the H_2O_2. Personnel, labs, or projects considering the use of the H_2O_2 will contact their cognizant safety office for guidance and aid in planning for use of H_2O_2.

5.13.3 Environmental Requirements

a. Procurement/Requisition: Refer to SPR 8500.2, *John C. Stennis Space Center Environmental Operations and Implementation Program Procedural Requirements*.

b. Storage Requirements
1) H_2O_2 is to be stored in containers fitted with safety valves or vents, constructed of only approved materials and suitably cleaned and passivated. Refer to MSDS for specific requirements.
2) Storage will be minimized as to the amount needed to support safe and efficient operations and will require justification to the NASA Safety Office prior to use/storage at SSC. All storage sites must be approved by NASA Safety and NASA Environmental.
3) Storage facilities should be constructed of noncombustible materials, preferably open sided with concrete floors that slope to the outside of the facility. Hard packed clay containment areas will be acceptable for testing programs of a short term limit, i.e., 3-6 months.
Any runoff should be captured by a dike to preclude saturation of moist soils outside of the containment area or release into nearby streams, lakes, or waterways. The containment area must be sized to hold 150% of the maximum credible spill that could be expected.
4) A source of emergency dilution water shall be provided for quick and safe hookup to storage containers of H_2O_2. The source shall be sized appropriate for the size of storage vessel to be protected in the event of a run-away reaction of the H_2O_2. Additional water sources shall be provided for cooling of the exterior of the storage vessel and any adjacent combustible materials (e.g. rubber tires on a transport trailer).

c. Decontamination/Disposal Requirements
1) Decontamination - Piping systems must be emptied of H_2O_2 by transfer of fluids through a safing system or by use. Then use deionized water to flush all piping previously containing H_2O_2.
2) Safing - Systems using high concentration H_2O_2 will be provided with safing systems to assure safe shutdown of test stands and the safe draining of residual peroxide in systems following tests.

3) Disposal of Shipping Containers - Shipping containers shall be returned to the manufacturer in compliance with DOT regulations.
4) Waste Disposal - H_2O_2 waste will not be sealed in containers that are not provided with adequate means of venting the product as it decomposes and builds up pressure.

5.14.3 Emergency Procedures

The following emergency procedures will be included in written operational procedures for H_2O_2, as well as posted at storage and use locations. Because of the hazardous nature of handling and using H_2O_2, each project/test program will develop unique emergency procedures tailored to the specific requirements of the project/test program.

a. Fire Fighting: Emergency Response for Runaway Decomposition of H_2O_2.
   1) In the event that temperature measurements indicate a run-away decomposition of the H_2O_2, large amounts of dilution water will be introduced into and onto the H_2O_2 storage container or drums.
   2) Decomposing H_2O_2 shall not be transferred into other storage containers or drums.

5.15 Critical Lifting Operations

Compliance with this standard is mandatory for all NASA-owned and NASA contractor-supplied equipment used in support of NASA operations. Lifting devices and equipment such as rental cranes used for construction and building maintenance are exempt from this standard unless deemed necessary by the contracting officer, the responsible NASA installation/program safety office and the NASA Lifting Devices and Equipment (LDE) Manager. This standard applies to overhead and gantry cranes (including top running monorail, under-hung, and jib cranes) mobile cranes, derricks, hoists, winches, special hoist supported personnel lifting devices, hydra-sets, load measuring devices, hooks, slings and rigging, mobile aerial platforms, powered industrial trucks and jacks. This chapter does not include coverage for front-end loaders, and elevators**.**

5.15.1 Requirements

a. Procedures: Critical lifts shall have specific written procedures (lift plans) approved by the LDE Manager (LDEM), or his designee. Lift plans will direct lifting operations only. Associated work performed in conjunction with lifting operations will be controlled on separate documents. Field changes to lift plans shall be approved by the S&MA personnel present at the lift. The below listed minimum requirements may be appropriately amended by the LDEM as required for certain lifting requirements (i.e. verification of weather conditions for indoor operations may not be required).
   1) Identify the LDE, including all rigging gear.
   2) Verify operator and equipment certifications.
   3) Verify appropriate weather conditions at the lift site.

4) Identify object to be lifted including weight and center of gravity, or refer to the applicable analysis, drawing, or specification documents.
5) Verify pre-operational inspection of equipment.
6) Verify area safety zone security.
7) Describe lifting process.

Non-critical lifts typically involving routine, minimal hazard lifting operations do not require written instructions.

b. Rigging Equipment: Tag each item of rigging equipment to clearly identify the manufacturer, the rated load, and the date tested. For multiple part equipment that can be separated (e.g. shackles with pins), the subordinate part (pin) shall be identified to the primary part (bow). Use a "dog-tag" system to certify and mark rigging gear with the exception of synthetic web and synthetic fiber (round) slings. The dog-tags shall be color coded to identify the categories of the rigging gear in accordance with the following.

"Dog-tag" Color	Lift Category
Red	Critical Lift Gear
Blue	Non-load Test Slings
Green	Personnel Lift Gear
Silver	Non-Critical Lift Slings

In the case of synthetic web and synthetic fiber (round) slings, the vendor's tag shall include:

1) Name or trademark of manufacturer.
2) Manufacturer's code or stock number.
3) Unique identification number for the individual sling.
4) Rated load for the type of hitch (usually vertical, basket and choker).
5) Type of material and construction.
6) Month and year of last load test (Proof or periodic rated load test -- should be same as date of manufacture).

Non-critical lift shackles, turnbuckles, lifting eyes, swivel hoist rings, etc. shall not require periodic load testing or tagging, but shall be manufactured by a domestic manufacturer and permanently marked to identify the manufacturer, the size, and the rated load.

In the case of synthetic web and round slings used in the hoisting of personnel, mark each sling (stenciled or other legible manner) "Personnel Lifting Only" on the body (webbing of the sling) or (in the case of round slings) on the protective fabric cover of the sling.

c. Operations: The supervisor or designee assigned by management of the contractor, agency, or organization performing a critical lift shall be responsible for the safety of the operation and shall ensure the following activities are completed.
   1) Prepare a critical lift written procedure and have it approved by the SSC LDE Manager.
   2) Hold a documented prelift meeting with all personnel involved with the lift.
   3) Assign and identify a flagman to the lifting equipment operator when required.
   4) Assure that involved personnel are qualified and certified, if required, and understand how the job will be accomplished.
   5) Select proper equipment and hardware and verify conformance with the applicable requirements.
   6) Check to see that equipment is properly set up and positioned.
   7) Inspect the work area for hazardous/unsafe conditions and secure from unauthorized or non-essential personnel entry.
   8) Assure that the lifting operation is directed per the lifting procedure.
   9) Document details of the lifting operation, transmit them to the appropriate manager, and place the documentation in a history file.
   10) During critical lifts, there shall be one person present designated as responsible for the safety of the operations. That person will be in the S&MA organization of the company performing the lift.

d. Communications: Operators and riggers shall understand and use the Standard Hand Signals (ref. NASA-STD-8719.9) for controlling lifting device operations. Direct voice and radio communications shall also be acceptable. The operator of the lifting device shall not engage in any movement of the lifting device without receiving an approved hand or voice signal from a rigger or another appropriate team member.

   When making critical, complex, or "blind" lifts, the rigger shall remain in constant communication with the operator, conveying all pertinent information as it happens, describing how the lift is situated. It shall be understood that if the communication ceases, the operator shall stop operation until communication is reestablished.

e. Saftey Zones: Establish appropriate safety zones for suspended operations prior to the initiation of lifting operations. Safety zones shall be clearly marked with appropriate barriers (rope, tape, cones, etc.). Only personnel associated with the lifting operation are allowed in the safety zone. All personnel working inside the safety zone must wear a hard hat and steel-toed boots/shoes. Any personnel handling the load or rigging equipment must also wear leather gloves. At no time should personnel working inside the safety zone be allowed under a suspended load.

f. Weather: Outdoor lifting operations shall not commence if winds exceed 15 mph steady state, 25 mph gusts for material lifts or 10 mph steady state, 15 mph gusts for personnel lifts. Do not initiate outdoor lifting operations while under a lightning alert. Should inclement

weather conditions or a lightning alert occur during a lifting operation, the person in charge of the lift shall determine appropriate action, i.e., secure the load and terminate the lift.

g. Emergency Procedures: The procedure for loss of power, brake failure, loss of speed control of any hoisting or travel or other emergencies during crane operations shall consist of:
   1) Immediate "opening" of the main power source disconnect.
   2) Institution of standard lock-out and tag-out requirements.
   3) Securing of area immediately below the suspended load. (Including evacuation of all affected personnel from the area directly below the suspended load).
   4) Initiation of an emergency facility "trouble call" (extension 8-3293).
   5) No attempt to bypass any safety devices or fail-safe means or devices in an attempt to move or lower the load.
   6) If emergency lowering of the load is required, follow the specific emergency instructions in the "Critical Lift Plan" or initiate steps to develop a separate "Critical Lift" plan with the proper reviews and approvals prior to initiating any attempt to lower the load." Alternately, secure load until a mobile crane or forklift can transfer the load.

h. Personnel: All personnel operating lifting equipment must meet the requirements of SWI-8834-0001, *SSC Lifting Devices and Equipment Management Plan*.

6.0 FIRE SAFETY AND HEALTH OPERATING PROCEDURES

6.1 Specific References

SPR 8715.3, SSC Hot Work Permit Program
National Fire Protection Association (NFPA) Codes on Fire Protection
29 CFR 1910.145, Specifications for Accident Prevention Signs and Tags

6.2 Flame Permits Procedure

This directive establishes the requirements for the Hot Work Permit Program SPR 8715.3 at SSC. This SPR is applicable to all NASA and NASA contractor personnel. It is also applicable to resident agencies and contractors performing work at SSC. Compliance with this procedure is required for all of the following operations or activities:

a. Electric Arc Welding.
b. Oxy-Acetylene cutting/welding/heating operations.
c. Operation of electrical, pneumatic or mechanical tools in a Hazardous Classified area that is not intrinsically safe.
d. Soldering torches powered by flammable gases.
e. Open flame producing devices, or devices that produce hot sparks during operation.
f. Burning of woodlands and brush piles.

6.3 Selection, Use, and Inspections of Fire Extinguishers

This procedure outlines the general requirements for the use, selection, and inspection of portable fire extinguishers at Stennis Space Center.

6.3.1 Responsibilities

a. Supervisors: Supervisors and/or facility managers shall be responsible for assuring portable fire extinguishers are located and identified in their areas of responsibility.

b. Fire Department Aid: When requested by supervisors and/or facility managers at SSC, the FOSC's Fire Department shall provide aid in determining the quantity, type, and location of portable fire extinguishers.

c. Inspection: The FOSC's Fire Department is responsible for inspecting and maintaining fire extinguishers located in facilities at SSC.

d. Training: The FOSC's Fire Department is responsible for developing, maintaining and providing fire extinguisher training as requested by SSC onsite personnel.

6.3.2 Requirements

a. Used Extinguishers: **Do not place a fire extinguisher intended for fire fighting back into a cabinet/recess or re-hang on a bracket prior to recertification by the SSC Fire Department.** Tag the extinguisher as unsafe for use and return it to the SSC Fire Department for replacement or recharging.

b. Specific Requirements: Keep fire extinguisher records on a tag or label attached to the fire extinguisher or in an electronic system (e.g., bar coding) that provides a permanent record.

c. Training Requirements: Employees who have been designated to use portable fire extinguishers shall be trained in the following prior to their placement on the job and at least annually each year thereafter. Fire extinguisher training shall consist of the following as a minimum:
   1) General principles of classes of fire and fire extinguisher use.
   2) Warnings/Cautions of determining when to fight a fire and when to leave.
   3) Actual hands on use of a fire extinguisher.

6.4 Emergency Response/Employee Evacuation of Personnel in the Event of Fire

This procedure provides the general requirements for assuring the safety of personnel given an emergency situation arising as the result of a fire in the workplace.

6.4.1 Responsibilities

a. Resident Agencies: Each resident agency (organization or an organization in association with its own contractors) located at SSC will develop its own unique Emergency Fire Evacuation Plan for its personnel. Each resident agency shall forward these plans to the SSC Fire Department for review and approval.

b. Supervisors/managers: Supervisors/managers are responsible for assuring that employees are adequately trained in the necessary actions to take in the event of a fire in their workplace. Employees shall be trained at least annually on their organization's "Emergency Fire Evacuation Plan."

c. Employees: Employees are responsible for becoming familiar with their emergency escape routes and the required assembly points located outside their building. Employees are also responsible for following these evacuation plans in the event of an emergency situation.

6.4.2 General Requirements

a. Evacuations Plans. Emergency fire evacuation plans will include the following information as a minimum:

1) General and specific responsibilities of supervisors and employees during an evacuation.
2) Specific building drawings depicting the emergency routes within the building and assembly points located safely away from the building.
3) Specific actions necessary to evacuate personnel from areas in which classified information is handled.
4) Specific actions necessary to evacuate individuals with disabilities who require assistance.

b. Notifying Emergency Fire Personnel. Upon suspecting or discovering a fire, employees shall immediately notify the SSC Fire Department by using the nearest fire alarm pull station or via radio or telephone. For fires located outside of a building or in remote areas, employees shall call the SSC Security Dispatcher (911 for SSC phones or 688-3636 for phones on site that are routed through the Bay St. Louis phone system). If an employee phones to report an emergency, he/she shall remain on the phone to answer any questions the dispatcher might have. The employee shall not hang up until directed to do so by the dispatcher.

c. Evacuation. Employees shall immediately evacuate to their designated assembly points away from the building given a fire alarm has sounded within their facility or if directed to do so by Security or the Fire Department. Employees will close their office doors, without locking them, as they leave. Supervisors shall assure all employees are present and notify the SSC Fire Chief in the event of someone missing.

d. Visual Sweep. Supervisors are required to perform a visual sweep of their areas of responsibility to assure all personnel or visitors have evacuated.

e. Entering a Burning Building. Emergency Response Personnel of the SSC Fire Department are the only personnel authorized to enter a burning building and attempt a rescue.

f. Fire Drills. As a minimum, a yearly fire drill shall be conducted of all work areas/buildings at SSC. The fire drill shall be conducted by the SSC Fire Department, with fire department personnel stationed throughout the building/facility, timing and observing the evacuation. Building custodians/supervisors of work areas are responsible for providing assistance to the fire department during the fire drill. A written report of the activity including deficiencies (if any) shall be prepared by the Fire Dept. and forwarded to NASA Safety. NASA Safety shall be responsible for assuring the appropriate facility manager/supervisor is made aware of any problem areas and have these are corrected by the responsible party in a timely manner. False alarms shall not be recognized as a Fire Drill.

6.4.3 Emergency Fire Evacuation Plan

Below is a sample Emergency Fire Evacuation Plan for SSC and individuals with disabilities location listing template.

EMERGENCY FIRE EVACUATION PLAN

1.0 Emergency Fire Evacuation of NASA Employees in Bldg 1100. Individuals will evacuate the building via designated emergency routes. All employees should be familiar with designated Marshalling Areas.

2.0 Emergency Fire Evacuation of individuals with disabilities employees at SSC. SSC Organizations requiring evacuation assistance for individuals with disabilities shall complete the Emergency Evaluation form (example below) and forward to the SSC Fire Department to keep on file. If evacuation needs change for personnel, the SSC organization must notify the SSC Fire Department. A completed form must be forwarded to the SSC fire department to keep on file for each employee needing assistance.

EMERGENCY EVACUATION
OF
PHYSICALLY CHALLENGED
NASA EMPLOYEES AT SSC

The following employees have been identified as needing assistance during emergency evacuation of the facilities in which they work. Each individual's specific needs have been evaluated and the appropriate assistance tailored for those needs. A completed copy of this document was placed in each physically challenged employee's "Official Personnel Folder."

NAME OF INDIVIDUAL: _____
LOCATION: Building ____
ASSISTANCE: _____(_____) and _____ (_____) have been assigned as primary and secondary assistants, respectively; to aid _____ in the event of a fire alarm sounding or other emergency evacuation of Building _____. Aid will include assuring _____ is aware of the alarm and that one of the assistants stays with _____ during the evacuation procedure to assure any special instructions from emergency response personnel are conveyed to _____.

NAME OF INDIVIDUAL: _____
LOCATION: Building ____
ASSISTANCE: _____(_____) has been assigned as an assistant to aid _____ in the event of a fire alarm sounding or other emergency evacuation of Building _____. Aid will include assuring _____ is aware of the alarm and _____ stays in close proximity to _____ during the evacuation to assure any special instructions from emergency response personnel are conveyed to _____.

NAME OF INDIVIDUAL:_____
LOCATION: Building____
ASSISTANCE:_____(_____) and_____(_____) have been assigned as primary and secondary assistants, respectively; to aid _____ in the event of a fire alarm sounding or other emergency evacuation of Building ____. Aid will include assuring _____ is provided assistance and _____ is escorted safely to the assembly point outside the building.

6.5 Fire Symbols

This procedure outlines the general requirements for the use, selection, and posting of fire symbols at SSC. It is not the intent of this instruction to address every labeling requirement for

areas in which large storage vessels of flammable/combustible liquids, hazardous materials or any quantity of ammunition or explosives are stored/handled but rather to focus on the more common requirements at SSC and provide the "Basic Authority Documents" that will provide a broader range of guidance/requirements for labeling such areas.

6.5.1 Responsibilities

It is the responsibility of facility managers, or operational leads to assure the proper fire symbols/warning signs are provided and installed.

6.5.2 Requirements

a. Conformance to Regulations and Standards. Danger signs and labeling used shall conform to requirements specified by 29 CFR 1910.145.

b. Display of Explosive Fire Symbols for Transportation. Fire symbols/ DOT placards shall be placed on all transport vehicles immediately prior to loading and shall be removed from the vehicles immediately upon completion of unloading. Railcars with the DOT placard "Explosive" shall be treated as "Fire Division" 1 and those labeled with a DOT placard "Dangerous" shall be treated as "Fire Division" 3, where identification of fire hazards is dependent on the DOT classification only.

6.6 Safety Requirements for Using/Storing/Dispensing Gasoline

This procedure outlines the basic safety requirements to be observed when working around gasoline.

6.6.1 General Requirements

a. Spill Handling and Reporting: In the event a small spill occurs, the gasoline will be flushed with water. Large spills (greater than 5 gallons) will be reported to the Spill Response Team and the cognizant safety officer by calling ext. 911 from an SSC phone extension or via cell phone by dialing 228-688-3636.

b. Maintenance and Inspection of Storage Containers: Perform periodic maintenance and inspections of gasoline storage containers to identify external damage or deformation, corrosion, need for lubrication, cleanliness and adequate general housekeeping and proper pressure relief mechanisms.

c. SAFETY CRITICAL Classification: Classify configuration changes to gasoline storage containers and related systems as SAFETY CRITICAL.

d. Use of Gasoline for Cleaning: Do not use gasoline as cleaning solvent.

e. Portable Heating: Do not use portable gasoline stoves for heating purposes, unless specifically approved by the NASA/SSC Office of Safety and Mission Assurance.

6.7 Natural Gas Systems

This procedure outlines the basic safety requirements to be observed when working around natural gas systems.

6.7.1 General Requirements

a. Safe Distance: Do not smoke or allow other possible ignition sources within 50 feet of gas piping, gas utilization equipment or accessories.

b. Static Grounding: Statically ground all natural gas lines and related components.

c. Relief Valves: Relief valves, which are inspected, tested and reset annually, are included in natural gas systems.

6.7.2 Operational Requirements

Installation and replacement of gas piping, gas utilization equipment, or accessories, and repair and servicing of equipment is SAFETY CRITICAL and shall be performed only by qualified personnel. The term "qualified personnel" means any individual and/or contractor that is engaged in and is responsible for the installation or replacement of gas piping or the connection, installation, repair, or servicing of equipment. The aforementioned work requirements shall be accomplished in accordance with an approved operating procedure or process plan.

7.0 CONSTRUCTION SAFETY AND HEALTH OPERATING PROCEDURES

7.1 Specific References

29 CFR 1926, Subpart P, *Excavations*
29 CFR 1926.603, *Pile Driving Equipment*
29 CFR 1926, Subpart Q, *Concrete and Masonry*
29 CFR 1926, Subpart Y, *Diving*
29 CFR 1926, Subpart R, *Steel Erection*
29 CFR 1926, Subpart K, *Electrical*
29 CFR 1926, Subpart W, *Rollover Protective Structures; Overhead Protection*
29 CFR 1926, Subpart N, *Cranes, Derricks, Hoists, Elevators, and Conveyors*
ANSI B 15.1 – 1958, *Safety Code for Mechanical Power Transmission Apparatus*
SPR 8715.1, *John C. Stennis Space Center Safety and Health Procedural Requirements*
SSTD-8070-0119-MISC, *SSC Standard for Dig Permit*

SSC Form 618, *SSC Dig Permit*

7.2 Construction Safety Program Plans

The purpose of this procedure is to provide the general requirements for safety program plans and informational submittals for construction projects at Stennis Space Center. This safety procedure is applicable to all offsite construction contractors performing work at Stennis Space Center under contract to NASA. These requirements shall apply to NASA and NASA contractors as expressed in the terms of their respective contracts.

7.2.1 Requirements

Prior to commencing work activities at SSC, the contractor shall present to the Contracting Officer (CO) or the Contracting Officers Technical Representative (COTR) (or the respective office within the FOS Contractor's organization), a Construction Safety Program Plan, Appendix H, which details the employer's safety and health program for review and approval. The CO or COTR (or the respective office within the FOS Contractor's organization) shall submit this plan to the NASA Safety Office or the FOS Contractor's safety office for technical review and approval. The written plan will be developed to a level of detail that is commensurate with the project's scope, complexity, and level of risk. Appendix H and its attachments depict the basic outline of a Contractor's Safety Program Plan.

Safety Assurance – Appendix H and its attachments depict the documentation necessary to assure that OSHA/NASA safety requirements are being met by Construction contractors. This will be provided by the contractor as required within the attachment.

7.3 Excavations and Trenching Safety

This procedure outlines the general safety requirements for excavating at SSC.

7.3.1 General Requirements

a. Interference Tolerances: Known or questionable interferences shall be "hand-dug" within six feet (1.8 meters) of the interferences.

b. Deep Excavation: Prior to any excavating or trenching operation deeper than 12 inches (300mm), a dig permit must be obtained and posted at the work site. (See paragraph "d" for Dig Permit Procedure).

c. Shoring: Soils at SSC generally will be of the type B (requiring a 1:1 slope*) or type C (requiring a 1½: 1 slope*). If this slope cannot be attained, shoring is required. (***Note:** For excavations 20 feet (6.1 meters) or less in depth.)

d. Dig Permit: All excavations, trenches, drilling and other ground penetrations which will extend 12 inches (300 mm) or more below the ground surface will require a Dig Permit (SSC Form 618).
   1) When a design project requires excavating, trenching, or drilling work, the Design engineer or Construction Manager's Representative will contact the FOS Facilities Engineering Department. (In new undeveloped construction areas Facilities Engineering may allow Construction Engineering to authorize the dig permit, at which time Construction Engineering is responsible for the procedure requirements referred to as Facilities Systems Engineering duties.)
      a) The Design Engineer and/or Construction Manager's Representative will, as a minimum, furnish Facilities Systems Engineers with a SWR and a sketch (with an Engineering Modification Instruction (EMI) Index sheet if applicable) showing a ten-foot (three meters) right-of-way (five feet (1.5 meters) on either side of the centerline) along the route of the excavation.
      b) All known information sources will be utilized to determine if there are any utilities located in the proposed excavation area.
   2) Facilities Systems Engineering shall coordinate the approval of all Dig Permits prior to issue.
   3) Facilities Systems Engineering shall send a copy of each Dig Permit to the Facility Support Contractor's Safety Office and to the Technical Support Services Contractor/Communications for consultation and review during the approval process.
   4) The Dig Permit is valid only when all required signatures are present on the form.
   5) The Safety Representative will review and approve (signature required) when the depth of the excavation exceeds 48 inches (1.22 m) below grade and personnel will enter the excavation.
   6) Underground utilities in the area or along the route of the excavation (as identified by the Dig Permit and depicted on the sketch) must be staked or marked with paint under the direction of or by Facilities Systems Engineering before any excavation, trenching, or drilling begins.
   7) After Facilities Systems Engineering has identified the utility locations and before any excavating begins, the Facilities Engineer shall communicate (verbally or in writing) to the Dig Site Supervisor what utilities are present, pipe sizes, pressures, and any hazards or consequences involved if the utilities are ruptured or interrupted.
   8) Facilities Systems Engineering will complete the required pre-excavation information of the Dig Permit and will obtain all required signatures (with the exception of the equipment operator).
   9) Facilities Systems Engineering will retain a copy of the Dig Permit and forward the other two copies to the Dig Site Supervisor.
   10) Each equipment operator performing excavation work must sign the Dig Permit.
   11) The durable copy of the Dig Permit and a copy of the sketch will be available at the excavation site at all times.
   12) The Dig Site Supervisor will keep a copy of the Dig Permit on file for the duration of the excavation.

13) During the excavation, any deviations from the originally proposed route (as depicted on the requester's sketch) will require the issuance of another Dig Permit.

7.4 Pile Driving

This procedure provides the general safety requirements for pile driving operations occurring within the confines of SSC.

7.4.1 Responsibilities

a. Construction Contractors. The construction contractor performing the pile driving operation is responsible for assuring:
   1) Compliance with SPR 8715.1 and with this document.
   2) That equipment is maintained for safe usage and that OSHA requirements are met.
   3) That cranes used for pile-driving operations are inspected and certified by an independent crane inspection service.
   4) That personnel are trained to safely operate pile driving equipment.

b. Off-site Contractors. NASA and NASA's FOSC field engineers are responsible for assuring that offsite contractors are made aware of these requirements and that they comply with these requirements.

c. Equipment Inspection. NASA and/or NASA's FOSC field engineers are responsible for conducting an equipment inspection prior to the setup and use of any crane or pile driving equipment within the confines of SSC.

d. Auditing. NASA and/or NASA's FOSC safety engineers are responsible for periodically auditing pile driving work sites to assure safe working conditions.

7.4.2 Requirements

a. Boom Stops: In all pile driving/extraction operations, use a continuous boom stop with gradually increasing resisting force between the boom and structure of the crane.

b. Operating Wind Conditions: Do not conduct sheet piling operations during winds in excess of 20 mph.

c. Personnel Safety: Personnel shall not remain on top of piles during driving activities.

d. Use of Prototype Equipment: Do not use prototype pile driving equipment at SSC unless permission is obtained from the SSC Construction Manager and NASA Safety & Mission Assurance.

e. Fixed Leads: Fixed leads shall be provided with ladders and safety climbing devices, or similar attachment points, so loft workers constantly have their safety harness lanyards attached. If the leads are provided with loft platform(s), such platform(s) shall be protected by standard guardrails. (Riding leads are prohibited).

f. Minimum Safety Equipment: Personnel in the immediate vicinity of pile driving operations shall wear, as a minimum, hard hats, eye protection, hearing protection, and safety shoes.

g. Matting: Use matting as necessary where pile driving and crane equipment will not be properly supported and stabilized by the soil.

h. Dogs on Pile Driver Hoist Drums: Do not use dogs on pile driver hoist drums that automatically disengage either by relieving the load or rotating the drum.

i. Hanging or Swinging Leads: Hanging or swinging leads of pile drivers shall have fixed ladders. Employees shall not remain on leads or ladders while pile is being driven. Fixed leads shall be provided with ladder and climbing device, or attachment points so the aloft worker may engage his/her safety harness lanyard to the leads.

j. Storage Prohibited: Landings or leads shall not be used for storage of any kind.

k. Pile Hammers: Lower pile hammers to bottom of leads while pile driver is being moved.

l. Pile Extractor: If piling cannot be pulled without exceeding the load rating of equipment, use a pile extractor.

m. Load Indicator: Use a load indicator on the hoisting equipment when extracting piling with lattice boom type setups.

n. Fall Protection: Personnel engaging in stabbing activities shall use fall protection (safety harness with attached lanyard).The use of fall protection safety belts is prohibited at SSC. **A full body harness with safety lanyard and shock absorber shall be used in lieu of safety belts on all elevated work associated with pile driving.**

o. Tag Lines: Use tag lines during sheet piling hoisting operations to control piling movement.

p. Number of Stabbed Sheet Piles: Limit the number of stabbed sheet piles within any run to an amount that will remain stable until driving.

q. Heavy Clothing: In addition to head protection, eye protection, and foot protection, personnel engaged in stabbing piles shall wear heavy shoes, heavy long sleeve shirts, and heavy jeans or pants.

r. Equipment Requirements: Pile driving equipment and cranes used for handling of such shall also comply with the requirements of 29 CFR 1926.603 and 29 CFR 1926 Subpart N respectively.

s. Cutting Off of Piles: Do not perform work involving the cutting off of piles or other work within a radius of twice the length of the pile being driven.

t. Moving-Parts Guarding: Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains, or other reciprocating, rotating, or other moving parts or equipment guarded if such parts are exposed to contact by employees, or otherwise create a hazard. Guarding shall meet the requirements of the American National Standards Institute B 15.1-1958 Rev., Safety Code for Mechanical Power Transmission Apparatus.

u. Hooking Up Piles: An employee engaged in hooking up piles should be the only individual allowed in the immediate area of the pile driving operation.

v. Securing the Piling from Movement: Secure all piling from rolling by chocking the stack. No employee shall climb on a stack of piles where the movement within the stack is possible.

w. Checking for Defects: Examine piles for defects and cracks which could cause the pile to fail at any time during lifting or driving. These should be marked and removed safely from stock.

x. Manhandling Piles: Employees shall refrain from manhandling piles.

y. Rigging Selection: Rigging selection should be appropriate for the type and known weight of the piles.

z. Employee Positioning: Employees shall not place themselves between the leads and the pile or the leads and the crane.

aa. Noise Protection: Personnel operating and working in the vicinity of pile driving equipment shall wear noise protection.

7.5 Safety in Concrete and Masonry Construction

This procedure provides the general safety requirements for the building of concrete and masonry structures/facilities at Stennis Space Center.

7.5.1 General Requirements

a. Design/Analysis/Authorization: Introduction of loads onto "green" or partially cured concrete structures is prohibited without specific design analysis and authorization from the NASA CO or the COTR.

b. Working Under Loads: No employee shall be permitted to place or tie reinforcing steel more than ten feet above any adjacent working surface unless the employee is protected by the use of a safety harness or equivalent fall protection.

c. Reinforcing Steel
   1) Securely tie together bundles of reinforcing steel moved by crane to prevent slipping. Handle steel bundles more than 20 feet in length with two properly spaced slings. Tag lines must be used.
   2) All vertical assemblies of rebar, such as columns and piers must be guyed to prevent collapse.
   3) Do not use reinforcing steel for scaffolding hooks or stirrups, or for any load bearing hook or device in any application.
   4) All exposed vertical ends of reinforcing steel will be protected with an approved end cap.

7.5.2 Specific Requirements for Concrete Finishing Equipment

a. Power Concrete Trowels
   1) Do not modify the "dead man" switch in any way, and test it before each use.
   2) Do not refuel gasoline powered trowels while the engine is running.

b. Concrete Saws, Abrasive Saws and other Powered Equipment
   1) Equip all tools all guards as provided by the manufacturer.
   2) Use only appropriate blades, disc and other consumable parts designed and "RATED" for the tool, saw or equipment.
   3) Do not use saws, drills, abrasive saws and other tools for purposes other than for which they were designed and only use within the manufacturer's limitations.

7.5.3 Specific Requirements for Cast-in-place Concrete

Where the potential for a form to fall exists, make provisions to:
a. Suspend the form and support it prior to stripping.
b. Provide a safe area below, free of hazards and barricaded to prevent entry.
c. Employ enough manual labor to help assure that the form cannot fall.

7.6 Diving/Underwater Work

This procedure outlines the general requirements for performing diving operations related to construction/maintenance activities at SSC.

7.6.1 General Requirements

The contractor performing diving operations shall form a Diving Control Safety Board with the majority of the members being active, certified divers and which contains at least on member from the NASA/SSC Office of Safety and Mission Assurance.

7.6.2 Specific Requirements

Diving safety requirements based on water depth and type of work to be performed are provided in Tables 8 and 9 below.

Table 6. Dives Less than 33 Feet in Depth

Type and Depth	No. Divers	Diving Stand-by Supervisor	Tender	Total
Scuba-under 12 ft., clear water allows observation of diver at work at all times from surface	1(c)	1(b)	(a)	2
Scuba-under 12 ft., limited visibility	1	1(b)	(a)	2
Scuba-over 12 ft. and less than 33 ft.	1	1(b)	1	3
Scuba-"Buddy" diver safety system-under 12 ft.	2(c)	1(b)	(a)	3
Scuba-"Buddy" diver safety system-12ft. to 33 ft.	2	1(b)	1	4
Surface Supplied divers	1	(1b)(d) 1(e)	1	4

NOTES:

a. One of the qualified divers on the crew shall also be qualified as Diving Supervisory and shall assume the duties and responsibilities of that position.
b. The stand-by diver may alternate with the working diver(s) in any 24-hour period.
c. Divers may dive without a tending line.
d. The stand-by diver will not be required if two or more submerged divers are receiving air and are tended from the same surface platform or barge, are in direct communication with each other or the same central station, and each diver has sufficient length of air supply hose to reach the other in the event of an emergency. Each member of this group of divers will be considered an effective stand-by diver for the other members.
e. The Diving Supervisor, in an emergency situation, will act as a tender when the stand-by diver has to dive.

Table 7. Dives Over 33 Feet in Depth

Type	Repetitive Dives or Decompression Involved	No. Divers	Standby	Diving Supervisor	Tender	Time-Keeper	Total
Surface -	No	1	1(a)	1(c)	1		4
Supplied Air	Yes	1	1(a)	1(c)	1	1	5
"Buddy - pair"	No	2	1(a)(b)	1	1		5
Scuba	Yes	2	1(a)	1	1	1	6

NOTES:
a. The designated stand-by diver shall not dive during any 24-hour period except in emergencies.
b. The stand-by diver may perform time-keeping duties as necessary.
c. The Diving Supervisor, in an emergency situation, will act as a tender when the stand-by diver has to dive.

7.7 Building Modifications within Occupied Facilities

This procedure outlines the general requirements for conducting building modifications within facilities occupied by employees/visitors.

7.7.1 General Requirements

Construction activities related to building modifications will conform to OSHA requirements and SSC safety requirements outlined in the various procedures of this handbook and OSHA regulations.

7.7.2 Specific Requirements

a. Storage of Materials and Life Safety
   1) Materials will not be stored in a way which obstructs any way of exit travel from any point in a building or structure to a public way.
   2) No exit door shall be locked.
   3) No exit enclosure (enclosed stairway be used for any purpose that would interfere with its use as an exit (such as for storage purposes).
   4) No fire rated doors (e.g. stairway enclosure doors) shall be left open and unattended where smoke or fire could pass through unchecked.
   5) A sufficient width will be maintained for all corridors and other means of egress that will accommodate the occupant load of the currently occupied portions of the

building/facility. (Under no circumstances will obstructions create a means of egress width of less than 44 inches).

a) All saved or stored material shall be stored on only one side of the corridor and without protrusions from the stored materials.
b) Gypboard, piping, and other bulk materials that may shift or slide during storage shall be stored in a rack (preferably in the vertical position for wood sheets).
c) All stacked materials and equipment in storage shall be stable.

6) In the event that office or building contents are too bulky or present hazardous protrusions for temporary storage in corridors, then a suitable storage location shall be used for the storage. (A suitable alternate storage location shall be provided for all long-term renovations.)

b. Housekeeping

1) Protruding nails from scrap lumber shall be immediately removed from the lumber or bent over to reduce puncture hazards.
2) All debris shall be kept cleared from work areas, passageways, and stairs.
3) Combustible scrap and debris shall be removed at regular intervals during the course of construction (generally daily).
4) Containers shall be provided for the collection and separation of waste, trash, oily and used rags, and other refuse.
   a) Covered metal containers shall be provided for garbage and other oily, flammable, or hazardous wastes.
   b) Containers shall be emptied daily.
5) Areas adjacent to the modification/construction area will be properly protected from hazardous activities or processes.
   a) This will include as a minimum the erection of plastic sheets (from the floor to the bottom of the ceiling or floor above) where dust or debris must be minimally contained.
   b) If considerable dust and/or debris may be encountered or if high noise levels will cause disturbances to adjoining area, then a solid wall shall be erected (from the floor to the bottom of the ceiling or floor above).
   c) Where dust or debris is tracked into hallways outside of the barrier, the area will be vacuumed daily to prevent the spreading into occupied areas.

c. Signs and Barricades. Appropriate warning signs and barricades will be posted to prevent unauthorized entry to the modification/construction area. If the modification/construction area may be required to be traversed in cases of emergency, appropriate signs will be hung denoting the exit access as to "use only for emergency exit."

d. Flammable and Combustible Liquids.

1) No flammable or combustible liquids will be stored in the facility overnight unless an approved flammable storage cabinet is provided.

2) Flammable liquids stored outside must be stored in approved containers in a secure location.

e. Ventilation
   1) The MSDS for adhesives, paints, and other fume producing liquids or pastes will be submitted to the FOSS Environmental Health Office to assure safety of personnel in occupied parts of the building to be modified.
   2) Adhesives, paints, and other fume producing liquids or pastes will be vented outside of the building by forced air ventilation. (Natural ventilation may be adequate in some cases.)
   3) Ventilation ducts will be isolated from the occupied section of the building to preclude dusts and fumes from entering occupied spaces.

f. Electrical
   1) Loose electrical switches and wiring will be tied or fixed in such a way that personnel will not come in contact with them.
   2) Electrical circuits will be locked and/or tagged in accordance with SPR 8715.1 and this document on Procedure of Lockout/Tagout of Energy, at the controlling panel while electrical work is being performed.
   3) Extension cords shall not be laid across hallway/corridor as to pose a tripping hazard to employees occupying the facility.
   4) Temporary construction wiring shall conform to Subpart K of OSHA (29 CFR 1926) and the National Electrical Codes.
   5) Electrical extension cords will not be run from inside of buildings to outside workplaces without the installation of a GFCI breaker installed at the receptacle location. Extension cords run outside will be protected from damage.

7.8 Steel Erection

The purpose of this procedure is to provide the general safety requirements for the erection of steel structures at SSC.

7.8.1 Responsibilities

a. SSC Agencies/Organizations: SSC agencies/organizations and their respective contractors are responsible for complying with this procedure and the requirements listed in the "Basic Authority Requirements" above.

b. Supervisors: Supervisors of SSC agencies/organizations and their respective contractors are responsible for assuring employees are informed of potential hazards. Supervisors are also responsible for assuring employees wear PPE as in compliance with the applicable procedures of SPR 8715.1, *SSC Safety and Health Manual*, their organizations' Safety/Environmental Procedures, and the "Basic Authority Requirements" above.

c. Employees: Employees are responsible for abiding by respective safety standards/procedures on steel erection and for wearing PPE as required.

7.8.2 Requirements

Hard hats will be worn during all indoor construction activities.

a. Fall Protection: Use fall protection on all steel erection activities in accordance with the above "Basic Authority Requirements" and SPR 8715.1.

b. Securing Ladders: Securely lash all ladders used during steel erection operations to preclude slippage.

c. Full Body Harness: Use full body safety harnesses with appropriate fall protection systems in lieu of safety belts for all steel erection activities at SSC. Safety belts are not authorized for use at SSC.

d. Open Web Steel Joists: Do not place open web steel joists on any structural steel framework unless the framework is safely bolted or welded.

e. Hauling Tools and Other Hand-Held Equipment: Do not carry bolts, connectors, welding rods, tools and other hand held equipment up ladders or walkways. Haul all material in secure containers. The use of five gallon buckets is permissible but the wire bail must be removed and a substantial support installed.

f. Throwing Tools Prohibited: No employee shall engage in the practice of throwing tools, bolts, fasteners or materials at any time for any reason.

g. Removing Trash: Remove trash, debris and materials not being used in the activity as soon as possible.

h. Securing Hoses, Leads and Cords: To eliminate the potential of causing an employee to be pulled from the structure by an unsecured supply line to a tool or equipment, secure air lines, hoses, welding leads, and other devices such as extension cords to the structure.

i. Avoiding Tripping Hazards: Route hoses, cords, leads and other supply lines in a safe manner to avoid tripping hazards and inadvertent damage or disconnection.

j. Posting Sign When Working Overhead: Wherever men are working overhead post a sign to alert employees of their presence stating: **WARNING: MEN WORKING OVERHEAD**. Install barricading or warning devices to keep employees away from areas where accidentally dropped tools and material may strike them.

k. Good Housekeeping: Maintain good housekeeping on and around the work site when steel erection is taking place.

7.9 Safety Requirements Related to Roofing Jobs at SSC

This procedure outlines the general requirements for safely performing roofing operations at SSC.

Although OSHA allows for personnel to watch over others referred to as a "Safety Monitoring System" for certain roofing activities, past history has shown this is not an effective fall protection methodology for roofing activities at SSC. Because of this, a means of fall protection as outlined in OSHA and Section 3.6 of this document, Fall Protection in Industrial & Construction Activities, shall be used to provide worker protection when working off either high or low-pitched roofs with a roof edge height greater than 6 feet from the ground level.

Operation of hot tar kettles associated with roofing activities.

a. All tar kettles or heating devices employing pressurized fuel burners shall be located at least 25 feet from any combustible structure, building, material, or equipment.

b. No material of any nature shall be stored within 10 feet of the heating kettle.

c. The immediate work area shall be free of all tripping hazards.

d. When drawing off and transporting buckets of hot liquid, when loading kettles, and when inside the kettle barricade, safety glasses, face shields, and gauntlet-type gloves with sleeves rolled down will be required for minimum protection.

e. Two 20-pound dry chemical extinguishers shall be located in the immediate vicinity of the kettle operator.

f. All gauges, valves, hoses, fittings, clamps, etc., on and from the pressure fuel chamber to the burner will be examined on a daily basis.

g. Careful control of temperature of molten tar inside kettle shall be maintained so as to prevent accidental ignition.

h. The kettle operator shall be aware of recommended temperatures of material being melted.

i. Contractors shall ensure that the kettle operator is aware of how to properly extinguish an ignited kettle.

j. Contractors shall ensure that all equipment, including buckets or carrying containers, are free of all moisture to prevent "splattering" of hot liquid.

k. Contractors shall barricade the area and post signs around the work area.

l. Contractors shall insulate pipes used to convey hot materials to upper elevations when there is any possibility of personnel contact.

m. Contractors shall ensure, when hoisting buckets of hot tar on roofs, that the area beneath the hoisting device is barricaded and that all personnel remain outside the barricade while buckets are being hoisted.

n. The kettle operator shall be present at the kettle at all times when the kettle is in operation.

o. Contractor shall verify proper placement of tar kettle with contracting officer when placing tar kettles for use near inhabited buildings. **(Placement near air intakes shall be avoided.)**

8.0 RECORDS AND FORMS OR QUALITY RECORDS AND FORMS

All records and forms are assumed to be the latest version unless otherwise indicated. Quality Records are identified in the SSC Master Records Index.

9.0 ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

9.1 Acronyms

- AABA – Ambient Air Breathing Apparatus
- ACGIH – American Conference of Governmental Industrial Hygienists
- ACLS – Advanced Cardiac Life Support
- ACM – Asbestos-Containing Materials
- AED – Automated External Defibrillator
- AHJ – Authority Having Jurisdiction
- AMO – Aircraft Management Office
- ANSI – American National Standards Institute
- ASO – Aviation Safety Officer
- ASTM – American Society for Testing and Materials
- ATC – Air Traffic Controller
- ATP – Airline Transport Pilot
- ATV – All Terrain Vehicle
- BLS – Basic Life Support
- CAP – Corrective Action Plan
- CFR – Code of Federal Regulations
- CHO – Chemical Hygiene Officer

- CM – Configuration Management
- CO – Contracting Officer
- COTR – Contracting Officer Technical Representative
- CPR – Cardio Pulmonary Resuscitation
- dBA – decibel level measured on the "A" scale
- DoD – Department of Defense
- DOP – Detailed Operating Procedure
- DOT – Department of Transportation
- EH – Environmental Health
- EMI – Engineering Modification Instruction
- EMS – Emergency Medical Services
- EMT – Emergency Medical Technicians
- ESD – Electrostatic Discharge of Energy
- EWR – Engineering Work Requests
- FAA – Federal Aviation Administration
- FARs – Federal Aviation Regulations
- FCPF – Fluid Component Processing Facility
- FOS – Facility Operating Services
- FOSC – Facility Operating Services Contractor
- FRB – Facilities Review Board
- FRI – Facility Risk Indicators
- FRR – Flight Readiness Review
- GH_2 – Gaseous Hydrogen
- GMAL – Gas Material Analysis Lab
- GN_2 – Gaseous Nitrogen
- GSA – General Services Administration
- H_2 – Hydrogen
- H_2O_2 – hydrogen peroxide
- HAZMAT – Hazardous Materials
- HAZWOPER – Hazardous Waste Operations and Emergency Response
- He - helium
- HRI – Hazard Risk Index
- HRPS – Hazard Reduction Precedence Sequence
- HZM – Hazardous Material
- IH – Industrial Hygiene
- IP – In Process
- LDE – Lifting Devices and Equipment
- LDEM – LDE Manager
- LEL – Lower Explosive Limit
- LH_2 – liquid hydrogen
- LHe – liquid helium
- LN_2 – liquid nitrogen
- LO – lockout

- LOX – liquid oxygen
- MAWP – Maximum Allowable Working Pressure
- mph – miles per hour
- MR – Material Request
- MS&CL – Measurements, Standards and Calibration Lab
- MSDs – Musculoskeletal Disorder
- MSDS – Material Safety Data Sheet
- NASA – National Aeronautics and Space Administration
- NDE – Non-Destructive Examination
- NFPA – National Fire Protection Association
- NIOSH – The National Institute for Occupational Safety and Health
- NPR – NASA Procedural Requirement
- NR – No Response
- NSTC – NASA Safety Training Center
- O_2 – oxygen
- OEM – Original Equipment Manufacturer
- OHS – Occupational Health Services
- OI – Operating Instruction
- ORA – Operational Readiness Assessment
- ORAB – Operational Readiness Assessment Board
- ORI – Operational Readiness Inspection
- OSHA – Occupational Safety and Health Administration
- PEL – Permissible Exposure Limit
- PPE – Personnel Protective Equipment
- psia - pounds per square inch absolute
- psig – pounds per square inch gauge
- PSM – Process Safety Management
- QC – Quality Control
- QD – Quality Distance
- RAC – Risk Assessment Code
- RAD – Risk Assessment Document
- ROPS – Rollover Protective Structures
- RPPAs – Respiratory Protection Program Administrators
- RPV – Remotely Piloted Vehicles
- RSC – Radiation Safety Coordinator
- RSO – Radiation Safety Officer
- S&MA – Safety and Mission Assurance
- SATERN – System for Administration, Training, and Educational Resources for NASA
- SCBA – Self Contained Breathing Apparatus
- SCWI – Stennis Common Work Instruction
- SPR – Stennis Procedural Requirements
- SRT – Safety Review Team

- SSC – John C. Stennis Space Center
- SSCRA – Stennis Space Center Recreation Association
- SSCRC – Stennis Space Center Recreation Center
- SSTD – Stennis Space Center Standard
- STD – Standard
- SWR – Stennis Work Request
- TCRS – Training Certification Record System
- TEAL – Triethylaluminum
- TLV – Threshold Limit Valve
- TO – tagout
- TPS – Test Preparation Sheet
- TWA – Time Weighted Average
- UV – Ultraviolet
- VFR – Visual Flight Rules

9.2 Definitions

Authorized Employee – A person who must, in accordance with the provided guidelines, lock and tag out machines or equipment to service or maintain the machine or equipment.

Affected Employee – An employee whose job requires operation or use of a machine or piece of equipment of which may be serviced or maintained under the LO/TO program or whose job may require work in an area in which LO/TO may be implemented.

Capable of Being Locked Out – An energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed or has a locking mechanism built into it. Other energy isolating devices are capable of being locked out if lockout can be achieved with the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

"Critical" Lifts - Refer to any lifting operation/device or equipment used to handle flight hardware or unique, one-of-a-kind NASA articles or major facility components whose loss would have serious programmatic impact. Critical lifts also includes the lifting of personnel with a crane or derrick, lifts of 75% of the capacity of a crane in its current configuration, and lifts utilizing multiple lifting devices. Additionally, for programmatic lifts at Stennis Space Center, the respective Program Manager will classify lifts involving program hardware as "Critical" or "Non-Critical". Program lifting operations identified as "Non-Critical" may be reclassified as "Critical" by the SSC Lifting Devices and Equipment (LDE) Manager or the SSC NASA Safety and Mission Assurance Office if the lift involves hazards that are not program specific but reflect safety or facility concerns beyond normal lifting operations.

Critical Person - Any person who makes real-time decisions or performs real-time actions that could directly affect personnel safety and/or operational mission accomplishment.

DANGER Tag - A tag used to provide an immediate alert of a hazardous or unsafe condition or process that might result in personnel injury or property damage in the event a component, system, or process is activated or utilized prior to corrective action being accomplished.

Detailed Operating Procedure (DOP) - The step-by-step procedure for performing tasks associated with research and development activities/experiments or propulsion test activities.

Electric Shock - Occurs when the human body becomes part of a path through which electrons flow either directly or indirectly.

Energy Isolation Device – Mechanical devices such as locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, and other hardware that safely isolates, secures, or blocks the

equipment/systems from their energy sources and physically prevents the transmission or release of energy.

Energy Source – Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Entry Permit – An *SSC Confined Space Entry Permit* (SSC Form 576), that allows a controlled entry into a confined space that contains or has the potential to contain hazards.

Ergonomics – The science of fitting the job to the worker.

Ergonomic Disorders - Disorders which can originally manifest as strains and sprains and can be an indication that the capacity of the body to accommodate stress has been exceeded. Acute muscle strain disorders occur when a concentrated episode has overstressed the musculoskeletal system. Chronic strains are disorders which result from less intense stresses that accumulate over a period of time, thus reducing the rate of recovery. (Also known as Musculo-Skeletal Disorders or MSDs.)

Exclusive Control (as applied to LO/TO) – When the employee has physical possession of a plug, or the plug is within arm's reach and in line of sight, or when a LO/TO device has been affixed to the plug.

NOTE: Exclusive control only applies to cord and plug connected equipment. OSHA does not consider a switch, breaker, valve, etc., turned "off" in the area where the work is actually being performed as being under the employee's exclusive control.

Hazardous Operations - Operations involving materials or equipment that have a high potential to result in loss of life, serious injury to personnel, or damage to systems, equipment, or facilities (e.g, laboratory operations, high-pressure gas operations in excess of 150 psig, low-pressure high volume gas operations, voltages above 550 volts, storage and handling of liquid or solid propellants, storage and handling of explosives, use of "heavy lift" material handling equipment associated with critical lifts, extreme temperature environments, environments with less than 19.5 percent or more than 25 percent oxygen by volume at normal atmospheric temperature and pressure, confined space entries, lockout/tagout operations associated with pressure systems, electrical systems, or mechanical systems). A potentially dangerous process or series of acts involving hazardous materials or chemicals, technology, or systems with potential hazards to life, the environment or property.

Hazardous Operational Certification - A process that both documents and demonstrates the employee's capability to safely perform unique skills and/or specialized work associated with hazardous operations.

Hot Work Permit - NASA/SSC written authorization (*Hot Work Permit*, SSC Form 68), to perform operations that requires flame producing equipment. This form is only issued by the SSC Fire Department.

Laboratory - A laboratory is a facility where the "laboratory" use of hazardous chemicals occurs.

Lightning Protection System - Lightning protection system refers to a complete system of air terminals, conductors, ground terminals, interconnecting conductors, arresters, and other connectors or fittings required to complete the system.

Lockout Device – A device that utilized a positive means, such as a key or combination lock, to hold an energy-isolating device in the safe position and prevent the energizing of equipment or a machine. Included are blank flanges and bolted slip blinds.

Lockout/Tagout - The placement of a LO device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the LO device is removed.

"Non-Critical" Lifts - All standard lifting operations that cannot be classified as "Critical."

Non-Service Maintenance Hazardous Energy Isolation – A documented process by which hazardous energy sources shall be locked and tagged when equipment/systems are not undergoing any form of maintenance or service activity, but could still expose employees to hazardous conditions created by an unexpected energy release.

Off-site Contractor - A contractor hired to perform temporary work at SSC (e.g., a construction contractor, a field radiography service, etc.).

Operating Procedure - A detailed step-by-step procedure listing the functions, work tasks, safety precautions, tools and materials by which a person or team will perform a work or test activity. A good procedure assures that work is accomplished in a safe and efficient manner.

PBI and PTE - Flame retardant fabric used in PPE.

Process Skill Certification - A process that both documents and demonstrates the specific training required to demonstrate proficiency in a skill associated with the quality of an end product or task.

Pyrophoric - Used to describe the action of spontaneously igniting in air.

Radiation Safety Coordinator (RSC) - The NASA manager of the radiation safety program for Stennis Space Center.

Radiation Safety Officer (RSO) - One who has the knowledge and responsibility to apply appropriate radiation protection regulations. Contractors and tenant agencies are required to have a RSO if they have licensable radiation sources or use licensable sources at their facilities or in their operations/activities located within the confines of SSC.

Responsible Organization - Those accountable for the specific duties that are performed to produce a desired result or effect. (NASA Directorates, Prime contractors)

Safety Critical - Safety Critical includes any operation, process or procedure involving materials, equipment or tasks which have a high potential to result in loss of life, serious injury to personnel, and/or damage to systems, equipment, or facilities. These include but are not limited to, laboratory operations; high-pressure gas operations in excess of 150 psig; low-pressure high volume gas operations; voltages above 550 volts; storage and handling of liquid or solid propellants; storage and handling of explosives; use of "heavy lift" material handling equipment; extreme temperature environments; oxygen-deficient or -enriched environments; confined space entries; and lockout/tagout operations associated with pressure systems, electrical systems, or mechanical systems.

Servicing/maintenance – Workplace activity such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning, or fixing jammed machines or equipment, and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Tagout (TO) – The placement of TO device on an energy-isolating device in accordance with an established procedure to indicate that the energy isolating device and equipment being controlled may not be operating until the TO device is removed.

Tagout device – A prominent warning device, such as a tag with a means of attachment, which can be securely fastened to an energy-isolating device in accordance with an established procedure to indicate that the energy-isolating device and the equipment being controlled may not be operated until the TO device is removed.

Test Preparation Sheets (TPS) - A procedural document used to authorize and describe test activation/operation and associated manufacturing tasks not covered by DOPs. TPSs are generally used by Test Operations personnel to document daily work activities of personnel associated with test programs.

Unqualified Persons - Persons not properly trained in the operations and associated hazards of a process, procedure or task. This also includes individuals who are not properly trained and certified for specific programs as required by regulatory guidance (i.e. respiratory protection use, confined space entry, asbestos abatement, etc.).

Voltage (High) – Over 550 Volts.

Work Authorizing Document (WAD) – Approved detailed documentation used to implement processes or operations.

APPENDIX A – SAFETY RULES FOR DRILL PRESSES

1. Read and understand the manufacturer's instruction manual before operating the drill press.

2. If you are not thoroughly familiar with the operation of drill presses, obtain advice from your supervisor or other qualified person.

3. Make sure to follow wiring codes and recommended electrical connections and the machine is properly grounded.

4. Do not operate while under the influence of drugs, alcohol or medication.

5. Always wear eye protection (safety glasses or a face shield).

6. Do not wear gloves, a tie or loose clothing. REMOVE rings, watch and other jewelry, and roll up sleeves.

7. Long hair should be placed under a ball cap or hair net to prevent entanglement with the rotating shaft of the drill press.

8. Guards should be in place and used at all times.

9. Clamp work to table if it is too short to contact the column. HOLD the material securely with a vise or clamp.

10. Clamp work when using hole saw or cutting tools larger than 1/2" diameter.

11. Do not exceed recommended speed for the drill, accessory, and work piece.

12. Be sure that the chuck key is removed from the chuck before starting the drill press.

13. Make all adjustments with the power off.

14. Adjust the table or depth stop to avoid drilling into the table.

15. Be sure the drill bit or cutting tool is securely locked in the chuck.

16. Disconnect drill from the power source when making repairs. (Use appropriate LOCKOUT/TAGOUT procedures).

17. Shut off the power, remove the drill bit or cutting tool, and clean the table before leaving the machine.

APPENDIX B – REQUIREMENT FOR OFFSITE CONTRACTOR LOCKOUT/TAGOUT (LO/TO)

When requested SSC work is performed by offsite contractors and the work requires use of LO/TO procedures for worker protection, special responsibilities shall be assumed by both the requesting organization and the offsite contractor(s) in accordance with the following requirements:

1. The requesting SSC organization shall provide the offsite contractor with a current copy of SSP 8715-0001, "Lockout/Tagout Program."

2. The requesting SSC organization shall ensure the offsite contractor provides a copy of their Safety and Health Plan to the Industrial Safety Department (ISD) to the monitoring safety office prior to starting any work to ensure all potential LO/TO conflicts are resolved before the commencement of work.

3. The requesting SSC organization shall ensure the offsite contractor provides a request for SSC LO/TO training to the FOSC prior to starting any work.

4. The offsite contractor and the requesting SSC organization shall fully understand that **NO** work can begin until the offsite contractor's Safety and Health Plan is approved.

5. The offsite contractor shall fully understand that special or additional LO/TO procedures can be required when working at SSC, above and beyond those described in their own Energy Control Program.

6. The requesting SSC organization and offsite contractor shall fully understand and comply with all the SSC LO/TO program requirements. Contact responsible organization's safety office if additional information is needed.

7. The offsite contractor shall fully understand that a supervisor/foreman who is familiar with the SSC LO/TO program shall be onsite at all times while any LO/TO activities are being performed.

8. The requesting SSC organization shall ensure that all affected and other employees working in the area where the offsite contractor is performing LO/TO activities are informed of this work.

9. The requesting SSC organization and offsite contractor shall ensure any LO/TO activities performed by more than one crew or contractor are coordinated, and a group LO/TO procedure is initiated in accordance with Section 3.10.1(a)(7)(f).

10. If the requesting SSC organization does not have an authorized employee to lockout the equipment/system during service by the offsite contractor, the organization shall coordinate this support service through the FOSC, as necessary.

11. The requesting SSC organization shall monitor the offsite contractor to ensure compliance with all the SSC LO/TO program requirements and that they identify and report any potential problems to the NASA Safety Office.

12. The requesting SSC organization shall ensure removal of all offsite contractor LO/TO devices occurs at job completion and before the contractor leaves the center.

APPENDIX C – RECREATIONAL FACILITIES

ATTACHMENT 1

RULES/GUIDELINES FOR USING THE RECREATIONAL AREAS AT STENNIS SPACE CENTER

1.0 Recreational Areas

1.1 Recreation Activities

1. Swimming is prohibited in all areas other than the Wellness Center's lap pool.

2. Children are not allowed at river's edge or in the woodlands unless escorted by an adult.

3 WARNING: Alligators can be found by the river's edge.
   a) DO NOT FEED THE ALLIGATORS. Feeding alligators constitutes harassment of a protected species per Mississippi Code 49-5-101 through 49-5-119. Violators shall be fined $1,000 or be imprisoned for one year or both.

4. Adults responsible for the care of children are encouraged to supervise their children's activities on the playground equipment at the SSC Child Care Facility.

5. Volleyball is only allowed at the permanent sand volleyball courts located near the intersection of Upper Gainesville Rd. and Lower Gainesville Rd. Volleyball is not allowed at the pavilion area.

6. The game of horseshoes is only allowed at the horseshoe pit areas. The players of the game are responsible for watching for others and assuring their safety prior to throwing the shoes.

7 The game of lawn darts is prohibited at SSC.

8 Fireworks are prohibited.

9. Watch for Snakes: All visitors must recognize that the Cypress House recreational area is a rural site. Visitors should always be cognizant that poisonous snakes may be present. Employees should watch where they step and be especially careful if they are picking up or moving materials.

10. In the event of a severe thunderstorm, persons should seek shelter to avoid related hazards.

11. In the event of severe lightning activity, visitors should seek cover inside the Cypress House, under the metal covered pavilion or inside an enclosed vehicle with a metal top and body. WARNING: Persons inside a building should avoid open doors and windows. Persons under the pavilion should stay six (6) feet away from the edge of the facility, due to the metal structure of the facility. If a person is too close to the metal, he/she runs the risk of being struck by lightning traveling through the metal structure.

12. In the event of a FIRE or need of Emergency Ambulance Service or security, contact NASA Emergency response at extension 911 or at 228-688-3636 from a cell phone. Provide the Emergency Response Officer information as to location (i.e. Cypress House Recreational Area) and nature of the incident. Do not hang up the phone unless directed to by the Emergency Response Officer.

13. Persons should be cognizant children are present and be especially careful when backing their automobiles or driving through the recreational area.

1.2 Picnicking Activities

1. Bonfires/open campfires are not allowed without prior approval of NASA Safety & Mission Assurance and SSC's Fire Chief.

2. Charcoal fires: only approved charcoal lighter fluid shall be used to start a fire. Gasoline or other flammable liquids shall not be used to start a charcoal fire.

3. No alcoholic beverages shall be brought onto Stennis Space Center from offsite. All alcoholic beverages purchased through the Recreational Association's Cypress House must be consumed on the site. Only wines and beer of 10% alcohol (by volume) or less may be consumed on the premises.

4. Persons who exhibit signs of intoxication shall not be allowed to drive off the premises. Do not provoke a resistive intoxicated individual who insists on driving. Please notify security and let them handle the situation.

5. Personal/Private Liquid Propane (LP) Gas Cookers and LP Tanks
    a) LP gas bottles shall have a regulator and fuel hose that matches the designed pressure and intended use. The 20-pound LP gas regulator shall control the pressure to less than 1 psig.
    b) LP bottles having both vapor phase and gas phase connections are prohibited.
    c) LP bottles shall have only approved connections and fuel hose.
    d) Cooking containers will be of single wall construction. Lids to containers must be designed so that they cannot be locked in a closed position.
    e) Must have a means of spreading flame or heat over a large area of the cooking vessels.

f) LP gas tanks shall have valve shields.
g) LP gas tanks must be in good condition with manufacturer's data tag or Department of Transportation data stamped on valve shield and clearly legible.
h) LP gas bottles shall not be cross-connected to fill a smaller bottle from a larger bottle.

2.0 Volleyball Courts

Prior to play, the sand courts should be inspected for glass bottles or cans that could pose a hazard to those playing the game.

3.0 Softball Fields

1. Prior to play, the fields should be inspected for glass bottles, rocks, or cans that could pose a hazard to those playing the game.

2. Softball is the only form of ball game allowed at the SSC softball fields. (T-ball with a soft-rag ball is an acceptable form of the game for children.)

3. The wearing of steel spikes by players of the game is prohibited.

4. Bases shall be of the type that will move in circular motion within a specified area and shall not present a solid immovable object that will cause injury to the lower extremities when a player slides against it.

5. A general release and hold harmless statement must be signed by participants of softball games sponsored by the SSC Recreation Association.

4.0 Gun and Archery Club

1 This section or chapter of the SSC Recreation Association is controlled by an elected group. Personnel desiring membership must apply, pay dues, and read and sign a set of safety and range rules prior to participation in any shooting sport. In addition, the persons must attend a safety orientation.

2. A general release and hold harmless statement must be signed by members of the SSC Gun and Archery Club or participants of organized events sponsored by the Gun and Archery Club. An example of this statement follows.

GENERAL AGREEMENT BETWEEN SSC AND PLANNER/ORGANIZER

As the planner/organizer of _____ (activity) on _____ (date), I have read the rules/guidelines for using the recreational facilities at SSC. I agree my group/organization will abide by these requirements and I understand failure to comply with such can result in immediate termination of the activity by the Recreation Association. I have further signed the attached "General Release and Hold Harmless Agreement" on behalf of my organization and participants.

_____
Printed Name/Organization

_____
Signature/Date

GENERAL RELEASE AND HOLD HARMLESS AGREEMENT

KNOW all men by these presents that I, _____, for the consideration of my participating in_____, one of the athletic activities offered by the John C. Stennis Space Center Recreation Association (SSCRA) do hereby release and discharge, and do hereby hold harmless, and by these presents for myself, my heirs, executors, administrators, and assigns, release and forever discharge said SSCRA and the National Aeronautics and Space Administration (NASA) from any and all claims, demands, damages, actions, causes of action, or suits at law or in equity, of whatsoever kind of nature, for or because of any matter or thing done or to be done, omitted or suffered to be done by the said SSCRA and NASA as a result of my participating in the athletic activities offered by the SSCRA. It is understood that this release shall be a complete bar to all claims or suits for injuries or damages of whatsoever nature resulting or to result from the use of the facilities at SSC.

In witness whereof, I have hereunto set my hand on this the

____ day of _____, 20__.

_____
Signature

In the presence of:

_____

_____

WITNESSES

ATTACHMENT 2

GENERAL RANGE SAFETY RULES

1. General Safety Rules
    a) All firearms and bows must be checked-in with the security guard when you enter this reservation.
    b) The range flag will be raised before any firing begins.
    c) Strongly recommend that you never shoot alone.
    d) For all informal shooting, one person will assume range officer duties to supervise all activity.
    e) Guests and dependents are the responsibility of the sponsoring member, who will instruct them in all safety rules and supervise activity.
    f) Range cleanliness is YOUR job!
    g) Shooting glasses will be worn by all shooters.
    h) Safety glasses will be worn by all members participating in construction/maintenance activities at the range.
    i) No alcoholic beverages or illegal drugs shall be permitted upon SSC premises, nor shall any person, member or guest, under the slightest influence of such a beverage or drug, be permitted to enter or remain upon the premises.
    j) Improper handling of a firearm or bow and arrow will not be tolerated and can be cause for termination of membership.
    k) Posted safety rules for use of reloading equipment shall be followed.

2. Safety Rules on Rifle and Pistol Ranges
    a) Treat every firearm as if it is loaded. A loaded firearm is defined as one which contains a cartridge, live or spent, in any part of it; or a muzzleloader which is capped or primed.
    b) When not being fired, firearms will be unloaded, action opened, and properly carried, racked, or holstered.
    c) No firearm will be loaded or pointed downrange until that area forward of the firing line has been cleared of all personnel.
    d) Loading and firing will be done only at the firing line on the command of the range captain. Muzzleloaders may be loaded, but not primed, at the loading benches behind the firing line.
    e) Fire only at designated targets placed downrange on a proper target holder.
    f) No individual will shoot at the metal gongs on the rifle range at a distance closer than 100 feet.

3. Safety Rules on Skeet Range
    a) Guns will remain unloaded with the breech open at all times when not on a shooting station. Range participants will not rely on safety mechanisms.

b) No gun will be loaded until the shooter is on the shooting station. Loading is defined as putting a shell into ANY PART of the gun.
c) The loaded gun must be kept pointed downrange of the trap houses at all times.
d) Loading of more than two shells is prohibited at all times.
e) Two shells may be loaded for singles except on station #8.
f) Fire only at authorized skeet targets.
g) Only squad members, scorer, and referee are allowed forward of station #4 during the round. Spectators must remain behind station #4.
h) No personnel are allowed forward of station #8.
i) No shot size larger than 7-1/2 may be used.
j) Empty hulls will not be picked up during the round.
k) Upon completion of all shooting, the traps will be secured, power turned off, control cord stowed, all hulls picked up, and all debris placed in trash receptacle.

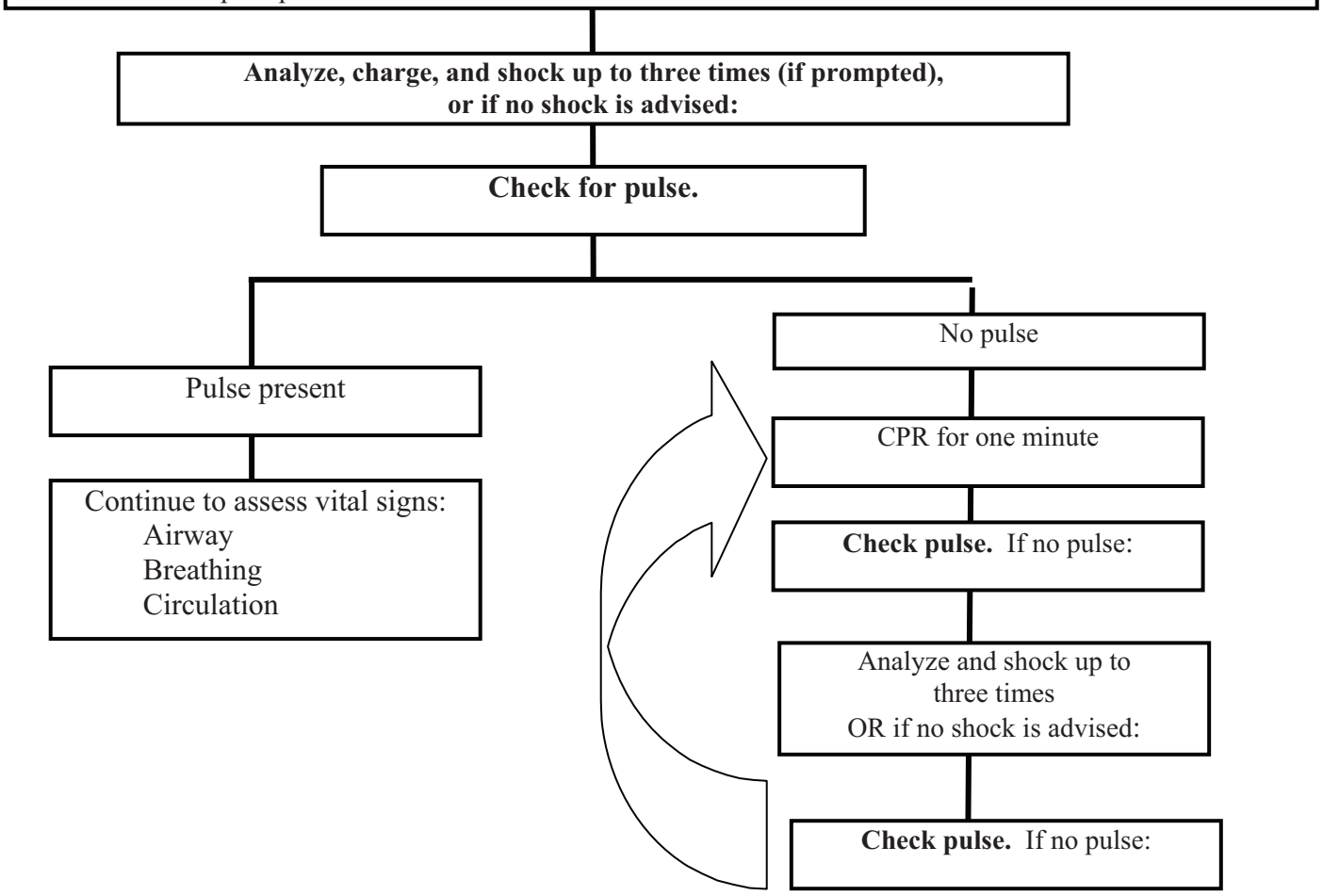
4. Safety Rules on Archery Range
   a) Crossbows will comply with all archery and firearms safety rules.
   b) No bow will be drawn or pointed downrange until that area forward of the firing line has been cleared of all personnel.
   c) When not being shot arrows shall be unnocked.
   d) No bow shall be shot or pointed in any direction other than at designated targets.
   e) Archers will stand within five feet of the shooting line.
   f) Paper target faces shall be used.
   g) Hunting arrows with cutting edges on their heads shall be shot at foam rubber targets.

Keep These for Your Use - Do NOT Return with Application

APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 1 AED Protocol

* Determine if the victim is **unconscious, pulseless,** and **not breathing. At Stennis Space Center, call x 911 from an SSC extension or 228-688-3636 from a cell phone.**
* Ensure the patient is 8 years old or older.
* Turn on the AED and have someone **perform CPR** until electrodes are attached.
* Stop CPR and press the ANALYZE button.
* Follow the voice prompts.



APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 2

AED POST UTILIZATION CHECKLIST

Utilization date: _____ **Initials**

1. AED Program Director notified _____
   (Verbally as soon as possible)

2. FR 2 and connector socket _____
   Clean, no contamination

3. FR 2 and connector socket _____
   Intact, no damage

4. Status indicator _____
   Black hourglass flashing

5. Self-test passed _____

6. Used data card removed _____
   Sent to Program Director

7. New Data Card inserted _____
   (Must be inserted prior to turning machine on)

8. Replenish supplies _____
   Accessories, spares:
   - 3 sets of chest pads with attached cables
   - 2 pocket face masks
   - 2 pair disposable gloves
   - 2 safety razors
   - 1 absorbent towel
   - 5 – 4 x 4 gauze
   - 1 extra AED battery

9. Response form completed and sent to Program Director _____

Note: Remarks, problems, corrective actions.

_____

_____

***Note: Continue on reverse side if necessary.*

APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 3

AED RESPONSE SUMMARY REPORT

Date of Response _____ Time of first call _____A.M./P.M.

Unit Responding

☐ Fitness Center
☐ FIRE DEPT./EMT
☐ PAD Building_____Floor ____

AED Team members responding:

Name	Time of arrival

AED unit arrived on scene at:_____A.M./P.M.
AED unit attached and functional at:_____ A.M./P.M.

Summary of incident, (include description of patient condition, vital signs, status, CPR, changes in patient condition and action of team etc.)

_____

_____

_____

_____

_____

_____

☐ AED Data Card removed and sent to Program Director
☐ New Data Card inserted

APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 4
AUTOMATED EXTERNAL DEFIBRILLATOR (AED) PROGRAM MONTHLY CHECK LIST

Monthly Check List	**Year:** _____											
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Check supplies, accessories and spares for damage and expiration												
Replace anything due to expire in coming month. Item(s)												
Check presence of Data Card												
Wipe FR2 and connector socket, using only soft cloth dampened with Isopropyl Alcohol												

Date: _____ Initials _____

Date: _____ Initials _____

APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 5

CHECKLIST FOR AED REQUIRED ACCESSORIES

- ☐ 3 sets defibrillation electrode pads
- ☐ 2 pocket facemasks
- ☐ 1 extra battery
- ☐ 2 prep razors
- ☐ 1 scissor
- ☐ 10 alcohol wipes
- ☐ 5 sterile gauze pads, 4" x 4", individually wrapped
- ☐ 1 absorbent cloth towel
- ☐ 2 pairs gloves
- ☐ 2 hazmat waste disposal bags

APPENDIX D – AED PROTOCOL AND CHECKLISTS

ATTACHMENT 6

DEFINITIONS

AED - Device used to administer an electric shock through the chest wall to the heart. It is computer controlled and provides audio and visual prompts to guide the user through the process.

AED RESPONDER - A First Responder trained in the use of the AED.

AED RESPONSE - An incident in which responders employed or should have employed an AED device.

AED USE - When an AED electrodes/pads are applied to a patient and the device is turned on, together these shall constitute "use of the AED."

CASE REVIEWS - A quality control program utilizing critical review and assessment of the response process and the performance of equipment and personnel.

VENTRICULAR FIBRILLATION - An abnormal and disorganized rate of the main pumping chamber of the heart, which is too rapid to allow effective pumping of blood.

DEFIBRILLATION - The use of electricity to shock the heart back into a more normal rate.

MEDICAL PROTOCOLS - The specific patient care protocols for the AED responder when using an AED.

AED CONTROL COMMITTEE - The committee that monitors the AED program to ensure appropriate patient care, documentation and medical control of the AED program.

APPENDIX E – CONFINED SPACE ENTRY PROGRAM REQUIREMENTS FOR CONSTRUCTION ACTIVITIES AT SSC

1.0 Purpose

The scope of this program is to provide the safety requirements for entering confined spaces at Stennis Space Center by Offsite Construction Contractors performing work on site at SSC. The purpose of the program is to ensure safe entry and work in confined spaces by these personnel.

2.0 Basic Requirement(s):

29 CFR 1910.146, *Permit-Required Confined Spaces*. This procedure will be used for all construction activities.

3.0 Additional SSC Requirement(s)

The cognizant SSC Safety and Mission Assurance Office; will issue confined space permits at SSC. All confined space entry operations are classified as SAFETY CRITICAL and must be approved by the cognizant safety representative prior to performing work in any tank, vessel, or other confined space. All confined space entries require a written procedure, a Confined Space Entry permit SSC Form 576, copies of the Material Safety Data Sheets (MSDSs) and a preliminary hazard analysis to be submitted to the cognizant safety representative as far in advance of the desired entry date as possible to allow for a thorough assessment of associated and potential hazards. Prior to performing any work involving confined space, the sub-contractor shall contact the contractor representing the Government detailing the work to be performed, who will then notify the appropriate personnel. The SSC Fire Department shall be notified at least 24 hours in advance of proposed entry. In addition, the SSC Fire Department shall be notified before entry is made, in an emergency, and upon completion of the entry. Confined spaces may include but are not limited to storage tanks, vessels, boilers, ducts, sewers, underground utility vaults, pipelines, and open top spaces over four feet in depth, such as pits, tubs, vaults, shafts, caissons, cofferdams, or any other space which may be subject to the accumulation of toxic or flammable containment's or had the potential for an oxygen-deficient atmosphere.

1. Before entry, the confined space will be isolated from all incoming lines (except breathable air), interconnecting vent lines and tie lines. This will be accomplished by blanking them off with blind flanges or by disconnecting the lines. Disconnected lines will be rolled 90% to prevent flow into adjacent pipes. Since valves may leak, simply shutting off valves will be

unsuitable unless specifically approved by the cognizant safety representative. Blind flanges will be identified with tags or by using frying-pan-handle types.

2. Bonding: The nozzle of air, inert gas and steam lines or hoses, when used in the cleaning or ventilation of tanks and vessels which may contain flammable vapors shall be bonded to the external portion of the tank or vessel shell. Bonding devices shall not be attached or detached in the presence of hazardous concentrations of flammable gases or vapors.

3. Monitoring devices: Portable and/or fixed oxygen, flammable gas, and toxic gas analyzers with visual/audible alarms shall be provided by the contractor in areas where oxygen deficient atmosphere may occur during entry. Supplementary continuous monitoring may be required in areas designated by the cognizant safety representative.

   Note: OSHA exposure standards (29 CFR 1910, Subpart Z) will be used unless the American Conference of Governmental Industrial Hygienists (ACGIH) TLVs are more restrictive, in which case ACGIH guides will be used.

4. Confined Space Temperature: Entry into a confined space where the internal temperature is less than 40ºF or greater than 120ºF must be specifically approved by the cognizant safety representative.

5. Safety Briefing: Immediately prior to a confined space entry, the responsible supervisor and cognizant safety representative shall conduct a briefing with all involved personnel on the applicable safety requirements, the chemical hazards identified in the MSDSs, and emergency actions and the identification and function of equipment to be used during the operation. No individual shall be allowed to enter or work within the confined space until this briefing has been conducted.

6 Trained and qualified personnel working in confined spaces shall be assigned in teams. At least two team members shall be designated as standby personnel for permit required space entries. All personnel assigned to confined space entry operations must be trained in confined space entry procedures prior to entering and performing work in a confined space. The records of this training will be maintained by the contractor/subcontractor. Copies of these records will be made available to the cognizant SSC safety representative upon their request.

7. Valve pit entries:All SSC designated valve pits shall be permit required confined space.

8. Prior to the confined space entry, the contractor and Rescue Service provider shall insure that essential rescue equipment will fit through the confined space entryway, and that all necessary communications media are functioning properly.

9. The SSC Fire Department will determine the requirement for a constant presence of rescue services and equipment at the confined space entry point for the duration of the task.

APPENDIX F – EXPLOSIVE SAFETY SUBMISSION/SITE PLANNING

The following provides guidance for determining when an Explosive Safety Submission/Site Plan is required and generally what is expected in the documentation package.

1. Safety approval of site plans and general construction plans must be obtained from the cognizant safety engineer and NASA/SSC Office of Safety and Mission Assurance for the following types of facilities and operations:
    a) Facilities used for handling, transporting, storing, testing, or maintaining explosives, liquid propellants, solid propellants, pyrotechnics, and ammunition.
    b) Operations that increase exposure of personnel, equipment, or resources to explosives.
    c) Operations that increase the Net Explosive Weight (NEW) of a storage or operating location.
    d) Operations that alter an explosive facility major support structures, such as beams or girders.
    e) Operations that cause a reduction in the blast or fragment suppression capability of walls, doors, etc. of an explosives location.
    f) Operations that result in permanent reduction in the effectiveness of explosion protection systems, such as explosion proof lighting, wiring, or motors, where such protection systems are required.
    g) Operations which remove any protective barricades or beams.

2. Site plans need not be submitted for approval when increased storage capacity results from changes in storage criteria and there is no effect on the established quantity distances.

3. Initial submission of site plans will be concurrent with the conceptual design review. Final safety approval can be obtained no later than the 60% design review process.

4. A site plan requirements package must contain the following basic information:
    a) Distances between the facility to be constructed/modified and other installations; the installation boundaries; underground pipelines; public traffic routes; and power transmission/utility lines. The distances may be listed in narrative form or reference may be made to the scaled drawing/facility map on which the specific distances are designated or clearly shown.
    b) Identification and brief description of the mission of all facilities within inhabited building distance of the facilities to be constructed/modified.
    c) General description of the components, items, and hazardous materials to be handled or stored in the new/modified facilities, to include explosives limits and hazard classifications.
    d) Anticipated personnel capacity of the facilities to be constructed/modified.

e) Data pertaining to walls, roofs, shields, barricades, windows, exits, floors, explosives operating equipment, fire protection systems, lightning protection and static electricity grounding systems, electrical installations, ventilation systems and equipment, hazardous waste disposal systems, auxiliary support structures, monitoring equipment, and general materials, and construction.
f) Explanation and rationale or justification for any variance from the requirements of this manual or any other NASA/SSC manual.
g) Test results and other substantiating documentation supporting in process hazard classifications.

5. All site plan requirements packages will be filed in the Central Engineering Files (CEF), after obtaining approval from the NASA/SSC Office of Safety and Mission Assurance.

6. A master drawing/map, indicating all quality distance (QD) limits for SSC will be maintained and updated by the Facilities Operating Services Contractor (FOSC).

7. It is the responsibility of the cognizant NASA/SSC project manager/director to assure that all QD limits for new or modified facilities are added to the SSC master QD drawing/map.

APPENDIX G – OUTLINE OF CONTRACTOR'S SAFETY PROGRAM PLAN

ATTACHMENT 1

OVERVIEW

1. A policy statement signed by the top manager of the company depicting his/her commitment to safety.

2. The specific objectives of the safety program.

3. The administrative responsibilities for effecting the accident prevention program (i.e. the identification and accountability of the employer's personnel responsible for accident prevention). A resume depicting the experience of the individual assigned the responsibility of safety management/oversight shall be included in the plan. Provide a key list of personnel to be contacted in time of emergency.

4. A statement depicting the contractor will not invalidate the integrity of safety systems without proper authorization.

5. The methods by which the employer intends to meet the objectives of the safety program, to include plans for:
    a) Layout of temporary construction buildings and facilities.
    b) Conducting safety training and safety meetings.
    c) Traffic control and marking of hazards to cover haul roads, intersections, railroads, utilities bridges etc.
    d) Maintaining continued job cleanup, safe access, and egress.
    e) Fire protection.
    f) Disaster and emergency preparedness to include emergency actions to be taken to secure dangerous conditions and protect personnel in the event of an accident.
    g) Inspection of the job sites by competent persons including reports to be kept.

6. Assuring compliance with 29 CFR 1910, 29 CFR 1926 and the requirements of this manual.
    a) Immediate reporting of accidents to the Contracting Officer, as well as the procedures for securing an accident scene to preserve evidence in the event of an accident or an act of nature.
    b) Fall protection program.
    c) Confined Space Entry (wherever it is necessary to perform confined space entry activities).
    d) Respiratory Protection Program (wherever it is necessary to use respiratory protective equipment).

e) Pneumatic testing of pressure systems (wherever pneumatic pressure testing is to be conducted).
f) Underwater diving (wherever diving activities are to be performed during the course of construction).

7. The plans for preventing alcohol/drug abuse on the job.

8. The contractor shall provide a detailed outline of the "Safety Orientation" that is intended for briefing of employees/subcontractor personnel to the unique safety requirements of working at SSC.

9. An activity hazard analysis section (Attachment 3 shows instructions, a typical format, and examples of an activity hazard analysis) depicting:
   a) The types of hazards present for hazardous construction activities (e.g. excavations/shoring, confined space, scaffolding, crane lifts, pile driving, radiography, etc.).
   b) The precautionary actions planned to control the hazards identified.
   c) The activity hazard analysis is also applicable to hazardous construction activities of subcontractors to the Contractor.

APPENDIX G – OUTLINE OF CONTRACTOR'S SAFETY PROGRAM PLAN

ATTACHMENT 2

SAFETY ASSURANCE

1. The following documentation shall be provided prior to the equipment being inspected/used on the job site or operations being performed.
    a) Current and valid certifications by a national board certified ASME inspector of pressure vessels or boilers used on the job site.
    b) Submittals for underwater diving operations as outlined in Section 7.6, Diving / Underwater Work.
    c) Record (data and results) of current, thorough annual inspection of hoisting/lifting machinery made by a competent person. A competent person is defined as an individual who has had sufficient classroom education on crane inspections/certification from a professionally developed training program and sufficient practical experience to assure that deficiencies are identified upon performing inspections on hoisting/lifting equipment.
    d) Material Safety Data Sheets (MSDSs) for all chemicals and hazardous materials proposed for use as SSC must be provided to the Contracting Officer for submission to SSC Office of Safety and Mission Assurance for approval PRIOR TO THE DELIVERY OF THE CHEMICAL(S) OR HAZARDOUS MATERIALS AT SSC. Prior to use of the material the Contractor must inform SSC Office of Safety and Mission Assurance as to the proposed industrial hygiene controls to be implemented when performing work with the chemicals or hazardous materials.

2. The following documentation (if applicable) shall be made available to SSC Office of Safety and Mission Assurance upon request for purposes of safety audits/reviews to assure the Contractor is maintaining an effective safety program.
    a) Contractor safety orientation for employees.
    b) Records of hazard communication training for employees.
    c) OSHA Form 300 depicting accident reporting.
    d) Records of current training in first aid/CPR. (For electrical workers and personnel involved in confined space entry and standby operations).
    e) Industrial hygiene sampling reports or noise measurements made by the Contractor.
    f) Records depicting the individuals are properly trained and medically fit for respirator use.
    g) Records or training for Confined Space Entry and standby operations.
    h) Records of weekly toolbox safety meetings for employees.
    i) Records of safety inspections to include findings and corrective actions taken.
    j) The Contractor's safety manual/handbook provided to employees.
    k) Employee qualifications/certifications.

APPENDIX G – OUTLINE OF CONTRACTOR'S SAFETY PROGRAM PLAN

ATTACHMENT 3

ACTIVITY HAZARD ANALYSIS
(Description/Examples)

INSTRUCTIONS FOR THE COMPLETION OF THE ACTIVITY HAZARD ANALYSIS

1. Contractor/subcontractor - Name of contractor or subcontractor conducting construction activities.

2. Construction Activity - General description of construction activity. Examples: Pile Driving, Pouring Foundation, Structural assembly of building, etc.

3. Facility - Description of facility end item. Examples: Equipment Storage Building, Gantry Crane, Potable Water Line, Test Stand, etc.

4. Date - Date of Activity Hazard Analysis.

5. Location - Location of construction activity. Example: Stennis Space Center (Project) Area.

6. Estimated Start Date - Estimated start date of construction activities at SSC.

7. Item - Numerical identification for each phase of work.

8. Phase of Work - Description of each phase of work associated with each individual position. Examples: Arc Welding, Electric hand tools, Acetylene & oxygen cutting, Painting, Fuel powered hand tools, Compressed Air, Excavation and backfill, etc.

9. Safety Hazard - Description of all of the hazards to which the employee or other employees in the area are exposed for each phase of work. Example: Flammability, Falls from heights, Fumes, Paint Spills, Electric shock, Defective ladders, Maintenance of the leads, etc.

10. Precautionary Action Taken - Description of the precautionary action taken to insure the identified hazard doesn't cause an accident. Examples: Store in well ventilated area free from excessive heat, sparks, open flames, or direct rays of the sun; Inspect electric cord before use and use ground fault circuit interrupter; Excavated material shall be stored and retained at least two feet from the edge of the excavation and at a distance to prevent excessive loading on the face of the excavation.

11. Contractor/Subcontractor Signature - Self Explanatory.

APPENDIX H – STENNIS SPACE CENTER (SSC) SCAFFOLD INSPECTION CHECKLIST

This checklist will be used by the competent person to verify the safe working condition of scaffolds erected by offsite contractors working at SSC under a contract to NASA or one of NASA's onsite contractors. This checklist is intended to be used for the pre-shift as well as the erectors inspection.

PROJECT: CONTRACTOR:

INSPECTOR/TITLE:

DATE: OF INSPECTION:

1926.451 GENERAL REQUIREMENTS FOR ANY SCAFFOLD	YES	NO
Has the scaffold been constructed to maintain a safety factor of 4 to 1 (a1)		
Has the scaffold been designed by a qualified person? (a6)		
Has the scaffold platform been fully planked with less than 1" between planks or between planks and uprights? (b1i)		
Are all platforms at least 18 inches wide? (b2)		
Are platforms that are less than 18 inches protected by guardrail systems or will all employees have personal fall arrest systems? (b2ii)		
Are open sides of scaffold less than 14 inches from the face of the work? (b3)		
Where open sides of scaffolds are more than 14 inches, will fall protection systems be used by all employees? (b3)		
For scaffolds that will be used for lathing and plastering is the platform less than 18 inches from the face of the work? (b3ii)		
Are all platforms of 10 feet or less extending over their end supports no more than 12 inches? (b5i)		
Where platforms of 10 feet or less extend more than 12 inches have guardrails been installed to block access to the overhang? (b5i)		
Are platforms of 10 feet or more extending over their end supports no more than 18 inches? (b5ii)		
Where platforms of 10 feet or more extend more than 18 inches have guardrails been installed to block access to the overhang? (b5i)		
Are abutted planks resting on separate support surfaces? (b6)		
Where planks are overlapped are they lapped over the supports? (b7)		
Are planks overlapped at least 12 inches, nailed together or otherwise secured? (b7)		
Are planks that rest on the bearer at other than a 90 degree angle laid first? (b8)		

Are the top and bottom surfaces of the plank visible and free from paint and other opaque finishes? (b9)		
If scaffold components of different manufacturers are used, do they fit together without force and has a competent person determined that they are safe for use? (b10)		
Has the use of dissimilar metals (if any) been evaluated by a competent person? (b11)		
The following questions are from subpart C 1926.451 (C)	**YES**	**NO**
Does the scaffold conform to the 4 to 1 base to height ratio requirement? (c1)		
Scaffolds that do not meet the 4 to 1 base to height ratio must be secured to the structure by use of ties (to include ties, guying, bracing or equivalent means) as follows:		
Has the tie been installed at a horizontal member that supports the inner and outer legs? (c1i)		
Has the first vertical tie been installed at a height less than 4 times the minimum base dimension? (c1ii)		
Have vertical ties been repeated every 20 feet or less for scaffolds that are 3 feet or less in width? (c1ii)		
Have vertical ties been repeated every 26 feet or less for scaffolds wider than 3 feet? (c1ii)		
Is the vertical distance from the top tie to the top of the scaffold less than the 4 to 1 minimum base dimension? (c1ii)		
Are ties installed at each end of the scaffold and at horizontal distances not to exceed 30 feet? (c1ii)		
Where eccentric loads are imposed have ties been installed to counteract these loads? (c1iii)		
Are scaffolds erected on adequate firm footings? (c2)		
Are footings capable of supporting 4 times the intended load without settling? (c2i)		
Is the use of unstable objects prohibited for footings? (c2ii)		
Is scaffold plumb and braced to prevent swaying or displacement? (c3)		
The following questions apply to access from 1926.451 (e)	**YES**	**NO**
Has safe access been provided for all scaffold platforms that are more than 2 feet above or below the point of access? (e1)		
Have cross braces been prohibited as a means of access? (e1)		
If used; do portable ladders (i.e. extension or free-standing) meet the specific requirements of 1926 subpart X)		
Are ladders positioned so as not to tip the scaffold? (e2i)		
Is the bottom rung less than 24 inches above the supporting surface? (e2ii)		
Are rest platforms installed every 35 feet vertically? (e2iii)		
The following applies to hook on and attachable ladders	**YES**	**NO**

Are the ladders specifically designed for use with the type of scaffold used? (e2iv)		
Do the ladders have a minimum rung length of 11 ½ inches? (e2v)		
Is the rung spacing uniform and no more than 16 ¾ inches between rungs? (e2vi)		
The following applies to ladder rungs built into the frame:	**YES**	**NO**
Integral prefabricated scaffold access frames shall conform to the following:		
Was the fram e designed and built to be used as an access ladder? (e6i)		
Are the rungs at least 8 inches in length? (e6ii)		
Are rungs uniformly spaced within each frame section? (e6iv)		
Are rest platforms provided every 35 feet? (e6v)		
Is the distance between the rungs less than 16 ¾ inches? (e6vi)		
Do rungs and steps of ladders line up vertically between the rest decks? (e7)		
Is direct access from other structures prohibited when that distance is more than 24 inches vertically or 14 inches horizontally? (e8)		
The following applies to scaffold use from 126.451 (F)	**YES**	**NO**
Are scaffolds and components loaded within their rated capacities? (f1)		
Is the use of shore or lean to scaffolds prohibited? (f2)		
Has the scaffold been inspected by a competent person as required? (f3)		
Has any damaged part of the scaffold been repaired, replaced or removed as required? (f4)		
Has the movement of occupied scaffolds been prohibited? (unless designed by a registered professional engineer) (f5)		
Do scaffolds and any conductive material handled on them observe the proper clearances from power lines? (f6) refer to distances as shown in 1925.451 (f) (6)		
Are slippery conditions removed as soon as possible? (f8)		
Are tag lines used to control loads being hoisted onto or near scaffolds? (f9)		
If storms or high winds are present has a competent person been consulted and wind screens or personal fall arrest used? (f12) Note: If winds are steady at 18 knots or gusts of 22 knots or more, no erection or work on floats, spiders, or scaffolds is allowed at SSC		
Are tools, material, and debris removed from scaffold to prevent an accumulation? (f3)		
Has the use of makeshift devices to increase the working level height been prohibited? (f14)		
Are ladders on top of scaffold decks prohibited? (f15) check 1926.451 (f) (15) (I, ii, iii, and iv) for criteria that will allow for ladders on scaffold decks.		

Have provisions to prevent platforms from deflecting more than 1/60th of the span been made? (f16)		
The following applies to fall protection 1926.451 (g)	**YES**	**NO**
Are guardrails used on all scaffolds over 10 feet in height?		
Are personal fall arrest systems used where guardrails are not feasible?		
Are guardrails and midrails installed on all open sides (more than 14" from the work surface)?		
Are guardrails installed at 38 to 45 inches in height? (g4ii)		
When mesh or screens are installed do they extend from the top of the guardrail to the platform? (g4v)		
Will the guardrails withstand 200 pounds in a downward or outward direction?		
The following applies to falling object protection 1926.451 (h)	**YES**	**NO**
Have falling object hazards been eliminated according to 1926.451 (h)		
Have toeboards been installed to prevent falling objects? (h2ii)		
Where required, have screens been installed to protect employees from falling objects? (h2iii)		
Are toeboards at least 3 ½ inches in height? (h4ii)		
The following applies to tube and coupler scaffolds 1926.452 (b)	**YES**	**NO**
Is "X" bracing installed on the ends of the scaffold and every third set of Posts horizontally and every fourth runner vertical? (b2)		
Are ties installed at the bearer level? (b2)		
Is longitudinal bracing installed at a 45 degree angle on both faces of the Scaffold? (b3)		
Does the longitudinal bracing extend from the first (left hand) post to the Extreme top of the scaffold? (b3)		
If the scaffold is longer than five posts, is a new line of bracing begun at Every fifth post? (b3)		
Is bracing installed as close as is possible to the node point? (b3)		
Are the bearers attached to both posts and does the inboard coupler rest on the runner coupler? (b5)		
Do the ends of the bearer tube have full contact within the clamp? (b6)		
Are runners installed on the inside and outside of the scaffold at level heights? (b7)		
If outside runners are left out, are there midrails and guardrails above and below the point where the runner would have been? (b7)		
Are runners interlocked and coupled to each post? (b8)		
Do light and medium-duty scaffolds have posts, runners, bearers and braces of 2" O.D. steel tubing? 1926 Subpart L Appendix A table (b)		
Are posts on light-duty scaffolds spaced no more than 4' apart by 10' along the length of the scaffold? 1926 Subpart L Appendix A table (b)		

Are posts on medium-duty scaffolds spaced no more than 4' apart by 7' along the length of the scaffold? 1926 Subpart L Appendix A table (b)		
Is the maximum vertical runner spacing of 6'6"? Appendix A table (b)		
If the maximum number of planked levels, working levels, or height exceed those shown in table b are drawings done by a registered professional engineer? 1926 Subpart L Appendix A (2) table (b)		
Fabricated Frame scaffolds 1926.452 (c)	**YES**	**NO**
Are frames secured by braces which secure the vertical members laterally? (c2)		
Do the braces automatically square and align the frames? (c2)		
Are all brace connections secured? (c2)		
Are frames joined together by coupling pins or equivalent means? (c3)		
Where uplift may occur are the frames locked together? (c4)		
Has the use of side brackets and their impact on the overall scaffold been fully evaluated? (b5 i, ii, and iii)		
Have scaffolds over 125 feet in height been constructed and loaded according to design of a registered professional engineer? (b6)		
Mobile scaffolds 1926.452 (w)	**YES**	**NO**
Are frames secured by braces which secure the vertical members laterally? (w1)		
Do the braces automatically square and align the frames? (w1)		
Are all brace connections secured? (w1)		
Do scaffolds constructed of tube and clamp meet the requirements of that type of scaffold? (w1i)		
Do scaffolds constructed of frame scaffolding meet the requirements of that type of scaffold? (w1ii)		
Are casters locked during use? (w2)		
Is the manual force used to move the scaffold applied as close to the base as possible? (w3)		
Are scaffolds stabilized to prevent tipping during movement? (w5)		
Are casters pinned into the frames or adjustment screws? (w9)		

NOTE 1**: The above checklists were prepared for the most common scaffolds in use today. Separate checklists would have to be developed in the event that one of the many other types of scaffolds was to be used on the job site. One of the various SSC safety offices should be consulted to help in developing these checklists, if needed.**

NOTE 2**: Stennis Space Center extends its appreciation to the Scaffold Training Institute for allowing it to utilize their copyrighted "Scaffold Inspection Form" in creating this checklist. Persons desiring to use this form should contact the Scaffold Training Institute out of Houston Texas (Phone: 713-286-0261, Fax: 713-538-4203) for permission.**

APPENDIX I- STENNIS SPACE CENTER CONSTRUCTION SITE INSPECTION CHECKLIST

Date of Inspection:_____
Project:_____
Contractor:_____ Job Site: _____
Inspector:_____

1.0 Posters & Records	N/A	Yes	No	Comments
1.1 OSHA poster displayed?	☐	☐	☐	
1.2 Foreman holding weekly safety meetings?	☐	☐	☐	
1.3 Emergency medical numbers posted?	☐	☐	☐	
1.4 Explosives inventory complete?	☐	☐	☐	
1.5 Copy of OSHA regulations on site?	☐	☐	☐	
1.6 Have utility contacts been made/recorded	☐	☐	☐	
1.7 Are safety talk subjects available and being conducted?	☐	☐	☐	
2.0 Housekeeping & Sanitation	**N/A**	**Yes**	**No**	**Comments**
2.1 Are general housekeeping procedures used of the jobsite?	☐	☐	☐	
2.2 Are the passageways and walkways clear?	☐	☐	☐	
2.3 Are nails removed from lumber, or bent down to prevent injury?	☐	☐	☐	
2.4 Is an area provided for waste and trash and is it removed regularly?	☐	☐	☐	

2.5 Are the toilet facilities adequate and Clean?	☐	☐	☐	
2.6 Is there a sanitary supply of drinking water available?	☐	☐	☐	
2.7 Is there disposable drinking cups and refuse container on site?	☐	☐	☐	
2.8 Is there means provided for sanitizing personal protective equipment?	☐	☐	☐	
2.9 Are materials of all types properly stockpiled?	☐	☐	☐	
2.10 Is there adequate lighting in passageways, stairways and work site?	☐	☐	☐	
3.0 Fire Protection	**N/A**	**Yes**	**No**	**Comments**
3.1 Are "No Smoking" or "Flammable" signs posted at all storage and fueling locations?	☐	☐	☐	
3.2 Is clear access provided to all fire fighting equipment?	☐	☐	☐	
3.3 Is the location of all fire fighting equipment prominently marked, or in plain sight?	☐	☐	☐	
3.4 Are flammable/combustible liquids stored in approved containers and properly labeled?	☐	☐	☐	
3.5 Are fire extinguishers adequate in size?	☐	☐	☐	
3.6 Are large fuel tanks properly diked and separated?	☐	☐	☐	
3.7 Are gas cylinders separated, secured upright, and capped if not in use?	☐	☐	☐	
4.0 First Aid	**N/A**	**Yes**	**No**	**Comments**

4.1 Are first aid kits available and well stocked?	☐	☐	☐	
4.2 Is a trained first aid responder on site?	☐	☐	☐	
5.0 Electrical	**N/A**	**Yes**	**No**	**Comments**
5.1 Distribution boxes covered or marked?	☐	☐	☐	
5.2 Are GFCI's in use or has the positive grounding been tested?	☐	☐	☐	
5.3 Are temporary lights protected?	☐	☐	☐	
5.4 Are there any exposed live electrical wiring conditions?	☐	☐	☐	
5.5 Are extension cords being used of the Hard or Extra hard type and in good condition?				
6.0 Fall Protection	**N/A**	**Yes**	**No**	**Comments**
6.1 Are employees working above 6 Ft. and wearing the appropriate fall protection?	☐	☐	☐	
6.2 Are employees that are wearing full body harnesses tied off, and if they are is it a proper anchorage point?	☐	☐	☐	
6.3 Are employees inspecting their fall protection before each use?	☐	☐	☐	
7.0 Portable Power Tools	**N/A**	**Yes**	**No**	**Comments**
7.1 Damaged or broken tools tagged out of service?	☐	☐	☐	
7.2 Is there proper storage space provided?	☐	☐	☐	
7.3 Are there operative guards on all power tools?	☐	☐	☐	

7.4 Are guards on grinders?	☐	☐	☐	
7.5 Are tools being used properly?	☐	☐	☐	
7.6 Is the correct PPE for the tools being used?	☐	☐	☐	
7.7 Are tool rests adjusted properly on bench-mounted grinders?	☐	☐	☐	
7.8 Are persons using powder actuated tools certified?	☐	☐	☐	
8.0 Structures	**N/A**	**Yes**	**No**	**Comments**
8.1 Are floor openings covered or guardrails provided?	☐	☐	☐	
8.2 Are standard guardrails provided on scaffolds, bridge decks, and floors of bldg., work platforms, and walkways?	☐	☐	☐	
8.3 Are work areas clear of debris, and grasses?	☐	☐	☐	
8.4 Are stairways provided with handrails and guardrails?	☐	☐	☐	
8.5 Are job made ladders properly constructed?	☐	☐	☐	
8.6 Do the side rails of ladders extend 36” above the landing area?	☐	☐	☐	
8.7 Are ladders tied off to prevent movement while in use?	☐	☐	☐	
8.8 Are scaffolds properly anchored, braced, and plumb.	☐	☐	☐	
8.9 Are employees staying clear of suspended loads?	☐	☐	☐	
8.10 Is protection provided over vertical rebar when working above?	☐	☐	☐	
9.0 Traffic Control	**N/A**	**Yes**	**No**	**Comments**

9.1 Is advance-warning signs posted at approaches to work areas?	☐	☐	☐	
9.2 Are correct messages posted on the warning signs?	☐	☐	☐	
9.3 Are flag persons properly dressed and equipped?	☐	☐	☐	
9.4 Are flag persons performing properly?	☐	☐	☐	
9.5 Does traffic control on SSC highways meet DOT regulations?	☐	☐	☐	
10.0 Welding & Cutting	**N/A**	**Yes**	**No**	**Comments**
10.1 Correct type of eye protection?	☐	☐	☐	
10.2 Gages, Valves, torches & lines in good condition and free of oil & grease?	☐	☐	☐	
10.3 Cylinders not in use capped?	☐	☐	☐	
10.4 Cylinders in use or in storage secured upright?	☐	☐	☐	
10.5 Anti-flashback valves at torch?	☐	☐	☐	
10.6 Stored oxygen separated from acetylene by 20 ft.?	☐	☐	☐	
10.7 Fire extinguisher near welding or cutting operation?	☐	☐	☐	
10.8 Burn permit obtained from fire dept.?	☐	☐	☐	
10.9 Adequate ventilation provided?	☐	☐	☐	
10.10 Grounding for arc welding machine?	☐	☐	☐	
10.11 All parts of arc welding outfits properly insulated?	☐	☐	☐	

11.0 Heavy Equipment	N/A	Yes	No	Comments
11.1 Operators wearing hard hats?	☐	☐	☐	
11.2 Hearing protection being used when needed?	☐	☐	☐	
11.3 Haul roads adequate and maintained?	☐	☐	☐	
11.4 Equipment speeds within safe limits?	☐	☐	☐	
11.5 Do horn's and backup alarms function?	☐	☐	☐	
11.6 Are engines shut down when refueling or lubrication/ maintenance performed?	☐	☐	☐	
11.7 Blades/buckets on parked or unattended equipment lowered to the ground.	☐	☐	☐	
11.8 Are charged fire extinguishers located at refueling stations	☐	☐	☐	
11.9 Are overhead guards located on all forklifts?	☐	☐	☐	
11.10 Are vehicles with restricted rear visibility equipped with working back-up alarms?	☐	☐	☐	
12.0 Cranes	**N/A**	**Yes**	**No**	**Comments**
12.1 Are machines located a safe distance from power lines?	☐	☐	☐	
12.2 Are cables/rigging in safe condition?	☐	☐	☐	
12.3 Are workers protected from the rear swing arm of the crane?	☐	☐	☐	
12.4 Are gears, shafts, and belts guarded?	☐	☐	☐	
12.5 Is the operator's manual & load capacity charts located within the operating cab?	☐	☐	☐	

12.6 Are operators performing daily inspections and operating tests?	☐	☐	☐	
12.7 Are tag lines used on suspended loads?	☐	☐	☐	
12.8 Are annual inspections current on all cranes?	☐	☐	☐	
12.9 Are signs/flags used on cranes when being transported on SSC?	☐	☐	☐	
13.0 Trenches & Excavations	**N/A**	**Yes**	**No**	**Comments**
13.1 Are trench sides shored, or boxed?	☐	☐	☐	
13.2 Are proper dig permits obtained prior to any excavation and posted?	☐	☐	☐	
13.3 Are ladders in the trench?	☐	☐	☐	
13.4 Is excavated material stock-piled far enough from the edge of the trench?	☐	☐	☐	
13.5 Is adequate ventilation in place?	☐	☐	☐	
13.6 Is traffic control/barriers adequate?	☐	☐	☐	
13.7 Are sides of excavation for buildings shored or protected?	☐	☐	☐	
13.8 Is the public protected from exposure to open excavations?	☐	☐	☐	
13.9 Are safeguards in place to assure adequate oxygen in tunnels, shafts, or confined spaces?	☐	☐	☐	
13.10 Are workers protected from equipment working in close proximity of the excavation?	☐	☐	☐	
14.0 Program Effectiveness	**N/A**	**Yes**	**No**	**Comments**

14.1 Adequate quantity of PPE on the job site?	☐	☐	☐	
14.2 Are procedures in place for handling toxic and carcinogenic materials?	☐	☐	☐	
14.3 Are MSDSs available and an inventory of chemicals kept up to date?	☐	☐	☐	
14.4 Are proper industrial hygiene measures being taken for chemical vapors, fumes, or dusts present?	☐	☐	☐	
14.5 Is a Lockout/Tag out Program in place and evidence of it being utilized?	☐	☐	☐	
14.6 Is a confined Space Program in place and evidence of it being utilized?	☐	☐	☐	
14.7 Are all personnel on the construction site wearing hardhats/safety glasses, and safety shoes?	☐	☐	☐	
14.8 Are all guards in place on wood or metal working equipment?	☐	☐	☐	
14.9 If explosives are being used on site, has permission been granted by NASA	☐	☐	☐	
14.10 Is adequate lighting provided for the construction site?	☐	☐	☐	
14.11 Are lightning warnings, when issued, being followed?	☐	☐	☐	
14.12 Are emergency procedures in place and are workers knowledgeable?	☐	☐	☐	

Notes:_____

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Signature of Safety Engineer/Inspector_____

I the undersigned superintendent/foreman have reviewed the indicated hazards and will take the necessary action to immediately correct them.

Signature of Site Superintendent/foreman_____