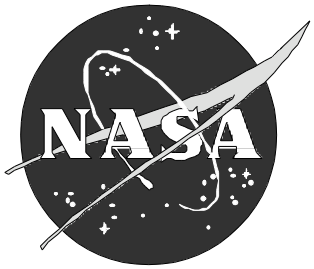

Langley Research Center

LPR 1710.42

Effective Date: July 22, 2004

Expiration Date: August 11, 2005

SAFETY PROGRAM FOR MAINTENANCE OF GROUND-BASED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

National Aeronautics and Space Administration

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PREFACE

All ground based pressure vessels, pressurized components, and pressurized systems shall be designed, fabricated, installed, operated, periodically inspected, maintained, repaired, and certified/recertified in accordance with applicable codes, standards, guides, and Federal regulations. This Langley Research Center (LaRC) Procedural Requirements (LPR) details the LaRC program for maintaining pressure system safety.

Authority for this LPR is NASA Policy Directive (NPD) 8710.5, “NASA Safety Policy for Pressure Vessels and Pressurized Systems.”

Comments, suggestions, or proposed changes to this LPR should be addressed to the Office of Safety and Mission Assurance (OSMA).

Delma C. Freeman
Deputy Director

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TABLE OF CONTENTS

This Document is Uncontrolled When Printed.
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APPENDICES

This Document is Uncontrolled When Printed.
Check the LDMS Library via the LMS web site to verify that this is the correct version before use.

LIST OF FIGURES

Page

LIST OF TABLES

Page

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1. INTRODUCTION

1.1. PURPOSE

The purpose of this LPR is to provide instructions for the elements of the safety program for maintaining ground-based pressure vessels and systems at LaRC. This pressure system safety program consists of five elements: documentation, inservice inspection, maintenance & repair, operation, and training, as depicted in Figure 1-1. The first three of these elements: documentation, inservice inspection, and maintenance & repair make up the Pressure Systems Recertification (RECERT) Program here at LaRC. This document provides detailed instructions for the RECERT program by:

1. Delineating the RECERT Program by outlining the process for recertifying ground-based pressure vessels and systems at LaRC and
2. Delineating organizations and individuals, including their responsibilities, who are responsible for recertifying ground-based pressure vessels and systems at LaRC.

1.2. APPLICABILITY

Pressure vessels and systems that shall be included in the RECERT Program are detailed in NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems.” In general, any vessel or system that has an operating pressure at or above 150 psi shall be included. Vacuum systems shall be included to ensure the vessel and/or piping can withstand the external pressure. Systems with pressures below 150 psi shall be entered in the program based on the type of media (hazardous) or the potential risk if a failure occurs. These systems shall be designated by the Pressure Systems Manager (PSM) along with the Pressure Systems Committee (PSC). A complete listing of all systems in the recertification program and their status shall be maintained by the PSM.

In accordance with NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems,” the items identified in Table 1-1 may be excluded from the RECERT Program. These items are excluded because inservice inspection for these systems is covered by a national consensus standard or they do not present sufficient hazard to require other than normal routine maintenance.

1.3. ORGANIZATIONAL RESPONSIBILITIES

1.3.1. Executive Safety Board (ESB)

The Executive Safety Board (ESB) shall:

- Review and approve/disapprove written deviation requests that have been recommended for approval by the Pressure Systems Committee (PSC).

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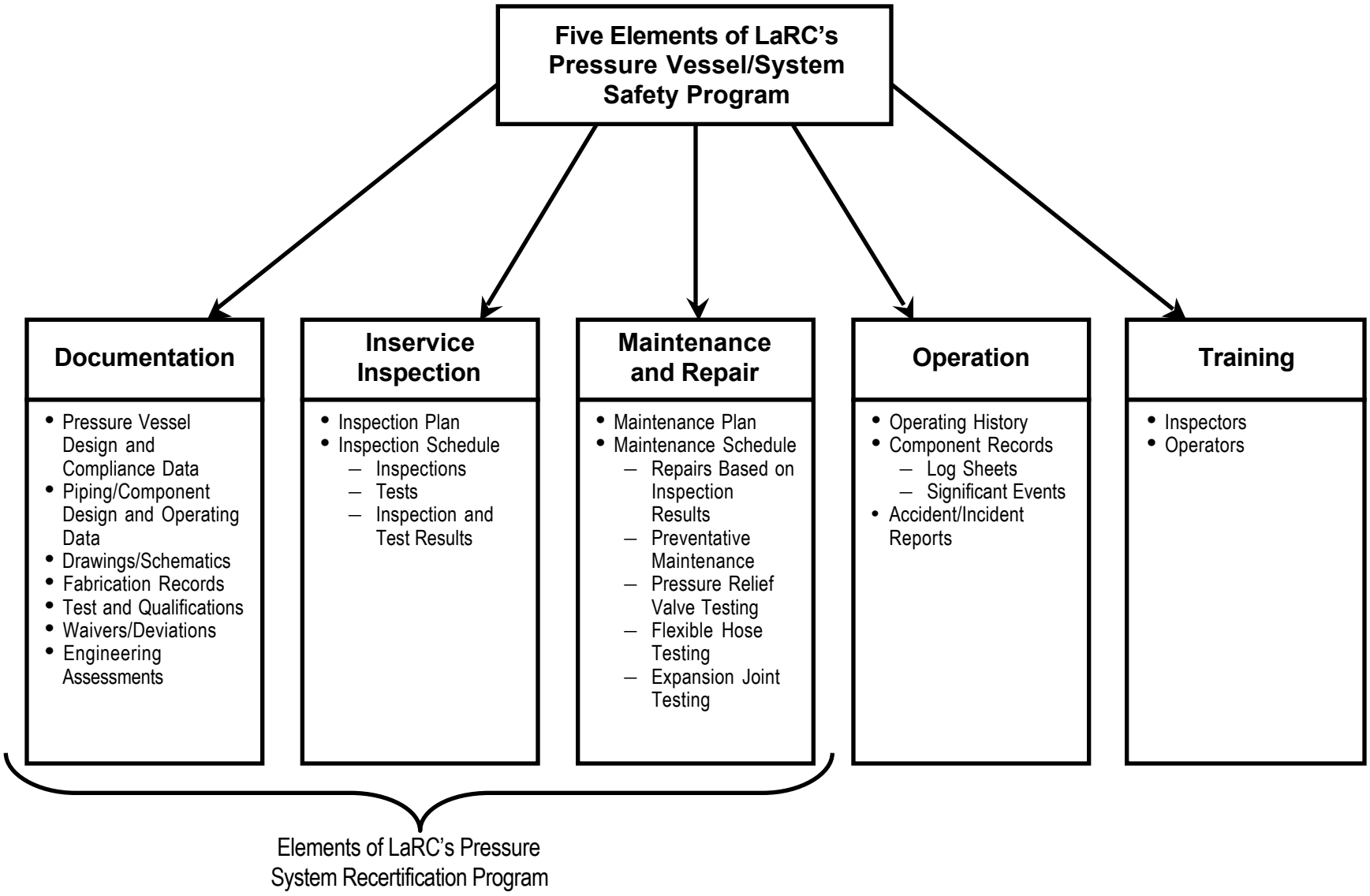

Figure 1-1, The Five Elements of Langley's Pressure Vessel/System Safety Program.

Table 1-1, Systems Excluded from Recertification Program.

Item	Justification for Exclusion
Fire Extinguishers	Fire extinguishers shall be covered by the Code of Federal Regulations Title 29 - Labor (CFR 29), Chapter XVII- OSHA Part 1910, Subpart L.
Heating Boilers	Heating boilers shall be covered by ASME Boiler and Pressure Code, Section VI.
Power Boilers	Power boilers shall be covered by ASME Boiler and Pressure Code, Section VII.
Air-Pak Rescue Equipment or Other Self-Sustaining Breathing Apparatus	Air-pak rescue equipment and other self-sustaining breathing apparatus shall be covered by 29 CFR Labor, Chapter XVII - OSHA part 1910, Subpart I, Sections 1910.134 - 1910.140.
Mobile Equipment for Gases and Liquids	Mobile equipment for gases and liquids shall be covered by Department of Transportation (DOT) Regulations 49 CFR.
Heating, Ventilation, Air Conditioning, and Refrigeration Systems	Heating, ventilation, air conditioning, and refrigeration systems shall be covered by manufacturer installation, operation, and maintenance instructions.
Utilities	Many pressure vessels and systems in use at LaRC fall into a utility category and present minimum potential hazard. Typically, pressure vessels/systems (e.g., water heaters, space heaters, or similar general utility services) that meet the guidelines established in NPR 1700.6A "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," shall be excluded from the certification and recertification program.
Other Energy Systems	Other low energy, low risk systems shall be submitted to the PSM for review and consideration.

1.3.2. Pressure Systems Committee (PSC)

The members of the Pressure Systems Committee (PSC) shall include the appointed chairperson of the committee, the Standard Practice Engineer (SPE), the PSM, a representative from the Office of Safety and Facility Assurance (OSFA), the Cryogenic Systems Consultant, and other technical experts appointed by the chairperson. The Office of Safety and Mission Assurance (OSMA) shall maintain the current membership list for the committee. The PSC shall:

- Recommend requirements, standards, and procedures for systems designed to use, confine, or distribute pressurized media.
- Review written deviation requests and recommend approval to the ESB or

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return deviation to design organization for redesign.

1.3.3. Pressure Systems Manager (PSM)

The Pressure Systems Manager (PSM) shall be designated in writing by the Center Director. The PSM shall:

- Serve as a member of the PSC.
- Ensure that all LaRC pressure vessels/systems are recertified in compliance with applicable codes, standards, and guidelines.
- Act as the technical and managerial authority for the LaRC RECERT program.
- Ensure that necessary documentation to support the recertification program is received for all pressure vessels/systems.
- Control the retention of all pressure vessel/system certification/recertification documents as part of the permanent record file for the specific system.
- Assign pressure vessels/systems to the Recertification and Configuration Management (R&CM) contractor for field surveys and non-destructive examination (NDE).
- Ensure that Pressure Systems Documents (PSDs) are prepared for all existing pressure vessels/systems at LaRC.
- Submit proposed deviations to the PSC when appropriate.
- Approve disposition (e.g., derate, repair, scrap) of all pressure vessels/systems which do not meet the requirements of this LPR.
- Prepare and forward a NASA RECERT Status Report annually. This report shall be sent to NASA Headquarters with a courteous copy sent to the OSFA.
- Maintain baseline inventory/status of all pressure vessels/systems and prepare a yearly summary report for NASA Headquarters, which shall be included with NASA RECERT Status Report above. The status shall indicate current pressure vessel/system PHASE (1, 2, or 3). The summary report shall indicate anticipated inspection/repair time frames for all PHASE 1 or 2 systems.
- Act as the primary pressure system advisor for the LaRC PSC.
- Review/approve all field survey or Inservice Inspection Plan (IIP) procedures for all inservice pressure systems.
- Establish periodic maintenance checks regarding pressure vessels, piping components, relief valves, flexible hoses, expansion joints, and other components as required. These checks shall be listed in the IIP schedule.
- Provide guidance to Project Managers (PMs) in the initial certification of pressure vessels and systems.
- Ensure appropriate permanent record file is forwarded to another installation if any pressure vessel/system is transferred from one installation to another, either by physical movement or through transfer of responsibility to a non-LaRC agency. Ensure that appropriate waivers and deviations are included in the permanent record file.

1.3.4. Field Engineering Support Services (FESS) Contractor COTR

The Field Engineering Support Services (FESS) Contracting Officers Technical

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Representative (COTR) shall ensure the FESS Contractor:

- Performs a periodic maintenance check in accordance with the Computerized Maintenance Management System (CMMS).
- Tags relief valves and flexible hoses, as required at installation and during preventative maintenance checks. See appendix A for further guidance.
- Maintains individual logs of relief valves tested. The logs shall depict date tested, valve number, pressure setpoint, and adjustments or repairs made to the relief valves.
- Submits completed maintenance data sheets to the applicable Facility Coordinator (FC) including, as necessary, any historical data sheets to indicate adjustments or repairs completed to components.

1.3.5. Facility Safety Head (FSH)

Every facility at LaRC has a Facility Safety Head (FSH) who is nominated by the line organization and approved by the Vice-Chairperson of the ESB. The FSH shall:

- Review computer maintenance entries to ensure that pressure vessel/system repairs have been documented.
- Review inservice inspection sheets with Recertification and Configuration Management (R&CM) contractor to coordinate non-destructive evaluation (NDE) as required.
- Ensure that personnel training and facility operational knowledge of procedures for working with pressure vessels and systems is current. Qualified operators shall be certified in writing.
- Coordinate pressure systems training as required. General pressure system safety training shall be conducted after system modifications and after any extended “down” period.
- Maintain pressure vessel/system training records for personnel assigned to the facility.
- Review operational procedures and ensure that changes, modifications, or alterations are appropriately reflected.
- Maintain current log of operations.

1.3.6. Facility Coordinator (FC)

Every facility at LaRC has a Facility Coordinator (FC) who is appointed by the line organization and FSH. The FC shall:

- Initiate maintenance requests for repairs and/or facility modifications.
- Submit work requests as required.
- Review and submit to the Systems Engineering Competency (SEC) all computerized maintenance sheets, whether performed by the FESS contractor or in house maintenance personnel.
- Coordinate with PSM and R&CM Contractor for walk-through of pressure vessels/systems to verify/update Pressure Systems Documents (PSDs).

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1.3.7. Recertification and Configuration Management (R&CM) Contractor COTR

The Recertification and Configuration Management (R&CM) COTR shall ensure the R&CM contractor:

- Performs detailed field surveys.
- Prepares the Recertification Status Sheets for pressure system components.
- Performs non-destructive evaluation (NDE) on existing pressure systems as part of the RECERT program.
- Performs engineering analyses and provide PSM with recommendations to be taken regarding specific pressure system components.
- Prepares the initial CAD isometric drawings for the Pressure Systems Documents (PSD).
- Prepares the initial PSD and maintains them as Configuration Controlled Documents.
- Prepares the Inservice Inspection Plan/Schedule/Requirements.
- Gathers documentation for the Permanent Record File for assigned pressure vessels and systems.
- Maintains permanent RECERT files including NDE results.
- Performs inspections as required by IIP.
- When directed, repairs major deficiencies discovered during non-destructive examinations and analyses.
- Participates in the formulation of the annual pressure systems priority inspection list.
- Obtains and maintains documentation for the permanent system record files. Specific contents of the permanent record files are denoted in Chapter 2.
- Notifies PSM if IIP schedule cannot be met.

1.3.8. Standard Practice Engineer (SPE)

The Standard Practice Engineer (SPE) shall:

- Serve as a member of the PSC.
- Evaluate and approve all designs and modifications to previously certified/recertified pressure vessels/systems.
- During normal system repairs, certify compliance with applicable codes, standards, guides and LaRC supplements.
- Ensure referral to the PSC when a system does not comply with applicable codes.
- Grant waivers of hydrostatic testing if necessary. See Appendix B of this document for details on waivers and deviations.

1.3.9. Facility Systems Project Manager (PM)

The Facility Systems Project Manager (PM) shall:

- Initiate a Change Notification Sheet (CNS) covering each specific pressure system project.

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- Ensure that an inspector is assigned to inspect all new pressure piping and associated equipment and all alterations, repairs, modifications, and additions to pressure vessels and pressure piping.
- Ensure compliance with standards, codes and regulations regarding pressure vessels/systems or ensure that deviations have been approved by the PSC.
- Provide specifications, drawings, purchase requests, and inservice inspection and recertification requirements.
- Provide written certification that the pressure system installation was performed in accordance with all documentation as defined in LPR 1710.40, "Safety Regulations Covering Pressurized Systems."
- Ensure that documentation (see Chapter 2 for types of documentation) regarding the components used in the modification, alteration, or construction of pressure systems are retained. This information shall be required by contract specifications to be submitted by the contractor during the initial construction or modification of a pressure system. This documentation shall become a major part of the permanent record file. The PM shall turn over documentation collected during the initial construction or modification to the PSM after the completion of Operational Readiness Review (ORR) or Systems Operations Committee (SOC).
- Obtain guidance from the PSM, regarding pressure vessel/system documentation, inservice inspection, and recertification plan.

1.3.10. Systems Engineering Competency (SEC)

The Systems Engineering Competency (SEC) shall:

- Maintain the CMMS program/data
- Enter data from the maintenance input data sheets completed by either the FC or the FESS contractor.
- Enter and retain historical maintenance information that has been submitted regarding a particular facility.
- Maintain the database for all computerized preventative maintenance at LaRC.
- Approve all radiography taken of existing pressure vessels/systems at LaRC.

1.3.11. Construction Inspection Contractor

The Construction Inspection (CI) Contractor COTR shall ensure the CI Contractor works with the PM and Construction Management Team and ensure the CI Contractor.

- Checks to ensure that all installation inspections of new pressure systems and vessels meet the applicable portion of the specifications.
- Witnesses all tests (hydrostatic, pneumatic and operational) as specified by the designer.
- Coordinates with PM to resolve any problems with interpretation of specs.
- Verifies that test apparatus is in calibration before use.

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2. RECERT PROGRAM

2.1. GENERAL

The primary focus of the LaRC Pressure Systems Recertification (RECERT) program is to examine existing pressure vessels and systems to ensure their structural integrity and minimize the potential for mishaps. This shall be accomplished via inspection, documentation, non-destructive evaluation (NDE), repairs, and engineering assessment. The LaRC RECERT program is based on requirements defined within NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems" and NPR 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems." Specific products of the RECERT program shall consist of:

- The Pressure Systems Document (PSD),
- The Inservice Inspection Plan (IIP), and
- The Recertification Letter.

2.2. METHODOLOGY

LaRC's RECERT program must account for the fact that LaRC has numerous existing systems that require recertification and new systems that do not require recertification but must be incorporated into the RECERT program. As depicted in Figure 2-1, each pressure vessel/system goes through three RECERT phases. A brief description of each phase and what shall be accomplished for an existing or new system is provided in Table 2-1.

Table 2-1, Brief Description of Each RECERT Phase.

Phase	Existing System	New System
1	R&CM COTR ensures the R&CM Contractor gathers/develops documentation and performs field survey, initial NDE, and engineering analysis of the pressure vessel or system.	PM shall gather documentation for permanent record file and provide it to the PSM.
2	Additional actions (such as repairs, modifications, or more extensive NDE) that are required to recertify the system shall be performed. Additionally, the pressure systems documentation and permanent record file is completed.	The R&CM COTR shall ensure the R&CM Contractor prepares the permanent record file. If not provided by PM, the R&CM COTR ensures the R&CM Contractor prepares the IIP.
3	The R&CM COTR ensures the R&CM Contractor performs periodic inspections in accordance with the	The R&CM COTR ensures the R&CM Contractor performs periodic inspections in accordance with the

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	IIP.	IIP.

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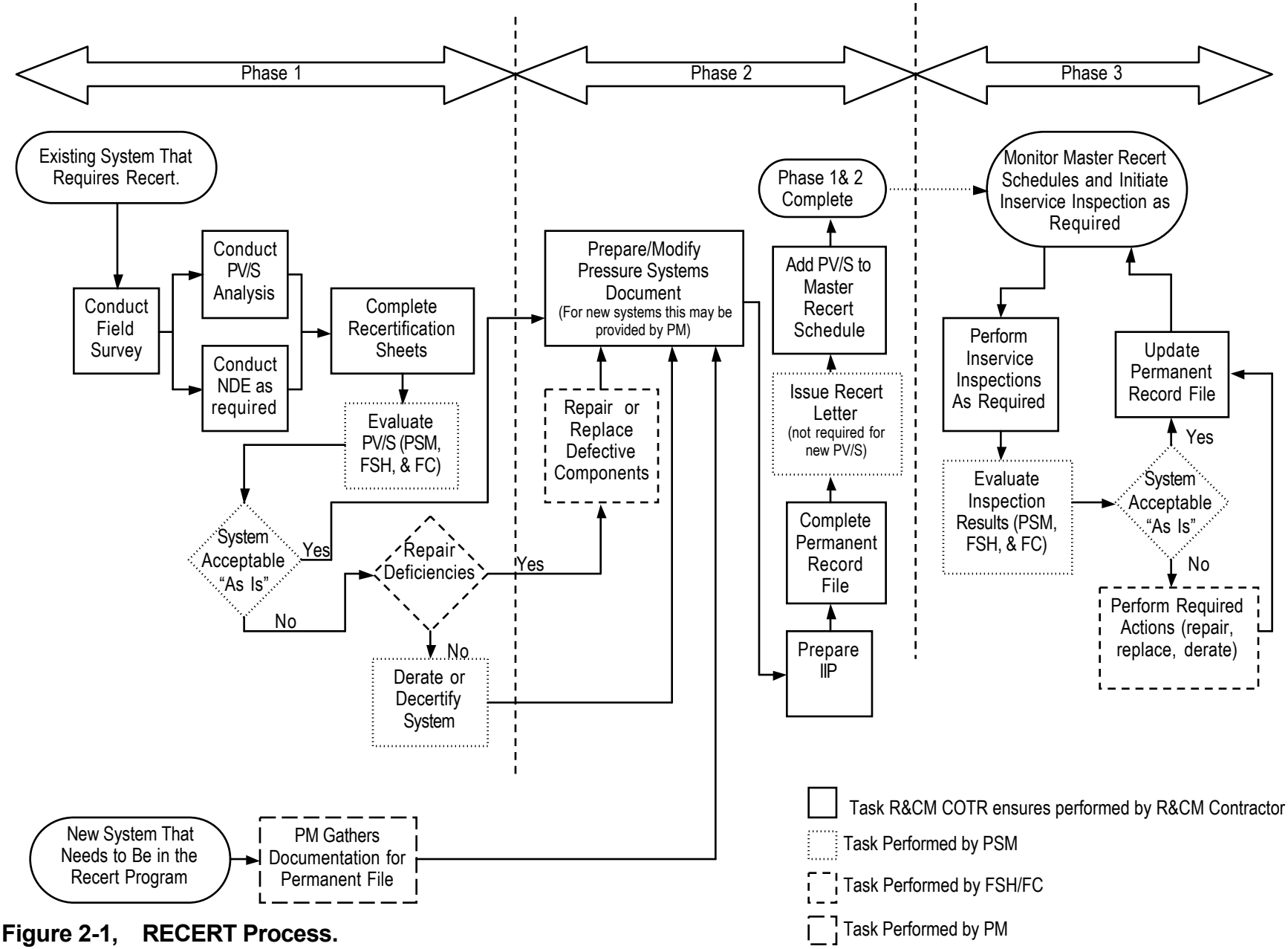

Figure 2-1, RECERT Process.

2.3. PRIORITY INSPECTION LIST

As part of the RECERT program the PSM shall determine the priority of recertifying particular pressure systems and vessels. Using risk assessment techniques, the PSM shall prioritize pressure vessels and systems that have not been entered into the RECERT program. Elements that are used in prioritizing the inspection list shall include energy considerations (amount and type of agent under pressure), cyclic duty, environmental considerations (susceptibility to erosion/corrosion), number and proximity of personnel, cost of replacement, schedule impact, and age. In determining the priority list, a combination of likelihood of a failure along with the consequence of a failure shall be used to formulate the total risk. The PSM shall review and update the priority inspection list at least annually.

2.4. RECERT PHASE 1

The activities that shall be performed during phase 1 depend on whether the system is an existing system of a new/modified system. This section details the activities that shall be performed during phase 1.

2.4.1. New Systems

For new pressure vessels and systems, after the Operational Readiness Review (ORR) or Systems Operations Committee (SOC) review, the Facility Systems Project Manager (PM) shall send to the PSM all documentation required for the establishment of the pressure system database and permanent record file. See section 2.5.5 for a detailed description of the data/documentation required.

It shall be the responsibility of the PM to either develop the required documentation or incorporate the development of the documentation into the appropriate contract specification. For those cases where the appropriate documentation is not available, the PM shall inform the PSM. The PM and PSM shall work together to have the appropriate actions taken (i.e., field surveys, perform NDE, or perform pressure vessel/system analysis) to develop the necessary documentation.

2.4.2. Existing Systems

For an existing system, the first phase of the RECERT program shall consist of gathering and evaluating the information regarding a specific pressure vessel or system. Additionally, during the first phase of RECERT, the establishment of the pressure system database and permanent record file shall be initiated. The primary results of phase 1 shall be recommendations of action(s) that shall be taken with respect to specific system components. These recommendations shall include decertifying (removal from service), recertifying (either to original or changed operational parameters), conducting repairs, or additional tests necessary to recertify the pressure vessel/system. As depicted in Figure 2-1, there shall be several items completed in phase 1 of the RECERT program: perform field surveys, perform NDE, and perform pressure vessel/system analysis.

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UPPER LEFT: Facility Name and Building Number. System Name. Reference Sketch for Recertification Status Sheet. Date of latest computer printout. Page Number.
UPPER RIGHT: System Designation.

Fifteen Columns - Read Left to Right

(1) NO: Component number which can be found on the sketch referred to in the upper right of the recertification status sheet. (Example: REF SK. 60-A-1)

(2) COMPONENT: Component name. The names are derived from ANSI and SAE.

(3) END: End connection. It is listed by abbreviation: TH = threaded; SW = socket weld; BW = butt weld; FL = flanged; CW = connection weld; SO = slip on (flange only; WN = weld neck (flange only).

(4) MANUFACTURER/DESCRIPTION: Consists of the information which shall be gathered in the field. The first line gives the manufacturer (if known). The second line lists the line size of the component and also any information such as model number, class or type. The last line contains any additional information.

(5) MATERIAL: Material the component is made of or is assumed to be made of.

(6) INSTALLATION: Component's installation date.

(7) INSPECTION: Inservice inspection date.

(8) RATED PRESSURE: Maximum allowable working pressure (APRES) of the component. This number is arrived at by: information found on the component; information found in the manufacturer's catalog; comparing the components dimensions to dimensions given in the applicable code or standard; by making contact with the manufacturer by phone or by letter; or by using the pipe pressure formula from ANSI B31.

(9) WORKING PRESSURE: Working pressure (WPRES) of the system at the component's location.

(10) CODE: Code or standard that the component is designed to. These codes are abbreviated. The abbreviations are explained on the Definition of Symbols page. Entries in the CODE column come from the Manufacturer's catalogs, crossing the component's dimensions with dimensions listed in the code, or by contacting the manufacturer. ASMD in this column means assumed.

(11) ANALYSIS: Method of analyzing or evaluating the component. Abbreviations are explained on the Definition of Symbols page.

(12) NDE: Method of non-destructive examination used to evaluate the component. Abbreviations are explained on the Definition of Symbols page.

(13) FOOTNOTES: Footnotes which further explain or clarify the information for the component. Footnotes are by system and can be found on the Footnotes page.

(14) REFERENCE: NASA specifications, NASA drawings, TAI Engineering Analysis, and TAI Non-Destructive Examination. These can be referenced on the Recertification Document Reference List.

(15) REC: Recommendation for each component. The component is either recertified or recommended for removal, repair, derating, or waived.

Figure 2-2, Key To Recertification Status Sheets (Component Inventory).

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NO.	Component	END	Manufacturer/Description	Material	Installation	Inspection	Rated Pressure	Working Pressure	Code	Analysis	NDE	Foot Notes	Reference	Rec
1	PIPE ELL	SW	VOGT 2", 6000 CWP	STEEL	12/64	12/92	6000	6000	B11	MC	V	3	D1,D4,E3,S1	RC
2	PIPE ELL	SW	BONNY FORGE 2', 6000#	A105	12/64	12/92	6599	6000	B11	MC	V	62	D1,D4,E3,S1	RC
3	PRE FILTER	BW	DOLLINGER 2', S/N 30781 6500 PSI, "U' STAMP	STEEL	06/76	12/92	6500	6000	81	ES	V		D1,D4,E3	RC
4	BUSHING	TH	UNKNOWN 1/2 X 1/4"	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
4A	MALE ELL	TH	CRAWFORD 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
5	MALE CONNECTOR	TH	UNKNOWN 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	6500	6000	SA5	CE	V	8	D1	RC
6	DIFFERENTIAL PRESSURE GAUGE	TH	ORANGE RESEARCH, INC. 1/4", M/N 1202 PG-1-2 0-100 PSID RANGE	STEEL	06/76	12/92	9352	6000	N/A	TC	V	58	D1	RC
7	MALE CONNECTOR	TH	UNKNOWN 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	SA5	CE	V	8	D1	RC
8	BUSHING	TH	UNKNOWN 1/2 X 1/4"	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
8A	MALE ELL	TH	CRAWFORD 1/4", 1/8" SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
8T	TUBE		UNKNOWN 1/8", T=.028"	STAINLESS	06/76	12/92	7482	6000	B3	PS	UT	4	D1,E2	RC
9	COUPLING	SW	BONNY FORGE 3/4', 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC
10	PIPE ELL	SW	BONNY FORGE 3/4', 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC

Figure 2-3, Recertification Status Sheet (Example).

2.4.3. Field Survey

The R&CM COTR shall ensure that the R&CM Contractor performs field surveys as outlined below. The purpose of the field survey is to identify components within a given system. Experience has indicated that for older systems at LaRC there is rarely any documentation on components. Consequently, detailed field surveys shall be accomplished to assemble data on pressure vessel and system configurations, pipe sizes and schedule, flange, and valve pound-class ratings, manufacturers' pressure ratings, and the location of all welds and support structures. During the field survey, each system shall be visually inspected and any cracks, corrosion, leakage, wear, vibration, missing fasteners, broken supports or welds with surface defects shall be noted.

The information gathered during the field surveys shall be assembled into the pressure system database. Specific information that comprises the pressure system database shall be illustrated on recertification status sheets (Component Inventory). Figure 2-2 details the key to recertification status sheets (Component Inventory) and Figure 2-3 is a sample of a compiled recertification sheet. In addition to gathering documentation regarding a specific pressure vessel or system, an isometric drawing of the pressure system shall be generated using a computer-aided drawing (CAD) package. This drawing shall later become part of the PSD, which shall be a configuration controlled document (CCD).

Frequently, required information for a particular component is not available. When this problem is encountered, the PSM shall provide guidance to the R&CM Contractor to determine a solution. Table 2.2 provides typical problems with possible solutions.

2.4.4. Evaluation of Pressure Vessel or System

After the initial field surveys are conducted and components have been identified, all items shall be analyzed to determine if they are adequate for the system working pressure. This analysis shall be performed as directed by the PSM and shall use the criteria noted in sections 2.4.5, 2.4.6, and 2.4.7 with regards to nondestructive examination, pressure vessel analysis, and piping analysis. Typically, the PSM directs the R&CM Contractor to perform this assessment and denote recommendations on the recertification sheet. However, the PSM may use other assets within LaRC to perform the engineering assessment.

If the analysis indicates that all components are adequate for the system working pressure, the analysis portion of recertification is complete. However, if components are identified that are not considered adequate for the working pressure, they shall be replaced, the system operation pressure shall be reduced to an acceptable level (i.e., derated), or additional analysis/NDE shall be performed. The decision to replace, repair, perform additional NDE, derate, decertify or certify shall be made by the PSM.

A letter shall be sent by the PSM to the Facility Coordinator (FC) and the Facility Safety Head (FSH) indicating the new limits, with regards to the pressure vessel or system.

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Also, the engineering assessment report shall become part of the permanent record file for the specific system. It shall be referenced within the PSD on the document reference sheet (see Figure 2-4).

Table 2-2, Typical Data Problem With Possible Solutions.

Problem	Solution
Unknown material properties	Whenever feasible, sections of these materials shall be removed and both hardness and x-ray fluorescence tests conducted. These tests generally yield good indications of the tensile strength and chemical properties of the materials.
Unknown material properties and it is not feasible to remove a section of material	The material shall be assumed to be fabricated of the lowest strength material available in the applicable Code. The following presents the materials assumed for various applications. Application — Material Assumed Carbon steel pipe — ASTM A53 Gr. A Carbon steel fittings — ASTM A234 Gr. WPA Carbon steel forgings — ASTM A181 Gr. I Stainless steel pipe — ASTM A312 Gr. TP304 Stainless steel fittings — ASTM A182 Gr. 304 Stainless steel forgings — ASTM A182 Gr. F304 The charpy impact energies for the above materials shall be obtained from the technical literature. System operating temperatures shall be modified, if necessary, to ensure that these materials have the impact energies required by the Codes.
Flanges that cannot be reasonably analyzed using the criteria of Section VIII Division 1 of ASME Boiler and Pressure Vessel (B&PV) Code.	In one case, 616 identical flanges were found. The maximum allowable working pressure for these flanges was established by proof testing one flange according to the procedures outlined in Paragraph UG-101, “Proof Tests to Establish Maximum Allowable Working Pressure,” of Section VIII Division 1 ASME B&PV Code.
Component made of known, but not Code-approved materials	For these components, the "Basis for Establishing Stress Values" section of the appropriate Code shall be used to determine allowable stresses.

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DOCUMENT REFERENCE SHEET

FACILITY: SML. BLDG 1148
SYSTEM: 500 PSI NITROGEN DATE: April 17, 1996

Page 1

REF #	TYPE OF DOCUMENT	IDENTIFICATION NO.	TITLE	LOCATION	
A 1 FILES	T. A. I. ANALYSIS	500	500 PSI NITROGEN ANALYSIS (RECERT)	PSCM	CONT.
C 1 FILES	CNS	23-37	UPDATE TO REFLECT MINOR CHANGES AS A RESULT OF VISUAL EXAMINATION	PSCM	CONT.
D 1 FILES	T. A. I. SKETCHES	SK.S - N - 1 THRU SK. 5 - N - 3	500 PSI NITROGEN SYSTEM	PSCM	CONT.
D 2	NASA DRAWING	LC - 709889	B - 1148 VACUUM/PRESSURE CHAMBER MODIFICATIONS	EDF	
E 1 FILES	T. A. I. NDE		NON- DESTRUCTIVE EXAMINATION (RECERT)	PSCM	CONT.
S 1	NASA SPECIFICATION	NASI - 18493 SPEC.	S / M FOR CONSTRUCTION OF CARBON-CARBON LABORATORY ADDITION TO BUILDING 1205	CONTRACT FILES	

Figure 2-4, Document Reference Sheet.

2.4.5. Nondestructive Examination

Several NDE techniques can be used to assess the material conditions. The required NDE shall be based on whether the system contains high-pressure gas or liquid as outlined below.

Nondestructive examination of high-pressure gaseous systems shall consist of three levels of examination:

1. Visual inspection of the entire system to look for signs of cracks, corrosion, wear, leakage, vibration, missing fasteners, broken supports, or welds with surface cracks, etc.
2. Eddy current, dye penetrant or magnetic particle inspection (depending upon the application) of the high stressed areas identified in the system analysis.
3. Radiographic inspection of ten percent of all welds. (Note, welds on Code stamped pressure vessels shall not be radiographed since a National Board of Boiler and Pressure Vessel Inspectors inspector has already accepted the inspection of the vessels). If unacceptable welds are found during the radiographic inspection, one hundred percent of all welds shall be radiographed.

Nondestructive examination of high-pressure liquid systems shall consist of two levels of examination:

1. Visual inspection of the entire system to look for signs of corrosion, wear, leakage, support deterioration, etc.
2. Eddy current, dye penetrant or magnetic particle inspection (depending upon the application) of the high-stressed areas shall be identified in the system analysis. Welds in liquid systems shall not normally be radiographed since they contain significantly less potential energy than gaseous systems.

NDE performed on existing pressure systems shall be done in accordance with the

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guidelines provided in Tables 2-1a, b, c, d, and e for Code-Stamped Vessels; Non-Code-Stamped Vessels, Section VIII, Division 1 Analysis; Non-Code-Stamped Vessels, Section VIII, Division 2 Analysis; All piping except insulated steam piping; and Insulated steam piping, respectively.

2.4.6. Pressure Vessel Analysis

Under the LaRC RECERT program, pressure vessels shall fall into two general categories:

1. Vessels carrying the ASME Boiler and Pressure Vessel Code Stamp or
2. Vessels which do not carry the ASME Code Stamp.

The procedures for evaluating both categories of vessels shall be:

- **Code-Stamped Vessels**: Code stamping of a vessel by a manufacturer shall certify that the vessel has been designed and fabricated in accordance with a section of the ASME Boiler and Pressure Vessel Code (ASME B&PV Code). No additional analysis shall be performed in recertifying Code-stamped vessels. However, these vessels shall be visually inspected as required as part of the inservice inspection program.
- **Non-Code-Stamped Vessels**: These vessels shall be analyzed using the criteria of the current issue of either Section VIII, Division 1 or Section VIII, Division 2 of the ASME B&PV Code. Use of these criteria shall not qualify the vessels for Code stamping. However, these criteria shall provide a rationale for evaluating the integrity of the vessels.

A brief description of the Section VIII, Division 1 and 2 follows:

- **Section VIII, Division 1** (referred to as Division 1): Welded and riveted vessels shall be initially analyzed using the criteria of Division 1. This Division requires continuum analyses of the vessels and that numerous design rules be followed. Depending upon the materials and joint efficiencies used, Division 1 requires a range of 0 percent to 100 percent radiographic inspection of structurally significant welds. Division 1 has stringent requirements on vessel configuration, for example the slopes at head-to-cylinder and cone-to-cylinder junctions and the radii on the outside-corners of nozzles.
- **Section VIII, Division 2** (referred to as Division 2): In some instances, welded vessels satisfy the requirements of Division 1 only when their maximum allowable working pressures are reduced below NASA's operational requirements. In these instances, the vessels shall be analyzed using Division 2. This Division permits higher allowable stresses, and consequently higher pressures, in a given vessel. However, Division 2 requires detailed stress, thermal and fatigue analyses of the vessels. It is more restrictive on configurations and materials than Division 1 and more expensive and time-consuming than Division 1. Furthermore, Division 2 generally requires 100 percent radiographic inspection of structurally significant welds.

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Table 2-3a, Nondestructive Examination Performed During System Recertification: Existing Code-Stamped Vessels.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
High stressed areas and fillet welds are surface inspected using visual, magnetic particle, dye penetrant and/or eddy current techniques.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic Particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code.

Table 2-3b, Nondestructive Examination Performed During System Recertification: Existing Non-Code-Stamped Vessels, Section VIII, Division 1 Analysis.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Same as Code-Stamped Vessels, plus a minimum of 10% of all structurally significant welds are radiographed. A higher percentage may be radiographed if high joint efficiencies are required.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Radiography (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V.	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.

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Table 2-3c, Nondestructive Examination Performed During System Recertification: Existing Non-Code-Stamped Vessels, Section VIII, Division 2 Analysis.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Same as Code-Stamped Vessels plus 100% of all structurally significant welds are radiographed.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessel Code, current document.

Table 2-3d, Nondestructive Examination Performed During System Recertification: All Existing Piping Except Insulated Steam Piping.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
High stress areas and fillet welds are surface inspected using visual, magnetic particle, dye penetrant and/or eddy current techniques. Ten percent of all branch connection, girth, miter, groove and socket welds are radiographically inspected.	Visual (Per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure).	Evaluate per NDE VT-10A,"Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure.
	Magnetic particle (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Dye penetrant Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
	Radiography for girth and miter groove welds (Per ASME Boiler and Pressure Code, Nondestructive Examination, Section V).	Evaluate per ASME Code for Pressure Piping (B31series). Severe cyclic conditions.
	Radiography for socket and branch connection welds LPR 1710.41, "LaRC Standard for the Evaluation of Socket and Branch connection Welds."	Evaluate per LPR 1710.41, "LaRC Standard for the Evaluation of Socket and Branch Connection Welds."

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TABLE 2-3e, Nondestructive Examination Performed During System Recertification: Existing Insulated Steam Piping.

Nondestructive Examination	Inspection Procedure	Acceptance Criteria
Ten percent of all branch connection, girth, miter groove and socket welds are radiographically inspected	Radiography for all welds (Per Minutes of Meeting, NASA LaRC Pressure Systems Committee, May 9, 1988 and Gianettino, D.P., Slemp, G.E., Berry, R.F., Jr., and Hudson, C.M.: "Radiographic Inspection through Asbestos Insulation," Forty-Sixth Meeting of the Mechanical Failure Prevention Group, Vibration Institute, April 9, 1992.	For girth and miter groove welds, evaluate per ASME Code for Pressure Piping (B31 series) For socket and branch connection welds, evaluate per LPR 1710.41, "LaRC Standard for the Evaluation of Socket and ranch Connection Welds."

2.4.7. Piping Analysis

All piping components, except steam piping components, shall be analyzed using the criteria of the current issue of the Process Piping Code (ANSI/ASME B31.3). This Code applies to piping that handles liquids and gases and requires a detailed analysis of the piping.

All steam piping components shall be analyzed using the criteria of the current issue of the Power Piping Code (ANSI/ASME B31.1). This Code specifically addresses the design of steam systems. It gives the general design requirements for the design of components and assemblies, including their pipe supports.

2.5. RECERT PHASE 2

The primary objectives of phase 2 are:

1. Repair/replace any defective components found during phase 1,
2. Prepare an Inservice Inspection Plan (IIP), and
3. Complete/develop the permanent record file.

This section details how these three objectives shall be accomplished at LaRC.

2.5.1. New Systems

For a new system, repair/replace defective components is not required. Phase 2 for new systems shall consist of using the data/documentation provided by the PM to prepare the permanent record file and the IIP if not submitted by the PM. The R&CM COTR shall ensure this is performed by the R&CM Contractor. The PSM and PM shall provide guidance to the R&CM Contractor to obtain/develop any missing documentation.

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2.5.2. Existing Systems

For each existing system being recertified, the following actions shall be conducted during phase 2:

- If numerous unacceptable welds were identified in the PHASE 1 radiography, one hundred percent of all welds shall be radiographed.
- All of the unacceptable welds shall be repaired and all of the components that are not rated for the system working pressure, or higher, shall be replaced.
- The R&CM COTR shall ensure the R&CM Contractor prepares the IIP, completes the pressure systems document, and completes the permanent record file.

When all components and welds in the system satisfy the requirements of the applicable National Consensus Codes, the PSM shall recertify the system by issuing a recertification letter.

2.5.3. Repair/Replace Defective Components

As authorized and directed by the PSM, defective pressure components shall be repaired and tested. The PSM, via the R&CM COTR, directs the R&CM Contractor to perform emergency repairs. It shall be the responsibility of the PSM, working with the appropriate FC and FSH, to determine if a repair is an emergency. These are repairs that must be performed as soon as possible, taking into account the nature of the deficiency and the need to operate the pressure vessel/system. For non-emergency repairs, the R&CM COTR shall ensure the R&CM Contractor prepares a repair package under the direction of the PSM. It shall be the responsibility of the PSM to obtain repair services for non-emergency repairs using normal LaRC procurement process.

Specific details regarding repairs conducted as a result of RECERT activities shall be included in the permanent record file.

2.5.4. Inservice Inspection Plan/Schedule/Requirements

The purpose of the Inservice Inspection Plan (IIP) is to maintain system integrity. The IIP shall be applicable to all pressure components, including vacuum vessels and any other unique components designated by the PSM. The maximum period between inspections shall be based on fluid, pressure, and size of the pressure vessel or piping. Tables in NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems,” shall be used as a guide in producing the inspection schedule. Inspection intervals are permitted to be modified by the PSM based on engineering judgment to monitor known flaws or highly stressed areas.

The R&CM COTR shall ensure the R&CM Contractor develops the IIP. The IIP shall include the type and period of inspection (i.e., the inspection schedule) along with the specific inspection requirements (e.g., procedures, NDE, etc.). When a pressure system is recertified, the applicable IIP shall be attached to the recertification letter

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sent by the PSM to the facility coordinator.

The IIP shall use NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems,” as a guide to determine items to be inspected. The IIP shall always consider the following key items: Vessels, Piping & Components, Expansion Joints, Flexible Hoses, Relief Valves, and Rupture Disks. Additional items such as separators, traps, condensers, and heat exchangers shall be added based on engineering judgment or from guidance obtained from other national codes, standards, or consensus.

The IIP shall consist of two main sections:

- **Inspection Schedule**: This section of the IIP shall denote the type and periodicity for inservice inspections. Again guidance for the type of inspection (e.g. VT, MT, PT) shall be obtained from NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems,” engineering judgment, or other national codes, standards, or consensus. Any variation from the NPR 1700.6A must be authorized by the PSM and justification for the variance shall be provided within the permanent record file.
- **Inspection Requirements**: This section of the IIP shall denote the applicable procedure that shall be followed during inspections. Some procedures shall be locally produced, such as VT-10A from the NDES section at LaRC, while others shall be from the ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination. Table 2-3a, b, c, d, and e illustrates specific places for appropriate procedures and evaluations.

The IIP shall be sent to the FSH as an attachment to the Recertification letter (see Figure 2-5) at the end of RECERT phase 2.

2.5.5. Documentation for Pressure Vessels/Systems - Permanent Record File

As required by NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems,” each pressure system shall have a permanent record file. At LaRC, this permanent record file shall be established coincident with the production of the Pressure Systems Document (PSD). Information that constitutes the permanent record file shall include the items in Table 2.4. The party responsible for obtaining/developing the document is also provided in Table 2.4.

For new systems, the PM shall provide to the R&CM Contractor the data, as outlined in Table 2.4, required to develop the permanent record file. For those cases were the appropriate documentation has not been provided to the R&CM Contractor, the PSM shall work with the PM and/or R&CM Contractor to develop the necessary documentation.

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National Aeronautics and
Space Administration

Langley Research Center
Hampton, VA 23681-0001

447 Date

TO: XXX/Facility Safety Head

FROM: 447/Pressure Systems Manager, Systems Engineering Competency

SUBJECT: Recertification of the Air Storage Field Number 3, (50-ABS), Building No. 1247E

REF: (1) NPR 1700.6, “Guide for In-service Inspection of Ground-Base Pressure Vessels and Systems”, January 18, 1976
(2) LPR 1710.40, “Safety Regulations Covering Pressurized Systems”

The Recertification Team, Systems Engineering Competency has completed the Recertification (RECERT) analysis and inspection of the subject system. All components now satisfy the requirements of References 1 and 2.

The pertinent RECERT documentation has been entered into the Pressure Systems Configuration Management system. This documentation shall, with your assistance, be constantly updated.

The future inspection plan for the subject system is given in the enclosed NASA Drawings, LA-741804 and LA-741805.

Based upon the successful completion of the RECERT analysis and inspection, the subject system shall be recertified for continued use.

(SIGNED)
Pressure System Manager (PSM)

Figure 2-5, Recertification Letter (Example).

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Table 2.4, Required Documentation in the Permanent Record File.

Item	Description	Responsible Party	
		Existing	New
Pressure Systems Document (PSD).	This document shall be produced for all pressure vessels/systems and shall be a compendium of component information and sketches. The PSD shall be a CCD document and the R&CM COTR shall ensure the R&CM Contractor publishes the document. It shall contain the following two sections: Introduction: This section shall describe the particular pressure vessel/system. The major components shall be identified and brief descriptions of the operation and configuration of the system given. Photographs, sketches, or drawings shall be used. An isometric CAD drawing shall be included which clearly defines the system boundaries. System/Component Inventory: This section shall tabularize information regarding system components and shall include manufacturers data, material composition, installation date, inspection date, MAWP, working pressure at the components location, code or standard for which the component is designed, method of analyzing or evaluating the component, NDE used to evaluate the component, references, and recommendations regarding repairs, further NDE, or certification. These pages shall be produced as recertification status sheets.	R&CM COTR ensures performance by R&CM Contractor	PM
Engineering Assessment and Design Calculations.	These shall be required analyses that are used to make recommendations noted in system/component inventory above and shall include results of calculations, analysis of inspection results, and any special engineering analysis that was performed. This item shall include any supplementary engineering assessments that have been performed as a result of repairs, alterations or as conditions that have occurred during the service life of the system/component. Design calculations for components such as pressure vessels, vacuum vessels, and piping shall include pressure, temperature, vibration and any other applicable loading. They shall specify the applicable code, standard, or other design basis.	R&CM COTR ensures performance by R&CM Contractor	PM
Manufacturers ' Data Reports.[1]	These shall be any data reports produced by the component manufacturer that substantiates the integrity of the pressure vessel/system. For new pressure vessels/systems, the manufacturer's data reports shall be furnished with all components built to the rules of the ASME Boiler and Pressure Vessel Code (e.g., ASME forms U-1, U-1A, U-2, U-2A, U-3, U-4 as applicable).	R&CM COTR ensures performance by R&CM Contractor	PM
Vendor Information.[1]	For components such as pumps, compressors, valves, gages, relief devices, and flexible hoses, the drawings shall be certified outline and cross-sectional drawings showing information such as make, model, materials of construction, and design and operating data. Vendor data sheets shall also be collected and maintained.	R&CM COTR ensures performance by R&CM Contractor	PM

[1] One hundred percent of this data may not be obtainable for existing pressure vessels/systems, but as much historical data as possible shall be gathered.

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Table 2.4, Required Documentation in the Permanent Record File (Cont.).

Item	Description	Responsible Party	
		Existing	New
Manufacturers' Drawings.[2]	For components such as pressure vessels, vacuum vessels, piping, heat exchanges, separators, and expansion joints, the drawings shall be either the certified shop fabrication drawings or as-built drawings. The drawings shall contain the following: 1. Manufacturer's name and address; 2. Date of manufacture (see vessel nameplate); 3. Dimensions and details of construction; 4. Design and operating conditions, including service fluid, operations temperature, and MAWP; 5. Material thickness (including head and shell); 6. Identification of material, including type of alloy, tensile properties, and impact properties; 7. Efficiency of weld joints; 8. Nondestructive examinations performed (including radiographic, ultrasonic and magnetic particle.); and 9. Type of pressure tests performed (hydrostatic, pneumatic).	R&CM COTR ensures performance by R&CM Contractor	PM
Inspection, Examination, And Test Results.	Inspection, examination, and test results such as hydrostatic, pneumatic, ultrasonic, magnetic particle and radiographic shall be retained. Of particular importance shall be the records of relief valve tests. Radiographic film and weld joint location drawings shall be sent to the R&CM Contractor for stowage and retention.	R&CM COTR ensures performance by R&CM Contractor	PM
NDE Assessment.	This item shall contain any NDE reports that have been conducted on system components.	R&CM COTR ensures performance by R&CM Contractor	PM
Inservice Inspection Schedule	This section shall contain the inservice inspection schedule along with the corresponding inspection results.	R&CM COTR ensures performance by R&CM Contractor	
Weld Joint Map.	This section shall contain welding joint information and an index for the radiography film that the R&CM COTR shall ensure is kept by the R&CM Contractor.	R&CM COTR ensures performance by R&CM Contractor	
Facsimile of Nameplate Data.	This shall be a facsimile of National Board code stamps, which has been imprinted on the component or vessel.	R&CM COTR ensures performance by R&CM Contractor	
Material Certification of Compliance[1]	If required by contract specifications, material certifications shall be furnished by the material manufacturer for the material supplied to certify compliance with specifications. They shall contain information such as material manufacturer, purchaser, material specification, description of material furnished, heat number, chemical and mechanical properties and results of test.	R&CM COTR ensures performance by R&CM Contractor	PM

[2] One hundred percent of this data may not be obtainable for existing pressure vessels/systems, but as much historical data as possible shall be gathered.

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Table 2.4, Required Documentation in the Permanent Record File (Cont.).

Item	Description	Responsible Party	
		Existing	New
Welding Procedures and Procedure Qualifications.	These shall be required by contract specifications and shall be initially reviewed by NASA. Under normal conditions, these records are not required to be maintained as part of the permanent record file. However, if the welding was of a "special" type, the procedures shall be maintained.	R&CM COTR ensures performance by R&CM Contractor	PM
Records of Pre/Post Weld Heat Treatments.	These shall be required by contract specifications.	R&CM COTR ensures performance by R&CM Contractor	PM
Maintenance History.	This shall be retrieved from the Computerized Maintenance Management System (CMMS) maintained by the Systems Engineering Competency.	R&CM COTR ensures performance by R&CM Contractor	n/a
Records of Modifications.	This section shall contain any CoF specifications that have been completed on a particular system.	R&CM COTR ensures performance by R&CM Contractor	n/a
Accident/ Incident Reports.	These reports shall be maintained by OSFA. The R&CM COTR shall direct the R&CM Contractor to review these reports and include in the permanent record file any specific incident that is applicable to pressure systems, components, or vessels.	R&CM COTR ensures performance by R&CM Contractor	n/a
Cyclic Information or Record of Thickness Measurements.	This section shall contain information regarding the pressure vessel/piping designed cyclic data or records of thickness measurements. Also included in this section shall be the expected corrosion rate. This data shall be reviewed at the recertification date and be considered in the determination of the systems future life expectancy.	R&CM COTR ensures performance by R&CM Contractor	PM
Recertification Memo.	A copy of the recertification memorandum completed by the PSM shall also be included in the file.	R&CM COTR ensures performance by R&CM Contractor	n/a
Deviations.	This section shall contain applicable deviations that apply to the particular pressure system or vessel. The PSC must present a deviation for approval to the Executive Safety Board. Once the deviation has been approved, the PSM shall provide a copy of the approved deviation to the R&CM Contractor for inclusion in the permanent record file.	R&CM COTR ensures performance by R&CM Contractor	PM
Miscellaneous.	This section shall contain any particularly noteworthy observations, findings, evaluations, assessments, or reports that pertain to the applicable pressure system or vessel.	R&CM COTR ensures performance by R&CM Contractor	n/a

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For existing systems, the R&CM COTR shall ensure the R&CM Contractor gathers and reviews the following items not included in the PSD during the phase 1 engineering assessment:

- Engineering analyses of pressure system, including structural analysis and flexibility analysis, if applicable or required by ASME Code,
- Manufacturer's Data Reports,
- Facility and system description narrative,
- Inservice inspection plan,
- List of drawings for system,
- Material documentation,
- Field measurements,
- Recertification memorandum, and
- Other pertinent engineering data.

These items shall be referenced on the recertification sheet under the columns FN (footnotes) and REFERENCE (see Figure 2-3). The location of specific supporting data shall be noted in the document reference sheet supplied as part of the PSD (see Figure 2-4).

2.6. RECERT PHASE 3 – INSERVICE INSPECTION

Phase 3 is the inservice inspection element of LaRC's pressure vessels/systems safety program, and whether the system is an existing system or a new system, the activities performed are the same. The primary goal of inservice inspection shall be verification of the integrity of a pressure vessel/system or identification of repairs necessary to maintain the integrity. A secondary goal shall be updating the specific pressure systems documentation.

At the start of phase 3, every time the system is modified or whenever inservice inspections are conducted, the R&CM COTR shall ensure the R&CM Contractor incorporates changes to the pressure system documentation (i.e., the database and permanent record file) using the CNS process detailed in LPR 1740.4, "Facility Systems Safety Analysis and Configuration Management."

2.6.1. Performing Inservice Inspection

The R&CM COTR shall ensure the R&CM Contractor performs the appropriate inspections as required by the IIP and coordinates with the PSM and the Facility Coordinator (FC) to find a convenient time that does not interfere with facility activities to perform required inspections. All nondestructive evaluation personnel shall be qualified in accordance with American Society for Nondestructive Testing (ASNT) SNT-TC-1A, "Recommended Practice for Nondestructive Testing Personnel Qualification and Certification." Specific inspector qualifications shall be denoted within the NDES procedures.

2.6.2. Results of Inservice Inspection/Repairs

Results of the inservice inspection shall be forwarded to the PSM and appropriate FC

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and Facility Safety Head (FSH). In addition, a copy shall be placed in the permanent record file. The format for the inspection results shall be denoted within the applicable inspection procedure.

The R&CM COTR shall ensure the R&CM Contractor evaluates the results and determines corrective actions, if any, to be taken. The PSM shall review the R&CM Contractor's evaluations and recommended corrective actions. Similar to RECERT phase 2, actions may include further NDE inspections, no additional action necessary, repairs, or if conditions warrant, derating or decertifying of the system or vessel. If as a result of IIP inspections repairs are necessary, they shall be performed in accordance with section 2.5.3. Those deficiencies that are minor in nature, such as illegible pipe marking, lock wires missing and improper color banding on piping, shall be corrected by the FC through the normal maintenance channels.

2.6.3. Updating Pressure System Documents (PSD)

The R&CM COTR shall ensure the R&CM Contractor updates PSDs and forwards this CCD document through the CNS process per the requirements of LPR 1740.4. Using the results of the inservice inspections, the data in the pressure system database shall be updated or new Recertification Status Sheets shall be produced if none exist. These updated Recertification Status Sheets and the Pressure Systems Documents (PSDs) shall be available to all facilities at LaRC under the Configuration Management On-Line (CMOL) program. Users are permitted to download and print this information.

2.6.4. Periodic Review of Permanent Record File

Per NPR 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems," the recertification period for pressure vessels and piping shall last from ten to twenty years. At the end of the specified period of time, a review of the permanent record file shall be conducted by an OSFA representative and the PSM. The R&CM COTR shall direct the R&CM Contractor to assist with the review. The purpose of this review shall be to provide an opportunity to consider trends that may negatively (shorten) or positively (lengthen) affect the IIP and recertification interval for a particular system. The PSM shall also have representatives from the Systems Engineering Competency (SEC) and the facility involved in this review to allow comments and concerns from field maintenance and facility operations.

Particular items to be examined shall include:

- The permanent record file,
- Past inservice inspection results (paying particular attention to trends),
- Maintenance history file (from zone maintenance section of the SEC),
- Statistical trends denoted by the NDE inspections, operational concerns, and
- Other items as deemed appropriate.

This review shall consider if the already existing IIP needs modification. After the review has been completed, a new recertification letter shall be issued by the PSM

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along with the revised, if necessary, IIP. A report outlining findings of this review shall be issued by the PSM and given to the R&CM Contractor to become part of the systems permanent record file.

2.7. ANNUAL REPORTS

As required by NPD 8710.5, “NASA Safety Policy for Pressure Vessels and Pressurized Systems,” the PSM shall annually prepare and forward a NASA RECERT Status Report to NASA Headquarters. This report shall include any noteworthy lessons learned, failures, problems, and unique solutions regarding pressure systems.

2.8. PRESSURE SYSTEMS DATABASE

The R&CM COTR shall direct the R&CM Contractor to develop the pressure systems database during phase 1 and 2 and shall ensure the R&CM Contractor maintains the database during phase 3. This database shall include all of the pressure system component information collected during field surveys, IIP, and documentation review for recertification. It shall constitute a substantial portion of the data collected to support the Pressure Systems Document (PSD). Specific information that comprises the pressure systems database shall be illustrated on recertification status sheets. Figure 2-2 details the key to recertification status sheets and Figure 2-3 is a sample of a compiled recertification sheet.

These RECERT status sheets shall be accessible to users at LaRC through the Configuration Management On-Line (CMOL) program. Users can download and print this information.

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3. MAINTENANCE AND REPAIR PROGRAM

3.1. GENERAL

The material integrity of any high-pressure system shall be maintained through a program of regular maintenance, documented repairs, inservice inspections and planned facility upgrades. This chapter outlines the facets of the maintenance and repair programs that work together to maintain pressure system integrity.

3.2. PREVENTIVE MAINTENANCE (PM)

The Computerized Maintenance Management System (CMMS) is managed by the Zone Maintenance Section, Systems Engineering Competency (SEC). The preventive maintenance program shall consist of numerous maintenance checks that periodically occur on a particular system. Specific entries into this computerized maintenance system shall be the result of manufacturer's suggested maintenance, facility engineering recommendation, or by FC request. The FESS COTR shall ensure the FESS Contractor performs the periodic maintenance in accordance with the CMMS schedule and reports completed actions to the appropriate FC and the SEC.

The most important safety devices on any pressurized system are the safety devices provided for overpressure protection of that system. These are devices such as safety valves, safety relief valves, rupture disks, or other non-reclosing devices that are called upon to operate and reduce an overpressure condition. The FESS COTR shall ensure operational testing of these safety devices is conducted by the FESS contractor based on the periodicity denoted in the CMMS. Once these safety devices have completed satisfactory testing, they shall be tag (see Appendix A) and return them to service.

3.3. REPAIRS

Repairs to correct material deficiencies shall be documented using the same CMMS that records the preventative maintenance program. However, in the event that a repair modifies a high-pressure system, a CNS shall be submitted in accordance with LPR 1740.4, "Facility System Safety Analysis and Configuration Management." In this fashion, Configuration Management (CM) shall be maintained.

3.4. PLANNED SYSTEM MODIFICATIONS

From time to time it shall be necessary to upgrade or modify existing high-pressure facilities. Again, as noted in LPR 1740.4, "Facility System Safety Analysis and Configuration Management," modifications that affect configuration controlled systems must be documented. A CNS shall be completed and submitted. Through the CNS process, the R&CM Contractor is made aware of impending modifications to existing pressure systems or vessels. This allows the R&CM Contractor to be prepared to update the pressure system database, PSD, and the permanent record file respectively in order to maintain an up-to-date permanent record file and pressure

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systems database.

3.5. INTERFACE WITH PRESSURE SYSTEM DATABASE

As noted in Chapter 2, the permanent record file shall be the repository of all changes that have occurred to the pressure system or vessel. The key form that shall trigger all the document changes and alerts the R&CM Contractor to impending modifications shall be the CNS. Once the CNS form comes to the R&CM Contractor, it shall alert them to imminent pressure system modifications. This allows the R&CM Contractor to interface with the PSM and determine the most logical time to schedule a field survey and update the pressure system database regarding the respective vessel/system.

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4. OPERATIONS

4.1. GENERAL

Operating procedures and operational logs are critical to the operation of pressure vessels/systems. Operational records/logs shall provide a continuous chronological narrative of the facility operation and shall provide a history of service being conducted (continuous, intermittent, or irregular). Additionally, these types of logs shall be used in determining trends in system performance, cyclic information, and material issues. Issues, incidents, and mishaps that warrant further investigation shall be submitted in the format of an accident/incident report.

4.2. OPERATING PROCEDURES/CHECKLISTS

Standard Operating Procedures (SOPs) are essential to the safe operation of any pressure system and shall be developed as specified in LPR 1740.4, “Facility System Safety Analysis and Configuration Management.” Additionally, checklists may be developed using the same process as the SOP covering a particular segment of the systems operation.

4.3. OPERATIONAL RECORDS/LOGS

Within any particular facility, based on the judgment of the FSH and/or FC, a continuous log of operations shall be maintained. This log shall denote:

- The type of test being conducted,
- The date/time/duration of the test,
- Any items that might have caused delays (e.g. status lights not operating, communication difficulties, clogged filters, filling of tanks, model problems and test equipment failures), and
- Significant items of interest (e.g. car crash, power outage, environmental problems (storm, lightning, snow), acute illness of person(s) and fire).

Based on the operational complexity and/or material requirements, records pertaining to specific component or system operation shall be recorded by operators and retained at the facility. Information recorded in these records shall pertain, as a minimum, to temperature, pressure, fluid levels and component status. These records shall be stored chronologically at the facility and shall be used by the PSM in record reviews conducted before recertification. The FSH shall coordinate with the PSM to determine if recording specific information shall be required for maintaining system integrity and future recertification.

4.4. ACCIDENTS/INCIDENTS

As defined in LPR 1740.4, “Facility System Safety Analysis and Configuration Management,” accidents, mishaps, incidents, and close calls shall be documented as specific circumstances dictate. All completed accident/incident reports shall be

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filed with the OSFA. The R&CM COTR shall ensure the R&CM Contractor reviews these incident files periodically to determine if pressure vessels or systems were involved. Copies of such incidents, if noted, shall then be placed in the appropriate permanent record file.

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5. TRAINING

5.1. GENERAL

The introduction of the human element into a perfectly designed and controlled hardware system brings with it a potential for unexpected results. As depicted in statistics compiled by the National Board of Boiler and Pressure Vessel Inspectors, over the past several years anywhere from 15-40% of accidents that have occurred with unfired pressure vessels occurred because of human error. Hence, the only way to minimize the occurrence of "operator error" is using trained, knowledgeable, and qualified operators. The operator must be competent in the high-pressure system's operating procedures, emergency systems/components, and essential safety devices and limits. Several methods shall be employed to ensure personnel are trained/qualified, both in general pressure vessel/system safety, as well as specific system procedures and limits. This chapter outlines general and specific training requirements for operators and installation personnel.

5.2. HIGH-PRESSURE SYSTEM AWARENESS TRAINING

The OSFA shall be responsible to periodically provide to all installation personnel general pressure vessel/system awareness training. This training shall concern itself with the basic hazards and controls that are inherent in high-pressure systems. Specifically, the following subjects shall be covered:

- Definition of high-pressure systems and vessels;
- Overpressurization protection (safety relief devices);
- Relationship of various pressure terms (Maximum Operating Pressure, MAWP, pneumatic test pressure, hydrostatic test pressure, etc.);
- Programs to maintain integrity of systems (PSCM, IIP, preventative maintenance, inherent design safety factor, qualified operators, etc.);
- Review of incidents/accidents that have occurred (either at LaRC or at other NASA and non-NASA facilities as appropriate);
- Demonstrative illustrations of the potential power that pressurized vessels/systems contain;
- Necessity for procedural accuracy and compliance;
- Personnel/committee roles such as PSM, SPE, PM, PSC; and
- Necessity to conduct only approved modifications to any high-pressure system or vessel.

This training shall be conducted by OSFA either on-site, using the in-house television system or with posted E-mail reminders to be used at employee safety meetings. Each facility's FSH shall be responsible for attendance and informing the OSFA of compliance.

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5.3. HIGH-PRESSURE SYSTEM OPERATOR TRAINING

Pressure system operators/handlers shall be qualified/certified as required by NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems.” Qualified equipment operators shall be certified by line management, as required by LPR 1710.40, “Safety Regulations Covering Pressurized Systems.” The FSH/FC coordinate shall ensure that all equipment operators possess the requisite qualifications in the equipment/system to be operated. This specific training shall include:

- Overview of system design;
- Interrelationship of system components such as valves, control systems, safety devices, interlocks and monitoring equipment;
- Instruction in procedures for specific jobs;
- Alarm conditions (visual and audible) and required emergency action/operation;
- Specific instruction on handling of potentially dangerous fluid or gas used in the process;
- Review of incident and accident reports and the recommendations to prevent reoccurrence;
- Review of recent equipment failures and repairs;
- Review of any changes in system operation and procedures; and
- Review of system notes, cautions, and warnings.

Along with the list of certified operators, records of training shall be kept by the FSH and shall include date, areas discussed, copies of any handouts or lesson plans, and attendance sheets.

5.4. INSPECTOR TRAINING

All NDE of pressure vessels/systems shall be conducted by personnel who are qualified in accordance with American Society for Nondestructive Testing (ASNT) SNT-TC-1A. Additionally, all radiographs shall be reviewed/approved by government inspectors qualified as ASNT level II inspectors. All other acceptance testing of newly installed high-pressure system piping shall be performed by inspectors qualified as either Certified Welding Inspectors or Certified Assistant Welding Inspectors in accordance with American Welding Society (AWS) - D.1.1.

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A. TAGGING OF PRESSURE VESSELS, RELIEF VALVES, AND FLEXIBLE HOSES

A.1 Pressure Vessels

As required by NPD 8710.5 and NPR 1700.6A, a system of marking shall be utilized for pressure vessels and components. In compliance with national codes, all new pressure vessels, vacuum vessels and certain pressure components (e.g.. separators, steam ejectors and heat exchangers) shall have the appropriate “U” or “UM” stamp required by ASME Code Section VIII. This ASME stamping shall include:

- MAWP (psi at °F),
- Minimum design metal temperature (°F at psi),
- Manufacturer serial number, and
- Codes pertaining to radiography and post weld heat treatment.

A.2 Tagging of Relief Valves

Periodic inspection and maintenance of relief valves is critical to ensure their continued functioning and assurance of operation. As required by the American Institute (API) Standards, ASME Boiler and Pressure Vessel Codes, ASME Codes for Pressure Piping (B3 series) and NPR 1700.6A, relief valves shall be periodically inspected, tested, and tagged. The FESS COTR shall ensure tags are installed on the relief device by the FESS contractor and that they contain the following information:

- Valve number,
- Set pressure, and
- Test date.

Tags shall not impede the movement or operation of the relief valve or introduce stress concentrations or notches that would compromise the vessel/component integrity. Tagging shall be accomplished at initial installation and retagging shall be conducted during required maintenance checks. The R&CM COTR shall ensure tags are checked by the R&CM Contractor during inservice inspections and field surveys.

A.3 Tagging of flexible hoses

Flexible hoses shall be tagged at system installation with the following information:

- Unit identification,
- Test pressure, and
- Test date.

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B. WAIVERS/DEVIATIONS

B.1 Waivers

Due to the invasive nature of certain hydrostatic tests, it shall be acceptable to request a waiver from a hydrostatic test. This request for a waiver may be a result of a repair when the required hydrostatic test introduces water to large sections of piping that are dry. The water introduction may result in an even greater system hazard than the one presented by the omission of the hydrostatic test itself.

Waivers from hydrostatic testing shall be submitted to the Standard Practice Engineer (SPE) by the Facility Systems Project Manager (PM) or Facility Safety Head (FSH) as appropriate. Typically, the PM shall submit the waiver if it was the result of a Construction of Facility (CoF) and by the FSH due to emergency repairs or maintenance.

Waivers shall be submitted in writing and shall include the following information:

- Date of submission,
- Outline of repair or modification conducted,
- Outline of specific hydrostatic test that is being waived, and
- Justification for waiver submittal.

If the waiver request is approved by the SPE, then a signed approved copy of the waiver shall be returned to the PM or FSH as appropriate with a copy sent to the R&CM Contractor for filing in the permanent record file.

Pneumatic testing shall be conducted when hydrostatic testing is not feasible. Specific procedures for approval and conduct of a pneumatic test, including the required establishment of a hazard zone, are found in LPR 1710.40.

B.2 Deviations

Deviations from standards, codes, or guides, shall be submitted in writing by the PM or FSH, as appropriate, to the Pressure Systems Committee (PSC) via the PSM. As an example, a deviation shall be when a system modification does not meet the applicable code for construction (e.g., different pipe type, required radiography could not be performed or the safety factor is reduced).

The request for deviation shall include full justification for deviation, with supporting data and analysis. If the deviation is approved by the PSC, it shall be forwarded to the Executive Safety Board (ESB) for final review and approval.

The final approved deviation shall be returned to the PM or FSH as appropriate. The PSM shall forward a copy to the R&CM Contractor for inclusion within the permanent record file.

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C. VISUAL INSPECTION OF PRESSURE SYSTEMS

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VISUAL INSPECTION
OF
PRESSURE SYSTEMS

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1. Purpose

The purpose of this procedure shall be to establish the methods and reporting requirements for the RECERT Phases II and III visual examination of pressure systems.

2. Scope

This procedure identifies the requirements for performing a visual inspection of system piping, welds, and components.

The inspection shall consist of visual observation of exposed external portions of the piping, welds, and components. The System Inspection Plan shall specify when visual inspection of internal portions of the piping, welds, and components shall be required.

3. Visual Inspection Prerequisites

3.1 Personnel Certification
Personnel performing the visual inspection shall be certified in accordance with *NDES VT - 9*.

3.2 Component Cleanliness
The welds or components to be visually inspected shall be free of rust, grease, or surface contaminants which may obscure defects.

3.3 Lighting
The weld or component being visually inspected shall be illuminated to attain a minimum of 15 foot-candles. Flashlights or other auxiliary lighting shall be used to acquire the minimum illumination. There shall be no glare or shadows which would interfere with the detection anomalies.

4. Equipment

The following non-inclusive list of equipment shall be used to the extent required to perform individual inspection tasks under this procedure:

4.1 Illumination Equipment - Flashlights, fiberoptic cold light with fiber bundles, spot or area flood lights.

4.2 Vision Aids - Microscopes, jeweler's loupes, magnifiers, and coddington lenses.

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4.3 Measuring Devices - Scales, rules, gages, micrometers, verniers, reticules, and remote measuring borescope adapters.

4.4 Remote Viewing Devices - Fiberoptic or rigid borescopes, periscopes, mirrors, television, video and standard film cameras.

4.5 Recording Devices - Charts, drawings, video recorder or conventional film or radiographic image.

5.0 Initial Conditions

Inspections shall require the accessibility of all components and systems for complete inspection. The removal of coatings, disassembly of components or removal of insulation shall not be normally mandated. No loose debris, rust or other obstructions which may obstruct the inspection, shall be present.

6.0 Inspection Plan

The visual inspection shall be performed in accordance with an approved inspection plan. Inspection plans shall be developed by the Pressure Systems Manager and shall contain, as a minimum, the following:

6.1 System to be inspected.

6.2 Components and/or welds to be inspected.

6.3 Type and class of inspection to be performed.

6.4 Reference drawing numbers.

6.5 Dates for initial and follow-up inspections.

7.0 Types of Examinations

7.1 Direct Visual (DV) Method - This method shall be used when access is sufficient to place the eye within 24 inches of the surface to be examined and at an angle of not less than 30 degrees to the surface. Mirrors shall be used to improve the angle of vision, and aids such as magnifying lenses may be used to assist examinations. The specific part, component, vessel, or section, under immediate examination shall be illuminated with a flashlight on auxiliary lighting to attain a minimum of 15 foot-candles in order to detect small anomalies. Light intensity shall be increased to 50 foot-candles for the investigation and evaluation of suspected defects.

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7.2 Remote Visual (RV) Method - Remote visual inspection shall be substituted for direct examination when necessary. Remote examination shall require the use of mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments.

8.0 Inspection Procedure

All systems shall be inspected from all possible angles. Care shall be exercised to insure complete coverage of each system to the extent that geometry and surrounding equipment allow.

Storage vessel inspection shall consist of the observation of all portions of the pressure vessel shell, the shell penetrations, and reinforcing plates including welds, supports and foundations which are exposed to observation after fabrication. The pressure vessel boundary shall be the first weld or flange on a pipe leaving the pressure vessel, or as identified by drawing.

Weld and component inspection shall consist of observation of all portions of piping, welds, supports or components which are exposed to observation after fabrication.

9.0 Reportable Conditions

Any condition which seems to be a safety hazard shall be documented. Due to the large variety of storage vessels, piping components and ancillary equipment which may be encountered, the following shall also be reported:

9.1 Surface Condition - Severe rusting, corrosion, pitting, gouging, dents or other handling damage.

9.2 Leakage - Evidence of leakage such as stains, steam, or wetness.

9.3 Cracks - Cracks in any vessel, weld, or component.

9.4 Insulation - Loose, frayed or missing insulation.

9.5 Wear - Any loss of material due to mechanical interference between components or supports. The entire length of all flexible hoses shall be inspected.

9.6 Vibration - Evidence of any component movement in excess of 1/2 inch.

9.7 Fasteners - Failed, missing, damaged or undersized fasteners. Not more than one thread shall be disengaged in any nut.

9.8 Supports - Loose, failed or missing supports.

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9.9 Foundations - Broken, inadequate or shifted foundations.

9.10 Welds - Insufficient or excessive weld reinforcement, excessive undercut, or lack of fusion.

10. Reporting

The results of all visual examinations shall be documented and distributed to the Recertification and Configuration Management (R&CM) Contractor, the Pressure Systems Manager, and NDES facility files.

The inspection report shall include, as a minimum, the following:

10.1 System or components inspected.
10.2 Date of inspection.
10.3 Name of inspector with certification level.
10.4 Inspection results.
10.5 Inspection Plan Drawing Number and Item Number.
10.6 Inspection equipment and fixturing used so as to facilitate re-inspection as necessary.

Submitted By: _____ Date : _____

Title: _____

Approved By:_____ Date : _____

Title:_____

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D. ACRONYMS

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
B&PV	Boiler and Pressure Vessel
CAD	Computer-Aided Design
CCD	Configuration Controlled Document
CFR	Code of Federal Regulations
CM	Configuration Management
CMMS	Computerized Maintenance Management System
CMOL	Configuration Management On-Line
CNS	Change Notification Sheet
CoF	Construction of Facilities
DOL	Department of Labor
DOT	Department of Transportation
EC	Effort Code
FBL	Facility Baseline List
FC	Facility Coordinator
FSH	Facility Safety Head
IIP	Inservice Inspection Plan
LAPD	Langley Research Center Policy Directive
LPR	Langley Research Center Procedural Requirements
LaRC	Langley Research Center
MAWP	Maximum Allowable Working Pressure
MT	Magnetic Particle Testing
NB	National Board
NBIC	National Board Inspection Code
NDE	Nondestructive Evaluation or Nondestructive Examination
NPR	NASA Procedural Requirements
NTF	National Transonic Facility
NTS	NASA Technical Standard
ORR	Operational Readiness Review
OSMA	Office of Safety and Mission Assurance
OSFA	Office of Safety and Facility Assurance
OSHA	Occupational Safety and Health Administration
PFR	Problem/Failure Report
PM	Facility Systems Project Manager
PSC	Pressure Systems Committee
PSCM	Pressure Systems Configuration Management
PSD	Pressure Systems Document
PSM	Pressure Systems Manager
PV/S	Pressure Vessels and Pressurized Systems

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RT	Radiographic Testing
SEC	Systems Engineering Competency
SOP	Standard Operating Procedure
SPE	Standard Practice Engineer
UT	Ultrasonic Testing
VT	Visual Testing

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E. DEFINITIONS

Alteration: Any change in the original manufacturer's documentation which affects the pressure-containing capability of the pressure retaining item. Non-physical changes such as an increase in the maximum allowable working or design pressures (internal or external) or design temperature of a pressure retaining item shall be considered an alteration. A reduction in minimum temperature such that additional mechanical test(s) are required shall also be considered an alteration.

Applicable Codes, Standards, Guides: Any national consensus code, standard or guide or any LaRC accepted design code, standard or guide for the design verification of pressure vessels, systems or their components. See NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems" and NPR 1700.6A, "Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems."

Certification: The initial documentation attesting that a pressure vessel or system is designed, fabricated, and tested in accordance with applicable codes, standards, or guides (or PSC approved deviations have been obtained) and is safe to operate at a specified pressure in a specified environment and under specified conditions.

Change Notification Sheet (CNS) (NASA Langley Form 127) (LPR 1740.4, "Facility System Safety Analysis and Configuration Management"): A formal change notice identifying all existing Facility Baseline List (FBL) drawings (or other documents), and any new drawings/documents which are to be included in the Facility Baseline as CCD's at the conclusion of the specific project or modification.

Configuration Controlled Documents (CCD) (LPR 1740.4, "Facility System Safety Analysis and Configuration Management"): Documents that are part of the Configuration Management system and are listed in the FBL. A working master of all drawings listed in the FBL are kept at the facility and are the responsibility of the FC.

Configuration Management On-Line (CMOL): The on-line computerized system that allows all users to view CCD drawings, the pressure systems documents, and numerous other design, operational, and facility support items. The R&CM COTR shall ensure this system is maintained by the R&CM Contractor. Other users shall submit information to the R&CM Contractor as they are noted.

Construction Managers: Individuals, assigned to the Systems Engineering Competency , who coordinate the Construction of Facilities (CoF) projects, liaison with PM, the Office of Safety and Facility Assurance (OSFA), FC, Design and Inspection Contractor, and the builder to ensure the timely completion of contract requirements.

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Derating: The lowering of the maximum allowable working pressure or narrowing of the allowable operation temperature range of a pressure vessel or system.

Design Pressure: The pressure used in the design of a vessel or system for the purpose of determining the minimum permissible thickness or physical characteristics of the different parts. When applicable, static head shall be added to the design pressure to determine the thickness of any specific part of the vessel.

Design Temperature: The metal temperature used in the design of a vessel or system for determining the minimum required thickness of the components and for selecting the maximum allowable stress for the material used in the vessel or system.

Deviation: Document used to record and request acceptance of a design, fabrication, or use of a pressure vessel, piping, and associated equipment, which is not in compliance with applicable codes, standards, guides, or LaRC supplementary requirements that becomes a part of the permanent record for applicable systems or vessels. Deviations shall be approved by the Executive Safety Board.

Facility Coordinator (FC): Individual who has overall responsibility for the operations of an assigned facility.

Facility Safety Head (FSH): Individual who serves as the focal point between the facility, PSM, RECERT contractor, and PSCM contractor, for certification/recertification and inservice inspections.

Facility Systems Project Manager (PM): Individual designated to supervise and coordinate the design, fabrication, installation and initial certification of pressure vessels, pressure systems, piping, and associated equipment.

Field Surveys: Surveys used primarily on older pressure systems to identify all components within a particular high pressure system. Once completed and compiled this information shall be the basis for the component list within the recertification status sheet.

Hazardous Fluids: Gases or liquids of such a nature that a given quantity, when mixed or unmixed with air, is hazardous to personnel or equipment due to flammability, toxicity, or extremes of temperature.

Hydrostatic Test: The test of a pressure vessel or system during which the vessel or system is filled with a liquid (usually water) and pressurized to a designated level in a manner prescribed in the applicable code.

Inservice Inspection Plan (IIP): A plan for periodic inspection of a vessel, system or component while in service. If required, the vessel, system, or component shall be inoperative during the inspection. This inspection may be external or internal and use

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a variety of Nondestructive examination methods (e.g. visual, magnetic particle and ultrasonic testing. See ANSI/NB-23 section RB.

Inspection Schedule: The planned inspection schedule distributed with the certification or recertification letter from the PSM. It shall indicate the type of inspection and the year in which the inspection shall be completed.

Maximum Allowable Stress: The maximum stress permissible for any specified material that shall be used in the design formulas.

Maximum Allowable Working Pressure (MAWP): The maximum gauge pressure permissible at a designated temperature for a particular vessel or system. The MAWP shall be the basis for the pressure setting of the pressure relieving devices protecting the vessel.

Maximum Operating Pressure (MOP): The highest pressure at which a system may be operated shall be called the MOP.

National Consensus Standard: Any standard, or modifications thereof, which (1) has been adopted or distributed by a nationally recognized standards producing organization under procedures whereby it can be determined by the Secretary of Labor or by the Assistant Secretary of Labor for Occupational Safety and Health that persons interested and affected by the standard have reached substantial agreement on its adoption; (2) was formulated in a manner that afforded an opportunity for diverse view to be considered; and (3) has been so designated by the Secretary or the Assistant Secretary, after consultation with other appropriate Federal Agencies. A standard, as used in this definition, shall indicate the requirements necessary and appropriate to provide a safe and healthful employment environment.

Operating or Working Temperature: The metal temperature that shall be maintained in the part of the vessel or system under consideration during normal operation.

Operating Pressure: The gauge pressure at which a vessel/system normally operates. For a vessel, it shall not exceed the MAWP and, for a system, it shall not exceed the design pressure, except for occasional variations in accordance with ASME B31.3, paragraph 302.2.4 criteria.

Permanent Record File: A compendium of all documentation regarding a particular pressure vessel or system that contains the PSD, inservice inspection reports, special inspections, test results, weld maps, radiography index, accident/incident reports, computer maintenance history report, CNSs, previous certification and recertification letters, engineering assessments, nameplate data facsimile, any National Board Forms (ANSI/NB-23, “National Board Inspection”), and other documentation as outlined in Chapter 2.

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PHASE 1: The first phase of the recertification process where documentation shall be gathered, components identified, and initial non-destructive examinations performed. Initial field surveys occur in PHASE 1.

PHASE 2: The second phase of the recertification process where either additional repairs/modifications or NDE shall be completed before recertification.

PHASE 3: The third phase of the recertification process where the high pressure system has been recertified and the system shall then be periodically inspected as part of the IIP. The PSD shall be revised to reflect any changes in the system.

Pneumatic Test: A test of a pressure vessel or system in which a gas is introduced and pressurized to a designated level in a manner prescribed by the applicable code.

Pressure System: An assembly of components under pressure including vessels, piping, valves, relief devices, pumps, expansion joints, gages, etc. For the purpose of this LPR, pressure systems at or above 150 psi shall be routinely considered high pressure.

Pressure Systems Configuration Management (PSCM) (LPR 1740.4, "Facility System Safety Analysis and Configuration Management"): A subprogram under the Configuration Management (CM). In this subprogram, the component databases shall be constantly updated as modifications are made to the pressure systems.

Pressure Systems Document (PSD): A Configuration Controlled Document (CCD) that includes CAD produced isometric drawings of pressure systems generated as part of the certification/recertification efforts. They shall be the primary documents used to facilitate future recertification efforts. PSDs are useful to engineering and facility personnel in preparing design changes and during maintenance, repairs and system inspections. The PSD shall list all components that comprise the pressure system. Included are the recertification status sheets which tabulate the database collected during field surveys.

Pressure Systems Manager (PSM): Technical expert, designated by LaRC, for all matters involving pressure vessels/systems, their operations and related certification/ recertification activities and who shall serve as the technical team leader for the Recertification Team.

Pressure Vessel: Any vessel used for the storage or handling of gas or liquid under positive pressure. Included in this definition shall be the components of systems, e. g., heat exchanger shells and drying towers, and other shell structures for which the rules of the ASME Code, Section VIII would apply.

Recertification: The procedure (appropriate tests, inspections, examination, analyses, and documentation) which qualifies a previously certified vessel or system to continue or be returned to operation for its particular service.

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Recertification and Configuration Management (R&CM) Contractor: Personnel who perform field surveys, researches the MAWP for each system component, analyzes components as required, directs non-destructive examinations, and reports results to the PSM as required. They also update "redlined" CCD drawings as they are submitted in accordance with the appropriate CNS, forward finalized drawings to the Systems Engineering Competency and maintain the computerized on-line system for CNS submittals, system drawings and CCD documents.

Recertification Period: The time between recertifications when a certified status is maintained through documented periodic examinations and inspections to determine acceptable vessel or system condition as determined when the IIP is developed. The length of this period shall depend upon the results of the initial and subsequent inspection, test, and engineering analyses.

Recertification Status Sheets: These sheets shall be completed by the RECERT contractor during the PHASE 1 inspection of a specific pressure system. The sheets shall tabulate all the information known about a particular pressure system. Once completed, the sheets shall include all components of a particular pressure system, e.g., gauges, tees, unions, valves, connectors, fittings, flexible hoses, tubing, expansion joints, vessels and relief valves. Included shall be the component's installation date, the date of inspection, MAWP, and working pressure of the system at the components location, along with a recommendation to certify, recertify, remove, repair, derate, or waive a particular component.

Repair: The work necessary to restore a pressure vessel or system to a safe and satisfactory operating condition.

Safety-Relief Device Set Pressure: The pressure, exclusive of any tolerance, at which a pressure relief device shall be set to operate.

Standard Practice Engineer (SPE): Individual designated to review and approve the design and specifications of all pressurized ground systems, and verify compliance with applicable codes, standards, guides, and supplementary requirements of these regulations.

Vacuum System: An assembly of components under vacuum (internal pressure less than that of the surrounding atmosphere) including vessels, piping, valves, relief devices, pumps, expansion joints, and gages.

Vacuum Vessel: A vessel in which the internal pressure has been reduced to a level less than that of the surrounding atmosphere.

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F. REFERENCES

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b. NPR 1700.6A, “Guide for Inservice Inspection of Ground-Based Pressure Vessels and Systems.”
c. LPR 1710.40, “Safety Regulations Covering Pressurized Systems”.
d. LPR 1710.41, “Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds”.
e. LPR 1740.4, “Facility System Safety Analysis and Configuration Management”.
f. American Petroleum Institute (API) Standards.
g. ASME Boiler and Pressure Vessel Code.
h. ASME Code for Pressure Piping (B31 series).
i. ASME High Pressure Systems (1994).
j. American Society for Nondestructive Testing (ASNT) Standards.
k. National Board Inspection Code (ANSI/NB-23).
l. OSHA PUB 8-1.5, “Guidelines for Pressure Vessel Safety Assessment”.
m. “Occupational Safety and Health Standards,” Occupational Safety and Health Administration (OSHA), Department of Labor (DOL), 29 CFR Part 1910.
n. Visual Inspection of Pressure Systems, Nondestructive Evaluation Section Procedure, NDES VT-10A.
o. Nondestructive Examination, Section V, ASME Boiler and Pressure Code, current edition.
p. Procedure NDT-ET-702, Eddy Current Inspection, ADVEX Corporation, June 5, 1990. (See Nondestructive Evaluation Section for details).
q. Rules for Construction of Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code, current document.
r. Rules for Construction of Pressure Vessels, Section VIII, Division 2 - Alternative Rules, ASME Boiler and Pressure Vessels Code, current edition.
s. Minutes of Meeting, NASA-Langley Pressure Systems Committee, May 9, 1988.
t. Gianettino, D.P., Slemp, G.E., Berry, R.F., Jr., and Hudson, C.M.: “Radiographic Inspection through Asbestos Insulation,” Forty-Sixth Meeting of the Mechanical Failure Prevention Group, Vibration Institute, April 9, 1992.

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