NID 8831.124
NPR 8831.2F

Effective Date: April 20, 2023
Expiration Date: **Extended to**:
June 20, 2024

Responsible Office: Office of Strategic Infrastructure

Subject: NASA Interim Directive (NID): Use of Condition Based Maintenance and Maintenance Manager Training

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1. POLICY

It is NASA policy to define requirements for facility maintenance.

2. AUTHORITY

a. The National Aeronautics and Space Act, as amended, 51 U.S.C. 20113(a).

b. Standard Numbers 6, 8, 14, 35 and 40 of the Federal Accounting Standards Advisory Board, dated May 11, 2011, as amended.

c. NPD 1000.0B Governance and Strategic Management Handbook.

3. APPLICABLE DOCUMENTS AND FORMS

a. NPR 8820.2, Facility Project Requirements.

b. NPR 8831.2, Facilities Maintenance and Operations Management.

c. NASA Commissioning Guide, November 2015.

d. NASA Facilities Design Guide.

e. NASA Reliability Centered Maintenance Guide for Facilities and Collateral Equipment, September 2008.

f. NASA Reliability Centered Building & Equipment Acceptance Guide, July 2004.

4. APPLICABILITY

a. This interim directive is applicable to NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers. This directive applies to the Jet Propulsion Laboratory (JPL) (a Federally Funded Research and Development Center [FFRDC]) and other contractors only to the extent specified or referenced in applicable contracts.

b. In this interim directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term “shall.” The terms: “may” or “can” denote discretionary privilege or permission, “should” denotes a good practice, and is recommended, but not required, “will” denotes expected outcome and “are/is” denotes descriptive material.

c. In this interim directive, “NASA directives” refers to Agency-level directives.

d. In this interim directive, all document citations are assumed to be the latest version unless otherwise noted.

e. This interim directive is applicable to NASA directives developed or revised after the effective date of this NID.

5. RESPONSIBILITY

a. The Director, Facilities and Real Estate Division (FRED) shall have authority to:

   i. Incorporate this NID into the Agency's Facilities Operations and Maintenance Program.

   ii. Incorporate this NID into the Agency's Construction of Facilities Program.

b. NASA Center Directors, Center Operations Integrator (COI), and Managers, NASA Management Office - Jet Propulsion Laboratory, are responsible for:

i. Budgeting, per decision memo, for and providing oversight of facilities maintenance requirements for both institutional and critical program facilities and equipment commensurate with the principles of this directive.

ii. Implementing the policies of this directive.

6. REQUIREMENTS

The following outlines the requirements for determining the facility Tiering, equipment asset Criticality Ranking, level of maintenance, and training requirements. For clarification, the Tier category applies to the Facility and the Criticality Ranking applies to the equipment within a facility.

a. Facility Tier Determination

i. Tiered maintenance is a method of categorizing facilities for the purpose of planning and assigning maintenance resources based on the facilities' Mission Relevancy (MR) score.

ii. A facility is a term used to encompass land, buildings, structures, and infrastructure real property improvements, including utilities.

iii. All facilities have been assigned to the appropriate maintenance Tier based on facility MR scores. As new facilities come online, centers shall provide the information needed to generate an MR score which will dictate the appropriate Tier for that facility. Additionally, the MR score of all facilities shall be reviewed on an annual basis which may drive adjustments to Tiers. See appendix A for more information on facility Tiering.

iv. If a center believes the Tiering process results in an incorrect facility assignment, it can request an adjudication. FRED will review and adjudicate conflicts as warranted.

v. The Centers' preventive maintenance, base scope corrective maintenance, and base maintenance contracts shall be organized to follow Tiered Maintenance philosophy and minimum service levels.

vi. Significant repairs (IDIQ or task-based) requiring the use of form 1509 shall be prioritized and managed utilizing the Agency 5x5 risk management process. Repairs to be performed as funding and schedules allow. If funding is not available, risks shall be escalated to the Center's appropriate governing body and to the OSI Integrator when applicable for OSI consideration.

vii. Centers shall document changes within AWP that do not follow the Tier level philosophy outlined within the NID.

viii. Centers shall assess all newly constructed facilities. If the MR score of a newly constructed facility places it outside of Tier 1 or 2, contact FRED for adjudication.

b. Equipment Asset Criticality Analysis (EACA)

i. All Centers shall determine the Criticality of each equipment asset (EA) within a facility and assign the minimum service level. See Appendix B for EACA process.

ii. All Centers must assign a single point of contact as "Designated M&O Manager" who is responsible for implementing the requirements of this document. The Center Designated M&O Manager is responsible for ensuring that a Criticality Ranking is developed and maintained for each piece of equipment. Any deviation in methodology from this policy must be documented by the Centers and submitted for approval from FRED M&O Branch Manager.

iii. The Criticality procedure applies to collateral equipment (also known as related personal property) in all NASA facilities.

iv. Collateral equipment (also known as related personal property) within the facility shall be evaluated and processed through a Criticality Ranking evaluation. This evaluation ranks collateral equipment in a facility based on how its failure would adversely affect safety, environment, mission, maintenance schedule, and cost.

v. The Reliability Centered Maintenance (RCM) guide methodology has been consolidated from 1-10 (None – Hazard) to 1-4 (Critical - Low/Negligible). Table 3 within Appendix B has been developed to correlate RCM Guide and NID methodology.

c. Minimum Maintenance Requirement

i. Tiered Maintenance provides a framework for Centers to allocate their annual resources. The Tiers are broken down into four levels. These requirements fall under the application of RCM, which incorporates maintenance practices such as Condition Based Maintenance (CBM), Preventive Maintenance (PM), and Reactive Maintenance (R-M). Facilities are assigned to the appropriate Tier based on the MR score. The Minimum Maintenance Service Levels in Appendix C specifies the minimum maintenance requirements between system and Tier for the collateral equipment within the facilities in each Tier based upon EACA results.

ii. Centers shall document financial assumptions and constraints associated with exceptions to required service levels for each Tier within the Centers Annual Work Plan. (Example: PM vs. CBM if CBM technology is not available due to lack of funding). In addition, Centers shall document risk if minimum service level cannot be followed within each category and/or Tier. (Example: Tier 3 Facility, if there is a HVAC/AHU that has a Criticality of 1 and CBM is not being completed due to lack of funds or technology not installed, a risk shall be developed). Programs and Centers may choose and fund above minimum service level and requirements if desired.

d. RCM/CBM

i. All NASA facilities and collateral equipment shall be evaluated for the application of RCM, which includes CBM, PM, and R-M per NPR 8831.2F, Chapter 7&8, Reliability Centered Maintenance requirements. The appropriate minimum service level shall be implemented based on facility Tier and EA Criticality per the minimum service level table (reference Appendix C, Table 5). All new buildings or existing buildings that are considered for commissioning, retro-commissioning, or recommissioning shall include an appropriate level of CBM.

1) The maintenance Tier shall be determined as outlined in Appendix A. The Tier level shall be reviewed for all facilities within a 5-year basis and anytime the MR changes.

2) The EA Criticality Ranking shall be performed as outlined in 6B and Appendix B when a facility is assigned a Tier 1-4 level rating. The EA Criticality shall be reviewed at least every five years preferably during the Facility Condition Assessment (FCA) cycle or sooner for collateral equipment impacted by significant changes related to facility utilization, mission occupancy, or facility renovation.

3) Assign and implement the appropriate level of maintenance for each existing facility and/or facilities related equipment based on the facility Tier and EA Criticality per minimum service level table (reference Appendix C, Table 5).

ii. All new construction, repairs, and renovations where designs are initiated shall be analyzed at the 30%, 60%, 90% design stage by the Center's designated M&O Manager or their designee, in collaboration with the Center's Master Planner, to identify the anticipated MR score for the facility, which will dictate the appropriate Tier, and determine the Criticality of the facilities' collateral equipment at submission of the Functional Requirements Document (NF1509) and design.

1) Based on the Criticality determination, the Center's designated M&O Manager shall provide the designer with the RCM/CBM requirements as a part of the submission, so the RCM/CBM requirements can be designed into the project.

2) The requirements provided to the designer shall come from the Reliability Centered Building and Equipment Acceptance (RCB & EA) Guide in the interim until relevant CBM Unified Guide Specification Sections are released to supersede the RCB & EA Guide.

e. Civil Servant Facility Maintenance Manager Training

i. A fully trained facility management work force is key to establishing and sustaining an effective facility maintenance program. Maintenance and Reliability Fundamentals training should be attended by NASA HQ FRED/OSI leadership and Center Maintenance Branch Manager's/Deputy's/Center Reliability leaders. This training provides the latest developments in system/equipment asset maintenance technology, and leadership development topics including change management, and effective communication.

ii. Civil Servant personnel providing building operations and maintenance services, i.e. facility managers, facility operations specialists, facility/building POCs, shall use the Sustainable Facilities Tool (FEDSAT) website (https://sftool.gov/fedsat) to comply with the Federal Buildings Personnel Training Act (FBPTA). Developed and maintained by the General Services Administration (GSA), it provides training for facility managers tasked with maintaining efficient, healthy buildings for our nation's public servants, and buying goods and services that provide maximum value to the taxpayer.

iii. The FEDSAT site assists federal building professionals by assessing their current skill level and providing continuing education to increase their performance.

iv. FEDSAT is a no-cost, online skills assessment, and training tool for FBPTA-affected personnel to demonstrate knowledge of recognized high priority FBPTA "performances," defined as typical job functions for facilities personnel. FEDSAT has resources to help facility managers and facility operations managers assess their performance, demonstrate understanding of high-performance priority areas, locate free training and achieve compliance with the FBPTA. FEDSAT has the following resources relating to operations and maintenance and the FBPTA:

1) Online Skills Assessment Tool: Assesses compliance with Accelerate FM defined competency areas on PC or Mobile devices.

2) Demonstrate FBPTA Compliance: Demonstrate understanding of the 80 high-priority performance areas.

3) Locate Free Training Resources: Links to relevant information across a wide variety of sources.

4) Certificate of Completion: Upon achieving a passing score, print a Certificate of Compliance with the FBPTA.

7. DELEGATION OF AUTHORITY

None.

8. MEASUREMENT/VERIFICATION

a. Performance measurements are established in NPR 8831.2F, Facilities Maintenance and Operations Management, the Annual Budget Call by NASA Headquarters CFO, currently called Planning, Programming, Budgeting, and Execution (PPBE) guidance, and/or memorandum from the Director, Facilities and Real Estate Division, or the NASA Chief Engineer.

b. Annual Performance metrics for each NASA site for the past fiscal year are due to NASA Headquarters, Facilities and Real Estate Division, Maintenance and Operations Branch by November 10th of each year.

9. CANCELLATION

APPENDIX A – TIERED MAINTENANCE

MR Score and Tier Assignment

To create a consistent facility ranking throughout the centers, Mission Relevancy (MR) is used to determine the facility Tier. All facilities have been assigned to the appropriate maintenance Tier based on facility MR scores. As a new facility comes online, center master planners shall provide the information needed to generate an MR score which will determine the appropriate Tier for that facility. Additionally, the MR score of all facilities shall be reviewed on a recurring basis which will drive adjustments to Tiers.

For reference, the FRED/AMP/AIA team initially completed the baseline Mission Relevancy scoring and adjudication using the following formula: MR = User Demand + Mission Need (C score) + Interruptability + Redundancy + Future Mission Need

The facility is then assigned a Tier based upon its MR score as shown in Table 1.

Table 1: MR to Tier Assignment

Facility Tier Assignment	
MR Score	**Tier**
270 - 280	Tier 1
260 - 269	Tier 2
235 - 259	Tier 3
0 - 234	Tier 4

Tier 1: Mission Relevant Facilities that are required to meet the center's critical mission. *Approximately 25% of all facilities.* (i.e., critical infrastructure, utility plants, high risk facilities, highly critical [mission launch & monitoring] facilities, unique center priority as approved by center management/OSI-FRED, facility housing, and unreplaceable national treasures). The goal of the maintenance program for facilities in Tier 1 is to maintain or improve FCI and reduce risk and increase facility equipment asset availability and reliability based upon an EACA.

Tier 2: Necessary Facilities that are mission essential. (i.e., support services, component shops, laboratories, fabrication shops, and noncritical (NC) infrastructure). The goal of the maintenance program for facilities in Tier 2 is to maintain FCI and reduce risk and sustain facility equipment asset availability and reliability based upon an EACA.

Tier 3: Important Facilities that are non-mission essential. (i.e., office spaces, fitness centers, historical facilities, climate-controlled warehouses, NC facilities). The goal of the maintenance program for facilities in Tier 3 is to support facility equipment asset availability and reliability based upon an EACA and allow a possible decrease of FCI by < 5% over a 5-year time span.

Tier 4: Facilities that are non-essential. (i.e., low MR score, non-climate-controlled storage; standby, mothballed, and abandoned facilities). The goal of the maintenance program for facilities in Tier 4 is to focus maintenance resources upon relevant facility equipment assets at minimum maintenance service levels and allow a possible decrease of FCI by >5% over a 5-year time span.

Note:

1. High Criticality infrastructure/systems may exist within facilities of any Tier and may exist outside of any facility. This infrastructure should be maintained at a high level with respect to predictive, preventive, and reactive maintenance regardless of the Tier designation. Refer to minimum service table (reference Appendix C, Table 5) and EA Criticality.
2. FCI is determined, on a yearly basis, by the HQ Deferred Maintenance Assessment.

APPENDIX B – EQUIPMENT ASSET CRITICALITY ANALYSIS (EACA)

This procedure applies to all NASA facilities, structures, systems, equipment (rotating or fixed), and other components (electrical, mechanical and instrumentation). All collateral equipment within the facility shall be evaluated and processed through a Criticality Ranking. The Center's designated M&O Manager is responsible for ensuring that a Criticality Ranking is developed, maintained, and recorded in the computerized maintenance management system (CMMS) for each area or piece of equipment.

Safety and environmental protections are a key component of the development of NASA Criticality Rankings. However, the Criticality Ranking is not intended to fulfill any regulatory requirements nor preclude or replace any safety studies or environmental regulations.

Each equipment asset (EA) in a facility is ranked based upon the impacts to safety, the environment, and the mission if the EA fails. Additionally, the time required to return a failed EA to service, and the likely cost of repairs also factor into the ranking determination. At the conclusion of the ranking process each EA is assigned a Criticality Level ranked from 1 = Highest to 4 = Lowest.

An EA with a high Criticality level is regarded as more critical than an EA with lower values, consequently it receives a higher allocation of resources. EAs with lower Criticality levels receive an allocation of priority and resources too, but with consideration for their lower position in the ranking. This is reflected in the minimum service level table (reference Appendix C, Table 5).

All required life safety, environmental, regulatory, and code compliance, preventive or reactive maintenance shall be fully performed regardless of Criticality level, except as approved by the Authority Having Jurisdiction for standby, abandoned or mothballed facilities.

Once a Criticality Ranking is developed, it should remain static unless a change occurs in the process or mission climate. If a change does occur, then the list must be reviewed and updated to reflect the site's new needs. This review and updating of the critical equipment list should be part of the site Management of Change procedure.

Ranking Process

Facility MR and Tier rankings are key components used to determine equipment Criticality. Prior to starting the Criticality Ranking process, the facilities containing the EAs must have a MR and Tier assigned. See section 6a and appendix A for MR and Tier determination.

Select an Evaluation Team

Selection of an evaluation team is key to the success of this process. Developing EA Criticality requires knowledge about the process, environmental issues, maintenance, and operation of the facility. Input from multiple individuals will be required. Individuals on the evaluation team may include a process/facility, maintenance or reliability engineer, appropriate maintenance technician(s), a safety and environmental contact, and a scheduler. Each member of the team will be required to answer specific questions about each EA while developing the Criticality. The designated M&O Manager is responsible for ensuring a well-balanced team is selected. The team should have a maximum of 8 team members, anything larger will not be productive.

Performance of the Criticality analysis by an outside contractor is permissible providing they have access to the required information and can address questions to the appropriate knowledgeable center employees, including conducting review and information gathering sessions with a group like that described. The product must be reviewed by center employees at key points as it is being generated.

Drawings

Each person who participates in the evaluation process should have an up to date set of Piping & Instrumentation Diagrams, Schematics, facility, and utility mechanical, electrical, and civil drawings.

Data

Using the Master Equipment List or data downloaded directly from the Computerized Maintenance Management System (CMMS); develop an equipment list on an Excel spreadsheet.

The following data should be collected, downloaded, or developed for each piece of equipment:

- Equipment Name
- Equipment Number
- Equipment Type / Category (HVAC, Power, Pressure Systems)
- Cost center (optional)
- Facility Condition Assessment Report (FCA)
- Previous years Maintenance cost data, including:
  - Unscheduled Repair / Work Orders
  - Cost of each Repair / Work Order
  - Scheduled Maintenance Work Orders
  - Cost of each Scheduled Maintenance Work Order
  - Down time attributed to Work Order
  - Installation Date
  - Planned End of Life Replacement Date
  - Warranty Expiration Date
  - Original Equipment Cost
  - Current Replacement Value

Categories

The Criticality Ranking of each piece of equipment is based on the following five (5) categories as shown in Table 2:

- Safety
  Equipment failure has the potential to cause harm to personnel ranging from no harm to possibility of fatality or permanent disabilities.
- Environmental
  Equipment failure has the potential to cause harm to the environment ranging from no impact to a significant regulatory non-compliance event.
- Mission
  Mission relevancy score assigned to the facility containing the equipment.
- Schedule
  Time to restore functionality if the equipment fails, and whether failure impacts mission.
- Cost
  Projected cost to repair or replace the equipment if it fails.

Table 2: Determination of Values Chart

Qualitative	**Critical**	**High**	**Medium**	**Low / Negligible**
Quantitative	**1**	**2**	**3**	**4**
Safety	Failure may result in permanent disability or death.	Failure may result in injury requiring professional medical treatment.	Failure may result in minor injury to personnel resulting in first aid treatment.	No safety impacts.
Environmental	Significant environmental regulatory non-compliance that causes a center shutdown.	Environmental non-compliance that does not cause a center shutdown.	Non-compliance event with internal environmental policy and procedures.	No adverse impact to environment.
Mission	Potential mission impact to a Tier 1 Facility.	Potential mission impact to a Tier 2 Facility.	Potential mission impact to a Tier 3 Facility.	No mission impact OR- Tier 4 Facility.
Schedule **Time Impact (downtime)**	N/A	Potential mission impact resulting in disruption of services for greater than 1 month.	Potential mission impact resulting in disruption of services for greater than 1 week.	No mission impact or failure could result in mission disruption of services for less than 1 week.
Cost **Replacement \ Repair**	N/A	Greater than $1M.	Between $250k - $1M.	Less than $250k.

Table 2 Notes

The Table 2 categories are not equally important. To match the Criticality definitions, the table places the most emphasis on Safety, Environment, Mission, and lesser importance on schedule impact or cost. Therefore, no EA can be ranked greater than a Criticality level of two (2) based on schedule or cost alone.

Scoring

All personnel participating in the development process should meet as a team to assign values to the Criticality scoring categories shown in Table 2. After the values have been assigned choose the lowest numerical value of the five categories, this is the Criticality level. Criticality definitions are provided in Table 3.

Example 1:

An AHU is in a facility with a MR score of 275 (Facility Tier 1). Its failure will not cause any safety impact to personnel, nor will there be a negative environmental impact. Failure will have a negative impact on the mission activities in the building. It will take 3 days to repair a failure, and the cost will be $25k. Each category is ranked based on the definitions in Table 2 above and the highest Criticality ranking (lowest numerical ranking) determines the Criticality level.

Category	Score (1-4)
Safety	4
Environment	4
Mission	1
Schedule	4
Cost	4
Criticality Level:	1

In this example, Mission is scored the highest Criticality with a ranking of 1. The resultant Criticality level of this EA is "1-CRITICAL".

Example 2:

A 500,000-gallon fuel oil tank stores backup fuel for the utility plant in case of a natural gas interruption. It has a MR score of 240 (Facility Tier 3). Its failure will not cause a safety impact, but it will cause a large release of fuel oil that would be contained by a secondary containment dike. Cleanup and restoration after a spill will take over a month and cost about $200k. Each category is ranked based on the definitions in Table 2 above and the highest Criticality ranking (lowest numerical value) determines the Criticality level.

Category	Score (1-4)
Safety	4
Environment	2
Mission	3
Schedule	2
Cost	4
Criticality Level:	2

For this example, Schedule is ranked the highest with a ranking of 2. The resultant Criticality level of this EA is "2-HIGH".

Table 3: Criticality Definitions

Criticality	Criticality Definition
1-Critical	Failure may result in permanent disability or death to operating or maintenance personnel; loss of Mission Essential functionality, significant economic or environmental consequences.
2- High	Failure may result in injury requiring professional medical treatment, or a condition. Failure may result in loss of Mission Essential functionality with limited impact to mission schedule. Failure may result in loss of non-Mission Essential functionality with considerable economic or environmental consequences.
3-Medium	Failure may result in minor injury to personnel resulting in first aid treatment but no required professional medical treatment. Failure may result in moderate Mission impact or loss of non- Mission Essential functionality with mild economic consequences or environmental damage.
4- Low/ Negligible	Failure may result in a condition that has no visible adverse impact to safety, environment, and negligible mission or economic impacts.

Suggestions for Criticality Evaluation

- When trying to decide on a Mission Impact and Safety rating for a piece of equipment, evaluate the most-likely scenario. When going through this process having a Failure Modes and Effects Analysis (FMEA) available for each type of equipment would be beneficial.
- When determining the Schedule (Time Impact) that a failure will have, you need to understand the amount of time needed to obtain the replacement material, complete the corrective maintenance tasks, and return the equipment to operation.
- Redundant equipment should be treated as standalone equipment during the evaluation process. The redundant equipment must be ready to perform its function when put into operation.
- Some judgment will be required when evaluating the different scenarios. It is recommended that the team consider the likelihood of some of the scenarios when determining the ratings.

Using the Critical Ranking of the Equipment List

Once the Criticality Ranking has been determined for the equipment then resources can be appropriately allocated. As stated before, the equipment regarded as most critical receives the higher allocation of resources. Equipment regarded as less critical or “non-critical” receives an allocation of priority and resources too, but with consideration for its lower position on the Criticality list.

Examples of action taken for Level 1, Critical equipment, would be:

- Condition and/or Continuous-Based or Online Monitoring
- More frequent preventive maintenance tasks
- More spare parts
- Upon failure of a critical device, performance of a Root Cause Analysis (RCA) based on criteria listed in Root Cause Failure Analysis

Examples of action for Level 2 equipment might be:

- Less frequent predictive and preventive maintenance tasks and monitoring
- Stocking fewer spare parts

- Less frequent Condition monitoring

Examples of action for Level 3 equipment might be:

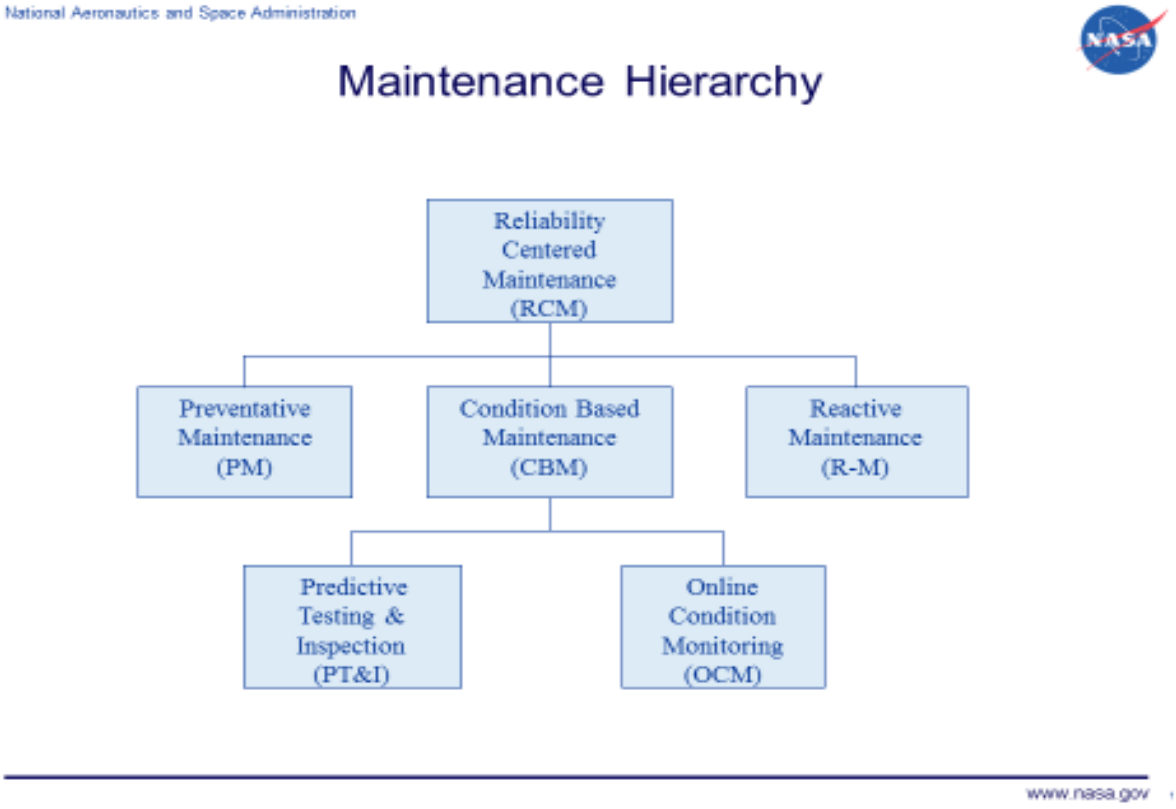
- Run to failure (where appropriate)
- Stocking fewer spare parts
- Less predictive and preventive maintenance tasks
- No Condition monitoring

Examples of action for Level 4 equipment might be:

- Run to failure
- No spare parts
- No predictive and preventive maintenance tasks
- No Condition monitoring

APPENDIX C - MINIMUM MAINTENANCE REQUIRED MATRIX

Table 4: Maintenance Hierarchy



Minimum Maintenance Service Levels (Table 5)

Minimum collateral equipment service levels are determined based on Facility Tier and equipment asset Criticality Ranking. Use Table 5 to determine service level. The facility Tier rating is across the top (Row 3) and equipment asset Criticality levels are shown in parentheses.

Example: Criticality level 3 process support equipment located in a Tier 1 facility.

1. Find equipment type in the first column. (Process Support)
2. Slide to the right and locate the facility Tier column. (Tier 1)
3. Find the service level for the equipment asset Criticality. (3-Medium)
4. The minimum service level for this equipment will be Preventive Maintenance. (PM 3-4)

Table 5: Minimum Maintenance and Operations Service Levels

Minimum Maintenance and Operations Service Levels							
All NASA Facilities (Collateral Equipment & Infrastructure)							
	Tier 1	**Tier2**	**Tier 3**	**Tier4**	**Assumptions**		
Life Safety	CBM/PM	CBM/PM	PM	PM R-M*	Fire detection & suppression, exit lights, fire detection, backflow preventors, (assumed all Life Safety is critical and Centers to choose best method).		* Only for abandoned facilities
Code Compliance	PM	PM	PM	PM/R-M *	NFPA, ASME.		
Structure	R-M	R-M	R-M	R-M	Visual inspection of structures (FCAs) completed. Bridge inspection per FHWA shall be completed.	PM	Preventive Maintenance
Roof	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	PM	R-M		CBM	Condition Based Maintenance
Exterior	R-M	R-M	R-M	R-M	Visual inspection of exterior (FCAs) completed	R-M	Run to fail
Plumbing	PM	PM	PM	R-M	This is building plumbing only		
HVAC	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Electrical	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Utilities (+ Interfaces)	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	PM	Electrical distribution, potable water, sewer, steam, chilled water		
Control systems	N/A	N/A	N A	N/A	Follow requirements listed above as a sub system requirement, includes software and hardware		
Interior Finishes	R-M	R-M	R-M	R-M			
Conveyance	N/A	N/A	N A	N A	Falls under Code Compliance and Life Safety		
Process Support Systems (Chemicals, Air & Gas)	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Launch Systems	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Test Facilities	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Lab Specific Systems	CBM (1-2) PM (3-4)	CBM (1-2) PM (3-4)	CBM (1) PM (2-4)	R-M			
Custodial					See Procurement Service Line		
Grounds					See Procurement Service Line		
Utilities	Cost Usage	Cost Usage	Cost Usage	Cost Usage			

Typical CBM Parameters and Equipment

Table 6: Reference Table CBM Technologies

CBM TECHNOLOGIES	Equipment Class																					
	Transformers	Circuit Breakers	Switchgears	High Voltage Switches	Relays & Meters	Low Voltage Distribution	Interior Emergency Area Lights	Heat Exchangers	Motors	Pumps	Valves	Backflow Preventers	Fans	Filters	Steam Traps	Air Compressors	Lifting Devices	Fire Detection and Prevention	Chiller	Boiler	Generator	Tanks, Piping
Bearing, Temperature/Analysis									X	X			X			X	X		X		X	
Breakaway or Coast-Down Testing									X	X						X					X	
Eddy Current Testing								X											X	X		
Electrical Monitoring	X		X	X	X	X			X									X			X	
Electrical Testing	X	X	X	X	X	X			X									X			X	
Flow Measurement / Differential Pressure								X		X	X		X	X	X	X			X	X		
Insulation Resistance	X	X	X	X	X	X			X												X	
Lubricant, Fuel Analysis	X								X	X						X	X		X	X	X	
Motor Circuit Analysis		X	X	X	X	X			X												X	
Motor Current Signature Analysis									X												X	
Non-Destructive Testing								X					X				X			X		X
Performance Monitoring including Building Automation System	X						X	X	X	X			X	X		X	X	X	X	X	X	
Polarization Index			X	X	X	X			X													
Infrared Thermography	X	X	X	X	X	X		X	X	X	X		X		X	X	X			X	X	
Ultrasonic Analysis	X		X	X	X	X		X	X	X	X	X			X	X			X	X	X	
Valve Operator Testing											X											
Vibration Monitoring/Analysis									X	X			X			X	X				X	
Visual Inspection	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Wear Particle Analysis									X	X						X	X				X	

APPENDIX D – ACRONYMS

AHU Air Handling Unit

AWP Annual Work Plan

CBM Condition Based Maintenance

CMMS Computerized Maintenance Management System

COI Center Operations Integrator

EACA Equipment Asset Criticality Analysis

FBPTA Federal Buildings Personnel Training Act

FCA Facility Condition Assessment

FCI Facility Condition Index

FEDSAT GSA's Sustainable Facilities Tool website

FFRDC Federally Funded Research and Development Center

FMEA Failure Modes and Effects Analysis

FRED Facilities and Real Estate Division

GSA General Services Administration

HQ NASA Headquarters

HVAC Heating, Ventilation, and Air Conditioning

IDIQ Indefinite Delivery, Indefinite Quantity

JPL Jet Propulsion Laboratory

MR Mission Relevancy

NASA National Aeronautics and Space Administration

NC Non-Critical

NID NASA Interim Directive

NPD NASA Policy Directive

NPR NASA Procedural Requirements

NTE Not to Exceed

OCM Online Condition Monitoring

OSI Office of Strategic Infrastructure

PM Preventive Maintenance

PPBE Planning, Programming, Budgeting, and Execution

PT&I Predictive Testing & Inspection

RCA Root Cause Analysis

RCM Reliability Centered Maintenance

R-M Reactive Maintenance