DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
2000 NAVY PENTAGON
WASHINGTON, DC 20350-2000

OPNAVINST 4790.16B
N43
1 Oct 2015

OPNAV INSTRUCTION 4790.16B

From: Chief of Naval Operations

Subj: CONDITION-BASED MAINTENANCE AND CONDITION-BASED MAINTENANCE PLUS POLICY

Ref: (a) DoD Instruction 4151.22 of 16 October 2012
(b) DoD MIL-STD 3034A, DoD Standard Practice Reliability Centered Maintenance Process, 29 April 2014
(c) SECNAVINST 5030.8B
(d) DoD Instruction 5000.02 of 7 January 2015
(e) OPNAVINST 4700.7L
(f) NAVAIRINST 4790.20B
(g) NAVSEAINST 4790.27A
(h) SECNAV M-5239.1 of 1 November 2005
(i) DoD Instruction 8500.01 of 14 March 2014
(j) NAVSEA SL720-AA-MAN-030
(k) OPNAVINST 1000.16L

Encl: (1) Definitions

1. Purpose

a. To establish policy and responsibility, per reference (a), for the implementation and integration of condition-based maintenance (CBM) and condition-based maintenance plus (CBM^{+}) for naval ships, expeditionary equipment, aircraft, and associated systems, equipment and infrastructure.

b. This revision incorporates policy changes for implementing CBM^{+} and follows standards set by reference (a), and for implementing CBM^{+} within maintenance practices. It also includes new language for reliability centered maintenance (RCM) and CBM^{+} that is in line with references (a) and (b). This instruction is a complete revision and should be reviewed in its entirety.

2. Cancellation. OPNAVINST 4790.16A.

3. Scope. This instruction applies to acquisition, logistics, and maintenance activities for all new and legacy programs. CBM and CBM$^+$ concepts, as described in reference (a), apply to all active and reserve naval ships, aircrafts, and the systems associated with them, as well as the infrastructure which supports them. Throughout this instruction, the term "ship" refers to all surface ships, aircraft carriers, submarines, and those patrol and service craft specified in reference (c). The fundamental goal of CBM is to perform maintenance only when there is objective evidence of need, while ensuring safety, equipment reliability, equipment availability, and reduction of total ownership costs (TOC). The evidence of need is objectively determined through RCM analysis.

4. Definitions. Applicable definitions are in enclosure (1).

5. Background

a. Maintenance comprises a major portion of TOC for Navy systems and equipment. Unnecessary maintenance contributes to inflated ownership costs and reduced readiness of deployable assets. Proper application of CBM$^+$ strategies, as part of an overall acquisition or modernization plan per reference (d), will reduce operating and support costs, avoid extensive maintenance man hours, and increase operational readiness. CBM$^+$ is the implementation of CBM by integrating RCM derived maintenance requirements with enabling processes, technologies, and capabilities that enhance the readiness and maintenance effectiveness of Department of Defense (DoD) systems and components. CBM$^+$ strategy consists of the technical requirements for CBM including infrastructure and programmatic elements that enable it to function as a true end-to-end process.

b. At the core of Navy maintenance, RCM, defined in references (b), (e), (f) and (g), provides the principles and rigorous methodology needed to select the appropriate type of maintenance. RCM is the foundation upon which a CBM program is built. CBM, utilizing CBM$^+$ technologies, establishes an integrated, predictive maintenance approach, which minimizes unscheduled repairs, eliminates unnecessary maintenance, and employs the most cost-effective maintenance health management methods. When implemented effectively, RCM and CBM$^+$-enabling technologies can reduce maintenance and supportability requirements. Recent advances in RCM and CBM$^+$ enabling

technologies (e.g., advanced signal processing techniques, neural networks and fuzzy logic, high speed image processing, serialized item management, unique identification (UID), dynamic modeling and simulation, micro-electromechanical systems, wireless data communications, and health monitoring systems) are expected to provide significant improvements in safety, availability, reliability, and affordability.

6. Policy

a. RCM must be used to select the appropriate type of maintenance trigger for Navy equipment and systems. RCM must be used to extend periodicities or eliminate unnecessary scheduled maintenance requirements based on maintenance data and operating experience, as applicable. Additionally, RCM must be used as the means to identify gaps in existing maintenance programs and to add or modify tasks to alleviate deficiencies.

b. CBM^{+} must provide a basis for maintenance decisions that focus limited resources on maintenance most needed to ensure safety and mission readiness.

c. Organic monitoring and control systems must be utilized where applicable to aid in failure analysis and optimize maintenance planning.

d. The transition to CBM^{+} involves changes in policy, processes, procedures, information systems, and logistics support. To this end, maintenance programs must incorporate CBM^{+} strategy to the maximum possible extent, where proven cost effective through business case analysis.

e. CBM^{+} strategy must be used to:

(1) Determine maintenance decisions and optimize calendar-based scheduled maintenance, unscheduled maintenance, and manpower requirements, while reducing operating and sustainment costs and ensuring appropriate maintenance is performed.

(2) Minimize equipment failures and improve operational availability by providing real-time prognostic and diagnostic monitoring capabilities, automated repair scheduling, updating

preventive maintenance schedules, and automated parts acquisition processes for afloat and ashore warfighting and infrastructure systems across the Navy.

(3) Reduce TOC by eliminating unnecessary maintenance and accurately pre-positioning required assets for an effective logistics footprint in support of war fighting requirements.

f. CBM$^+$ policy must be incorporated into existing maintenance programs and into the integrated product support program elements for systems and equipment under acquisition. Navy policy directs that CBM$^+$ must be documented in the system engineering plan and the life cycle sustainment plan program, and assessed during acquisition process reviews and evaluations per reference (d).

g. For legacy systems, rapid system demonstration and testing is desired to evaluate CBM$^+$ technologies. Initial logistics support need only be sufficient to ensure valid testing and proof-of-concept. Prior to comprehensive and repetitive installation of CBM$^+$ supported systems or equipment, complete logistics support is required.

h. CBM$^+$ implementation must include training for maintenance managers, technicians afloat, technical support personnel ashore, and maintenance requirements developers. Embedded and on-board training capabilities must be identified in training plan documentation.

i. CBM$^+$ enabling technologies must comply with DoD architecture framework initiatives and related standards concerning interoperability and openness. CBM$^+$ enabling information systems (data collection, diagnostics and prognostics, and information analysis) must be integrated with maintenance management and logistics support information systems. The impact of information systems data collection, processing, and warehousing requirements on afloat and ashore resources must be included in system design, development, and life-cycle planning.

j. All CBM$^+$ technologies must be compliant with Navy information assurance and cybersecurity policies per references (h) and (i).

k. Chief of Naval Operations (CNO) will fund naval programs, processes, and enabling technologies proven applicable and effective in supporting the maintenance, manning, and cost reduction objectives of this instruction, following the entitled process in reference (j).

l. CBM^{+} metrics must be tracked as specified in reference (a).

7. Responsibilities

a. Director, Naval Nuclear Propulsion (CNO (N00N)). Executive Order 12344 establishes the responsibilities and authorities of CNO (N00N), who also serves as the Deputy Commander, Naval Sea Systems Command, and as Deputy Assistant Secretary for Reactors, U.S. Department of Energy, over all facilities and activities which comprise the Naval Nuclear Propulsion Program. These responsibilities and authorities include all matters pertaining to maintenance, repair, and modification of naval propulsion plants and associated nuclear capable facilities. Nothing in this instruction supersedes or changes these responsibilities and authorities. Accordingly, CNO (N00N) must determine policies and practices pertaining to implementation of this instruction for matters under his or her cognizance.

b. Deputy Chief of Naval Operations for Information Dominance (CNO (N2/N6)); Office of the Chief of Naval Operations (OPNAV) Director, Strategic Mobility and Combat Logistics (OPNAV (N42)); OPNAV Director, Expeditionary Warfare (OPNAV (N95)); OPNAV Director, Surface Warfare (OPNAV (N96)); OPNAV Director, Undersea Warfare (OPNAV (N97)); OPNAV Director, Air Warfare (OPNAV (N98)); and OPNAV Director, Warfare Integration (OPNAV (N9I))

(1) Establish requirements and specific platform guidance for the development, test and evaluation, and implementation of CBM^{+}.

(2) Evaluate the installation and testing results of CBM^{+} enabling technologies with the goal of further refinement and follow-on installation of those items with the greatest potential for cost and manpower savings.

(3) Provide resource sponsorship for the installation of approved CBM+ enabling technologies in cognizant platforms, systems, and equipment, as well as CBM+ enabling processes and procedures and continuous training.

(4) Identify and promote the application of appropriate common CBM+ processes, procedures, and technologies across applicable naval platforms.

c. Deputy Chief of Naval Operations for Manpower, Personnel, Training and Education (CNO (N1))

(1) Coordinate the implementation of innovative manpower reduction initiatives resulting from the implementation of CBM+ policies, processes, and procedures, and the installation of CBM+ enabling technologies.

(2) Ensure fleet manpower documents reflect changes in manpower requirements resulting from installation of CBM+ enabling technologies and from workload reductions resulting from other CBM+ related initiatives per reference (k).

d. OPNAV Director, Fleet Readiness Division (OPNAV (N43)). Provide Navy policy for the development of CBM+.

e. OPNAV Director, Innovation, Technology Requirements and Test and Evaluation (OPNAV (N84/ONR))

(1) Identify science and technology (S&T) requirements for advancing CBM+ enabling technologies in close coordination with CNO, program executive offices (PEO), naval systems commands (SYSCOM), and fleet commanders.

(2) Plan, develop, and coordinate the transitioning of technologies responding to CBM+ S&T requirements.

(3) Coordinate with all SYSCOMs and PEOs the demonstration and rapid transition of requirements-driven CBM+ enabling technologies in Navy systems and platforms.

(4) As the S&T resource sponsor, conduct periodic assessments of the OPNAV (N84/ONR) CBM S&T program with respect to requirements.

f. Director, Strategic Systems Program. Determine policies and practices pertaining to implementation of this instruction for matters under his or her cognizance.

g. SYSCOMs

(1) Support CNO and PEO in the testing and assessment of CBM$^+$ processes, procedures, and enabling technologies with the goal of reducing maintenance costs, extending periodicities, or eliminating unnecessary scheduled maintenance requirements for applicable systems and equipment.

(a) Maintain a cross-competency working group to facilitate CBM$^+$ identification and implementation opportunities at the program level and across the naval enterprise.

(b) SYSCOM leads for CBM$^+$ must advise OPNAV resource sponsors on CBM$^+$ related initiatives to include identification of investment costs, readiness improvements, and potential savings.

(2) Provide technical support for installation, compatibility, and interface of shipboard information management systems and CBM$^+$ automated health monitoring systems. Promote compliance with networks and information integration initiatives and standards for shipboard information, local area network, and CBM$^+$ enabling technologies.

(3) Support the development, integration and standardization of CBM$^+$ technologies into modernization and engineering development efforts.

(4) Support the continual improvement and advancements of CBM$^+$ technologies by providing procedures and initial training to maintenance managers, technicians afloat, technical support personnel ashore, and maintenance requirements developers. Ensure professional development training courses, embedded and on-board training capabilities are identified in training plan documentation.

(5) Review and coordinate platform-specific CBM$^+$ initiatives that would reduce maintenance, personnel workload, and life cycle costs.

(6) Provide engineering support for CBM+ implementation on cognizant platforms and promote application of CBM+ technologies across all applicable platforms to CNO, PEO, fleet commanders, and other SYSCOMs.

(7) Under the principles of open systems architecture, develop a standard data format, interface standards for sensors, information technology, and data management that will serve as the enabling foundation for CBM+ capabilities that acquisition managers must use in the development and implementation of afloat and ashore CBM+ systems.

h. Fleet Commanders

(1) Identify and promote the implementation of proven CBM+ processes, procedures, enabling technologies, and maintenance effectiveness reviews to appropriate SYSCOMs.

(2) Provide operational assessment of CBM+ effectiveness to the PEOs and SYSCOMs recommending changes to CBM+ implementation plans and policy.

(3) Coordinate platform availability for the development and demonstration of emerging CBM+ technologies.

i. PEOs

(1) Support program offices through coordination and promotion of common CBM+ technologies and processes with multi-platform applications.

(2) Support commonality and standardization reviews focusing on products, components, and equipment that may be applicable and for use within the planned system design and development. Coordinate with the SYSCOM CBM+ working groups as appropriate, to expand the use of successful CBM+ initiatives across as many programs as is possible.

(3) Provide recommendations for further development or improvement of CBM+ equipment and systems installed for testing and evaluation.

(4) Promote full scale implementation of appropriate CBM+ technologies on existing and new construction platforms.

(5) Ensure that CBM+ requirements are documented in the system engineering plan and life cycle sustainment plan program, and supported during each acquisition process review.

(6) Ensure professional development training courses, embedded and on-board training capabilities, are identified in the training plan documentation.

j. Budget Submitting Offices. Ensure shore manpower requirements reflect changes in manpower requirements resulting from installation of CBM+ enabling technologies, and from workload reductions resulting from other CBM+ related initiatives, per reference (k).

8. Records Management. Records created as a result of this instruction, regardless of media and format, must be managed per Secretary of the Navy Manual 5210.1 of January 2012.

P. H. CULLOM
Deputy Chief of Naval Operations
(Fleet Readiness and Logistics)

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DEFINITIONS

1. Condition-Based Maintenance (CBM). CBM is a maintenance strategy derived from analysis, using DoD approved RCM principles. CBM includes maintenance processes and capabilities derived from real or near-real time assessments obtained from embedded sensors and external tests and measurements using either portable equipment or actual inspection. The objective of CBM is to perform maintenance based upon the evidence of need in order to ensure safety, reliability, and availability, at an acceptable TOC.

2. Condition-Based Maintenance Plus (CBM^+). CBM^+ is the application and integration of appropriate processes, technologies, and knowledge-based capabilities to achieve the target availability, reliability, and operation and support costs of DoD systems and components across their life cycle. At its core, CBM^+ is maintenance performed based on evidence of need, integrating RCM analysis with those enabling processes, technologies, and capabilities that enhance the readiness and maintenance effectiveness of DoD systems and components. CBM^+ uses a systems engineering approach to collect data, enable analysis, and support the decision-making processes for system acquisition, modernization, sustainment, and operations.

3. Maintenance Effectiveness Review. An RCM-based review of all levels of maintenance utilizing combined SYSCOM, fleet, and engineering integrated teams. The maintenance effectiveness review process applies "Backfit" and "Classic" RCM methodology to examine maintenance requirements for systems or equipment that are exhibiting negative maintenance and reliability trends in execution, such as extra cost through the execution of unnecessary maintenance overtime or the discovery of low reliability due to ineffective maintenance.

4. Preventive or Scheduled Maintenance. Maintenance that can be based on calendar, equipment-operating time, or a cycle, such as number of starts, aircraft landings, rounds fired, or miles driven.

5. Predictive Maintenance. The use of analytic processes to estimate the future (predicted) level of remaining service life

to initiate advance maintenance planning and scheduling. In some cases, a prediction is not viable, but only a diagnostic (current health) assessment can be made.

6. Reliability. The probability that an item will perform a required function under stated conditions for a specified period of time.

7. Reliability Centered Maintenance (RCM). A method for determining maintenance requirements based on the analysis of the likely functional failures of systems or equipment having a significant impact on safety, operations, and lifecycle cost. RCM supports the failure management strategy for any system based on its inherent reliability and operating context.

8. Serialized Item Management (SIM). SIM programs provide accurate and timely item-related data that identify populations of select items (parts, components, and end items) and mark all items in the population with a UID number to enable the generation, collection and analysis of maintenance data about each specific item. Candidate item populations include: repairable items down to and including sub-component repairable unit level; life-limited, time-controlled, or items with records (e.g., logbooks, aeronautical equipment service records); and items that require technical directive tracking at the part number level. See DoD Instruction 4151.19 of 9 January 2014 for more information.

9. Unique Identification (UID). DoD program that enables easy access to information about DoD possessions that will make acquisition, repair, and deployment of items faster and more efficient. UID permanently identifies an individual item and is a system of establishing globally ubiquitous unique identifiers within the DoD, which serves to distinguish a discrete entity or relationship from other like and unlike entities or relationships. UID connects processes such as financial transactions, contracting, logistics, maintenance and engineering. Harnessing this data power will reduce organizational costs in the near and long term, which is the key to success and is a mandatory requirement for all DoD solicitations issued on or after 1 January 2004. See DoD Directive 8320.03 of 23 March 2007 for more information.