# Naval Audit Service

## Audit Report

# Consideration of Hazardous Noise in the Acquisition of the CVN 78 Aircraft Carrier

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N2009-0022
19 March 2009

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19 Mar 09

MEMORANDUM FOR PROGRAM MANAGER, CVN 21 PROGRAM OFFICE
(PMS 378)

Subj: **CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF THE CVN 78 AIRCRAFT CARRIER (AUDIT REPORT N2009-0022)**

Ref: (a) SECNAVINST 7510.7F, "Department of the Navy Internal Audit"
(b) NAVAUDSVC Memorandum 7510 N2007-NIA000-0066, dated 10 Aug 07

Encl. (1) Status of Recommendations
(2) Scope and Methodology
(3) Pertinent Guidance
(4) Center for Naval Analyses Veterans Hearing Loss Disability Costs
(5) Management Response from PMS 378

**1. Introduction.** In accordance with reference (a), we have completed the subject audit (announced by reference (b)) as it relates to multiple selected acquisition programs. This report addresses the results of our audit for the Carrier Vessel Nuclear (CVN) 78 Aircraft Carrier. A senior Department of the Navy (DON) official requested that the Naval Audit Service verify that safety and occupational health issues were addressed during the acquisition process of the CVN 78 Aircraft Carrier through efforts to mitigate noise hazards. The CVN 21 Program Office (PMS 378)[1] made efforts to mitigate noise hazards for the CVN 78 Aircraft Carrier through design selection, which is compliant with the "System Safety Design Order of Precedence" contained in Military Standard 882D (MIL-STD-882D). While, in some cases, the design changes did not mitigate noise to required levels, PMS 378's efforts to mitigate these hazards through design selection helped reduce the exposure of sailors to hazardous noise. However, PMS 378 did not officially identify some known noise hazards on the carrier, including gallery deck[2] and

[1] The CVN 21 Program Office (PMS 378) oversees the acquisition of the future aircraft carrier replacement program for the USS Enterprise and Nimitz Class Aircraft Carriers, starting with the lead ship *Gerald R. Ford* (CVN 78).
[2] The gallery deck is located directly below the flight deck and contains crew living and work spaces. According to the Naval Safety Center, hazards on the gallery deck include exposure to hazardous noise from the flight deck, as well as the catapult, jet blast deflector, and arresting gear equipment.

flight deck[3] noise hazards, and did not assign a Risk Assignment Code (RAC) to, or track, these hazards. Additionally, PMS 378 made efforts to mitigate the gallery deck noise, but did not attempt to mitigate exposure to hazardous noise on the flight deck. We determined that PMS 378 could improve the program management process. Details on our CVN 78 Aircraft Carrier audit results are presented in Section 5, "Audit Results and Conclusions." Our recommendations, summarized management responses, and our comments on those responses are in Section 6, "Recommendations and Corrective Actions."

**2. Reason for Audit.** Our objective[4] was to verify that safety and occupational health issues were addressed during the acquisition process of the CVN 78 Aircraft Carrier through efforts to mitigate the identified noise hazards. We initiated the audit due to increasing concerns expressed by the DON's most senior leaders about hazardous noise.

## 3. Background

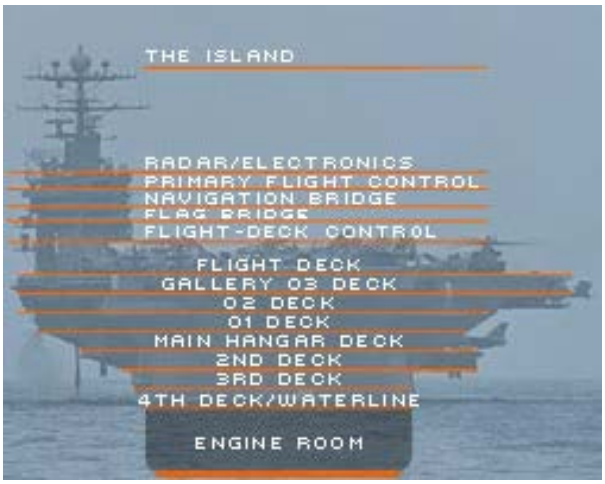
a. **Consideration of Safety and Occupational Health Issues.** The Department of Defense MIL-STD-882D, "Standard Practice for System Safety," dated 10 February 2000, directed the integration of environmental, safety, and health hazard management into the systems engineering process for acquisition programs. According to the Standard, management of mishap risk associated with actual environmental and health hazards is directly addressed by the system safety approach. The Standard defines system safety as the application of engineering and management principles, criteria, and techniques to achieve acceptable mishap risk within the constraints of operational effectiveness and suitability, time, and cost, through all phases of the system life cycle. The objective of system safety is to achieve acceptable mishap risk through a systematic approach of hazard analysis, risk assessment, and risk management.

b. **Global War on Noise.** On 8 June 2007, the Deputy Assistant Secretary of the Navy for Safety (DASN(S)) issued a memo outlining a new initiative known as the Global War on Noise to bring attention to the increasing combat noise-induced hearing loss problem throughout DON. DASN(S) expressed that "we continue to design and procure weapon systems that expose our personnel to levels of noise that even with the most advanced personal noise attenuation devices available, far exceed maximum allowable Occupational Safety and Health Administration (OSHA) standards. We can and must do a better job of protecting those men and women who routinely sacrifice so much for this country." He further states that "it is obvious that, if we are to resolve our escalating hearing loss problem, increased emphasis must be placed in the design and

[3] Hazards on the flight deck include exposure to hazardous noise from aircraft engines.
[4] The original objective was to verify that safety and occupational health issues are addressed during the acquisition process of the CVN 21 Aircraft Carrier. The objective was changed to specify the issue (noise hazard) that was assessed.

acquisition of quieter equipment and the use of more effective engineering controls to reduce ambient noise levels."

c. **Noise Hazard.** According to Military Handbook 1908B, dated 16 August 1999, steady-state noise is defined as a periodic or random variation in atmospheric pressure at audible frequencies. It may be continuous, intermittent, or fluctuating, with the sound pressure level varying over a wide range, provided such variations have a duration exceeding 1 second. The Handbook further defines impulse noise as a short burst of acoustic energy consisting of either a single impulse or a series of impulses. A single impulse lasts less than 1 second, where a series of impulses may last longer than 1 second. According to Office of the Chief of Naval Operations Instruction (OPNAVINST) 5100.23G, potentially hazardous noise exposure occurs in areas where steady-state noise levels exceed 84 decibels (dB) or where impulse noise levels exceed 140 dB. The Naval Sea Systems Command (NAVSEA) Shipboard Habitability Design Criteria Manual,[5] dated 1 December 1995, states that airborne noise levels for Navy ships and submarines are expressed as acceptable compartment noise levels and are categorized according to personnel functional requirements. For example, engine and auxiliary machinery rooms are assigned a Category D designation, which has a limit of 84 dB, while berthing and living spaces are assigned a Category B designation, which has a limit of 70 dB. The manual also states that the compartment categories and acceptable noise levels apply to steady-state noise and not to impact or impulse noise, for which the standard is 140 dB, as stated above.




d. According to a Naval Air Warfare Center Technical Report, dated 18 May 2006, flight deck personnel on an aircraft carrier work in close proximity to high-level aircraft engine noise for extended periods of time. It further reported that a typical busy day for flight deck personnel is approximately 60 aircraft launches and recoveries, and that flight deck personnel are exposed to 20-30 seconds of maximum power aircraft noise during each aircraft launch and 3 seconds during recovery. According to the Naval Safety Center, other noisy areas on aircraft carriers include the gallery deck (see illustration), located directly below the flight deck, and other workspaces, such as machinery rooms. Sources of airborne noise on the gallery deck include jet noise, as well as catapult, jet blast deflector, and arresting gear equipment. According to the Naval Safety Center, airborne noise levels on the gallery deck, where

[5] The NAVSEA Shipboard Habitability Design Criteria Manual is directed for use by OPNAVINST 9640.1A, "Shipboard Habitability Program," dated 3 September 1996, for developing new ship construction specifications.

sailors live and work, can exceed 100 dB. In addition, ventilation systems, auxiliary equipment, and the ship's propeller also contribute to airborne noise. According to the Naval Safety Center, continuous exposure to hazardous noise levels reportedly leads to hearing loss. Furthermore, the Center for Naval Analyses reported that from 1996 to 2005, total Navy disability costs associated with hearing loss have steadily increased. The cost in 2005 was approximately $200.7 million (see Enclosure 4) for DON.

e. **The CVN 78 Aircraft Carrier.** The CVN 21 Program is the future aircraft carrier replacement program for the USS *Enterprise* and *Nimitz* Class Aircraft Carriers. According to PMS 378, starting with the lead ship, *Gerald R. Ford* (CVN 78), the *Ford* Class will retain the *Nimitz* Class hull. The *Ford* Class will consist of three aircraft carriers (CVN 78-80) which will be delivered between 2015 and 2023. At the time of this report, the CVN 78 Aircraft Carrier was in the System Development and Demonstration (SDD) phase of the acquisition cycle. According to Department of Defense (DoD) Instruction 5000.2, SDD has two major efforts: System Integration and System Demonstration. System Integration is intended to integrate subsystems, complete detailed design, and reduce system-level risk. System Demonstration is intended to demonstrate the ability of the system to operate in a useful way consistent with the approved Key Performance Parameters (KPP). The next phase of the cycle is Production and Deployment.

f. The CVN 78 Aircraft Carrier will carry aircraft, including the Joint Strike Fighter and F/A-18E/F. According to a Naval Air Warfare Center Technical Report, dated 18 May 2006, those aircraft are expected to expose sailors to noise levels between 148-152 dB. The CVN 78 Airborne Noise Control/Design History Booklet, dated 23 September 2008, included the following predicted airborne noise levels based on ship design data: engine rooms, 76-99 dB; Supervisory Operation Stations (SOS) located in the engine room, 83-85 dB; and auxiliary rooms, 93-101 dB. Therefore, these compartments could exceed the steady-state noise limit of 84 dB, which according to OPNAVINST 5100.23G is considered hazardous. (See Paragraph 5c for a detailed discussion of these noise levels and PMS 378's mitigation efforts.)

g. **Meetings.** We briefed our audit results to PMS 378 on 6 October 2008. We provided a discussion draft to PMS 378 representatives on 14 January 2009 and met to discuss the discussion draft on 27 January 2009.

4. **Federal Managers' Financial Integrity Act**. The Federal Managers' Financial Integrity Act of 1982, as codified in Title 31, United States Code, requires each Federal Agency head to annually certify the effectiveness of the agency's internal and accounting system controls. Recommendations 1-3 address issues related to the internal controls over the mitigation of hazardous noise. This report is part of a series of reports on internal controls over the mitigation of hazardous noise. In our opinion, the weaknesses noted in this and the previous reports may warrant reporting in the Auditor General's annual FMFIA memorandum identifying management control weaknesses to the Secretary of the Navy.

## 5. Audit Results and Conclusions

a. PMS 378 made efforts to mitigate noise hazards through design selection, which comply with the MIL-STD-882D. While, in some cases, the design changes did not mitigate noise to levels required in the contract specifications, mitigating these hazards through design selection by enclosing, insulating, and relocating compartments helped reduce the exposure of sailors to hazardous noise. In addition, PMS 378 maintained an appropriate process for reducing the RAC associated with their only officially identified noise hazard (hazardous noise in the engine rooms and auxiliary rooms) from high to moderate. However, PMS 378 did not officially identify other noise hazards on the carrier, including gallery deck and flight deck noise hazards, and did not assign a RAC to, or track, these hazards. Even though PMS 378 made efforts to mitigate the gallery deck noise hazard, they did not attempt to mitigate the flight deck noise hazard. In addition, PMS 378 did not sufficiently track the officially identified noise hazard (hazardous noise in the engine rooms and auxiliary rooms) and its residual mishap risk, and did not establish risk acceptance authority levels.

The conditions discussed in this report were present for the period of our review from 21 April 2008 to 14 January 2009.

### b. Official Identification of Hazards.

(1) PMS 378 did not officially identify two noise hazards associated with the CVN 78 Aircraft Carrier. MIL-STD-882D, Section 3.2.3 defines a hazard as any real or potential condition that can cause injury, illness, or death to personnel; damage to or loss of a system, equipment, or property; or damage to the environment. According to Section 4.2 of the Standard, a program is required to identify hazards through a systematic hazard analysis process, and to consider hazards that could occur over the system life cycle. PMS 378 representatives stated that the only officially identified noise hazard for the CVN 78 was hazardous noise in the engine rooms and auxiliary rooms.[6]

[6] The official title given to this hazard by PMS 378 was "As Delivered ER [engine rooms] & AR [auxiliary rooms] Airborne Noise Levels."

According to the Naval Safety Center, noise levels on the flight deck and gallery deck are known hazards on an aircraft carrier. Even though PMS 378 did not officially identify the gallery deck noise as a hazard, they did take steps to mitigate the noise hazard. However, PMS 378 neither identified nor took steps to mitigate the flight deck noise hazard.

(2) PMS 378 representatives stated that a hazard was only officially identified if it could not meet contract specifications nor be mitigated through design. However, the contract specifications do not address two hazards that could occur over the system life cycle of the carrier, and could be modified at the request of the contractor and the approval of PMS 378. In addition, PMS 378 representatives stated that a mitigation approach was not sought for noise on the flight deck because it was not included in their Operational Requirements Document (ORD). We verified that flight deck noise requirements were not identified in the ORD. However, the MIL-STD-882D requires a program to consider hazards that could occur over the system life cycle regardless of whether they are specified in the ORD.

(3) As a result of not officially identifying the two hazards that could occur over the life of the carrier, those hazards were not properly assessed to determine appropriate and potential mitigation solutions, thus contributing to a hazardous environment to the sailor. For example, according to DON representatives, automation of flight deck positions and construction of acoustic rooms on the flight deck could potentially mitigate exposure to the flight deck noise hazard if found to be a viable solution. Further, mitigation solutions may not have been realized at the most cost-effective stages of the acquisition process. RACs directly impact the visibility of the risk and its potential consequences, and determine how high in the chain of command the authority to accept the risk is vested. Because those hazards were not officially identified, they were not assigned a RAC. Those hazards were also not tracked, which may limit management's ability to efficiently reference past efforts, associated levels of hazard severity and probability, and current initiatives, as well as to develop future goals and milestones.

c. **System Safety Design Order of Precedence.**

(1) PMS 378 incorporated design solutions to mitigate hazardous noise in the engine rooms and auxiliary rooms, as well as on the gallery deck. PMS 378 also plans to implement the use of hearing protection to mitigate exposure to hazardous noise. This complies with the MIL-STD-882D, Section 4.4, "System Safety Design Order of Precedence." Specifically, PMS 378 incorporated enclosed and insulated Supervisory Operating Stations (SOS) in the engine rooms design and recommended that auxiliary rooms be unmanned. According to PMS 378, personnel working in the engine rooms will spend two-thirds of their time in the SOS. According to the CVN 78 Airborne Noise Control/Design History Booklet, the noise levels in two of the six SOS compartments were projected to exceed the airborne noise requirement of 84 dB by one decibel.

According to official correspondence between PMS 378 and the contractor, the airborne noise level predictions were conservative and the SOSs were expected to be quieter than predicted and meet the requirement. PMS 378 conducted an analysis of several acoustic treatments for the open areas of the engine rooms. Based on the analysis, PMS 378 decided to install insulation in the upper engine room levels. They also decided that the benefit of installing the insulation in the remaining engine room and auxiliary room spaces did not warrant the additional cost and weight. According to the Booklet, the noise levels in 62 of the 64 engine room and auxiliary room compartments were projected to be 86-101 dB, which exceeds the airborne noise requirement. While the design changes did not mitigate noise to required levels, PMS 378 representatives stated that the use of hearing protection would also be required in those compartments that exceed requirements. According to the contractor's analysis, the hearing protection would lessen exposure to noise by 29 dB. This would reduce the highest noise levels (101 dB) to 72 dB, which is below the level considered hazardous (> 84 dB).

(2) PMS 378 directed the contractor to insulate compartments on the gallery deck, including living areas, work centers, offices, shop rooms, and compartments containing equipment that produce hazardous noise associated with the catapult, jet blast deflector, and arresting gear. Additionally, PMS 378 changed several compartment locations, such as the chaplain offices and crew libraries, from the gallery deck to lower decks to reduce exposure of sailors to airborne noise. PMS 378 also moved laundry rooms away from a high noise source to a lower deck. We validated the moves by comparing the current CVN 78 General Arrangement, which lists the location of all compartments, to the CVN 77 General Arrangement. According to the CVN 78 Airborne Noise Control/Design History Booklet, the chaplain offices and crew libraries, which exceeded the 65 dB airborne noise requirements in previous aircraft carrier designs, were predicted to be lower. Mitigating hazardous noise in the engine rooms and auxiliary rooms as well as on the gallery deck, in accordance with the system safety design order of precedence, reduced exposure of sailors to hazardous noise.

d. **Assignment of RAC.**

(1) PMS 378 assigned a RAC to the one officially identified hazard and maintained an appropriate process for reducing that RAC. MIL-STD-882D, Section 4.3 requires a program to assess the severity and probability of the mishap risk associated with each identified hazard. RACs directly impact the visibility of the risk and its potential consequences and determine how high in the chain of command the authority to accept the risk is vested. The RAC for this hazard was reduced from high to moderate based on the mitigation efforts discussed in the previous section. While we cannot determine if either of the RAC ratings was appropriate, the RAC reduction was based on mitigating exposure to hazardous levels of noise, which we conclude was appropriate.

As discussed in Section 5b, hazardous noise on the gallery deck and flight deck were not officially identified as hazards; therefore, RACs were not established for those hazards.

e. **Tracking of Hazards and Residual Mishap Risk.**

(1) PMS 378 did not sufficiently track the only officially identified noise hazard (engine rooms and auxiliary rooms airborne noise hazard) and its residual mishap risk. While PMS 378 tracked the engine rooms and auxiliary rooms airborne noise hazard in a hazard database, they did not maintain a current log that included the assessment of residual mishap risk for this hazard throughout the system life cycle, as required by MIL-STD-882D, Section 4.8 and A.4.4.8.1. Our analysis of the Risk Information Sheet for the engine rooms and auxiliary rooms airborne noise hazard identified weaknesses within the tracking process. Specifically, the initial and current RAC levels assigned to the hazard were not clearly stated. Also, the "Action/Event" section did not provide sufficient detail to show how the hazard was mitigated nor summarize the rationale for reducing the RAC. In addition, as discussed in Section 5b, hazardous noise on the gallery deck and flight deck were not officially identified as hazards; therefore, those hazards were not tracked in accordance with MIL-STD-882D.

(2) PMS 378 lacked internal controls related to ensuring that a current log of hazards, which included the assessment of residual risk, was maintained. After presentation of our audit results, PMS 378 representatives stated that they could access supporting documentation for hazard mitigation when needed; however, this information was not maintained in a centralized system. They also stated that their tracking process would be improved with the implementation of the System Safety Management Plan (SSMP), which was in development.

(3) As a result of not sufficiently tracking noise hazards, including the engine rooms and auxiliary rooms airborne noise hazard, and the assessment of residual mishap risk, a concise, dated record of mitigation efforts and their associated effectiveness on reducing residual mishap risk is not readily available for program management review. This may limit management's ability to efficiently reference past efforts, associated levels of hazard severity and probability, and current initiatives, as well as develop future goals and milestones. Basing program decisions on incomplete and inaccurate information could lead to insufficient mitigation of noise and other hazards, contributing to a hazardous environment to the sailor.

f. **Risk Acceptance Authority Levels.**

(1) PMS 378 did not establish risk acceptance authority levels to comply with requirements in MIL-STD-882D and DoD Instruction 5000.2. MIL-STD-882D, Section 4.1c, requires a program to define how hazards and residual mishap risk are

communicated to, and accepted by, the appropriate risk acceptance authority. In addition, DoD Instruction 5000.2, Enclosure 7, Section E7.1.6,[7] provides required risk acceptance authority levels (see Table 1).

**Table 1**
**DoD Instruction 5000.2 Risk Acceptance Authority Levels**

| Risk Level | Risk Acceptance Authority |
|---|---|
| HIGH | Component Acquisition Executive |
| SERIOUS | Program Executive Officer level |
| MEDIUM | Program Manager |
| LOW | Program Manager |

PMS 378 representatives stated that there was no internal document for risk acceptance authority levels. The PMS 378 ESOH (Environmental, Safety, and Occupational Health) Management Plan recognized the Component Acquisition Executive (Assistant Secretary of the Navy (Research, Development and Acquisition)) as the acceptance authority for "High" level risks; however, risk acceptance authority levels were not established for other risk levels.

(2) PMS 378 lacked internal controls related to ensuring that risk acceptance authority levels were established in compliance with MIL-STD-882D, Section 4.1 and DoD Instruction 5000.2, Enclosure 7, Section E7.1.6. After presentation of our audit results, PMS 378 representatives stated that the SSMP currently in development will formally assign risk acceptance authority levels in accordance with MIL-STD-882D. As a result of not establishing risk acceptance authority levels, a hazard and its residual mishap risk may not be visible to DON leadership and would not be accepted at the appropriate risk acceptance authority level.

g. **Summary.** During the acquisition process of the CVN 78 Aircraft Carrier, PMS 378 followed the system safety design order of precedence when mitigating hazardous noise in the engine rooms and auxiliary rooms, as well as on the gallery deck. While, in some cases, the design changes did not mitigate noise to required levels, Program Office efforts to mitigate these hazards through design selection helped reduce the exposure of sailors to hazardous noise. Further, they maintained an appropriate process for reducing the RAC for the one officially identified noise hazard (hazardous noise in the engine rooms and auxiliary rooms). However, they did not officially identify two known noise hazards (on the flight deck and on the gallery deck), did not sufficiently track the only officially identified noise hazard and its residual mishap risk, and did not

[7] DoD Instruction 5000.2 was cancelled with the issuance of DoD Instruction 5000.02 dated 2 December 2008. DoD Instruction 5000.02, Enclosure 12, Section 6 includes the same risk acceptance authority levels as noted in Table 1.

follow required DoD guidance relating to risk acceptance authority levels. These conditions may contribute to a hazardous environment for the sailors. In addition to the personal human cost to the sailor, the economic consequence to the Navy includes: lost time and decreased productivity, loss of qualified personnel through medical disqualification, military disability settlements, retraining, and expenses related to medical treatment.

**6. Recommendations and Corrective Actions.** Our recommendations, summarized management responses, and our comments on the responses are presented below. The complete text of management responses is in Enclosure 5.

We recommend that Program Manager, PMS 378:

**Recommendation 1.** Establish policies, procedures, and controls to ensure that all recognized/known hazards (e.g. engine rooms and auxiliary rooms, gallery deck, and flight deck noise hazards), as defined in MIL-STD-882D, Section 3.2.3, are officially identified and assessed, to include establishing RACs and maintaining a current log of efforts to mitigate those hazards, regardless of whether they are referenced in the ORD.

**Management response to Recommendation 1.** Concur. PMS 378 is developing internal policies and procedures, in accordance with MIL-STD-882D, to identify and track hazards, provide mechanisms for ensuring management visibility, and establish hazard acceptance levels and processes consistent with MIL-STD-882D and other guidance. Our integrated platform-level SSMP will document and implement these policies and procedures. In the near-term, the program has already begun to incorporate discussion and tracking of system safety risks into the Program Risk Board forum, a monthly meeting chaired by the Program Manager. Target completion date for SSMP is 31 May 2009.

**Naval Audit Service comment on management response to Recommendation 1.** A Program Executive Office (PEO) Carriers representative to whom PMS 378 reports, subsequently provided an e-mail on 16 March 2009 stating that "the PEO and PMS 378 fully concurred with recommendation 1 to include that PMS 378 intends to establish RACs along with ...identifying and tracking hazards, providing mechanisms for ensuring management visibility, and establishing hazard acceptance levels and processes." Therefore, the management response and planned actions meet the intent of the recommendation.

**Recommendation 2.** Identify mitigation efforts that may be possible (whether in design, devices, or other methods) to reduce the flight deck noise hazard, document those efforts, and establish a plan of action and milestones to implement the efforts.

**Management response to Recommendation 2.** Concur. PMS 378 will formally identify the flight deck noise hazards resulting from flight operations and capture any mitigation activities that have occurred to date (e.g., ongoing development of Advanced Hearing Protection). PMS 378 will also evaluate the feasibility of additional mitigation actions on the flight deck. PMS 378 is already a part of the F-35C Carrier Integration Working Group which is identifying risks, to include noise hazards, and investigating mitigation strategies. Target completion date is 28 February 2010.

**Naval Audit Service comment on management response to Recommendation 2.** The management response and planned actions meet the intent of the recommendation. Because the target completion date is more than 6 months in the future, we are assigning an interim target date of 22 September 2009, and we ask that PMS 378 inform us by that date of the status of the agreed-to corrective actions.

**Recommendation 3.** Establish risk acceptance authority levels in PMS 378 policies and procedures to ensure compliance with DoD Instruction 5000.02, Enclosure 12, Section 6.

**Management response to Recommendation 3.** Concur. As discussed in the response to Recommendation 1, PMS 378 is developing internal policies and procedures, in accordance with MIL-STD-882D, which will be documented and implemented by an integrated platform-level SSMP. This SSMP will formally establish hazard acceptance levels and processes consistent with DoD Instruction 5000.02, Enclosure 12, Section 6 and Secretary of the Navy Instruction 5000.2C, Chapter 7. Target completion date for SSMP is 31 May 2009.

**Naval Audit Service comment on management response to Recommendation 3.** The management response and planned actions meet the intent of the recommendation.

7. Actions planned by the Program Manager, PMS 378 meet the intent of all three recommendations. The recommendations are considered open pending completion of the planned corrective actions, and are subject to monitoring in accordance with reference (b). Management should provide a written status report on the recommendations within 30 days after the target completion dates. Please provide all correspondence to the Assistant Auditor General for Installations and Environment

Subj: **CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF THE CVN 78 AIRCRAFT CARRIER (AUDIT REPORT N2009-0022)**

Audits, [redacted], with a copy to the Director, Policy and Oversight, [redacted]. Please submit correspondence in electronic format (Microsoft Word or Adobe Acrobat file), and ensure that it is on letterhead and includes a scanned signature.

FOIA (b)(6)

8. Any requests for this report under the Freedom of Information Act must be approved by the Auditor General of the Navy as required by reference (b). This audit report is also subject to followup in accordance with reference (b).

9. We appreciate the cooperation and courtesies extended to our auditors.

[redacted]

FOIA (b)(6)

[redacted]
Assistant Auditor General
Installations and Environment Audits

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Enclosure 1:

# Status of Recommendations

| Rec. No. | Page No. | Subject | Status[8] | Action Command | Interim Target Completion Date[9] | Target Completion Date |
|---|---|---|---|---|---|---|
| 1 | 10 | Establish policies, procedures, and controls to ensure that all recognized/known hazards (e.g. engine rooms and auxiliary rooms, gallery deck, and flight deck noise hazards), as defined in MIL-STD-882D, Section 3.2.3, are officially identified and assessed, to include establishing RACs and maintaining a current log of efforts to mitigate those hazards, regardless of whether they are referenced in the ORD. | O | PMS 378 | | 5/31/09 |
| 2 | 11 | Identify mitigation efforts that may be possible (whether in design, devices, or other methods) to reduce the flight deck noise hazard, document those efforts, and establish a plan of action and milestones to implement the efforts. | O | PMS 378 | 9/22/09 | 2/28/10 |
| 3 | 11 | Establish risk acceptance authority levels in PMS 378 policies and procedures to ensure compliance with DoD Instruction 5000.02, Enclosure 12, Section 6. | O | PMS 378 | | 5/31/09 |

[8] O = Recommendation is open with agreed-to corrective actions; C = Recommendation is closed with all action completed; U = Recommendation is undecided with resolution efforts in progress.
[9] If applicable.

Enclosure 2:

# Scope and Methodology

The broader audit of "Consideration of Safety and Occupational Health Issues in Acquisition of Major Department of Navy (DON) Weapons Systems and Platforms," began on 10 August 2007 and is still ongoing as of the date of this publication. Separate interim reports will be issued on each system audited, and a summary report summarizing the individual system reviews and identifying systemic issues will be issued upon completion of our audit work. We conducted this audit of the consideration of hazardous noise in the acquisition of the CVN 78 Aircraft Carrier between 21 April 2008 and 11 February 2009.

We evaluated internal controls and reviewed compliance with regulations related to consideration of hazardous noise in the CVN 21 Program Office (PMS 378) acquisition process of the CVN 78 Aircraft Carrier. The data quality was adequate for use in this audit. We verified that the CVN 78 Aircraft Carrier noise level posed a hazard to DON sailors and assessed PMS 378's process of mitigating these identified hazards. Specifically, we assessed PMS 378's mitigation efforts related to noise hazards.

We conducted site visits and interviews with PMS 378 ESOH representatives at Washington Navy Yard, Washington, DC to:

- Determine if the CVN 78 Aircraft Carrier noise level posed a hazard, and
- Assess PMS 378's process for mitigating the identified noise hazards.

We reviewed the Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE); Operational Requirements Document; ESOH (Environmental, Safety, and Occupational Health) Management Plan; CVN 78 Airborne Noise Control/Design History Booklet, dated 23 September 2008; Airborne Noise Habitability Improvements, dated July 2000; "As Delivered ER [engine room] and AR [auxiliary rooms] Airborne Noise Levels" Risk Information Sheet; ship compartment listings from the most current CVN 78 and the CVN 77 General Arrangements; contract specifications; and official correspondence between PMS 378 and the contractor.

We conducted this performance audit in accordance with Generally Accepted Government Auditing Standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

There were no prior audits relating to this subject; therefore, this report does not include a followup review of past audit recommendations.

Enclosure 3:

# Pertinent Guidance

**Military Standard 882D (MIL-STD-882D), "Standard Practice for System Safety,"** dated 10 February 2000, outlines a standard practice for conducting the Department of Defense (DoD) system safety approach and managing safety and health mishap risks in order to meet the DoD commitment to protecting private and public personnel from accidental death, injury, or occupational illness.

- Section 3.2.3, Definition of hazard: Any real or potential condition that can cause injury, illness, or death to personnel; damage to or loss of a system, equipment or property; or damage to the environment.
- Section 4.1c, Documentation of system safety approach: Document the developer's and program manager's approved system safety engineering approach. This documentation shall define how hazards and residual mishap risk are communicated to and accepted by the appropriate risk acceptance authority and how hazards and residual mishap risk will be tracked.
- Section 4.2, Identification of hazards: Identify hazards through a systematic hazard analysis process encompassing detailed analysis of system hardware and software, the environment (in which the system will exist), and the intended use or application. Consider and use historical hazard and mishap data, including lessons learned from other system. Identification of hazards is a responsibility of all program members. During hazard identification, consider hazards that could occur over the system life cycle.
- Section 4.3, Assessment of mishap risk: Assess the severity and probability of the mishap risk associated with each identified hazard, i.e. determine the potential negative impact of the hazard on personnel, facilities, equipment, operation, the public, and the environment, as well as on the system itself.
- Section 4.4, Identification of mishap risk mitigation measures: Identify potential mishap risk mitigation alternatives and the expected effectiveness of each alternative or method. Mishap risk mitigation is an iterative process that culminates when the residual mishap risk has been reduced to a level acceptable to the appropriate authority. The system safety design order of precedence for mitigating identified hazards is:

    1. Eliminate hazards through design selection: If unable to eliminate an identified hazard, reduce the associated mishap risk to an acceptable level through design selection;

2. Incorporate safety devices: If unable to eliminate the hazard through design selection, reduce the mishap risk to an acceptable level using protective safety features or devices;
3. Provide warning devices: If safety devices do not adequately lower the mishap risk of the hazard, include a detection and warning system to alert personnel to the particular hazard; and
4. Develop procedures and training: Where it is impractical to eliminate hazards through design selection or to reduce the associated risk to an acceptable level with safety and warning devices, incorporate special procedures and training. Procedures may include the use of personal protective equipment.

- Section 4.8, Tracking of hazards, their closures, and residual mishap risk: Track hazards, their closure actions, and the residual mishap risk. Maintain a tracking system that includes hazards, their closure actions, and residual mishap risk throughout the system life cycle. The program manager shall keep the system user advised of the hazards and residual mishap risk.
- Section A.4.4.8.1, Process for tracking of hazards and residual mishap risk: Each system must have a current log of identified hazards and residual mishap risk, including an assessment of the residual mishap risk. As changes are integrated into the system, this log is updated to incorporate added or changed hazards and the associated residual mishap risk. The Government must formally acknowledge acceptance of system hazards and residual mishap risk. Users will be kept informed of hazards and residual mishap risk associated with their systems.

**Department of Defense (DoD) Instruction 5000.2, "Operation of the Defense Acquisition System,"** dated 12 May 2003, Enclosure 7, Section E7.1.6 includes the following risk acceptance authority levels:

- "High" risks: Component Acquisition Executive (CAE);
- "Serious" risks: Program Executive Officer (PEO) level; and
- "Medium"/"Low" risks: Program Manager (PM).

**Chief of Naval Operations Instruction (OPNAVINST) 5100.23G, "Navy Safety and Occupational Health (SOH) Program Manual,"** dated 30 December 2005, Section 1801a states that occupational hearing loss resulting from exposure to hazardous noise, the high cost of related compensation claims, and the resulting drop in productivity and efficiency highlight a significant problem that requires considerable attention. Noise control and hearing conservation measures contribute to operational readiness by preserving and optimizing auditory fitness for duty in Navy personnel. The Instruction defines a potentially hazardous noise area as any work area where the A-weighted sound level (continuous or intermittent) is greater than 84 decibels (dB).

**OPNAVINST 9640.1A, "Shipboard Habitability Program,"** dated 3 September 1996, provides policy regarding U.S. Navy shipboard habitability and establishes procedures which enhance conformity with, and approve deviations from, established design criteria. The instruction directs the use of the Naval Sea Systems Command (NAVSEA) Shipboard Habitability Design Criteria Manual, dated 1 December 1995, for developing new ship construction specifications. The manual implements the provisions of OPNAVINST 9640.1A by establishing U.S. Navy shipboard habitability design criteria which will ensure unit mission readiness and provide an acceptable level of quality of life for sailors and marines. The manual states that airborne noise levels for Navy ships and submarines are expressed as acceptable compartment noise levels and are categorized according to personnel functional requirements. The manual also states that the compartment categories and acceptable noise levels only apply to steady-state noise rather than to impact or impulse noise. The compartment categories are defined as follows:

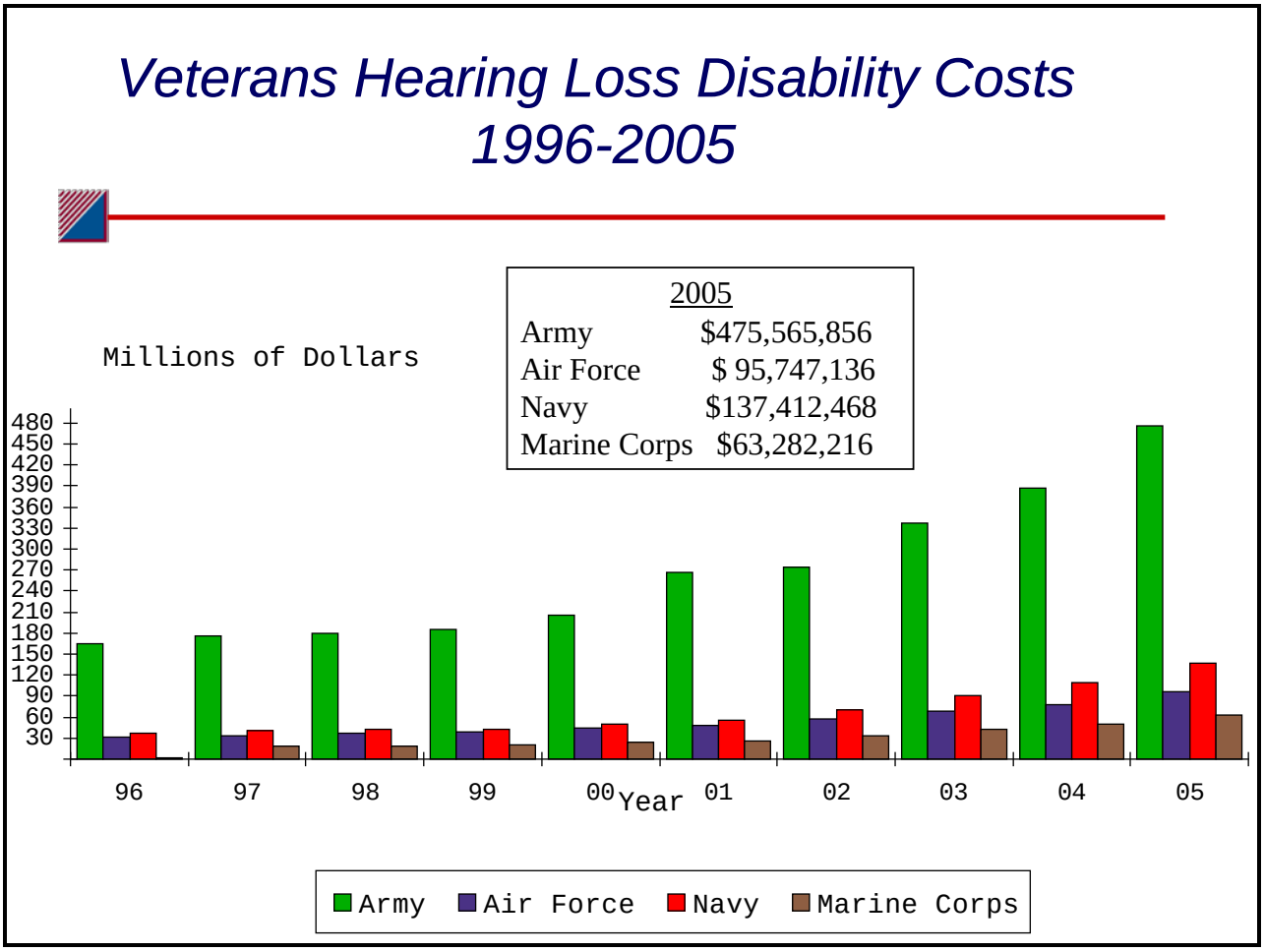
- Category A**:** Spaces in which direct speech communication must be understood with minimal error and without need for repetition. Acceptable noise levels are based on approximate talker-listener distances of either 3 feet or 12 feet. Category A-3 shall be assigned when extreme talker-listener distance is less than 6 feet. Category A-12 shall be assigned when the extreme talker-listener distance is 6 feet or greater. A-3 or A-12 designators are dependent on compartment size and arrangement which influence talker-listener distances;
- Category B: Spaces in which comfort of personnel is the primary consideration and where communication considerations are secondary;
- Category C: Spaces in which it is essential to maintain especially quiet conditions;
- Category D: High noise level areas in which voice communication is not normally important and prevention of hearing loss is the primary consideration; and
- Category E: High noise level areas in which voice communication is at high vocal effort and short distance and where amplified speech mechanisms and telephones are normally available.

Acceptable noise levels for each compartment category are illustrated below:

| Compartment Category | Acceptable Noise Level (dB) |
|---|---|
| A-3 | 70 |
| A-12 | 60 |
| B | 70 |
| C | 65 |
| D | 84 |
| E | 80 |

Enclosure 4:

# Center for Naval Analyses Veterans Hearing Loss Disability Costs




Source: Center for Naval Analyses, "Computing the Return on Noise Reduction Investments in Navy Ships: A Life-Cycle Cost Approach," September 2006.

Enclosure 5:

# Management Response From Naval Sea Systems Command (PMS 378)

**DEPARTMENT OF THE NAVY**
NAVAL SEA SYSTEMS COMMAND
1333 ISAAC HULL AVE SE
WASHINGTON NAVY YARD DC 20376-0001

7500 IN REPLY TO:
Ser 00N3C/36
9 March 2009

From: Commander, Naval Sea Systems Command
To: Auditor General of the Navy

Subj: DRAFT AUDIT REPORT ON CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF THE CVN 78 AIRCRAFT CARRIER (N2007-NIA000-0066.004)

Ref: (a) NAVAUDSVC ltr 7510 N2007-NIA00-0066.000 of 11 Feb 09

Encl: (1) NAVSEA/PEO Carriers Response

1. In response to reference (a), enclosure (1) provides the Program Executive Officer, Aircraft Carriers' response to the subject audit report. Based on our review of the subject report, we concur with the report's findings and recommendations.

2. Enclosure (1) and the report do not contain information that we consider to be exempt from release under FOIA. The point of contact for this audit is [redacted] who may be reached at [redacted] DSN [redacted] or e-mail [redacted]

FOIA (b)(6)

[redacted]
Deputy Inspector General

Copy to:
NAVINSGEN (N43)

**NAVSEA Response to**
**Naval Audit Service Final Draft Audit Report**
**No. N2007-NIA000-0066.004**

**Overall Comments:**

The Future Aircraft Carriers Program Office (PMS 378) appreciates the efforts and insights of the auditors, and we accept the audit recommendations. We wish to comment that the draft audit report appears to be focused upon using the MIL-STD-882D system safety process as the sole mechanism for identification, tracking and mitigation of airborne noise hazards. The Future Aircraft Carriers Program has a robust Noise Control Program, highly integrated into the systems engineering process, which addresses airborne noise hazards -- primarily by driving change into the design. As documented in the "CVN 78 Airborne Noise Control/Design History Booklet," which was provided to the NAVAUDSVC in November 2008, the airborne noise level for each space is calculated and tracked, and issues are mitigated through the Noise Control Program vice the system safety process. While PMS 378 acknowledges that the Noise Control Program is requirements-driven (e.g., Operational Requirements Documents (ORD)) and consequently has not addressed intermittent noise from flight operations, it has nonetheless resulted in significant improvement over the NIMITZ-Class aircraft carriers in airborne noise levels throughout the entire ship.

PMS 378 would further like to comment on the addition of paragraph 4 in which the draft audit report states, “In our opinion, the weaknesses noted in this report may warrant reporting in the Auditor General’s annual FMFIA memorandum identifying management control weaknesses to the Secretary of the Navy.” While we have accepted the audit recommendations and are taking action to implement corrections, we do not believe the “weaknesses” cited are of sufficient magnitude to warrant reporting at this level.

Specific Program Office responses to the audit report recommendations are contained in the section below.

**PMS 378 Responses to Naval Audit Service Final Draft Audit Report Recommendations:**

**Recommendation 1:**

Establish policies, procedures, and controls to ensure that all recognized/known hazards (e.g., ER and AR, gallery deck, and flight deck noise hazards), as defined in MIL-STD-882D, Section 3.2.3, are officially identified and assessed, to include establishing RACs and maintaining a current log of efforts to mitigate those hazards, regardless of whether they are referenced in the ORD.

**PMS 378 Response:**

Concur. PMS 378 is developing internal policies and procedures, in accordance with MIL-STD-882D, to identify and track hazards, provide mechanisms for ensuring management visibility, and

Enclosure (1)

establish hazard acceptance levels and processes consistent with MIL-STD-882D and other guidance. Our integrated platform-level System Safety Management Plan (SSMP) will document and implement these policies and procedures. In the near-term, the program has already begun to incorporate discussion and tracking of system safety risks into the Program Risk Board forum, a monthly meeting chaired by the Program Manager.

Target completion date for SSMP is 31 May 2009.

**Recommendation 2:**

Identify mitigation efforts that may be possible (whether in design, devices, or other methods) to reduce the flight deck noise hazards, documents those efforts and establish a plan of action and milestones to implement the efforts.

**PMS 378 Response:**

Concur. PMS 378 will formally identify the flight deck noise hazards resulting from flight operations and capture any mitigation activities that have occurred to date (e.g., ongoing development of Advanced Hearing Protection). PMS 378 will also evaluate the feasibility of additional mitigation actions on the flight deck. PMS 378 is already a part of the F-35C Carrier Integration Working Group which is identifying risks, to include noise hazards, and investigating mitigation strategies.

Target completion date is 28 February 2010.

**Recommendation 3:**

Establish risk acceptance authority levels in PMS-378 policies and procedures to ensure compliance with DoD Instruction 5000.02, Enclosure 12, Section 6.

**PMS 378 Response:**

Concur. As discussed in the response to recommendation 1, PMS 378 is developing internal policies and procedures, in accordance with MIL-STD-882D, which will be documented and implemented by an integrated platform-level System Safety Management Plan (SSMP). This SSMP will formally establish hazard acceptance levels and processes consistent with DoD Instruction 5000.02, Enclosure 12, Section 6 and SECNAVINST 5000.2C, Chapter 7.

Target completion date for SSMP is 31 May 2009.

Use this sheet as

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