

# Naval Audit Service



## Interim Audit Report



# Consideration of Hazardous Noise in the Acquisition of the F/A-18E/F Super Hornet and EA-18G Growler Strike Fighter Variants

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N2009-0008  
31 October 2008

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7510  
N2007-NIA000-0066.003  
31 Oct 08

MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (RESEARCH,  
DEVELOPMENT AND ACQUISITION)  
THE F/A-18 STRIKE FIGHTER PROGRAM OFFICE  
(PROGRAM MANAGER AIR 265 (PMA265))

Subj: **CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF  
THE F/A-18E/F SUPER HORNET AND EA-18G GROWLER STRIKE  
FIGHTER VARIANTS (FINAL INTERIM AUDIT REPORT N2009-0008)**

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

Encl. (1) Status of Recommendations  
(2) Scope and Methodology  
(3) Pertinent Guidance  
(4) Center for Naval Analyses Veterans Hearing Loss Disability Costs  
(5) Hearing Protection Suite  
(6) Program Executive Officer (Tactical Aircraft Programs) - F/A-18E/F and EA-18G Noise Exposure Risk Acknowledgement  
(7) Commander, Naval Air Forces – F/A-18E/F and EA-18G Noise Exposure Risk Acknowledgement (NOTAL)  
(8) Appendix: Management Response from PMA265

## **1. Introduction.**

a. This interim report addresses the results of our audit for the F/A-18E/F Super Hornet and EA-18G Growler Strike Fighter variants (F/A-18 aircraft). A senior Department of the Navy (DON) official requested that the Naval Audit Service (NAVAUDSVC) verify that safety and occupational health issues were addressed during the acquisition process of the F/A-18 aircraft through efforts to mitigate the identified noise hazard. We determined that there were opportunities to improve the mitigation of the flight-line/deck jet noise hazard. Details on our F/A-18 audit results are presented in Paragraph 5, "Summary of Audit Results and Conclusions."

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b. Program Manager Air 265 (PMA265) responded to the recommendations. Summaries of the management responses, with our comments on the responses, are in paragraph 6. The complete text of the responses is in Enclosure 8.

(i) PMA265 concurred with Recommendations 1 and 3, which are open pending completion of agreed-to actions. Because the target completion date for Recommendation 1 is more than 6 months in the future, we are assigning an interim target date of 30 April 2009. Open recommendations are subject to monitoring in accordance with reference (b). Management should provide a written status report on the recommendations within 30 days after target completion dates.

(ii) PMA265 partially concurred with Recommendation 2; however, we do not feel that PMA265's position meets the intent of the recommendation. Because Naval Air Systems Command (NAVAIR) 1.6 has agreed with PMA265's position on the recommendation, we consider Recommendation 2 to be undecided, and we are elevating it to the Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN RDA) for action. ASN (RDA) should respond within 30 days indicating concurrence or nonconcurrence with the recommendation.

(iii) Please send all correspondence to the Assistant Auditor General for Installations and Environment Audits, Mr. Ron Booth, at ronnie.booth@navy.mil (phone (202) 433-5551), with a copy to the Director, Policy and Oversight, Vicki.McAdams@navy.mil.

**2. Objective.** Our objective<sup>1</sup> was to verify that safety and occupational health issues were addressed during the acquisition process of the F/A-18E/F and EA-18G aircraft through efforts to mitigate the identified noise hazard.

### **3. Background**

a. **Consideration of Safety and Occupational Health Issues.** In Military Standard 882D (MIL-STD-882D), Department of Defense Standard Practice for System Safety, dated 10 February 2000, Department of Defense (DoD) stated that, as standard practice, environmental, safety, and occupational health (ESOH) hazard management will be integrated into the systems engineering process for acquisition programs. According to MIL-STD-882D, 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

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<sup>1</sup> The original objective was to verify that safety and occupational health issues are addressed during the acquisition process of the F/A-18E/F and EA-18G aircraft. The objective was refined to specify the issue (flight-line/deck jet noise hazard) that was assessed.

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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. Noise Hazard to Flight Deck Personnel.** Steady-state noise is defined in Military Handbook-1908B, dated 16 August 1999, as periodic or random variation in atmospheric pressure at audible frequencies. Steady-state noise may be continuous, intermittent, or fluctuating, and have a duration exceeding one second. According to Office of the Chief of Naval Operations (OPNAVINST) 5100.23G, dated 30 December 2005, potentially hazardous noise exposure to personnel occurs in areas where noise levels exceed 84 decibels (dBs). According to a Naval Air Warfare Center Technical Report, "U.S. Navy Flight Deck Hearing Protection Use Trends: Survey Results," dated 18 May 2006, legacy military aircraft, such as the F-16 and F-22, produce about 130-150 dBs. The report stated that aircraft carrier flight deck personnel 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. PMA265 representatives stated that many flight-deck personnel exceed total daily exposure limits in approximately one launch while wearing hearing protection that provides 30 dBs attenuation. According to Naval Safety Center representatives, continuous exposure to these hazardous noise levels reportedly leads to hearing loss among sailors. Furthermore, the Center for Naval Analyses reflected in their report that from 1996 to 2005 total Navy and Marine Corps veterans' disability costs associated with hearing loss from various exposures have steadily increased. The cost in 2005 was approximately \$200.7 million (see Enclosure 4) for DON.<sup>2</sup>

**c. The F/A-18E/F Super Hornet and EA-18G Growler Strike Fighter Variants.** According to the F/A-18E/F and EA-18G Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE),<sup>3</sup> dated March 2007, the F/A-18E (single seat)/F/A-18F (dual seat) variant is the third variant to the F/A-18 aircraft, managed by NAVAIR, PMA265. It is a high-performance, twin engine, mid-wing, multi-mission, tactical aircraft designed to replace the F/A-18C (single seat), F/A-18D (dual seat), A-6E, and F-14 aircraft. The F/A-18E/F variant is fielded and in the Operations and Support (O&S) phase of the acquisition cycle. According to DoD Instruction (DoDI) 5000.2,

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<sup>2</sup> Of the approximately \$772 million in veteran hearing loss disability costs in 2005, the breakdown between the Services was approximately 61.5 percent Army, 18 percent Navy, 12.5 percent Air Force, and 8 percent Marine Corps.

<sup>3</sup> The document has three objectives: (1) to summarize the current status of the ESOH program, actions, and initiatives being undertaken by the F/A-18E/F and EA-18G Programs; (2) to formally identify ESOH issues that require near-term resolutions; and (3) to provide a roadmap for embedding ESOH into the program throughout its life cycle. According to SECNAVIST 5000.2C, the PESHE should include ESOH risks, a strategy for integrating responsibilities, a method for tracking progress, and a schedule for National Environmental Policy Act (NEPA) compliance.

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dated 12 May 2003, the objective of the O&S phase is to execute a support program that meets operation support performance requirements and sustains the system in the most cost-effective manner over its total life cycle. This is the last phase of the acquisition cycle and will terminate with system disposal at the end of the useful life.

d. According to the PESHE, the EA-18G variant will be the fourth major variant of the F/A-18 aircraft and will serve as the Navy's replacement for the aging fleet of carrier-based EA-6Bs. The EA-18G platform is a modified version of the F/A-18F platform equipped with weapon system upgrades and is being acquired through the Spiral Development acquisition process. According to DoDI 5000.2, Spiral Development occurs when a desired capability is identified, but the end-state requirements are not known at program initiation. According to the F/A-18 PESHE, the EA-18G Program is currently in Low-Rate Initial Production (LRIP) (Production and Deployment Acquisition Phase), which is beyond System Design and Demonstration (SDD) phase. DoDI 5000.2 states that LRIP should result in adequate and efficient manufacturing capability to produce the minimum quantity of units necessary for Initial Operational Test and Evaluation (IOT&E). Upon successful completion of operational testing, the next phase of the acquisition cycle will be full-rate production.

e. **Meetings.** We briefed our audit results to PMA265 management on 11 June 2008. In addition, we briefed our audit results to the following customers/stakeholders:

- Deputy Assistant Secretary of the Navy (DASN) for Research, Development and Acquisition (RDA) for Air Programs representatives – 19 March 2008;
- DASN for Safety (DASN(S)) – 8 May 2008;
- Director Air Warfare (N88) representatives – 25 March 2008;
- Fleet representatives from Fleet Forces Command, U.S. Pacific Fleet, Naval Air Forces Safety, and Commander, Naval Air Forces – 9 April 2008; and
- Naval Safety Center representatives – 9 April 2008.

f. We provided a discussion draft to PMA265 representatives on 16 July 2008 and received comments on 24 July 2008. There were no significant problems that needed to be addressed during the audit.

**4. Noteworthy Accomplishment.** PMA265 was involved in the efforts of other organizations (Office of Naval Research (ONR) and various universities) to identify and/or develop design solutions to the jet noise hazard. Specifically, PMA265 provided direct support in the form of aircraft, fuel, and personnel to conduct F/A-18E/F aircraft flyover noise footprints, which were used to establish a baseline for noise exposures. According to PMA265 representatives, if future modifications are made, PMA265 will be

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able to accurately measure the reduction in noise levels. Based on documentation reviewed, PMA265 provided two F/A-18C/D engines (F404-400 engine) to ONR in 2004 for testing of potential design solution noise mitigation initiatives. PMA265 also requested funding in Fiscal Year (FY) 2008 through the Rapid Technology Transition (RTT) Program, sponsored by ONR, to demonstrate and validate noise reduction technology specific to the F/A-18 E/F and E/A-18G engine. According to PMA265 representatives, ONR has approved this request and, once PMA265 obtains confirmation from N88 and end-user operational commanders through Memoranda of Agreement (MOA), funding will become available in FY 2009.

## **5. Summary of Audit Results and Conclusions**

a. According to PMA265 representatives, the F/A-18E/F aircraft emits, and the EA-18G will emit, a maximum of 150 dBs, which is well above the noise level considered hazardous to hearing (greater than 84 dBs). According to PMA265, they made no initial attempts to mitigate the flight-line/deck jet noise hazard through design selection. This is contrary to the system safety design order of precedence specified in the MIL-STD-882D. Test results indicate that new technology hearing protection devices will reduce noise exposure on the flight deck by at least 43 dBs; however, this is still above the level considered hazardous to hearing. A professional audiologist further validated that a hazard will continue to exist even with the improved hearing protection. We also found that PMA265:

- Appropriately maintained a Risk Assessment Code (RAC) of “Serious-Undesirable” associated with the flight-line/deck jet noise hazard; however, they established risk levels (Risk Assessment Matrix) and risk acceptance authority levels that did not comply with required guidance; and
- Did not maintain a current log of mitigation efforts associated with the flight-line/deck jet noise hazard.

b. **System Safety Design Order of Precedence.** To determine if PMA265 followed the system safety design order of precedence requirements, as outlined in Table A, we conducted meetings with PMA265 ESOH representatives, and obtained and reviewed the following documentation:

- F/A-18E/F and EA-18G Operation Requirements Document (ORD) to determine if jet noise was identified as a specific concern area or contained noise threshold requirements as Key Performance Parameters (KPPs);
- The F/A-18E/F and EA-18G Acquisition Strategy;
- The F/A-18E/F and EA-18G Contract Statement of Work;



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- ONR jet noise reduction briefings, itineraries, results, and reports of noise mitigation studies to determine PMA265's involvement in these ONR efforts; and
- E-mail correspondence to and from PMA265 representatives regarding jet noise efforts during the design and development of the aircraft.

c. Based on our review of the above documentation and discussions with PMA265 representatives, we found that PMA265 did not follow the system safety design order of precedence for mitigating the flight-line/deck jet noise hazard, as required by MIL-STD-882D, Section 4.4; and F/A-18's own System Safety Program Plan, Section 1.4 and 3.2.2. We also found that there was no mention of noise limitations in the F/A-18E/F and EA-18G acquisition strategy and contract Statement of Work. PMA265 provided an e-mail verifying that they did not initially attempt to mitigate the flight-line/deck jet noise hazard through design selection, nor another method, during the design and development of the F/A-18E/F and EA-18G aircraft. Table A lists each criterion and its requirements.



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**Table A: System Safety Design Order of Precedence – Required Guidance**

Criteria	Requirements
MIL-STD-882D, Section 4.4	<p>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:</p> <ol style="list-style-type: none"> <li>1. <b>Eliminate hazards through design selection:</b> If unable to eliminate an identified hazard, reduce the associated mishap risk to an acceptable level through design selection.</li> <li>2. <b>Incorporate safety devices:</b> If unable to eliminate the hazard through design selection, reduce the mishap risk to an acceptable level using protective safety features or devices.</li> <li>3. <b>Provide warning devices:</b> 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.</li> <li>4. <b>Develop procedures and training:</b> 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.</li> </ol>
F/A-18E/F Engineering Manufacturing Development System Safety Program Plan, Sections 1.4 and 3.2.2.	<p>Management understands that safety considerations are critical and that hazards should be identified and controlled during the design phase rather than "reacted to" following accidents.</p> <p>The following precedence applies when corrective action is required to control a hazard to an acceptable level of risk:</p> <ol style="list-style-type: none"> <li>a. <b>Design for Minimum Risk</b> - Design to eliminate hazards. The maximum effort consistent with contractual requirements will be made to ensure the optimum degree of safety by selecting appropriate design features and qualified components.</li> <li>b. <b>Incorporate Safety Devices</b> - Safety devices will be used when known hazards cannot be eliminated by design.</li> <li>c. <b>Provide Warning Devices</b> - Warning devices will be used in those instances when it is not possible to eliminate or adequately control the risk of a known hazard through design selection or safety devices.</li> <li>d. <b>Procedures and Training</b> - Special operating and emergency procedures will be recommended when it is not possible to control an identified hazard by design selection, or by the use of safety and warning devices. Navy concurrence is required whenever procedures are used to control a known Catastrophic or Critical hazard to an acceptable level of risk.</li> </ol>

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d. PMA265 did not first attempt to mitigate the maintainer noise hazard through design selection because they lacked internal controls to ensure compliance with the system safety design order of precedence. PMA265 representatives stated that they did not pursue minimizing noise generated by the F/A-18E/F engines through design because warfare sponsors (Commander, Naval Air Forces representatives) did not identify noise requirements as KPPs within the Operational Requirements Document (ORD). They also stated that the emphasis on reducing current personnel noise exposures did not exist at the time the ORD was issued, and therefore, funding was not allocated to mitigate the flight-line/deck jet noise hazard. We verified that noise requirements were not identified as KPPs within the ORD. PMA265 representatives also stated that noise was always part of the ship and aircraft environment and no viable technologies were available at the time the engines were designed.

e. Because PMA265 did not mitigate the identified flight-line/deck jet noise hazard in accordance with the system safety design order of precedence, the aircraft noise hazard may not be mitigated to its lowest level. This could result in sailor and Marine exposure to higher levels of noise. According to OPNAVINST 5100.23G, Chapter 18, Section 1801, Paragraph (a), dated 30 December 2005, hearing loss has been, and continues to be, a source of concern within the Navy. OPNAVINST 5100.23G further 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.

f. Although PMA265 verified that they did not mitigate the F/A-18E/F and EA-18G flight-line/deck jet noise hazard through design selection in the design and development phases, PMA265 has since sought design solutions, as noted in the Noteworthy Accomplishment. PMA265 representatives stated that if solutions and/or noise reductions to the jet noise hazard are recognized, ideally engine modifications would be implemented as part of the normal life-cycle engine maintenance process.

g. **Assignment of Risk Assessment Code (RAC).** We conducted meetings with PMA265 ESOH representatives. These meetings were held to determine if PMA265 assigned a RAC associated with the identified flight-line/deck jet noise hazard, and maintained an appropriate process for evaluating the RAC in accordance with required guidance. Additionally, we obtained and reviewed the following documentation:

- F/A-18E/F PESHE (According to SECNAVIST 5000.2C, dated 19 November 2004, the PESHE should include ESOH risks);
- Test result documentation for improved hearing protection;
- PEO (Tactical Aircraft Programs) Risk Acceptance Memorandum;

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- PEO (Tactical Aircraft Programs) Risk Acknowledgement Memorandum; and
- Commander Naval Air Forces Risk Acknowledgement Memorandum.

h. We found that PMA265 formally assigned a RAC for the flight-line/deck jet noise hazard within their PESHE, dated March 2007, and appropriately maintained the associated RAC as described below. The initial RAC for the flight-line/deck jet noise hazard was assessed as “Critical” and “Likely” (classified as “Serious-Undesirable”) (see Table B). According to PMA265, the RAC assessment methodology included recognizing jet noise as a longstanding problem for Naval aviation. PMA265 referenced in their PESHE ongoing jet design and improved hearing protection noise reduction efforts. However, since these mitigation efforts were not yet implemented,<sup>4</sup> the flight-line/deck jet noise hazard properly remained in the “Serious-Undesirable” classification. The associated residual risk was raised to the PEO level for formal program risk acceptance/acknowledgement, in accordance with SECNAVINST 5000.2 (see Enclosure 6 for the acknowledgement). Additionally, the residual risk was formally acknowledged by Commander, Naval Air Forces (System Command level), in a risk acknowledgement memorandum (See Enclosure 7).<sup>5</sup> As a result, the flight-line/deck jet noise hazard maintained appropriate awareness and visibility for the associated RAC of “Serious-Undesirable.”

i. **Risk Levels<sup>6</sup> and Risk Acceptance Authority Levels.** To determine if PMA265 established risk levels and risk acceptance authority levels in accordance with required guidance, we obtained and reviewed the following documentation from PMA265:

- “Risk Assessment Matrix”;
- “Management and Decision Authority Based on RAC”;
- “Updated Draft ESOH Risk Information.”

j. We found that PMA265 established risk levels that did not align with definitions and the risk matrix highlighted in SECNAVINST 5000.2C, Enclosure 7, Table E7T2. Specifically, PMA265’s Risk Assessment Matrix contained multiple occurrences of lower risk-level classifications. For example, PMA265’s matrix contains 10 categorizations of low-risk versus the 3 outlined in SECNAVINST 5000.2C. Risk levels are a combination of severity<sup>7</sup> and probability<sup>8</sup> levels. Tables B and C illustrate the

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<sup>4</sup> Naval Aircrew Systems Command (PMA202) verified that the improved hearing protection would not be available for fleet purchase until August 2008. PMA202 further verified that the improved hearing protection would provide 43 dBs of noise reduction.

<sup>5</sup> The PEO risk acknowledgement memorandum superseded the Commander, Naval Air Forces risk acknowledgement memorandum as the official recognition of risk.

<sup>6</sup> The Risk Assessment Matrix is made up of various risk levels.

<sup>7</sup> An assessment of the consequences of the most reasonable credible mishap that could be caused by a specific hazard.

<sup>8</sup> The aggregate probability of occurrence of the individual events/hazards that might create a specific mishap.

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differences between the PMA265 risk levels and those required by SECNAVINST 5000.2C. After presentation of our audit results, PMA265 provided an “Updated Draft ESOH Risk Information” document, which maintains a process (risk matrix) that still does not align with SECNAVINST 5000.2C. The ESOH Risk Assessment Matrix is still a 5x5 (5 levels of probability and 5 levels of severity) versus the 5x4 (5 levels of probability and 4 levels of severity) referenced in SECNAVINST 5000.2C. According to PMA265 representatives, the difference exists because NAVAIR’s Risk Management Instruction and Guide uses a 5x5 matrix to portray program cost, schedule, and performance risks. PMA265 used a 5x5 matrix to ensure consistency and translation of ESOH risks into the NAVAIR risk assessment process. However, this still does not comply with SECNAVINST 5000.2C.

k. In addition, PMA265’s risk acceptance authority levels (decision authority for residual risk) permit hazards categorized as “low” to be accepted by the Program Manager (PM) or a designee. This does not comply with DoDI 5000.2, Section E7.1.6 and SECNAVINST 5000.2C, Enclosure 7, Section 7.3, which state that risk acceptance authority may not be delegated below the PM. While PMA265 used an appropriate acceptance authority for the flight-line/deck jet noise hazard, the established risk acceptance authority levels provide the potential for the acceptance of risk below the PM level. The following tables illustrate the differences between PMA265’s risk acceptance authority levels and those reflected in SECNAVINST 5000.2C:

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**TABLE B: F/A-18 Program Office (PMA265) Risk Assessment Matrix**

Consequence Likelihood	Negligible (I)	Minor (II)	Moderate (III)	Critical (IV)	Severe (V)
Near Certainty (E)	Low Acceptable w/review	Serious Undesirable	High Unacceptable	High Unacceptable	High Unacceptable
Highly Likely (D)	Low Acceptable w/review	Medium Undesirable	Serious Undesirable	High Unacceptable	High Unacceptable
Likely (C)	Low Acceptable w/review	Medium Undesirable	Medium Undesirable	Serious Undesirable	High Unacceptable
Low Likelihood (B)	Low Acceptable w/o review	Low Acceptable w/review	Low Acceptable w/review	Medium Acceptable w/review	Serious Undesirable
Not Likely (A)	Low Acceptable w/o review	Low Acceptable w/o review	Low Acceptable w/review	Low Acceptable w/review	Medium Acceptable w/review

Risk Level	Decision Authority For Residual Risk
HIGH – Unacceptable RACs: VC-VE, and IIIE	Component Acquisition Executive (ASN (RDA))
SERIOUS – Undesirable RACs: VB, IVC, IIIC, and IIE	Program Executive Officer
MEDIUM – Undesirable / Acceptable w/ review RACs: VA, IVB, IIID, and IIC-IIID	PMA265 PM or F/A-18E/F and EA-18G PM
LOW – Acceptable w/ review RACs: IVA, IIIA-B, IIB, and IC-IE	F/A-18E/F and EA-18G PM or designee
LOW – Acceptable w/o review RACs: IIA and IA	F/A-18E/F and EA-18G PM or designee



\*Note: Blue circle indicates the risk category and the black arrow indicates the risk acceptance level for the noise hazard.

**TABLE C: SECNAVINST 5000.2C ESOH Risk Levels (Risk Matrix)**

Probability Severity	Frequent (A)	Probable (B)	Occasional (C)	Remote (D)	Improbable (E)
Catastrophic (I)	High	High	High	Serious	Medium
Critical (II)	High	High	Serious	Medium	Medium
Marginal (III)	Serious	Serious	Medium	Medium	Medium
Negligible (IV)	Medium	Medium	Low	Low	Low

Risk Level	Risk Acceptance Authority
HIGH	ASN (RDA)
SERIOUS	PEO/SYSCOM Commanders, or Flag -Level or SES designees
MEDIUM	Program Manager
LOW	Program Manager

\*Note: The colors were added for comparison purposes.

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l. PMA265 lacked internal controls to ensure compliance with DoDI 5000.2 and SECNAVINST 5000.2C. After presentation of our audit results, PMA265 provided an “Updated Draft ESOH Risk Information” document that contained revised risk acceptance authority levels to comply with guidance (removing all reference to a “designee”).

m. Establishing risk levels that were not compliant with required guidance increases the potential of hazards and residual risks to be assessed and classified in a manner that is not standardized and consistent with other programs. This could limit DON leadership’s ability to properly evaluate similar ESOH risks across like programs.

n. In June 2008, PMA265 provided an “Updated Draft ESOH Risk Information” document, which revised the risk acceptance authorities for all medium- and low-risks to the PM level.

o. **Tracking of Hazards and Residual Mishap Risk.** To determine if PMA265 tracked occupational health hazards and residual mishap risk, we reviewed the System Safety Program Progress Report, dated 19 October 2007, that listed all Safety Action Report hazards being tracked; however, no occupational health hazards were contained within the report.

p. PMA265 did not track occupational health hazards and residual mishap risk in accordance with required guidance. Specifically, PMA265 did not maintain a current log of identified occupational health hazards, to include the flight-line/deck jet noise hazard, and residual mishap risk throughout the system life cycle, as required by MIL-STD-882D, Section 4.8 and A.4.4.8.1.

q. PMA265 lacked internal controls to ensure that a current log of identified occupational health hazards and residual mishap risks were maintained. As a result of not tracking occupational health hazards and residual mishap risk, a concise dated log of hazard status, mitigation efforts, and their associated effectiveness 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 and Marine.

r. PMA265 representatives verified this weakness in an e-mail and stated that they planned to use an existing Safety Action Report<sup>9</sup> hazard database (which was used to

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<sup>9</sup> As stated in the F/A-18E/F System Safety Program Plan, Safety Action Reports document the official record of opening a hazard and tracking mitigation efforts in an attempt to reduce the risk level (severity and probability) to an acceptable level and close-out the hazard. Safety Action Report activity is to be updated at least monthly.



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track only safety hazards) to formally document and track occupational health hazards in the future. The Safety Action Report database has the functionality to adequately meet the requirements specified within MIL-STD-882D.

s. **Summary.** PMA265 maintained an appropriate process for evaluating the RAC for the flight-line/deck jet noise hazard and identified jet noise as a serious risk. However, PMA265 did not attempt to mitigate the jet noise hazard in the initial design and development of the aircraft, did not follow required guidance relating to risk levels and risk acceptance authority levels, and did not track the flight-line/deck jet noise hazard and its residual mishap risk. These conditions may contribute to a hazardous environment of high noise exposure associated with jet aircraft that, according to the Naval Safety Center, increases the likelihood of permanent hearing loss to sailors and Marines. According to the Naval Safety Center, in addition to the personal cost to the sailor and Marine, the economic consequences of hearing impairment to the Navy include: lost time and decreased productivity, loss of qualified workers through medical disqualification, military disability settlements, retraining, and expenses related to medical treatment. An example of Veterans hearing loss disability cost figures reported by the Center for Naval Analyses is found in Enclosure 4. As stated in the noteworthy accomplishment, PMA265 has pursued FY 2009 funding through the RTT Program to demonstrate and validate noise reduction technology specific to the F/A-18 E/F and E/A-18G engine.

**6. Recommendations and Corrective Actions.** Our recommendations, summaries of the management responses, and our comments on the responses are below. The complete text of the responses is in Enclosure 8.

We recommend that the F/A-18 Program Office, PMA265:

**Recommendation 1.** Establish a formal process to actively seek new, and document prior, ongoing, and future, efforts to identify potential design solutions to mitigate identified hazards, and determine what additional mitigation efforts may be possible (whether in design, devices, or other methods) to further reduce the noise hazard for the F/A-18 E/F and EA-18G aircraft.

**F/A-18 Program Office, PMA265 response to Recommendation 1.** Concur. PMA265 is actively engaged in ongoing research and development efforts for engine noise reduction technologies. Future opportunities would also be considered if promising. As reflected in the 5 March 2008 MFR, PMA265 will annually assess available and viable technologies. A process to document PMA265's efforts and assessments will be identified in the next 6 to 9 months, and would be implemented as part of PMA265's commitment to the annual assessment of solutions. However, PMA265 does not plan to "back track" since



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the inception of the F414 engine and F/A-18E/F to document all past design efforts. This could prove to be very time consuming with little return. Rather, only the efforts of the last 2 to 3 years will be noted by PMA265. The estimated date of completion is 31 October 2009.

**Naval Audit Service comment on response to Recommendation 1.**

PMA265's planned actions meet the intent of the recommendation, which is open pending completion of agreed-to actions. Because the target completion date is more than 6 months in the future, we are assigning an interim target date of 30 April 2009, and we ask that PMA265 inform us by that date of the status of the agreed-to corrective actions.

**Recommendation 2.** Reestablish risk levels (Risk Assessment Matrix) and risk acceptance authority levels in policies and procedures to ensure compliance with DoDI 5000.2, Section E7.1.6 and SECNAVINST 5000.2C, Enclosure 7, Section 7.3.

**F/A-18 Program Office, PMA265 response to Recommendation 2.** Partially concur. PMA265 has already corrected the risk acceptance authority levels for identified ESOH hazards and their associated risks for consistency with DoDI 5000.2 and SECNAVINST 5000.2C. While working with the NAVAIR 1.6 Environmental Programs Department, PMA265 will reevaluate over the next 3 to 4 months whether some of the risk levels currently ranked and reflected as "green" should be changed to "yellow" for greater consistency with DoDI 5000.2 and MIL-STD-882D. However, unless NAVAIR 1.6 changes the ESOH risk matrix configuration in NAVAIR's PESHE Template, PMA265 will continue to use a 5x5 matrix vice the 4x5 matrix of MIL-STD-882D. PMA265 will consult with NAVAIR 1.6 on whether or not all of the exact ESOH risk definition terminology of SECNAVINST 5000.2C (such as occupational health severity definitions and probability levels of Fleet and individual systems) should be included in NAVAIR's PESHE Template. Estimated date of completion is 28 February 2009.

**Naval Audit Service comment on response to Recommendation 2.**

PMA265's planned actions only partially meet the intent of the recommendation. The risk acceptance levels have been changed and are in compliance with stated guidance. Therefore, upon updating internal program policy, PMA265 has met the intent for this portion of the recommendation. PMA265 subsequently provided an e-mail on 30 September 2008 stating that as their PESHE for the F/A-18E/F & EA-18G is updated on an annual basis, PMA265 will include the updated/revised Risk Acceptance Authority levels in the next revision scheduled for completion by April 2009.

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However, the proposed actions related to the Risk Assessment Matrix do not meet the intent of the recommendation. Specifically, PMA265 stated they would continue to evaluate Environmental and Occupation Health hazards using a 5x5 matrix vice the 4x5 matrix outlined within SECNAVINST 5000.2C and MIL-STD-882D, unless NAVAIR 1.6 changes the ESOH risk matrix configuration in NAVAIR's PESHE Template.

We plan to issue a summary report for "Consideration of Safety and Occupational Health Issues in Acquisition of Major Department of Navy (DON) Weapons Systems and Platforms." In that summary report, we plan to address systemic issues, including enforcing use of a standard risk assessment matrix to ensure programs apply a common set of rules and use standard terminology in assessing risks. We believe standardization and consistency across programs are essential to corporate-level evaluations of program risks. Establishing risk levels that are not compliant with required guidance increases the potential for the significance of hazards and residual risks to be misunderstood. Additionally, lack of standardization could limit DON leadership's ability to properly evaluate similar ESOH risks across like programs. Each of the four programs reviewed for this audit utilized different risk assessment matrices to assess the risk of hazardous noise. Accordingly, to have a common understanding of the risks of hazardous noise across the four programs, DON leaders would need to understand the nuances of each of the different matrices.

A video teleconference (VTC) was conducted on 30 September 2008 with PMA265, PEO(T), and NAVAIR 1.6 in an attempt to resolve this issue; however, the involved parties could not come to an agreement on this matter. During this meeting, NAVAIR 1.6 stated that "NAVAIR's PESHE Template," which includes a 5x5 matrix, is not official policy but rather is a tool used by NAVAIR. NAVAIR 1.6 provided NAVAIR Instruction 5000.21B, "Naval System Command Risk Management Policy," dated 24 January 2008 via e-mail on 28 September 2008, which PMA265 felt supported their position. This instruction includes a 5x5 Program Risk Matrix and a 4x5 System Safety Risk Matrix. PMA265 explained that they assess ESOH risks with a 5x5 matrix because they feel the instruction only requires use of a 4x5 matrix for safety risks. During the VTC, PMA265 maintained their position, and PEO(T) and NAVAIR 1.6 supported the position, that SECNAVINST 5000.2C does not contain specific guidance stating that ESOH hazards are to be evaluated using a 4x5 risk assessment matrix.

We provided PMA265, PEO(T), and NAVAIR 1.6 with the details during the VTC, and in a subsequent e-mail dated 2 October 2008, to support that a

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4x5 matrix is required. Specifically SECNAVINST 5000.2C, Section 4 states that Enclosure 7 of this instruction should be utilized to support the Defense Acquisition System. Enclosure 7, paragraph 7.3 states that risk acceptance authorities shall be followed in accordance with the ESOH risk levels, as defined in Tables E7T1 and E7T2 (derived from MIL-STD-882D). Table E7T2 (see Table C of the finding) contains the Risk Assessment Matrix to be used for analyzing and identifying ESOH risk levels, and outlines a 4x5 matrix approach.

Additionally, the NAVAIR Instruction 5000.21B provided by NAVAIR 1.6 references SECNAVINST 5000.2C and MIL-STD-882D, and further supports our position that a 4x5 matrix be utilized for ESOH evaluation. Specifically, Section 4a states: "MIL-STD-882 defines a system safety mishap as unplanned event or series of events resulting in death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment." Per this definition, noise hazards resulting in hearing loss, which is an occupational illness, would be considered a system safety mishap. Section 5f states, "The management of a program's system safety process shall be in accordance with SECNAVINST 5000.2C," which aligns with the MIL-STD-882D 4x5 risk assessment matrix, as previously stated. Enclosure (3) of this instruction, which "shows a tailored system safety risk matrix which meets a specific community of systems (NAVAIR) needs," outlines a 4x5 approach for analyzing system safety (ESOH) risks to be utilized by NAVAIR commands. This matrix is in compliance with SECNAVINST 5000.2C and MIL-STD-882D, and supports our position.

NAVAIR subsequently provided an e-mail on 16 October 2008 stating that the Office of the Commander, NAVAIR understands and agrees with PMA265's position.

Therefore, we have determined the recommendation to be undecided, and are elevating it to ASN (RDA) for action.

**Recommendation 3.** Establish controls and provide oversight to ensure that the F/A-18 E/F and EA-18G flight-line/deck jet noise hazard is formally opened in a tracking database and that the associated residual risk, log of mitigation efforts, and all other relevant information is tracked in a formal process with accurate record keeping.

**F/A-18 Program Office, PMA265 response to Recommendation 3.** Concur. PMA265 corrective action has been initiated in that PMA265 is evaluating the feasibility of modifying data fields in the safety assessment report database used

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by the F/A-18E/F and EA-18G system safety engineers for hazard tracking. There is a portion of the database that could possibly be modified to accommodate data fields for “environmental” and “occupational health” hazards and their risks. Configuration management of this database is maintained by the Boeing Corporation, so PMA265 needs to evaluate what the costs would be for modifying the database, the reasonableness of those costs, and budget accordingly for such modifications if feasible. This evaluation will be conducted over the next 3 to 6 months. PMA265 will use, in the interim, a simple Excel spreadsheet for ESOH risk tracking purposes. Estimated date of completion for Feasibility Assessment of Database Modifications is 30 April 2009.

**Naval Audit Service comment on response to Recommendation 3.**

PMA265’s planned actions meet the intent of our recommendation, which is for PMA265 to track ESOH hazards with accurate record keeping. While, in our opinion, it would be most beneficial to achieve this with the use of a database, a dedicated database is not required and tracking can be accomplished with the use of an Excel spreadsheet as proposed by PMA265. The recommendation is open pending completion of agreed-to actions. PMA265 subsequently provided a target completion date of February 2009 for implementing the interim Excel spreadsheet tracking process.

**7. Other Information**

- a. 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).
- b. We appreciate the cooperation and courtesies extended to our auditors.



RON J. BOOTH  
Assistant Auditor General  
Installations and Environment Audits

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**Subj: CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF  
THE F/A-18E/F SUPER HORNET AND EA-18G GROWLER STRIKE  
FIGHTER VARIANTS (FINAL INTERIM AUDIT REPORT N2009-0008)**

Copy to:

UNSECNAV

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ASSTSECNAV (MRA)

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DASN (S)

CNO (VCNO, DSN-33, N40, N41)

CMC (RFR) (ACMC)

DON CIO

NAVINGEN (NAVIG-4)

DIRECTOR, AIR WARFARE (N88)

AFAA/DO

## Enclosure 1:

# Status of Recommendations

Rec. No.	Page No.	Subject	Status <sup>9</sup>	Action Command	Target Completion Date
1	13	Establish a formal process to actively seek new, and document prior, ongoing, and future, efforts to identify potential design solutions to mitigate identified hazards, and determine what additional mitigation efforts may be possible (whether in design, devices, or other methods) to further reduce the noise hazard for the F/A-18 E/F and EA-18G aircraft.	O	PMA265	4/30/09
2	14	Reestablish risk levels (Risk Assessment Matrix) and risk acceptance authority levels in policies and procedures to ensure compliance with DoDI 5000.2, Section E7.1.6 and SECNAVINST 5000.2C, Enclosure 7, Section 7.3.	U	ASN (RDA)	12/1/08
3	16	Establish controls and provide oversight to ensure that the F/A-18 E/F and EA-18G flight-line/deck jet noise hazard is formally opened in a tracking database and that the associated residual risk, log of mitigation efforts, and all other relevant information is tracked in a formal process with accurate record keeping.	O	PMA265	4/30/09

<sup>9</sup> / 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

## Scope and Methodology

On 10 August 2007, the Naval Audit Service began a broad audit of “Consideration of Safety and Occupational Health Issues in the Acquisition of Major Department of Navy (DON) Weapons Systems and Platforms.” As of the date of this publication, that audit is ongoing. 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 F/A-18E/F Super Hornet and EA-18G Growler Strike Fighter Variants” between 9 January 2008 and 14 August 2008.

We evaluated internal controls and reviewed compliance with regulations related to consideration of hazardous noise in the F/A-18E/F and EA-18G acquisition process. Data quality was adequate for use in the audit.

We conducted site visits at Naval Air Systems Command, Patuxent River, MD, and interviews with the F/A-18 Program Office (PMA265) Environmental, Safety, and Occupational Health (ESOH) representatives to:

- Determine if selected F/A-18 aircraft jet noise level posed a hazard; and
- Assess PMA265’s process for mitigating the identified noise hazard.

This was further accomplished by reviewing Safety Action Record hazard reports from the system safety hazard database; ESOH memorandums; the F/A-18 Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE); System Safety Program Plan; the Program Progress Report; the F/A-18 Acquisition Strategy; ESOH Statement of Work sections; the Operational Requirements Document; engine noise mitigation studies and reports; test result documentation for improved hearing protection; and studies related to hearing loss.

We verified that the F/A-18 noise level posed a hazard to DON sailors and Marines through discussions with Navy Safety Center (NAVSAFECEN) ESOH representatives, Naval Aircrew Systems Command (PMA202), and professional audiologist specialists. We further corroborated this hazard through meetings and discussions with the end users such as Naval Air Forces Command and Fleet Forces Command. We assessed PMA265’s process of mitigating the identified hazards associated with jet noise. Specifically, we assessed the PMA265’s mitigation efforts related to the flight-line/deck jet noise hazard (noise exposure to flight deck operators).



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.

## Pertinent Guidance

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Department of Defense Instruction (DoDI) 5000.2, “Operation of the Defense Acquisition System,” dated 12 May 2003; Section E7.1.6 states that the Component Acquisition Executive (CAE) is the acceptance authority for high Environmental, Safety, and Occupational Health (ESOH) mishap risks identified by the program. The Instruction adds that the Program Executive Office (PEO)-level is the authority for serious risks, and the Program Manager (PM) is the authority for medium and low risks, as defined in the industry standard for system safety.

Military Standard 882D (MIL-STD-882D), “Department of Defense 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 A.4.4.5 advises a program to reduce system mishap risk through a mitigation approach mutually agreed to by the developer, program manager, and using organization. Section A.4.4.8.1.2 states that the program manager will evaluate the hazards and associated mishap risk in close consultation and coordination with the ultimate end user, to assure that the context of the user requirements, potential mission capability, and the operational environment are adequately addressed.
- Section 4.4 states that 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 defined in this section. See the “Required Guidance” table (Table 1) in the System Safety Design Order of Precedence section for details.
- Section 4.8 requires a program to track hazards, their closures, and residual mishap risk. A tracking system for this information must be maintained throughout the system life cycle. The program manager must keep the system user apprised of this information. Section A.4.4.8.1 states each system must have a current log of identified hazards and residual mishap risk, including an assessment of 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 hazards and residual risk and keep users informed of hazards and residual mishap risk associated with their systems.

Secretary of the Navy Instruction (SECNAVINST) 5000.2C, “Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System,” dated 19 November 2004, Enclosure 7, Section 7.3 includes the following risk acceptance authority levels:

- High risks: Assistant Secretary of the Navy (Research, Development, and Acquisition) (ASN (RDA))
- Serious risks: PEO/Systems Command (SYSCOM) Commanders, or Flag-level or senior executive service (SES) designees/Direct Reporting Program Managers (DRPM), Chief of Naval Research (CNR); and
- Medium/low risks: Program Managers (PM). Risk acceptance authority may not be delegated below the PM.

Chief of Naval Operations Instruction (OPNAVINST) 5100.23G, “Navy Safety and Occupational Health (SOH) Program Manual,” dated 30 December 2005, Chapter 18, Section 1801, paragraph (a) 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<sup>10</sup> (continuous or intermittent) is greater than 84 dBs.

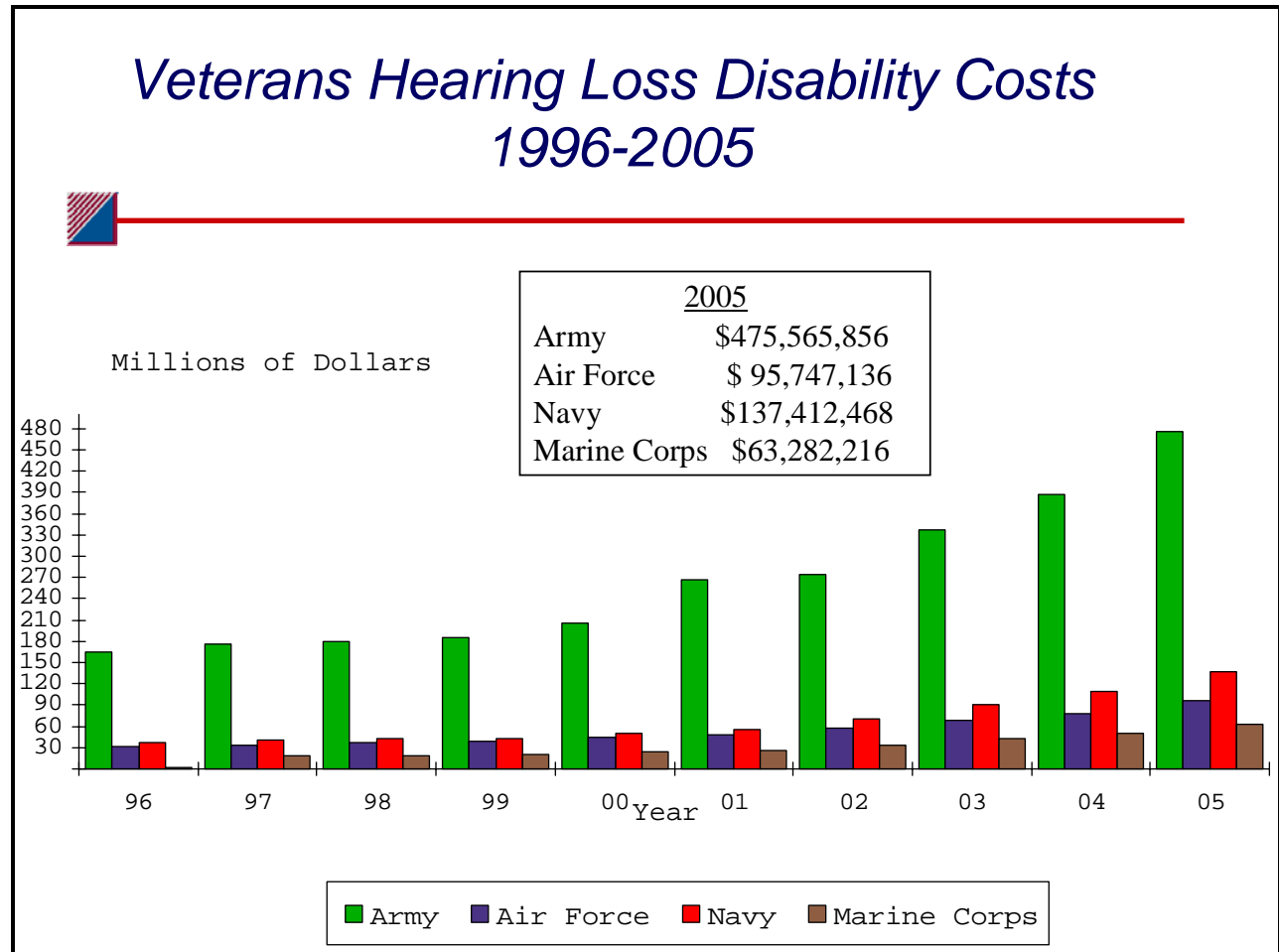
F/A-18 E/F Engineering Manufacturing Development System Safety Program Plan, revision B, dated 25 January 2008, Section 1.4, states that management understands that safety considerations are critical and that hazards should be identified and controlled during the design phase rather than “reacted to” following accidents. Section 3.2.2 states that the safety design order of precedence referenced in MIL-STD-882D applies when corrective action is required to control a hazard to an acceptable level of risk.

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<sup>10</sup> According to OPNAVINST 5100.23G, A-weighted sound level is designated to approximate the response of the human ear to sound.

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.

# Hearing Protection Suite



## Hearing Protection Roadmap

CURRENT		NEAR-TERM		FUTURE
<p><b>Components</b></p> <p>21 dB Mean Attenuation Legacy Earmuff</p> <p>22 dB Mean Attenuation Legacy Foamy Earplugs</p> <p>30 dB Mean Attenuation Legacy Earmuff + Legacy Foamy Earplugs</p> <p><i>Hearing protection using foam type devices varies depending on properly wearing both earplugs</i></p>	<p><b>Integrated</b></p> <p>30 dB Mean Attenuation Legacy Earmuff + Legacy Foamy Earplugs</p>	<p><b>Components</b></p> <p>25 dB Mean Attenuation Improved Earmuff</p> <p>28 dB Mean Attenuation Foam Tip Mini-Comm Earplug (CEP)</p> <p>29 dB Mean Attenuation Custom Molded Deep Insert Earplug</p> <p>43 dB Mean Attenuation Improved Earmuff + Custom Molded Deep Insert Earplug</p> <p>49 dB Mean Attenuation w/ or w/o Communication</p>	<p><b>Integrated</b></p> <p>43 dB Mean Attenuation Improved Earmuff + Custom Molded Deep Insert Earplug</p> <p>49 dB Mean Attenuation w/ or w/o Communication</p>	<p><b>Integrated</b></p> <p>50 dB Mean Attenuation Active Noise Reduction (ANR) + Improved Earmuff + Custom Molded Deep Insert Earplug</p> <p>50 dB Mean Attenuation w/ or w/o Communication</p>
<b>Legacy Cranial</b>		<b>Flight Deck Cranial Program</b>		

1. Naval personnel correctly wearing both Legacy Foamy Earplugs = 7%, results in 22 dB protection.
2. Naval personnel with shallow insertion or not wearing Legacy Foamy Earplugs = 79%, results in 0-6 dB protection.



Source: Program Manager Air – Naval Aircrew Systems (PMA202), “Flight Deck Cranial Status Brief to the NESB,” 25 March 2008

Enclosure 6:

# Program Executive Officer (Tactical Aircraft Programs) - F/A-18E/F and EA-18G Noise Exposure Risk Acknowledgement



DEPARTMENT OF THE NAVY  
PROGRAM EXECUTIVE OFFICER  
TACTICAL AIRCRAFT PROGRAMS  
47123 BUSE ROAD, UNIT IPT  
PATUXENT RIVER, MD 20670-1547

IN REPLY REFER TO  
5100  
Ser PEO(T)013  
5 Mar 08

MEMORANDUM FOR THE RECORD

Subj: F/A-18E/F AND EA-18G NOISE EXPOSURE RISK ACKNOWLEDGEMENT

Ref: (a) (USD/AT&L) Policy Memo: "Defense Acquisition System Safety – Environment, Safety and Occupational Health (ESOH) Risk Acceptance" of 7 Mar 07  
(b) CNAF memo 6000 Ser N8/278 of 4 Mar 08 (NOTAL)

1. Current Department of Defense (DoD) policy requires Program Managers to use the structured Environment, Safety, and Occupational Health (ESOH) risk assessment framework in the DoD Standard Practice for System Safety, Military Standard (MIL-STD)-882D, for all developmental and sustaining engineering activities. The objective is to design out ESOH risks early in the acquisition process. However, not all risks can be eliminated. Prior to exposing people, equipment, or the environment to known system related ESOH hazards, these risks must be acknowledged by the authorities identified in DoD Instruction 5000.2. Reference (a) directs that formal concurrence must be obtained for all serious and high risk acceptance decisions. The concurrence of Commander, Naval Air Forces is documented in reference (b). This Memorandum for the Record documents our acknowledgement of noise exposure risk for the F/A-18E/F and EA-18G, and describes our activities to reduce this risk.

2. ESOH risk involving exposure to flight line/deck jet noise is considered serious for the F/A-18E/F and EA-18G Programs. This is a long standing issue associated with many current and future jet aircraft in the DoD inventory. Current hearing protection devices do not adequately prevent noise exposure that personnel may experience when working around aircraft. PMA265 is closely monitoring various Naval Air Systems Command (AIR 4.4 & 4.6)/Office of Naval Research (ONR) projects focused on developing technical solutions to minimize personnel exposure to jet noise levels above Occupational Safety and Health Administration and United States Navy standards. A number of interim noise suppression concepts have been identified that may offer partial noise relief without performance impacts to Naval or Air Force high performance military aircraft. Promising projects addressing noise suppression include the University of Mississippi testing of corrugated jet nozzle seals, Pennsylvania State University's Nonlinear Propagation Modeling, and Boeing's Beveled Angle Nozzle Noise Reduction, which adapts and applies the beveled nozzle concept to the exhaust system of the F414 engine.

Moreover, the original equipment manufacturer for the F404/F414 engine, General Electric (GE) Aviation, has for years pursued Jet Noise Reduction Technology Development projects. These involve a wide variety of scaled acoustic solution tests such as fluidic injection and mechanical chevrons. A full scale static engine test to demonstrate and validate such technologies was conducted by GE/NAVAIR 4.4 at Naval Air Warfare Center Lakehurst, 7-28 September 2007. Results of this test show some promise of sound energy level reduction on F-4XX series engines. It should be noted that none of these applications have been fully flight tested in operational conditions. PMA265 is also staying abreast of on-going DoD efforts for improved hearing protection devices, such as the Attenuating Custom Communications Earpiece System. However, even with the most advanced hearing protection under development, under extremely high noise exposure conditions experienced on a carrier flight deck, the net noise levels remain unacceptable. In many cases only operational measures (e.g., moving of carrier flight deck plane handling personnel at a further distance from jet exhaust) offer near term solutions.

3. An additional consideration is the fact that the EA-18G produces less sound energy (in certain frequencies) than the EA-6B it replaces due to different engine/exhaust nozzle configurations. For this reason, the Navy was able to go forward with a Finding of No Significant Impact (FONSI) for basing the EA-18G at Naval Air Station Whidbey Island, WA, under National Environmental Policy Act (NEPA) procedures.

4. Until there are viable technologies to mitigate current and planned noise levels, noise exposure will continue to be an issue for the user community, especially aboard aircraft carriers. As solutions become available, PMA265 will assess, on an annual basis, the viability of incorporating proven technologies into the F/A-18E/F and EA-18G.



W. M. SKINNER

Source: Risk Acknowledgement Memorandum was provided by PMA265



Enclosure 7:

# Commander, Naval Air Forces – F/A-18E/F and EA-18G Noise Exposure Risk Acknowledgement (NOTAL)



DEPARTMENT OF THE NAVY  
COMMANDER NAVAL AIR FORCES  
BOX 357051  
SAN DIEGO, CALIFORNIA 92135-7051

6000  
Ser N8/278  
4 Mar 08

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICER (TACTICAL AIRCRAFT PROGRAMS)

Subj: F/A-18E/F AND EA-18G NOISE EXPOSURE RISK ACKNOWLEDGEMENT

Ref: (a) USD/AT&L Policy Memo "Defense Acquisition System Safety Environment, Safety and Occupational Health (ESOH) Risk Acceptance" of 7 Mar 07  
(b) Draft PEO(T) Memorandum for the Record "F/A-18E/F and EA-18G Noise Exposure Risk Acknowledgement"

1. Per reference (a), Commander, Naval Air Forces concurs with reference (b), acknowledgement of the noise exposure risk posed by the F/A-18E/F and EA-18G weapons systems.
2. In concert with the acknowledgement of this risk, Commander, Naval Air Forces supports efforts by the acquisition community to develop weapons systems with reduced noise signatures and hearing protection systems that will reduce personnel noise exposure to acceptable levels.
3. In addition, Commander, Naval Air Forces will continue to raise awareness within the Naval Air Force of the hazards associated with exposure to excessive noise levels produced by jet engines, the necessity of compliance with hearing conservation directives, the proper wearing of hearing protection, and operational strategies for minimizing personnel exposure to harmful levels of noise.

  
T. J. KILCLINE

Source: Risk Acknowledgement Memorandum was provided by PMA265.

Enclosure 8:

# Management Response from PMA265



DEPARTMENT OF THE NAVY  
NAVAL AIR SYSTEMS COMMAND  
RADM WILLIAM A. MOFFETT BUILDING  
47123 BUSE ROAD, BLDG 2272  
PATUXENT RIVER, MARYLAND 20670-1547

BY REPLY REFER TO

7540  
AIR-00G4A/073  
SEP 10 2008

From: Commander, Naval Air Systems Command  
To: Naval Audit Service, Assistant Auditor General for Installations and Environment Audits

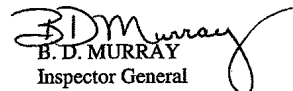
Subj: NAVAL AUDIT SERVICE DRAFT INTERIM AUDIT REPORT ON  
CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF THE  
F/A-18E/F SUPER HORNET AND EA-18G GROWLER STRIKE FIGHTER  
VARIANTS (DRAFT N2007-NIA000-0066.003)

Ref: (a) NAVAUDSVC Memo 7510 N2007-NIA000-0066.003 of 14 Aug 08

Encl: (1) PMA265 Response to Subject Draft Interim Audit Report

1. Reference (a) forwarded the subject draft interim audit report for review and comments. Accordingly, enclosure (1) provides our response.
2. Please direct questions concerning the response to [REDACTED]

FOUO - FOIA (b)(6)

  
B. D. MURRAY  
Inspector General  
Acting

~~FOR OFFICIAL USE ONLY~~

**PMA265 RESPONSE TO  
NAVAUDSVC DRAFT INTERIM AUDIT REPORT ON  
“CONSIDERATION OF HAZARDOUS NOISE IN THE ACQUISITION OF THE F/A-  
18E/F SUPER HORNET AND EA-18G GROWLER STRIKE FIGHTER VARIANTS”  
DRAFT INTERIM AUDIT REPORT N2007-NIA000-0066.003, DATED 14 AUGUST 2008**

**SUMMARY:** PMA265 maintained an appropriate process for evaluating the Risk Assessment Code (RAC) for the flight-line/deck jet noise hazard and identified jet noise as a serious risk. However, PMA265 did not attempt to mitigate the jet noise hazard in the initial design and development of the aircraft, did not follow required guidance relating to risk levels and risk acceptance authority levels, and did not track the flight-line/deck jet noise hazard and its residual mishap risk. These conditions may contribute to a hazardous environment of high noise exposure associated with jet aircraft that, according to the Naval Safety Center, increases the likelihood of permanent hearing loss to sailors and Marines. According to the Naval Safety Center, in addition to the personal cost to the sailor and Marine, the economic consequences of hearing impairment to the Navy include: lost time and decreased productivity, loss of qualified workers through medical disqualification, military disability settlements, retraining, and expenses related to medical treatment.

**PMA265 RESPONSE:** Partially Concur. This summary does not present a complete picture of the findings in the report. Specifically, PMA265 requested in July 2008 (based on the discussion draft report) the inclusion of a statement recognizing that despite the findings, there has been and continues to be a concerted effort by PMA265 to mitigate the identified hazard of jet noise.

Request the following sentence be inserted at the end of the summary: “Recognizing there are personnel exposure risks from jet noise, PMA265 has committed and continues to proactively seek viable and effective solutions to reduce noise generated from the high performance engines of the F/A-18E/F and EA-18G.”

Also, PMA265 requested in July 2008 the Memorandum for Record (MFR) of 5 May 2007 (Enclosure 6) be removed from the report. This MFR is now considered void with the issuance of the 5 March 2008 MFR (Enclosure 7).

**RECOMMENDATION 1:** Establish a formal process to actively seek new, and document prior, ongoing, and future, efforts to identify potential design solutions to mitigate identified hazards, and determine what additional mitigation efforts may be possible (whether in design, devices, or other methods) to further reduce the noise hazard for the F/A-18 E/F and EA-18G aircraft.

**PMA265 RESPONSE:** Concur. PMA265 is actively engaged in on-going research and development efforts for engine noise reduction technologies. Future opportunities would also be considered if promising. As reflected in the 5 March 2008 MFR, PMA265 will annually assess available and viable technologies. A process to document PMA265’s efforts and assessments

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will be identified in the next six to nine months, and would be implemented as part of PMA265's commitment to the annual assessment of solutions. However, PMA265 does not plan to "back track" since the inception of the F414 engine and F/A-18E/F to document all past design efforts. This could prove to be very time consuming with little return. Rather, only the efforts of the last two to three years will be noted by PMA265. Estimated date of completion is 31 October 2009.

**RECOMMENDATION 2:** Reestablish risk levels (Risk Assessment matrix) and risk acceptance authority levels in policies and procedures to ensure compliance with DoDI 5000.2, Section E7.1.6 and SECNAVINST 500.2C, Enclosure 7, Section 7.3.

**PMA265 RESPONSE:** Partially Concur. PMA265 has already corrected the risk acceptance authority levels for identified Environmental, Safety, and Occupational Health (ESOH) hazards and their associated risks for consistency with DoDI 5000.2 and SECNAVINST 5000.2C. PMA265, working with NAVAIR 1.6 Environmental Programs Department, will re-evaluate over the next three to four months whether some of the risk levels currently reflected/ranked as "green" should be changed to "yellow" for greater consistency with DoDI 5000.2 and MIL-STD-882D.

However, unless NAVAIR 1.6 changes the ESOH risk matrix configuration in NAVAIR's Programmatic Environment, Safety and Occupational Health Evaluation (PESHE) Template, PMA265 will continue to use a 5x5 matrix vice the 4x5 matrix of MIL-STD-882D. As previously discussed during the audit, the mishap categories and associated ESOH risk matrix of MIL-STD-882D are "suggested" and offer "guidance." An acquisition program can still choose to tailor their approach as long as the risk acceptance authorities are the same as mandated by DoDI 5000.2 and SECNAVINST 5000.2C. It is the position of PMA265 that the 5x5 ESOH risk matrix is appropriately aligned with DoD's and NAVAIR's risk assessment process which is founded on a 5x5 matrix. ESOH hazards and their risks are no different than all the other hazards and risks that are assessed by an acquisition program manager based on the DoD risk assessment process. Therefore, using a similar risk matrix approach for ESOH continues to make sense.

In addition, while not verbatim to SECNAVINST 5000.2C, Table E7T1, the risk consequence and probability definitions of the current ESOH risk matrix used by PMA265 and NAVAIR are appropriately aligned and consistent with the terminology in MIL-STD-882D, as well as including basic DoD risk definitions used by acquisition program managers. PMA265 will consult with NAVAIR 1.6 on whether or not all of the exact ESOH risk definition terminology of SECNAVINST 5000.2C (such as occupational health severity definitions and probability levels of Fleet and individual systems) should be included in NAVAIR's PESHE Template. Estimated date of completion is 28 February 2009.

**RECOMMENDATION 3:** Establish controls and provide oversight to ensure that the F/A-18 E/F and EA-18G flight-line/deck jet noise hazard is formally opened in a tracking database and that the associated residual risk, log of mitigation efforts, and all other relevant information is tracked in a formal process with accurate record keeping.

**PMA265 RESPONSE:** Concur. Action has been initiated in that PMA265 is evaluating the feasibility of modifying data fields in the safety assessment report database used by the F/A-18E/F and EA-18G system safety engineers for hazard tracking. There is a portion of the database that could possibly be modified to accommodate data fields for “environmental” and “occupational health” hazards and their risks. The current hazard report would be used for recording associated information on the hazard. Configuration management of this database is maintained by the Boeing Corporation, therefore PMA265 needs to evaluate what the costs would be for modifying the database, the reasonableness of those costs, and budget accordingly for such modifications; if feasible. This evaluation will be conducted over the next three to six months.

PMA265 will use, in the interim, a simple Excel spreadsheet for ESOH risk tracking purposes. In addition, future PESHEs will be developed using NAVAIR 1.6's PESHE Document Authoring Tool, which includes a standardized ESOH risk assessment module for identified technical hazards and their risks. This module includes a component to document mitigation plans with both assigned actions and associated milestones. This offers another mechanism for formally tracking and documenting ESOH risk management. Estimated date of completion for Feasibility Assessment of Database Modifications is 30 April 2009.

**FREEDOM OF INFORMATION ACT (FOIA) MARKING:** PMA265 has no position on FOIA release. The information contained in the draft report is unclassified and generally in the public domain. However, should noise induced hearing loss (NIHL) by United States Navy personnel ever become the basis of a class action suit against the Department of Navy, there may be cause to restrict release.

Naval Audit Service response to paragraph on FOIA marking: PMA265 has indicated that it has no position on possible release of this report under FOIA, and that the information contained in the report is unclassified and generally in the public domain. Because it is already in the public domain, there would be no justification for withholding the material in this report even if NIHL should become the basis of a class action suit against DON. Therefore, this report will be marked FOUO only for the protection of and possible redaction of personally identifiable information under Exemption (b)(6) of the Freedom of Information Act. All other information in the report will be released if requested under FOIA.

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