Defense Standardization Program

# Journal

JANUARY/MARCH 2016

## Standardization Stars

Low-Volatility Agent Permeation Test Method and Fixture

Revision of DoD Design Criteria Standard: Noise Limits (MIL-STD-1474)

Multipurpose Reconfigurable Training System 3D™

AN/FPN-63(V) Precision Approach Radar 400-Hertz Converter Replacement

Development of MIL-STD-3050, OBOGS

Development of Military Specification for Extended-Range, High-Reliability and Standard-Reliability Ceramic Chip Capacitors

Defense Collaboration Services

Defense Standardization Program Journal

# Contents *January/March 2016*






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# Director's Forum

**Each year, we recognize individuals and teams who, through their standardization efforts, have significantly improved technical performance, increased operational readiness, enhanced safety, or reduced costs.**

Individuals and teams are nominated for standardization awards. For FY15, we identified seven as being particularly deserving of recognition. Through their efforts, sometimes taking several years, the winners have played an integral part in keeping our men and women in uniform safe and in providing them the tools they need to get the job done.

The winners are as follows:

- Dr. Terrence D'Onofrio, from the U.S. Army Edgewood Chemical Biological Center, invented the contact-based permeation research fixture and method that closed a critical gap in protection testing. The low-volatility agent permeation system is the first contact-based method capable of accurately quantifying the permeation hazard of low-volatility contaminants, such as the chemical nerve agent VX, through clothing and protective equipment.
- An Army-led team—consisting of members from the Navy and the Air Force—revised MIL-STD-1474 for noise limits. A study revealed that the Department of Veterans Affairs (VA) was spending $1 billion per year on hearing loss claims. The Office of the Secretary of Defense requested that each of the services investigate ways to reduce noise from military equipment to prevent or lessen hearing loss injuries. This cross-service team updated the military standard for noise limits, and as a result of the team's work, the VA can expect a reduced number of claims related to hearing loss.
- A Navy team from the Naval Air Warfare Center Training Systems Division developed a standardized architecture and framework for producing a family of training simulators that replicate the functionality of the U.S. aviation, submarine, and surface ship tactical systems. This standardized framework can be used to produce photorealistic weapon sys-

**Gregory E. Saunders**
**Director**
**Defense Standardization Program Office**

tems in a simulated three-dimensional environment. The new Multipurpose Reconfigurable Training System 3D™ represents a significant step forward in low-cost, high-fidelity, tactical equipment and sets the standard for future trainers.

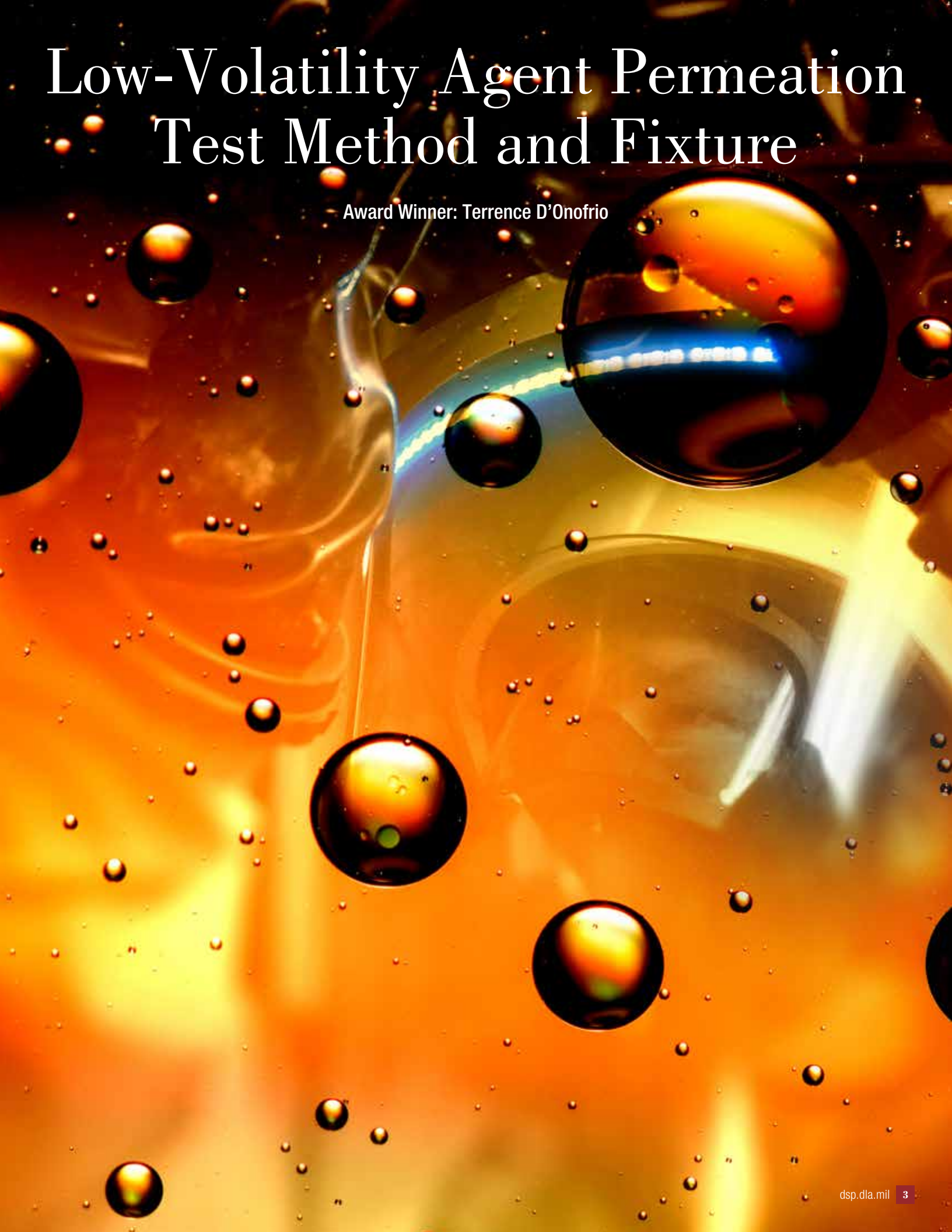
- A Navy team from the Space and Naval Warfare Systems Center, Pacific, determined that a standard 400-hertz converter produced for the Army could replace the problematic 400 Hertz converter used in the Navy's AN/FPN-63 (V) Precision Approach Radar (PAR). PAR is the Navy and Marine Corps' fixed-base primary approach aid used during conditions of poor visibility to provide radar guidance to an aircraft on final approach. Upon successful completion of testing the standard Army converter, the Navy made some refinements to handle overload conditions that would be beneficial for all services using the device. As a result, the electronics and programming of the new 400 Hertz converter is identical between the Army, Navy, and Marine Corps version, saving money and increasing component availability.
- An Air Force team developed MIL-STD-3050, "Aircraft Crew Breathing System Using On-Board Oxygen Generating System (OBOGS)," in response to a number of hypoxia-like incidents due to OBOGS requirements not being consistently applied. The Air Force—in conjunction with the Navy and aerospace industry—developed the standard to cover the design, integration, certification, and sustainment requirements for aircraft crew breathing systems using an OBOGS. MIL-STD-3050 will now prevent the inconsistent application of life support system critical items that include an OBOGS.
- John Bonitatibus of the Defense Logistics Agency developed a new performance specification (MIL-PRF-32535) and 10 specification sheets covering extended-range surface mount ceramic chip capacitors for high-reliability and standard-reliability applications. It is conservatively estimated that the new specification will preclude 50 nonstandard parts each year for the next 5 years and will result in a cost avoidance of $1.4 million annually.
- A team from the Defense Information Systems Agency replaced the legacy managed service, Defense Connect Online, with a collaboration service that features a modular, open-standards architecture. Defense Collaboration Services is an integrated solution based on mature, open-source web conferencing software and XMPP-based chat software. These services provide a modular suite of software components that make use of open standards to provide interoperability and reduce costs.

Congratulations to all of our award winners. I know that DoD leadership appreciates your work. These awards help call attention to the significant contributions that standards and standardization make to supporting our men and women in uniform, helping to multiply capability through interoperability, and saving money for the taxpayer.

Standards and standardization link common solutions to common problems across all services and frequently across nations. This issue of the ***DSP Journal*** showcases the accomplishments of the FY15 award winners. I hope that reading about their accomplishments will pique your interest and might even inspire you to submit an award nomination on the good work you are doing in standardization.

# Low-Volatility Agent Permeation Test Method and Fixture

Award Winner: Terrence D'Onofrio



Terrence G. D'Onofrio, of the U.S. Army Edgewood Chemical Biological Center (ECBC) at Aberdeen Proving Ground, MD, invented a contact-based permeation research fixture and method that invoked standardization to close a critical gap in protection testing. The low-volatility agent permeation (LVAP) system is the first contact-based method capable of accurately quantifying the permeation hazard of low-volatility contaminants, such as the chemical warfare nerve agent VX, through clothing and protective equipment. Applying traditional, vapor-based permeation test methods to low-volatility compounds can yield unreliable and dangerously misleading results. The LVAP method enables low-volatility agent testing that is nearly 10-fold more precise than vapor-based testing at one-tenth the cost. The LVAP system is an open architecture design; components are easily sourced, modified, and replaced. Key LVAP components are reusable commercial off-the-shelf (COTS) items, and required consumables are commercially sourced.

After the LVAP completed verification and validation (V&V) under the auspices of the Deputy Under Secretary of the Army for Test and Evaluation (DUSA TE), the V&V report earned concurrence from representatives of the four services and joint offices. The LVAP method is now endorsed as a DoD Test and Evaluation standard. Use of the LVAP method will yield improved operational readiness and safety among all service branches with a concomitant benefit to emergency responders, federal agencies, and international partners.

## Background

Accurate permeation testing[1] is an essential component of comprehensive safety assessment for clothing and personal protective equipment (PPE) used by soldiers and many civilians, including law enforcement personnel, first responders, and agricultural and industrial workers. It is impossible to fully evaluate the suitability and safety of any clothing or PPE without reliable data to describe how well the item excludes chemical contaminants.

Traditional, vapor-based permeation test methods (i.e., Test Operations Procedure 8-2-501) are appropriate for measuring the permeation of volatile contaminants, such as the nerve agent sarin. However, these vapor-based methods are insufficient for identifying and quantifying the permeation of low-volatility contact hazards, such as the nerve agent VX. Attempts to use traditional methods to quantify a contact hazard can result in a 20-fold under-prediction of the potential hazard.[2]

[1] All testing for the V&V was performed with materials that are known to be permeable to VX. At no time was military PPE found deficient outside the given specifications. No inference of vulnerability is intended or implied.

[2] D'Onofrio, T.G., *Development of a Contact Permeation Text Fixture and Method*, Technical Report ECBC-TR-1141, U.S. Army Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD, 2013.

The lack of a contact-based method raised questions regarding laboratory safety and test readiness. To resolve this problem, Dr. D'Onofrio designed and developed a contact-based method for permeation testing of low-volatility contaminants. The LVAP test fixture and method is the result of years of research at ECBC that has been supported by the Joint Science and Technology Office (Ft. Belvoir, VA), the U.S. Army Natick Soldier Research, Development and Engineering Center (Natick, MA), and the Joint Program Executive Office for Chemical and Biological Defense including the Joint Project Manager for Nuclear, Biological, and Chemical Contamination Avoidance (both at Aberdeen Proving Ground, MD). After a lengthy process of equipment and method design and redesign, implementation, and capability testing, Dr. D'Onofrio's LVAP system has been accepted and approved as a Test and Evaluation standard. Implementation of the LVAP standard enables PPE testing that is both scientifically rigorous and appropriate for contact hazards. The LVAP system also offers advantages over current ASTM standards (such as ASTM F-739); for example, no solvents are required during the contamination period. This allows the LVAP method to be used to test air-breathable materials and also allows for testing within operationally relevant contact scenarios, such as when an individual grasps a contaminated object.

## Problem/Opportunity

Without a consistent standard for measuring the potential contact hazard of low-volatility contaminants, questions were raised about the efficacy of the test for evaluating PPE in such a scenario. Consequently, associated decisions affecting capabilities, risk management, and operational readiness were subject to the variability in the traditional test methods. The initial purpose of this research was the protection of laboratory personnel handling these types of contaminants. However, it was quickly realized that the LVAP method is also appropriate for first responders; industrial and agricultural workers; and Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health, and law enforcement personnel. In addition to increasing the safety of personnel handling low-volatility contaminants, Dr. D'Onofrio's work has been motivated by the opportunity to develop and apply a new standard to close this gap in protection research and testing.

## Approach

The LVAP test fixture consists of a preconditioning chamber built from COTS polycarbonate sheets and wire shelves, where material swatches are acclimated to controlled temperature and humidity levels; a test chamber, which is a COTS incubator that maintains appropriate environmental conditions during testing; and test cells, where potentially contaminated material swatches are contact tested. Each test cell is a stacked assembly of a PTFE-lined polycarbonate petri dish, a solid sorbent pad, a material swatch, a PTFE disk, an O-ring gasket, and a stainless

steel weight, all contained within an inverted glass jar. The weight placed on top of the material swatch ensures that contact occurs between the swatch and sorbent pad layers. This contact is a crucial element of the system; it provides the necessary conditions for accurate measurement of agent permeation through the material.

For material testing, specific quantities of VX are applied to material swatches within a defined contamination area. Test cells are assembled and placed in the test chamber for a specific contact-time period. The sorbent pad from each test cell is then removed, and liquid chromatography–tandem mass spectrometry is used to quantify how much contaminant has permeated the swatch and absorbed into the pad.

During the V&V testing of the new method, extensive precision and accuracy calculations were conducted and documented in accordance with ISO 5725:3, Accuracy (Trueness and Precision) of Measurement Methods and Results. These statistics provided the necessary metrics for evaluating the LVAP system as a reliable test method.

The LVAP system design is based on open-architecture concepts. Given that the main LVAP components and consumables are commonly available commercial products, the LVAP system is resistant to many of the cost and technical risks associated with product obsolescence. Users can take advantage of supplier competition to minimize costs and simplify life-cycle management.

## Outcome

Standardization permitted the creation of a capability where previously none existed. Previous permeation test methods were based on vapor-collection methods, which have been proven inappropriate for contact-hazard scenarios. This is illustrated by the nearly 10-fold increase in precision that was documented during V&V testing of the LVAP system: variability was improved from ±80% using vapor-collection methods to ±8% using the LVAP contact-based method. Statistical comparisons consistently indicate that contact-based testing enabled by use of the LVAP method is more representative of the threat scenario for contact-based hazards.

LVAP method users gain the capability to accurately measure the mass of low-volatility agent that has permeated material swatches. This translates to the ability to reliably test PPE and other materials for vulnerability to permeation by toxic agents or other contaminants. Ultimately, this capability will benefit protection programs that rely on Test and Evaluation data to make programmatic and milestone decisions. From the perspectives of safety, risk management, and operational readiness, this capability will ultimately benefit the warfighter.

The modular LVAP system has a relatively small logistical footprint. Vapor-based permeation test fixtures are custom-built and cost on the order of $400,000 each. The LVAP system uses a COTS incubator for temperature control with modified shelving (to facilitate sample handling),

multiple smaller COTS components, and customized stainless steel weights (to apply contact pressure). The LVAP fixture costs approximately $30,000 to implement, a savings of more than 10-fold over vapor-based test systems. The simplified, open-architecture design of the LVAP also enables a significant cost savings for system setup and maintenance. The modularity of the fixture design is well illustrated by the use of a different incubator in each of the four LVAP systems that are currently being established, including one each at ECBC, the West Desert Test Center (Dugway Proving Ground, UT), the Battelle Hazardous Materials Research Center (Jefferson, OH), and the Defence Science and Technology Laboratory (Porton Down, UK). The incubator, weight, and much of the supportive equipment are not only reusable, they are COTS items that are available from many vendors. On a cost basis, approximately 93 percent of the system fixture is reusable, and all of the consumables associated with the LVAP (except the chemical agent) are easily sourced COTS items.

By focusing on contact permeation and removing the vapor-collection components, the physical footprint of the fixture decreased from an 8 × 3 ft (24 $ft^2$) area for vapor-collection racks to a 2 × 2 ft (4 $ft^2$) region for the LVAP. The simplified design also allows for more samples to be incorporated into the smaller region; while using the same number of operators, throughput increased from 27 samples per experiment for a vapor-collection system to 40 samples per experiment for the LVAP system. For the same operating costs, 27 samples could be processed through the traditional method with a variability of ±80 percent and no true contact capability; alternatively, 40 samples could be processed through the LVAP method with a variability of only ±8 percent, using a proven contact-based capability that also has a smaller footprint and a lower initial setup investment.

## Current Status

The LVAP V&V report earned O-6 level concurrence signatures from the following: the Joint Science and Technology Office, the Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense, the Joint Program Executive Office for Chemical and Biological Defense, and the operational test authorities for the Army, Air Force, Navy, and Marine Corps. The V&V report was endorsed by Test and Evaluation Executive James C. Cooke, with the DoD Chemical and Biological Defense Program, as a Test and Evaluation standard. With this endorsement, the LVAP transitioned from Science and Technology research to the Test and Evaluation community, and it is now available to DoD Programs of Record for all services.

At present, the LVAP system is being used at several DoD-associated facilities in support of the Uniform Integrated Protection Ensemble Increment 2 (UIPE2) Program, to ensure the performance of candidate protective equipment for fielding. The LVAP system is also currently being used in partnership with the U.S. Army Natick Soldier Research, Development and Engineering Center; the Battelle Hazardous Materials Research Center; and ECBC to research and develop

novel materials for future protective ensembles. At the University of Maryland Eastern Shore (Princess Anne, MD), the LVAP system has been incorporated into academic research to ultimately identify protective clothing standards for agricultural workers.

Partners from the Department of Homeland Security, EPA, the Federal Bureau of Investigation, and the intelligence community are considering incorporating LVAP systems into their programs to protect operators, law enforcement personnel, and first responders from low-volatility threats. Dr. D'Onofrio has shared the V&V report with academic and industrial partners to broaden the implementation of the LVAP method. He has an active and ongoing relationship with ASTM to implement LVAP as a new ASTM method.

The transition of this method to an official Test and Evaluation standard closed a significant and longstanding gap in protection research: it established the first contact-based research and test method capable of quantifying the permeation hazard of the chemical warfare agent VX (and other low-volatility hazards) through protective equipment.

Dr. D'Onofrio is cross-training personnel at other organizations in the use and implementation of the LVAP method standard. At present, LVAP systems are being set up in several DoD-affiliated laboratories. He is currently helping to establish an LVAP system at the Defence Science and Technology Laboratory (UK).

## Challenges

Many hurdles were crossed during the LVAP standardization process. Some were technical, such as the need to characterize the proportion of background signal from vapor cross-contamination, which caused a potential bias in the results in the previous designs. This problem was solved by incorporating a COTS O-ring gasket into each test cell, which effectively removed the vapor cross-contamination without interfering with permeation testing. Several other "lessons learned" for avoiding potential cross-contamination and improving reproducibility were also documented. As part of the LVAP implementation, bench chemists, technicians, and operators from other organizations were invited to observe testing at ECBC. Encouraging dialogue between personnel who perform the experiments facilitates understanding beyond that provided by printed documentation, and it enables effective leveraging of lessons learned.

Some challenges were political and derived from the assembly of a large group of diverse stakeholders and the need for concurrence within a short suspense. The LVAP test plan and V&V report both required O-6 level concurrences from the operational test authority from each service branch, the Joint Requirements Office, the Joint Program Executive Office for Chemical and Biological Defense, the Joint Science and Technology Office, and the DUSA TE. The planning and testing was completed within 9 months of V&V initiation, with final concurrence and transition occurring 7 months later. This accelerated timeline was required to enable LVAP to be used for upcoming Programs of Record.

The political challenges were overcome by open communication with all stakeholders for improved management of expectations, rigorous documentation of results, and leveraging of lessons learned. All data, including those incorporating mistakes and efforts that did not meet requirements, were clearly presented during update briefings. Stakeholders and potential LVAP users were invited to the laboratory to witness testing and offer input. The personal interactions between the laboratory staff and the stakeholders helped to build a relationship of trust that ultimately enabled the success of this effort.

## About the Award Winner

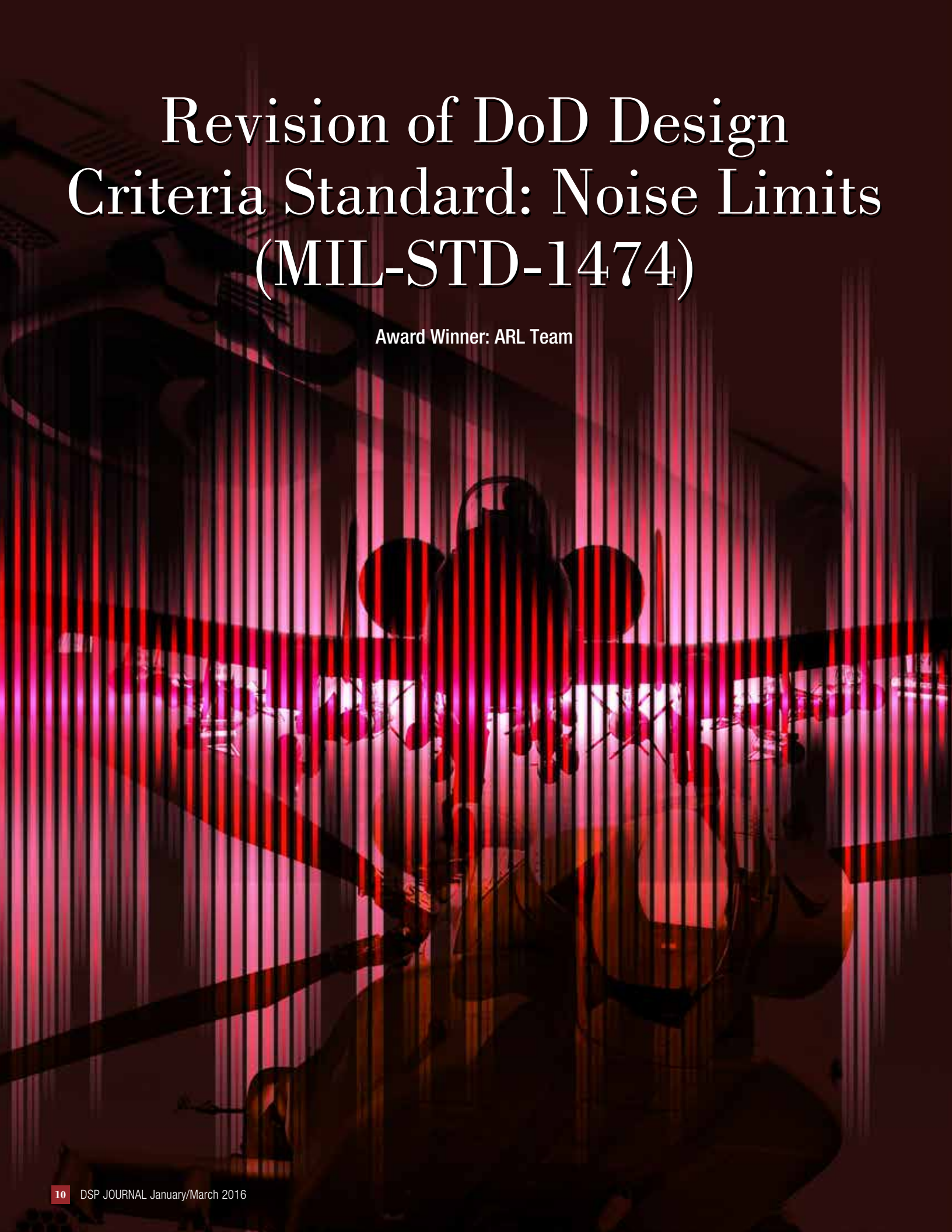
Terrence G. D'Onofrio has been researching permeation methods for improved safety performance since 2007. To address the critical need for contact-based permeation testing, he invented the LVAP fixture and method (U.S. Patent 9,021,865, May 2015). The LVAP system is the basis for the new Test and Evaluation standard.

Dr. D'Onofrio was directly involved in the laboratory research. In fact, he often wore the same PPE being tested in the LVAP experiments. During the standardization process, he initiated discussions with stakeholders from all four service branches, joint offices, and the DUSA TE to ensure that all of the stakeholders' needs were incorporated into the final standard. Dr. D'Onofrio led the research effort, wrote the test plan, conducted the research, wrote many technical reports, coordinated discussions with stakeholders, and authored the final V&V report to document the precision and accuracy of the new LVAP test method standard. The successful transition of the method to a Test and Evaluation standard was recognized by the DUSA TE, which presented Dr. D'Onofrio with a Department of the Army Achievement Medal for Civilian Service.

Dr. D'Onofrio is now cross-training personnel at other organizations in the implementation and use of the LVAP method standard. At present, he is participating in a 1-year exchange program at the Defence Science and Technology Laboratory (the UK equivalent of ECBC), where he is helping to institute the LVAP method as an international standard.

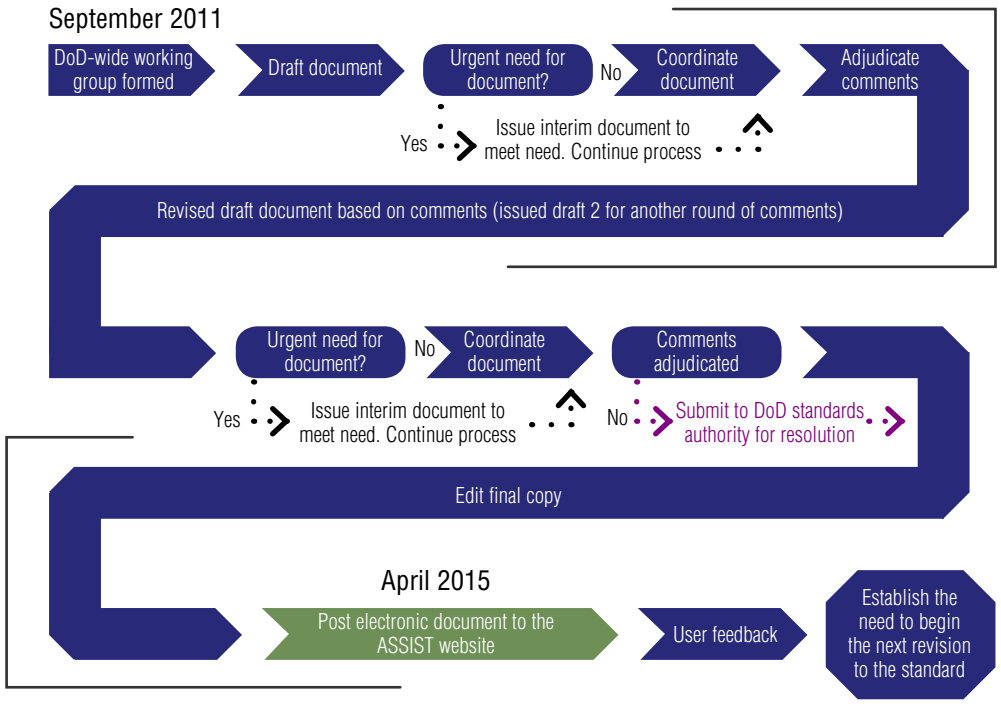
# Revision of DoD Design Criteria Standard: Noise Limits (MIL-STD-1474)

**Award Winner: ARL Team**



An Army Research Laboratory (ARL) team revised and published MIL-STD-1474E, "Design Criteria: Noise Limits," as much of the information contained in MIL-STD-1474D was out of date. Since 1997, when MIL-STD-1474D was published, the types and levels of military noise sources have changed dramatically, and significant scientific and computational advances have been made in assessing noise-induced hearing loss. Revision E allows designers to produce systems that are at or below required noise levels. The cross-services working group, with representation from the Army, Air Force, Navy, and Marine Corps, produced design requirements and guidance to support the acquisition and sustainment of U.S. military aircraft, land vehicles, ships, and weapon systems, including rockets, missiles, and large and small caliber guns. MIL-STD-1474E establishes acoustic noise limits, prescribes testing requirements, and describes measurement procedures for determining conformance to the noise limits. The standard specifies sound pressure level limits and measurement procedures to promote personnel safety, speech intelligibility, and security from acoustic detection and recognition. In the 2005–06 time frame, DoD began undertaking studies to fully understand the risk of hearing loss among service members. A key issue was that MIL-STD-1474D did not provide scientifically proven methods for reducing or assessing noise. The cross-services working group applied the current science and best practices to establish design requirements for steady-state noise, impulsive noise, aural non-detectability, aircraft noise, shipboard equipment noise, and shipboard compartment noise. (See Figure 1.)

**Figure 1. The Process Followed to Revise MIL-STD-1474**




Source: Modified from S. Lowell, Defense Standardization Program 101 (retrieved from http://dsp.dla.mil/APP_UIL/content/documents/2007-DSP-conf/Lowell-DSP101.ppt), 2007.

## Background

Military operations and training produce pervasive and injurious noise levels. In the 2005–06 time frame, a study revealed that the Department of Veterans Affairs (VA) was spending $1 billion per year on hearing loss claims. With the number of hearing disability claims continuing to rise, the Office of the Secretary of Defense requested that each of the services investigate ways to reduce the noise of unique military equipment and improve legacy systems to reduce the current injury rate. The U.S. Army had developed a hearing hazard model (Auditory Hazard Assessment Algorithm for Humans) to better quantify impulsive noise to which warfighters are exposed during large- and small-caliber gun firing. The U.S. Navy started an initiative to reduce shipboard equipment noise and define habitability noise limits for shipboard spaces. The U.S. Air Force started an initiative to protect aircraft ground crew from jet engine noise and protect aircrews from impulsive noise. The Army, Air Force, Navy, and Marine Corps came to a similar conclusion that MIL-STD-1474D must be updated as the requirements of the military standard are not adequately protecting soldiers, sailors, airmen, and marines from noise.

## Problem/Opportunity

The design criteria for reducing noise levels, the techniques for measuring noise levels, and the means for establishing safe criteria for the firing of large- and small-caliber guns was based on nonscientific data. The update of MIL-STD-1474 provides noise engineers and scientists with the opportunity to establish scientifically based requirements that are achievable and measurable.

The design criteria for setting shipboard equipment noise requirements were outdated and not consistent with Navy and Coast Guard noise criteria for shipboard equipment. The update to the military standard allowed the Navy to codify the noise requirements for shipboard equipment and establish the noise requirements for shipboard spaces. The updated shipboard equipment and ship compartment noise requirements will flow into new ship construction's detailed design specifications to produce quieter ships and reduce the noise-induced injury rate for sailors and marines. Further, the evaluation and mitigation methods outlined in the military standard will allow the operational Navy to better protect personnel deployed on board legacy ships.

## Approach

The updated version of MIL-STD-1474 applies to the acquisition and product improvement of all designed or purchased (non-developmental items) facilities, systems, subsystems, and equipment that emit acoustic noise or contain sources of noise. This standard is intended to address noise levels emitted during the full range of typical operational conditions and over the life cycle of the system under consideration. It covers tests for steady-state noise for military vehicles, aircraft, ships, general equipment, and portable shelters, and impulsive noise from weapons and explosive-ordnance materiel.

MIL-STD-1474E (published on April 15, 2015) provides specific noise limits and other requirements to equipment designers and manufacturers. It is intended to cover typical operational conditions. Required noise limits shall not be exceeded if the materiel is to be acceptable to the procuring activity.

MIL-STD-1474E specifies the maximum permissible noise levels produced by military systems and the test requirements for measuring these levels. This standard is neither a hearing damage risk criterion nor a hearing conservation criterion. It is a set of design criteria.

Due to the possibility of unpredictable interactions of various noise sources during military operations, MIL-STD-1474E requires that all new equipment, whether newly designed or purchased, emit the lowest feasible noise level.

## Outcome

Below is an overview of resulting outcomes:

- ***Cost avoidance***. Over the next few years, the VA will begin seeing reduced numbers of claims relating to hearing loss. The current estimate is a 5 percent reduction in hearing-loss claims starting in 2020 or $50,000,000/year and continuing each year until 2025. Although legacy equipment will continue to emit high levels of noise, better measurement and mitigation techniques outlined in MIL-STD-1474E will lower the overall numbers of VA claims.
- ***Improved performance***. Reduced noise levels and scientifically accurate measurement allows for improved man-machine interface performance.
  - Noise is a form of energy. Reduced noise levels produced by equipment greatly improve their efficacy and allow for increased performance.
  - Noise causes operator fatigue. Reduced noise levels greatly improve the performance of operators, reducing human error and improving readiness.
- ***Quality***. The operator/user perceived quality of DoD equipment procured or upgraded using the MIL-STD-1474E requirements and design criteria will be greatly improved by producing quieter equipment and reduced operator fatigue.
- ***Sustainability***. Equipment sustainability is projected to be improved as less noise will also result in less vibrations that cause premature failures.
- ***Operational improvement***. Operational equipment upgraded to meet the design requirements or equipment procured that used the MIL-STD-1474E design criteria will be improved over legacy equipment.

The operating environments on flight lines, on ships, and inside land vehicles currently in inventory are excessively loud. Operators will now be better able to communicate, to understand hearing protection requirements, and to be provided with quieter equipment, thereby improving situational awareness.

- ***Breadth of applicability***. MIL-STD-1474E has been approved for use by all departments and agencies of the Department of Defense. This military standard applies to the acquisition and product improvement of all designed or purchased facilities, systems, subsystems, and equipment that emit acoustic noise or contain sources of noise. MIL-STD-1474E is applicable to all DoD acquisition programs, legacy equipment, and planned upgrades for the Army, Air Force, Navy, and Marine Corps.
- ***Cost of development***. The cost to update and develop the MIL-STD was kept to a minimum by setting up ground rules for each service to self-fund working group meetings and scientific studies. Excluding research costs to establish the means to best protect service members from noise and to measure noise correctly, the cost of revising MIL-STD-1474 was approximately $150,000 (excluding the labor costs of the working group members who all volunteered their participation in addition to their regularly assigned duties).

## Current Status

MIL-STD-1474E is published (2015) and will be invoked in all new system acquisitions and major legacy system upgrades. This is a profound improvement over MIL-STD-1474D (1997) and will significantly improve warfighter situational awareness, lethality, and survivability, ultimately enhancing mission success. (See Table 1.)

**Table 1. Organization of MIL-STD-1474E Compared to Organization of MIL-STD-1474D**

| MIL-STD-1474D (1997) | | | MIL-STD-1474E (2015) | | |
|---|---|---|---|---|---|
| Foreword and Main Body | | | Foreword and Main Body | | EXPANDED |
| Requirement | | | Appendix | | |
| 1 | Steady-State Noise, Personnel Occupied Areas | | A | Steady-State Noise in Personnel Occupied Areas | |
| 2 | Aural Non-Detectability | | B | Impulsive Noise in Personnel Occupied Areas | |
| 3 | Community Annoyance | DELETED | C | Aural Non-Detectability | |
| 4 | Impulsive Noise in Personnel Occupied Areas | | D | Aircraft Noise | |
| 5 | Shipboard Equipment Noise | | E | Shipboard Equipment Noise | |
| 6 | Aircraft Noise | COMBINED | F | Shipboard Compartment Noise | NEW |
| 7 | Rotary-Wing Aircraft Noise | COMBINED | | | |
| Appendix | | | Note 1: Includes Annex A describing the Auditory Hazard Assessment Algorithm for Humans | | |
| A | Guidance for Requirement 6 | NO LONGER NEEDED | | | |
| B | Hearing Protector Noise Attenuation | NO LONGER NEEDED | | | |

## Challenges

Members of the DoD working group initially operated very parochially (e.g., Army members were only interested in land vehicles and weapons; the Navy was interested in ships and aircraft; and the Air Force was only interested in aircraft). Over time, this changed and all members of the working group began to think globally. This change in attitude opened the doors to an excellent collaboration and technical discussions with the common goal of developing the best solution for our warfighters (soldiers, sailors, airmen, and marines).

There were two important issues, each requiring significant discussion and compromise. Both were successfully resolved and incorporated in the final published version of MIL-STD-1474E. Both of these issues, described below, will provide significant payoff in the future:

- Establishing two shipboard requirements for equipment noise and for noise in shipboard compartments was critical for the Navy to begin to address the overall shipboard noise hazard that has affected the Navy for 40 years. The introduction of both equipment and compartment noise requirements allows the Navy to establish firm requirements for the shipbuilders to meet. Further, the establishment of shipboard noise requirements allows for the Navy to assess noise levels in a common way.
- Establishing two methods to assess impulsive noise allows the individual services to apply the best model for their use. Cancelling MIL-STD-1474D and implementing MIL-STD-1474E provides the designers of large- and small-caliber guns with a scientific model for assessing how many rounds may be fired per day. The MIL-STD-1474D model was a non-scientific table that did not provide guidance for implementation and caused overexposure to noise during training and exercises.

### About the Award Winner

The ARL team consisted of Bruce E. Amrein, John Mallino III, Charles R. Jokel, Richard L. McKinley, and Kurt Yankaskas.

Bruce E. Amrein, of the Army Research Laboratory, was the U.S. Army lead and co-chair of the DoD MIL-STD-1474E working group. (He became chair of the working group in early 2015 upon the departure of Mr. Mallino.) Along with Mr. Mallino, Mr. Amrein coordinated initial in-person meetings, developed Draft 1 of MIL-STD-1474E, and arranged for contract support to assist the working group in soliciting comments from interested parties and adjudicating comments. Mr. Amrein arranged for Army funding of the support contractor and coordinated award of the task orders in conjunction with personnel at the U.S. Army Aviation and Missile Research Development and Engineering Center. During year 2 of this 3.5-year effort, travel restrictions made in-person meetings difficult to attend. Mr. Amrein established weekly tele-

conferences to keep the work moving forward to the common goal of publishing MIL-STD-1474E. These teleconferences and weekly deadlines for action items enabled the working group to develop draft 2 of MIL-STD-1474E. Mr. Amrein retired from federal service in October 2014, but at that time MIL-STD-1474E was not ready for publication. As an unpaid, guest researcher, Mr. Amrein continued to lead the working group until all issues requiring adjudication were complete and a final version of MIL-STD-1474E was approved by representatives of the Army, Navy, and Air Force. In April 2015, he submitted the final draft to the proponent at the U.S. Army Aviation and Missile Research Development and Engineering Center.

John Mallino III, representing the Naval Sea Systems Command, was the co-chair of the DoD MIL-STD-1474 working group from its inception until early in 2015 when he left government service. During his time as co-chair, Mr. Mallino established the tri-services (Army, Air Force, Navy [Marine Corps]) MIL-STD-1474E working group, coordinated initial comments to the first draft of MIL-STD-1474E, and coordinated initial working group meetings. He coordinated action items highlighting critical errors in MIL-STD-1474D that required an update, and he adjudicated critical disagreements between the services on the proper way to measure and analyze noise. He ensured that all Navy stakeholders were cognizant of the MIL-STD-1474 update and solicited input from critical personnel. Mr. Mallino led the effort to establish requirements for both shipboard equipment noise and shipboard space noise requirements, a significant change from MIL-STD-1474D. He initiated the effort to remove the impulse noise daily exposure limits table, which allowed the Army and Navy to find common ground with the Air Force to apply the latest scientific models to better protect against hearing damage during use.

Charles R. Jokel, representing the U.S. Army Public Health Center, was responsible for preparing the requirements for steady-state noise, which involved intense technical discussion and coordination with subject matter experts (SMEs) from the Navy and Air Force members of the working group before finalization. He was also an active participant in developing the basic portion of the standard (that portion that is applicable to aspects of all types of noise in all locations). Additionally, Mr. Jokel served as an SME for the impulsive noise requirements appendix. The crafting of specific requirements to enable the addressing of the diverse possible applications across all services was a challenging task, to which he made significant contributions. Without his dedicated participation in more than 3.5 years of discussion, it is doubtful that MIL-STD-1474E would have been published.

Richard L. McKinley, of the Air Force Research Laboratory, was the Air Force lead and chief proponent for aircraft noise. His standing in the DoD, national, and international scientific communities aided significantly in the development and consensus building of updated requirements for aircraft noise. The new standard includes ANSI standard measurement techniques to verify compliance with the MIL-STD requirements. Including the new ANSI standard puts DoD in a legally defensible position relative to measurement techniques. The details of the measurement methods have been publically vetted and represent the consensus of the U.S. scientific community. This levels the playing field for contractors attempting to comply with the military standard and will result in repeatable, reliable, and accurate data. The updated requirements and measurement techniques will apply to the acquisition of all aircraft and will affect the aircrews operating the aircraft, the maintainers servicing the aircraft, and the communities overflown by the aircraft. Mr. McKinley coordinated inputs on aircraft noise from the Army, Navy, and Air Force into the revised standard. He also provided substantial input into the impulsive noise exposure section describing one of the two metrics for impulsive noise exposure detailed in the military standard.

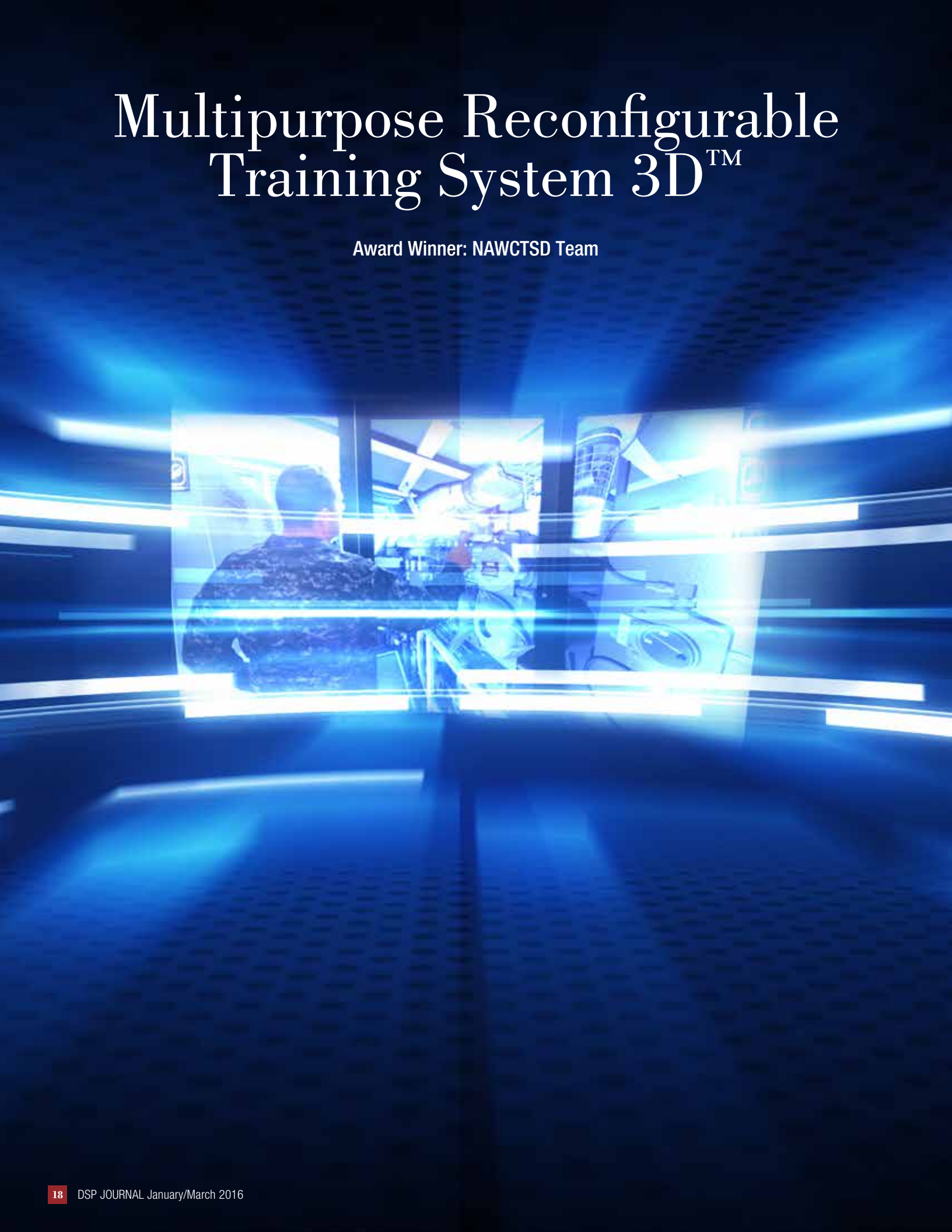
Kurt Yankaskas, of the Office of Naval Research, was the Navy lead and chief proponent for shipboard compartment and equipment noise. His extensive expertise in shipboard noise control provided critical technical

input to the shipboard noise section. He extensively rebuilt the habitability section and acoustic modeling sections, providing the necessary design tools. He coordinated inputs from the Navy's ship design community and provided Navy resources to supplement the working group effort. Mr. Yankaskas provided access to international-level ship designers to provide end-user input to ensure a usable product. He marshaled Navy resources to support the effort and canvassed and adjudicated numerous comments to complete the standard. His contributions apply to a broad scope of naval platforms, including from small to large ships, and provide vibration guidance for submarines. Additionally, he collaborated enthusiastically with other service colleagues representing Navy interests in flight and vehicle requirements to produce a reliable requirement.

**Team members (left to right) John Mallino (Naval Sea Systems Command), Charles Jokel (Army Public Health Center), Bruce Amrein (team lead, Army Research Laboratory), Richard McKinley (Air Force Research Laboratory), and Kurt Yankaskas (Office of Naval Research).**

# Multipurpose Reconfigurable Training System 3D™

**Award Winner: NAWCTSD Team**



In a breakthrough application of the latest three-dimensional (3D) physics-based gaming technologies, a team from the Naval Air Warfare Center Training Systems Division (NAWCTSD) has developed a standardized architecture and framework for producing a family of training simulators that replicates the functionality of the U.S. Navy's aviation, submarine, and surface ship tactical systems. This standardized framework can be used to produce photorealistic weapons systems in a simulated 3D environment for the military departments and our allies. The new Multipurpose Reconfigurable Training System (MRTS) 3D™ VIRGINIA Torpedo Room trainer and the MRTS 3D VIRGINIA Emergency Diesel Generator (EDG) trainer, both developed by NAWCTSD's Surface and Undersea Programs, represent a significant step forward in low-cost, high-fidelity simulation of tactical shipboard equipment and set the standard for future trainers. The MRTS 3D project has been focused on reducing total ownership cost since its inception. Compared to producing traditional single-purpose trainers using tactical equipment, NAWCTSD was able to significantly reduce costs by approximately $15 million (80 percent reduction) leveraging open-source, industry-standard software development tools and the free Unity game engine. Employing commercial off-the-shelf (COTS) computer hardware running a commercial, open-source, physics-based gaming engine, the team created one of the most realistic 3D trainers available anywhere in the world.

## Background

A traditional approach to weapons system trainers has been to modify tactical equipment for training use. Tactical training equipment (TTE) costs about as much as actual equipment fielded on naval platforms, requires specialized maintenance technicians, and competes with the fleet for spares and materials. TTE also tends to be single purpose in nature and takes a relatively large footprint in the Navy's training facilities.

There are dozens of computer-based training simulators in use by the Department of Defense. However, the vast majority of these multimillion-dollar trainers are limited in use to a specific airframe, ship, or vehicle.

## Problem/Opportunity

Submarine training sites already had Legacy MRTS Weapons Launch Console Team Trainers (WLCTTs), which were two-dimensional representations of the Weapons Launch Console subsystem of the whole weapons system. These trainers used a single set of hardware to simulate three different classes of submarine weapon systems, and five different system configurations within those classes.

There were three problems:

- A full VIRGINIA Torpedo Room training simulation needed to be added to the WLCTT to three training sites. This simulation had to simulate the entire room's hydraulic and electronic systems and a full load-out of torpedoes and Tomahawk cruise missiles. The trainer had to enable the crew's entire weapons handling party to perform all actions associated with handling weapons and conducting torpedo and missile launch operations in a realistic 3D environment. The approximate cost to procure TTE was over $12 million per site plus facilities modifications.
- A VIRGINIA Emergency Diesel Generator trainer needed to be added to two training sites. An actual diesel generator would cost $3.5 million per training site, plus facilities modifications.
- The Groton, CT, training site had a diesel front panel simulator using much older non-MRTS technology and tactical components, but it failed and the Navy was having technical difficulty in repairing the trainer.

## Approach

The MRTS 3D team has been focused on reducing project total ownership cost since its inception. The team was able to significantly reduce costs by leveraging open-source, industry-standard software development tools and the free Unity game engine. The team also developed government-owned editing tools to speed the creation of Navy-unique environments such as the VIRGINIA Torpedo Room. The MRTS 3D VIRGINIA Torpedo Room project totaled just $1 million in software development costs and $250,000 in hardware procurement. Because the software code is owned by the government, future installations will incur only the cost of new COTS hardware. The training simulation enabled the program office to offer weapons reload party team training without the cost of adding $12 million torpedo tube banks at each of the seven training sites.

In regards to the Groton failed diesel front panel simulator, the MRTS 3D VIRGINIA Emergency Diesel Generator provided a very low-cost solution. Groton already had the MRTS 3D VIRGINIA Torpedo Room trainer, and the MRTS 3D VIRGINIA EDG software had already been produced for other training sites. For less than $3,000 in labor and travel, NAWCTSD sent one engineer up to Groton and installed the MRTS 3D VIRGINIA EDG software application onto the MRTS 3D trainer and provided training to the diesel instructors. When compared to the approximately $40,000 in materials that would be required to repair the diesel front panel simulator, the MRTS 3D VIRGINIA EDG trainer yielded 93 percent savings and actually provided improved training fidelity and capability compared to the older front panel simulator.

The MRTS 3D trainers use 55-inch flat panels with display technologies that allow for pressure sensitivity on the display with unlimited inputs. The display features near-zero parallax and ul-

tra-low latency so that the touch interface moves objects precisely, and with no hesitation. The physics engine used to develop the simulation is an industry standard that enables rigid body and soft body creation and object collision detection. The physics engine implements logical constraints between the objects, giving maximum flexibility during content creation.

The simulator allows an operator, by touching a display panel, to open and close the torpedo breech door, align the pivot tray with the torpedo tube, and use the hydraulic rammer to tubeload a torpedo or cruise missile in a realistic 3D environment. What makes the NAWCTSD trainer stand out, in addition to 3D imaging, is the successful replication of the real-world physical characteristics of each task. For instance, valves do more than simply turn "on and off." Each valve is programmed to emulate common, real-world characteristics such as "stuck," "easy to turn," "hard to turn," and "sticky." As a result, NAWCTSD was able to achieve a training environment that is so realistic that, according to one submariner, "it's almost like the actual component is there—and just sitting behind a sheet of glass."

With the development of a standardized hardware specification and software architecture, additional MRTS 3D training applications can be developed for a single hardware device. By avoiding the use of proprietary software packages and ensuring that the government retained all software data rights, the team ensured that future device installations and code maintenance would come at minimal cost.

## Outcome

The MRTS 3D VIRGINIA Torpedo Room and MRTS 3D VIRGINIA EDG are currently fielded on a shared hardware trainer to two training sites, with a third site scheduled to receive them soon. The Legacy MRTS WLCTT training applications also run on these hardware devices, saving approximately $250,000 in hardware costs per training site, or $750,000 total.

With the standardization of the COTS hardware specs for all MRTS 3D software applications, multiple training simulations can be loaded onto a single type of hardware, greatly reducing the cost and square footage required to train on a variety of training systems. The MRTS 3D VIRGINIA EDG software was loaded onto the same fielded hardware trainer as the VIRGINIA Torpedo Room, saving $250,000 in computer hardware. Adding multiple software applications to a single hardware trainer also saves approximately 400 square feet in footprint requirements and tens of thousands of dollars in facilities preparation and installation work.

The MRTS 3D VIRGINIA Torpedo Room and MRTS 3D VIRGINIA EDG trainers yielded over $45 million in cost avoidances compared to procuring tactical training equipment. MRTS 3D life-cycle costs are approximately 75 percent less compared to operating and maintaining tactical trainers.

Due to the success of the MRTS 3D program for the Naval submarine force, the Naval aviation and surface communities have funded additional MRTS 3D products, including trainers for the ***FORD*** class aircraft carrier's Electromagnetic Aircraft Launch System (EMALS) and Advanced Arresting Gear (AAG), the Mobile Electric Power Plant (MEPP) for aviation support equipment, and a radio room simulation for the ***NIMITZ*** class aircraft carriers.

## Current Status

Fielded MRTS 3D trainers support sailors in initial pipeline courses, pre-deployment team training, and submarine crew operational performance. The aviation support equipment trainer, MRTS 3D MEPP, will be fielded in 2016 to support Navy and Marine Corps technician pipeline courses. The MRTS 3D EMALS and MRTS 3D AAG trainers are in the early stages of development and will be fielded in FY18–20. All of these trainers can operate on a single-hardware platform, allowing a single set of hardware to provide training to an almost unlimited variety of mechanical and electronic technicians.

## Challenges

Some technicians and training leadership personnel were hesitant to shift from tactical hardware to computerized simulations of their equipment. After personnel have seen and used the MRTS 3D products, the popularity of NAWCTSD's approach has exploded, which has resulted in the aviation and surface communities funding additional MRTS 3D projects. NAWCTSD has been able to achieve a training environment that is very realistic.

### About the Award Winner

The NAWCTSD team consisted of David Thomas, Darrell Conley, Bill Zeller, Khoa Vu, and Christopher Freet. Mr. Thomas was the lead project manager for all MRTS projects. Mr. Conley was the project manager for the MRTS 3D VIRGINIA Torpedo Room and MRTS 3D VIRGINIA EDG. Mr. Zeller was the lead systems engineer for the MRTS 3D VIRGINIA Torpedo Room, Mr. Vu was the lead systems engineer for the MRTS 3D VIRGINIA EDG, and Mr. Freet was the lead software engineer for both projects.

# AN/FPN-63(V) Precision Approach Radar 400-Hertz Converter Replacement

Award Winner: SPAWAR Team

The AN/FPN-63(V) Precision Approach Radar (PAR) is the Navy and Marine Corps' primary precision landing aid for pilots during periods of inclement weather. The system was fielded in 1978, and 37 years later it is facing severe obsolescence issues. Failures of the 400-hertz converter, used for the high-speed cooling fans in the transmitter, was the number 3 system degrader, affecting operational availability (Ao) with 18 failures over a 3-year period. The Space and Naval Warfare Systems Center's PAR In-Service Engineering Team developed requirements for a replacement, conducted market research, and located a small business currently supplying similar converters to the Army. Working closely with the vendor's engineers, the government-commercial team created a design that was 98 percent identical to the Army's converter. This unique design allowed the vendor to standardize its production line so that both converters can be produced during the same production run. This effort resulted in increased Ao for fleet units, a 400 percent increase in mean time between failures (MTBF), and a 67 percent decrease in unit cost. With this converter being used by the Navy, Army, and Marine Corps, the standardization of this part offers the Department of Defense cost savings through increased operational readiness, improved performance, lower cost, interoperability, and a reduced logistics footprint.

## Background

The AN/FPN-63(V) PAR is used at Navy and Marine Corps air installations in conjunction with an airport surveillance radar system to provide air traffic control services for Navy, Marine Corps, and other military and civilian aircraft as required. The PAR is the Navy and Marine Corps' fixed-based primary approach aid used during conditions of poor visibility to provide radar guidance to an aircraft on final approach. The PAR has been in service more than 20 years beyond its estimated product life cycle, is experiencing parts obsolescence issues, and has degraded Ao. Over the past 5 years, repair parts have had an average turnaround time of 194 days. The major reason cited is the difficulty locating or developing new part suppliers. As a result, 47 percent of the PAR systems operated in a severely degraded condition, and 15 percent were non-operational.

A component that has plagued the PAR for quite some time is the 400-hertz converter, which is used to run high-speed cooling fans in the transmitter and is a critical single point of failure item. High-speed cooling fans operated by 400 hertz are required because of the amount of heat generated by the magnetron and charging circuits within the transmitter and the small confined space the transmitter occupies. During a 3-year period, 18 400-hertz converters failed, creating a backlog in the Naval Supply System because the sole-source vendor was slow to respond. The original manufacturer design had a mean time between failures of 1 to 2 years. The original design had several issues that caused the low MTBF to be greatly accelerated by temperatures over 77 degrees Fahrenheit and by worn bearings in the fans, which would cause a failure of a 1-ohm, 5-watt resistor that was in series with the entire 400-hertz converter. With a consumable cost of $6,000 per unit, a low MTBF, and a sole-source vendor with low production runs and poor quality, the fleet stakeholders were extremely frustrated with the sustainment of this part.

## Problem/Opportunity

The In-Service Engineering Agent (ISEA) engineers analyzed the existing converter, finding several design vulnerabilities. These vulnerabilities generated a considerable amount of heat inside a sealed metal enclosure, leading to breakdown of all other components within, and an oscillator circuit dependent on a custom wound toroidal transformer and transistors in an "H-bridge" switching arrangement. The team logistician determined that the toroidal transformer and transistors were obsolete and unobtainable. Based upon this knowledge, the project manager determined that it was not cost-effective to reverse engineer the existing converter and approved research to identify a replacement unit. The engineering staff built several breadboard prototypes, and the data gained from those prototypes led the team to consider industrial variable-frequency drive models as a potential solution.

Requests for information and requests for quotes were sent to industry based upon the developed requirements for a replacement converter. The team evaluated the responses and ordered several potential solutions for evaluation; however, all were evaluated to be insufficient for the application and would require extensive nonrecurring engineering costs. Though each of the evaluated solutions could have been designed to work for this application, the team did not want another "one-of-a-kind" solution that only worked for this system. Through this journey, the team was led to an association with a small business named Invention House, LLC, a customizer of commercial off-the-shelf (COTS) variable-frequency drives, which happened to make three-phase 400-hertz converters for the Army.

## Approach

Armed with the knowledge of the design vulnerabilities of the original 400-hertz converter, the ISEA engineers began a reverse engineering process to see if it was feasible to build a solution in-house. They produced a prototype "H-bridge" substitute 400-hertz converter, which functioned while driving the target load fan assembly at one-third power for an hour and was extremely stable. However, when it was run at one-half power for 10 minutes, the converter was unstable. After investigation, it was found that lower-quality components caused the instability during power increase. With a proof of concept under partial load achieved, the team set out to identify a higher-quality construction and standard components for the next design.

During this period of research, industrial variable-frequency drive models were identified as a potential solution. An existing COTS solution was identified as the most efficient solution, as the unit was already in production. The project manager discussed the approach with the sponsor and secured funding to procure an article for testing and evaluation. After discussing the requirements with the vendor, the ISEA obtained a unit that was advertised as capable of accepting an input from 110 to 115 volts and providing an output from zero to 500 hertz. Throughout testing, there was difficulty getting this unit to work within this application. After much discus-

sion with the vendor's engineers, it was determined that this unit was not capable of providing a stable 400 hertz as advertised. Additionally, this unit required a 28 vdc input, which would have negated the form-fit-function requirement. The vendor apologized for the inconvenience and provided the ISEA with the contact information for Invention House, LLC. After discussing the requirement with Invention House engineers, the ISEA thought that a three-phase 400-hertz model it produced for the Army could work for this application. Because the unit was composed of an individual 400-hertz converter for each phase, it appeared practical that this could become a standardized part for Army, Navy, and Marine Corps applications.

The ISEA obtained a unit for evaluation and testing that worked well within this system. However, the ISEA remained concerned about two critical areas of operation: Could it survive an overload condition, such as a fan-bearing seizure, and could it survive in the PAR operating temperature range of –40 degrees to 131 degrees Fahrenheit? These were the main sources of failure of the original 400-hertz converter. After much discussion with the engineers, many design changes, and subsequent testing, a solution was found for both areas of concern.

Originally, it was thought that excessive high-current draw causing an overload fault would happen during motor start-up in high temperatures due to the increasing resistance in the motor windings. What was found was just the opposite. Because the air is denser at colder temperatures, a greater load was placed on the motor during start-up, causing an overload fault. The programmable read-only memory was adjusted through several iterations of testing until an optimized solution was discovered. If an overload fault were detected, the 400-hertz converter would go into an overcurrent cycle sequence where it would shut down for 40 seconds, then come on for 25 seconds, to see if the overload condition was removed. If the overload condition was still in effect, the converter would shut down for 60 seconds and then come on for 19 seconds to test for an overload condition. This sleep then wake up and test sequence would progress, incrementally increasing the sleep time until the overload condition was removed. This created an overload capability of 350 percent for 25 seconds. During environmental testing, the 400-hertz converter passed while operating two fans for 24 hours throughout the temperature range of –40 degrees to 131 degrees. It also passed the same 24-hour test while both fans were locked, simulating an overload condition.

The resultant product is a military design with conformal coating that has passed vibration and temperature testing. Invention House engineers were so impressed with the overload protection design that the ISEA helped them create, they incorporated it into the Army product as well. This standardized improvement will provide increased performance, reliability, and readiness for Army, Navy, and Marine Corps applications.

## Outcome

With a usage rate of six per year and an MTBF of 1–2 years, at a cost of $10,550 per unit, the original 400-hertz converter would cost the fleet $1,139,475 over 10 years. At a cost of $1,955 per unit, it cost the Navy $144,670 to replace all 400-hertz converters. With an MTBF of 5–6 years, the Navy will save $850,135 in maintenance costs over 10 years. The government cost of developing and implementing this solution was $81,250 in labor and $1,500 for material. The 400-hertz converter reliability improved 400 percent and increased system Ao by 7 percent, and it has solved the number 3 degrader affecting the system. The original 400-hertz converter had an output of only 1.31 amps maximum and no overload protection, so any increase in the load would cause the converter to fail. The new system has a 2-amp maximum output and a programmed sensing function that puts the converter into a sleep mode, protecting the unit from overload failure. MTBF is expected to increase as long-term data are analyzed. The electronics and programming of the new 400-hertz converter are identical between the Army, Navy, and Marine Corps versions. The only difference is in the housing and base plate, which makes it a form-fit-function replacement for the Navy and Marine Corps.

## Current Status

The new 400-hertz converter was fully provisioned and has a National Stock Number (NSN). The Navy and Marine Corps have implemented it, and in the years since, there have been no failures.

## Challenges

### SPONSOR

The sponsor was reluctant to provide funding for this project because there was a replacement for the PAR that was beginning the acquisition phase. The project manager was able to achieve the funding required by persuading the sponsor of the importance of sustaining the current system until a replacement PAR system is found to be viable.

### STAKEHOLDERS

The stakeholders were comfortable with what they had been using over the past 37 years and were hesitant about the development of a new component. Again, the project manager was able to convince the stakeholders that it was in their best interest to allow the ISEA time to identify a replacement for the original 400-hertz converter.

## About the Award Winner

The PAR In-Service Engineering Team included Richard Gunn, Stephen Cox, Terry Stockton, and Erin Yakes.

Richard Gunn, project manager, was instrumental in leading the team that developed the design solution. He overcame obstacles, including sponsor reluctance to provide funding, initial engineering failures, and slow user buy-in, to lead the team of government and industry engineers to develop the design solution. He was able to influence the sponsor to provide the required funding and obtain fleet buy-in by presenting the new design to fleet stakeholders at various events, demonstrating the improved capability, and selling the new system to the fleet community. Before Mr. Gunn's involvement, the 400-hertz converter was a top degrader that was consistently cited as a major problem by the fleet at all user forums. However, thanks to his leadership and expertise, the 400 Hertz converter is now seen as an example of ISEA success by fleet stakeholders.

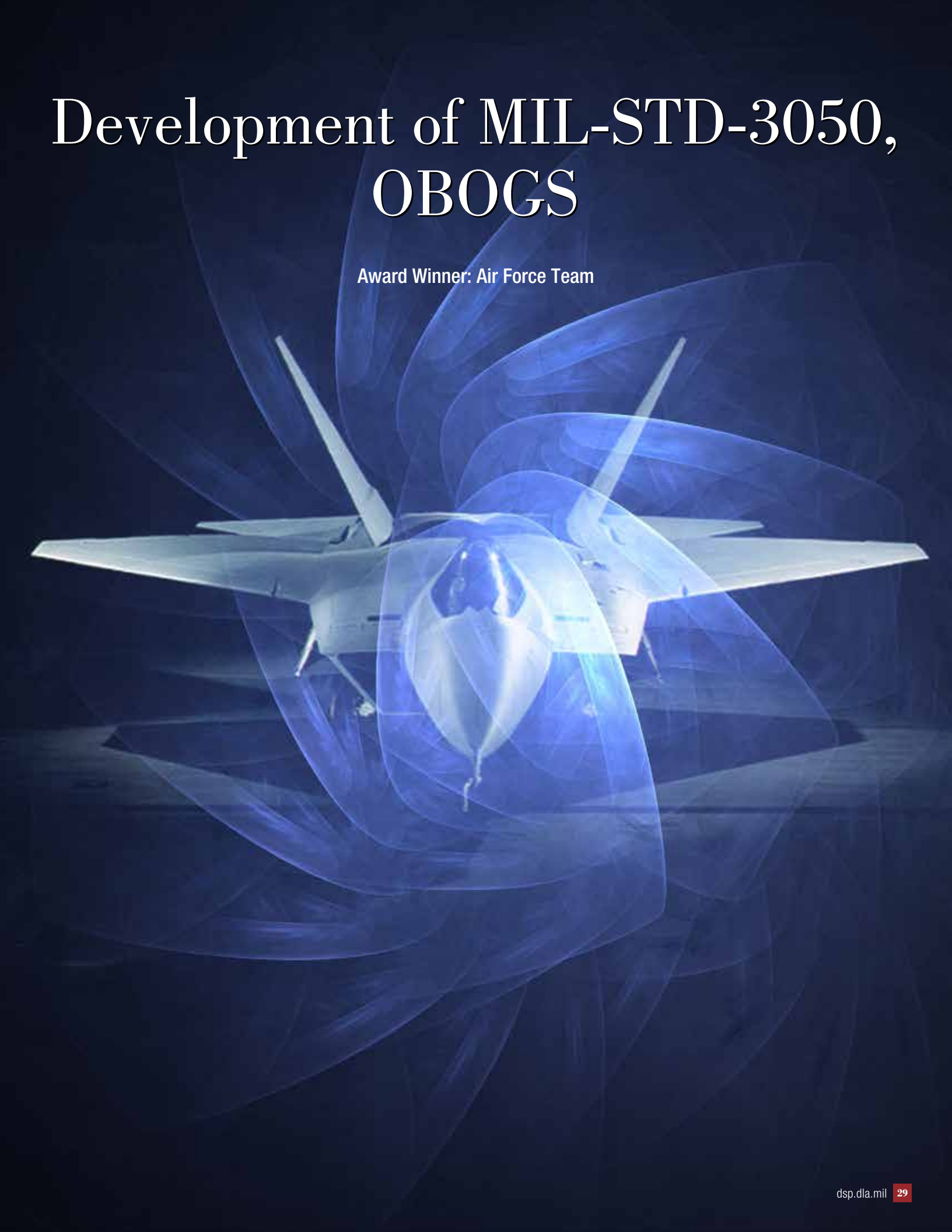
Stephen Cox, lead engineer, provided analysis of the failure mode of the original unit, producing the reverse-engineered schematic and toroid characterization. He then researched replacement components, mounts, and packaging for a suitable circuit substitution and originated schematics for several prototype replacement options for evaluation. He was also the principal engineer in reaching out to industry to locate a commercial firm capable of addressing the obsolescence issues. Mr. Cox's background in manufacturing engineering, knowledge of existing and future manufacturing technologies, and practical experience were critical in the identification and development of 400-hertz converter requirements. He led the engineering effort for the ISEA, providing key suggestions for design solutions, ensuring continued forward progress to keep the effort on schedule and on budget, and ensuring that the final design met all critical design requirements.

Terry Stockton, ISEA engineer, was the key engineer responsible for initial prototype efforts, playing a critical role in developing the engineering requirements, and he brought a much needed fleet perspective to the efforts. He originated schematics for several prototype replacement options and conducted construction of replacement circuit options. He additionally provided "Simulation Program with Integrated Circuit Emphasis" circuit analysis to evaluate replacement options. Mr. Stockton conducted all testing evolutions and ensured that the final solution would indeed meet the MTBF requirements and would continue to operate successfully in the defined operational environment.

Erin Yakes, logistician, coordinated all logistics efforts required to make the new 400-hertz converter available to the fleet. She worked directly with the vendor to ensure that the new 400-hertz converter maintained a form-fit-function replacement profile. Additionally, she ensured that all drawings were accurate and complete, and she reviewed all testing data to validate indicated performance and MTBF. Ms. Yakes was also responsible for developing the provisioning data and submitting it to the Naval Supply Systems for the creation of an NSN. She also updated the system Allowance Parts List and technical manuals with the new part number.

# Development of MIL-STD-3050, OBOGS

**Award Winner: Air Force Team**



A 36-month project developed MIL-STD-3050, "Aircraft Crew Breathing Systems Using On-Board Oxygen Generating System (OBOGS)," in response to a recommendation by the U.S. Air Force (USAF) Scientific Advisory Board Quicklook Study of Aircraft Oxygen Generation involving F-22 system safety issues. The full coordination design criteria standard covers the design, integration, certification, and sustainment/maintenance requirements for aircraft crew breathing systems using an OBOGS. It provides a minimum set of criteria for future acquisitions to correct technical and management weaknesses and ensure the safety and effectiveness of these flight critical systems. MIL-STD-3050 is a standardization management benchmark for the successful development of a fully coordinated military standard among Department of Defense equities, prime aircraft manufacturers, and life support subsystem suppliers to meet a high-visibility need.

## Background

Many aircraft make use of an on-board oxygen generation system to provide breathing oxygen for the aircrew. Compared to historical experience through early 2012, there had been an increasing number of hypoxia-like incidents in the F-22 Raptor aircraft that may have been related to the OBOGS or its installation. Following the loss of an F-22 in Alaska in November 2010 and several hypoxia-like incidents at Elmendorf Air Force Base in May 2011 that led to grounding of the F-22 aircraft fleet, the USAF Scientific Advisory Board (SAB) was tasked in June 2011 to conduct a Quicklook Study of system safety issues involving OBOGS to help ensure that the appropriate steps were being taken to enhance flight safety of these aircraft. One of three areas for investigation was to "review the policies, processes, and procedural changes that occurred during the F-22's development and fielding, and evaluate the implications with respect to design limitations, risk analysis, program execution, and acquisition workforce." The Quicklook Study report was published in February 2012.[1]

## Problem/Opportunity

The need for a standardization solution was underscored by SAB findings in the review and evaluation of policies, processes, and procedures. The findings included the following:[2]

- The F-22 was developed during the period of acquisition reform when significant development and sustainment activities were transitioned to major defense contractors and contract-usable military specifications and standards were cancelled or converted to guidance-only handbooks.

[1] This paragraph is from the Foreword of the *USAF Scientific Advisory Board Report on Aircraft Oxygen Generation*, February 1, 2012.

[2] These findings are from the USAF Scientific Advisory Board Report on Aircraft Oxygen Generation, February 1, 2012.

- An applicable multi-national standardization document from the Air and Space Interoperability Council (ASIC; formerly Air Standardization Coordinating Committee)—currently ASIC Advisory Publication 4060, "The Minimum Quality Criteria for On-Board Generated Oxygen"—was called out as advisory guidance for the F-22.
- The Air Force substantially diminished its application of systems engineering and reduced its acquisition core competencies (e.g., systems engineering, human systems integration, aviation physiology, cost estimation, contracting, and program and configuration management). Lost capabilities and expertise to perform the critical function of human systems integration led to atrophy of policies/standards and research and development expertise with respect to the integrity of the life support system.
- Three life support system-critical subsystems (OBOGS, Back-up Oxygen System [BOS], and Emergency Oxygen Subsystem [EOS]) were not classified as "safety-critical items" and were integrated or eliminated without sufficient analysis.
- Modeling, simulation, and integrated hardware-in-the-loop testing to support the development of the F-22 life support system and the thermal management system were insufficient to provide an "end-to-end" assessment of the range of conditions likely to be experienced by the F-22.
- The OBOGS was developed as a "fly-to-warn/fail" system with no requirement for initial or periodic end-to-end certification of the breathing air or periodic maintenance and inspection of key components.

## Approach

The SAB recommendations[3] drove the action for and content of a standardization solution:

- Develop and implement a comprehensive Aviation Breathing Air Standard to be used in developing, certifying, fielding, and maintaining all aircraft oxygen breathing systems.
- Develop and install an automatic BOS in the F-22 life support system.
- Reenergize the emphasis on human systems integration throughout a weapon system's life cycle, with much greater emphasis during Pre-Milestone A and during the engineering and manufacturing development phases. Develop the capability to research manned high-altitude flight environments and equipment, develop appropriate standards, oversee contractor development, and independently certify critical, safety-of-flight elements.
- Improve the ease of activating the EOS and provide positive indication to the pilot of successful activation.
- Develop and implement appropriate inspection and maintenance criteria for the OBOGS and life support system to ensure that breathing air standards are maintained.

[3] These recommendations are from the USAF Scientific Advisory Board Report on Aircraft Oxygen Generation, February 1, 2012.

- Clearly define the "inherent governmental roles and responsibilities" related to acquisition processes and identify the core competencies necessary to execute those responsibilities.

The Air Force formed a team in June 2012 with primary membership from the Air Force Research Laboratory's 711 Human Performance Wing/Warfighter Interface Division and the Air Force Life Cycle Management Center's Flight Systems Division and Systems Engineering Services Division. The team was supported by contractor staff from the F-22 Program Element Monitor's (PEM's) office (SAF/AQPF) and the Air Force Departmental Standardization Office (DepSO–SAF/AQRE).

The team's plan for addressing the SAB recommendations was to convert the ASIC Advisory Publication 4060 guidance on minimum quality criteria for on-board generated oxygen to a formal military standard and to expand its scope to include the other recommendations involving life support subsystem identification/management as safety critical items and specification of the certain functional requirements, physiological operational conditions, and verification requirements for new designs. The initial approach was to use two steps: first, to develop and issue a limited coordination USAF-only standard in June 2013 to meet emerging Air Force needs; and second, to expand coordination to formally include the Navy and industry.

As development of the USAF-only standard proceeded with the Navy included for information, the team recognized that incorporating and harmonizing Navy requirements would have a substantial impact on the standard. After consultation with the PEM and DepSO staffs, the team changed the approach and decided to develop a single, full-coordination standard with extensive industry participation.

This shift in approach extended the development time an additional 24 months from June 2013 to May 2015. Navy and prime airframe contractor comments and coordination began with Air Force organizations in June 2012 and completed in June 2014. Non-airframe industry comments and coordination began serially in June 2014 and completed in March 2015. Industry participants included prime airframe contractors (Lockheed-Martin, Boeing, Airbus), OBOGS suppliers (Honeywell, Cobham), ejection seat suppliers (Martin Baker, UTAS), and physiological testing contractors (Wyle Labs).

## Outcome

Three years of effort to develop and publish MIL-STD-3050 has resulted in the following:

- Acceptance by Air Force executive leadership that action has been completed to prevent acquisition reform-based engineering and management process deficiencies in the F-22 from occurring in future procurement and sustainment of life support system safety-critical items, including an OBOGS.

- Demonstration that with due diligence, the Defense Standardization Program (DSP) is able to produce a consensus military standard among DoD and a diverse group of industry suppliers for use in acquiring a military unique capability.

## Current Status

MIL-STD 3050 was published on May 11, 2015. It is already being hailed as a must-read document for anyone working in this domain.

## Challenges

Several significant technical and cultural barriers were overcome in the development of this standard: the resolution of differences in the OBOGS input air interface and in human system testing requirements between Air Force and Navy systems, and compromises with industry on OBOGS performance requirements and design constraints.

Lengthy but collaborative discussions were required to establish common OBOGS air input requirements between Air Force aircraft with an environmental control system and Navy aircraft with a direct engine bleed air supply. Similarly, standard requirements for the Air Force approach to man-rating its life support systems were reconciled with the Navy's approach of system testing without a man-in-the-loop.

Compromises with industry to reach common requirements included industry acceptance of an increased OBOGS output flow rate and constraints on the type of OBOGS molecular sieve material used (without requiring additional safety qualification/certification) and government acceptance of a reduced number of required OBOGS monitoring, recording, and warning parameters.

## About the Award Winner

The team consisted of George W. Miller, Jose L. Ubinas, and Madeleine M. Istvan.

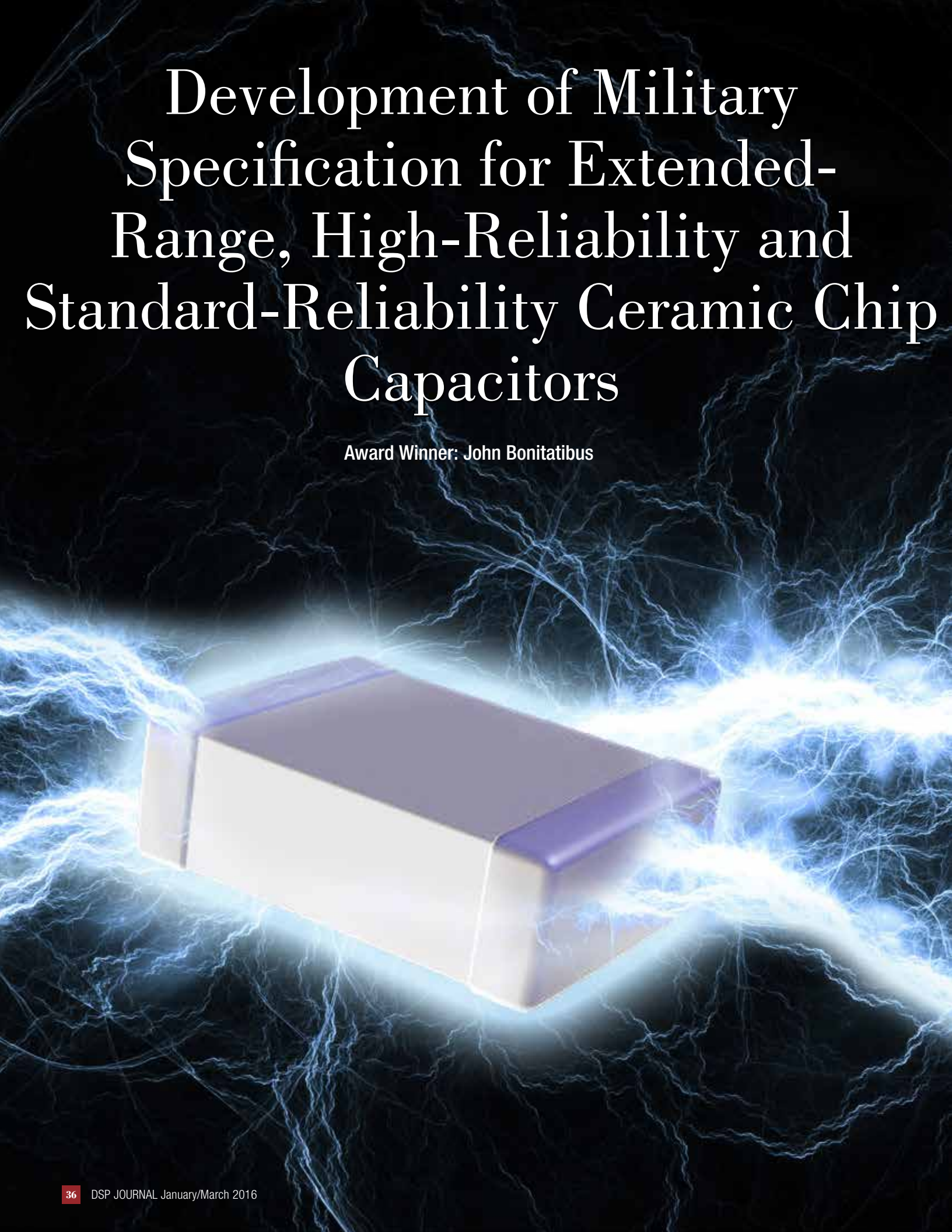
George Miller is a 711 HPW/RHCP technical expert, the MIL-STD-3050 development team lead, and responsible engineer for the published document. His involvement began in November 2011 as a subject matter expert presenter to the SAB Quicklook Panel on the ASIC Advisory Publication 4060, other related multi-national standards, and planning for what was then called a "USAF Air Standard Directive" but later identified as a DoD military standard. As the lead, Mr. Miller managed all team activities and coordinated actions of the other members. He planned and led all technical actions with the Navy, prime airframe contractors, and OBOGS suppliers; performed the technical adjudication of all reviewer comments; and prepared them for discussions among team members. Administratively, he accurately developed and maintained version control of the initial and all subsequent working drafts of MIL-STD-3050 and related comment resolution matrixes, and he distributed all incremental versions among team members and reviewers, including industry reviewers who reviewed and commented sequentially.

Jose Ubinas is an AFLCMC/EZFC crew systems engineer and MIL-STD-3050 development team member. His involvement began with formation of the team in June 2012 and continued through final coordination for approval in April 2015. Mr. Ubinas was responsible for ensuring that the life support system/OBOGS requirements were technically and contractually compatible with crew systems performance specifications, including the applicable Joint Service Specification Guides. He had a strong influence on the military standard's adherence to establishing design criteria in performance and functional terms to the greatest extent possible. Mr. Ubinas managed the coordination of the evolving draft standard within his office, with F-22 and F-35 Program Office staffs, and with the ejection seat suppliers who had or may have an interface with OBOGS. He actively participated in all team coordination meetings and technical interchange telecons with Navy and industry representatives.

Madeleine Istvan is an AFLCMC/EZSS lead technical editor and MIL-STD-3050 development team member. Her involvement also began with formation of the team in June 2012 and continued through submittal of the standard for publication in May 2015. Ms. Istvan was responsible for all DSP standardization management/preparing activity actions for document development and publishing, including project initiation/approval, formatting the initial draft development document to MIL-STD-962 requirements and iterating subsequent versions to accommodate major changes in scope and content, managing the final formal DSP document coordination via the Acquisition Streamlining and Standardization Information System, and editing the final version for approval by the Air Force standardization executive. Her expertise was invaluable in properly crafting and securing full Navy coordination on a coherent design criteria standard for OBOGS in highly diverse life support subsystem architectures.

# Development of Military Specification for Extended-Range, High-Reliability and Standard-Reliability Ceramic Chip Capacitors

Award Winner: John Bonitatibus



John Bonitatibus of the Defense Logistics Agency (DLA) demonstrated outstanding leadership and accomplishments in the significant engineering standardization effort with the development of a new specification (MIL-PRF-32535) and 10 specification sheets covering extended-range surface mount ceramic chip capacitors for high-reliability and standard-reliability applications. Mr. Bonitatibus completed the multi-year effort with the dating of the specification and 10 associated specification sheets on September 28, 2015. He is continuing work on three additional specification sheets.

## Background

Mr. Bonitatibus is the lead engineer for capacitors at DLA Land and Maritime. He knew that the use of smaller capacitors with higher-capacitance values was rapidly increasing in new programs. The desire for lighter, smaller, and faster systems is driving the need for ever smaller and faster electronics to meet mission needs. Mr. Bonitatibus knew that the needed capacitors were not available as a military product.

## Problem/Opportunity

Mr. Bonitatibus knew that a standardization document covering higher-capacity surface mount capacitors in sizes smaller than those in current military specifications was desperately needed. Designers have been using commercial capacitors with unproven reliability in their systems, and Mr. Bonitatibus had been receiving requests to approve nonstandard parts for these capacitors for years. Original equipment manufacturers (OEMs) were either using the unproven commercial capacitors directly or up-screening them with additional testing in an attempt to ensure their reliability. The need existed to standardize the requirements for smaller higher-capacity capacitors with proven reliability.

## Approach

Mr. Bonitatibus knew that a new ceramic chip capacitor specification allowing base metal electrodes (BMEs) would be the best way to help solve the problem by providing the needed capacitors. He formally started drafting the requirements for the documents with weekly WebEx teleconferences. The first teleconference was held in March 2013 with participation from the National Aeronautics and Space Administration (NASA), the Aerospace Corp., SAE G-11 and G-12 committees, capacitor manufacturers, microcircuit and hybrid manufacturers, and major OEMs. The teleconferences continued weekly until the final draft was agreed upon and approved. Mr. Bonitatibus was a major participant and contributor during the teleconferences, and he is still actively involved in the teleconferences to identify the details for three additional specification sheets.

MIL-PRF-32535 is the first military capacitor specification that allows BME in ceramic capacitors. Although commercial BME ceramic capacitors have been around for years, their reliability was unproven. No standard test or design criteria existed, time was needed for the capacitors to develop, the technology needed to be proven, and testing needed to be defined. The allowance of BMEs will enable this specification to offer higher-capacitance values that military and space users need. The electrodes in BME capacitors are nickel as opposed to the palladium silver that is used in precious metal electrode (PME) capacitors. Four manufacturers were eager to qualify the capacitors.

Mr. Bonitatibus ensured that standard-reliability products were included in the specification for applications that didn't require space-grade parts. The original desire of the committee was to create a military specification for high-reliability BME capacitors. The inclusion of standard reliability parts will make the parts a good fit for more applications, by alleviating costly requirements that are not required for non-space-level programs.

Conventional multi-layer ceramic capacitors contain PMEs. Manufacturers started developing multi-layer ceramic capacitors with BME over 15 years ago due to the high cost of palladium silver used for electrodes in PME capacitors. Palladium prices rose from around $100 per troy ounce in 1991 to more than $1,000 per troy ounce in 2001. The BME capacitors use nickel that is much less expensive. Manufacturers used standard testing requirements from PME capacitors in an effort to prove reliability of the BME capacitors. These requirements weren't ideal and didn't prove their true reliability.

The industry standard for ceramic chip capacitors is now BME, and new capacitors designed with BME have a much greater capacity. While the BME capacitors were evolving, Mr. Bonitatibus studied them, reviewed reports, and discussed the capacitors with groups since their early years. The manufacturers were reluctant to take the steps to create a new military specification and to qualify to it until the product was mature and the demand was high enough to justify the qualification cost. This specification will be a great benefit for the military and space customers.

## Outcome

The new capacitors will provide the military, NASA, and industry with the reliable, higher-capacity capacitors needed for their missions. Military capacitors have not been able to meet many of the needs for smaller and higher capacity. The new capacitors will meet these needs and they are expected to be used in every future military and NASA system for many years.

Mr. Bonitatibus reviewed many nonstandard parts evaluations submitted for approval by OEMs for use in their systems during the past several years. The new specifications will help provide the needed capacitors and avoid the use of nonstandard capacitors. Nonstandard parts are typically more expensive, are harder to procure, are not as reliable, and become obsolete

and out of production sooner than standard military parts. Nonstandard parts also often contain pure tin finishes that promote tin whiskers that cause system failures. The new specifications will help meet the long system life of current military and space programs without the capacitors becoming obsolete and unavailable. These capacitors are also protected by the trademarked JAN branding to make them less susceptible to counterfeiting.

Mr. Bonitatibus' efforts support the needs of the military departments for standardization by providing reliable ceramic capacitors that meet performance needs. The end result will be thousands of new ceramic capacitors for use in demanding military systems. His efforts preclude the costly piecemeal introduction of nonstandard parts to try to achieve a similar end. The new specification is conservatively estimated to preclude a minimum of 50 nonstandard parts each year for the next 5 years. Based on the DoD Parts Management Program Model, this will result in a cost avoidance of $1.4 million annually ($6.8 million for 5 years). An added benefit of this new military specification will be the multiple qualified manufacturers for these capacitors that will result in supply availability for many years to come.

## Current Status

MIL-PRF-32535 and 10 capacitor specification sheets were dated September 28, 2015. Mr. Bonitatibus is developing three additional specification sheets for interdigitated capacitors that will be used in hybrid applications covered in the hybrid specification, MIL-PRF-38535. He continues to provide support to the DLA Land and Maritime Sourcing and Qualifications Division and the four manufacturers interested in qualifying to the new specifications. Mr. Bonitatibus participated in the first qualification audit for MIL-PRF-32535 in December 2015. Because manufacturers need site audits and qualification requires a 4,000-hour life test, the estimate for manufacturers being qualified is by September 2016.

## Challenges

There were many challenges in this project that Mr. Bonitatibus was able to overcome. Because there were no industry standard requirements for BME capacitors, a great amount of research and discussions was needed. Mr. Bonitatibus needed to encourage component manufacturers to support the new specification, work with the many manufacturers and users, come to a consensus on requirements, and resolve the hundreds of official comments from the draft documents.

Once the final drafts were ready, Mr. Bonitatibus sent them to the DLA Departmental Standardization Office for final approval as required by DoD 4120.24-M for new specifications that contain qualification requirements. He wrote a justification for qualification for this specification and received the final approval.

## About the Award Winner

John Bonitatibus is the Defense Logistics Agency's capacitor expert and was a critical part of the development of this effort from the inception of the initial concept. He was an integral member of the working group that consisted of 45 members from NASA, the Aerospace Corp., SAE G-11 and G-12 committees, capacitor manufacturers, microcircuit and hybrid manufacturers, and major OEMs. He helped guide the group and keep them on track.

Mr. Bonitatibus' responsibilities in preparing for the new documents were many, including adding valuable input during teleconferences and meetings, requesting projects, generating and coordinating multiple drafts, consolidating comments and recommending their dispositions, resolving the comments, obtaining final approval for documents, and answering the many questions along the way. He also has the necessary knowledge of the requirements for military specifications. His expertise in DoD 4120.24-M (Defense Standardization Program Policies and Procedures) and MIL-STD-961 (Defense and Program-Unique Specifications Format and Content) was vital to the development and dating of these specifications. Mr. Bonitatibus took the very rough outline developed during the teleconferences and developed the full military specifications. He developed the qualification procedures and finalized the specifications. He prepared the justification for qualification and presented it along with the documents to the DLA Departmental Standardization Officer for final approval.

# Defense Collaboration Services

**Award Winner: DISA Team**

An Enterprise Collaboration Team of the Defense Information Systems Agency (DISA) sought to replace the legacy managed service, Defense Connect Online (DCO), with a collaboration service that is based on open standards and is open source. The chosen solution, Defense Collaboration Services (DCS), features a web conferencing solution based on Big Blue Button and chat services based on OpenFire. DCS features a modular, standards-based architecture that is more flexible and cost-effective than DCO. After an initial $34 million investment into DCS, the cost was reduced by 50 percent, from $39 million to $19 million per year. The breakeven point for the investment is projected to be May 2016.

## Background

The mission of the Enterprise Collaboration Program is to provide enterprise collaboration capabilities that improve the operational efficiency of our joint warfighters by enabling collaboration across organizational boundaries. Using these collaboration capabilities, joint warfighters are able to collect and disseminate administrative and command and control information in real time. The legacy collaboration service offering, Defense Connect Online, was a proprietary licensed product offered by a managed service provider.

Throughout 2012 and 2013, in a time of DoD-wide budget cuts and travel restrictions, the demand for online collaboration capability steadily increased, requiring additional licenses and consuming an ever increasing percentage of the available budget for the entire portfolio of services. In lieu of this, the Enterprise Collaboration Team realized that it needed to pursue an alternate approach for providing secure collaboration capability for DoD. The Enterprise Collaboration Team performed an analysis of alternatives to identify a suite of open-source collaboration services that met program requirements while providing a flexible and interoperable architecture. The selected approach, Defense Collaboration Services, provides web conferencing and instant messaging/chat capabilities in a manner that is more secure, modular, and cost-effective.

## Problem/Opportunity

- DCO provided collaboration services as licensed products delivered by a managed service provider. Under this arrangement, the Enterprise Collaboration Program was locked into one specific product and was dependent on the vendor for upgrades and new features. Additional licenses were required to support the increasing users of the service. Licensing and management costs for web conferencing and chat services were $38.72 million in FY15, and costs were projected to rise yearly. With these limitations as drivers, the Enterprise Collaboration Team looked to the open-source community for a collaboration tool with a standards-based open architecture that is more cost-effective.

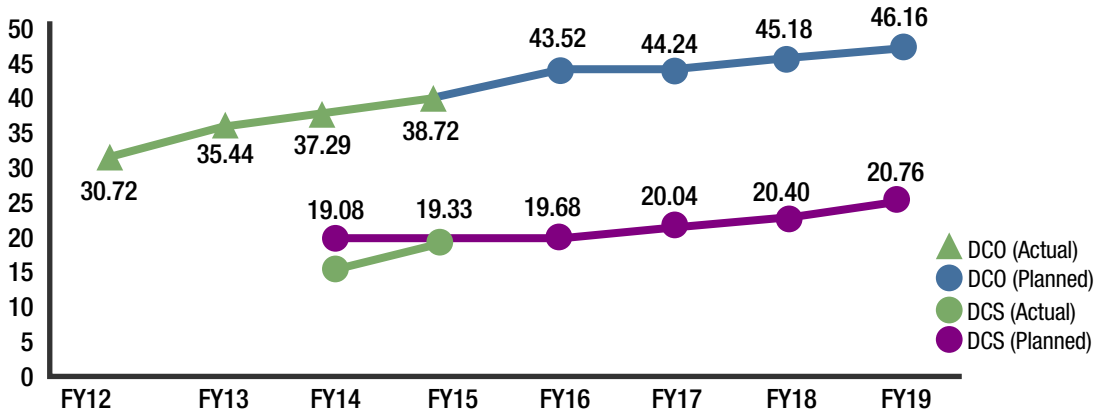
## Approach

The Enterprise Collaboration Team performed a functional analysis that concluded that open-source software alternatives could satisfy collaboration requirements while providing a cost-efficient and open architecture. The new collaboration service, DCS, is an integrated solution based on a mature open-source web conferencing software package, Big Blue Button, and XMPP-based chat software, OpenFire. These services are a modular suite of software components that make use of standards to provide interoperability. For example, conference Voice Over Internet Protocol is provided by Free-switch, which uses G729 and can be easily modified to support commercial telephones, and the XMPP-based chat solution is not client dependent, eliminating licensing costs. DoD services are leveraging open-source chat clients that use XMPP to communicate, including SWIFT and Transverse. SWIFT and Transverse do not require license fees, reducing the cost to agencies to implement chat services.

## Outcome

Figure 1 shows that after an initial $34 million investment into DCS, the cost was reduced by 50 percent, from $39 million to $19 million per year. The breakeven point for the investment is projected to be May 2016.

**Figure 1. DCO/DCS Estimated Costs (in millions of dollars operations-and-maintenance)**

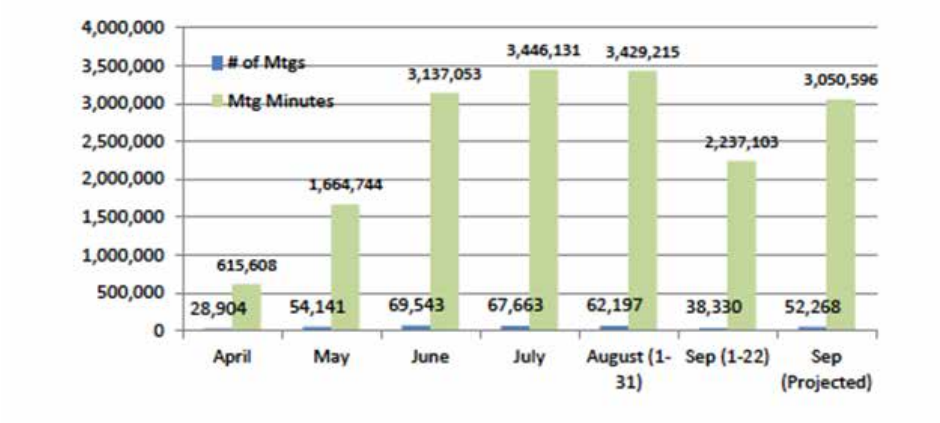



The benefits of an open standards-based architecture are already being realized. Performance problems were experienced in large meetings when using the desktop-sharing capability due to the inefficiency of Flash Video. With relatively little effort and a quick turnaround, the Enterprise Collaboration Team was able to upgrade the service to the H264 standard to increase the desktop-sharing performance during large meetings.

## Current Status

After a cycle integration and testing, DCS was implemented in milCloud. DCS reached its full operational capability in June 2015, fully replacing DCO as the DoD cloud service offering. Figure 2 shows that DCS supports more than 60,000 monthly meetings, totaling more than 3 million meeting minutes.

### Figure 2. DCS Monthly Usage




## Challenges

The approach taken with DCS was a major shift away from the way services were provided in the past. Previously, contracts were issued for software licenses and managed services from commercial providers. This shift forced a culture change at DISA and rebuilding of internal system integration skills, particularly in improving cybersecurity of communications services. Additionally, the software industry is undergoing a major shift from perpetual licenses for software to a recurring usage fee model. When DoD cybersecurity requirements are added to these new services, these fees can increase dramatically. Through the systems integration work to implement this open-source collaboration service in a secure network environment, DISA has gained a better understanding of these security requirements and how to buy these capabilities in other services. In addition, industry realizes our resolve in lowering the cost of software and services while maintaining our high standard of cybersecurity.

## About the Award Winner

DISA's Enterprise Collaboration Team included Yangwei Wang, Deepak Seth, Brian Fuchs, Jay Chung, and Steven Crum.

The Enterprise Collaboration Team looked to the open-source community for conferencing solutions that met the program's requirements for functionality, performance, and interoperability. Yangwei Wang reviewed open-source software products and found that Big Blue Button met the conferencing requirements and that Open-Fire met the XMPP chat requirement. Once a set of products was chosen, Dr. Wang developed and executed a pilot to verify the findings of his initial research and move the products into the integration phase.

Once an open-source solution was chosen, the architecture had to be documented to aid in deployment troubleshooting and interoperability with other services. Deepak Seth applied the Systems Modeling Language to document the architecture and interactions between components. These architectural models were an integral tool that aided the deployment and testing of DCS.

In order to create DCS, the open-source software had to be enhanced to meet the Security Technical Implementation Guide requirements for web applications. Brian Fuchs led the effort to integrate these services with DISA's Identity Access Management and Authentication Gateway Services to ensure a secure and interoperable product. These enhancements enabled DCS to attain an authority to operate on DoD networks and support users worldwide.

DISA's cloud service provider, milCloud, was chosen to host DCS. Jay Chung led the deployment team. His first priority was to design a computing infrastructure that provided the resources necessary to serve users DoD-wide. Mr. Chung also employed a new cloud provisioning system, DISA CONS3RT & BMC BladeLogic, to automate virtual system deployment and configuration management, thereby improving efficiency and significantly reducing information technology management costs.

Steven Crum led the development testing team that ensured the functionality, performance, scalability, and interoperability of DCS. Mr. Crum developed a testing strategy to test DCS against its requirements. Testing was performed on a per-release basis and led to improved stability and performance.

# Program News

*Topical Information on Standardization Programs*

## DSP Recognizes Achievements in Standardization

Annually, the Defense Standardization Program recognizes individuals and teams from the military departments and defense agencies who have achieved significant improvements in interoperability, cost reduction, quality, reliability, and readiness through standardization. Since 1987, DSP has recognized these outstanding performers in a formal ceremony. This year's ceremony took place on March 16 in the Pentagon's Halls of Heroes. Mr. Greg Saunders, Director, DSPO, officiated the ceremony with help from Ms. Kristen Baldwin, Acting Deputy Assistant Secretary of Defense, Systems Engineering.

Dr. Terrence D'Onofrio, U.S. Army Edgewood Chemical Biological Center, was the 2015 Distinguished Achievement Award winner for his work in inventing the contact-based permeation research fixture and methodology (test standard) that closed a critical gap in protection testing. The Low-Volatility Agent Permeation (LVAP) system is the first contact-based method capable of accurately quantifying the permeation hazard of low-volatility contaminants, such as the chemical nerve agent VX, through clothing and protective equipment. The new LVAP system enables low-volatility agent testing that is nearly ten-fold more precise at one-tenth the cost of traditional methods. Dr. D'Onofrio received an engraved crystal Pentagon for his achievement.

The remaining awards were presented to five teams and one individual:

- An Army-led team with members from the Navy and Air Force revised MIL-STD-1474 for noise limits. A study showed that the Department of Veterans Affairs is spending $1 billion a year on hearing-loss claims. The defense secretary's office asked each service find ways to reduce noise from military equipment and the team updated the military standard for noise limits.

- A Navy team from the Naval Air Warfare Center Training Systems Division developed a standardized architecture and framework for producing training simulators that replicate the functionality of U.S. aviation, submarine and surface-ship tactical systems. The framework can be used to produce photorealistic weapon systems in a simulated 3D™ environment. The new Multipurpose Reconfigurable Training System 3D represents a significant advance in low-cost, high-fidelity tactical equipment and sets the standard for future trainers.
- A Navy team from Space and Naval Warfare Systems Center, Pacific, determined that a standard 400-hertz converter produced for the Army could replace a problematic 400-hertz (cycles per second) converter used in the Navy's AN/FPN-63 (V) precision-approach radar, or PAR. PAR is the Navy and Marine Corps' fixed-base primary approach aid used in poor visibility to radar-guide an aircraft on final approach. After testing, the Navy made refinements to handle overload conditions and the 400-hertz converter's electronics and programming are identical in Army, Navy, and Marine Corps versions.
- An Air Force team developed a standard for aircraft crew breathing systems using on-board oxygen generating systems, or OBOGS, in response to hypoxia-like incidents that occurred because OBOGS requirements were not consistently applied. The Air Force, in conjunction with the Navy and aerospace industry, developed MIL-STD-3050, which covers the design, integration, certification, and sustainment requirements for aircraft crew breathing systems using an OBOGS. The standard now will prevent the inconsistent application of life-support-system-critical items that include an OBOGS.
- John Bonitatibus of the Defense Logistics Agency developed a new performance specification—MIL-PRF-32535—and 10 specification sheets covering extended-range surface-mount ceramic chip capacitors for high- and standard-reliability applications. The new specification could preclude 50 nonstandard parts each year for the next 5 years, resulting in cost savings of $1.4 million annually, according to the award citation.
- A team from the Defense Information Systems Agency replaced the legacy managed service Defense Connect Online with a collaboration service that features modular open-standards architecture. The Defense Collaboration Services system is based on mature open-source web-conferencing software and XMPP-based chat software to reduce costs.



Mr. Gregory Saunders, Director, Defense Standardization Program Office.

Ms. Kristen Baldwin, Acting Deputy Assistant Secretary of Defense, Systems Engineering, delivering the Keynote Speech at the March 16 event.

Dr. Terrence D'Onofrio accepting the award for his work on the low-volatility agent permeation system.

Mr. Bruce Amrein from the U.S. Army's Research Laboratory accepting the award on behalf the DoD Design Criteria Standard: Noise Limits (MIL-STD-1474) team.

Mr. Christopher Paquette, Navy Departmental Standardization Officer, and Mr. Adam Nave, from the Office of the Assistant Secretary of the Navy, Research, Development, Testing, and Engineering, accepting the award on behalf of the Multipurpose Reconfigurable Training System 3D Team.

Mr. Richard Gunn from the U.S. Navy SPAWAR Systems Center accepting on behalf of the AN/FPN- 63 (V) Precision Approach Radar 400-Hertz Converter Replacement team.

Mr. George Miller of the U.S. Air Force Research Lab accepting on behalf of the MIL-STD-3050 team.

Mr. John Bonitatibus of the Defense Logistics Agency accepting the award for his work developing military specifications for high-reliability and standard-reliability ceramic chip capacitors.

Ms. Pam Watkins, Defense Information Systems Agency (DISA) Standardization Executive, and Mr. Deepak Seth, Systems Architect, DISA, accepting the award on behalf of the Defense Collaboration Services Team.

# Events

## *Upcoming Events and Information*

### August 8–11, 2016, Denver, CO

***65th Annual Standards Engineering Society Conference***

The Standards Engineering Society (SES) will be holding its 65th Annual Conference on August 8–11 at the Grand Hyatt Hotel in Denver, CO. This year's conference theme is "New Frontiers in Standards and Conformity Assessment." The Keynote will be delivered by Keith Williams, president and CEO of Underwriters Laboratories Inc. For more information on this event, go to the SES website at http://www.ses-standards.org and click "annual conference."

### October 24–28, 2016, Washington, DC

***World Standards Week***

Save the date—World Standards Week will take place the week of October 24, 2016. While many of the details are still being worked out, please "save the date" for what promises to be a comprehensive week of both meetings and events. A must attend for all standards professionals. For more information and event updates, go to http://www.ansi.org/wsweek.

### November 28–December 1, 2016, Denver, CO

***2016 DMSMS Conference***

The 2016 Diminishing Manufacturing Sources and Material Shortages Conference will be conducted simultaneously with the Defense Manufacturing Conference, joining together their exhibitions to bring participants a diverse knowledge base in the manufacturing world and more networking opportunities, all in one location. While each conference will have its own unique agenda, focus its program to its specific conference audience, and have a separate registration procedure to attend, one registration fee will give access to both conferences. The DMSMS registration is open to defense industry, military, and government personnel. See http://www.dmsmsmeeting.com/pages/registration.html#.

# Events

*Upcoming Events and Information*

**December 5–8, 2016, Albuquerque, NM**
***2016 DoD Maintenance Symposium***

The mission of the 2016 DoD Maintenance Symposium is to create an environment that enables attendees to share relevant information, identify critical issues, discuss key topics, and increase their awareness of Department of Defense maintenance initiatives. Join military, government, and industry leaders and maintainers from all levels at this distinctive, first-class event—the maintenance community's primary venue for networking and content sharing. For more information or registration details, go to http://www.sae.org/events/dod.

# People

*People in the Standardization Community*

## Welcome

**Ms. Edilia Correa** became the Technical and Quality Assurance Division chief and process owner at the Defense Logistics Agency (DLA) on April 4, 2015. Prior to coming to DLA Headquarters, she worked at DLA Aviation where she served as an engineer handling value engineering projects as well as serving as the Navy team lead in the sustainment engineering branch. She later served as chief in both the Engineering Division and Value Engineering Program and the Hazardous Materials Information Systems division. Ms. Correa started her career with McDonnell Douglas Corporation (now Boeing), in St. Louis, MO, as a test engineer.

**Mr. Edward "Doug" Fosnaught** recently became the DLA departmental standardization officer (DepSO), taking over for long-time DepSO Bill Lee, who retired over a year ago. Mr. Fosnaught will continue representing the Defense Logistics Agency as its DepSO as well as supporting the Technical and Quality Assurance Branch of DLA.

**Ms. Robin Brown** became the DoD DMSMS lead, replacing Alex Melnikow who retired in February. Prior to joining the Defense Standardization Program Office (DSPO), Ms. Brown was the Naval Air Systems Command (NAVAIR) Diminishing Manufacturing Sources and Material Shortages (DMSMS) lead and established a core centralized team for NAVAIR, which won the DoD DMSMS Team of the Year in 2014 and 2015, and she helped NAVAIR avoid spending over $1 billion by managing DMSMS proactively. While at NAVAIR, she provided DMSMS support to all 35 NAVAIR program offices, served as co-chair for the Department of Navy DMSMS Working Group, and participated as a member of the DoD DMSMS Working Group. She looks forward to continuing to leverage her past experience to empower mitigation of DMSMS issues across the services.

**Ms. Nicole Dumm** recently returned to the DSPO after a three-year hiatus working with DLA Pacific at Pearl Harbor, Hawaii. She began her federal career in 2004 as a student hire with DLA and has since worked as a program analyst for both DLA Installation Support and DLA Logistics Operations (J3). Ms. Dumm returns as the ***DSP Journal*** editor, and she will also take over the Standardization Awards Program as well as manage the new DSPO website. She is happy to be back with the team and looks forward to leveraging her past experience to empower mitigation of DMSMS issues across the services.

# People

*People in the Standardization Community*

## Farewell

**Mr. Robert Bamberg** is stepping down as chief of the U.S. Air Force International Standardization Office after 7 years. During his time as the chief, he oversaw the coordination and implementation of international agreements (NATO STANAGs and ASIC air standards) and directed the budget supporting Air Force international standardization. He was the U.S. representative to both the NATO Military Committee Air Standardization Board and the Air and Space Interoperability Council.

**Mr. Alex Melnikow** retired with more than 40 years of federal service. In his last position, he served as the lead analyst for Diminishing Manufacturing Sources and Material Shortages within the Defense Standardization Program Office. Throughout his career, Mr. Melnikow served in a variety of engineering, logistics, and acquisition positions with the Defense Logistics Agency, the U.S. Naval Air Systems Command, and the Tennessee Valley Authority. We wish him well in his retirement.

**Mr. Bill Lee** retired after more than 42 years of combined military and civilian service. He served as the Defense Logistics Agency departmental standardization officer for over 16 years. As the DLA DepSO, he was responsible for the development and management of the Materiel Standardization Program at the DLA Centers. He also ensured that Standardization Management Activities properly implemented the policies, procedures, and goals of the Defense Standardization Program (DSP), which encompassed such ancillary programs as Parts Management, Specifications and Standards, Non-government Standards, Data Items Descriptions, Qualification, Item Reduction, and Diminishing Manufacturing Sources and Material Shortages. Over the span of his 16-year tenure, he supported three DLA standardization executives on the Defense Standardization Council and worked on many initiatives, innovations, and plans. Mr. Lee was a special comrade of the DSP and offered continuous support and advice. He will be greatly missed. We wish him well in retirement.

# Upcoming Issues
## Call for Contributors

We are always seeking articles that relate to our themes or other standardization topics. We invite anyone involved in standardization—government employees, military personnel, industry leaders, members of academia, and others—to submit proposed articles for use in the *DSP Journal*. Please let us know if you would like to contribute.

Following are our themes for upcoming issues:

| Issue | Theme |
|---|---|
| April/June 2016 | Interoperability |
| July/September 2016 | Standards Policy |
| October/December 2016 | Agency Standardization |

If you have ideas for articles or want more information, contact Nicole Dumm, Editor, *DSP Journal*, Defense Standardization Program Office, 8725 John J. Kingman Road, STOP 5100, Fort Belvoir, VA 22060-6220 or e-mail DSP-Editor@dla.mil.

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