MIL-STD-705: An Overview

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EXECUTIVE SUMMARY

This paper is about military standard MIL-STD-705, *Military Standard Generator Sets, Engine Driven, Methods of Test and Instructions*. This paper provides an overview of MIL-STD-705, its legal authority and history, and its development and maintenance. This paper focuses on the standard's purpose and how it is used; in the development of new generator set families, in the procurement of generator sets, and in the sustainment of the fleet after production has ended.

MILITARY GENERATOR TEST METHODS

MIL-STD-705 is titled *Military Standard Generator Sets, Engine Driven, Methods of Test and Instructions*. Its companion Handbook, MIL-HDBK-705 is titled *Generator Sets, Electrical, Measurements, and Instrumentation*. MIL-STD-705 and MIL-HDBK-705 are the definitive reference standards for testing of military generator sets and components. They provide detailed standard test procedures, processes, and test equipment for a wide variety of tests typically used to validate: generator electrical performance, environmental operational conditions, human factors and safety standards, noise limits, etc. In short, it is the "Bible" of military generator testing[1].

MIL-STD-705 establishes the uniform test methods for the Military Services. MIL-HDBK-705 establishes uniform test equipment, facilities, and uniform procedures for conducting the tests. This standard does NOT specify the limiting values for the tests, nor does it specify the tests required for a specific generator set[2]. The limiting values for the tests and a list of the required tests are provided in the procurement documents.

MIL-STD-705 not only provides the test procedures for the US Government, but it is also used extensively by North Atlantic Treaty Organization, Allied Armed Forces, and the commercial industry as well. The fact that neither the Electrical Generating System Association (EGSA) nor the Underwriter's Labs (UL) has complete sets of commercial/non-Governmental standards available for the testing of generator sets makes this standard very important to industry as well as the Government[3].

LEGAL AUTHORITY/ HISTORY

MIL-STD-705 traces its legal authority to the Defense Standardization Program (DSP). The DSP was established by Department of Defense (DoD) Instruction 4120.24, *Defense Standardization Program*, which implements Title 10 USC 2451-2457, authorizes publication of DoD manual 4120.24-M ,*DSP Policies and Procedures*, and charters the Defense Standardization Council (DSC)[4]. MIL-STD-705 is directly related to Title 10 USC sections 2451 and 2452.

The Lead Standardization Activity for MIL-STD-705 under the authority listed above is CR1, the US Army Communications Electronic Command (CECOM), Logistics and Readiness Center (LRC), 10115 Gridley Road, Suite 228, Fort Belvoir, Virginia[5].

The Defense Cataloging & Standardization Act 10 USC 145 § 2451-2457 was approved on 1 July 1952 according to Joe Delorie of the Defense Standardization Program Office (DSPO). MIL-STD-705 was first published on 17 October 1958. The majority of its content and structure was based on MIL-G-10228A (CE), a set of Generator Test Standards under Army control, dated 8 January 1953. MIL-G-10228 was only coordinated within the Army. The other services (Navy, Marines, Air Force, and Coast Guard) were not asked to provide comments about MIL-G-10228. MIL-G-10228

(CE) was first issued on 7 April 1950[6]. MIL-STD-705A was revised and issued on 5 March 1963; MIL-STD-705B was revised and issued on 26 June 1972; and MIL-STD-705C, the current revision, was issued on 24 April 1989.

Development and Maintenance of the Standard and Handbook

MIL-STD-705 and MIL-HDBK-705 are based largely on MIL-G-10228 which used series 100 through series 700 to group like functions or tests. Much of the 100 and 200 series from MIL-G-10228 are included in MIL-HDBK-705 and are devoted to explaining and establishing conventions for terminology, instrumentation, methods of measurement and accepted procedures associated with testing and evaluation[7]. Most of the 300 through the 700 series of MIL-G-10228, which are test methods, went into MIL-STD-705. This is why the test methods of MIL-STD-705 start at 300[8].

MIL-STD-705 is organized using the decimal system to list similar or associated methods in numerical sequence which provides a ready means to identify main and subparagraphs for reference purposes. The general format with a brief explanation of each section is as follows: There may be a Caution preceding the Test methods. This Caution is usually about observing general safety practices. For example, there might be a warning that the voltages used in the test are dangerous to human life. There might be a warning to arrange the wiring of the test setup so as not to cause an inadvertent short circuit. Also, if the test is potentially dangerous, there is usually a warning to never perform the test without at least one other person assisting.

The following paragraphs provide an example of the format for the test methods described in MIL-STD-705.

608.1.1 General: This section gives a description of what is to be accomplished, warnings of potentials hazards, and general instruction on setup.

608.1.2 Apparatus: This section gives a description of the equipment required to conduct the test. Often, this paragraph references the test equipment described in MIL-HDBK-705.

608.1.3 Procedure: This section is usually comprised of:

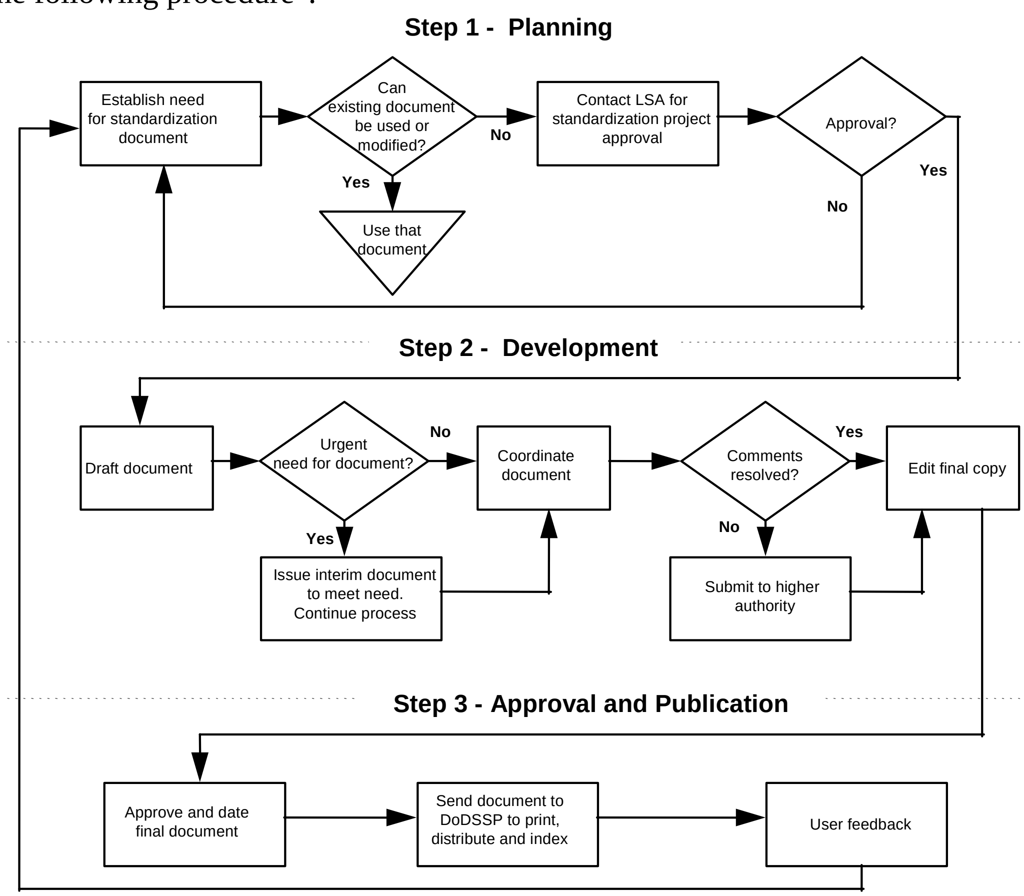
608.1.3.1 Preparation for test: This section usually contains additional steps that are required in order to conduct the test.

608.1.3.2 Test: This section gives a description of steps necessary to accomplish the test.

608.1.4 Results: This section includes “Compare the results with the procurement document”. This section may include information on how to determine the needed test results. For instant, this section may provide information on how to calculate or determine frequency and voltage regulation and frequency and voltage recovery times.

608.1.5 Procurement document required: This section gives a description of what must be specified in the individual procurement documents. This information usually includes threshold test values that must be achieved to indicate compliance with the requirements, special instructions concerning the test, conditions in which the test must be performed, and definitions of test parameters.

The format of MIL-STD-705 is defined in MIL-STD-962 which is the standard for writing DoD standards. MIL-STD-962 includes information on how to write a DoD standard. MIL-STD-962 specifically includes information on how to write each of the five basic standards: interface, practices, design criteria, manufacturing process, and test method. The requirements for DoD handbooks are similarly covered by a different standard, MIL-STD-967. Under the guidance of DoD 4120.24-M, DSP POLICIES & PROCEDURES, both MIL-STD-705 and MIL-HDBK-705 are reviewed every five years using the following procedure[9]:



Typical Standardization Document Development Process

HOW MIL-STD-705 IS USED

Purpose

MIL-STD-705 is intended to explain, establish and standardize specific methods for measurements associated with the evaluation of electric generators, generator sets and related components. The intended use of this standard is to determine compliance with characteristics represented by procurement documents. In no case is failure criteria established within MIL-STD-705.[10] This flexibility in the standard allows the procuring activity to tighten or loosen the requirements for specific characteristics as needed for different generations of the standard family. There are no uniform requirements for specific characteristics of a load the generator set is required to provide. For example, electronics such as radar units and communication require that the power quality be better than those powering heaters. The frequency bandwidth requirement for precise electronic equipment is much narrower than the requirement for heaters. Therefore, MIL-STD-705 does not have limits established in the Test Methods to deal with the different load requirements.

The specific test methods are included in this standard, while the terminology, instrumentation, general methods of measurement, and informative electrical technology are presented in MIL-HDBK-705. MIL-STD-705 is closely allied with MIL-HDBK-705 and references from one to the other are freely used, particularly from the standard to the handbook[11].

Due to the complexity of the requirements needed in procurement documents, specification writers and equipment inspectors will find the need for both the Standard and Handbook when evaluating electric generator equipment. The proper use of this

Standard through referencing the applicable specific test method should greatly simplify the preparation of specifications and help to expedite the purchase and acceptance of the subject equipment. Each test method includes a procurement document requirement paragraph, to give an indication of the procurement data required in the procurement documents to validate the performance requirements.

MIL-STD-705 is a collection of 104 test methods. These 104 methods are used to verify conformance of component parts, subsystems and the total system to specific requirements relating to power quality, survivability, reliability, maintainability, transportability, and operation in specific environmental conditions. Not every generator set design will require that every test of MIL-STD-705 be used; indeed some of the test methods are specific to certain technologies that go into making up of the total system.

The majority of test methods in MIL-STD-705 are applicable to all generator sets. However a few of the test methods only apply to generator sets with specific technology. For example, while most of the DoD military generator sets today use rotating field, fixed speed alternators to produce power, there are exceptions. The two kW Military Tactical (MTC) 28 volt DC generator set has a generator that used brushes. Test Method 416.1b of MIL-STD-705 is a method that determines brush contact loss while Test Method 652.2d is used to judge the amount of sparking at the commutator. These Test Methods are only used with generator sets that have brushes. They are not used very often however they are very important in ensuring that a generator that uses brushes in their design will perform satisfactorily.

Testing the brushes used on the two kW set is an example of using MIL-STD-705 to test an older technology. The current technology for generators is rotating field, fixed speed alternators. These alternators use rotating excitation to maintain voltage. Test Method 414.1c, *Rotating Exciter Saturation Curve Test*, is used to determine the saturation curves of the exciter to aid in determining the suitability of a particular exciter for use with a particular generator. This is a very important test that is used by design engineers in most of the generator sets being produced today, for both the military and the commercial market.

The variable speed 3 kW TQG set uses permanent magnets which do not use exciters and therefore does not require that the set be testing in accordance with Test Method 414.1c. The 3 kW TQG set produces its alternating power output electronically using a variable speed permanent magnet alternator and inverter. Variable speed generator sets, such as the 3 kW TQG, are a newer technology than the fixed speed generator sets. As the technology for variable speed generator sets matures more than likely additional tests will have to be added to MIL-STD-705 to test design parameters unique to this technology.

The test methods of MIL-STD-705 are used in three stages of the generator set's lifecycle: development, procurement, and sustainment. MIL-STD-705 is not used in the decommission stage of the lifecycle since no tests are required to dispose of a set. The generator set requirements are developed by the combat developer, US Army Training and Doctrine Command (TRADOC), based on the needs of the war-fighters in order to accomplish their missions. The design activity requires specific tests to ensure that the new generator set design has met all of the requirements of the combat developer. The procurement activity requires that specific tests be conducted on all generator sets during manufacturing in order to ensure that the generator sets are safe, fully functional, and provide the power required in the field. They also use testing to ensure engineering changes during the manufacturing run do not degrade generator set performance or keep it from complying with any of the original requirements. For the same reason, the sustaining activity uses testing to qualify new sources of supply after the generator set manufacturing period has ended throughout the life of the set.

Development

DoD Directive 4120.11, Standardization of Mobile Electrical Power (MEP) Generating Sources establishes Project Manager – Mobile Electrical Power (PM-MEP) and gives it the mission to procure and manage all MEP sources 750-kilowatt (kW) and smaller for all branches of the US military [12]. PM-MEP uses Purchase Descriptions (PD) and Statements of Work (SOW) in its solicitations for contractors to bid on the design and production of the standard families of generator sets.

The contractors' proposals must include a detailed test plan in their bids. This test plan will need to use relevant test methods to test the components and then subsystems that will makeup the contractor's design. The contractors have to do this in order to mature their designs to the point that the total systems can be tested. The contractors will need to conduct many more tests that the Government will in order to insure the equipment will meet the Government's requirements. Depending on the particular needs of their designs, the contractors will choose which tests to subject their equipment to during the initial design phase.

During testing, the Government requires that specific test methods from MIL-STD-705 be used to confirm the generator sets meet the requirements. When the requirements are met the design is accepted and the product baseline is transferred to

Government control. This baseline is given to the Government as Technical Data Packages (TDPs), made up of drawings and specifications which depict all the parts that makeup the individual generator set configuration. These configurations include sizes: 2 kW, 3 kW, 5 kW, 10 kW, 15 kW, 30 kW, 60 kW, 100 kW, and 200 kW and modes: 28 Volts DC, 50/60 Hz AC, and 400 Hz AC, that makeup a standard family of generator sets. Many of these drawings describe parts that have to undergo conformance testing. This conformance testing may require testing from some recognized standard other than MIL-STD-705. However by the part passing the required test of the recognized standard its fitness for use in the generator set will have been confirmed by the series of MIL-STD-705 testing that the generator set passed originally.

For example, the individual steel parts of the generator sets that are to be painted require the parts be pretreated in accordance with TT-C-490, *Cleaning methods for Ferrous Surfaces and Pretreatments for Organic Coatings*, which is a Federal standard. The generators sets are subjected to the following MIL-STD-705 tests: Solar Radiation, Sand and Dust, Salt Fog, Rain, Ice Glaze and Wind, Humidity, Hot Storage, and Extreme Cold Storage. These specific MIL-STD-705 tests confirm the durability of the pretreatment system, thereby verifying that replacement parts treated in accordance with TT-C-490 will not degrade the original performance requirements of the generators sets.

The Advanced Medium Mobile Power Sources (AMMPS) program is an effort to design, procure, and field a new generation of 5 through 60 kW tactical generator sets. The PD for AMMPS lists all the requirements that each size generator set must meet and the specific test method(s) of MIL-STD-705 needed to confirm conformance with each requirement. The AMMPS solicitation was structured with three Phases. The first Phase required that contractors submit a proposal detailing their design. The Government evaluated these competing proposals. The Government selected two of the competing contractors who submitted bids to enter into the second Phase.

The AMMPS program is currently in the second Phase. During the second Phase, two contractors built two prototypes for each size generator set. The prototype generator sets from the two contractors were evaluated using the same test criteria and the same test methods of MIL-STD-705. The test data will allow the Government to make a fair and balanced technical evaluation of the competing designs. The evaluation portion of the second Phase is complete although the final decision has not been made. Upon completion of the second Phase, the wining design will proceed to the third Phase of the program where the design will be finalized, tested and a decision will be made on whether or not to proceed to production and fielding.

This illustrates the contractor's and the Government's use of development testing. The two contractors' generator sets have to undergo the same MIL-STD-705 end-item testing. In order for contractors to ensure that their end items will meet the Government's requirements, the contractors will need to perform individual component and subsystem testing relevant to their set designs. These individual components and subsystem testing are necessary to mature the designs to the stage where end-item testing is feasible. This testing should also help the contractors improve their designs in the hope of being awarded the contract.

Procurement

Once the production approval is granted, all generator sets coming off the production line must undergo quality testing to determine their fitness for fielding. The

Tactical Quiet Generator (TQG) set family is currently in production. One contractor produces the three kW size set which is considered a small set. This contractor also produces the five, ten, and fifteen kW size sets, which are considered medium size; and the one hundred and two hundred kW size sets which are considered large size. Another contractor produces the thirty and sixty kW size sets, which are considered medium size sets.

During production, each of these generator sets has to pass three generator only tests and one test of the generator and excitation system. These tests evaluate mechanical strength and insulation quality of the generator. Each produced generator set must pass nineteen tests that are designed to test the total system's readiness to be fielded. These tests are mainly concerned with safety, fault indication, power quality, power rating, and the performance of the generator set. These MIL-STD-705 tests answer questions such as: Does it produce power of sufficient quality and at the rated power? Is the generator set safe to operate by the users? Are the protective devices operating correctly?

In addition, two samples from each lot have to undergo additional MIL-STD-705 testing to validate the lot. The lot size is typically twenty five generator sets of the same size and mode. For this lot size, two sample generator sets will have two tests done on their generators with excitation system that is a more severe test of the generator's mechanical strength. These two samples will have seven generator set tests done to determine if they still meet the original requirements. These tests include noise, endurance, operation at high temperature, reverse battery polarity, and three tests for power quality.

TQG sets have been in production since 1988 and will be produced through at least 2010. Over this time period there have been many changes to the original design. In the past, a few changes were made to correct deficiencies in the design. Other changes were made to replace parts that were no longer being manufactured by the original source. Other changes came about as a result of changes to manufacturing process, etc.

In the future, the Government anticipates few changes needed in the design; however, the Government anticipates other changes will be needed especially to secure new sources of supply for components to support the continued manufacturing of the generator sets. The Government requires that any change does not degrade the original combat developer's requirements for the TQG sets. Depending on the type of change, the Government will determine which of the original tests that the generator sets underwent will be required to be repeated to confirm that the performance of the generator sets has not been degraded by the change. This is in addition to any testing that the contractor does.

Sustainment

Based on historical funding for spare parts, the Government is planning on thirty to forty years as the useful life for military generator sets. The sustainment community is still purchasing spare parts for generator sets designed in the early 1970's. Over 40 years, some component companies form while others go out of business. Obsolescence becomes a real problem. Depending on the obsolete part, the Government has three choices. The Government can qualify new vendors. The Government can choose to repair old parts. As a last resort, the Government's option is cannibalization. MIL-STD-705 needs to support testing these choices over the long term[13].

PM-MEP specifies end item performance requirements in the PD and the appropriate MIL-STD-705 test method to confirm the requirements with end-item testing. The development and procuring activities are the major Government users of MIL-STD-705, however sometimes the sustainment community tests spare or component parts differently than those activities. When testing a complete generator set, the tester may frequently infer that internal parts are functioning properly if the generator set meets all original requirements. Twenty years after manufacturing has ended, a working generator set can be hard to obtain for testing purposes and sometimes it is cheaper to bench test even if one were available. Drawings for individual parts contain part performance and testing requirements that are generally different than that of the complete generator set[14].

Each generation of the military's standard generator fleet has hundreds of drawings that call out or need MIL-STD-705 tests for spare parts qualification over the life cycle of the generator sets. The sustainment community uses MIL-STD-705 to ensure that the same part from two or more manufacturers do not compromise the original requirements. The sustainment community also requires that components with different designs but designed to provide the same performance capabilities actually do perform identically. This ensures repeatability of testing to ensure that components and end items meet the requirements

An example of different designs performing the same function would be two switches using different technologies. One switch uses cam-action contacts and the other switch uses rotary sliding contacts. One switch is round and the other switch is rectangular. The switches use different technologies and appear different, but as long as they mount into the same space, perform the same electrical and mechanical functions as tested by the same MIL-STD-705 tests; then they are form, fit and functionally interchangeable.

In the private sector, the same generator set might have three different ratings given to it by three different manufacturers because of the lack of standardized test protocols. This makes comparison of commercial generator sets difficult if not impossible without standardized testing. The Government uses MIL-STD-705 to make comparisons. Military generator sets have performance requirements defined by the combat developer that the sustainment community must be able to verify at different facilities, with different measuring equipment operated by different companies over long periods of time[15].

The sustainment community is not overly concerned about what test equipment is used to perform the tests as long as when tested, the test results of a component or set remain constant no matter what company manufactured the test equipment or which company manufactured the component. The test equipment used should have its accuracy traceable to a recognized standard and the data collected should be capable of being interpreted in accordance with MIL-STD-705.

Consistency in testing is important or the sustainment community might qualify a spare part that would not meet the original generator set requirements or degrade the generator set's performance. Inconsistent testing might force the contractor to design a component with better performance than the original, increasing generator set capability, but potentially at a higher cost. The sustainment community has the need for testing consistency when qualifying new military generator parts to support generator parts that were first qualified decades ago.[16]

CHALLENGES FOR THE FUTURE

The need for electrical power on the battlefield will continue to grow. Currently most of the tactical power needs are met by generator sets using fixed speed alternators. MIL-STD-705 currently has 104 test methods that are adequate to confirm the sets' conformance to military requirements. However, technologies are under investigation so that future designs will not rely on fixed speed alternators. Some of these technologies being investigated are solar cells and thermovoltaics that do not use alternators to produce electrical power. Exportable power technologies from military vehicles are being investigated to determine whether extra power from the vehicle can be used to provide electricity in a tactical environment.

The challenge for the future is to make sure that MIL-STD-705 continues to have all the test methods necessary to evaluate the performance of all current and future technologies of power generating equipment. Also, MIL-STD-705 must continue to confirm that power sources in production meet the quality assurance provisions of production contracts. Lastly, MIL-STD-705 needs to support qualification of new sources of supply for components of legacy power systems.

ENDNOTES

[1] DEPARTMENT OF DEFENSE, PROJECT MANAGER MOBILE ELECTRICAL POWER, References Mil-Std-7605C, http://www.pm-mep.army.mil/reference/705c.htm

[2] Ibid.

[3] Ibid.

[4] Department of Defense INSTRUCTION NUMBER 4120.24, June 18, 1998. http://www.dsp.dla.mil/APP_UIL/content/policy/4120-24.htm

[5] DEFENSE STANDARDIZATION PROGRAM, STANDARDIZATION DIRECTORY, 1 September 2006, Page ARMY 9, http://www.dsp.dla.mil/APP_UIL/displayPage.aspx?action=content&accounttype=displayHTML&contentid=81

[6] MIL-G-10228A (CE), *MILITARY SPECIFICATION, GENERATOR SETS, ENGINE – DRIVEN, METHODS OF TEST*, 8 JANUARY 1953.

[7] MIL-HDBK-705C, *MILITARY HANDBOOK GENERATOR SETS, ELECTRICAL, MEASURMENT AND INSTRUMENTATION METHODS.*), 29 MAY 1987. Page iii

[8] MIL-STD-705 *MILITARY STANDARD GENERATOR SETS, ENGINE DRIVEN, METHODS OF TEST AND INSTRUCTIONS*, 24 April 1989, 1.2.1, page 1

[9] DoD 4120.24-M DSP POLICIES & PROCEDURES March 2000, http://www.dtic.mil/whs/directives/corres/html/412024m.htm

[10] MIL-STD-705 *MILITARY STANDARD GENERATOR SETS, ENGINE DRIVEN, METHODS OF TEST AND INSTRUCTIONS*, 24 April 1989, 1.2.1, page iii

[11] MIL-HDBK-705C, *MILITARY HANDBOOK GENERATOR SETS, ELECTRICAL, MEASURMENT AND INSTRUMENTATION METHODS.*), 29 MAY 1987.

[12] DoD Directive 4120.11, Standardization of Mobile Electrical Power (MEP) Generating Sources. http://www.dtic.mil/whs/directives/corres/html/412011.htm

[13] Greg Youll, Position Paper, Maintenance Engineering, attached appendix A.

[14] Ibid.

[15] Ibid.

[16] Ibid.

APPENDIX

Position Paper, Maintenance Engineering’s response to a suggestion that test methods be removed from MIL-STD-705.

Jon,

I listened at the last meeting with interest. I've been participating in the IPT to represent the spare parts user community and to learn more about testing. I don't have any test equipment, I don't witness tests, I don't even have any generators to test, so I can't contribute like some of the engineers down at Ft. Belvoir, but I do know about long term support. Below are my thoughts from a sustainment perspective.

In terms of a generator set life you need to think 30-40 years, based on historical funding. I'm still purchasing spare parts for generator sets designed in the early 1970's. I suspect we'll be purchasing spare TQG parts through the late 2020's. Over 40 years companies form, others go out of business and obsolescence is a real problem. Depending on the obsolete part, sometimes we qualify new vendors, sometimes we repair because we can't purchase new parts, and sometimes our only option is cannibalization. Mil-Std-705 needs to support testing over the long term.

All the places you looked for Mil-Std-705 tests were end item specifications. Though probably the major user of Mil-Std-705, sometimes we test spare or component parts differently than end items. When testing a complete generator you can frequently infer that internal parts are functioning properly by measuring the output of the generator set, but 20 years into a program working generator sets can be hard to obtain and sometimes it's cheaper to bench test. PM-MEP specifies end item performance requirements in the PD/Specifications and uses these for end item testing. Drawings for individual parts contain part performance and testing requirements that are generally different than that of the complete generator set.

Though we may not use, or even need in the future, all the tests in Mil-Std-705, I'm concerned about removing tests. The cost of keeping the tests in Mil-Std-705 is negligible. We have hundreds of drawings that could call out or need Mil-Std-705 tests for spare parts qualification over the life cycle of the generator sets. It could take weeks to months to identify which drawings to review and then to actually review them. I don't see the benefit of spending scarce engineering hours when the potential savings from identifying tests no longer required is so small.

I need consistency over the long term for the tests in Mil-Std-705. If a contractor or I pull out Mil-Std-705B or Mil-Std-705D and perform a 608 test on the same generator set according to either revision, the test results should be the same. In the contracting world many contracts actually state that the latest specification revision is applicable. This reduces drawing ECPs and revisions, since only the specification, less its revision, must be called out on the drawing. If tests were identified by specification and spec revision, each time the specification changed the drawing would need to be reviewed. Using older specification revisions can cause problems too, as they may not be widely available. For example, Assist only contains the current revision of Mil-Std-705, revision C. If test methods are revision neutral, long term use of the methods is improved.

I also need Mil-Std-705 to ensure that two or more cont ractors who test the same part, or different parts with the same performance capabilities, obtain the same test results. I think of this as test repeatability. In the private sector, the same generator set might have three different ratings given to it by three different manufacturers because they don't have standardized test protocols. This makes generator set comparisons difficult. We use Mil-Std-705 to make comparisons. We have performance requirements defined by the combat developer that we must be able to verify at different facilities, with different measuring equipment operated by different companies over long periods of time.

I'm not overly concerned about what equipment is used to measure the tests. The equipment used should have it's accuracy traceable to a recognized standard and the data collected should be capable of being interpreted in accordance with Mil-Std-705 and yield the test results consistency I seek in the previous two paragraphs.

Here is a typical scenario for the future. Ten years from now the manufacturer of the Source Control 5 & 10 kW TQG Voltage Regulator goes out of business and we have to qualify a new source of supply. The VR is defined on a source control drawing, with envelope and performance requirements, but no design detail information. In 10 years, Bill Merrill has retired, Tom Dooley is working somewhere else because PM-MEP moved to Aberdeen and I'm a branch chief in another office. The engineer assigned the qualification task will use MIL-DTL-53133 for end item performance requirements, he will use the Source Control Drawing for additional requirements, and he'll use the latest revision of Mil-Std-705. He won't know to do anything else. To properly maintain the TQG performance requirements the tests in Mil-Std-705 must yield the same results for the same inputs as produced in 1990 when the original VR was qualified for use in the 5 & 10 kW TQGs. If the test results are not consistent we potentially qualify a spare part that wouldn't meet the original TQG requirements, degrading the generator set's performance, or we might force the contractor to design a VR with better performance than the original, increasing generator set capability, but potentially at a higher cost. I have the same need today for testing consistency when qualifying new Mil Std parts that were first qualified in the 1970's.

After all discussed above is considered, I'm all for adding additional tests to Mil-Std-705. I know from personal and 3 kW TQG experience that inverter technology behaves differently than wound alternators. I burned up a 300W inverter powering a 23W compact fluorescent bulb. We also had trouble with the output semiconductors in the 3 kW TQG failing prematurely. A search on the internet revealed that the compact fluorescents have a high speed switching circuit. Other research suggested the high speed switching circuits appear like a short term dead short to the power source. The 3 kW TQG inverter manufacturer told me that his output semiconductors are not designed for dead shorts (and really can't be because of their nature) and their life is shortened by our short circuit test. The 3 kW TQG has a dead short protection requirement and has production acceptance tests that apply a short circuit to test the control circuits. Do we have the right short circuit test for this technology? How many times should it be run? Are we performing the right tests to verify the performance of inverter technology generators? I don't believe semiconductors are as forgiving of transient overloads as alternator windings. I also wonder if high speed switching loads could lead to premature failures of inverter hardware. Has Belvoir researched or tested this technology? How should it be tested? The nature of loads is changing. Do we specify performance with the right loads? Should we add tests to Mil-Std-705 to validate performance with additional types of loads? The test measurement instruments of today are capable of measuring orders of magnitude smaller time increments than analog instruments originally used for Mil-Std-705. Are there any benefits or advantages to characterizing generator set output in smaller time intervals? Is there noise in the generator output wave form that isn't visible with analog technology? Is this noise harmful to today's semiconductors and ICs? Is today's technology more tolerant of noise and voltage spikes, since most circuits now run on DC power supplies? Is there other data we could or should be collecting to characterize generator set performance?

I think one of your IPT missions and opportunities should be to look at the tests in Mil-Std-705, look at the technologies used to generate power for weapon systems, and look at the latest types of mission loads and the power characteristics they require to determine if Mil-Std-705 has the right tests in it.

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