CDC Z3E052

Electrical Power Production Journeyman

Change Supplement for Volume(s): 1 and 5

IMPORTANT: Make the corrections shown in this supplement before beginning your study of the volume(s) it affects. This supplement has both pen-and-ink changes and replacement pages. Tear out the replacement pages and insert them in your volumes.

Air Force Career Development Academy
The Air University
Air Education and Training Command

Changes for the Text: Z3E052 01 1512, edit code 01

Pen-and-Ink Changes

Page-Col	*Subject*	*Line(s)*	*Correction*
1–19	003–13		Delete.
1–19	003–14		Delete.
G–1	Glossary	5 from top	Add "AFTO – Air Force Technical Order"

Page Changes:

Remove:	*Insert:*
1–1 to 1–2	1–1 to 1–2
1–7 to 1–8	1–7 to 1–8
1–13 to 1–18	1–13 to 1–18

Changes for the Text: Z3E052 05 1607, edit code 03

Pen-and-Ink Changes

Page-Col	*Subject*	*Line(s)*	*Correction*
After 2–7	Duplicate glossary pages		After page 2–7, delete pages G–1 and G–2

Page Changes:

Remove:	*Insert:*
2–3 to 2–4	2–3 to 2–4

Unit 1. Safety and Technical Publications

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POWER PRODUCTION IS a very diverse career field. During your time as an Electrical Power Production Journeyman, you will work on electrical and mechanical systems. This volume will cover many of the tasks and pieces of equipment that you will encounter on a regular basis. This unit will cover safety and the Air Force specialty code (AFSC) field forms and technical orders (TO) you will use while working with generators.

1–1. Safety

You will be working around electrical equipment throughout your career in power production. You need to know how to prevent getting shocked or electrocuted. Getting yourself tied into an energized circuit will not be the highlight of your day. You also need to know what to do if one of your co-workers gets shocked. The next few paragraphs will provide you with information that can save your and your co-workers' lives.

001. Working around energized circuits

Voltages are different around the world. The most common voltage and frequency in the United States is 120 volts, alternating current (VAC), 60 Hertz (Hz). As little as one tenth of an amp (0.1 A), or one hundred *milliamperes* (100 mA), of current can kill you. Power production personnel routinely produce and work with voltages from 120 up to 4160 VAC and currents from 100 mA and up. Use the chart below to find out what kind of effect specific amperages can have on the human body.

SPECIFIC AMPERAGES EFFECT ON THE HUMAN BODY	
Current	**Body Response**
.007 – 5 mA	Start to feel the energy, tingling.
5 – 15 mA	Experience pain, muscle contraction.
15 – 50 mA	Grip paralysis threshold (brain says let go, hand will not listen)
50 – 100 mA	Respiratory system shuts down.
100 – 300 mA	Heart fibrillation.
300 – 700 mA	Heart clamps tight, full contraction with no rest.
700 – 2,000 mA	Tissue and internal organs burn.

Air Force Instruction (AFI) 91–203, *Air Force Consolidated Occupational Safety Instruction*, states that you will normally de-energize electrical circuits and equipment before performing maintenance *except* as necessary to support a critical mission, prevent injury to persons, or protect property. This instruction also requires that when you *must* work on an energized circuit, a *minimum* of two people who are fully qualified for energized, or "hot," work *must* be present. Regardless of what you must do if you work on energized circuits, the *safest* way to do your business is to de-energize all circuits

regardless of the voltage. Always treat circuits with maximum respect, as energized, or "hot," until you double-check. Only the Base Civil Engineer can authorize work on energized circuits and or equipment.

Power production electrical standards

There is a variety of electrical safety standards for power production. Some are AFIs while others are unified facility criteria (UFC) along with commercial standards such as the National Fire Protection Agency (NFPA) 70E, Standard for Electrical Safety in the Workplace. The table below gives a description of these standards:

ELECTRICAL SAFETY STANDARDS	
Standard	**Description**
AFI 91–203	This is the Air Force consolidated safety standard. It covers everything safety including working around energized circuit.
AFI 32–1064, Electrical Safe Practices	This is the instruction for electrical safe practices as it relates to civil engineering.
UFC 3–560–01, Operation and Maintenance: Electrical Safety	This document covers operations and maintenance (O&M) of electrical systems and applies to all branches of the Department of Defense (DOD).
NFPA 70E	This is the National Fire Protection Association's commercial standard for electrical safety in the workplace.

Arc flash safety

When working around energized circuits, one of the most important hazards to be aware of is the danger of an arc flash. An arc flash is the result of the passage of electric current through air, the air failing as an insulator but serving as a conducting medium. Blasts result when the metal at the arc site expands and vaporizes. High-energy arcs can be fatal even at distances of 10 feet (ft) or more.

Figure 1–1. Arc flash warning label.

Arc flash warning labels (fig. 1–1) must be on electrical equipment likely to require examination, servicing, or maintenance while energized. Some typical types of equipment include pad-mounted transformers, switchgear, switchboards, panel boards, disconnect switches, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling occupancies.

When working around energized circuits, you must be aware of the approach limits and boundaries involved. They are the arc flash boundary, limited approach boundary, restricted approach boundary, and prohibited approach boundary.

Arc flash boundary

The distance from an arc source (energized exposed equipment) at which the potential incident heat energy from an arcing fault on the surface of the skin is 1.2 calories per centimeter squared (cal/cm2) or 5 joules per centimeter squared (J/cm2). Within this boundary, workers are required to wear appropriate personal protective equipment (PPE) clothing. The minimum flash protection boundary must be 10 ft for voltages up to 750 volts, and 20 ft for voltages greater than 750 volts. Only qualified workers wearing appropriate PPE are permitted to be within this boundary.

Limited approach boundary

A *limited* approach boundary is a shock protection boundary to be crossed by only qualified personnel (at a distance from a live part). Unqualified personnel will not cross the shock protection boundary unless escorted by qualified personnel.

002. First aid for electrical shock

1. What factors contribute to the *severity* of electrical burns?

2. Why should you elevate the legs of a person in shock about 12 inches, unless you suspect head, neck, or back injuries?

1–2. AFSC forms and technical publications

Throughout your time as a power production technician, you have the responsibility to maintain and operate all kinds of different equipment. To do so, you must perform maintenance actions according to technical orders (TO) and DOD or commercial publications and document your inspections and maintenance on approved forms. Being able to recognize and properly use these forms and publications are key to keeping your equipment in peak operating condition. We will discuss the forms you will use for documentation, and then we will delve into the technical publications you will use to maintain equipment.

003. AFSC specific forms and other requirements

During your time operating and maintaining generators, you are required to use several forms. These forms show historical trends and allow for diagnosis of system faults. Additionally, they are used to size a generator to a facility. It is important to remember the job is *not* done until the paperwork is done.

Filling out Air Force Form 487, Generator Operating Log (Inspection Checklist)

The Air Force Form 487, Generator Operating Log (Inspection Checklist), is the most commonly used form you will use during your career. You use this form to annotate generator operations and show a history of generator, transfer switch, and load conditions at a generator site.

When filling out the AF Form 487, be sure to fill out *all* 19 blocks *legibly*. This lesson covers how to fill out this form. Follow along with figures 1–3 and 1–4 as we give a description of each block.

GENERATOR OPERATING LOG (Inspection Checklist)

Front: annotate optimal readings (operating temp., peak kW and amps, etc.) Reverse: continuation of readings and annotate any discrepancies and/or corrective actions.

1. GENERAL INFORMATION

A. INSPECTOR/OPERATOR (Print)	B. DATE	C. SUPERVISOR (Print/Signature)	D. DATE
	20 Feb 2015		22 Feb 2015

E. RECORD ID	F. SITE NAME/BUILDING NUMBER	G. ORGANIZATION	H. BASE
187	RAPCON/1515	555CES	PRIME BEEF AFB

I. START HRS	J. FINISH HRS	K. TIME	L. OUTSIDE TEMP.	M. SYSTEM TYPE	N. EQUIPMENT TYPE
125	126.2	1230	65	AUTO ☐ MANUAL ☑	RPIE ☑ EAID ☐

2. ALTERNATOR INFORMATION

A. MAKE	B. MODEL	C. SERIAL NUMBER	D. POWER FACTOR
Marathon	123456B	123456789	.8
E. VOLTAGE	**F. AMPERAGE RATING**	**G. KILOWATT RATING**	**H. OTHER**
120/208	208	60	

3. ENGINE INFORMATION

A. MAKE	B. MODEL	C. SERIAL NUMBER	D. RPM/HZ	E. EXHAUST GAS TEMP.
Cummins	B1250	02154623	1800/60	

4. AUTOMATIC/MANUAL TRANSFER SWITCH DATA ☐ N/A (This section is not required for generators without switchgear)

A. MAKE	B. MODEL	C. SERIAL NUMBER	D. BYPASS CAPABILITY
Kohler	1256987	2349851357	YES ☑ NO ☐

E. AMP RATING	F. PHASE	G. POLES	H. DISCONNECT METHOD FOR LOAD TEST	I. ATS OPERATED (Attempt)
250	3	4	KEY/TEST SWITCH ☐ MAIN DISCONNECT ☑	FIRST ☑ SECOND ☐ THIRD ☐ MANUAL ☐

5. GENERAL SITE AND GENERATOR SET CONDITIONS

	SAT	REMARKS/CORRECTIVE ACTION		SAT	REMARKS/CORRECTIVE ACTION
A. CLEANLINESS	✓		E. BELT CONDITION	✓	
B. LOOSE ITEMS	✓		F. CONTROLS/GAUGES	✓	
C. AREA (Room) LIGHTING	✓	Light burned out, opened w/o #F13654	G. ENGINE VIBRATION	✓	
D. GROUND CONNECTION	✓		H. EXHAUST TEMP./CONDITION	✓	°F

6. COOLING SYSTEM

A. LEAKS	✓	
B. COOLANT LEVEL	✓	
C. HOSES	✓	
D. RADIATOR, LOUVERS	✓	
E. AMBIENT TEMP.	65	°F
F. OPERATING TEMP.	202	°F

7. FUEL SYSTEM

A. LEAKS	✓				
B. TRANSFER PUMP OPERATION	✓				
C. TANK CAPACITY (Gal)	DAY	N/A	STORAGE	450	
D. TANK LEVEL (Gal)	DAY	N/A	STORAGE	385	
E. WATER DRAINED (Gal)	YES	☐	NO ☑	QUANTITY	

8. LOAD DEMAND

A. KILOWATTS (PEAK)		30.8				
B. AMPERAGE	PH1	112	PH2	102	PH3	107
C. VOLTAGE (L-L)	PH1	208	PH2	208	PH3	208

9. LUBRICATION SYSTEM

A. LEAKS	✓	
B. OIL LEVEL	✓	
C. OIL PRESSURE	55	PSI
D. OIL TEMP. (If applicable)	N/A	°F

10. BATTERY AND CHARGING SYSTEM

A. WIRING CONNECTIONS	✓				
B. BATTERY VOLTS DC	☐	C. INSTALL DATE (mm/yy)		12/14	
D. BATTERY TYPE	WET CELL	☐	SEALED	✓	
E. BATTERY CHARGING	VOLTS DC	14.2	AMPS	1	
F. BATTERY LOAD TEST	GOOD ✓	WEAK ☐	NOT TESTED ☐		

11. AUTOMATIC/MANUAL TRANSFER SWITCH

A. WIRING AND CONNECTIONS	✓
B. CONTACT CONDITION	✓
C. COMPONENTS AND CONTROLS	✓
D. MECHANISM OPERABILITY	✓
E. INDICATOR LIGHTS	✓

12. MAINTENANCE ACTIONS ✓ (No maintenance due)

A. FILTER CHANGE	AIR ☐	COOLANT ☐	FUEL ☐	OIL ☐		
B. FLUIDS ADDED (Gal)	COOLANT	1 quart	OIL	N/A		
C. LAST OIL CHANGE DATE (mm/yy)	12/14					
D. OIL ANALYSIS DATE (mm/yy)	12/14	RESULTS	Sat			

13. INSPECTION TYPE

A. SEMI-MONTHLY ☐	B. MONTHLY ✓	C. QUARTERLY ☐			
D. SEMI-ANNUAL ☐	E. ANNUAL ☐	F. OTHER			
G. TEST METHOD (EGT, 30% Load or Less Than 30% Load)					
H. LOAD TYPE (Facility/Load Bank/Both)		I. DENIED LOAD TEST ☐			

14. SITE DOCUMENTATION (Current Documentation)

A. OI's	B. TRAINING LETTER	C. ONE-LINE DIAGRAMS
✓	✓	✓

15. UNIT STARTED

A. FIRST	B. SECOND	C. THIRD	D. DID NOT START
✓	☐	☐	☐

Figure 1–3. AF Form 487, front.

C. Test batteries to determine status. (e.g., battery load tester, hydrometer, or similar device).

D. Check battery chargers for output voltage and amperage. (Engine driven chargers are not included in this inspection).

17. Continuation readings will be annotated depending on the length of time the generator will remain operational. This form is to be used as a daily form and will be closed out at the end of every day and a new form will be started.

18. Remarks: user inputs for additional information during the inspection or about the equipment or generator room.

19. Facility Representative: Print and sign.

A. The facility representative marks this block if he or she denied test.

B. The facility representative marks this block if the test was completed.

Maintenance forms and power plant logs

Whether you are completing maintenance or operating a power plant, documentation is the key to keeping generators running efficiently. Two forms you will use are the AF Form 719, Historical Record – Diesel-Electric Generator and System, and the AF Form 1167, Daily Power Plant Operating Log (Diesel-Electric). Both forms are located on the Air Force E-Publication site; however, you must order AF Form 1167, so plan ahead if you need this form at your location.

AF Form 719

When completing generator maintenance, other than monthly inspections, use the AF Form 719 to annotate actions. . This form documents maintenance and stays with the generator for the life of the unit. Figure 1–5 is an example of an AF Form 719. Remember, whenever any maintenance is completed, it must be annotated on the AF Form 719.

HISTORICAL RECORD - DIESEL-ELECTRIC GENERATOR AND SYSTEM | CARD NO.

COMMAND	BASE		SITE	RECORD IDENTIFICATION NO.	DATE INSTALLED *(YYYY MM DD)*	
Air Combat Command	Prime BEEF AFB		RAPCON	187	20101212	
ENGINE MAKE	**SERIAL NO.**	**MODEL**	**RATING KW**	**PRIME**	**EMERGENCY**	**VOLTAGE**
Cummins	02154623	B1250	60		X	120/208

DATE	ENGINE HRS	DESCRIPTION OF MAINTENANCE AND/OR INSPECTION	MAN HOURS	LABOR COST	PARTS COST	CUMULATIVE TOTAL COST
20101212	1.0	Installed at RAPCON				
20111210	25	Performed Annual/changed oil, oil filter, fuel and air filters				
20120505	55	Replaced injection pump				
20121211	70	Performed Annual/changed oil, oil filter, fuel and air filters				
20131220	100.2	Performed Annual/changed oil, oil filter, fuel and air filters				
20141215	122.5	Performed Annual/changed oil, oil filter, fuel and air filters				

AF IMT 719, 19670201, V3

Figure 1–5. AF Form 719.

AF Form 1167

The AF Form 1167 allows for detailed logging of power plant information. Some of the areas that you fill out on this form include the engine information such as oil pressure and temperature. Additionally, this form allows you to log load information and generator output. This form can help identify load changes and forecast peak demand to allow for efficient use of prime power generators.

Some other forms that you will use are the Generator Authorization Design Request and the New Facility Generator Authorization Request. These forms request approval from the Air Force Civil Engineer Center (AFCEC) for generator installation.

Generator Authorization Design Request

Use the Generator Authorization Design Request form when design information is available. Load data information is available from several different sources: generator-operating logs, monitoring systems, load surveys, design notes, and so forth. Use this form to obtain advanced design approval before ordering the generator. This will help eliminate getting generators that are sized incorrectly for the load.

New Facility Generator Authorization Request

Use the New Facility Generator Authorization Request form during the planning and programming portion of a new project. Fill this form out to obtain the authorization for the generator for the specific facility.

Environmental Protection Agency requirements

Federal regulatory air quality requirements for generator engines must be met; however, they vary greatly from engine to engine and are frequently amended. Requirements include, but are not limited to, emissions limits, operating limits, management practices, maintenance requirements, performance testing, recordkeeping, and reporting. The specific requirements differ according to whether the engine is new or existing and whether the engine is located at an area source or major source of hazardous air pollutant (HAP) emissions. Each state has different requirements beyond the federal laws. You may be required to fill out a run log or take air samples. All of these requirements have their own documentation that must be completed.

Generator training requirements

At every generator site, there should be a list of all personnel trained to operate the emergency power system. You will be required to perform training on the system and to ensure that the documentation is completed.

Facility one-lines

Each facility that has a generator must have a one-line diagram on both the electrical and fuel systems.

Electrical one-lines

When posting an electrical one-line diagram, ensure that it shows all the electrical components in the system. The on-line diagram should include switch positions in the various operating positions of the generator and transfer switches.

Fuel one-lines

If an external fuel tank is installed, post a one-line diagram of the fuel system indicating tank size and valve locations.

003a. Technical Order System

The Technical Order (TO) System is the framework for the Air Force to achieve its objectives in maintaining equipment and programs. Within this system are TOs, a web-based application, and

procedures for TO improvements. Your understanding of this system will enhance your asset management capabilities and could potentially provide you with monetary gain for your ideas. The first thing you will learn about the TO System is the TOs themselves.

TOs

You will use various TOs while you perform inspections, maintenance procedures, and troubleshooting steps on any equipment having a TO assigned to it. The type of material found within each TO will determine which classification it will receive. These classifications will aid you in deciding which TOs you need to perform the activity you wish to accomplish. Nine TO classifications exist, but you primarily will deal with only four of them: operations and maintenance, methods and procedures, joint-use, and commercial-off-the-shelf (COTS).

Operations and maintenance

Many different types of TOs exist under the operations and maintenance classification. Most of them you will never use with the type of equipment we operate in our career field. However, a specific type does play a significant role in the maintenance of new military specification (MILSPEC) generators: the Work Package TO. This TO breaks down into individual packages and allows us to perform all three levels of maintenance (organizational, intermediate, and depot) on a single piece of equipment. You would think with a name like work package, you could obtain just the packages you needed at your site. This logical assumption, unfortunately, cannot happen. You must obtain the complete TO or none of it because each package is *not* a standalone TO.

Methods and procedures

The methods and procedures types of TOs are general in content and do not belong to any specific military system or end item. They provide procedures on a multitude of areas of interest. The most notable areas are maintenance management and practices; inspection and operation of Air Force equipment; and administration methods. Interestingly enough, these TOs are not required at the job site for DOD personnel. However, if listed in the statement of work (SOW) for a contractor, then the contractor's personnel must have the TO with them while performing their contractual obligations.

Joint-use

Joint-use TOs govern equipment the Air Force shares with our sister services. This is only true if they meet Air Force requirements. A perfect example of these types of TOs governs the Mobile Electric Power (MEP) series generators. Joint-use TOs can integrate right into the Air Force TO System just like any other TO and receive the same treatment.

Commercial off the shelf

COTS TOs come from the manufacturer that support equipment designed and manufactured for commercial use. They do not include commercial manuals for real property because real property installed equipment (RPIE) operation and maintenance manuals are excluded from the TO system. A perfect example of a COTS TO is 38G1–160–2–1, *Cummins Service Manual*, covering the basic expeditionary airfield resources (BEAR) power unit's QSK38 engine. COTS TOs commonly provide operating instructions, installation, service, and repair procedures for equipment item(s).

Enhanced Technical Information Management System

When the Air Force required the use of electronic TOs, the decision resulted in the creation of a secure web-based application called the Enhanced Technical Information Management System (ETIMS). This system functions as the principle automated TO management application; implementing the Air Force's vision of technical data in digital format from a single access point. With the vision realized, ETIMS became responsible for storing, distributing, and displaying all *official* TOs. A good way to explain all that is like this: ETIMS has the TOs you need to complete maintenance on equipment found within the career field. To access ETIMS and view TOs, you must use some type of electronic device, with an adequate visual display, to use the TO for maintenance

purposes. Lastly, a wide area network is necessary to retrieve updates to your TO should the Air Force need to distribute one out. You can see ETIMS plays a big role in maintaining Air Force equipment. It lessened all of the tedious work maintenance personnel had to put into maintaining TOs and freed them to make a larger impact on their local mission.

TO improvement reporting

As you work in the Power Production career field, you will no doubt come across errors or antiquated processes within TOs. When you do, you can submit a change recommendation to correct these problems. These change recommendations are the method by which you, the user, can improve TOs. However, you do *not* have the authorization to edit electronic TOs as you see fit. The Air Force has a process in place that you must follow because it ensures accuracy, validity, and completeness of what you want to be changed. You will learn about this process, but before you do, see the table below to understand some terms which will make learning this subject a little easier.

TO Improvement Reporting Process Terminology	
Term	**Definition**
Improvement	A change recommendation that will result in an addition or significant change to a process or procedure which allows a function to be performed better, safer, faster, or cheaper.
Correction	Merely fixes a minor error or omission in the TO.
Initiator	The individual who identifies a discrepancy or deficiency in a TO.
Initiator supervisor	The supervisor of the initiator who assists with preparation of the documentation of the change recommendation for submission to the approving authority.
Product improvement manager (PIM)	The individual or office at a base who is responsible for the quality and continuous improvement of the operations and maintenance of assigned equipment.
MAJCOM & Lead Command Control Point (CCP)	The MAJCOM or delegated individual or office responsible for reviewing the Air Force Technical Order (AFTO) Form 22, Technical Manual (TM) Change Recommendation and Reply, on a designated system or end item.
Technical order manager (TOM)	The individual who is responsible for managing the configuration of TOs and providing users with accurate, reliable, and timely data.
Technical content manager (TCM)	The individual or office responsible for the accuracy, adequacy, modification, classification, and review of TO procedures, engineering data, and related technical content of a TO.

With these terms fresh in your mind, you will now learn the improvement reporting method. This method is simplistic in nature with just a few people involved in the whole process. However, it can take a large amount of time to complete depending upon the change recommendation submitted. Everything begins with you, the initiator, discovering a potential problem within the TO and discussing your concerns with your supervisor (fig. 1–2a). Once you and your supervisor have discussed the problem, submit an Air Force Technical Order (AFTO) Form 22, Technical Manual (TM) Change Recommendation and Reply, to the product improvement manager (PIM). It is important to note if multiple errors/discrepancies are discovered within the TO, you must submit a change recommendation per error/discrepancy. The reason for this standard is that each change recommendation must be evaluated separately to see the affect it will have on the program or equipment. After submitting, an AFTO Form 22, your part is complete and you will learn of the change recommendation's disposition once it has made its way through the process. The PIM sends the AFTO Form 22 and supporting documentation to the MAJCOM and Lead Command Control Point's (CCP) for review. Once they review the documentation, they send it back to the PIM who then forwards it to the technical order manager (TOM). The TOM reviews the paperwork and, when finished, sends the change recommendation to the technical content manager (TCM). The TCM will

make a decision concerning the change recommendation submitted and give it a disposition rating of one of the following: approved, deferred, abeyance, advisement, duplicate, disapproved, or other. The TCM will then send an email regarding their decision to all parties involved in the process and take the corrective action appropriate to the disposition given.

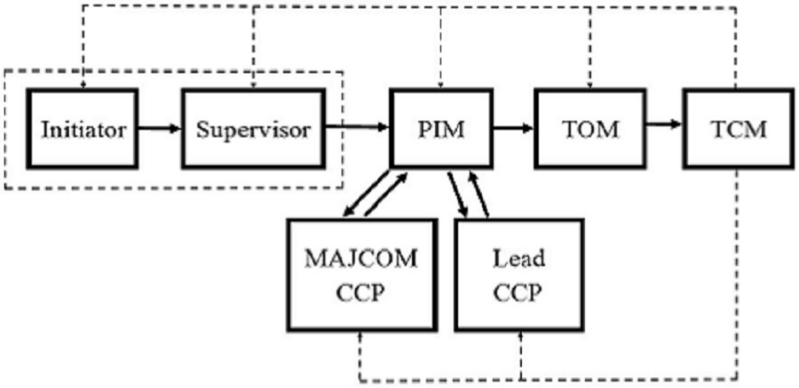

Figure 1–2a. Technical order improvement process.

Understanding the TO improvement process will enhance your ability, as Power Production Journeyman, to affect an Air Force-level program or asset. However, what kind of benefits should you expect for submitting improvements to a TO? Should it just be satisfaction of knowing you added value, or should you expect financial compensation for your ideas? The first one for sure, but monetary rewards for your change recommendation depends on a couple factors. First, the change recommendation must be an improvement type. Secondly, after your change recommendation has been approved through the TO improvement process, it must also pass through the Airman Powered by Innovation (API) process. If your change recommendation is approved through the API process, then you could receive up to $10,000 dollars! This of course largely depends on how much you saved the Air Force, but if you're up for the challenge, the opportunity is there.

In short, the TO System deals with more than just TOs themselves. It truly encompasses people, hardware, and software carrying out the maintenance needs of programs and equipment. Internalize this knowledge so that you can better execute your mission wherever that may be.

004. Technical publications

There is a variety of technical publications that are used in the power production career field. Some of these are produced by the Department of Defense (DOD) and others by private industry. Regardless of who produces them, knowing where to look for technical information will make your job much easier.

Engineering technical letters

Engineering technical letters (ETL) are an important part of power production's technical publication collection. These are used to supplement current Air Force instructions, to rescind certain parts of instructions, or to clarify new procedures. You must follow these publications just as you follow an Air Force instruction or TO.

Unified facility criteria

Unified facility criteria (UFC) are created at the DOD level and are agreed upon standards that all services follow. Many UFCs provide the foundation for our AFIs and ETLs. A UFC applies directly to power production. One of them that you should be familiar with is UFC 3–540–01, *Engine-Driven Generator Systems for Backup Power Applications.* As we continue to evolve into a joint force, UFCs will become more common for practical everyday use.

Accessing UFCs and ETLs

You can access the UFCs through the Whole Building Design Guide website http://www.wbdg.org/ this site allows access to UFCs and ETLs. Go to the page, click the DOD link, then click UFC Technical publications. To access an ETL from the UFC page, select Air Force Criteria then click Engineering Technical Letters (AFETL).

Commercial manuals

Commercial manuals are developed by manufacturers to provide technical information on their products. The manuals serve the same purpose as a TO. They provide operations, maintenance, and repair information. There is not any one standard for how these are laid out or even how the electrical diagrams are arranged. Commercial manuals are essential for maintaining a reliable generator fleet.

National Fire Protection Agency standards

NFPA 70, *National Electric Code (NEC),* is the basis for all electrical installation for facilities. It provides safe practices for all aspects of electrical wiring. When installing generators and automatic transfer switches, you must know the correct method for your specific application. In addition, the NFPA 110, *Standard for Emergency and Standby Power Systems,* provides you with the information needed for compliance with commercial standards.

You must follow numerous technical publications while in the power production career field. It is important to remember that they may not always line up with each other. If there are any questions on what to follow, talk with your base electrical engineer and the Air Force Civil Engineer Center (AFCEC) for clarification.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

003. AFSC specific forms

1. When filling out AF Form 487, in which block do you annotate load demand?

2. When filling out AF Form 487, what do you check for when reviewing site documentation?

3. Which form do you use to document generator maintenance?

4. What are some methods you can used to gather load data on a generator?

5. What type of one-line diagrams must be at *every* generator facility?

003a. Technical Order System

1. What three parts make up Order System the Air Force TO System?

2. Organizational, intermediate, and depot level maintenance activities are contained in what type of Operation and Maintenance TO?

3. Method and Procedures TOs issue guidance on what type of practices?

4. What functions as the principle automated TO management application?

5. ETIMS is responsible for what in the TO System?

6. What is an example of an “improvement” type of recommended change?

7. What is an example of a “correction” type of recommended change?

8. What are the seven disposition ratings a TCM can give TO change recommendations?

004. Technical publications

1. Match the type of technical publication in column B with the description in column A. Items in column B are used once.

Column A	*Column B*
____ (1) Supplements current Air Force instructions or clarifies new procedures.	a. Unified facility criteria.
____ (2) DOD level instructions that all services follow.	b. Commercial manuals.
____ (3) Provides operation, maintenance and repair information.	c. Engineering technical letters.

2. What does the National Electric Code provide concerning facilities and safety?

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Answers to Self-Test Questions

001

1. 15 – 50 mA.
2. De-energized all circuits regardless of the voltage.
3. AFI 91–203.
4. NFPA 70E.
5. Metal at the arc site expands and vaporizes.
6. Pad-mounted transformers, switchgear, switchboards, panel boards, disconnect switches, industrial control panels, meter socket enclosures, and motor control centers.
7. When escorted by a qualified person.
8. Restricted approach boundary.
9. Prohibited approach boundary.
10. With your legs.

002

1. (1) Length of contact with current.
   (2) Strength of current.
   (3) Type of current AC or DC.
   (4) Direction, or path, of current through the body.
2. This will help the blood return to the main organs.

003

1. Block 8.
2. (1) Are the operating instructions at the site and shop record current?
   (2) Is the training letter at the site and shop record current?
   (3) Are the one-line diagrams at the site and shop record current?
3. AF Form 719.
4. Generator-operating logs, monitoring systems, load surveys, and design notes.
5. Electrical and fuel systems.

003a

1. TOs, a Web-based application, and procedures for TO improvements.
2. Work Package TOs.
3. Maintenance, management, and practices; inspection and operation of AF equipment; and administration methods.
4. Enhance Technical Information Management System.
5. Storing, distributing, and displaying all *official* TOs.
6. Change recommendation that will result in an addition or significant change to a process or procedure which allows a function to be performed better, safer, faster, or cheaper.
7. Change which merely fixes a minor error or omission in the TO.
8. (1) Approved, (2) Deferred, (3) Abeyance, (4) Advisement, (5) Duplicate, (6) Disapproved, or (7) Other.

004

1. (1) c.
   (2) a.
   (3) b.
2. The NEC provides the basis for all electrical installations and safe work practices for all aspects of electrical wiring.

Do the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (001) What is the *minimum* number of fully qualified people that the Air Force instructions require to be present when you must work on an energized circuit?
   a. 1.
   b. 2.
   c. 3.
   d. 4.

2. (001) Who is authorized to approve work on energized circuits and/or equipment?
   a. Base Civil Engineer.
   b. Flight Commander.
   c. Facilities Superintendent.
   d. Shop noncommissioned officer in charge (NCOIC).

3. (001) Which boundary is based upon the arc fault on the surface of the skin and requires anyone within the boundary to wear the proper personal protective equipment (PPE)?
   a. Arc flash.
   b. Limited approach.
   c. Prohibited approach.
   d. Restricted approach.

4. (001) What is the *minimum* distance for the flash protection boundary for all energized equipment under 750 volts alternating current (VAC)?
   a. 3 ft 6 in.
   b. 7 ft.
   c. 20 ft.
   d. 10 ft.

5. (001) What type of materials is prohibited to be worn when working near energized equipment?
   a. Acetone, nylon, polyester, and rayon.
   b. Cotton, nylon, and polyester.
   c. Denim, rayon, and polyester.
   d. Acetone, denim, and polyester.

6. (002) If the power cannot be turned off, what should you use to move the victim connected to a live circuit away from the energized conductor or the conductor away from the victim?
   a. Wet rope.
   b. Bare hands.
   c. Insulated object.
   d. Galvanized conduit.

7. (002) You *never* apply what to a burn because it causes more damage to the tissue?
   a. Ice.
   b. Dry dressing.
   c. Clean bandage.
   d. Burn ointment.

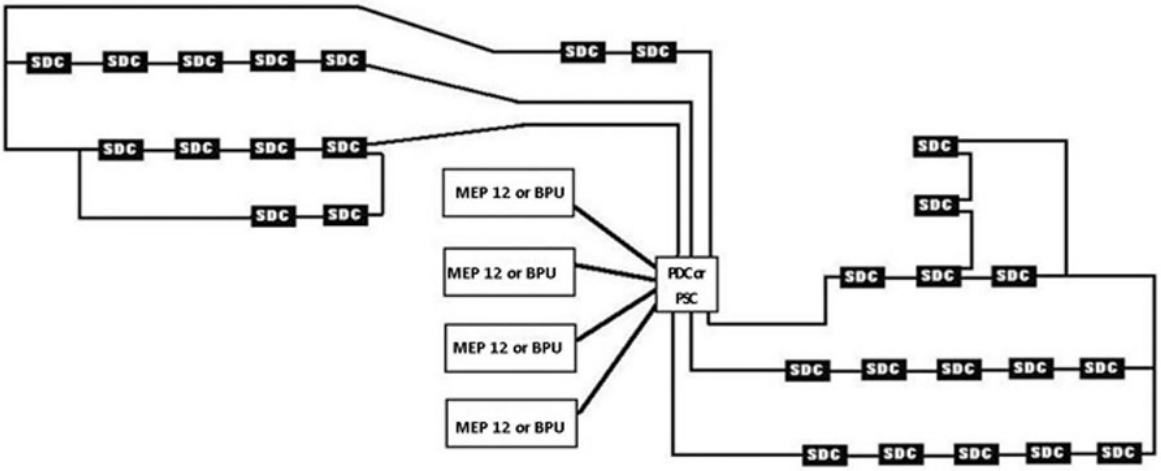

Figure 2–2. Electrical distribution, loop layout.

Primary distribution center

The PDC, shown in figures 2–3 and 2–4 are a high-voltage switching station. It serves as a connection point for the power plant generators and a connection and isolation point for the primary distribution circuits.

Figure 2–3. Primary distribution center.

Electrical configuration

The PDC has four three-phase inputs on the line side and six three-phase outputs on the load side. The connection points use bushing wells and bushing well inserts that accept 200-amp load-break elbow terminations.

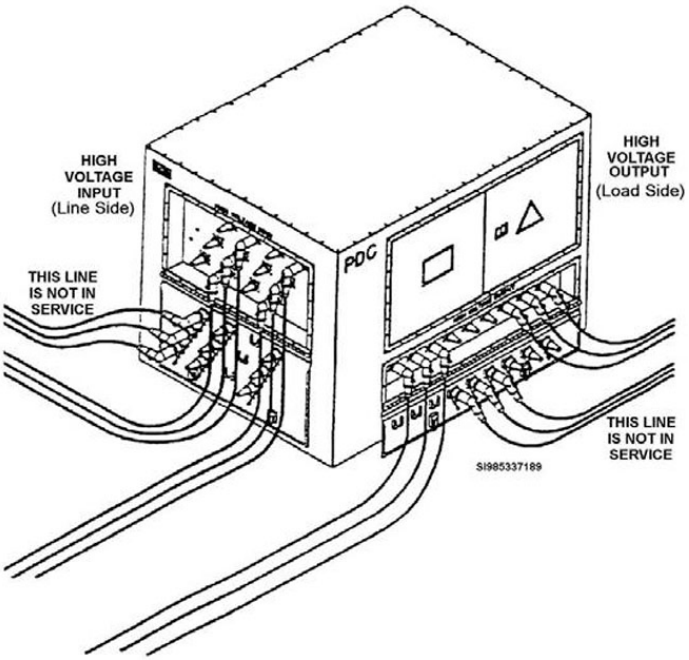

Figure 2–4. Primary distribution center.

Primary switching center

The PSC is a high-voltage switching station (fig. 2–5). Like the PDC, serves as a connection point for the power plant generators and a connection and isolation point for the primary distribution circuits.

Since the PSC is also quite large, we should use a 10K adverse terrain forklift to set it in place. Choose nearly level ground surface with a minimal slope to prevent it from moving for the installation of the PSC. The area should also provide adequate water drainage to prevent puddles from forming.

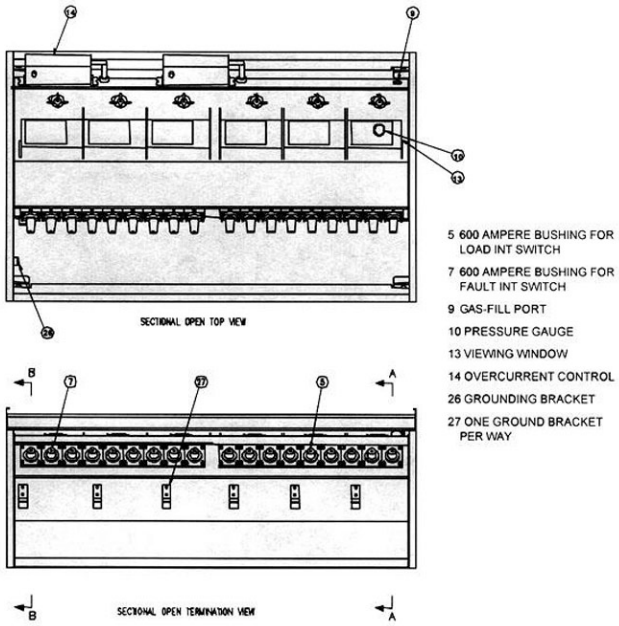

Figure 2–5. Primary switching center.

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