2012 – 2013

Florida Department of Education
Curriculum Framework

Program Title: **Turbine Generator Maintenance, Inspection and Repair**
Program Type: **Career Preparatory**
Career Cluster: **Energy**

	Secondary	PSAV
Program Number	9700500	X600500
CIP Number	0715050304	0715050304
Grade Level	9-12, 30, 31	30, 31
Standard Length	9 Credits	1,350 Hours
Teacher Certification	TEC CONSTR @7 G MILLWRIGHT @7 G BLDG CONST @7 G IND ENGR @7 G	TEC CONSTR @7 G MILLWRIGHT @7 G BLDG CONST @7 G IND ENGR @7 G
CTSO	SkillsUSA	SkillsUSA
SOC Codes (all applicable)	49-9041, 49-9042 51-8013	49-9041, 49-9042 51-8013
Facility Code	245 - http://www.fldoe.org/edfacil/sref.asp (State Requirements for Educational Facilities)	
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm	
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.asp	
Industry Certifications	http://www.fldoe.org/workforce/fcpea/default.asp	
Statewide Articulation	http://www.fldoe.org/workforce/dwdframe/artic_frame.asp	
Basic Skills Level	N/A	Mathematics: 9 Language: 9 Reading: 9

Purpose

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the energy career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the energy career cluster. This program offers a broad foundation of knowledge and skills to prepare students for employment in industrial-machinery maintenance positions.

The content includes but is not limited to understanding all aspects of the industrial-turbine generator equipment maintenance-technology industry, and demonstrates elements of the industry such as planning, management, cost management skills, technical and production skills, underlying principles of technology, labor issues, and health, safety, and environmental issues.

Program Structure

This program is a planned sequence of instruction consisting of three occupational completion points.

When offered at the postsecondary level, this program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44 (3)(b), F.S.

The following table illustrates the **PSAV** program structure:

OCP	Course Number	Course Title	Course Length	SOC Code
A	EEV0140	Turbine Generator Maintenance Tech I	450 Hours	49-9042
B	EEV0141	Turbine Generator Maintenance Tech II	450 Hours	49-9041
C	EEV0142	Turbine Generator Maintenance Mechanic	450 Hours	51-8013

The following table illustrates the **Secondary** program structure:

OCP	Course Number	Course Title	Length	SOC Code	Level
	9700510	Turbine Generator Maintenance Skills 1	1 Credit		2
	9700520	Turbine Generator Maintenance Skills 2	1 Credit		2
A	9700530	Turbine Generator Maintenance Skills 3	1 Credit	49-9042	2
	9700540	Turbine Generator Maintenance 4	1 Credit		2
	9700550	Turbine Generator Maintenance 5	1 Credit		2
B	9700560	Turbine Generator Maintenance 6	1 Credit	49-9041	2
	9700570	Turbine Generator Mechanic 7	1 Credit		2
	9700580	Turbine Generator Mechanic 8	1 Credit		2
C	9700590	Turbine Generator Mechanic 9	1 Credit	51-8013	2

Laboratory Activities

Laboratory activities are an integral part of this program. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes related to these occupations. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

Career and Technical Student Organization (CTSO)

SkillsUSA is the appropriate career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered. The activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, F.A.C.

Cooperative Training – OJT

On-the-job training is required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

Essential Skills

Essential skills identified by the Division of Career and Adult Education have been integrated into the standards and benchmarks of this program. These skills represent the general knowledge and skills considered by industry to be essential for success in careers across all career clusters. Students preparing for a career served by this program at any level should be able to demonstrate these skills in the context of this program. A complete list of Essential Skills and links to instructional resources in support of these Essential Skills are published on the CTE Essential Skills page of the FL-DOE website (http://www.fldoe.org/workforce/dwdframe/essential_skills.asp).

Basic Skills

In PSAV programs offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Mathematics 9, Language 9, and Reading 9. These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02(7), Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01(3)(a), F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91(3), F.S.

Students who possess a college degree at the Associate of Applied Science level or higher; who have completed or are exempt from the college entry-level examination; or who have passed a state, national, or industry licensure exam are exempt from meeting the Basic Skills requirement (Rule 6A-10.040, F.A.C.) Exemptions from state, national or industry licensure are limited to the certifications listed at http://www.fldoe.org/workforce/dwdframe/rtf/basicskills-License-exempt.rtf.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations' plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received

in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

In addition to accommodations, some secondary students with disabilities (students with an Individual Educational Plan (IEP) served in Exceptional Student Education or ESE) will need modifications to meet their needs. Modifications change the outcomes or what the student is expected to learn, e.g., modifying the curriculum of a secondary career and technical education course. Note postsecondary curriculum cannot be modified.

Some secondary students with disabilities (ESE) may need additional time (i.e., longer than the regular school year), to master the student performance standards associated with a regular Occupational Completion Point (OCP) or a Modified Occupational Completion Point (MOCP). If needed, a student may enroll in the same career and technical course more than once. Documentation should be included in the IEP that clearly indicates that it is anticipated that the student may need an additional year to complete an OCP/MOCP. The student should work on different competencies and new applications of competencies each year toward completion of the OCP/MOCP. After achieving the competencies identified for the year, the student earns credit for the course. It is important to ensure that credits earned by students are reported accurately. The district's information system must be designed to accept multiple credits for the same course number (for eligible students with disabilities).

Articulation

The PSAV component of this program has no statewide articulation agreement approved by the Articulation Coordinating Committee. However, this does not preclude the awarding of credits by any college through local agreements.

For details on statewide articulation agreements which correlate to programs and industry certifications, refer to http://www.fldoe.org/workforce/dwdframe/artic_frame.asp.

Bright Futures/Gold Seal Scholarship

Course substitutions as defined in the Comprehensive Course Table for this program area may be used to qualify a student for Florida's Gold Seal Vocational Scholarship, providing all other eligibility requirements are met. Eligibility requirements are available online at https://www.osfaffelp.org/bfiehs/fnbpcm02_CCTMain.aspx.

Fine Arts/Practical Arts Credit

Many courses in CTE programs meet the Fine Arts/Practical Arts credit for high school graduation. A listing of approved CTE courses is published each year as a supplemental resource to the Course Code Directory (http://www.fldoe.org/articulation/CCD/default.asp).

Standards

After successfully completing this program, the student will be able to perform the following:

01.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
02.0 Demonstrate science knowledge and skills and explain the basic elements of physics as related to industrial machinery maintenance and repair.
03.0 Explain basic electricity and electronics.
04.0 Demonstrate mathematics knowledge and skills.
05.0 Demonstrate language arts knowledge and skills.
06.0 Read plans and drawings and be able to identify basic turbine generator nomenclature.
07.0 Use information technology tools.
08.0 Solve problems using critical thinking skills, creativity and innovation.
09.0 Demonstrate ability to recognize turbine and generator components and subcomponents and describe their function.
10.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives.
11.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.
12.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas.
13.0 Demonstrate organizational skills in planning and implementation of a turbine generator component inspection.
14.0 Demonstrate personal money-management concepts, procedures, and strategies.
15.0 Describe the importance of professional ethics and legal responsibilities.
16.0 Explain the importance of employability and entrepreneurship skills.
17.0 Be able to identify and properly use all turbine generator tooling and demonstrate ability to maintain and make repairs to Hy-Torq, impact, and other hydraulic tools.
18.0 Demonstrate application of lubricants and lubricating systems.
19.0 Explain the various fastening mechanisms used on turbine and generator components including the types of materials and why.
20.0 Demonstrate tightening operations on high pressure flanges and cylinders.
21.0 Demonstrate removal techniques of galled bolting and repair of damaged threads.
22.0 Disassembly and reassembly of high speed turbines and generators.
23.0 Perform machine-shop operations.
24.0 Demonstrate piping and tubing systems.
25.0 Understand basic operation of a steam turbine and generator.
26.0 Perform pump maintenance and repair.
27.0 Prepare for machinery startup
28.0 Perform measuring and rotor alignment operations.
29.0 Demonstrate Predictive-Preventive-Maintenance (PPM) technologies.
30.0 Perform failure analysis.
31.0 Generate machine improvements and maintenance management.
32.0 Perform failure analysis.
33.0 Perform bench work skills including breakdown and inspection of control valve components.
34.0 Non-Destructive examination of turbine components.
35.0 Understand principals of generator operation and testing.
36.0 Troubleshoot hydraulic systems.
37.0 Apply vibration-analysis skills.
38.0 Perform machinery balancing.

2012 – 2013

Florida Department of Education
Student Performance Standards

Program Title: **Turbine Generator Maintenance, Inspection and Repair**
PSAV Number: **X600500**

Course Number: EEV0140
Occupational Completion Point: A
Turbine Generator Maintenance Tech I – 450 Hours – SOC Code 49-9042

01.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance--The students will be able to:

- 01.01 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE 1.0
- 01.02 Explain emergency procedures to follow in response to workplace accidents.
- 01.03 Create a disaster and/or emergency response plan. SHE 2.0
- 01.04 Perform Lock Out And Tag Out (LOTO) procedures. Understand why a LOTO system is necessary and your responsibilities in utilizing the system.
- 01.05 Identify Occupational Safety and Health Administration (OSHA) and Mine Safety Health Administration (MSHA) requirements and procedures.
- 01.06 Use Materials Safety Data Sheets (MSDS) including knowing how to access the sheets and interpret them.

02.0 Demonstrate science knowledge and skills and explain the basic elements of physics as related to industrial machinery maintenance and repair--The student will be able to:AF4.0

- 02.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF4.1
- 02.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.AF4.3
- 02.03 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
- 02.04 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
- 02.05 Explain the relationship of work, power, and energy and the Rankine Cycle.
- 02.06 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
- 02.07 Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and the types of work done by a crane hook, forklift truck, and screw or bolt.
- 02.08 Understand and demonstrate rigging and lifting principals and perform simple load/lift calculations.
- 02.09 Describe the mechanical and chemical properties of materials commonly used in industry.
- 02.10 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
- 02.11 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.

02.12 Draw conclusions or make inferences from data.
02.13 Have a basic understanding of the steam turbine.
02.14 Have a basic understanding of the gas turbine.
02.15 Have a basic understanding of a turbo generator.
02.16 Identify health-related problems that may result from exposure to work-related chemicals and hazardous materials, and know the proper precautions required for handling such materials.

03.0 Explain basic electricity and electronics--The student will be able to:

03.01 Define electrical terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe Direct Current (DC) and Alternating Current (AC) circuits.
03.05 Explain the purpose of a megger test and what a Polarization Index means when determining the acceptability of electrical motor and generator winding acceptability.
03.06 Describe the various components of a generator and motor and their functions.
03.07 Describe the various components of an exciter and their functions.

04.0 Demonstrate mathematics knowledge and skills--The students will be able to: AF3.0

04.01 Demonstrate knowledge of arithmetic operations. AF3.2
04.02 Analyze and apply data and measurements to solve problems and interpret documents. AF3.4
04.03 Construct charts/tables/graphs using functions and data. AF3.5
04.04 Convert measurements from English to metric and from metric to English units.
04.05 Solve job-related problems using proportions.
04.06 Solve job-related problems using statistics.

05.0 Demonstrate language arts knowledge and skills--The students will be able to: AF2.0

05.01 Locate, comprehend and evaluate key elements of oral and written information.AF2.4
05.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF2.5
05.03 Present information formally and informally for specific purposes and audiences.AF2.9

06.0 Read plans and drawings and be able to identify basic turbine generator nomenclature--The student will be able to:

06.01 Identify dimensions.
06.02 Identify lists of materials and specifications.
06.03 Identify section and detail views.
06.04 Sketch and dimension a part.
06.05 Disassemble and assemble parts using an exploded-view drawing.
06.06 Identify dimensioning of radii, round holes, fillets, and chamfers.
06.07 Identify screw threads and bolt types.
06.08 Apply dimensional tolerances.

07.0 Use information technology tools--The students will be able to:

07.01 Use Personal Information Management (PIM) applications to increase workplace efficiency. IT1.0
07.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT2.0
07.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT3.0
07.04 Employ collaborative/groupware applications to facilitate group work. IT4.0

08.0 Solve problems using critical thinking skills, creativity and innovation--The students will be able to:

08.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS1.0
08.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS2.0
08.03 Identify and document workplace performance goals and monitor progress toward those goals. PS3.0
08.04 Conduct technical research to gather information necessary for decision-making.PS4.0

09.0 Demonstrate ability to recognize turbine and generator components and subcomponents and describe their function--The student will be able to:

09.01 Understand and explain a turbine generator outline drawing.
09.02 Be able to identify each major component of a turbine and generator from the outline drawing and explain its function, e.g.: cylinders, rotor, bearings, valves.
09.03 Be able to identify and explain the function of subcomponents, e.g.: diaphragms, buckets/blades, bearing seals, valve seats, plugs, stems.

10.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives--The students will be able to:

10.01 Employ leadership skills to accomplish organizational goals and objectives. LT1.0
10.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT3.0
10.03 Conduct and participate in meetings to accomplish work tasks. LT4.0
10.04 Employ mentoring skills to inspire and teach others. LT5.0

11.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment--The students will be able to:

11.01 Describe the nature and types of business organizations. SY1.0
11.02 Explain the effect of key organizational systems on performance and quality.
11.03 List and describe quality control systems and/or practices common to the workplace. SY2.0
11.04 Explain the impact of the global economy on business organizations.

12.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas--The students will be able to:

12.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM1.0

12.02 Locate, organize and reference written information from various sources. CM3.0
12.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM5.0
12.04 Interpret verbal and nonverbal cues/behaviors that enhance communication.CM6.0
12.05 Apply active listening skills to obtain and clarify information. CM7.0
12.06 Develop and interpret tables and charts to support written and oral communications. CM8.0
12.07 Exhibit public relations skills that aid in achieving customer satisfaction.CM10.0

13.0 Demonstrate organizational skills in planning and implementation of a turbine generator component inspection--The student will be able to:

13.01 Develop and explain an equipment laydown plan/drawing.
13.02 Develop and explain a plan (work package) for disassembly, inspection, and reassembly of a turbine component, including:
  a. Inspection hold points
  b. Tagging plan
  c. Estimated man-hours
  d. Inspection data sheets
13.03 Develop a simple critical path schedule for the inspection of a turbine generator component.

14.0 Demonstrate personal money-management concepts, procedures, and strategies--The students will be able to:

14.01 Identify and describe the services and legal responsibilities of financial institutions. FL2.0
14.02 Describe the effect of money management on personal and career goals. FL3.0
14.03 Develop a personal budget and financial goals. FL3.1
14.04 Complete financial instruments for making deposits and withdrawals. FL3.2
14.05 Maintain financial records. FL3.3
14.06 Read and reconcile financial statements. FL3.4
14.07 Research, compare and contrast investment opportunities.

15.0 Describe the importance of professional ethics and legal responsibilities--The students will be able to:

15.01 Evaluate and justify decisions based on ethical reasoning. ELR1.0
15.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR1.1
15.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR1.2
15.04 Interpret and explain written organizational policies and procedures. ELR2.0

16.0 Explain the importance of employability and entrepreneurship skills--The students will be able to:

16.01 Identify and demonstrate positive work behaviors needed to be employable.ECD1.0
16.02 Develop personal career plan that includes goals, objectives, and strategies.ECD2.0
16.03 Examine licensing, certification, and industry credentialing requirements. ECD3.0
16.04 Maintain a career portfolio to document knowledge, skills, and experience.ECD5.0

16.05 Evaluate and compare employment opportunities that match career goals.ECD6.0
16.06 Identify and exhibit traits for retaining employment. ECD7.0
16.07 Identify opportunities and research requirements for career advancement.ECD8.0
16.08 Research the benefits of ongoing professional development. ECD9.0
16.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD10.0

Course Number: EEV0141
Occupational Completion Point: B
Turbine Generator Maintenance Tech II – 450 Hours – SOC Code: 49-9041

17.0 Be able to identify and properly use all turbine generator tooling and demonstrate ability to maintain and make repairs to Hy-Torq, impact, and other hydraulic tools--The student will be able to:

17.01 Describe, explain and demonstrate use of all turbine generator tooling including:
a. Gas bolt heaters
b. Tensioners
c. Slugging wrenches
d. Torque wrenches including multipliers
e. Hydraulic jacks
f. Rotor skid pan and rotor blocks
17.02 Demonstrate common maintenance and service repairs on:
a. Impact wrenches
b. Hy-Torq heads
c. Hydraulic pumps

18.0 Demonstrate application of lubricants and lubricating systems--The student will be able to:

18.01 Explain the functions of lubrication.
18.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
18.03 Identify the types, advantages, and functions of lubricant additives.
18.04 Explain a typical turbine generator lube oil system and the various components associated with it.
18.05 Identify areas of the turbine where grease would be applied and why.
18.06 Explain the types of oil filtration used in turbine generator systems including strainers.
18.07 Understand principals of a lube oil flush and how to set up various types of turbine generator maintenance lube oil flushes.
18.08 Explain oil sampling and demonstrate how to take an oil sample and perform cleanliness analysis.

19.0 Explain the various fastening mechanisms used on turbine and generator components including the types of materials and why--The student will be able to:

19.01 Demonstrate understanding of the types of materials used to properly clamp steam and oil cylinders and flanges.
19.02 Have basic understanding of and be able to explain torque, stress, stretch, corrosion, galling, and thread types.

20.0 Demonstrate tightening operations on high pressure flanges and cylinders--The student will be able to:

20.01 Explain the various types of tightening mechanisms that are used on turbine generators and auxiliary components.
20.02 Have an understanding of the materials used for different flange tightening applications based on pressure and temperatures.
20.03 Explain and demonstrate the tools used for tightening and measuring tightening mechanisms.
20.04 Explain the types of gaskets used in turbine generator applications and the advantage and disadvantage of each.
20.05 Understand gasket compression and demonstrate proper assembly of various types of gaskets including neoprene, Garlock, corrugated metal, serrated, and spiral wound.
20.06 Demonstrate ability to measure and cut a gasket from a sheet of gasket material.
20.07 Understand and explain the different types of lubricants utilized on high temperature bolting including advantages and disadvantages.
20.08 Understand and demonstrate tightening principals including torque and bolt stretch and outside influences on each.
20.09 Demonstrate proper use of various tightening tools.

21.0 Demonstrate removal techniques of galled bolting and repair of damaged threads--The student will be able to:

21.01 Understand alternative methods of removing galled bolting and how to determine best alternative based on type of material and location of fastener.
21.02 Understand safety requirements before initiating grinding or burning operations.
21.03 Demonstrate proper setup of cutting torch and demonstrate ability to cut bolting from a cylinder case.
21.04 Demonstrate proper use of grinding burrs to remove galled bolting.

22.0 Disassembly and reassembly of high speed turbines and generators--The student will be able to:

22.01 Develop a component and parts laydown plan and explain logic for it.
22.02 Understand all of the various lifting tools and devices used when disassembling a turbine generator.
22.03 Understand and demonstrate the use of a rigging and lifting plan.
22.04 Understand and demonstrate ability to inspect and identify problems with lifting devices including slings (wire rope, nylon, Kevlar) and hoists/come-a-longs.
22.05 Demonstrate proper use of a sling for lifting turbine generator components of various geometries.
22.06 Understand lifting capabilities of slings and the relationship between angles and stress.
22.07 Understand the function of a lifting beam and how to set up a load for proper lifting.
22.08 Understand and demonstrate ability to remove a generator rotor from the stator.
22.09 Understand necessity and the process for parts tagging and bagging.
22.10 Understand storage requirements including protection of flange surfaces during outage duration.

22.11 Understand process for protecting ingress of foreign objects into lubrication and steam systems.
22.12 Understanding of rigging and lifting principals.
22.13 Demonstrate ability to rig and lift a non symmetrical turbine component.
22.14 Demonstrate ability to disassemble and reassemble a steam piping flange.
22.15 Understand crane signals and demonstrate ability to communicate with team during a lift.

23.0 Perform machine-shop operations--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.
23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

24.0 Demonstrate piping and tubing systems--The student will be able to:

24.01 Identify the components of a piping system.
24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
24.03 Describe the safety requirements for working with piping and tubing systems.
24.04 Join copper tubing.
24.05 Join common fittings.
24.06 Join metallic piping
24.07 Bend back-to-back, stub-ups, and doglegs in Electrical Metallic Tubing (EMT)

25.0 Understand basic operation of a steam turbine and generator--The student will be able to:

25.01 Understand transforming work from high pressure steam
25.02 Understand the difference between a reaction and impulse turbine
25.03 Understand means of controlling the turbine.
25.04 Understand the difference between speed control and load control.
25.05 Understand extraction in a cogeneration facility.

26.0 Perform pump maintenance and repair--The student will be able to:

26.01 Demonstrate the safety procedures for performing pump maintenance.
26.02 Determine pump capacity and system requirements.
26.03 Perform pump maintenance.
26.04 Identify packing and seal requirements.
26.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive placement, and vacuum pumps.
26.06 Disassemble and reassemble a pump.

27.0 Prepare for machinery startup--The student will be able to:

27.01 Describe the requirements and precautions for machinery startup.
27.02 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.
27.03 Position and secure machinery on a foundation.
27.04 Level machinery and install balance-vibration dampeners.
27.05 Identify pipe-stress standards for machine-maintenance applications.
27.06 Perform finish alignment and check for pipe stresses in machinery- maintenance applications.

Course Number: EEV0142
Occupational Completion Point: C
Turbine Generator Maintenance Mechanic – 450 Hours – SOC Code: 51-8013

28.0 Perform measuring and rotor alignment operations--The student will be able to:

28.01 Demonstrate the safe use of hand tools such as wrenches, files, scrapers, taps, dies, torque wrenches, grinders, and cutoff wheels.
28.02 Demonstrate the proper use of precision measuring devices such as inside and outside micrometers, depth gauges, and dial indicators.
28.03 Select correct tools for metric and standard fasteners.
28.04 Explain the types of misalignment and how to calculate the moves necessary to correct the misalignment.
28.05 Demonstrate how to set up dial indicators to perform a turbine generator coupling alignment check.
28.06 Demonstrate how to perform a Swing Check to align a three bearing unit.
28.07 Explain the purpose of a tight wire and how it is set up in a turbine.
28.08 Demonstrate how to take measurements from the wire to check alignment of the internal components

29.0 Demonstrate Predictive-Preventive-Maintenance (PPM) technologies--The student will be able to:

29.01 Explain the use of infrared thermography.
29.02 Explain the use of ultrasound technology.
29.03 Explain the use of advanced alignment techniques
29.04 Explain the use of oil ferrography and the types of oil sampling
29.05 Describe the safety requirements for PPM technologies.
29.06 Demonstrate the use of one of the above predictive-maintenance procedures
29.07 Plan an advanced PPM schedule.

30.0 Perform failure analysis--The student will be able to:

30.01 Conduct/lead a failure analysis meeting to determine the root cause of a failure.
30.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
30.03 Explain the types of bearing failures.
30.04 Explain the types of shaft fatigues and failures.
30.05 Explain the types of lubrication breakdowns.
30.06 Estimate the cost and the impact on production of a specific failure.

31.0 Generate machine improvements and maintenance management--The student will be able to:

31.01 Review and critique machinery and base design for improvement, before the equipment is placed on order.
31.02 Identify the essential elements of effective maintenance management:
a. Reward system
b. Predictive-preventive maintenance
c. Planning
d. Work-order systems
e. Organizations
f. Goals and tracking
g. Facilities
h. Storerooms
i. Contractors
j. Shutdowns
31.03 Write a report on the design and effective use of at least two of the essential elements of management.

32.0 Perform failure analysis--The student will be able to:

32.01 Conduct/lead a failure analysis meeting to determine the root cause of a failure.
32.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
32.03 Explain the types of bearing failures.
32.04 Explain the types of shaft fatigues and failures.
32.05 Explain the types of lubrication breakdowns.
32.06 Estimate the cost and the impact on production of a specific failure.

33.0 Perform bench work skills including breakdown and inspection of control valve components--The student will be able to:

33.01 Identify and explain the various components of a turbine generator control system including hydraulic, and electro hydraulic.
33.02 Understand the importance and various types of material used for sealing control systems.
33.03 Understand and demonstrate proper preparation for disassembling and inspecting a control mechanism.
33.04 Understand the importance of cleanliness during the disassembly of a control mechanism.
33.05 Explain how a control mechanism works and the critical measurement required to assure proper operation.
33.06 Demonstrate proper removal and installation of hydraulic lines.

34.0 Non-Destructive examination of turbine components–The student will be able to:

34.01 Understand the various materials in a steam and gas turbine.
34.02 Understand the relevant turbine non destructive examination techniques and how each one is used, including:
a. Ultrasonic Testing

b. Penetrant Testing
c. Magnetic Particle Testing
d. Radiographic Testing

34.03 Indentify the proper non destructive testing technique for various turbine components.
34.04 Understand the cleanliness standards and cleaning methods required on turbine components.

35.0 Understand principals of generator operation and testing--The student will be able to:

35.01 Understand basic principal of electrical energy production.
35.02 Basic understanding of excitation.
35.03 Understand function of each major generator component:
a. Core
b. Rotor/Field
c. Stator/Armature
d. Exciter
35.04 Understand the difference in megawatts and KVA.
35.05 Understand electrical testing.

36.0 Troubleshoot hydraulic systems--The student will be able to:

36.01 Explain the safety procedures for troubleshooting hydraulic systems.
36.02 Read a hydraulic schematic.
36.03 Install hydraulic components.
36.04 Connect electrically controlled valves.
36.05 Explain hydraulic-system troubleshooting techniques.
36.06 Repair and replace valves.
36.07 Repair and replace cylinders.
36.08 Repair and replace pumps and motors.

37.0 Apply vibration-analysis skills--The student will be able to:

37.01 Collect vibration data.
37.02 Interpret vibration data.
37.03 Determine velocity, acceleration, spike energy, frequency, amplitude, and other vibration sources.
37.04 Describe the safety requirements and precautions for vibration analysis.
37.05 Operate and use vibration software.
37.06 Predict and verify the condition of machinery in an industrial setting using vibration tools.
37.07 Explain the approximately 25 sources of vibration.
37.08 Explain the Bearing Frequency (BIFO) Formulas.
37.09 Demonstrate proficiency in vibration detection.

38.0 Perform machinery balancing--The student will be able to:

38.01 Describe the safety requirements and precautions for balancing procedures and equipment.
38.02 Identify the principles of static balancing.
38.03 Perform a vector balance in the classroom.

38.04 Identify balancing standards, ISO 1940 or equal.
38.05 Perform a stand balance in a shop.
38.06 Perform a field balance in an industrial setting.
38.07 Use portable or stationary balancing equipment.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Maintenance Skills 1**
Course Number: **9700510**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include a safe working environment, science and math skills, electricity and electronics skills along with basic turbine generator nomenclature.

01.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance--The students will be able to:

- 01.01 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE1.0
- 01.02 Explain emergency procedures to follow in response to workplace accidents.
- 01.03 Create a disaster and/or emergency response plan. SHE2.0
- 01.04 Perform Lock Out And Tag Out (LOTO) procedures. Understand why a LOTO system is necessary and your responsibilities in utilizing the system.
- 01.05 Identify Occupational Safety and Health Administration (OSHA) and Mine Safety Health Administration (MSHA) requirements and procedures.
- 01.06 Use Materials Safety Data Sheets (MSDS) including knowing how to access the sheets and interpret them.

02.0 Demonstrate science knowledge and skills and explain the basic elements of physics as related to industrial machinery maintenance and repair--The student will be able to:AF4.0

- 02.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF4.1
- 02.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.AF4.3
- 02.03 Explain the standards of measurement and the impact of action and working forces, including tension, compression, torque, and shear.
- 02.04 Identify the principles and laws of motion and explain how they affect acceleration and deceleration.
- 02.05 Explain the relationship of work, power, and energy and the Rankine Cycle.
- 02.06 Explain the operation of simple machines, including the lever, inclined plane, screw, wedge, wheel and axle, pulley, and jacking screws.
- 02.07 Identify the ways of producing power for mechanical efficiency, in terms of gear ratios, work forces, and the types of work done by a crane hook, forklift truck, and screw or bolt.
- 02.08 Understand and demonstrate rigging and lifting principals and perform simple load/lift calculations.
- 02.09 Describe the mechanical and chemical properties of materials commonly used in industry.

02.10 Explain the laws and conditions governing static and kinetic friction, the problems caused by friction, and the effects of the angle of repose.
02.11 Explain molecular action as a result of temperature extremes, chemical reaction, and moisture content.
02.12 Draw conclusions or make inferences from data.
02.13 Have a basic understanding of the steam turbine.
02.14 Have a basic understanding of the gas turbine.
02.15 Have a basic understanding of a turbo generator.
02.16 Identify health-related problems that may result from exposure to work-related chemicals and hazardous materials, and know the proper precautions required for handling such materials.

03.0 Explain basic electricity and electronics--The student will be able to:

03.01 Define electrical terms.
03.02 Explain the theory and application of magnetism.
03.03 Explain Ohm's law.
03.04 Describe Direct Current (DC) and Alternating Current (AC) circuits.
03.05 Explain the purpose of a megger test and what a Polarization Index means when determining the acceptability of electrical motor and generator winding acceptability.
03.06 Describe the various components of a generator and motor and their functions.
03.07 Describe the various components of an exciter and their functions.

04.0 Demonstrate mathematics knowledge and skills--The student will be able to: AF3.0

04.01 Demonstrate knowledge of arithmetic operations. AF3.2
04.02 Analyze and apply data and measurements to solve problems and interpret documents. AF3.4
04.03 Construct charts/tables/graphs using functions and data. AF3.5
04.04 Convert measurements from English to metric and from metric to English units.
04.05 Solve job-related problems using proportions.
04.06 Solve job-related problems using statistics.

05.0 Demonstrate language arts knowledge and skills--The student will be able to: AF2.0

05.01 Locate, comprehend and evaluate key elements of oral and written information.AF2.4
05.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF2.5
05.03 Present information formally and informally for specific purposes and audiences.AF2.9

06.0 Read plans and drawings and be able to identify basic turbine generator nomenclature--The student will be able to:

06.01 Identify dimensions.
06.02 Identify lists of materials and specifications.
06.03 Identify section and detail views.
06.04 Sketch and dimension a part.
06.05 Disassemble and assemble parts using an exploded-view drawing.
06.06 Identify dimensioning of radii, round holes, fillets, and chamfers.
06.07 Identify screw threads and bolt types.

06.08 Apply dimensional tolerances.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Maintenance Skills 2**
Course Number: **9700520**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include using technology, solving problems; recognize turbine generator components along with leadership and teamwork skills.

07.0 Use information technology tools--The student will be able to:

- 07.01 Use Personal Information Management (PIM) applications to increase workplace efficiency. IT1.0
- 07.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT2.0
- 07.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT3.0
- 07.04 Employ collaborative/groupware applications to facilitate group work. IT4.0

08.0 Solve problems using critical thinking skills, creativity and innovation--The student will be able to:

- 08.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS1.0
- 08.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS2.0
- 08.03 Identify and document workplace performance goals and monitor progress toward those goals. PS3.0
- 08.04 Conduct technical research to gather information necessary for decision-making.PS4.0

09.0 Demonstrate ability to recognize turbine and generator components and subcomponents and describe their function--The student will be able to:

- 09.01 Understand and explain a turbine generator outline drawing.
- 09.02 Be able to identify each major component of a turbine and generator from the outline drawing and explain its function, e.g.: cylinders, rotor, bearings, valves.
- 09.03 Be able to identify and explain the function of subcomponents, e.g.: diaphragms, buckets/blades, bearing seals, valve seats, plugs, stems.

10.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives--The student will be able to:

- 10.01 Employ leadership skills to accomplish organizational goals and objectives. LT1.0
- 10.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT3.0
- 10.03 Conduct and participate in meetings to accomplish work tasks. LT4.0

10.04 Employ mentoring skills to inspire and teach others. LT5.0

11.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment--The student will be able to:

11.01 Describe the nature and types of business organizations. SY1.0
11.02 Explain the effect of key organizational systems on performance and quality.
11.03 List and describe quality control systems and/or practices common to the workplace. SY2.0
11.04 Explain the impact of the global economy on business organizations.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Maintenance Skills 3**
Course Number: **9700530**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include communication skills, implementation of turbine generator skills, along with personal money management and professional responsibilities.

12.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas--The student will be able to:

12.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM1.0
12.02 Locate, organize and reference written information from various sources. CM3.0
12.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM5.0
12.04 Interpret verbal and nonverbal cues/behaviors that enhance communication. CM6.0
12.05 Apply active listening skills to obtain and clarify information. CM7.0
12.06 Develop and interpret tables and charts to support written and oral communications. CM8.0
12.07 Exhibit public relations skills that aid in achieving customer satisfaction. CM10.0

13.0 Demonstrate organizational skills in planning and implementation of a turbine generator component inspection--The student will be able to:

13.01 Develop and explain an equipment laydown plan/drawing.
13.02 Develop and explain a plan (work package) for disassembly, inspection, and reassembly of a turbine component, including;
a. Inspection hold points
b. Tagging plan
c. Estimated man-hours
d. Inspection data sheets
13.03 Develop a simple critical path schedule for the inspection of a turbine generator component.

14.0 Demonstrate personal money-management concepts, procedures, and strategies--The student will be able to:

14.01 Identify and describe the services and legal responsibilities of financial institutions. FL2.0
14.02 Describe the effect of money management on personal and career goals. FL3.0
14.03 Develop a personal budget and financial goals. FL3.1
14.04 Complete financial instruments for making deposits and withdrawals. FL3.2
14.05 Maintain financial records. FL3.3

14.06 Read and reconcile financial statements. FL3.4
14.07 Research, compare and contrast investment opportunities.

15.0 Describe the importance of professional ethics and legal responsibilities--The student will be able to:

15.01 Evaluate and justify decisions based on ethical reasoning. ELR1.0
15.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR1.1
15.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR1.2
15.04 Interpret and explain written organizational policies and procedures. ELR2.0

16.0 Explain the importance of employability and entrepreneurship skills--The student will be able to:

16.01 Identify and demonstrate positive work behaviors needed to be employable.ECD1.0
16.02 Develop personal career plan that includes goals, objectives, and strategies.ECD2.0
16.03 Examine licensing, certification, and industry credentialing requirements. ECD3.0
16.04 Maintain a career portfolio to document knowledge, skills, and experience.ECD5.0
16.05 Evaluate and compare employment opportunities that match career goals.ECD6.0
16.06 Identify and exhibit traits for retaining employment. ECD7.0
16.07 Identify opportunities and research requirements for career advancement.ECD8.0
16.08 Research the benefits of ongoing professional development. ECD9.0
16.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD10.0

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Maintenance 4**
Course Number: **9700540**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include identifying and using generator specific tools. Explain how lubricants and the lubricating system functions along with various mechanical fastening systems.

17.0 Be able to identify and properly use all turbine generator tooling and demonstrate ability to maintain and make repairs to Hy-Torq, impact, and other hydraulic tools--The student will be able to:

17.01 Describe, explain and demonstrate use of all turbine generator tooling including:
a. Gas bolt heaters
b. Tensioners
c. Slugging wrenches
d. Torque wrenches including multipliers
e. Hydraulic jacks
f. Rotor skid pan and rotor blocks

17.02 Demonstrate common maintenance and service repairs on:
a. Impact wrenches
b. Hy-Torq heads
c. Hydraulic pumps

18.0 Demonstrate application of lubricants and lubricating systems--The student will be able to:

18.01 Explain the functions of lubrication.
18.02 Explain the properties of oil lubricants and the factors determining the selection of lubricants.
18.03 Identify the types, advantages, and functions of lubricant additives.
18.04 Explain a typical turbine generator lube oil system and the various components associated with it.
18.05 Identify areas of the turbine where grease would be applied and why.
18.06 Explain the types of oil filtration used in turbine generator systems including strainers.
18.07 Understand principals of a lube oil flush and how to set up various types of turbine generator maintenance lube oil flushes.
18.08 Explain oil sampling and demonstrate how to take an oil sample and perform cleanliness analysis.

19.0 Explain the various fastening mechanisms used on turbine and generator components including the types of materials and why--The student will be able to:

19.01 Demonstrate understanding of the types of materials used to properly clamp steam and oil cylinders and flanges.
19.02 Have basic understanding of and be able to explain torque, stress, stretch, corrosion, galling, and thread types.

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Student Performance Standards

Course Title: **Turbine Generator Maintenance 5**
Course Number: **9700550**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include tightening operations, removal techniques. Disassembly and reassembly of high speed turbines and generators along with machine-shop related operations.

20.0 Demonstrate tightening operations on high pressure flanges and cylinders--The student will be able to:

- 20.01 Explain the various types of tightening mechanisms that are used on turbine generators and auxiliary components.
- 20.02 Have an understanding of the materials used for different flange tightening applications based on pressure and temperatures.
- 20.03 Explain and demonstrate the tools used for tightening and measuring tightening mechanisms.
- 20.04 Explain the types of gaskets used in turbine generator applications and the advantage and disadvantage of each.
- 20.05 Understand gasket compression and demonstrate proper assembly of various types of gaskets including neoprene, Garlock, corrugated metal, serrated, and spiral wound.
- 20.06 Demonstrate ability to measure and cut a gasket from a sheet of gasket material.
- 20.07 Understand and explain the different types of lubricants utilized on high temperature bolting including advantages and disadvantages.
- 20.08 Understand and demonstrate tightening principals including torque and bolt stretch and outside influences on each.
- 20.09 Demonstrate proper use of various tightening tools.

21.0 Demonstrate removal techniques of galled bolting and repair of damaged threads--The student will be able to:

- 21.01 Understand alternative methods of removing galled bolting and how to determine best alternative based on type of material and location of fastener.
- 21.02 Understand safety requirements before initiating grinding or burning operations.
- 21.03 Demonstrate proper setup of cutting torch and demonstrate ability to cut bolting from a cylinder case.
- 21.04 Demonstrate proper use of grinding burrs to remove galled bolting.

22.0 Disassembly and reassembly of high speed turbines and generators--The student will be able to:

- 22.01 Develop a component and parts laydown plan and explain logic for it.

22.02 Understand all of the various lifting tools and devices used when disassembling a turbine generator.
22.03 Understand and demonstrate the use of a rigging and lifting plan.
22.04 Understand and demonstrate ability to inspect and identify problems with lifting devices including slings (wire rope, nylon, Kevlar) and hoists/come-a-longs.
22.05 Demonstrate proper use of a sling for lifting turbine generator components of various geometries.
22.06 Understand lifting capabilities of slings and the relationship between angles and stress.
22.07 Understand the function of a lifting beam and how to set up a load for proper lifting.
22.08 Understand and demonstrate ability to remove a generator rotor from the stator.
22.09 Understand necessity and the process for parts tagging and bagging.
22.10 Understand storage requirements including protection of flange surfaces during outage duration.
22.11 Understand process for protecting ingress of foreign objects into lubrication and steam systems.
22.12 Understanding of rigging and lifting principals.
22.13 Demonstrate ability to rig and lift a non symmetrical turbine component.
22.14 Demonstrate ability to disassemble and reassemble a steam piping flange.
22.15 Understand crane signals and demonstrate ability to communicate with team during a lift.

23.0 Perform machine-shop operations--The student will be able to:

23.01 Demonstrate safety in performing machine-shop operations.
23.02 Identify the types of cutting tools.
23.03 Bore a hole to a specified size.
23.04 Chase an external V-thread.
23.05 Identify the different types of work-holding devices.
23.06 Prepare metal for finishing.
23.07 Set up, use, and adjust an arbor press.
23.08 Set up, use, and adjust a hydraulic press.
23.09 Set up, use, and adjust broaching tools.
23.10 Cut keyways with an end mill.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Maintenance 6**
Course Number: **9700560**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include the piping and tubing system and the basic operation of a steam turbine and generator. Perform pump maintenance and repair activities along with preparing for machinery startup operations.

24.0 Demonstrate piping and tubing systems--The student will be able to:

- 24.01 Identify the components of a piping system.
- 24.02 Explain the maintenance considerations of metallic and nonmetallic piping systems.
- 24.03 Describe the safety requirements for working with piping and tubing systems.
- 24.04 Join copper tubing.
- 24.05 Join common fittings.
- 24.06 Join metallic piping
- 24.07 Bend back-to-back, stub-ups, and doglegs in Electrical Metallic Tubing (EMT)

25.0 Understand basic operation of a steam turbine and generator--The student will be able to:

- 25.01 Understand transforming work from high pressure steam
- 25.02 Understand the difference between a reaction and impulse turbine
- 25.03 Understand means of controlling the turbine.
- 25.04 Understand the difference between speed control and load control.
- 25.05 Understand extraction in a cogeneration facility.

26.0 Perform pump maintenance and repair--The student will be able to:

- 26.01 Demonstrate the safety procedures for performing pump maintenance.
- 26.02 Determine pump capacity and system requirements.
- 26.03 Perform pump maintenance.
- 26.04 Identify packing and seal requirements.
- 26.05 Explain the operating principles of centrifugal, propeller and turbine rotary, reciprocating, diaphragm, positive placement, and vacuum pumps.
- 26.06 Disassemble and reassemble a pump.

27.0 Prepare for machinery startup--The student will be able to:

- 27.01 Describe the requirements and precautions for machinery startup.
- 27.02 Align machinery using wire line, transit, dial indicators, a computer, and laser-alignment devices.
- 27.03 Position and secure machinery on a foundation.

27.04 Level machinery and install balance-vibration dampeners.
27.05 Identify pipe-stress standards for machine-maintenance applications.
27.06 Perform finish alignment and check for pipe stresses in machinery-maintenance applications.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Mechanic 7**
Course Number: **9700570**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include performing alignment operations and Predictive-Preventive-Maintenance (PPM) technology and how to generate machine improvement and maintenance activities.

28.0 Perform measuring and rotor alignment operations--The student will be able to:

- 28.01 Demonstrate the safe use of hand tools such as wrenches, files, scrapers, taps, dies, torque wrenches, grinders, and cutoff wheels.
- 28.02 Demonstrate the proper use of precision measuring devices such as inside and outside micrometers, depth gauges, and dial indicators.
- 28.03 Select correct tools for metric and standard fasteners.
- 28.04 Explain the types of misalignment and how to calculate the moves necessary to correct the misalignment.
- 28.05 Demonstrate how to set up dial indicators to perform a turbine generator coupling alignment check.
- 28.06 Demonstrate how to perform a Swing Check to align a three bearing unit.
- 28.07 Explain the purpose of a tight wire and how it is set up in a turbine.
- 28.08 Demonstrate how to take measurements from the wire to check alignment of the internal components

29.0 Demonstrate Predictive-Preventive-Maintenance (PPM) technologies--The student will be able to:

- 29.01 Explain the use of infrared thermography.
- 29.02 Explain the use of ultrasound technology.
- 29.03 Explain the use of advanced alignment techniques
- 29.04 Explain the use of oil ferrography and the types of oil sampling
- 29.05 Describe the safety requirements for PPM technologies.
- 29.06 Demonstrate the use of one of the above predictive-maintenance procedures
- 29.07 Plan an advanced PPM schedule.

30.0 Perform failure analysis--The student will be able to:

- 30.01 Conduct/lead a failure analysis meeting to determine the root cause of a failure.
- 30.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
- 30.03 Explain the types of bearing failures.
- 30.04 Explain the types of shaft fatigues and failures.
- 30.05 Explain the types of lubrication breakdowns.
- 30.06 Estimate the cost and the impact on production of a specific failure.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Mechanic 8**
Course Number: **9700580**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include how to generate machine improvements and maintenance activities along with performing failure analysis. Perform bench work skills along with the non-destructive examination of turbine components.

31.0 Generate machine improvements and maintenance management--The student will be able to:

- 31.01 Review and critique machinery and base design for improvement, before the equipment is placed on order.
- 31.02 Identify the essential elements of effective maintenance management:
  - a. Reward system
  - b. Predictive-preventive maintenance
  - c. Planning
  - d. Work-order systems
  - e. Organizations
  - f. Goals and tracking
  - g. Facilities
  - h. Storerooms
  - i. Contractors
  - j. Shutdowns
- 31.03 Write a report on the design and effective use of at least two of the essential elements of management.

32.0 Perform failure analysis--The student will be able to:

- 32.01 Conduct/lead a failure analysis meeting to determine the root cause of a failure.
- 32.02 Create a failure-analysis form and write a minimum of two different types of failure-analysis reports.
- 32.03 Explain the types of bearing failures.
- 32.04 Explain the types of shaft fatigues and failures.
- 32.05 Explain the types of lubrication breakdowns.
- 32.06 Estimate the cost and the impact on production of a specific failure.

33.0 Perform bench work skills including breakdown and inspection of control valve components--The student will be able to:

- 33.01 Identify and explain the various components of a turbine generator control system including hydraulic, and electro hydraulic.
- 33.02 Understand the importance and various types of material used for sealing control systems.

33.03 Understand and demonstrate proper preparation for disassembling and inspecting a control mechanism.
33.04 Understand the importance of cleanliness during the disassembly of a control mechanism.
33.05 Explain how a control mechanism works and the critical measurement required to assure proper operation.
33.06 Demonstrate proper removal and installation of hydraulic lines.

34.0 Non-Destructive examination of turbine components--The student will be able to:

34.01 Understand the various materials in a steam and gas turbine.
34.02 Understand the relevant turbine non-destructive examination techniques and how each one is used, including:
a. Ultrasonic Testing
b. Penetrant Testing
c. Magnetic Particle Testing
d. Radiographic Testing
34.03 Indentify the proper non destructive testing technique for various turbine components.
34.04 Understand the cleanliness standards and cleaning methods required on turbine components.

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Florida Department of Education
Student Performance Standards

Course Title: **Turbine Generator Mechanic 9**
Course Number: **9700590**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of turbine generator maintenance, inspection and repair. These competencies include understanding principles of generator operation and testing, how to troubleshoot hydraulic systems. Apply vibration-analysis skills and how to perform machinery balancing.

35.0 Understand principals of generator operation and testing--The student will be able to:

- 35.01 Understand basic principal of electrical energy production.
- 35.02 Basic understanding of excitation.
- 35.03 Understand function of each major generator component:
  - a. Core
  - b. Rotor/Field
  - c. Stator/Armature
  - d. Exciter
- 35.04 Understand the difference in megawatts and KVA.
- 35.05 Understand electrical testing.

36.0 Troubleshoot hydraulic systems--The student will be able to:

- 36.01 Explain the safety procedures for troubleshooting hydraulic systems.
- 36.02 Read a hydraulic schematic.
- 36.03 Install hydraulic components.
- 36.04 Connect electrically controlled valves.
- 36.05 Explain hydraulic-system troubleshooting techniques.
- 36.06 Repair and replace valves.
- 36.07 Repair and replace cylinders.
- 36.08 Repair and replace pumps and motors.

37.0 Apply vibration-analysis skills--The student will be able to:

- 37.01 Collect vibration data.
- 37.02 Interpret vibration data.
- 37.03 Determine velocity, acceleration, spike energy, frequency, amplitude, and other vibration sources.
- 37.04 Describe the safety requirements and precautions for vibration analysis.
- 37.05 Operate and use vibration software.
- 37.06 Predict and verify the condition of machinery in an industrial setting using vibration tools.
- 37.07 Explain the approximately 25 sources of vibration.
- 37.08 Explain the Bearing Frequency (BIFO) Formulas.
- 37.09 Demonstrate proficiency in vibration detection.

38.0 Perform machinery balancing--The student will be able to:

38.01 Describe the safety requirements and precautions for balancing procedures and equipment.
38.02 Identify the principles of static balancing.
38.03 Perform a vector balance in the classroom.
38.04 Identify balancing standards, ISO 1940 or equal.
38.05 Perform a stand balance in a shop.
38.06 Perform a field balance in an industrial setting.
38.07 Use portable or stationary balancing equipment.