# SOLAR ENERGY EDUCATION & TRAINING

# BEST PRACTICES

## Curriculum and Program Development

Interstate Renewable Energy Council, Inc.

U.S. Department of Energy | Solar Instructor Training Network | National Administrator

SunShot U.S. Department of Energy

www.sitnusa.org

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# Letter from the Program Manager for IREC

## National Administrator of the Solar Instructor Training Network

As a boy, I was fascinated with tools while working with my father, and later, as an electrician in the construction industry. The phrase, the right tool for the right job, became readily apparent to me. I appreciated the value of using the right tool to complete a task efficiently, producing a high-quality result. As a former community college professor of 32 years, I look at the Best Practices documents with the same appreciation of the right tool for the right job.

IREC assembled some of the best experts in the country on solar training, education, and workforce development to create this compendium of Best Practices. I am forever indebted to them for their efforts. The documents were thoughtfully designed to give solar instructors the right tools for the job of training a highly-skilled, globally-competitive solar energy workforce for the 21st Century. This suite of Best Practices documents builds on IREC's earlier versions of Best Practices from 2008 and 2010.

As a college professor building my solar program, I had scarce resources and tools to choose from to support my efforts. Separately and collectively, these Best Practices documents enable instructors to easily enhance current solar curriculum, while providing a detailed roadmap for instructors who are considering adding solar to related trades curriculum. These documents have the potential to significantly enhance the quality of solar education and training. How I wish I had something like these Best Practices when I was developing my solar program.

And now, thanks to the SITN, you do. As National Administrator of the SITN, IREC believes these documents will hasten the development of exemplary solar training programs. I am enormously proud to be associated with such an erudite team of solar educational professionals.

IREC will be working closely with the Regional Training Providers (RTPs) of the SITN to further enhance these Best Practices documents. By tapping the strengths of each RTP, the SITN will garner even more resources and best practices to share with solar instructors, creating an even brighter future for solar education and training here in the U.S.

From all of us at the SITN and IREC Team, we are pleased to offer these tools for you in your work.

**Joe Sarubbi**
PROJECT MANAGER

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## About IREC

The Interstate Renewable Energy Council, Inc. supports market-oriented services targeted at education, coordination, procurement, the adoption and implementation of uniform guidelines and standards, workforce development, and consumer protection. IREC's mission is to accelerate the sustainable utilization of renewable energy and energy efficient sources and technologies. IREC is a nonprofit organization formed in 1982.

## About the SITN

Launched in 2009, the U.S. Department of Energy established the Solar Instructor Training Network, composed of nine Regional Training Providers (RTPs) to help fulfill a critical need for high-quality, local, and accessible training in solar system design, installation, sales, and inspection through train-the-trainer programs. The nine RTPs are well-established solar training institutions that offer expert trainers and first-class training facilities across the U.S. The institutions and organizations are listed by region:

**Region 1:** Kennebec Valley Community College and Hudson Valley Community College
**Region 2:** Pennsylvania State University
**Region 3:** The Solar Center at North Carolina State University.
**Region 4:** Florida Solar Energy Center at University of Central Florida
**Region 5:** Midwest Renewable Energy Association
**Region 6:** Houston Community College-Northeast and Ontility
**Region 7:** Salt Lake Community College, Solar Energy International and Utah Solar Energy Association
**Region 8:** California Community Colleges Board of Governors, California Energy Commission, California Centers for Sustainable Energy, the Labor Management Cooperation Committee

## About DOE SunShot Initiative

The U.S. Department of Energy SunShot Initiative is a collaborative national initiative to make solar energy cost competitive with other forms of energy by the end of the decade. Reducing the installed cost of solar energy systems by about 75% will drive widespread, large-scale adoption of this renewable energy technology and restore U.S. leadership in the global clean energy race.

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## Curriculum and Program Development

## Introduction

Solar education programs have existed for more than three decades. Three of the earliest and most notable programs were developed by ARCO Solar (a PV module manufacturer), the Florida Solar Energy Center (FSEC, a university-based research, testing and education institution), and Solar Energy International (SEI, a private training organization).

These organizations independently developed education and training programs based on their assessment of constituent needs. The primary target audience for all three was the solar industry. However, the duration of training, technical content, and focus on specific solar occupations varied.

In 2002, the first national job task analysis (JTA) was prepared by industry experts and professionals for photovoltaic (PV) system installers. Originally, this JTA was to be a framework for a national certification examination. However, it has also been used as a guide for the development of PV installer curricula and programs. The North American Board of Certified Energy Practitioners' (NABCEP) PV System Installer JTA has been updated several times since 2002. Other NABCEP JTAs have been produced for jobs in solar thermal, PV technical sales, and small wind.

This paper gives a brief overview of the curriculum development process—with special attention to DACUM (Developing A CurriculUM) methodology and JTA. We have used the terms curriculum and program interchangeably because we are discussing the ***process of development*** rather than a specific set of courses that might constitute a particular curriculum or program.

Typically, an ***instructional program*** is a set of structured learning experiences used to teach a particular subject that is offered by an educational institution or recognized educational provider. It can, but does not have to, lead to a formal degree or formal award such as a certification. A ***curriculum*** is a set of courses or a plan for a particular area of study that may or may not be linked to a particular provider and may or may not lead to a formal award. The process of ***course development*** is addressed in a separate section.

## What is a Curriculum?

Any curriculum should reflect current conceptions about how people learn and how they should be taught. There are basically three approaches to curriculum development:

- Curriculum as syllabus—a body of knowledge to be transmitted
- Curriculum as product—an attempt to achieve certain ends in students
- Curriculum as process—what actually happens in the classroom and what people do to prepare and evaluate learning

The first two are most relevant to solar education and training. The third, curriculum as a ***process***, is often thought of as having more to do with instruction, which is specific to classroom practice and more immediate.

For a syllabus to be a curriculum—and not just a list of topics, office hours, and assignments—it must contain certain attributes, including a set of learning objectives or standards and a way to evaluate student mastery of the content. Because curriculum as a ***product*** is defined as aligning with standards and learning objectives, the common way of looking at curricula for technical training is to address it as a product. Students' achievement of a set of outcomes that can be verified through assessment and testing is paramount.

A GOOD CURRICULUM:

- Is easy to use
- Aligns with standards
- Is specific enough to organize learning
- Allows instructor creativity and independence
- Supports students' skill and knowledge levels
- Contains materials to measure achievement of core learning objectives

## Key Components of a Curriculum

Most curriculum documents contain nine key components. In some cases, a curriculum will be presented in a single document (what many call a syllabus). It is also common to create an instructor's manual that presents individual unit plans, learning activities, and assessments. The key components of such a manual include:

- **Introduction**—the purpose and goals of the curriculum
- **Audience**—a brief description of the intended students, including prerequisite skills and knowledge levels, and demographics
- **Outcomes**—a clear articulation of the observable and measurable skills and knowledge students will need to demonstrate that indicates mastery of course content within the curriculum
- **Content framework**—a detailed outline of the major topics and sub-topics that will be taught in individual courses, ideally matched to learning outcomes
- **Unit plans**—lesson plans that organize content and learning objectives into discrete units
- **Verification of learning**—methods the instructor and students use to determine whether the learning objectives have been met
- **Delivery methodologies**—teaching strategies and learning activities that will be used to deliver the content, including problems to solve, case studies, scenarios, hands-on labs, two-way exchanges of information such as question and answer with an instructor, small group activities, discussions, and real-life experiences
- **Resources and references**—sources of information or teaching methods
- **Program evaluation and modification**—a strategy for continually revising and updating the curriculum based on how well it is meeting the instructional purposes and needs of the target audience

For a more complete discussion of curriculum development, read the complete article by Interstate Renewable Energy Council (IREC) staff member Diane DePuydt, *"Basic Guidelines for Training Curriculum"* (www.irecusa.org/wp-content/uploads/ISPQ-curriculum-guidelines.pdf). Another good general resource for curriculum development can be found in the Encyclopedia of Informal Education (http://www.infed.org/biblio/b-curric.htm).

## DACUM
## Developing A CurriculUM

DACUM (Developing A CurriculUM) is an ***occupational analysis method*** that can be applied to the development of education and training curricula. It often results in a job or task analysis. A DACUM is intended to be a quick and effective method for carrying out an occupational analysis at a low cost. It results in the production of a chart listing the duties, tasks, knowledge, skills, traits, and, in some cases, tools a worker uses to perform a job or occupation. The DACUM chart provides the relevant foundation for developing a curriculum and related instructional materials.

The DACUM process uses direct observation, interviews, and surveys to generate data for training materials and competency tests. It uses teams of five to 12 workers and subject matter experts (SMEs) guided by a facilitator to describe in a clear and precise way the "know how" involved in a particular job. SMEs are included to insure that the DACUM results identify both what workers ***actually* do** and what successful workers ***should do***.

The DACUM process is based on three premises:

- Expert workers can describe or define their jobs better than anyone else.
- Any job can be described in terms of the tasks that successful workers perform.
- All tasks depend on workers possessing a specific body of knowledge, skills, and attitudes.

The process identifies job duties and tasks and then ranks them according to which ones are important and which ones are difficult to learn (Hale, 2000).

In the case of a renewable energy curriculum, experts would convene to determine what the job focus of the curriculum would be—such as conservation/energy management, building sciences, installer training (solar thermal, wind, or PV) or some combination of these. The SMEs would identify the knowledge and skills that define the job *and* produce a job or task analysis that could be used to determine the courses a curriculum should include.

A sample DACUM for distributed energy technicians is included in Appendix A of this document. The Advanced Technology Environmental and Energy Center (ATEEC) offers a very good description of the DACUM method at www.ateec.org/dacums/about.

## The Job Task Analysis

The JTA is a formal process for determining what people do, under what working conditions, and with what knowledge and skills. According to Judith Hale (2000), the analysis provides data to support the development of ***performance standards, tests, training, and criteria*** to judge ***experience, work samples, and efforts***. Usually a technical committee of subject matter experts is convened to develop the task analysis, often using the outcomes of the DACUM process.

***Performance standards*** describe a task in enough detail to support the development of tools that will help evaluators fairly judge proficiency in performing a task. Defining the ***standards*** is the cornerstone for developing the task analysis. A standard has three parts:

- **Conditions**—the context in which work is performed
- **Performance**—the task, behaviors, and actions involved in the work
- **Criteria**—the outcomes required for performance that is "done to standard"

Hale (2000) provides a checklist for evaluating the development of performance standards. (See Figure 1)

**FIGURE 1**
Checklist for Evaluating the Development of Performance Standards

| Development of Performance Standards | YES | NO |
|---|---|---|
| 1. There is documentation that describes how data from a job or task analysis were converted into standards | | |
| 2. There is a list of performances, including: | | |
| The conditions, or givens, based on - | | |
| Input, requests, and directives | | |
| Desired business outcomes or the desired end state | | |
| Availability and access of aids, equipment, information, etc. | | |
| The criteria, or what will be accepted as evidence of proficiency (at different levels if appropriate) | | |
| 3. There is a list of those who participated in development of the task statements or descriptions, performance criteria, and performance level (if appropriate)—such as: | | |
| Authorities in the discipline | | |
| Exemplary practitioners | | |
| Clients, customers, and users of outcomes | | |
| Technical staff (experts in developing performance statements) | | |
| 4. The basis on which the people were selected is described | | |
| 5. There is a process to review and validate the standards | | |

Although developing a JTA is part of the curriculum development process, ***course*** developers, who may or may not be the same people as the ***curriculum*** developers, use the task analysis to decide which skills should be taught and in what depth. The same task analysis can be used to develop courses that last one day, two days, or one week by establishing the ***prerequisites*** that students need before a course begins. These prerequisites can often be taken directly from the JTA.

Prerequisites differ from ***entry skills***. Prerequisites are ***specific*** lower-order tasks and skills that students must master to accomplish a more complex, or higher-order, skill or task. Skills generally refer to intellectual processes, whereas tasks refer to duties, jobs, or responsibilities. Both skills and tasks may be included in the JTA.

Entry skills, on the other hand, are ***general*** statements of what a student must be able to do to succeed in a course. Entry skills might include statements like "the ability to read technical documents at the 8th grade level," "basic math skills including algebra," or "good communication skills."

One important component of a JTA is to identify how ***critical*** or how ***important*** each task is to the performance of the job. These critical and very important tasks can be selected from the task analysis for inclusion in a course. Correct selection of tasks and prerequisites helps insure that the students in a course reach the specified goal of the course or workshop. Appendix B provides a checklist that can be used to evaluate a job or task analysis. This checklist gives the steps that are required to conduct and document a ***JTA validation study.*** (See Appendix B)

THE DIFFERENCE BETWEEN DACUM AND JTA

- Both list the pertinent skills required for performing a job or task
- DACUM defines **job standards**
- JTA further defines **job performance** by identifying how important each task or skill is to the overall job
- JTA lists **performance standards** (condition statements, performance or behaviors) that help in the development of evaluation instruments, as well as criteria that define performance outcomes.

NABCEP has produced several task analyses that can guide the curriculum and instructional development process (www.nabcep.org). These include: PV Installer Job Task Analysis, Solar Thermal Task Analysis, PV Technical Sales Job Task Analysis, and Professional Small Wind Energy System Installer Task Analysis.

NABCEP-Certified Solar PV installers are required to specify, configure, install, inspect, and maintain a solar electric system that 1) meets the performance and reliability needs of customers, 2) incorporates quality craftsmanship, and 3) complies with all applicable safety codes and standards.

The NABCEP PV task analysis covers six major areas:

1. Verifying system design
2. Managing the project
3. Installing electrical components
4. Installing mechanical design
5. Competing system installation
6. Conducting maintenance and troubleshooting activities

This task list begins with performance standards: the installation contractor starts with an approved solar system design package, complete with major components, manufacturer installation manual, system schematics, and assembly and troubleshooting instructions. While the solar installation contractor may not design the system, the contractor must often be knowledgeable about many aspects of systems design and may be required to adapt certain designs to fit a particular application or customer need.

NABCEP also has approved a task analysis for solar thermal installers that defines a general set of knowledge, skills, and standards that are typically required of practitioners who install and maintain solar hot water or pool heating systems. The NABCEP Solar Thermal Task Analysis covers 12 major areas:

1. Working safely with solar hot water and pool heating systems
2. Identifying systems and their components
3. Adapting a system design
4. Conducting a site assessment
5. Installing solar collectors
6. Installing water heater and storage tanks
7. Installing piping, pipe insulation, and connecting system piping
8. Installing mechanical/plumbing equipment and other components
9. Installing electrical control systems

10. Installing operation and identification tags and labels
11. Performing a system checkout
12. Maintaining and troubleshooting a solar thermal system

Full descriptions of these task analyses are available at www.nabcep.org.

## Summary

In this paper, we noted that:

- A curriculum can be viewed as a syllabus, product, or process.
- Components of a curriculum include identification of students, outcomes and assessments devices, a content framework, and delivery methodologies.
- The common way of looking at curricula for technical training is to address it as a product. That is, as a set of outcomes that can be verified through assessment and testing.
- Curriculum, as a product, is based on defining and establishing standards.
- The process for defining those standards is critical.
- A formal and respected method for defining *job standards* (tasks and duties) is creating a DACUM document. (See Appendix A for a sample DACUM document)
- A DACUM document relies on experts (job performers and other stakeholders) who come together to decide the focus of a curriculum, including what courses should be included to meet the needs of the identified job duties and task statements.
- A job task analysis (JTA) lists *performance standards* that allow evaluation instruments to be developed. These include condition statements, performance or behaviors, and criteria that define the outcome of the instruction (See Appendix B for a JTA evaluation checklist)
- Prerequisites and entry skills should be identified when planning a curriculum and designing courses using the JTA.
- The North American Board of Certified Energy Practitioners has developed several task analyses in renewable energy.

### Sources

This document is part of the Solar Energy Education and Training Best Practices document series. All Best Practices documents can be accessed online at http://sitnusa.org/trainer-resources/best-practices. Other resources available online are referenced throughout this document with web-addresses and hyperlinks. Text-only resources are listed below.

Hale, Judith. 2000. Performance-Based Certification: How to Design a Valid, Defensible, and Cost Effective Program. San Francisco, Jossey-Bass.

# Appendix A

Florida Resource Center (FRC) Profile for
Distributed Energy Technicians

For Brevard Community College and the Florida Solar Energy Center

| | |
|---|---|
| **Ben Kroposki** | National Renewable Energy Laboratory |
| **Blake Morrison** | Kinectrics North America |
| **John Holbrook** | Elliott Energy Systems |
| **Brian Inglett** | Turbec Americas, Inc. |
| **Juan Santos** | Central Florida Electrical J.A.T.C. |
| **Rick Wallace** | UTC Fuel Cells |
| **Mario Nadal** | Teledyne Energy Systems |

FRC Facilitator
**Jerry W. Lancio**, Director

## Date
February 6, 2002

## Place
Florida Solar Energy Center
Cocoa, FL

**Focus Statement:** A distributed energy technician uses a working knowledge of electronic and electrical systems, mechanical systems, plumbing, fuel systems, and computer systems to install and maintain distributed energy systems.

| Duties | Tasks | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **A. Installation** | 1. Assess Site Condition | 2. Verify the Site Matches the Plan | 3. Verify Tools and Components Necessary at Site | 4. Install Electrical System | 5. Install Controls Systems | 6. Install Mechanical System | 7. Install Thermal System | 8. Verify Subsystem Perfor-mance |
| | 9. Start Unit | 10. Verify Operation to Specs | 11. Demonstrate Operating Proce-dure to User | | | | | |
| **B. Service** | 1. Check Fluid Levels | 2. Change Filters | 3. Perform Scheduled Maintenance | 4. Perform Visual Inspection | 5. Verify Electrical Operation to Specs | 6. Verify Mechanical Operation to Specs | 7. Verify Con-trol Operation Systems to Specs | 8. Verify Thermal Operation to Specs |
| | 9. Verify Fuel System to Specs | 10. Document Maintenance Performed | | | | | | |
| **C. Trouble-shooting** | 1. Assess Existing Condition of Unit | 2. Identify Nature of the Problem | 3. Perform Diagnostic Tests | 4. Identify Symptoms | 5. Identify Subsystem Related to Symptoms | 6. Document Problems | 7. Identify Solution | 8. Inform User of Situation |
| | 9. Determine Action to Be Taken | | | | | | | |
| **D. Repair** | 1. Perform Lock-Out, Tag-Out | 2. Identify Parts Needed | 3. Identify Specialized Tools Needed | 4. Replace Components | 5. Verify Subsystem Performance | 6. Start Unit | 7. Verify Operation to Specs | 8. Clean Up Site |
| | 9. Document Repair | | | | | | | |
| **E. Customer Relations** | 1. Represent Company and Product in Positive Manner | 2. Respect Customer Property | 3. Listen to the Customer | 4. Educate Customer Regarding Technology | 5. Give Options to Customers | | | |
| **F. Health & Safety** | 1. Wear Appropriate Protection Equipment | 2. Use Lock-Out, Tag-Out Procedure | 3. Locate MSDS | 4. Dispose Hazmats Properly | 5. Perform Emissions Test | 6. Iden-tify Confined Space | 7. Follow Confined Space Procedures | 8. Use Pro-per Lifting Techniques |
| | 9. Follow ESD Procedure | 10. Contain Spills | 11. Verify Site Safety | | | | | |

## Knowledge and Skills

| | |
|---|---|
| 1. Background of Distributed Energy Industry | 13. Physical Science |
| 2. Blueprint Reading | 14. Test Equipment |
| 3. Electrical Schematics | 15. College Algebra |
| 4. Legal Issues | 16. Applied Technical Math |
| 5. Codes and Standards | 17. Basic Harmonics |
| 6. Problem Solving | 18. Communications and Controls |
| 7. Technical Reading | 19. Computers |
| 8. Technical Writing | 20. Ducting |
| 9. CPR | 21. Basic Plumbing |
| 10. Safe Use of Power Tools | 22. Basic Electricity |
| 11. Quality Control Principles | 23. Soldering |
| 12. AC/DC Theory | |

## Traits and Attitudes

| | |
|---|---|
| 1. Manual Dexterity | 4. Willing to Change with Technology |
| 2. Diplomatic | 5. Detail Oriented |
| 3. Mechanically/Electrically Inclined | 6. Patient |

## Tools and Equipment

| | |
|---|---|
| 1. Multimeter | 6. Phase Analyzer |
| 2. Oscilloscope | 7. Pressure Gauge |
| 3. Frequency Analyzer | 8. Hydrometer |
| 4. Gas Analyzer | 9. Phase Rotation Meter |
| 5. Power/Hand Tools | |

# Classes

## Introduction to Distributed Energy Systems

- Assess Site Condition (A1)
- Demonstrate Operating Procedures to User (A11)
- Represent Company in a positive manner (E1)
- Respect Customer Property (E2)
- Listen to the Customer (E3)
- Educate Customer Regarding Technology (E4)
- Give options to Customer (E5)
- Knowledge of Background of Distributed Energy Industry
- Legal Issues
- Codes and Standards
- Quality Control Principles
- Customer Service

## Health and Safety in Distributed Energy Systems (2 credits: 1 lecture, 1 lab)

- Perform Lock-out, Tag-out
- Clean Up site
- CPR
- Fire Extinguisher use
- Electrical Safety
- Follow Confined Space Procedures (F7)
- Locate MSDS (F3)
- Identify Confined Spaces (F6)
- Dispose of Hazmats Properly (F4)
- Use Proper Lifting Techniques (F8)
- Contain Spills (F10)
- Keep Clean and Orderly Workspace
- Follow FOD Procedures
- Use Lock-out Tag-out procedures (F2)
- Wear Appropriate Protection Equipment (F1)
- Verify Site Survey (F11)

## CGS (3 Credits, existing class)

- Basic Computer Operation

## Technical Math (3 Credits, existing course)

- Problem Solving
- Tech Math

## Physical Science (3 Credits, existing class)

- Physical Science

## Electrical Circuits (3 Credit Hours: 2 class, 1 lab)

- Install electrical system
- Circuit soldering
- Follow Electrostatic Discharge (ESD) Procedure
- Electrical Schematics
- AC/DC Theory
- Harmonics (Basic)
- Basic Electricity

## Communication and Control (3 credits: 2 lecture, 1 lab)

- Communication and controls
- Fiber optics
- Verify Control System Operation to Specs (B7)
- Verify Operation To Specs (D7)

## Blueprint Reading (2 credit hours)

- Verify the site matches the plans
- Blueprint Reading
- Electrical Drawings

## Technical Writing (3 Credits, existing class)

- Document Problem
- Document Repair
- Document Installation site-specific parameters
- Technical Writing/Reading interpretation

# Classes continued

## Microturbine Generating Systems (3 credits: 2 class, 1 lab)

- Perform Diagnostic Tests (C3)
- Verify Subsystem Performance (A8)
- Hand/Power Tools
- Identify Subsystem Related to Symptoms (C5)
- Verify Operation to Specs
- Install Control System
- Identify Symptoms
- Verify Electrical Operation to Specs (B5)
- Start Unit (A9)
- Identify Solution
- Verify Mechanical Operation to Specs
- Ducting
- Verify Subsystem Performance
- Verify Fuel System to Specs
- Basic Plumbing
- Perform Emission Tests (NOx) (F5)
- Install Fuel System
- Pipe Soldering
- Install Mechanical System
- Start Unit
- Verify Thermal Operation to Specs (B8)
- Install Thermal System
- Test Equipment
- Identify Nature of the Problem

## Fuel Cell Power Generating Systems (3 credits: 2 class, 1 lab)

- Perform Diagnostic Tests (C3)
- Verify Subsystem Performance (A8)
- Hand/Power Tools
- Identify Subsystem Related to Symptoms (C5)
- Verify Operation to Specs
- Install Control System
- Identify Symptoms
- Verify Electrical Operation to Specs (B5)
- Start Unit (A9)
- Identify Solution
- Verify Mechanical Operation to Specs
- Ducting
- Verify Subsystem Performance
- Verify Fuel System to Specs
- Basic Plumbing
- Install Fuel System
- Pipe Soldering
- Install Mechanical System
- Start Unit
- Verify Thermal Operation to Specs (B8)
- Install Thermal System
- Test Equipment
- Identify Nature of the Problem

## Co-op

- Verify Necessary Tools and Components Are at the Site (A3)
- Perform Scheduled Maintenance (B3)
- Assess Existing Condition of Unit (C1)
- Determine Action to Be Taken (C9)
- Check Fluid Levels (B1)
- Perform Visual Inspection (B4)
- Inform User of Situation (C8)
- Identify Specialized Tools Needed (D3)
- Identify Parts Needed (D2)
- Change Filters (B2)
- Document Maintenance Performed (B10)
- Replace Components
- Inform User of Situation

## Student Schedule

| | |
|---|---|
| **Semester I**<br>Introduction to Distributed Energy<br>Health and Safety in Distributed Energy<br>CGS | **Semester II**<br>Technical Math<br>Physical Science<br>Electrical Circuits |
| **Semester III**<br>Communications and Controls<br>Blueprint Reading<br>Technical Writing | **Semester IV**<br>Microturbine<br>Fuel Cell<br>Co-op |

# Appendix B

Checklist to Evaluate a Job Task Analysis Validation Study

| | YES | NO |
|---|---|---|
| **1. Input from the following people were included:**<br>• The people who do the job or task | | |
| • Supervisors | | |
| • Customers | | |
| • Others who depend on or are vested in the quality of the job or task output | | |
| **2. The process of development is documented** | | |
| **3. Documentation includes:**<br>• How people were selected to participate in the process | | |
| • When the job or task analysis was done | | |
| • Which tasks were assessed | | |
| • Which people decided upon the tasks that were ultimately included | | |
| • How the data were gathered (DACUM, critical incident study, etc) | | |
| • What steps were taken to control:<br>• Sampling error<br>• Design errors<br>• Administrative errors | | |
| • What documents and records were searched and verified | | |
| • How many people were observed | | |
| • How those observed were selected | | |
| • How many people were interviewed | | |
| • Which stakeholders those interviewed represent | | |
| • How those interviewed were selected | | |
| • How many people were surveyed | | |
| • Which stakeholders those surveyed represent | | |
| • How the data were analyzed | | |
| • How tasks were rated (importance, difficulty, frequency) | | |
| • What the results were | | |
| • What the recommendations were | | |