**MODEL COURSE ATON**

**LEVEL 2 – TECHNICIAN**

**DC POWER SYSTEMS**



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**PART A - COURSE OVERVIEW**

**Section 1 - Introduction**

**Purpose of the Model Course**

The purpose of the model course is to assist training institutes and their teaching staff in organizing and introducing new training courses, or in enhancing, updating, or supplementing existing training material where the quality and effectiveness of the training courses may thereby be improved.

It is not the intention of the model course to present instructors with a rigid teaching package which they are expected to follow blindly. For teaching purposes, the subjects may be grouped and re-arranged where that is considered an advantage. The knowledge, skills, and dedication of the instructor are key components in the transfer of knowledge and skills to those being trained through this model course.

The required standard of competence is considered to be the level of proficiency that should be achieved for the proper performance of the duties carried out by the technician in his or her organization.

**Use of the Model Course**

This course is intended to cover the knowledge and practical competence required for a technician to properly service and maintain DC power systems used on aids to navigation (ATON) buoys, Lighthouses and major floating aids. The complete course comprises 9 modules, each of which deals with a specific subject representing an aspect of DC Power systems servicing and maintenance. Each module begins by stating its scope and aims, and then provides a teaching syllabus.

**Presentation and Lesson Plans**

This is a practical, job-centered course designed to provide trainees with a realistic, hands-on educational experience. The modular presentation enables the instructor to adjust the course content to suit the trainee intake and provide any revisions to the learning objectives as required. Where no adjustment has been found necessary in the learning objectives, the lesson plans may simply consist of the syllabus with keywords or other reminders added to assist the instructor in making their presentation of the material.

**Evaluation or Assessment of Trainee Progress**

Trainees will be evaluated on their understanding of the material and their ability to carry out the tasks associated with each module of the course. Additional guidance is provided in Section 5 of this Course Overview.

**Implementation**

For the course to run smoothly and effectively, considerable attention must be paid to the availability and use of:

 Qualified instructors

 Support staff

 Rooms and other spaces  Training equipment

 Safety equipment

 Reference material

Thorough preparation is the key to successful implementation of the course.

**Validation**

The information contained in this document has been validated by a group of subject matter experts drawn from the IALA membership. Validation in the context of this document means that the group has found no grounds to object to its contents.

**Section 2 - Course Framework**

**Scope**

This course is intended to provide technicians with the practical training necessary to become efficient and competent in the servicing and maintenance of ATON DC Power systems.

**Objective**

Upon successful completion of this course, trainees will have acquired sufficient knowledge and skill to service and maintain ATON DC Power systems on the job within their organizations.

**Entry Standard**

The Competent Authority may prescribe minimum standards for education or work experience for prospective trainees to enter this course. In preparing this course, it has been assumed that trainees would have the minimum physical ability and educational background necessary to successfully carry out the function of servicing and maintaining ATON DC power systems. This will include a basic education in Electrical DC theory , basic electronic control principles and Health and Safety at work.

**Requirements for Certification**

Every candidate for certification should:

 Be not less than 18 years of age.

 Satisfy the Competent Authority that they possess the theoretical and practical knowledge necessary to carry out the responsibility of servicing and maintaining AtoN DC Systems.

**Course Intake Limitations**

Class sizes my be limited at the discretion of the Competent Authority in order to allow the instructor to give adequate attention to individual trainees. In general, it is recommended that a maximum of 8 students be the upper limit that a single instructor can be expected to train satisfactorily to the level of competence required.

**Training Staff Requirements**

All instructors, supervisors, and assessors should be appropriately qualified in the subject matter covered by this course. In addition to technical expertise in the subject matter, accredited training programs should ensure that all members of the teaching staff have appropriate training in instructional techniques and assessment methods. As well as instructors, supervisors, and assessors, additional staff may be required for the maintenance of equipment and the preparation of materials, supplies, and work areas.

**Teaching Facilities and Equipment**

This course involves both classroom instruction and practical visit in a work area. Classrooms should be equipped with blackboards, whiteboards, and overhead projectors to enable presentation of the subject matter. An alternative to classroom instruction would be to provide the lecture material to students at a distance via the Internet or other electronic means (i.e., "e-learning"). In that case, students would need access to computers and related equipment, and should be provided with a means of interacting with instructors for discussion and to answer questions.

**Teaching Aids**

Trainees should have access to the types of equipment that they will be expected to work with on the job. This would include such things as multimeters, block diagrams, circuit drawings and samples of equipment in use.

**Reference**

In addition to any specific references required by the Competent Authority, the following material is relevant to this course:

 IALA Guideline

 IALA Guideline

Technical documentation from equipment manufacturers would be another useful source of information.

**Section 3 – Course Outline**

The complete course comprises of nine modules, each of which deals with a specific aspect of DC power systems, servicing and maintenance.

The topics of these five modules are to be considered as a minimum requirement for developing the Level 2 Course. However, the lesson content can be adapted or expanded to meet the specific requirements of the Competent Authority.

**Section 4 - Guidelines for Instructors**

|  |  |  |
| --- | --- | --- |
| Module title | Time in hours | Overview |
| 1 – Overview of DC power systems | 2 | Identification of the main components in a typical DC power system |
| 2 – Solar generation | 1 | Photo voltaic generation systems |
| 3 – Wind generation | 1 | Wind turbine generation |
| 4 – Battery charging | 1 | Power sources, charging regimes, charging technology |
| 5 – Battery storage | 2 | Battery types & selection  Capacities, H&S |
| 6 – Isolation & Protection | 1 | Low voltage cut out & change over systems |
| 7 – Distribution | 2 | DC Distribution systems. Cable sizing, installation standards, EMI |
| 8 – Visit | 4 | Visit to a complex DC system |
| 9 – Evaluation | 1 |  |
| **Total Hours:** | 15 |  |

**Introduction**

The intent of this course is to enable students to return to their jobs prepared to service and maintain DC power systems found in a typical Aid to Navigation. Particular emphasis should be placed on proper safety procedures, both through lecture and--most importantly--the instructor's personal example.

**Curriculum**

Although the learning objectives are set out here in a certain order, instructors are not obliged to teach them in this order. Instead, the instructor should treat them in the order which they consider to be the most effective for their trainees and circumstances.

The recommended hours for the module durations are intended to be used as approximate guidelines for planning purposes. The hours should be adjusted as necessary to suit local circumstances or based on experience with similar courses. It is also quite usual for different trainees to require different lengths of time to cover the same work. The course should therefore be implemented with some flexibility to allow for adjustments during its running. Using the time estimates, modified as appropriate, a timetable should be drawn up to suit the normal working day and terms of the training institute.

The success of the course will depend to a large extent upon coordination of the individual subjects into a coherent teaching scheme. It is important that an experienced instructor act as course coordinator to plan and supervise the implementation of the course. The course coordinator should then monitor the running of the course, and conduct regular discussions with the teaching staff concerning the progress of trainees and any problems that have become apparent. At the conclusion of the course, a discussion should be held to determine whether changes should be made to improve future courses**.**

**Section 5 - Evaluation or Assessment**

To evaluate trainee progress, regular assessments must be undertaken. The nature of these assessments and the evaluation criteria used will depend on the needs of the Competent Authority, the style of training used, and the requirements of the training institute. However, the subject matter of this course would lend itself primarily to short written exams.

**PART B - COURSE MODULES**

**Module 1 – Overview of DC power systems**

**Scope**

This module describes the main components in a DC power system

**Learning Objective**

To be able to identify the main components in a DC power system and understand their individual and collective purposes.

Lesson 1 – Primary Power sources

1. Photo Voltaic cells & arrays
2. Wind generation
3. Mains supply
4. Local generator supply
5. Other potential sources of supply

Lesson 2 – System components

1. Solar regulation
2. Wind generation regulators
3. Mains chargers
4. Battery storage
5. Low voltage isolation and protection
6. Low voltage change over
7. Charging regimes
8. Loads
9. Distribution systems

**Module 2 – Solar generation**

**Scope**

This module describes the use of Solar PV cells as a source of power, their configuration, application and maintenance.

**Learning Objective**

Upon completion, the student will be familiar with the configuration of a PV array, it’s regulation and maintenance and have an understanding of the solar modelling techniques for capacity planning

**Syllabus**

Lesson 1 – PV Cells

1. PV cells – various types available and in use
2. PV Load / voltage curves
3. HV generation
4. LV generation
5. Regulation
   1. Integral
   2. Remote

Lesson 2 – Maintenance and Inspection

1. Care and maintenance
2. Inspection and testing
3. Expected life
4. Solar modelling for correct selection

**Module 3 – Wind generation**

**Scope**

This module provides an overview of wind generation

**Learning Objective**

Upon completion, the student will have an understanding of the principles of wind generation, the types of generator available and in use as well as an understanding of the inspection and maintenance requirements

**Syllabus**

Lesson 1 – Wind generators

1. Types available
   1. Axial
   2. Radial
2. Location selection
3. Maintenance and inspection
4. Modelling to assess output

**Module 4 – Battery charging**

**Scope**

This module outlines the principles of battery charging and the various options available.

**Learning Objective**

Upon completion, the student will understand the types of battery chargers in service and those available and will be able to fault find and replace a faulty charger..

**Syllabus**

Lesson 1 – Power sources and charger principles

1. Primary power sources
   1. Solar PV
   2. Wind generation
   3. Local diesel alternator
   4. Mains AC supply
2. Basic rectifier charger

Lesson 2 – Charger types

1. Intelligent chargers with profiled charge rates
2. Float charging
3. Special charging – HF pulsing
4. Charge regulation - PWM

Lesson 3 – Solar charge optimisation

1. Review of solar PV load / voltage graphs
2. MPPT

**Module 5 – Battery storage**

**Scope**

This module outlines the principles of battery storage

**Learning Objective**

Upon completion, the student understand the types of batteries available, those in service, their application and maintenance

**Syllabus**

Lesson 1 – Types of batteries

1. Flooded lead acid
2. Gel lead acid
3. Nickel Metal Hydride
4. Nickel Cadmium
5. Characteristics of each type

Lesson 2 – Health & Safety

1. Ventilation
2. Energy storage
3. Manual handling
4. High voltage hazards

Lesson 3 – Selection

1. Sizing and coded sizes
2. Peak output & maximum capacity
3. Capacity and type selection
4. Matching to charger
5. Autonomy requirements following power failure

Lesson 4 – Inspection and maintenance

1. Maintenance and inspection
2. Expected battery life
3. Capacity testing and verification
4. Battery conditioning

**Module 6 - Isolation and protection**

**Scope**

This module outlines the principles isolation to protect the battery and to maintain security of supply to the AtoN

**Learning Objective**

Upon completion, the student will understand the purpose of low voltage isolation and low voltage change over

**Syllabus**

Lesson 1 – Low voltage isolation

1. Why LV isolation is required
2. Where LV isolation may not be installed
3. Maintenance of LV cut out systems

Lesson 2- Low Voltage change over

1. Change over switching to an alternative power source
2. Systems available
3. Systems in service
4. Maintenance of LV change over switch systems

**Module 7 – Distribution**

**Scope**

This module outlines the principles DC distribution for an AtoN supply circuit

**Learning Objective**

Upon completion, the student will understand the components in a DC supply system and be capable of inspecting and maintaining such a system

**Syllabus**

Lesson 1 – Loads and distribution

1. Load definition
2. Peak power and acceptable voltage drop
3. Cable sizing
4. Electrical protective devices
5. Lightning protection
6. Mechanical protection

Lesson 2 – Standards

1. Local electrical standards
2. Installation standards
3. Electro Magnetic Interference

**Module 8 – Site visit**

**Scope**

Visit to a site of sufficient complexity to cover the range of topics in the previous 7 modules

**Learning Objective**

To give a practical overview to the students to consolidate their knowledge gained in the class room modules

**Syllabus**

Site visit to enable students to view the equipment in use and to inspect, test and fault find on it