Document Revisions

This document has been reformatted to comply with the latest IALA template for Model Courses.

**Model Course**

**For**

**Aids to Navigation**

**Level 2 – Technician**

**Solar Panel Maintenance**

**Edition 1**

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Revisions to the IALA Document are to be noted in the table prior to the issue of a revised document.

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| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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PART A – COURSE OVERVIEW

# 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 solar panels used on aids to navigation (AtoN) buoys, structures, lighthouses, and major floating aids. The complete course comprises five modules, each of which deals with a specific subject representing an aspect of solar panel 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-centred 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 his or her 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.

# 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 solar panels.

## Objective

Upon successful completion of this course, trainees will have acquired sufficient knowledge and skill to service and maintain ATON solar panels 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 solar panels.

## 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 solar panels.

## Course Intake Limitations

Class sizes may 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 12-14 students be the upper limit that a single instructor can be expected to train satisfactorily to the level of competence required. Larger numbers may be admitted if extra staff and tutorial periods are provided to deal with trainees on an individual basis.

## 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 experience 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. For the hands-on portion of the course, work areas should be suitable for trainees to safely and efficiently practice with solar panels and associated equipment. The practical section of working with solar panels requires working in the sun and proper sun protection should be observed.

## 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 solar panels, wiring, charging equipment and testing equipment.

### Equipment Required for Each Trainee

At a minimum, each student should be provided with the following safety equipment:

* Sun screen;
* Broad brimmed hat;
* Steel-toed shoes.

## References

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

1. IALA Guideline 1067-0 on Selection of Power Systems for Aids to Navigation and Associated Equipment
2. IALA Guideline 1039 on Design Solar Power Systems for Aids to Navigation Engineering
3. IALA Guideline 1067-2 on Power Sources

Other applicable guidelines and standards would be available from the Institute of Electrical and Electronics Engineers ([www.ieee.org](http://www.ieee.org)), and the International Electrotechnical Commission ([www.iec.ch](http://www.iec.ch)). Technical documentation from solar panel manufacturers would be another useful source of information.

# Course Outline

The complete course comprises five modules, each of which deals with a specific aspect of battery servicing and maintenance.

1. Course Modules

|  |  |  |
| --- | --- | --- |
| **Module** | **Duration (hours)** | **Description** |
| 1 Introduction to Solar Panels technology | 1.0 | Solar panel technology, terminology, and the types of solar panels used in aids to navigation |
| 2 Safety | 1.0 | Safely storing, handling, and working with solar panels at height |
| 3 Installation | 2.0 | Wiring, and installing solar panels on buoys, ground, structures, lighthouses, and major floating aids |
| 4 Inspection, Testing and Maintenance | 3.0 | Understanding manufacturers specification and testing, inspecting, and troubleshooting problems with solar panels. |
| 5 Inventory Management and Disposal | 0.5 | Managing the solar panels inventory, and properly disposing and recycling of solar panels |
| **Total Hours:** | **7.5** |  |

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.

# Guidelines for Instructors

## Introduction

The intent of this course is to enable students to return to their jobs prepared to service and maintain ATON solar panels. Thus, a significant portion of the instruction should be devoted to hands-on training with actual solar panels and associated equipment. The instructor should be willing and able to physically demonstrate the various procedures, and work with the students individually and as a group as they go through the exercises. 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.

## Practical Training

As noted throughout this Course Overview, the intent is for students to have a realistic, hands-on educational experience. Many of the subjects in this course lend themselves to practical training exercises in which students would be expected to work directly with solar panels and related equipment. Examples would include wiring, installing and testing solar panels.

# 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 physical demonstrations of competence, perhaps supplemented by short written examinations.

PART B - COURSE MODULES

Module 1 - Introduction to Battery Technology

**SCOPE**

This module provides an overview of solar panels technology and the types of solar panels used to power aids to navigation.

**LEARNING OBJECTIVE**

Upon completion, the student will understand how solar panels work and be familiar with the types most commonly used on aids to navigation.

**SYLLABUS**

1. Lesson 1 – SOLAR PANEL Technology
   1. Physical construction
   2. Principles of operation
   3. Terminology
      1. Service life
      2. Sizing
      3. a
      4. a
      5. a
      6. a
      7. a
      8. a
2. Lesson 2 – SOLR PANEL Types
   1. Multicrystaline Cells
      1. Description
      2. a
      3. a
      4. a
   2. Rechargeable (secondary) batteries
      1. Description
      2. a
      3. a
      4. a
   3. Advantages and disadvantages of each type
   4. Typical applications for each type

Module 2 - Safety

**SCOPE**

This module describes the methods for safely storing and handling solar panels.

**LEARNING OBJECTIVE**

Upon completion, the student will understand how to work with solar panels safely.

**SYLLABUS**

1. Lesson 1 - Potential Hazards
   1. Short circuiting
      1. Methods of prevention
      2. First aid measures
      3. Dangerous voltages
   2. Personal protection
      1. Sun protection
      2. Body protection
      3. Foot protection
   3. Safe handling and storage
      1. Material safety data sheets
      2. Guidelines for transportation and storage
      3. Proper lifting methods

Module 3 - Installation

**SCOPE**

This module describes the methods for charging, wiring and installing solar panels on buoys, structures, lighthouses and major floating aids. Applicable safety procedures from Module 2 will be reinforced during the lessons.

**LEARNING OBJECTIVE**

Upon completion, the student will be able to properly and safely install solar panels on aids to navigation.

**SYLLABUS**

1. Lesson 1 - Inspection Prior to Installation
   1. Physical condition
   2. Date of manufacture
2. Lesson 2 - Wiring
   1. Series and parallel
   2. Cable types
   3. Connections
3. Lesson 3 - Installation
   1. Physical requirements
      1. Solar panel orientation
      2. Protection of the solar panels against site environmental conditions
      3. Working at heights
   2. Installing solar panels
      1. Solar panel frames
      2. Dissimilar materials contact
      3. Solar panel terminal boxes
      4. a
      5. a

Module 4 - Inspection and Testing

**SCOPE**

This module outlines the procedures for load testing, bench testing, inspection methods, and troubleshooting problems with solar panels. Applicable safety procedures from Module 2 will be reinforced during the lessons.

**LEARNING OBJECTIVE**

Upon completion, the student will be able to properly and safely inspect, test, and troubleshoot problems with solar panels.

**SYLLABUS**

1. Lesson 1 - Measurement and Test Equipment
   1. Multimeter
   2. a
   3. ar
      1. a
      2. a
2. Lesson 2 – Tests, Inspections & Maintenance
   1. Voltage testing
   2. Short circuit testing
   3. Open circuit testing
   4. Changing orientation of the panels
   5. Insulation resistance
   6. Visual inspection
      1. Corrosion at connections
      2. Condition of cables
      3. Integrity of solar panel support structures and enclosures
      4. Condition of safety equipment
   7. Troubleshooting problems found during tests and inspections

Module 5 - Inventory Management and Disposal

**SCOPE**

This module describes the procedures for managing the solar panel inventory, and for proper disposal and recycling of solar panels.

**LEARNING OBJECTIVE**

Upon completion, the student will be familiar with the policies and regulations in his or her organization which govern the proper management and disposal of solar panels.

**SYLLABUS**

1. Lesson 1 - Inventory Management
   1. Legal requirements and regulations governing solar panel management
   2. Procedures for life-cycle inventory tracking
   3. Solar panel labelling
   4. Inspection records
2. Lesson 2 - Disposal
   1. Legal requirements and regulations governing solar panel disposal
   2. Methods of disposal
      1. Recycling options
      2. Proper disposal methods
   3. Disposal records