

A conceptual image featuring a glowing lightbulb with a realistic Earth globe inside it. The lightbulb is surrounded by dynamic water splashes and numerous small bubbles, set against a light blue background. The overall theme is environmental and innovative.

RES-SKILL

**Reskilling coal industry workers for
the renewables energy sector**

O3-T1: RES-SKILL
Curriculum

May 2022



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Introduction

The third intellectual output of the RES-SKILL project includes tasks which help to define the specifications (i.e. learning outcomes) for the RES-SKILL curriculum. Accordingly, we have carried out an analysis of the evidence collected on skill complementarities, new RES sector requirements, and training opportunities for the transition of coal workforce to the RES industry with the view to conclude on the learning outcomes report.

- **RES-SKILL_O1-T4_Definition of RES-SKILL Learning Outcomes**

The above document provides a comprehensive report of learning outcomes which are “statements of what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and competences”. It also gives some guidelines on how to prepare corresponding learning lessons.

This report provides the definition of RES-SKILL learning lessons. It represents the outcome of the O3-T1 is structured as follows:

- **Section 2.** Reviews the Learning Outcomes structured into 4 units
- **Section 3.** Makes some global consideration on the Course Structure
- **Section 4.** Presents the Learning Lessons of each unit

RES-SKILL Learning outcomes

Previous RES-SKILL tasks have structured the course outcomes in 4 Units as follows:

- Learning Unit 1: PV system installer
- Learning Unit 2: Advanced service technician for PV applications
- Learning Unit 3: Wind turbine and farm technician
- Learning Unit 4: Safety considerations & protocols in the RES industry

The learning outcomes of each module are specified hereafter, in Table 1 to 4, in terms of knowledge, skills and competences. These correspond to statements of what professionals should know, understand and be able to do upon the completion of the RES-SKILL course.



Learning Unit 1	PV system installer		
Learning outcomes correspond to EQF Level 4	<ul style="list-style-type: none"> • explain how solar energy is captured and converted into electrical energy. • name the components of PV systems • assemble and put in place the mechanical components of the system on different sites. 		
	Knowledge	Skills	Competence
	Knows / Aware of: - a PV installation site is a construction site and an electrical installation site and as such must comply with all relevant health and safety precautions and working practices - analyse and disseminate the informations about the PV systems	Able to: - describe using basic knowledge the different components of a PV systems and how these components function	Capable to: - explain the modality to capture the solar energy and how it is converted into electrical energy. - describe all the components of PV systems - assemble and put in place the mechanical components of the PV system on different sites and on different grounds

Learning Unit 2	Advanced Service technician for Solar PV Case Studies		
Learning outcomes correspond to EQF Level 4	Case studies for learning designed Advanced Service technician for Solar PV aims at giving them more insight and reality into the PV topic.		
	Knowledge	Skills	Competence
	Knows / Aware of: <ul style="list-style-type: none"> • analyse and disseminate the information about the PV systems 	Able to: <ul style="list-style-type: none"> • provide a comprehensive overview of some case studies 	Capable to: - analyse and use the case studies presented and to apply those informations in other PV systems



Learning Unit 3	Wind turbine and farm technician		
Learning outcomes correspond to EQF Level 4	<ul style="list-style-type: none"> • explain how wind turbine are working. • give examples of hoe the wind energy is used in different environements • assemble an wind farm 		
	Knowledge	Skills	Competence
	Knows / Aware of: <ul style="list-style-type: none"> • know some basic information about the history of wind energy 	Able to: <ul style="list-style-type: none"> • provide a comprehensive overview of some case studies 	Capable to: <ul style="list-style-type: none"> - explain how wind turbine are working. - give examples of hoe the wind energy is used in different environements - assemble an wind farm

Learning Unit 4	Safety consideration and protocol in RES industry		
Learning outcomes correspond to EQF Level 4	<ul style="list-style-type: none"> • Identify hazards • Assess the risk • Control the risk • Review the control measures 		
	Knowledge	Skills	Competence
	Knows / Aware of: <ul style="list-style-type: none"> • analyse and disseminate the information about safety procedures 	Able to: <ul style="list-style-type: none"> • provide a comprehensive overview of safety consideration and protocol in PV systems 	Capable to: <ul style="list-style-type: none"> - Find out what could cause harm to people. - Understand the nature of the harm, how serious is can be and likelihood of it happening. - Implement the most effective control measure that is reasonably practicable in the circumstances



			<p>and ensure it remains effective over time.</p> <ul style="list-style-type: none"> - Review the hazards and control measures to make sure they are working as planned.
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General concerns on the course structure

Most learners will already have this background from their previous jobs and they will not have any problem following the RES-SKILL course. However, other learners may have diverse backgrounds and they may need to review these topics. The course will include links to recommended resources that students can check in case they need to. The linked resources will be mainly in English, but the topics are so general that it will not be hard to find similar resources in any of the languages covered by the course.

As a guideline, each one of the units is assumed to have a workload of 12 hours for a prototypical learner. Units are broken into lessons, each lesson having a set of lecture notes, slides, and self-contained examples (use cases).

For the purpose of evaluation, each lesson also contains some Questions & Answers and Multiple Choice Quizzes.

All learning material will be made available in all the languages of the partnership. That is: German, Greek, Romanian, Bulgarian, Polish.

Formulation of learning units in lessons

The RES-SKILL lessons lay the ground for the development of RES-SKILL training and assessment material. The learning training and assessment material should be specified in intellectual output 3, according to the project application form. A lesson should include the following items: a title, the learning unit of which the lesson is part of, the list of topics of the learning unit content, prerequisites, learning materials, planned duration of the lesson and references.

Training materials will be created and if suitable reused to support learning on the technical components and practical applications, such as lecture notes, slide presentations, case studies, FAQs. Assessment of learning outcomes means methods and processes used to establish the extent to which a learner has in fact attained particular knowledge, skills and competences. In order to determine whether the learner has acquired the proposed knowledge, skills and competences and to provide learners with the opportunity to evaluate the extent to which they have attained the desirable knowledge and skills, assessment materials for each learning unit will be developed.

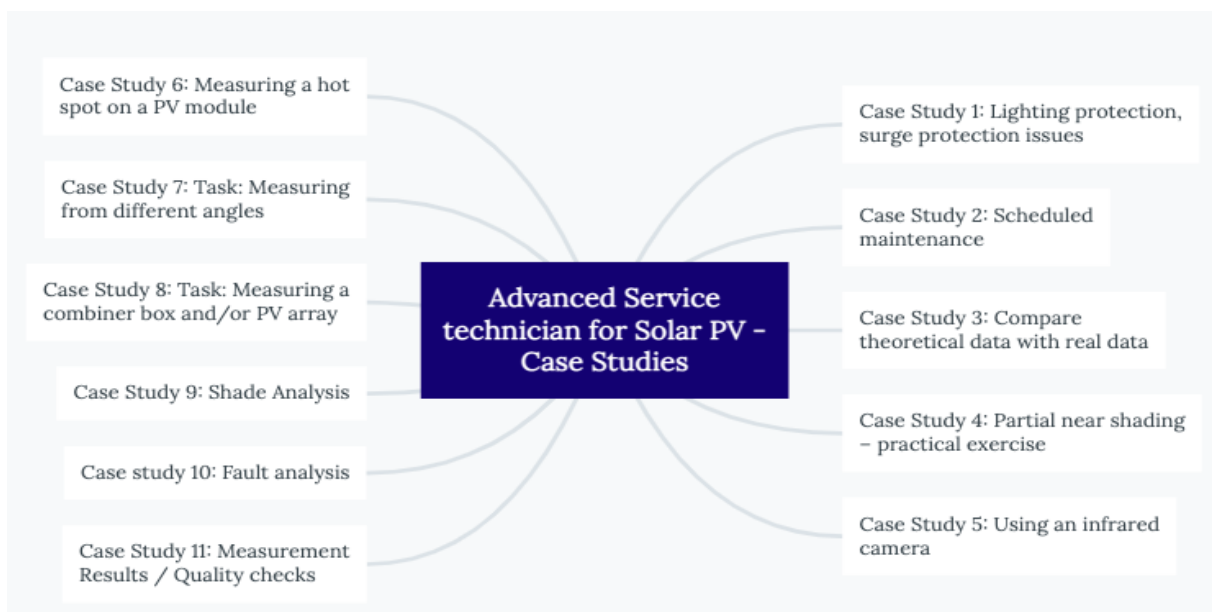
The four learning units in which learning outcomes have been structured constitute a natural founding ground for learning units. Each learning unit has been divided into a set of coherent lessons. The following figure gives a graphical view of the global structure. After that, each lesson is specified.



Learning Unit 1: PV system installer

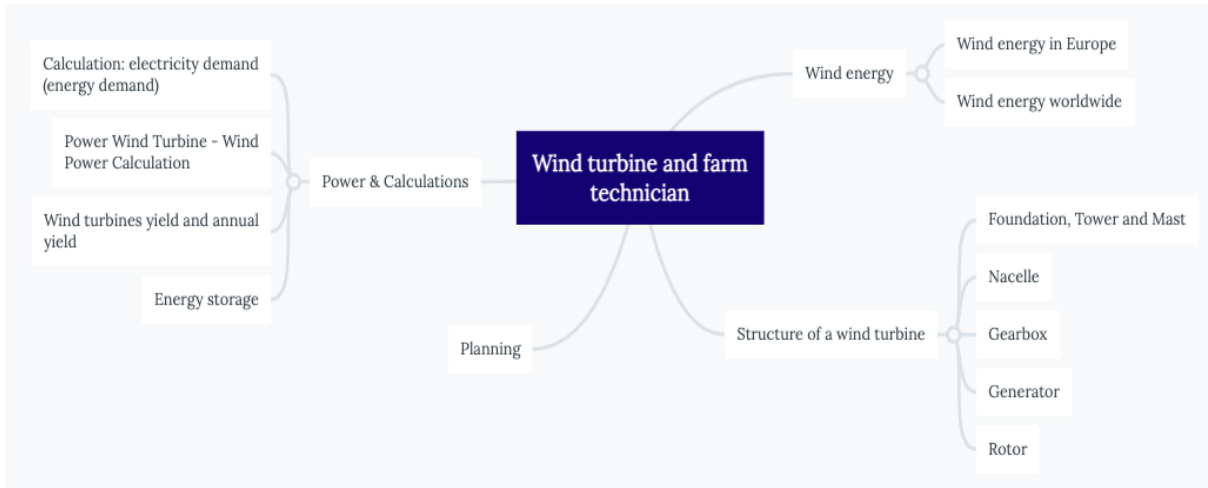


Learning Unit 2: Advanced Service technician for Solar PV - Case Studies





Learning Unit 3: Wind turbine and farm technician



Learning Unit 4: Safety consideration and protocol in RES industry





Learning Unit 1: PV system installer

Lesson title:
Solar energy and PV systems basics
Lesson objectives
describe using basic knowledge the different components of a PV systems and how these components function
Topics / Content
Introduction to solar Energy Photovoltaic technology fundamentals and system components
Prerequisites
a PV installation site is a construction site and an electrical installation site and as such must comply with all relevant health and safety precautions and working practices
Learning materials
Presentation slides and lecture notes: 20 Slides/4 pages of Lecture Notes <u>Assessment material:</u> Multiple choice questions: 5 Questions answers: 5
Planned duration of the lesson
- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h - Learner personal work: 0.5h
References



EurObserv'ER. (2020). The state of renewable energies in Europe. Retrieved 02 12, 2021, from <https://www.eurobserv-er.org/19th-annual-overview-barometer>

European Commission. (2011). Using Learning Outcomes - European Qualifications Framework Series: Note 4. (P. O. Union, Ed.) doi:10.2766/17497

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

Lesson title:

Photovoltaic system design and site survey

Lesson objectives

to install civil and mechanical components of the Solar Photovoltaic systems

Topics / Content

Photovoltaic system categories / application

Energy flow and metering options

Main components of grid-tied PV systems

Solar resource assessment and site survey

Design and sizing of grid-connected PV systems

Design and yield simulation with standard software

Prerequisites

basic knowledge the different components of a PV systems

Learning materials

Presentation slides and lecture notes: 20 Slides/30 pages of Lecture Notes



Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Biggs, J. B. (2003). Teaching for quality learning at university (2 ed.). Buckingham: Open University Press/Society for Research into Higher Education.

BP. (2020). BP Statistical Review of World Energy – All data 1965-2019. Retrieved 02 21, 2021, from <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2020-all-data.xlsx>

Cedefop. (2010). Learning outcomes approaches in VET curricula. Luxembourg: Publications Office of the European Union.

Cedefop. (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office of the European Union. Retrieved from <http://dx.doi.org/10.2801/566770>

Lesson title:

Installation of civil and mechanical components of PV system

Lesson objectives

to install civil and mechanical components of the Solar Photovoltaic systems.

Topics / Content

Preparation/planning



Who is allowed to install a PV system?

Installation guidelines

Tools, instruments, other equipment

Review of the whole construction and installation process

PV-specific occupational Health and Safety

Prerequisites

basic knowledge the different components of a PV systems

Learning materials

Presentation slides and lecture notes: 20 Slides/30 pages of Lecture Notes

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Education 2030. (2016). Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Paris: UNESCO.

UNESCO. (2017). Making textbook content inclusive: A focus on religion, gender, and culture. Paris: UNESCO.

UNESCO. (2021, 01 11). Learning and teaching materials. Retrieved 02 15, 2021, from Learning Portal-Planning education for improved learning outcomes: <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/learning-and-teaching-materials>



Learning Unit 2: Advanced Service technician for Solar PV Case Studies

Lesson title:
Installation of electrical PV components
Lesson objectives
to install electrical components of the Solar Photovoltaic systems
Topics / Content
Overview of photovoltaic systems Grid-connected inverters Overview of the electrical design and installation process Final connection to the grid
Prerequisites
to install civil and mechanical components of the Solar Photovoltaic systems.
Learning materials
Presentation slides and lecture notes: 20 Slides/10 pages of Lecture Notes Case studies: 3 case studies <u>Assessment material:</u> Multiple choice questions: 5 Questions answers: 5
Planned duration of the lesson
- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h - Learner personal work: 0.5h
References



Biggs, J. B. (2003). Teaching for quality learning at university (2 ed.).
Buckingham: Open University Press/Society for Research into Higher Education.

BP. (2020). BP Statistical Review of World Energy – All data 1965-2019.
Retrieved 02 21, 2021, from <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/xlsx/energy-economics/statistical-review/bp-stats-review-2020-all-data.xlsx>

Cedefop. (2010). Learning outcomes approaches in VET curricula. Luxembourg:
Publications Office of the European Union.

Lesson title:

Completing system installation, testing and commissioning

Lesson objectives

to test and commission electrical components of Photovoltaic Systems

Topics / Content

Installing and wiring monitoring systems

Commissioning: testing, measuring and fault-finding

Who does or rather should do the commissioning?

Pre-commissioning requirements

Safety precautions during commissioning

Instruments required

The commissioning process

System handover, documentation and reporting

Prerequisites

to install electrical components of the Solar Photovoltaic systems

Learning materials

Presentation slides and lecture notes: 20 Slides/10 pages of Lecture Notes

Case studies: 3 case studies



Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Cedefop. (2010). Learning outcomes approaches in VET curricula. Luxembourg: Publications Office of the European Union.

Cedefop. (2017). Defining, writing and applying learning outcomes: a European handbook. Luxembourg: Publications Office of the European Union. Retrieved from <http://dx.doi.org/10.2801/566770>

Education 2030. (2016). Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Paris: UNESCO.

Lesson title:

Operation, maintenance and Troubleshooting on PV systems

Lesson objectives

to analyse a PV system, maintaining and troubleshoot

Topics / Content

PV systems operation and maintenance (preventive, corrective and predictive)

Troubleshooting for PV systems

Prerequisites

to install and test electrical components of the Solar Photovoltaic systems



Learning materials

Presentation slides and lecture notes: 20 Slides/10 pages of Lecture Notes

Case studies: 3 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

EurObserv'ER. (2020). The state of renewable energies in Europe. Retrieved 02 12, 2021, from <https://www.eurobserv-er.org/19th-annual-overview-barometer>

European Commission. (2011). Using Learning Outcomes - European Qualifications Framework Series: Note 4. (P. O. Union, Ed.) doi:10.2766/17497

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

Lesson title:

Service and repairs

Lesson objectives

to analyse a PV system and carrying out service and repair work

Topics / Content

Asset management

PV system assessment, performance analysis and optimization



Reporting

Repairs

Prerequisites

to analyse a PV system, maintaining and troubleshoot

Learning materials

Presentation slides and lecture notes: 20 Slides/10 pages of Lecture Notes

Case studies: 2 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

UNESCO. (2017). Making textbook content inclusive: A focus on religion, gender, and culture. Paris: UNESCO.

UNESCO. (2021, 01 11). Learning and teaching materials. Retrieved 02 15, 2021, from Learning Portal-Planning education for improved learning outcomes: <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/learning-and-teaching-materials>



Learning Unit 3: Wind turbine and farm technician

Lesson title:
Wind energy
Lesson objectives
Basic knowledge about wind energy
Topics / Content
History of wind energy First wind turbines in the Arab region Denmark: Cradle of modern wind power utilization First wind farms in USA and Germany Wind energy in Europe The strongest of all renewable energies Europe has done pioneering work Energy transition towards renewable energies Billions for nuclear, coal and gas Wind energy worldwide 2020 Wind power expansion record Worldwide wind power expansion since 2001 Functionality of a wind turbine The kinetic energy becomes electrical energy
Prerequisites
Basic knowledge about wind power
Learning materials
Presentation slides and lecture notes: 20 Slides/10 pages of Lecture Notes



Case studies: 5 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

UNESCO. (2017). Making textbook content inclusive: A focus on religion, gender, and culture. Paris: UNESCO.

UNESCO. (2021, 01 11). Learning and teaching materials. Retrieved 02 15, 2021, from Learning Portal-Planning education for improved learning outcomes: <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/learning-and-teaching-materials>

Lesson title:

Structure of a wind turbine

Lesson objectives

knowledge about the structure of a wind turbine

Topics / Content

Foundation, Tower and Mast

Tower and mast



Nacelle

Resolved design

Generator

Rotor

Prerequisites

Basic knowledge about wind energy

Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Case studies: 5 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

UNESCO. (2017). Making textbook content inclusive: A focus on religion, gender, and culture. Paris: UNESCO.

UNESCO. (2021, 01 11). Learning and teaching materials. Retrieved 02 15, 2021, from Learning Portal-Planning education for improved learning outcomes: <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/learning-and-teaching-materials>



Lesson title:

Wind farm – power calculation

Lesson objectives

Wind energy – power calculation

Topics / Content

Calculation: electricity demand (energy demand)

Power Wind Turbine - Wind Power Calculation

Wind turbines yield and annual yield

Energy storage

Energy storing & batteries

How a windfarm is created

Site search/selection

Data collection

Permitting standards

Turbine choices

Permitting processes

Legal framework

Prerequisites

knowledge about the structure of a wind turbine and wind energy

Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Case studies: 5 case studies

Assessment material:

Multiple choice questions: 5



Questions answers: 5

Practical Exercises: 2

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

Reitz, F. (2021, 01 25). Europe Beyond Coal: European Coal Plant Database. Retrieved 02 21, 2021, from https://beyond-coal.eu/wp-content/uploads/2021/01/2021-01-25_Europe_Beyond_Coal-European_Coal_Database_hc.xlsx

UNESCO. (2017). Making textbook content inclusive: A focus on religion, gender, and culture. Paris: UNESCO.

UNESCO. (2021, 01 11). Learning and teaching materials. Retrieved 02 15, 2021, from Learning Portal-Planning education for improved learning outcomes: <https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/curriculum-and-materials/learning-and-teaching-materials>

Learning Unit 4: Safety consideration and protocol in RES industry

Lesson title:

Safety in the Renewable Energy Industry

Lesson objectives

To evaluate the potential risks

Topics / Content

Evaluate Potential Risks

Fulfill Training Requirements

Collaborate and Establish Expectations

Maintain Equipment and PPE



Building a Culture of Safety

Work Safety: Renewable Energy vs. Fossil Fuels

Common Hazards in the Renewable Energy Industry

Renewable Energy Presents Unique Risks for Workers

Prerequisites

Basic safety knowledge

Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Case studies: 2 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

<http://www.solarabcs.org/about/publications/reports/operations-maintenance/pdfs/SolarABCs-35-2013.pdf>

<https://www.nrel.gov/docs/fy19osti/73822.pdf>

<https://www.intechopen.com/chapters/68880>

Lesson title:

Health & safety in the wind industry

Lesson objectives



Evaluate risks and find solutions

Topics / Content

OSH risks associated with the construction of wind turbines

Onshore substation development

Hazards encountered during the construction phase of wind farms

Health and Safety

Health and Safety Checklist

Maintenance of a solar installation: from the system check to refitting and repowering

Routine scheduled preventive maintenance

Manufacturer-Specific Data Acquisition System Inspection

Prerequisites

risks observation

Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Case studies: 2 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Practical Exercises: 2

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References



<https://www.rpc.com.au/pdf/Solar%20PV%20Maintenance.pdf>

<https://solarrooftop.gov.in/knowledge/file-79.pdf>

<https://www.sciencedirect.com/science/article/pii/S2352484721004303>

Lesson title:

PV system installation and maintenance

Lesson objectives

System installation – testing and troubleshooting

Topics / Content

Typical PV system configurations

How PV systems are different

Potential PV problems

Testing and troubleshooting

Maintaining solar panels

Work health and safety requirements for Solar PV installers

The risk management process

Common hazards for Solar PV installation

Control measures

Prerequisites

Knowledge about risk management

Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Assessment material:

Multiple choice questions: 5

Questions answers: 5



Practical Exercises: 2

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h
- Learner personal work: 0.5h

References

https://research.unl.pt/ws/portalfiles/portal/5518661/OSH_in_Wind_energy_sector.pdf

https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy

<https://www.irsst.qc.ca/media/documents/PubIRSST/R-858.pdf?v=2020-02-18>

Lesson title:

General Safety Considerations

Lesson objectives

Safety procedures

Topics / Content

Photovoltaic Systems - Safety at work- Safety first

Legislative/Regulatory Requirements

General Safety Considerations

Electrical Hazards

Important Points to Consider When Working On PV Systems

Fall Protection

Prerequisites

risk management knowledge



Learning materials

Presentation slides and lecture notes: 20 Slides/20 pages of Lecture Notes

Case studies: 2 case studies

Assessment material:

Multiple choice questions: 5

Questions answers: 5

Planned duration of the lesson

- Average duration for reading the lecture notes, slide presentations and case studies: 1.5h

- Learner personal work: 0.5h

References

https://www.osha.gov/sites/default/files/2018-12/fy10_sh-21009-10_Participant_Booklet.pdf

<https://worksafe.nt.gov.au/forms-and-resources/bulletins/work-health-and-safety-requirements-for-solar-pv-installers>

https://www.ihsa.ca/pdfs/magazine/volume_18_Issue_2/working-safely-with-pv-systems.pdf