

WIND AND SOLAR PV POWERED DESALINATION SYSTEMS (RO AND EDR)

**A 4-day intensive course
4–7 November 2013**



**Pozo Izquierdo – ITC facilities
Gran Canaria Island, Spain**

Introduction

Fresh water shortage is a raising problem, especially in some parts of the world, as North Africa and Middle East areas. Global climate change and progressive increment of population are reducing day by day the availability of per capita drinking water supply; this is becoming a critical question for certain developing countries.

Desalination has narrowed the gap of water demand for more than 20 years thanks to a cheap energy supply; but the age of “easy oil” is coming over and the link water – energy is more and more critical. A hopeful option is desalination powered by reviewable energies (RE).

The Canary Islands Institute of Technology (ITC) has been testing and monitoring wind and solar photovoltaic powered desalination systems for more than 15 years. This course summarizes the main outcomes of this long experience, focusing on the more practical questions to be considered in order to implement new RE desalination projects.

The ITC facilities in Pozo Izquierdo (Southeast of Gran Canaria Island), with approximately 100,000m², are an ideal platform for testing RE desalination systems due to the local excellent conditions: direct access to seawater, abundant renewable energy resources (annual average wind speed of 8 m/s, average daily solar radiation of 6 kWh/m²) together with the staff formed by high qualification experts; all this makes ITC one of the best places to offer this specific training.

Objectives

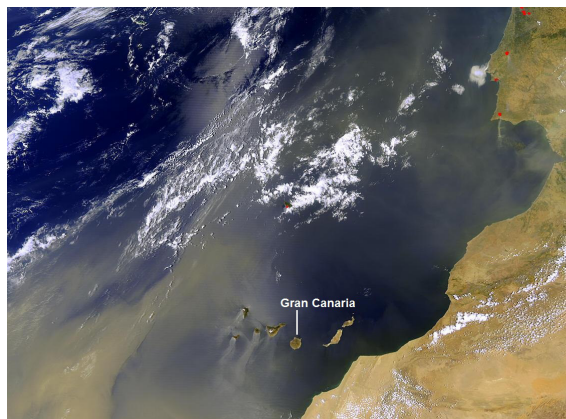
The main purpose of this 4-day intensive course is to provide experts, professionals and post-graduate students from any country with the latest knowledge of the different existing systems and technologies on wind and solar PV powered desalination. More specifically, the course will instruct on the basic theory of desalination using RE, the experiences acquired so far, the current state of the art and the most promising initiatives. Theory lessons will be complemented with technical visits and practical sessions using the facilities of ITC in Pozo Izquierdo, including a wide set of RE powered desalination units.

Venue

The course will take place at the facilities of the Canary Islands of Technology (ITC) in Pozo Izquierdo (Gran Canaria Island, Canary Islands). The accommodation will be in a hotel located in the touristic area of the island; the organization will provide a bus for the transport to the ITC (about 15 minutes).

This research institute belongs to the Government of the Canary Islands. The facilities of Pozo Izquierdo are probably the most diverse existing for the research, testing and development of renewable energy technologies and their applications. It is located near the village of Pozo Izquierdo, about 40 km from Las Palmas de Gran Canaria city.

Gran Canaria is a miniature continent. An island close to Europe, with a wide range of beaches as diverse as the changing sceneries waiting to be discovered. Nearly 60 kilometres of beaches on 236 kilometres of coastline under a gentle sun that seems to have settled down here for good. This is what makes Gran Canaria the port of destination of a huge crowd of Europeans. This has been so for generations. Sailors, divers, surfers, deep-sea fisher people, and windsurfers — all getting away to the island that works like a magnet. It hides a magnetic spring with which it attracts anyone wanting to get away to a sea of fine weather.



ITC FACILITIES

Maps of the Canary Islands archipelago and the Gran Canaria Island



ITC facilities in Pozo Izquierdo (Sta. Lucía, Gran Canaria Island, Spain)

Gran Canaria is a sample of quite uncommon sceneries in the middle of an extremely diverse archipelago. This is why UNESCO awarded the island the Biosphere Reserve label, to actively support the conservation of the pieces that make up this puzzle of natural settings, a different and very peculiar micro-world. Nearly half the island's geographical space has been included in this reserve, comprising six rural communities linked to traditional activities.



Syllabus

The course is organized in four modules

A) Introduction

1. Fundamentals of stand-alone RE (wind and solar PV) systems. Applications to RO and EDR.
2. Fundamentals of RO and ED.
3. Research trends.

B) Wind powered desalination systems

4. Review of operated systems and lessons learnt.
Future trends
5. Energy storage options
6. Fundamentals of design. Practical case
7. Economic and environmental aspects.

C) PV powered RO systems

8. Review of operated systems and lessons learnt
(DESSOL® patent). Future trends
9. Possible configurations
10. Fundamentals of design. Practical case
11. Economic and environmental aspects

D) Technical visits

12. Technical visit to PV-EDR unit.
13. Technical visit to PV-RO unit.
14. Technical visit to wind powered RO unit.
15. Technical visit to a large scale RO unit.
16. Technical visit to wind farm associated to a large scale RO unit.



30 mcd solar PV powered RO plant



Autonomous solar PV-RO system installed in Tunisia

Lecturers

The course will be given by researchers and scientists from the ITC:

Vicente J. Subiela (Mech. Eng.): Head of Section of the Water Department. He has been working on different RE powered systems (solar distillation, wind powered desalination, PV–RO units) since 1998. He has been researcher and coordinator of EU and international cooperation projects, and projects manager of autonomous desalination units. 12 publications.

Juan A. de la Fuente (Chem. Eng and Marine Sci. Grad.): Researcher of the Water Department. He is expert on the design, operation and optimization of RO desalination plants. He has been involved in assessment of wind and PV powered RO units and testing of different energy recovery systems for low capacity RO desalination plants since 2007. 6 publications

Baltasar Penate (Ph.D. Chem. Eng.): Head of the Water Department and coordinator of national and international projects on RE powered desalination, non-conventional wastewater treatments, water quality analysis, management and sustainability in water treatment projects. Coauthor of the PV-RO patent DESSOL® and the CONTEDES© utility model. 20 publications.

Course Program

DAY 1 Introduction

09:00–09:15 Opening and Introduction to the course. Presentation of ITC

09:15–10:15 Fundamentals of wind powered systems

- The wind resource

- Introduction to wind generators

10:15–11:15 Fundamentals of solar PV powered systems

- The PV technology

- Description of components

11:15–11:30 *Coffee break*

11:30–12:30 Fundamentals of RO desalination

- Main principles

- Definitions and fundamental parameters

- Operation and maintenance

- Current world outlook

12:30–13:30 Fundamentals of EDR desalination

- Main principles

- Definitions and fundamental parameters

- Operation and maintenance

- Current world outlook

13:30–15:00 *Lunch*

15:00–16:00 Application of wind power to RO/EDR

16:00–17:00 Application of PV power to RO/EDR

17:00–17:30 Review of main points, questions and clarification of doubts

17:40 *Return to hotel*

DAY 2 Wind powered desalination

08:30–10:45 Visit to wind farm associated to a RO unit (Playa Vargas)

11:00–11:15 *Coffee break*

11:15–13:15 Introduction I

- Description of the system

- Theoretical analysis. Energy & power balances

- Operational aspects. The challenge of variable load operation

- Monitoring and control aspects

- Current state of the art, challenges and future trends

13:30–14:30 *Lunch*

14:30–16:00 Real tested systems (ITC experience)

- Medium capacity

 - Wind-diesel RO unit

 - Wind-farm coupled to a multi-unit RO system.

 - Wind farm coupled to EDR

- Low capacity: First and upgraded (battery-less) versions

16:00–17:00 Practical case of design

- Input data

- Analysis and solution.

17:00–17:45 Economic and environmental aspects

- Possible options and related cost. Future perspectives

- Environmental impacts

17:45–18:00 Review of main points, questions and clarification of doubts

18:10 *Return to hotel*

DAY 3 PV powered desalination

09:00–11:00 Introduction to PV desalination

- Description of the system

- Theoretical analysis. Energy & power balances

- Operational aspects. The challenge of variable load operation

- Monitoring and control aspects

- Current state of the art, challenges and future trends

11:00–11:15 *Coffee break*

11:15–12:15 Presentation of tested and operating systems I. Seawater

- Case 1. 400 L/h RO unit (no energy recovery)

- Case 2. 1,250 L/h (ER included)

- Comments on other options: hybrid supply, battery-less case

12:15–13:15 Presentation of tested and operating systems II. Brackish water

- Case 1. 2,000 L/h (PV-RO unit in Tunisia)

- Case 2. 1,000 L/h (PV-RO unit in Morocco)

- Case 3. 4,000 L/h PV-EDR

13:30–14:30 *Lunch*

14:30–15:30 Presentation of business case: R&D Globe, DESSOL technology (external company)
15:30–16:30 Practical case of design
 Input data
 Analysis and solution
16:30–17:30 Economic aspects
 Evolution of costs in PV and RO.
 Current costs and future perspectives
17:30–17:45 Review of main points, questions and clarification of doubts
18:00 *Return to hotel*

DAY 4. Practical Work at Pozo Izquierdo

09:30–10:45 Visit to RO plant (South East region)
11:00–11:15 *Coffee break*
11:15–13:15 Technical visit ITC facilities in Pozo Izquierdo
 Hydrogen generation systems
 Biodiesel-powered compact RO system
 Solar MD systems (3 units)
 Micro-grid lab
13:30–14:30 *Lunch*
14:30–15:30 Technical visit to other ITC desalination facilities
 PV–RO unit
 PV–EDR unit
 Wind powered RO units
15:30–16:15 Final meeting and evaluation of the course
16:30 *Return to hotel*



Desalination dome. Facilities of the ITC in Pozo Izquierdo

WIND AND PV POWERED DESALINATION SYSTEMS

A 4-day intensive course

Lecturers Baltasar Penate, Vicente J. Subiela, Juan A. de la Fuente

4-7 November 2013, Gran Canaria Island, Spain

REGISTRATION FORM

Surname _____ Name _____

Affiliation address _____

Country _____ Telephone _____

Fax _____ Email _____

Registration fee:

- | | |
|--------------------------------------|--------------|
| <input type="checkbox"/> EDS members | €2500 |
| <input type="checkbox"/> Non-members | €2700 |

The fee includes 5 nights accommodation, lunches, coffee, dinners, course Workbook and CD.

Payment can be made by:

Credit card

☐ Visa ☐ Mastercard

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