



# Integrated & Responsible Solutions



# The Company

**TEMAK** is a Greek Company founded in 1972 with the purpose to study, design & manufacture Water Treatment Systems.



## Headquarters



## Production Department



# Certificates

## ISO 9001: 2015 Production Quality



**CERTIFICATE**

Management system as per  
**ISO 9001: 2015**

In accordance with TUV NORD CERT procedures, it is hereby certified that

**TEMAK S.A.**  
62, Tatoi Str.  
158 77 Athinas (Merisi) Attika, Athens  
Hellas



according to the substructure:  
applies a management system in line with the above standard for the following scope:

- Design, Development, Production, Storage, Installation, Servicing and Sale of Water Treatment Systems, Chemical Products and Industrial Equipment
- Operation of Water Treatment Systems

Certificate Registration No. 041 10 0022  
Valid from 2018-07-01  
Valid until 2020-07-01  
Initial certification 2016

Valid from 2018-07-01  
Valid until 2020-07-01  
Initial certification 2016

Certification Body  
at TUV NORD CERT Group

This certification was conducted in accordance with the TUV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.

TUV NORD CERT Group  
Langermannstrasse 33  
46149 Essen  
www.tuv-nord.com



TUV HELLAS S.A. JSC, Messolonghi Ave., 105 62 Chalkida, Attika, Greece

## ISO 14001: 2015 Environmental Quality



**CERTIFICATE**

Management system as per  
**ISO 14001: 2015**

In accordance with TUV HELLAS (TUV NORD S.A. procedure), it is hereby certified that

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Certificate Registration No. 041 10 0010  
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Initial certification 2015

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Initial certification 2015

Certification Body  
TUV HELLAS (TUV NORD S.A. Certification Body)

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TUV HELLAS S.A. JSC, Messolonghi Ave., 105 62 Chalkida, Attika, Greece

## EC CERTIFICATE



**ΕΘΝΙΚΟ ΚΕΝΤΡΟ ΑΣΦΑΛΙΣΗΣ  
ΤΗΣ ΥΓΙΕΝΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ  
ΕΙΣΗΓΕΙΑ Α.Ε.  
NATIONAL CERTIFICATION CENTER  
OF QUALITY & TECHNOLOGY  
IN HEALTH S.A.**

**ΠΙΣΤΟΠΟΙΗΤΙΚΟ ΕΚ / EC CERTIFICATE**

**ΔΙΑΣΤΡΑΒΕΝ ΙΦΟΚΑΤΑΛΑΒΗ ΠΑΡΑΓΩΓΗΣ ΠΡΟΪΟΝΤΩΝ ΠΟΙΟΤΗΤΑΣ ΑΣΦΑΛΙΣΗΣ**

Επιβεβαιώνει ότι η επιχείρηση παραγωγής προϊόντων ΕΚ, σύμφωνα με το πρότυπο εθνικού θεσπίσματος, το πρότυπο ενσωμάτωσης με το πρότυπο ΕΝ ISO 9001:2015, με την προϋπόθεση της τήρησης των απαιτήσεων του προτύπου, για το κλάδο της παραγωγής, της εγκατάστασης και της συντήρησης των μηχανημάτων, των συστημάτων απορροής αερίων, των συστημάτων επεξεργασίας βιοαερίων, της κατασκευής και της λειτουργίας των συστημάτων επεξεργασίας βιοαερίων, της κατασκευής και της λειτουργίας των συστημάτων επεξεργασίας βιοαερίων, της κατασκευής και της λειτουργίας των συστημάτων επεξεργασίας βιοαερίων, της κατασκευής και της λειτουργίας των συστημάτων επεξεργασίας βιοαερίων.

It hereby certifies that the under-mentioned manufacturer has established and maintains a quality assurance system according to the requirements of the applicable standard, Annex V and its incorporation in Greek legislation.

The certificate is valid in respect of the products mentioned in this certificate.

Any significant changes in design or manufacture may render this certificate invalid.

Αριθμός Πιστοποιητικού / Certificate Number: 20001041

Επιχειρηματικό: **TEMAK S.A.**  
Μεταποιητικό: **TEMAK S.A.**  
Εργοστάσιο: **62, ΤΑΤΟΙΟΥ ΣΤΡ., 158 77 ΑΘΗΝΑΙΣ ΑΤΤΙΚΗΣ, ΕΛΛΑΔΑ.**  
Εργοστάσιο: **62, ΤΑΤΟΙΟΥ ΣΤΡ., 158 77 ΑΘΗΝΑΙΣ ΑΤΤΙΚΗΣ, ΕΛΛΑΔΑ.**  
Όργανο: **ΕΘΝΙΚΟ ΚΕΝΤΡΟ ΑΣΦΑΛΙΣΗΣ ΤΗΣ ΥΓΙΕΝΗΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ ΕΙΣΗΓΕΙΑ Α.Ε.**  
Πρόσκληση: **ΠΡΟΣΚΛΗΣΗ ΚΑΤΑΡΤΙΣΤΩΝ ΣΕΜΙΝΑΡΙΩΝ ΔΙΟΧΕΤΗΣΗΣ ΤΕΧΝΟΛΟΓΙΑΣ ΚΑΙ ΠΑΡΑΓΩΓΗΣ ΒΙΟΑΕΡΙΩΝ ΣΥΣΤΗΜΑΤΩΝ**

Κατασκευαστικός Οργανισμός:  
Διεύθυνση Διασφάλισης Ποιότητας, Υγιεινής και Τεχνολογίας  
Εθνικό Κέντρο Ασφάλισης Ποιότητας και Τεχνολογίας  
ΕΙΣΗΓΕΙΑ Α.Ε.  
158701018  
158701003  
158701001

Εκδότης πιστοποιητικού:  
Αθήνα, 2018/07/04



Το Πρωτόκολλο Αξιολόγησης, της Πιστοποίησης και της Συντήρησης της Έκδοσης 041/10/001041 είναι διαθέσιμο στην ιστοσελίδα της ΕΙΣΗΓΕΙΑ Α.Ε. στην διεύθυνση [www.eisegiata.gr](http://www.eisegiata.gr).  
The scope of the certification is limited to the manufacturing of products as mentioned in the certificate.  
Οποιαδήποτε αλλαγές στο σχέδιο ή στην κατασκευή μπορεί να ακυρώσει αυτό το πιστοποιητικό.  
Any significant changes in design or manufacture may render this certificate invalid.



TUV HELLAS S.A. JSC, Messolonghi Ave., 105 62 Chalkida, Attika, Greece

## OHSAS 18001: 2007 Occupational Health & Safety Management Systems



**CERTIFICATE**

Management system as per  
**EN ISO 18001:2007/OHSAS 18001:2007**

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# Global Reach

46 years

26 countries

600.000 m<sup>3</sup>/day

# Applications – High Quality Products & Services



**Industrial  
Sector**

**Power  
Plants**



**Public  
Sector**

**Hemodialysis  
Centers  
& Hospitals**



**Tourism  
Sector  
(H.O.RE.CA.)**

**Marine  
Industry**



**Greenhouses  
Organic Farms  
& Other**

**Housing  
Complexes  
& Residence**





# Indicative Installations



## Municipality

Capacity: 1.800m<sup>3</sup>/day  
Feed Water Quality: Sea Water  
Product Water Quality: Potable



## Hospital

Capacity: 35 m<sup>3</sup>/day  
Feed Water Quality: Network  
Product Water Quality: Hemodialysis Standards



## Residence

Capacity: 125 m<sup>3</sup>/day  
Feed Water Quality: Sea Water  
Product Water Quality: Potable



## Hotel

Capacity: 500 m<sup>3</sup>/day  
Feed Water Quality: Sea Water  
Product Water Quality: Potable

# Indicative Installations



## Power Plant

Capacity: 960m<sup>3</sup>/day

Feed Water Quality: Sea Water

Product Water Quality: 300µS/cm



## Food Industry

Capacity: 2.800 m<sup>3</sup>/day

Feed Water Quality: Brackish Water

Product Water Quality: <40µS/cm



## Motor Vessel

Capacity: 60 m<sup>3</sup>/day

Feed Water Quality: Sea Water

Product Water Quality: Potable



## Municipality

Capacity: 4.000 m<sup>3</sup>/day

Feed Water Quality: Heavy Brackish

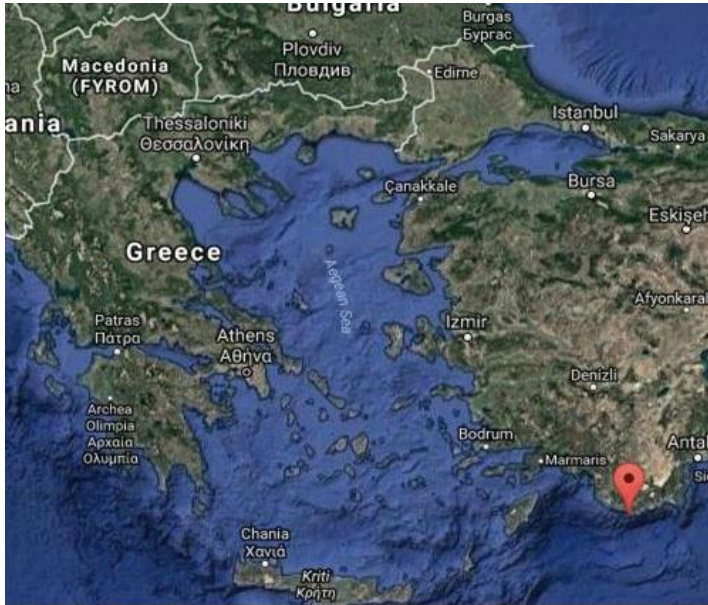
Product Water Quality: Irrigation

# Innovative Solution & Technology – **CASE STUDY**

**AUTONOMOUS REVERSE OSMOSIS (RO) DESALINATION SYSTEM  
POWERED BY A SMALL PHOTOVOLTAIC (PV) SYSTEM  
AT AN ISOLATED GREEK ISLET - *STRONGILI***



## Isolated Islet - Strongili



- 1km<sup>2</sup> Island in the South East Mediterranean sea
- 20 people located on the Islet
- Lacks basic infrastructure (ports, roads, vehicles)
- Not connected to the electricity grid
- No natural sources of fresh water
- Max Daily Water requirements: **4000L/day**

# Water Supply to Strongili Islet ?

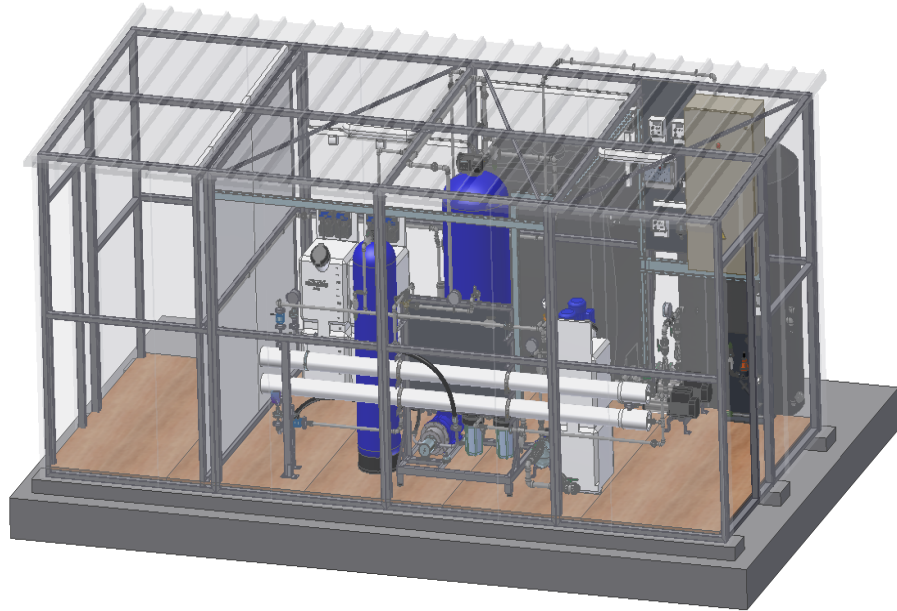
## ***Via small tanker ships***

- High Cost: 20€/m<sup>3</sup> !
- Infrequent Schedule - Once a week ( depending on weather conditions)
- Catering to more than 15 Islets together
- Sometimes.. No water supply for several days!

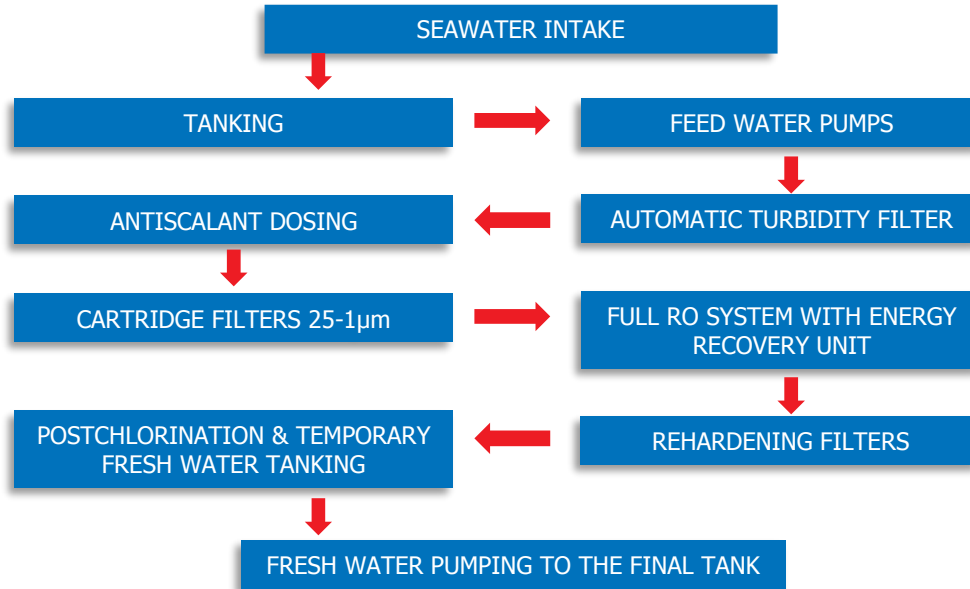
## The Idea?

**PERMANENT** ON SITE WATER PRODUCTION VIA A  
CONTAINERIZED AUTONOMOUS REVERSE OSMOSIS (RO) **DESALINATION**  
**SYSTEM** POWERED BY A SMALL **PHOTOVOLTAIC (PV) SYSTEM**

# The Idea?



# The Solution (Technology & Process Design)





# Design Characteristics

## Reverse Osmosis

- Feed Water TDS: **42.000ppm**
- Open intake Slit Density Index (SDI) **<5**
- RO unit hourly production: **0.85 m<sup>3</sup>**
- Hour of operation: **5 hours**
- Daily production: **4m<sup>3</sup>**
- RO unit recovery: **32.56%**
- Power consumption: **5.4kW**
- Specific Energy Consumption: **6.35kWh/m<sup>3</sup>**

## PV Panels

- PV Panels total capacity: **10kW**
- 39 panels x 260W each
- PV Panels surface : **300m<sup>2</sup>**
- Storage capacity of batteries: **40kWh**
- Battery autonomy: **1.5 days**

## Produced water quality in comparison to the parametric values

PARAMETER	METHOD	UNIT	PARAMETRIC VALUE	RESULT
Hydrogen ion concentration (pH)	ISO 10523:2008	pH units	6.5- 9.5	7.7
Conductivity (25°C)	ISO 7888: 1995	μS/ cm	<2500	<b>656</b>
Total Hardness	ELOT 170: 1980	mg/l CaCO <sub>3</sub>	<100*	26
Alkalinity	ISO 9963-1: 1994	mg/l CaCO <sub>3</sub>		22
Bicarbonate	ISO 9963-1: 1994	mg/l		27
Total Dissolved Solids (as NaCl)		mg/l		314
Barium (Ba)	ICP- MS	μg/l	<700	6.23
Calcium (Ca)	ELOT 169: 1978	mg/l	<100*	9.62
Magnesium (Mg)		mg/l	<50*	<5
Potassium (K)	ICP- MS	mg/l	<12	0.83
Sodium (Na)	ICP- MS	mg/l	<200	4.32
Stroke (Sr)	ICP- MS	μg/l		11.2
Chloride (Cl)	ISO 9297: 1989	mg/l	<250	193
Fluorine (F)	APHA 4500 F-D, 22 <sup>nd</sup> EDITION	mg/l	<1.5	<0.05
Nitrate (NO <sub>3</sub> )	LCK 339	mg/l	<50	<3
Sulfate (SO <sub>4</sub> )	APHA 4500 F-D, 22 <sup>nd</sup> EDITION	mg/l	<250	<7
Silicon Dioxide (SiO <sub>2</sub> )	HACH 8186	mg/l		4.7

*\*Taste, odor and appearance aspects*

## The Challenge

### *Flexibility*

On site assembly of the plant due to transportation and access difficulties

Container and RO unit had to be assembled in the factory



Disassembled and placed on truck to be transported to the shipping port





Shipped to the Island of MEGISTI & Transferred to Island of Strongyli



## Carried Equipment and material on site / Reassembled & Commissioned

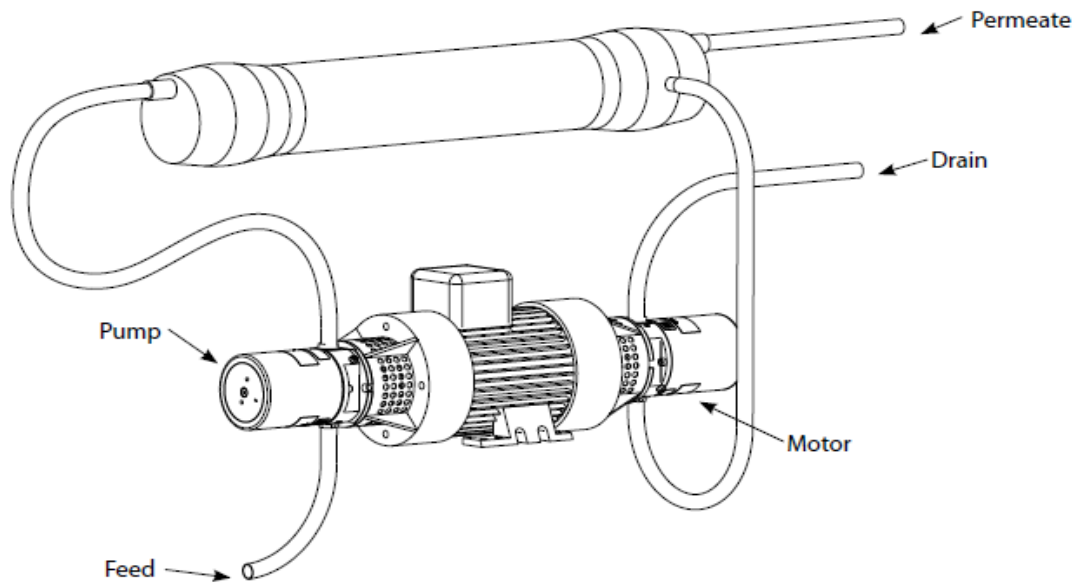


# The Challenge

## ***Minimum power consumption***

ERD device to minimize power consumption and downsize the PV system

- **APP-APM energy recovery device**



Specific Energy  
Consumption:  
**3.45kWh/m<sup>3</sup>**

*Instead of*

**6.0kWh/m<sup>3</sup>**

# The Challenge

## Reliability

Flawless technical design that minimizes the risk of technical problems as there is no alternative water source.

## Robustness

Robust construction that can endure extreme conditions.



# RO Maintenance

- Cartridge filter replacement every 4 months
- DANFOSS APP/APM system service every two years
- Chemical cleaning (*not made yet!*)
- Membrane changes : Every 5 years, according to membrane guideline

# PV Maintenance

- Check once a year, the level of electrolytes contained in batteries and filling them with RO product water
- Battery replacement, after 13 years of operation (2000 Cycles)

## Return on Investment

### Operation Parameters (for 3 years operation)

Battery Life [cycles]	Hours or system operation in 3 years (data from control panel) [hr]	RO Hourly production [m <sup>3</sup> /hr]	m <sup>3</sup> product/year	Water transportation cost/ m <sup>3</sup> [€]	Water transportation cost/ year	RO operation cost/ m <sup>3</sup> [€]	RO operation cost/year [€]
2000 (corresponds to 13 years but estimated 10 years)	<b>1067</b>	0,85	<b>302</b>	20	6,040	0,05	16

*The water up to 2012 was transferred to Strongili Island by an army's boat, with a cost higher than 20 €/m<sup>3</sup>.*

### Full Capacity Operation Cost (365 days/year, 5h/day)

<b>Interest rate</b>	8%
<b>NPV</b>	133.651,79 €
<b>IRR</b>	26%
<b>Payback time&gt;[years]</b>	4

*The NPV and IRR values in case of full operation (5 hours/day and 365 days/ year) of the system are presented.*

*The production per year will be 1551.3 m<sup>3</sup> instead of 302 m<sup>3</sup>.*

*if the system operated in full capacity, it would be a profitable investment with an NPV of 133.651,79 € and the IRR around 26%, and a payback time of 4 years.*

# Conclusions

- The presented system proved to be an ideal solution for ensuring constant fresh water in an isolated region that lack basic infrastructure or suffer from drought region:
  - Fully Autonomous solution (Independent of electrical grid)
  - Fully Automatic
  - Highly reliable and robust
  - Minimum operational requirements and cost

## More importantly!

- A profitable investment: Payback time < 4 years since cost of production of water by RO is 0.05 €/m<sup>3</sup> instead of 20 €/m<sup>3</sup> of that shipped by water tankers.

# INTERNATIONAL AWARDS



مبادرات محمد بن راشد آل مكتوم العالمية  
Mohammed Bin Rashid  
Al Maktoum Global Initiatives

**SECOND PRIZE**







**THANK YOU  
FOR YOUR KIND ATTENTION!**