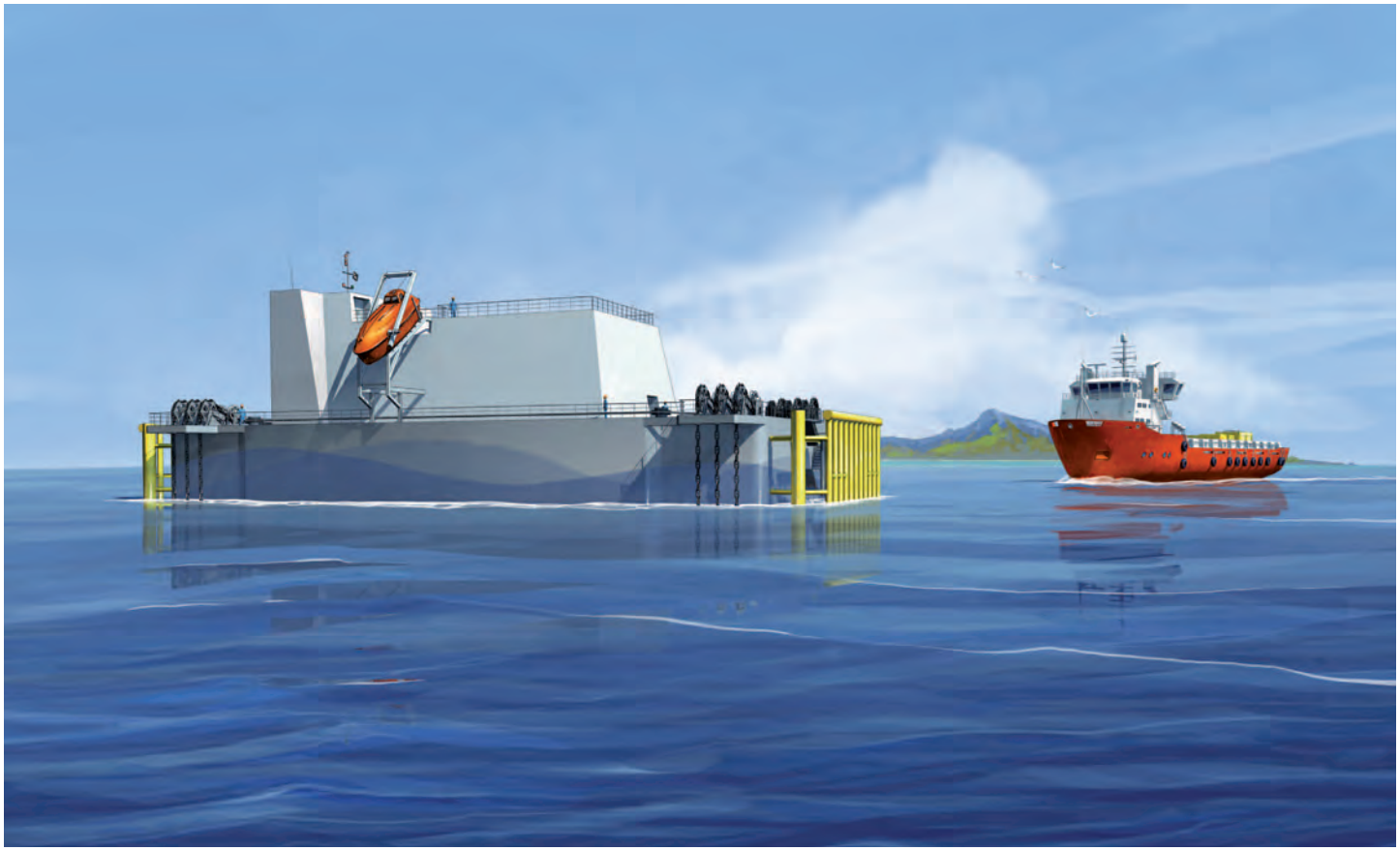


Ocean Thermal Energy Conversion

A MARINE RENEWABLE ENERGY PRODUCTION SYSTEM FOR TROPICAL AREAS

Objectives

DCNS' ambitious goals in this area are to:

- develop and build a 10 MW offshore pilot plant
- establish partnerships with contractors in France and abroad with complementary capabilities
- assess the feasibility of building OTEC plants around the world

→ **UNLIMITED OCEAN THERMAL RESOURCE IN TROPICAL SEAS**

→ **STABILIZED AND CONSTANT ELECTRICITY PRODUCTION (24/7 BASELOAD ELECTRICITY AND STEADY FLOW OF POWER TO THE GRID)**

→ **POTENTIAL CO-PRODUCTS (FRESH WATER, ...)**

STRENGTH AT SEA

DCNS

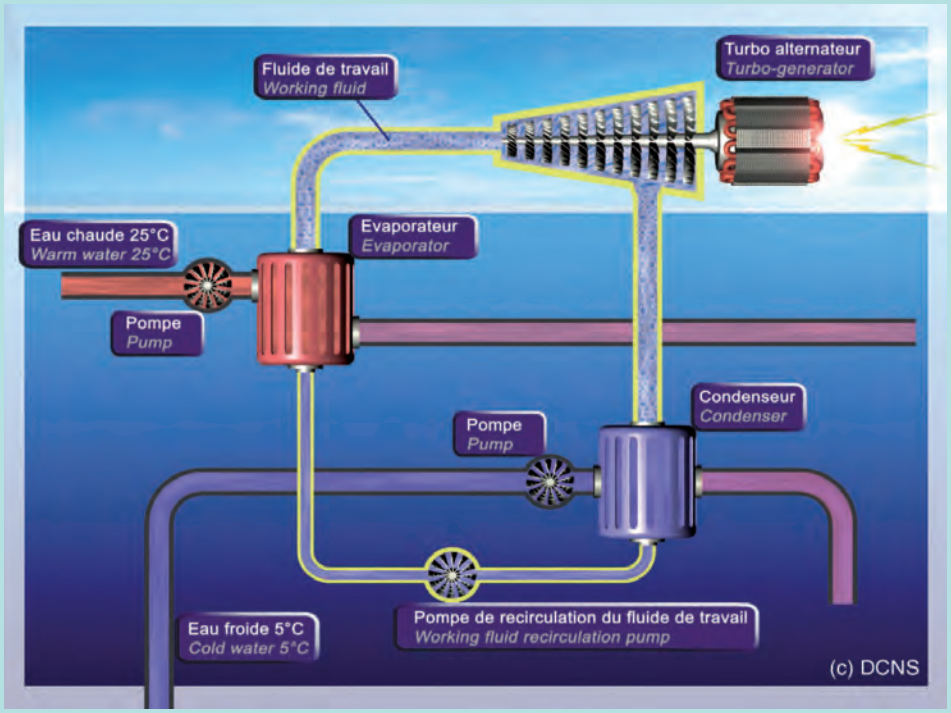
DCNS in Ocean Thermal Energy Conversion

- Ocean Thermal Energy Conversion uses tropical seas temperature gradient of 20°C, existing naturally between sea surface water about 25°C and cold deep water (-1000m) about 5°C to produce electricity.

- DCNS plans to build a pilot plant to validate the technology and demonstrate its benefits for electricity utilities in tropical areas wishing to reduce their dependence on fossil fuels.

- **End 2009: 5M€ project signature**, in partnership with La Réunion regional council, and French estate (economic recovery plan), for the construction of a land base prototype.

- **2010-2011:** DCNS responded to **European commission NER 300 call for tender**, with Martinique regional council and STX for a **10 MW pilot plant construction in 2015**.



Operating principle

OTEC Land Based Prototype

A small scale prototype of OTEC energy

DCNS teams designed **several OTEC** thermodynamic cycles with different key components linked to **numerical models**. The land-based prototype, called in french PAT ETM, aims to test these different configurations to **confirm and correct theoretical results**.
OTEC **key components, such as heat exchanger**, will be **tested** on the prototype and other thermodynamic fluid could be tested.

OTEC Land Based Prototype Advantages

- Fully – autonomous OTEC energy production system prototype
- Adjustable to different key components and thermodynamic cycles
- Removable and re-buildable

In the prototype, heat exchangers are 3 or 4 meters long. On a real scale, they reach a 12 meter length and a 4 meters diameter.

2009-2010
Conception & construction and first tests in DCNS Nantes-Indret France

OTEC Land Based Prototype in Nantes Indret

"DCNS aims with the OTEC Land Based Prototype" to:

- Validate OTEC energy production system to secure future investment in OTEC full scale offshore plant.
- Test several OTEC **thermodynamic cycles and key components** simulating seawater temperatures
- Adapt and approve numerical models on OTEC energy production system
- Train DCNS teams to OTEC plant working.

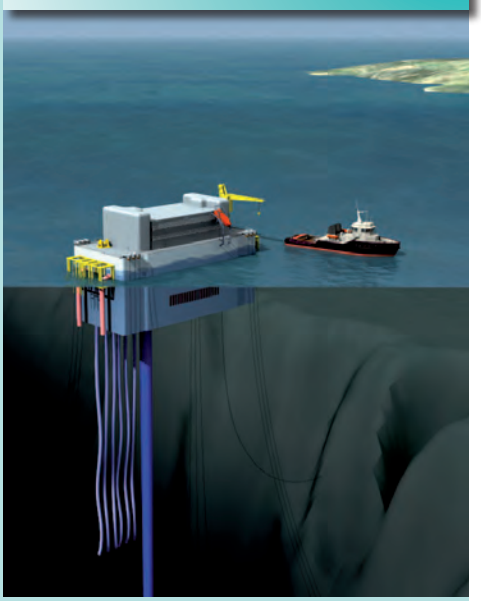
production system

2011
Shipping and re-assembly in La Réunion island on the University campus as a research and training tool on OTEC

Objective: OTEC Pilot Plant

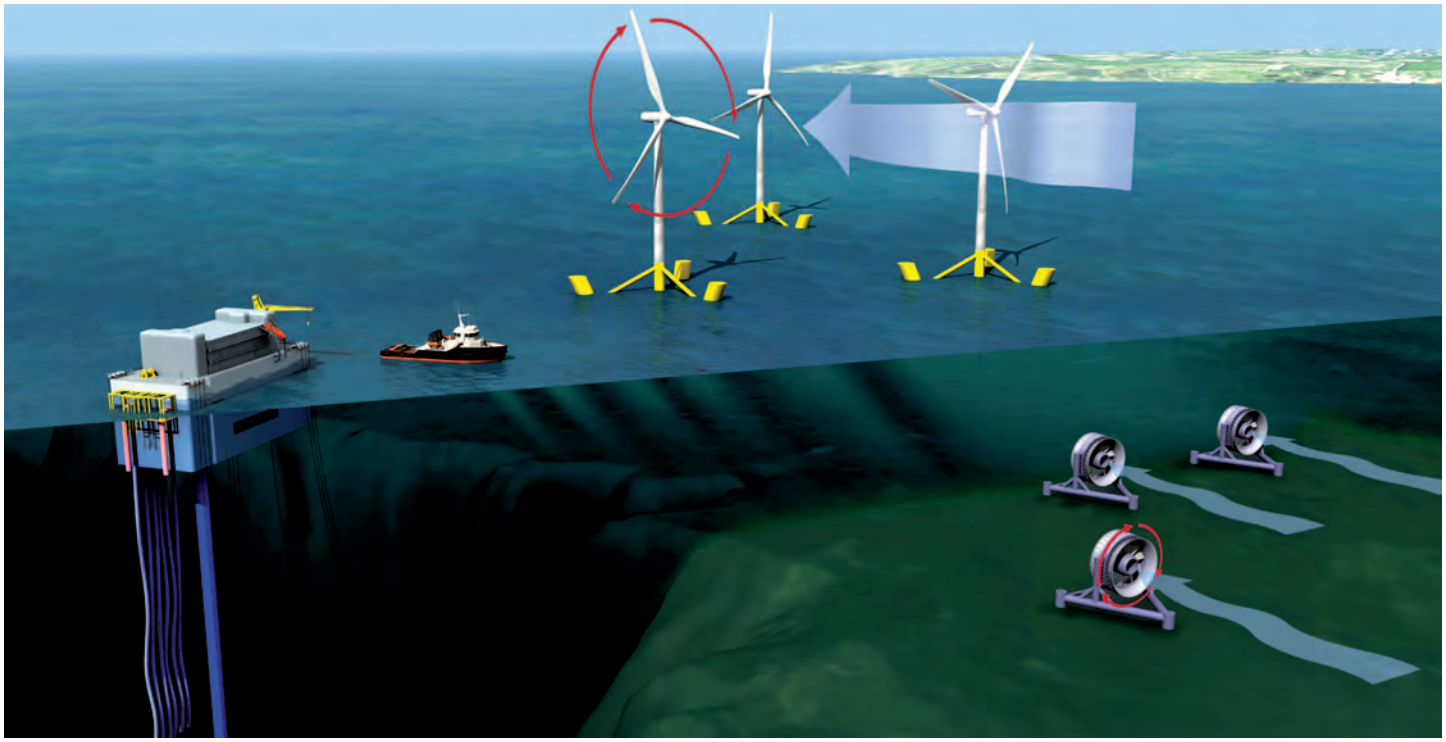
A full scale OTEC plant

2015
OTEC offshore pilot plant at La Martinique (10 MW)



Ocean Thermal Energy Conversion

A marine renewable energy production system for tropical areas



An innovator in energy

"Marine renewable energies represent a development opportunity for DCNS. The technology, industrial means and expertise that we master enable us to cover the complete cycle of these new power production systems: conception, construction and maintenance."
(Bernard Planchais, Executive Vice-President & Chief Operating Officer)

DCNS, through its Incubator, considers every types of marine renewable energies and aims to participate, with its partners, to large demonstrators' developments. These projects will serve as precursors to industrial scale-up and applications.
To realise this ambition, the Group is investing in four sustainable marine energies:

- Offshore wind
- Tidal stream energy
- Ocean Thermal Energy Conversion (OTEC)
- Wave energy

DCNS
40-42, rue du Docteur Finlay
F-75732 Paris Cedex 15
www.dcnsgroup.com

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