REUNION Island
SWAC project : key energy infrastructure for the long term

Second Regional Conference on SWAC, OTEC and District Cooling Technologies in Latin America and the Caribbean

Panama City, October 26 – 2015

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ADEME: 3 main Playing Fields

- Energy: Renewables, Energy Effciency
- Environmental Protection Agency (French EPA)
- R&D, innovation in key sectors (low carbon economy)

17 Regional Offices nationwide

(4 overseas Teams in Tropical areas)

ADEME: partner of communities, private investors…..
expertise, financing, EU energy community networking

REUNION ISLAND in THE INDIAN OCEAN


REUNION ISLAND

SWAC project presentation: Northern Part of REUNION Island

Marine Cooling District System
Saint Denis and Sainte Marie
REUNION ISLAND

Sea Water Air Conditioning (SWAC)

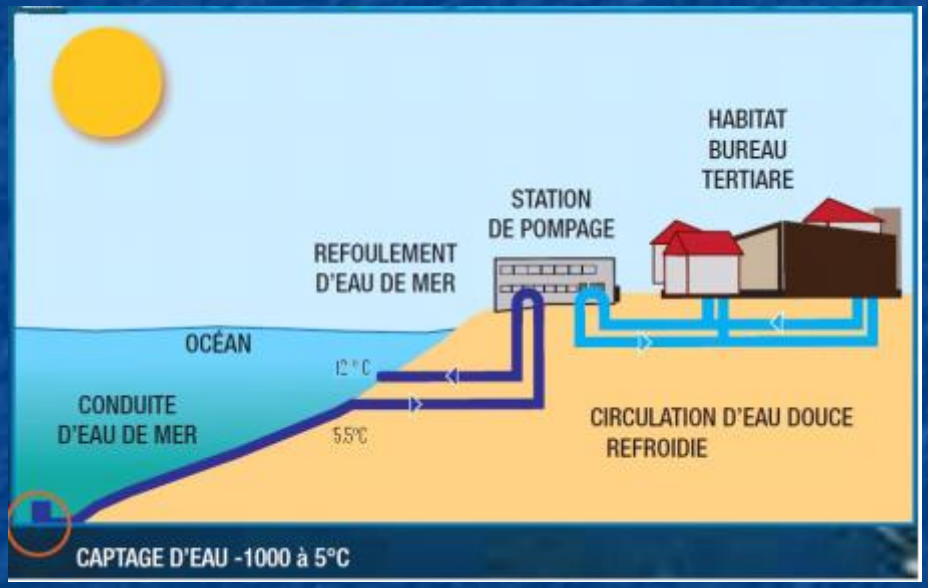


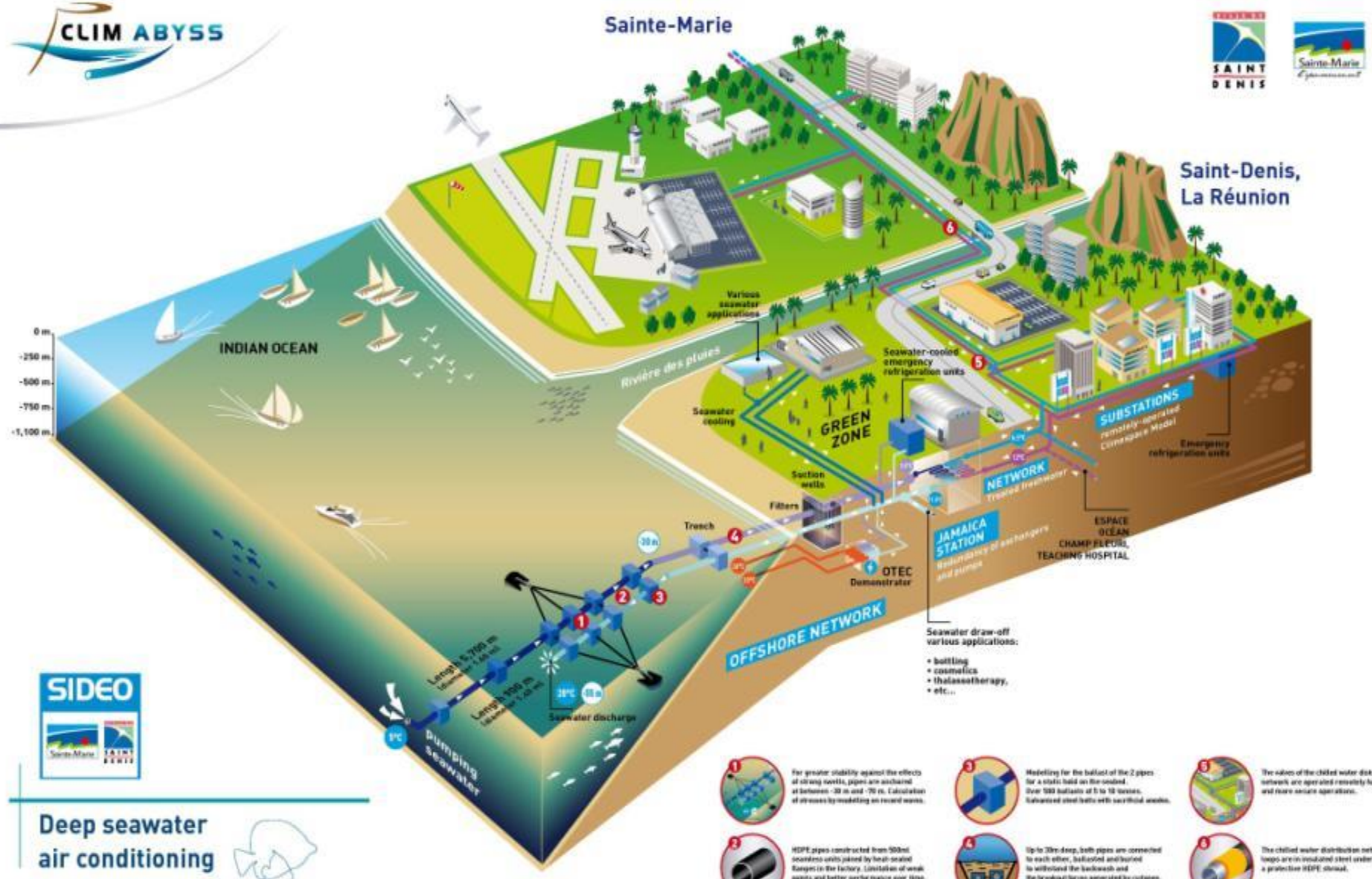
Photo courtesy of Makai Ocean Engineering

UNION EUROPEENNE

26 October 2015

CLIM ABYSS

Deep seawater air conditioning



SIDEO

"Energy is our future, let's save it"

CLIMESPACE GDF Suez

ENGIE

Energy performance of the SWAC project in the Reunion island context

From 90% to 75% energy efficiency according to the load ratio of the distribution system (number of clients).

40 GWh : Power consumption avoided annually (30 GWh in the first stage). Electricity generation from fossil fuels at 65% (by 2014) in Reunion island (50% by 2020).

SWAC project will avoid the emission of 600 kt CO2 in the life time of the SWAC installation

→ this represents the emissions of 16 000 vehicles during 24 years.

Other SWAC systems to be implented at the world level

- Honolulu (Hawaii) : Urban distribution system coupled to a hybrid SWAC + Cooling generation unit. Depth : 500m – Temperature : 10° C – Cooling Capacity : 70 MWth Basic engineering studies realised – Implementation ?

- Bahamas : Resorts of 2250 rooms connected to a SWAC. Depth : 950 m – Temperature : 5° C – Cooling Capacity : 40 MWth with sucking pipe of 4.15 km and pipe diameter of 1400 mm – Implementation ?

- Curaçao (Dutch Antillas) : Airport cooling delivery by a SWAC system coupled with a Deep Ocean Water Applications (DOWA). Bathymetric survey ahieved in April 2012 (Makai)

- Tetiaroa (French Polynesia) – second luxury resort with a SWAC system (first project was made in Bora Bora - 2006 - Intercontinental) – Capacity : 4MWth – commissioned in 2013

- Hospital center at St Pierre (Reunion island) – Projet initiated by EDF with the support of ADEME (feasibility studies realised). Call for tenders launched by hospital in September 2015. Financing by ADEME / AFD / CDC to be confirmed

Other potential projects : Hospital in Tahiti, Mauritius, Mayotte, Malte, Canary islands, resorts in the Caribbean islands , Latin America,…

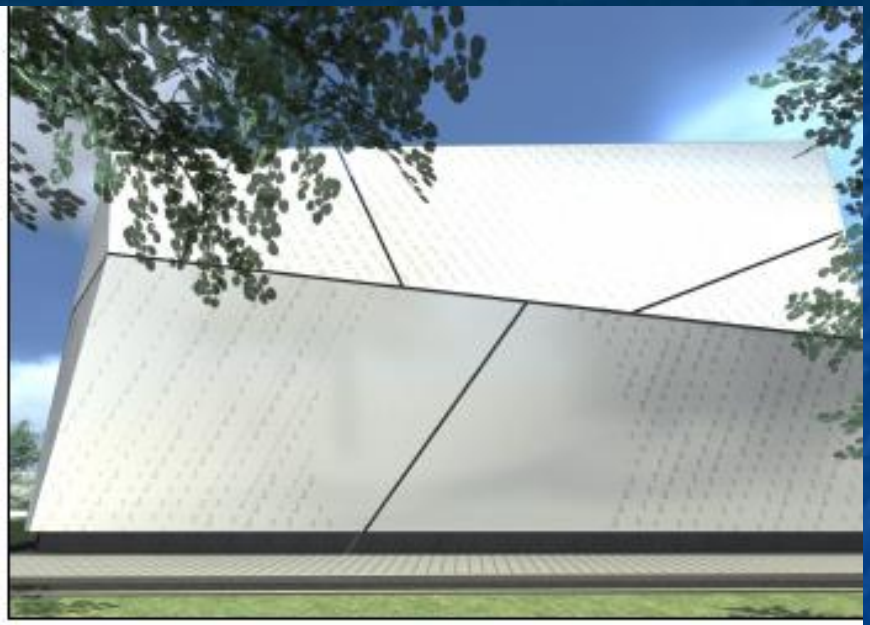
District cooling network within the communities of Saint Denis and Sainte Marie

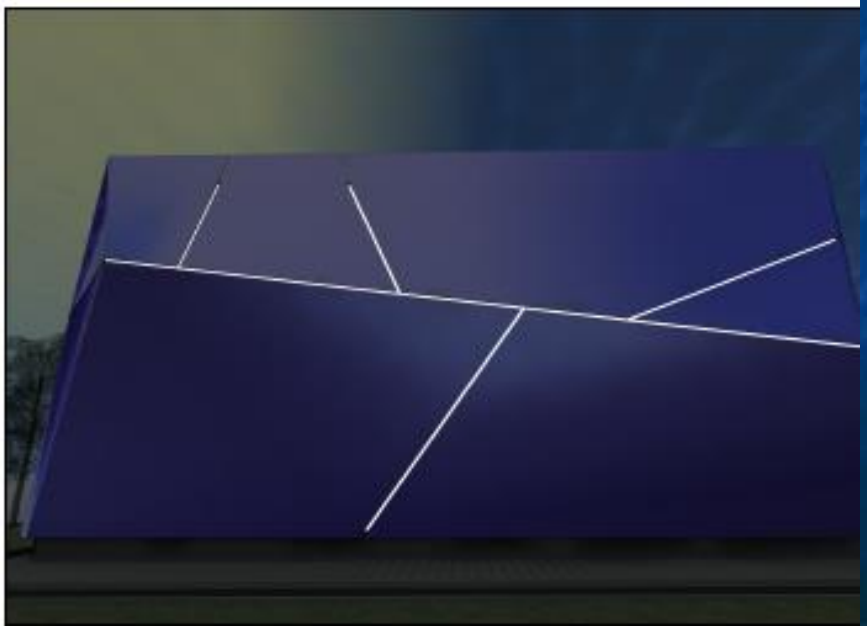
Implementation schedule (2 x 23 km of distribution pipes)

- 2016 / 2017 - Offshore works, Pumping station, Network : Chaudron, Technopole, Champ Fleuri, Hospital center
- 2017 / 2018 - Network : Sainte-Clotilde area, airport
- 2018 / 2019 - Network Duparc area, La Mare, Large Mall « Espace Ocean »

PUMPING STATION

PUMPING STATION





SWAC POSITIVE IMPACTS AT REGIONAL LEVEL

- Electricity consumption from the grid : **75%** off versus conventional cooling supply(stand-alone chillers)

- Avoid electricity generation by coal-fired power plant or oil-fired power plant in compliance with the EU 2030 objectives

- Avoid the emission of polluting gases (with a high greenhouse factor) and sanitary impacts with conventional cooling systems (hospital, airport, university, shopping centers,…)

- High potential to develop new deep sea water applications (resources – 1000 m)

- First large scale deployment of a green technology in the island environment

- Long term Energy infrastructure (expected life > 50 years) with very low environmental impacts

Economics

- Connection fees : **No extra costs** for the clients with existing cooling facilities

- Operation : No more concerns for the Maintenance and the refurbishing of cooling facilities

- End of noise and vibration impacts **generated by stand-alone chillers**

- **Compliance** with EU environmental regulations

- **Secure cooling supply by additional production (**ie SWAC system + stand-by Chillers for hospital energy needs)

- **Green image** for large companies having high environmental commitments

- 80% of the Tariff depending on long term bank debt

TARIFF STRUCTURE

• **Tariff depending on the number of hours at full power capacity (Energy/Power Capacity)** and peak demands in power

. **Tariff structure with two components**:

- Fixed tariff : cooling power contracted,
- Variable part : Thermal energy consumed and flow of water crossing the heat exchanger (incentives for energy efficiency)

❑ **Upto 2022 :**

Tariff SWAC aligned with stand-alone production costs

❑ **From 2022**:

Smart evolution of the tariff no more correlated with the market electricity prices (bonus for the clients on the long term)

Global Energy Efficiency Initiative

Task Force agreed between Clim Abyss, ADEME, University, Regional Council, Energy Cluster, SYREF (professional organisation dedicated to cooling business) to focus on

- the **dynamic behavior of buildings** : modeling buildings to specify their energy profile and identify potential energy savings,
- the **energy management of the buildings** connected to the SWAC
- the SWAC system linked to a **smart grid approach**: analysis at smaller scale (block of buildings) to limit electricity peak load (regional grid)

Major outcomes expected :

- **Cooling power limitation** : Clim Abyss could connect more clients owing to a better management of energy supplied.
- **Matching the cooling demand for residential sector with the energy profile of business sector (supply during nights and week-ends)**

Contractual matters
and
Financial aspects

STEP BY STEP…PROCESS

- First resource evaluation (SWAC) — August 2008
- Feasibilty studies launched by the two communities — December 2009
- SIDEO (two communities: Saint Denis and Sainte Marie) — March 2010
  - SIDO represents the communities involved
  - SIDEO: a legal obligation for energy distribution systems
- Launch of the European Call for tenders by SIDEO — July 2010
- Deadline for submitting proposals — December 2010
- Negociation and signature of contract (concession mode) — April 2011
- Phase 1 of the contract (permiting, commercial agreements, financing — To date

CONTRACTUAL ASPECTS

- Concession contract between SIDEO and **CLIMABYSS** :

  ENGIE and CLIMESPACE (87,5%), LA CAISSE DES DEPOTS ET CONSIGNATIONS (12,5%). PROPARCO (AFD) intends to join shortly

- Exclusive concession to supply cooling energy by district cooling network for Saint Denis and Sainte Marie municipalities

- The contracting company is in charge of design, building, operation and financing

- The contracting company will operate at its own risks for a 24 year period

FINANCING

(Public subsidies : 58% of investment costs)

ADEME : Promotion of projects dedicated to heating and cooling distribution networks if renewable energy contribution is over 50% (for this project : 20 M€)

TAX SCHEME: Specific tax scheme for projects located in islands (French overseas)

FEDER : European support for large infrastructures in Member States (PO 2015-2020) with a specific focus on renewables and energy efficiency

REGIONAL COUNCIL: additional financing resources coupled with FEDER

OTHER TAX INCENTIVES FOR ISLANDS : VAT, importation tax exemptions

SPECIFIC SUPPORT TO PROMOTE ENERGY EFFICIENCY OVERSEAS

◊ The electricity tariff in la Reunion is the same than in the continental French territory a compensation mechanism is paid to EDF, the local electricity supply Utilities (prices paid by consumers: 8 to 11 c€/ kWh)

◊ A new incentive scheme will be applied in 2015 to promote energy efficiency for large projects in non interconnected islands (overseas) to reduce the financial burden (compensation funds) for the State

◊ Climabyss will receive a part of this compensation for the electricity saved by the SWAC system. The French Energy Regulatory Commission will analyse the project to adjust the level of compensation to be paid.

SWAC Project CLIMABYSS: 150 M€

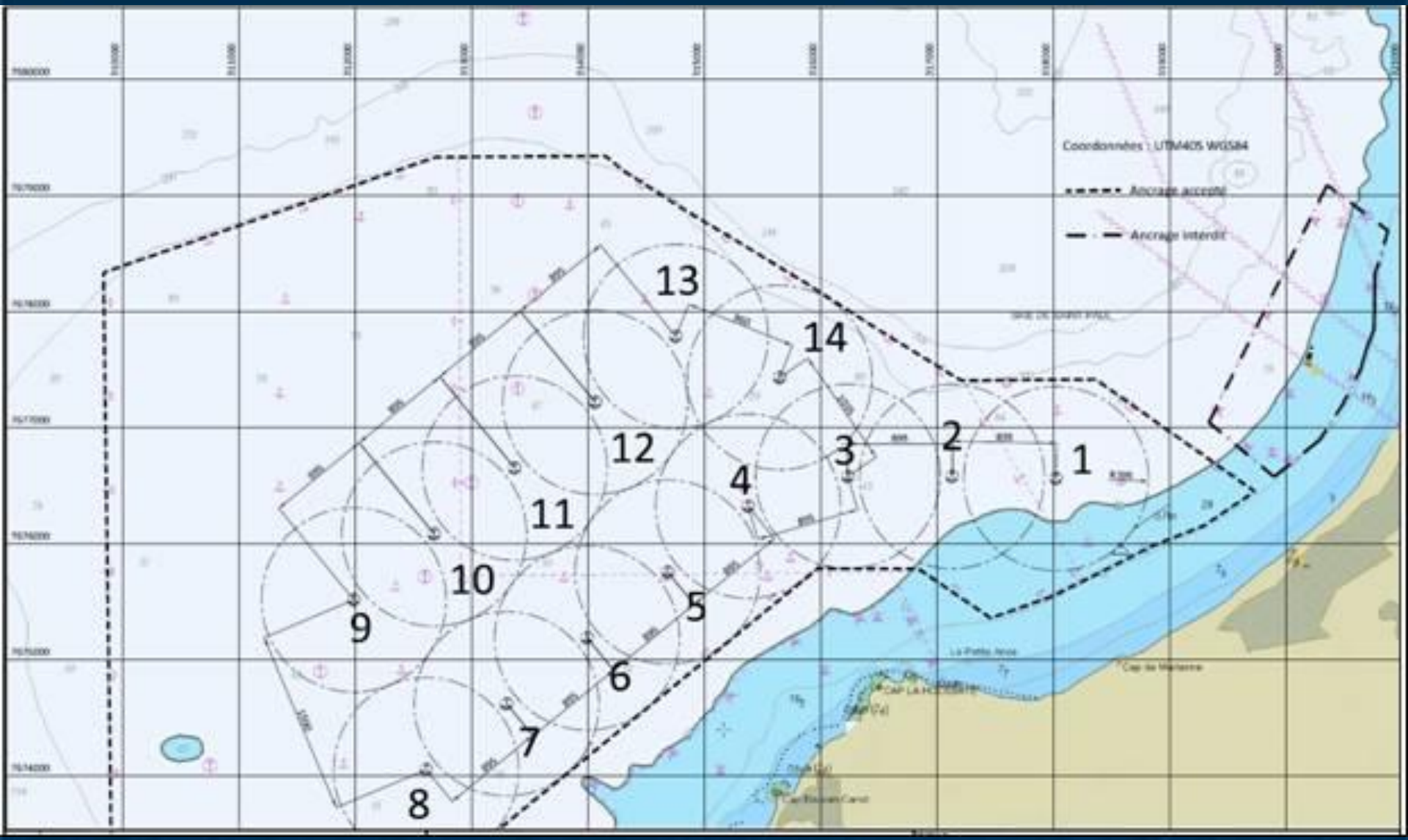
Offshore works	45 M€
Pumping station	22 M€
Cooling urban network	50 M€
Connections (clients)	19 M€
Technical Assistance	9 M€
Insurance, Communication, SIDEO fees	5 M€
Total Amount (VAT & Interest excluded)	**150 M€**

PROJECT SCHEDULE

SCHEDULE DETAILED AND UPDATED

Conditions met to launch operations	December 2015
Manufacturing of offshore pipes	December 2016
Commissioning of Offshore pipes	December 2017
Commissioning of Pumping Station	January 2018
Delivery of cooled water to first clients	March 2018
Achievement of the whole distribution network	End 2019
End of the concession contract (24 years)	2042

Technical aspects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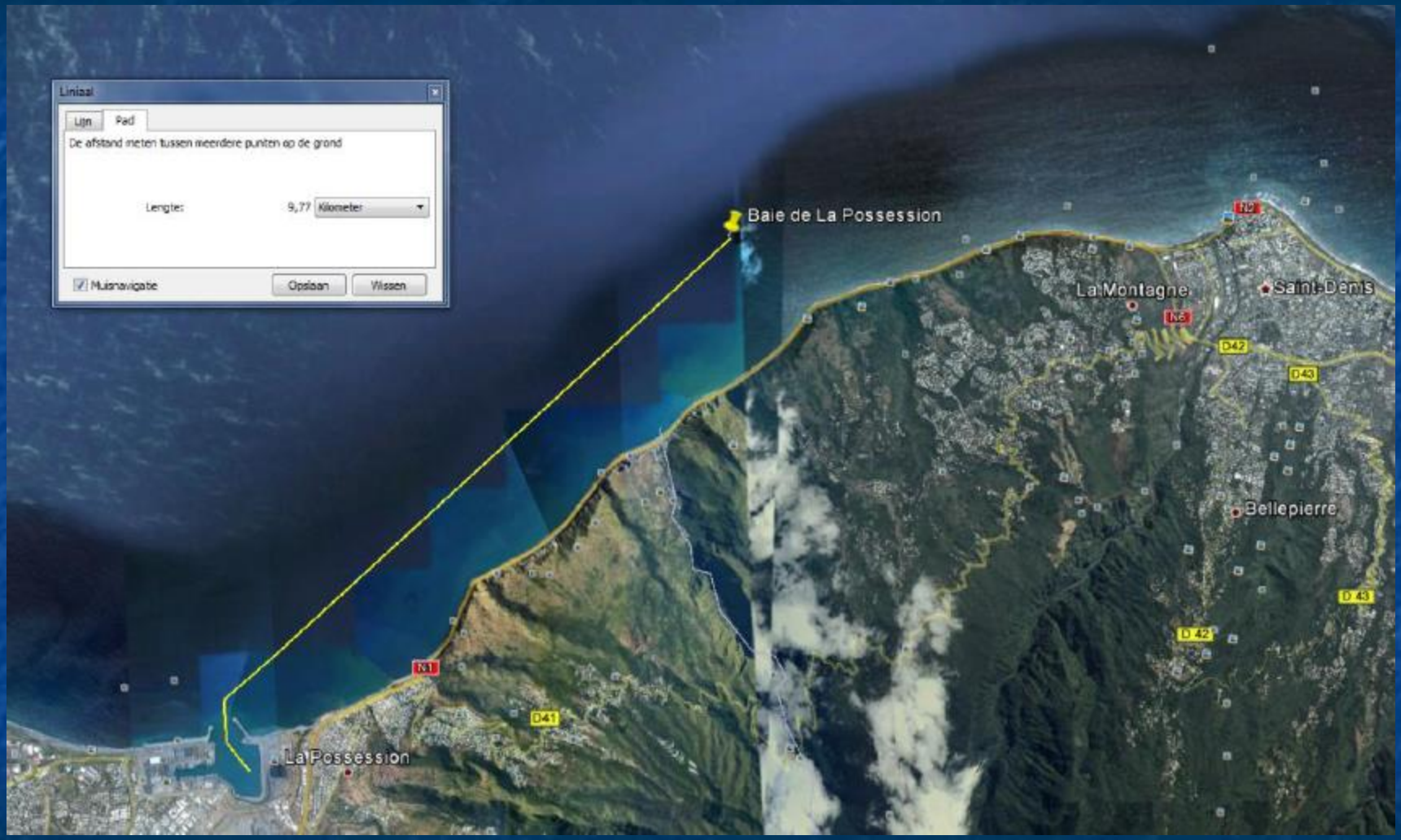
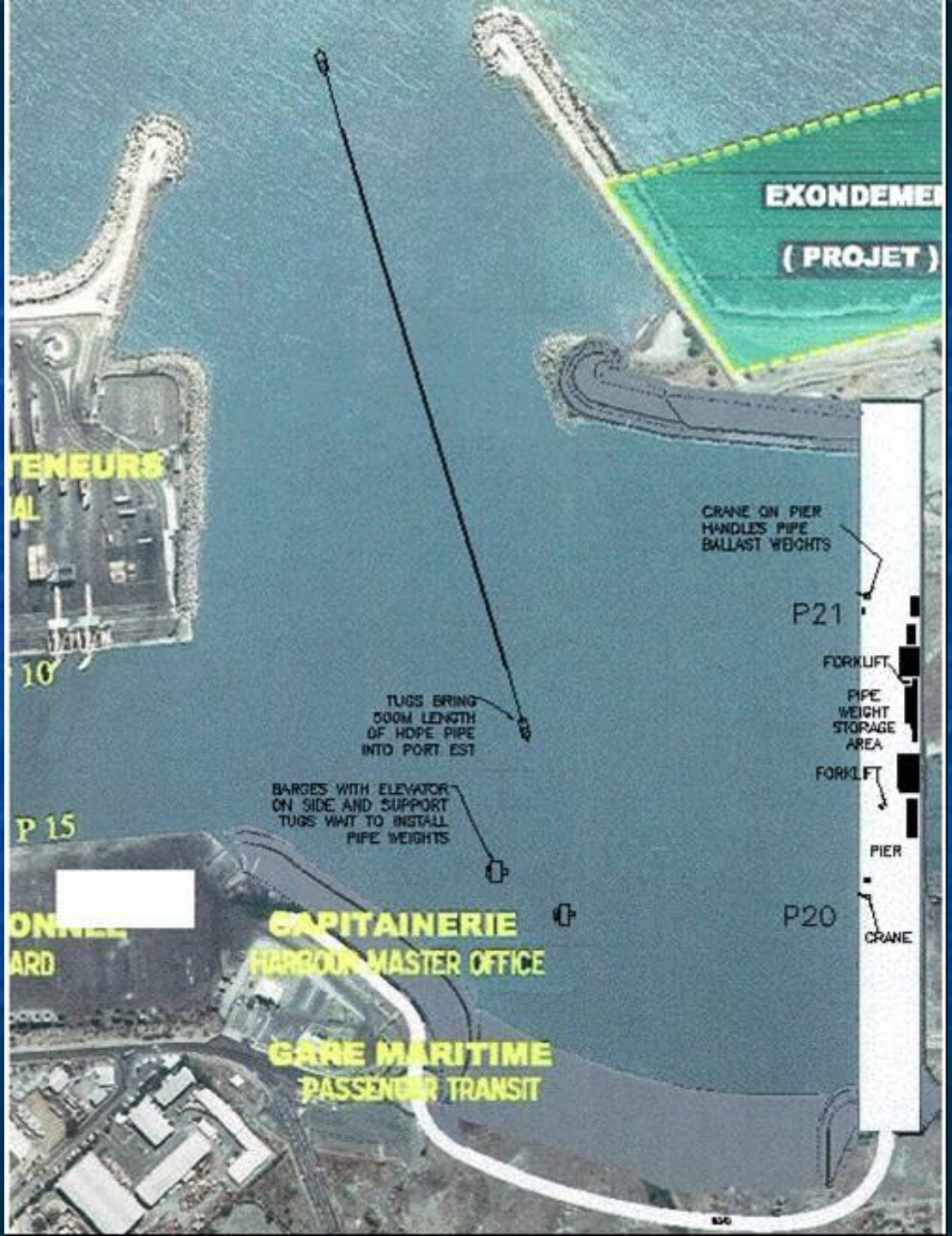
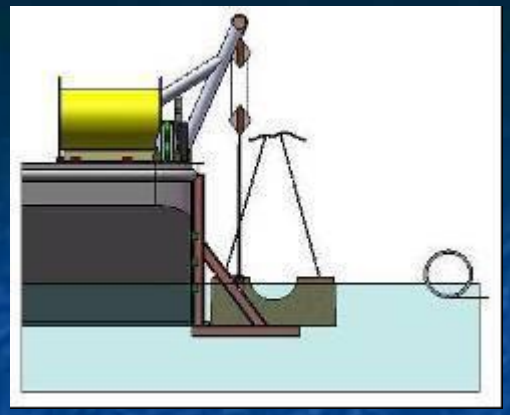
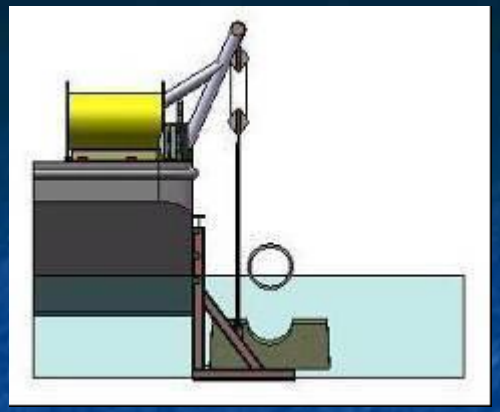
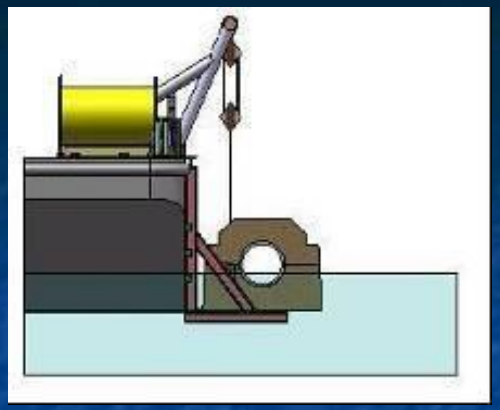
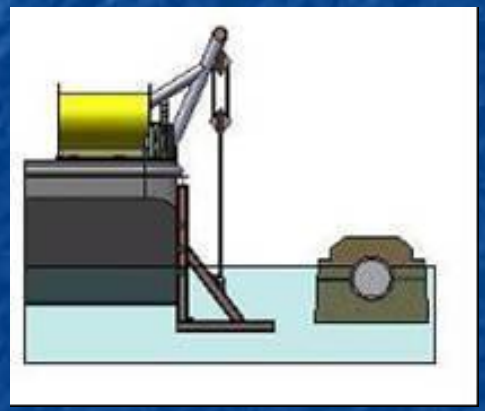

Liniaal
Lijn
Pad
De afstand meten tussen meerdere punten op de grond
Lengte:
9,77
Kilometer
Muisnavigatie
Opslaan
Wissen
Baie de La Possession
La Montagne
Saint-Denis
Bellepierre
La Possession
D41
D42
D43
N3
N6
N1


EXONDEMEN
(PROJET)
CRANE ON PIER
HANDLES PIPE
BALLAST WEIGHTS
P21
FORKLIFT
PIPE
WEIGHT
STORAGE
AREA
FORKLIFT
PIER
P20
CRANE
TUGS BRING
500M LENGTH
OF HDPE PIPE
INTO PORT EST
BARGES WITH ELEVATOR
ON SIDE AND SUPPORT
TUGS WAIT TO INSTALL
PIPE WEIGHTS
P 15
CAPITAINERIE
HARBOUR MASTER OFFICE
GARE MARITIME
PASSENGER TRANSIT


Règle
Ligne
Tracé
Longueur :
614,56
Direction :
179,45 degrés
Navigation à la souris
Enregistrer
Effacer
Stockage des blocs béton





Remorqueur 155T
Traversier/Pousseur
Traversier/Pousseur
- Remorqueur 30T
Traversier/Pousseur
Zone de stockage en mer des conduites préfabriquées
Remorqueur 30T
Remorqueur 15T
Traversier/Pousseur
Remorqueur 15T
Poseur connexion
Google earth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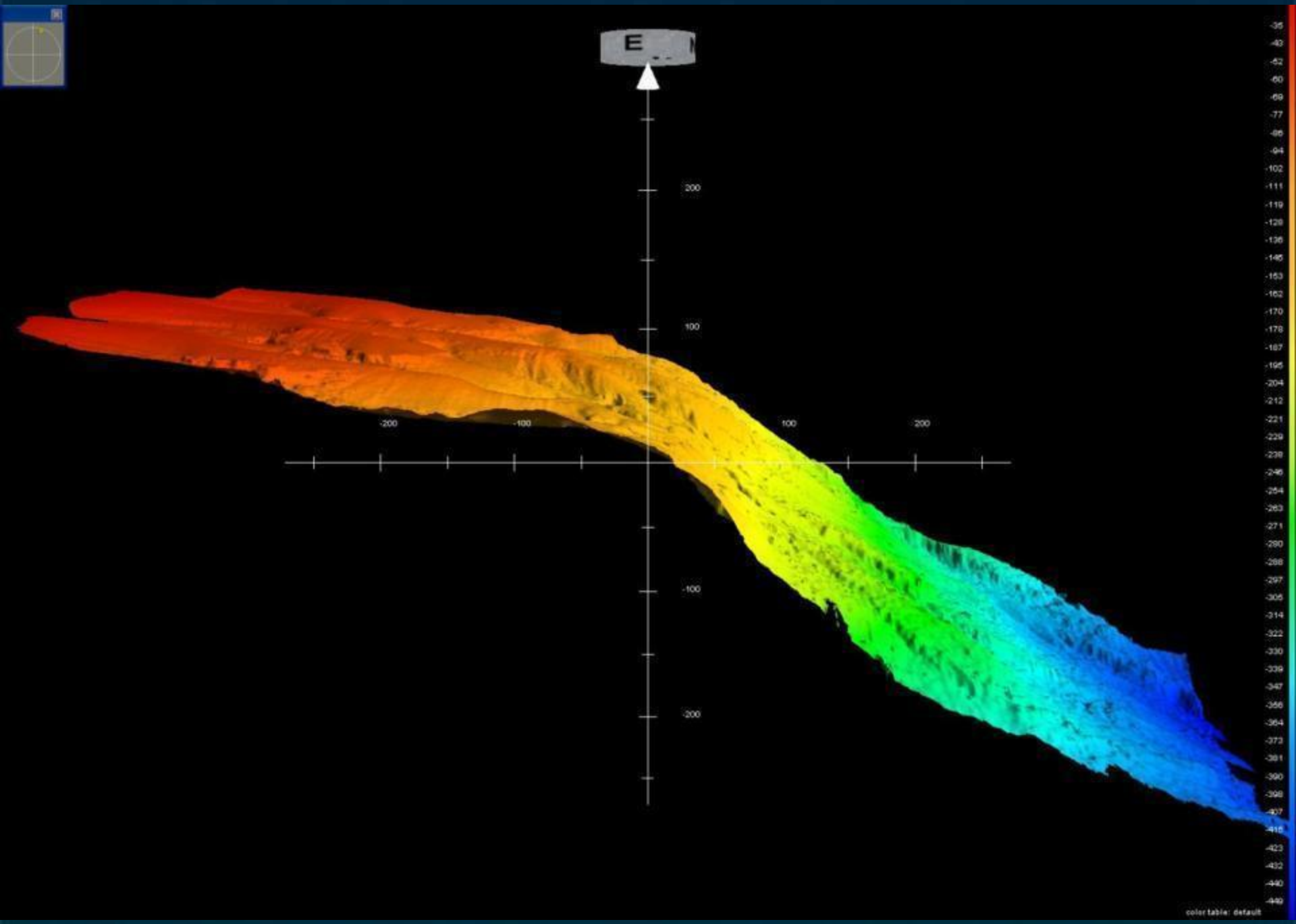
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color table: default

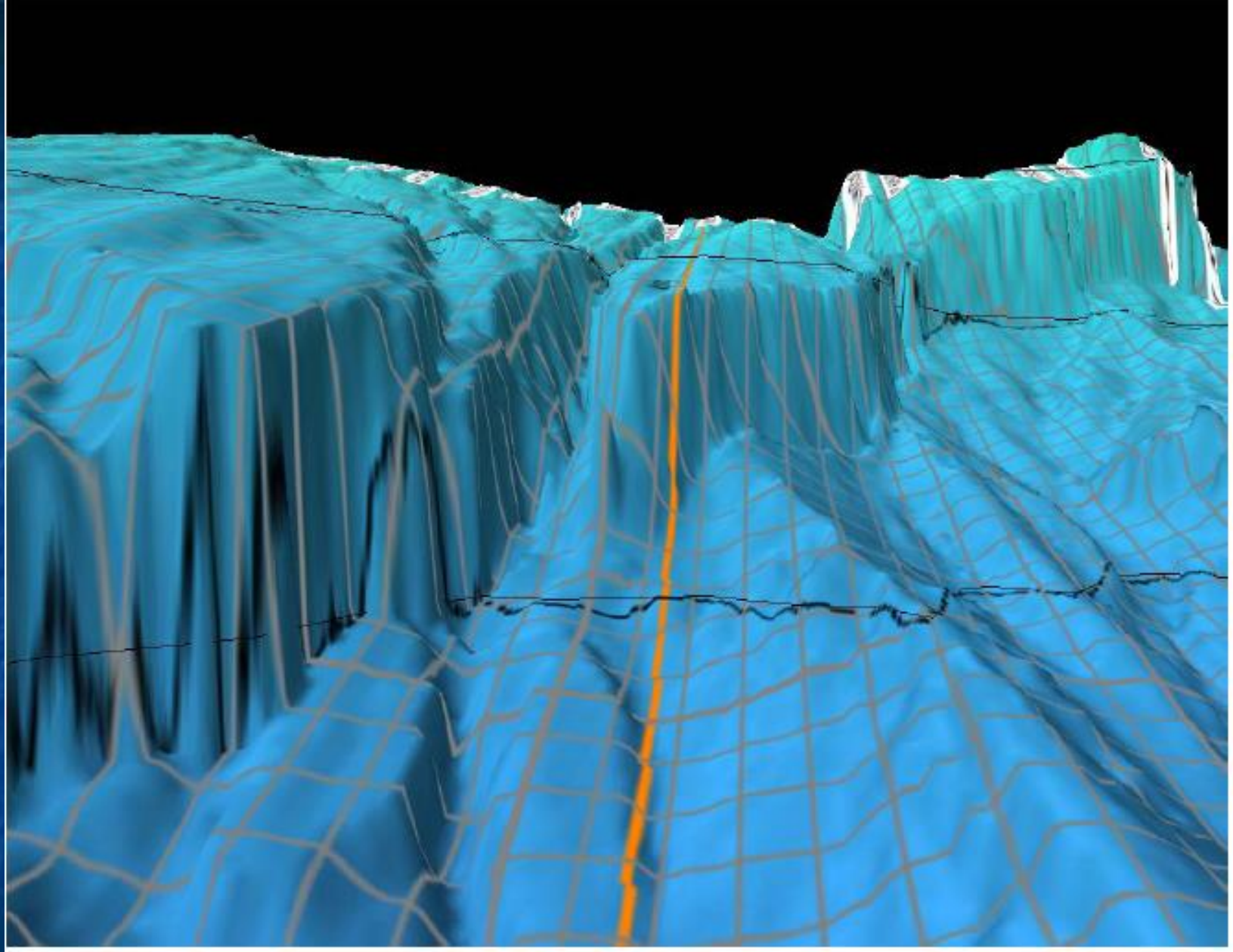
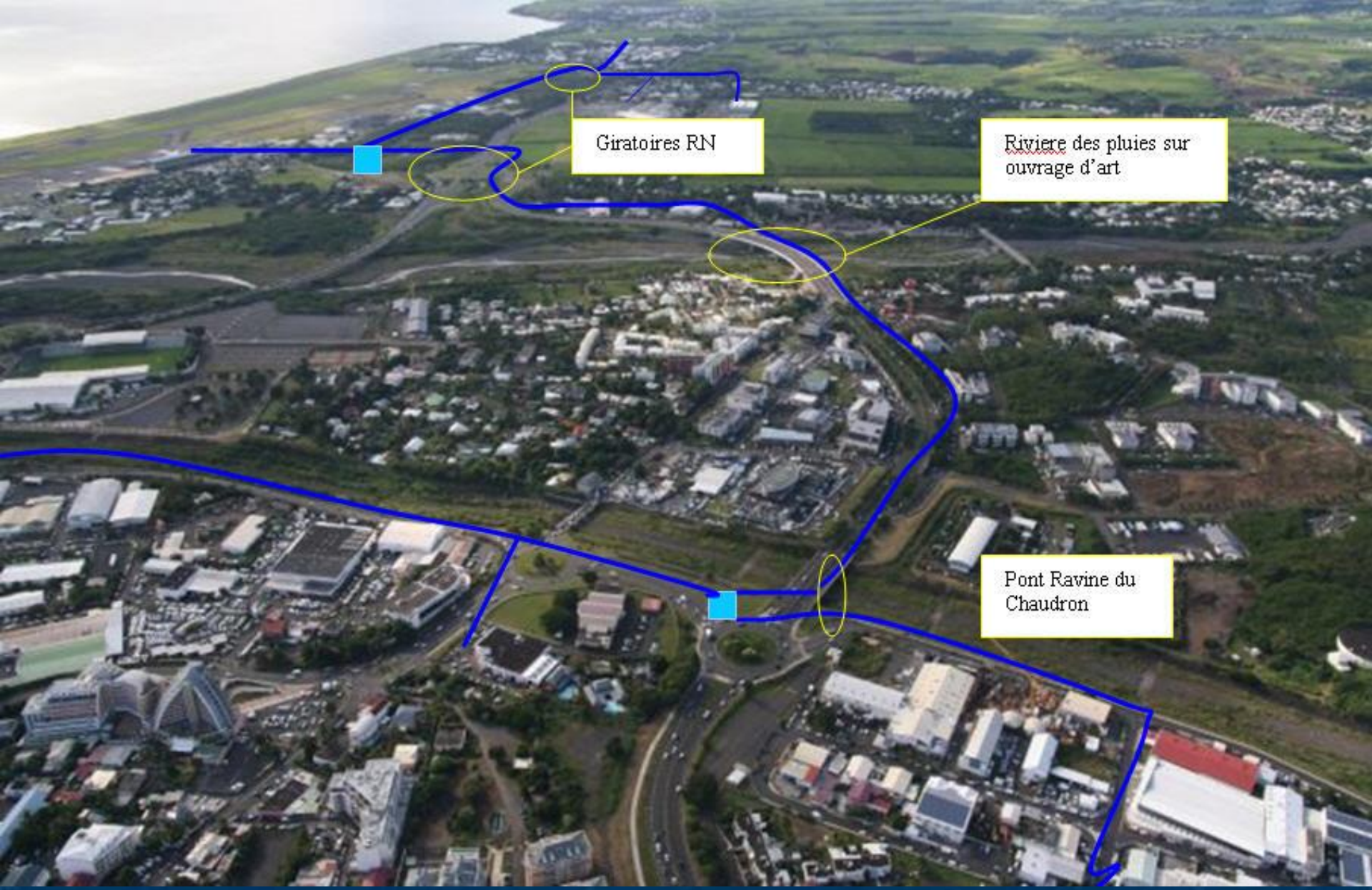
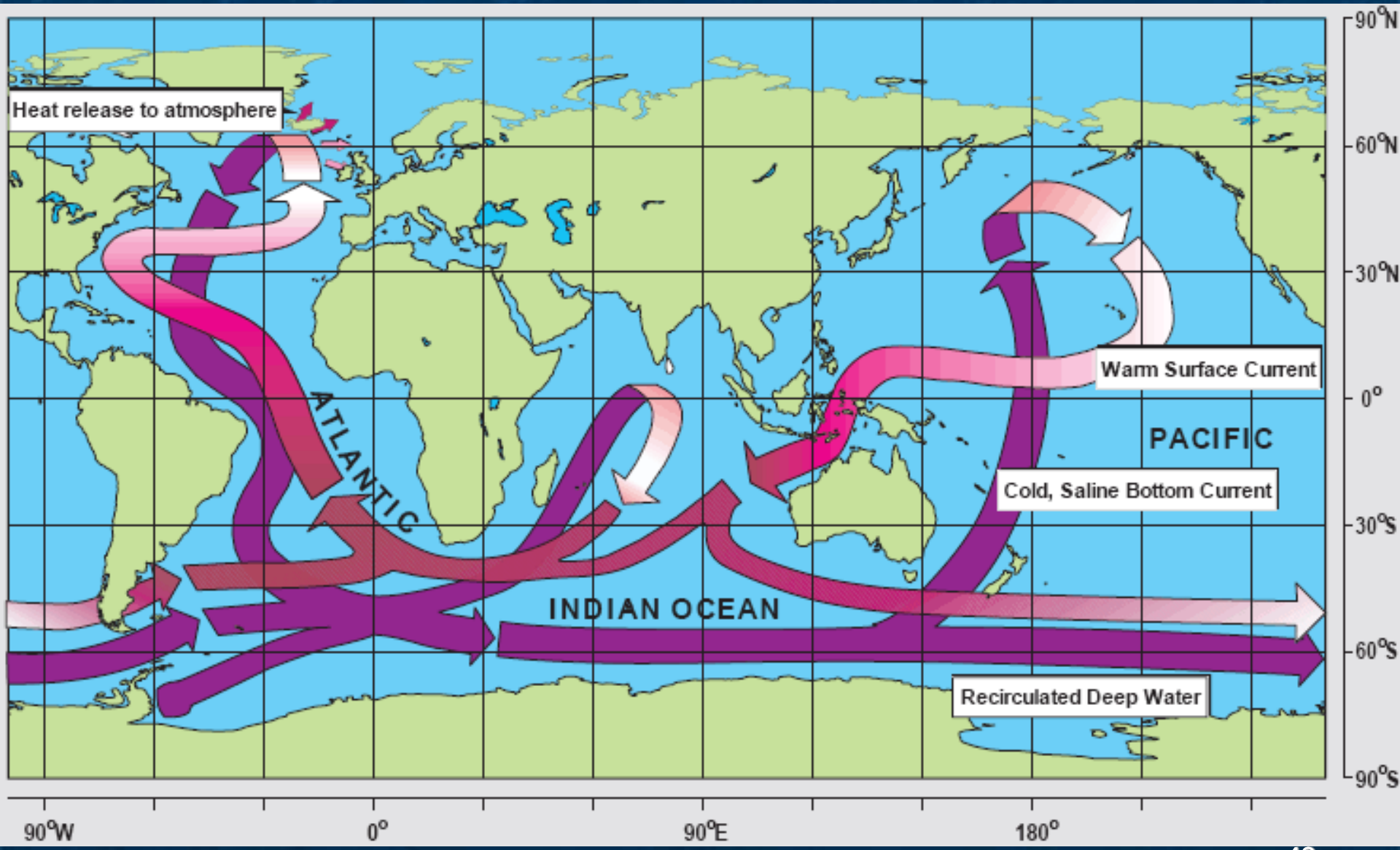


Figure 4. *Abrupt cliff at 515m depth. Pipeline will leave the bottom and be suspended in a tensioned catenary arrangement that touches down at 605m depth.*


Giratoires RN
Riviere des pluies sur ouvrage d'art
Pont Ravine du Chaudron

DEEP SEA WATER APPLICATIONS

DEEP SEA WATER : A HIGH POTENTIAL FOR NEW MARKETS



HAWAII EXPERIENCE

Hawaii has a very similar morphology compared to Reunion island

The Nelha laboratory in Hawaii was the first one to develop non energy applications of sea water (depth resources)

From the 80's, a cluster of SME has emerged on the American market or at international level to promote products of high quality from these research activities

The turnover of these activities are estimated at 800 M$ from the begining with a support of authorities amounting to 120 M$

An example to follow for La Reunion island…

SPIN-OFF APPLICATIONS

- **Food industry**
  - **Aquaculture**: Promotes the development of plants for the aquaculture (food) industry
  - **Fish farming**
  - **Highly pure drinking water**, **quality table salt**
- **Energy**
  - **Production of biofuels** from micro-algae
  - **Extraction of lithium** for use in batteries
- **Pharmaceuticals**
  - **Antioxidant properties** of deep-sea water
- **Aquarium, leisure centre**
- **Therapeutics**
  - **Remineralising properties** of deep-sea water
  - **Purity of water used** for thalassotherapy treatments

DEEP OCEAN SPA
BORA BORA
BY ALGOTHERM

Thank you for your attention