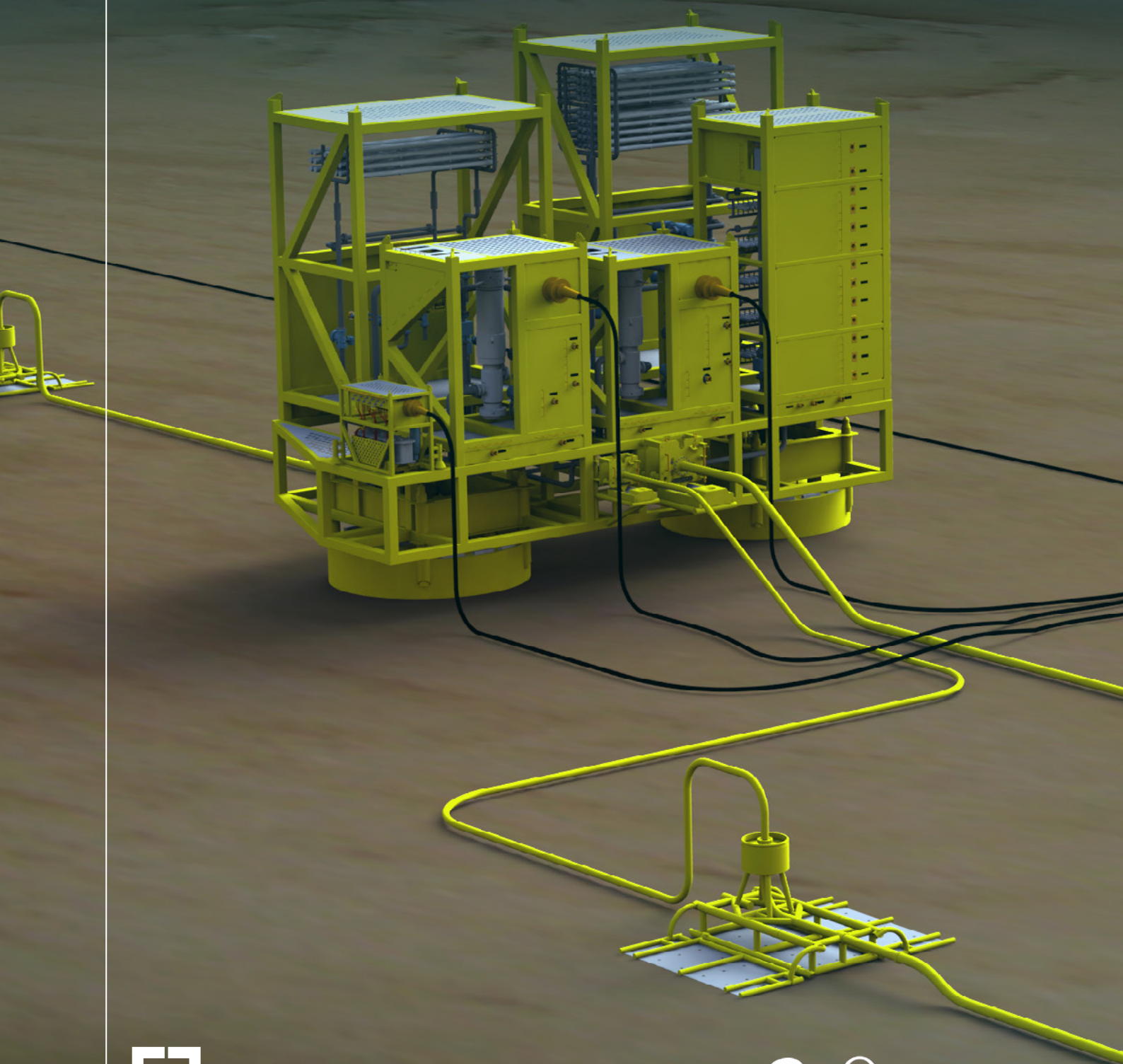


SAIPEM SPRINGS^(R)

SUBSEA SEAWATER
TREATMENT



SAIPEM



TotalEnergies



SPRINGS^(R): SUBSEA SEAWATER TREATMENT

A SULPHATE REMOVAL SYSTEM TO AVOID DEPOSITS

SPRINGS[®] (Subsea PROcess and INjection Gear for Seawater) is a subsea technology for the treatment of seawater utilizing Sulphate Removal (SR) membranes for the removal of sulphates prior to injection into the reservoir*.

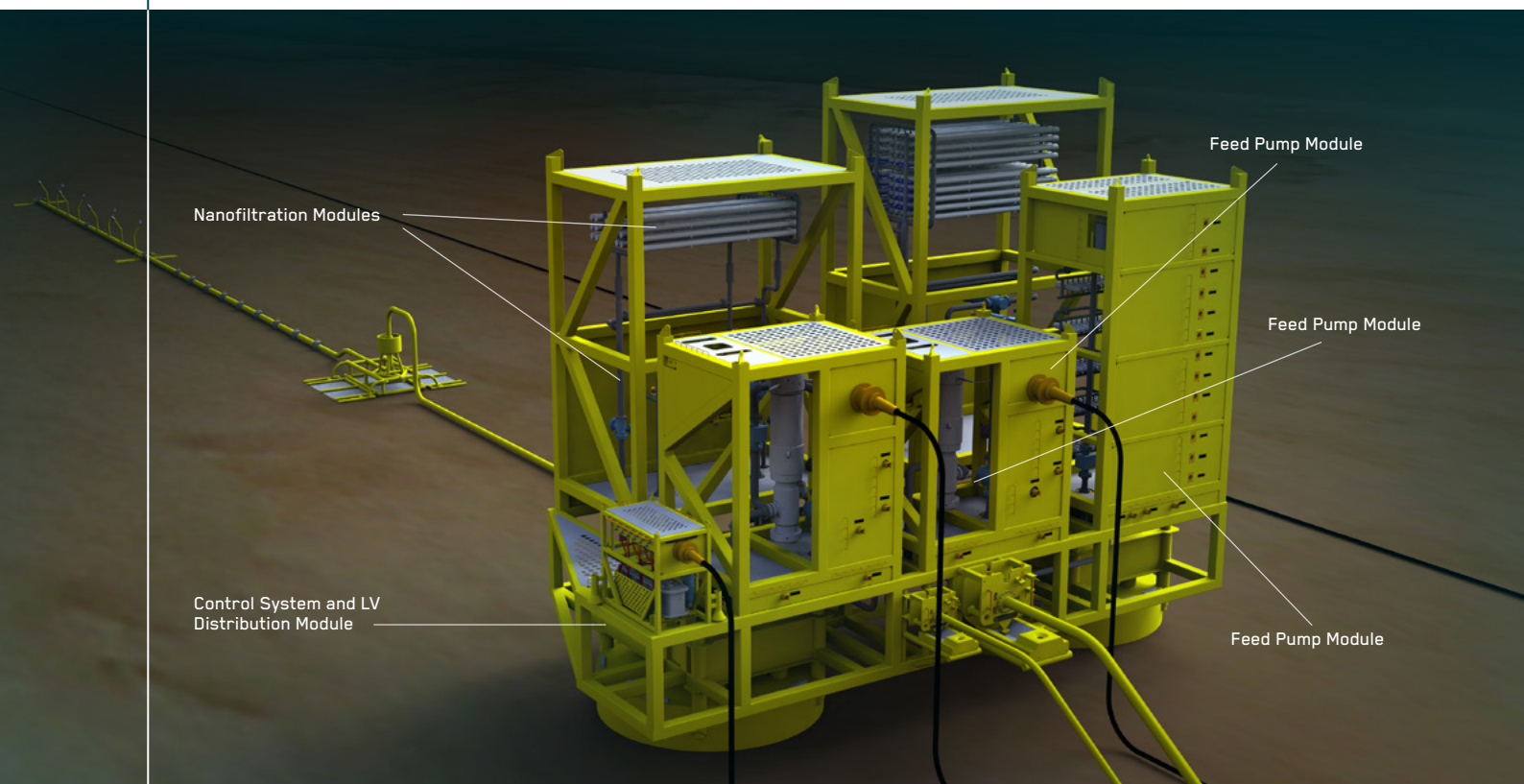
SPRINGS[®] is an alternate to conventional topsides seawater sulphate removal units. The main advantages are a greater flexibility in the water injection pattern in order to better sweep the reservoir and the removal of the subsea water injection network leading to savings on topsides weight and deck space.

SPRINGS[®] is the fruit of a collaboration between TotalEnergies, Saipem, and Veolia starting from the conceptual phase, going through the process qualification and completing with the industrialisation: now it is mature enough to be considered and implemented in subsea projects.

* When the reservoir contains barium or strontium, the sulphates contained in the seawater must be removed as to prevent any precipitation of mineral deposit.

SPRINGS^(R)

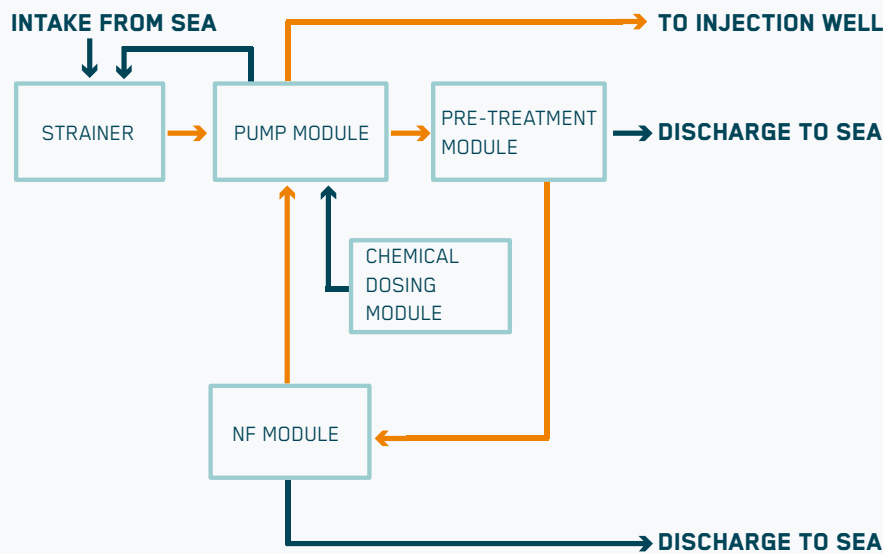
- A solution based on a Sulphate Removal (SR) membrane, a recognized and mature technology.
- Membrane fouling mitigated by a water intake located 100 m above sea bottom and a dedicated pre-treatment system.
- Conventional disinfection strategy with non-oxidizing biocide.
- A simple process easy to operate and easy to maintain.



BENEFITS OF THE TECHNOLOGY

- Simplify pre-treatment by using water from the depths which is of better quality.
- Injection network minimized or suppressed.
- Reduce modifications required on FPSO (brownfield).
- Completely all electric, connected only with subsea power and control cable.
- Particularly attractive for satellite fields by making it possible to inject water where no solution is technically or financially viable.

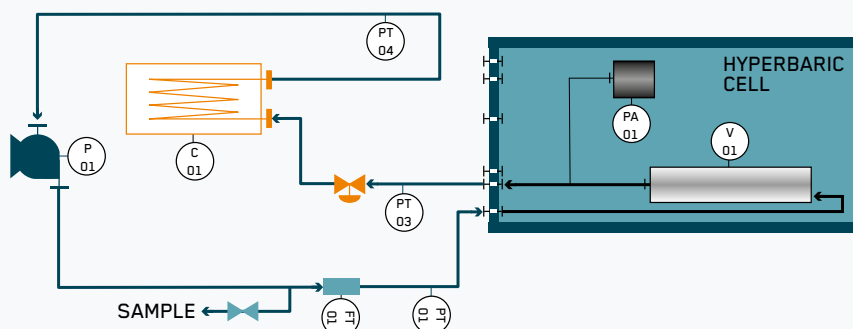
SPRINGS® PROCESS SCHEME



QUALIFICATION STEP 1: LABORATORY TESTING

- Performances and integrity of ultra-filtration and sulphate removal membranes have been successfully tested under 4°C and up to 300 bars.

HYPERBARIC TESTS PROCESS SCHEME

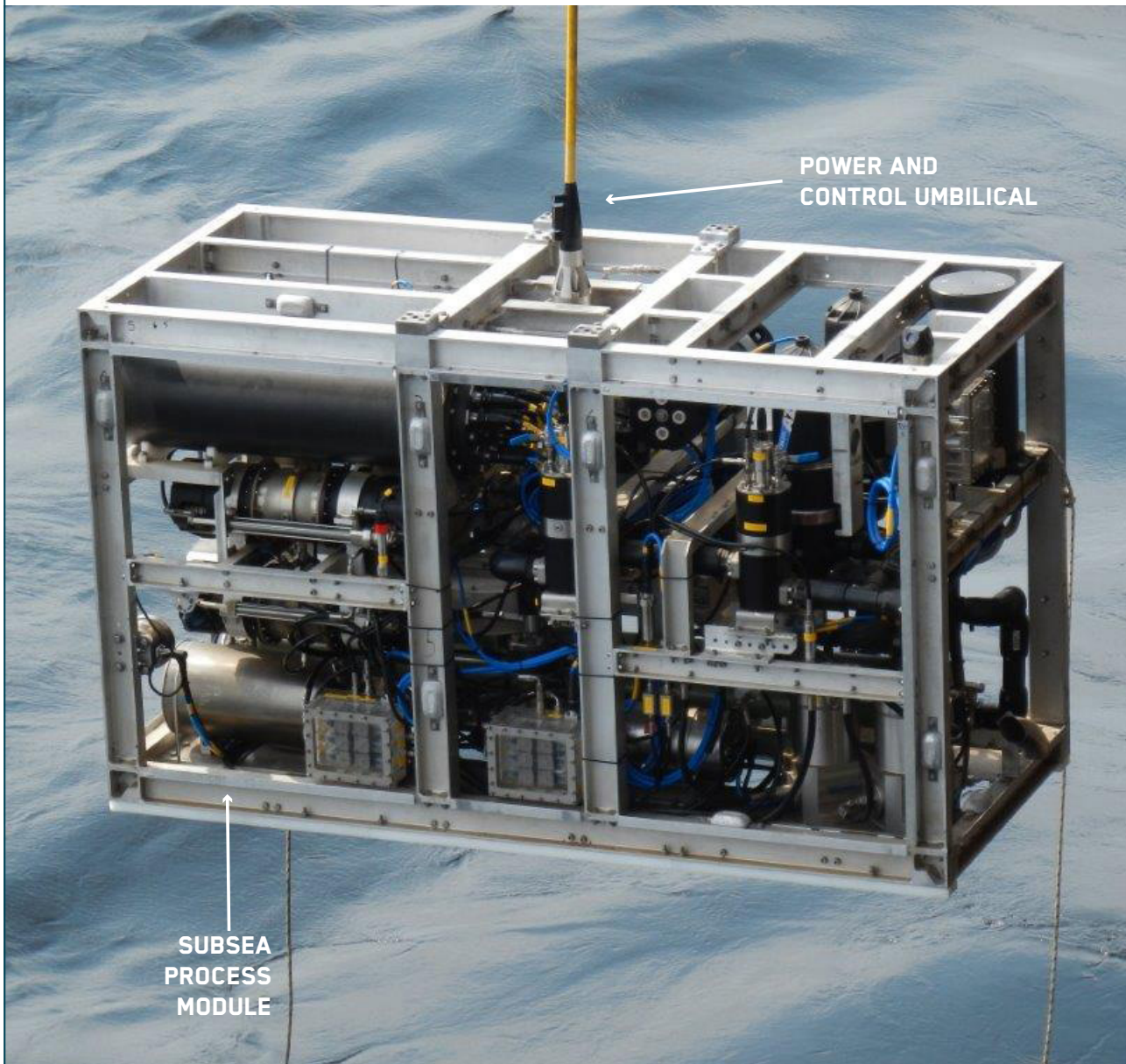


QUALIFICATION STEP 2: SUBSEA DEEPWATER TESTING

- The test campaign offshore Congo has allowed to measure performances and fouling rate of the NF membranes, combined with the simplified pre-treatment, and has thereby confirmed the viability of the SPRINGS® concept.

QUALIFICATION STEP 3: OPTIMISATION PILOT TEST

- Pilot plant was run to test SPRINGS® against a wide range of seawater qualities, allowing the fine tuning of design and operational parameters, confirming long term performances.



INDUSTRIALIZATION STEP

The programme ensured that every equipment, necessary for a full scale unit, was available and qualified. Several industrial partners were engaged to develop and qualify new products or upgrade existing ones, including:

- an "all electric" subsea control system
- a subsea single phase barrier fluid-less pump
- subsea electrical actuated valves
- a subsea online sulfate analyser

Furthermore, SPRINGS® avails of Saipem Fluideep® Technology for the Subsea Storage and Injection of the biocide.

In cooperation with





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LET'S KEEP IN TOUCH

