INSTITUTO MEXICANO DEL PETRÓLEO

Center for Deepwater Technology

CTAP®

CTAP

CTAP will increase IMP capacities for research, scaling and technological services

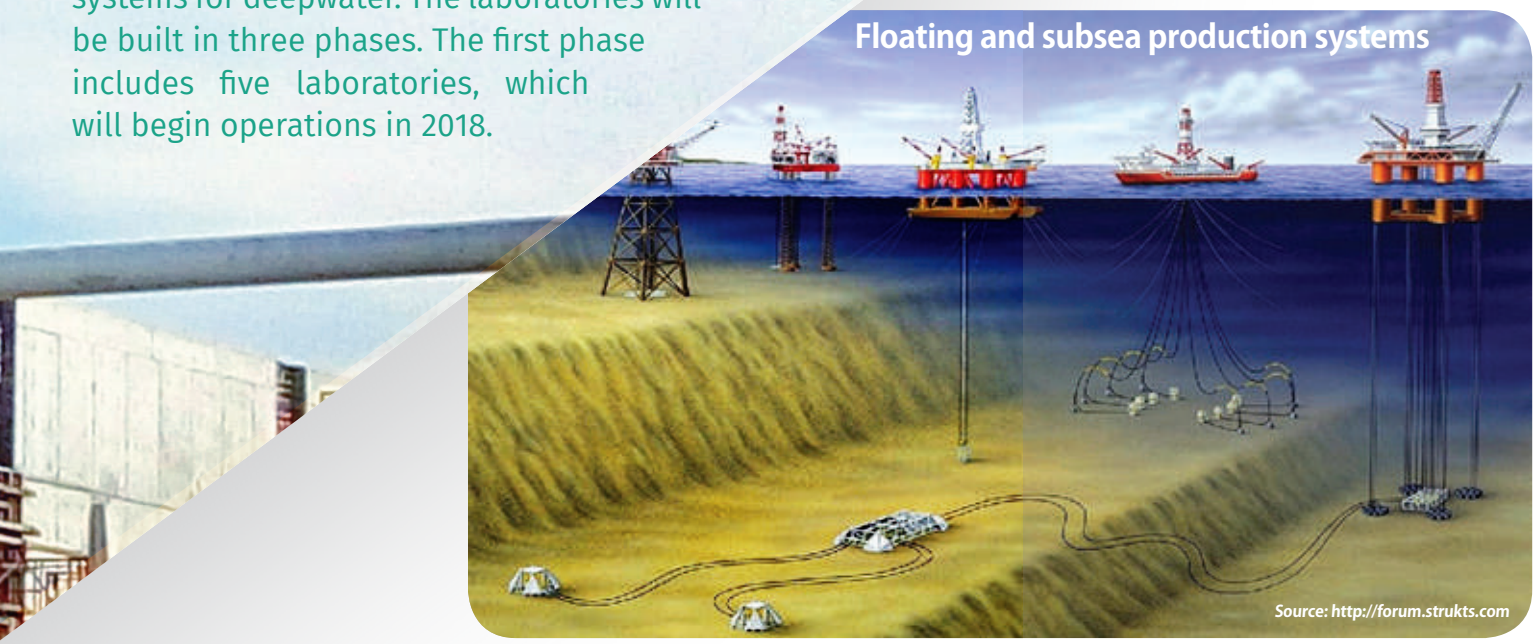
Mission

To asimilate, generate and qualify technologies for the development and operation of oil fields in deep and ultra-deep waters, through qualified human resources oriented towards efficiency and opportunity.

Vision

Center of excellence which provides technologies and highly-specialized services to the petroleum industry for a fast and efficient development of oil fields in deep and ultra-deep waters, and the formation of high-performance specialized human resources as well.

The Center for Deepwater Technology (CTAP) has been conceptualized to have twelve laboratories organized in three technological areas: drilling of wells, environmental and operational risks, and design of tools, equipment and production systems for deepwater. The laboratories will be built in three phases. The first phase includes five laboratories, which will begin operations in 2018.



CTAP

Drilling

- Drilling and Completion Fluids and Well Cementing
- Mechanics for Well Drilling and Completion

Risks

- Flow Assurance
- Geotechnics and Soil Structure Interaction
- Numerical Simulation of Metocean and Hydrodynamic Phenomena

Equipment and Systems

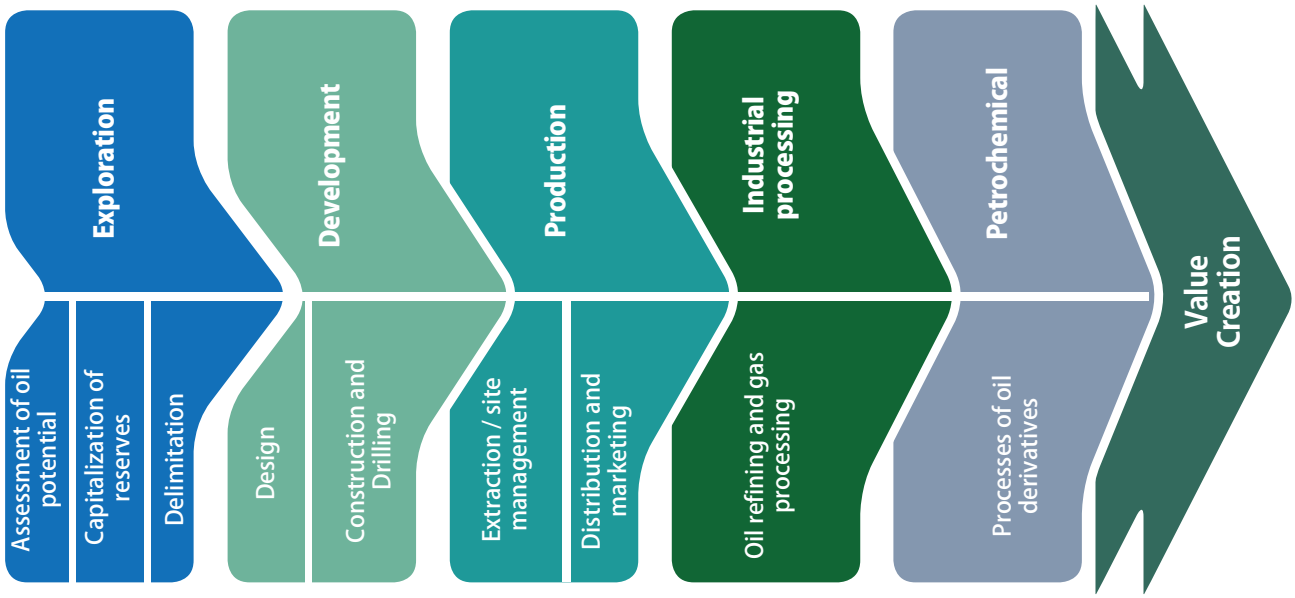
- Technology Qualification
- Components of Subsea Equipment
- Control Systems
- Processing Equipment
- Marine Structures
- Systems Integration Testing
- Hydrodynamics: Oceanic Tank

First phase (operation startsin 2018)

Second phase

Third phase

Impact of the laboratories in the oil and gas value chain



L01 Technology Qualification Laboratory

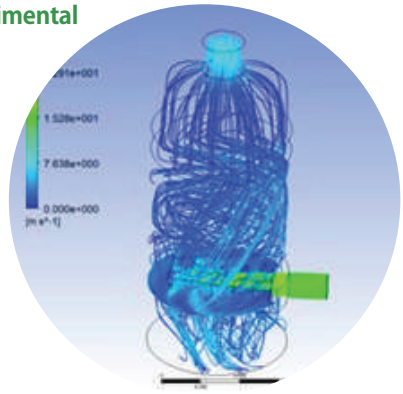
L02 Flow Assurance Laboratory

L03 Laboratory for Numerical Simulation of Metocean and Hydrodynamic Phenomena

L04 Laboratory for Drilling and Completion Fluids and Well Cementing

L05 Laboratory of Geotechnics and Soil-Structure Interaction

Key experimental facilities:



Software and hardware for CFD simulations

Loops for small and medium physical model testing (Low pressure)

L01 Technology Qualification Laboratory

Objective: To design, qualify and improve technologies for hydrocarbon processes utilized in onshore and offshore facilities, in order to increase and maintain production of oil and gas fields.

Scope:

- Solutions to prevent production stoppage due to improper operation of pumps or compressors as a result of inefficient separation.
- Solutions to production problems related to hydrocarbon separation, dehydration and desalination by using compact equipment or improving the equipment performance.
- Design or modification of equipment capable of handling a wide range of oil types, particularly heavy and extra-heavy oils.

Competitive advantages:

1. Facilities for numerical simulations and physical model testing.
2. High pressure loop for full-scale testing.
3. Recognized experience in the design of hydrocarbon process plants for oil industry.

Main Tests: Qualification of equipment for multiphase measurement, separation, dehydration and/or desalination of production:

1) CFD simulation of hydrocarbon separation mechanisms and design correlations.
2) Small-scale model fluid tests for measuring and visualizing physical flow phenomena.
3) Large-scale model fluid tests to verify design correlations for larger scale applications.
4) Full-scale tests with high pressure, realistic flow rates, and hydrocarbons, in order to verify equipment operation under field conditions.

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L02 Flow Assurance Laboratory

Objective: Research and technological development on hydrocarbon flow assurance to avoid and/or mitigate the formation and deposit of organic and inorganic solid phases, ensuring a safe and economic transportation of oil and gas from the reservoir to the storage/production facilities.

Scope:

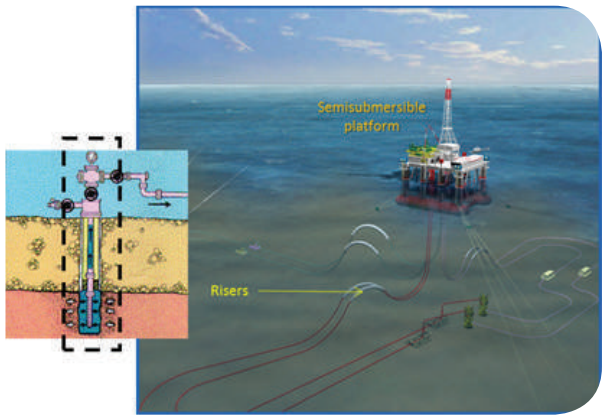
- Studies and services for thermodynamic and physicochemical characterization of hydrocarbons as well as the hydrocarbon transport under static and dynamic conditions. These are focused to ensure the continuity of production in wells.
- Simulation models of hydrocarbon production and transport scenarios associated to flow assurance.
- Integrated technological solutions to control, solve or mitigate flow assurance problems.

Competitive advantages:

- Specialized studies and services on thermodynamic and physicochemical characterization of hydrocarbons.
- Numerical simulation of realistic and complex scenarios of production and transportation systems.
- New generation experimental facilities for HPHT studies.
- Extensive experience in the analysis, design and execution of specialized studies on flow assurance

Main Tests:

- Determination of phase envelopes of organic solids including: asphaltenes, hydrates and paraffins.
- Evaluation of the performance of chemical products (flow improvers, viscosity reducers, formation inhibitors, etc.) subjected to dynamic conditions.
- Asphaltenes deposition studies in a Couette type cell.
- Structural characterization of materials by high-resolution optical methods.
- Studies of fluids displacement in porous media and damage formation.



Well, pipeline, risers and floating production system in deepwater

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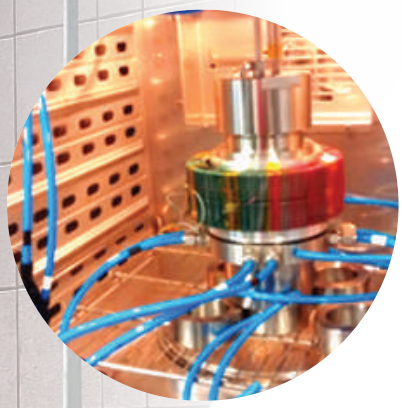
Key experimental facilities:



Couette type cell

HPHT Flow loop for dynamic solids deposition tests

High resolution optical microscope

PVT cell for phase equilibrium studies

HPHT cell for hydrates studies

HPHT Homogenizer equipment

L03 Laboratory for Numerical Simulation of Metocean and Hydrodynamic Phenomena

Objective: To design and optimize marine facilities taking into account the metocean risks, and characterize meteorological and oceanographic phenomena that impact the design of marine structures.

Scope:

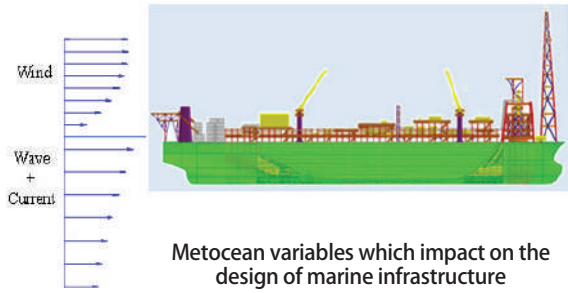
- Implementation and validation of meteorological and oceanographic models.
- Climatologic studies of extreme metocean phenomena for the Gulf of Mexico.
- Development, validation and implementation of hydrodynamic models for Floating Production Systems (FPS), moorings and risers.
- Development of virtual reality applications for training personnel of the petroleum industry.

Competitive advantages:

- Engineering software for analysis and design of marine infrastructure along their entire life cycle.
- Meteorological and oceanographic simulations and expertise for establishing metocean design criteria.
- In house development of methodologies as well as statistic and probabilistic models for risk analysis of marine infrastructure.

Main studies:

- Metocean characterization of sites.
- Metocean studies and hydrodynamic modeling of floating production systems for codes and standards.
- Numerical hydrodynamic modeling for evaluation, design and optimization of FPS hull, mooring lines and risers.
- Hydrodynamic modeling for marine operations.
- Integration of numerical simulations output in 3D or virtual reality environment.



Metocean variables which impact on the design of marine infrastructure

Key experimental facilities:

3D Screen

HPC cluster

Virtual reality Headset (Oculus)

Workstations

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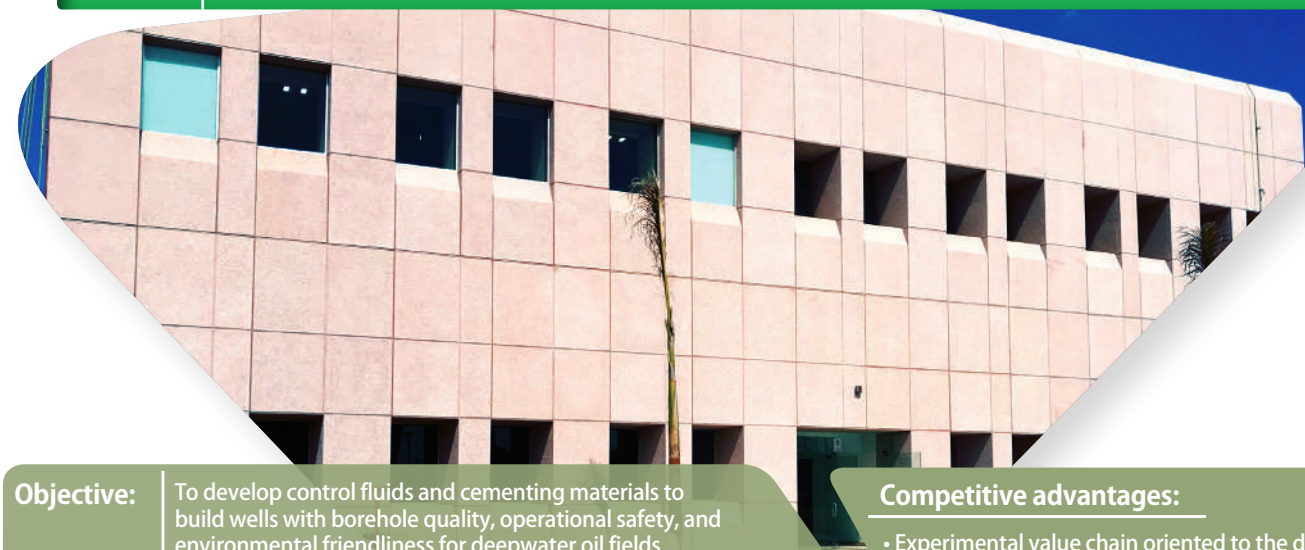
L04 Laboratory for Drilling and Completion Fluids and Well Cementing



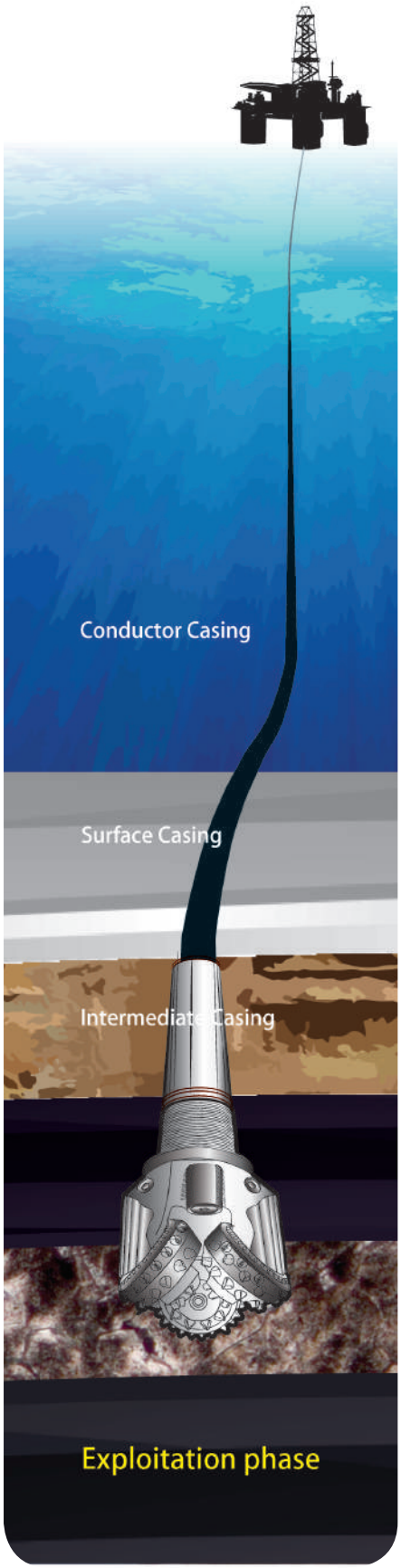
Objective: To develop control fluids and cementing materials to build wells with borehole quality, operational safety, and environmental friendliness for deepwater oil fields.

Scope:

- Development and innovation of robust drilling systems, completion fluids, and well cementing, taking into account rock formations and operational conditions in the Mexican sector of the deep Gulf of Mexico.
- Assessment of technologies for control fluids.
- Evaluation of the performance of control-fluid systems during the planning of oil field exploitation.

Competitive advantages:

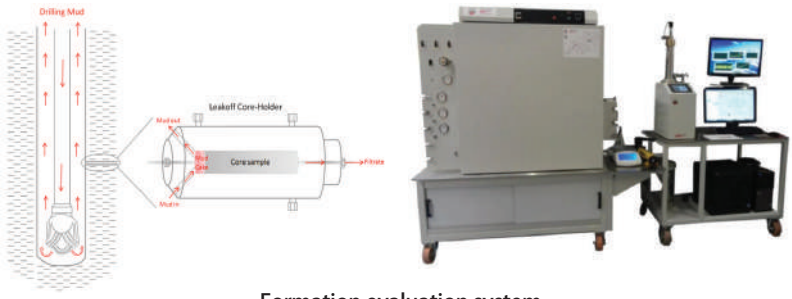
- Experimental value chain oriented to the development of integral solutions for drilling, completion and cementing fluids (control fluids).
- Capacities for the development or adaptation of additives and fluid control systems.
- Experimental equipment of special design and innovative techniques to HPHLT conditions with capacity to perform more representative and accurate studies of well phenomena, during drilling, completion and cementation.



Main Tests:

- Characterization of formation damage by tangential fluid recirculation at high pressures and high temperatures (representative of the drilling process).
- Rheological characterization of complex fluids at high and low temperatures and high pressures.
- Determination of crystallization points in simple and complex brines at high pressure and low temperature.
- Study of the structure of rock formation samples, before and after a treatment using high resolution 3D images at micron level by micro tomography.
- Kinetics and mechanism characterization of the interaction between fluid-rock and cementing using diffraction and high precision X-rays fluorescence.
- CFD simulation of simple and reactive flows in control fluids processes.

Key experimental facilities:



Formation evaluation system
(Image courtesy of Vinci Technologies)

Pressurized brine crystallization temperature tester
(Image courtesy of Vinci Technologies)

3D microtomograph (Image courtesy of Bruker)

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L05 Laboratory of Geotechnics and Soil-Structure Interaction

Objective: Characterization of marine soil subjected to deepwater conditions and development of physical modelling of foundations for floating systems and subsea infraestructure.

Scope:

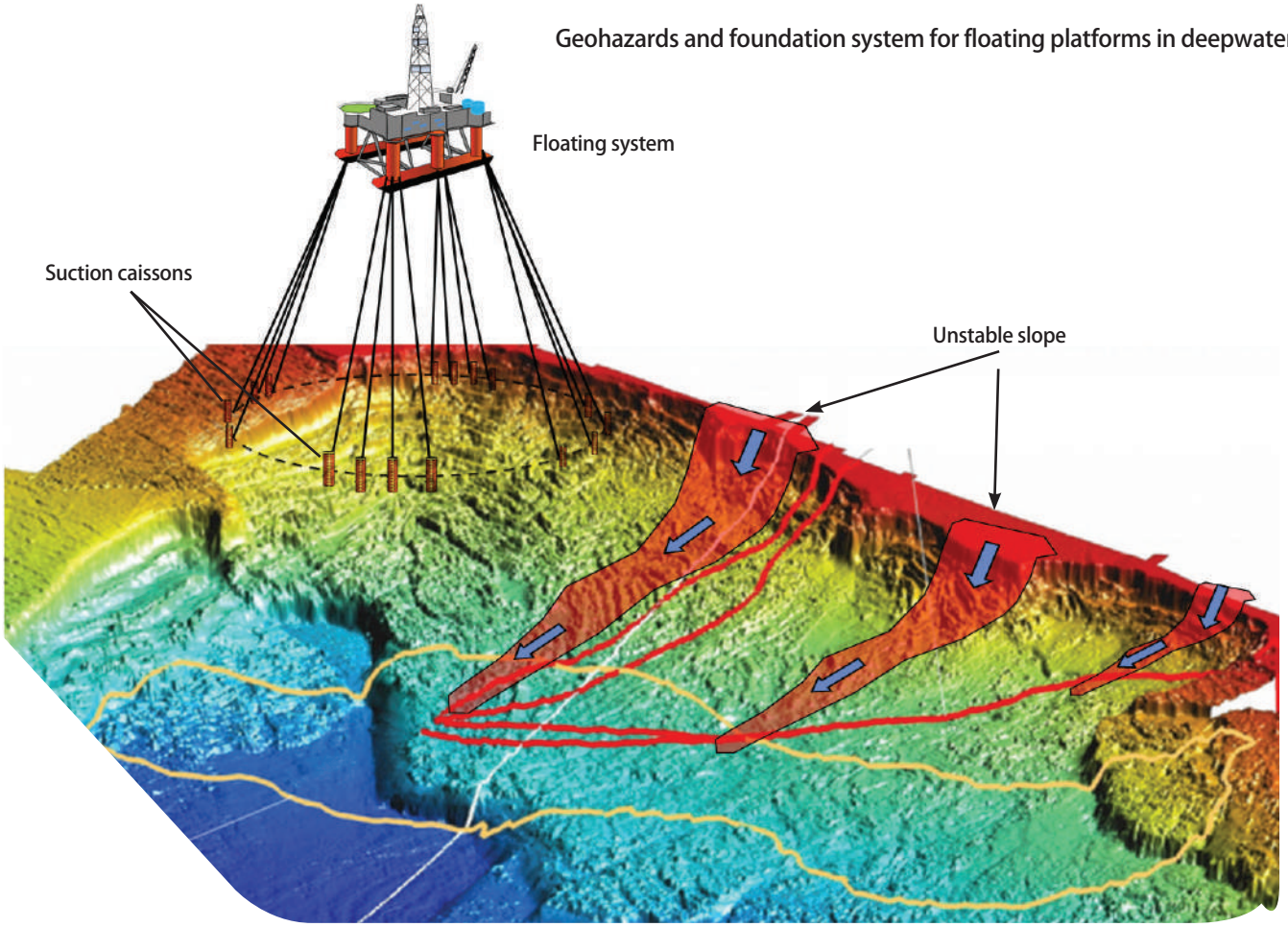
- Development and qualification of technologies associated with foundations for floating and subsea systems as well as submarine pipelines.
- Generation and qualification of experimental methodologies for characterizing marine soils in deep waters.
- Execution of experimental services for quality control of geotechnical exploration companies.

Competitive advantages:

- **Design and qualification of offshore infrastructure installed in complex geotechnical conditions supported with centrifuge testing.**
- Integral geotechnical exploration studies in the context and operational philosophy of the deep Mexican Gulf of Mexico.
- Development of geotechnical codes and standards according to specific geotechnical and operational conditions.
- Physical modeling of geotechnical infrastructure and reservoirs under specific conditions.

Main Tests:

- Testing of scaled physical models using a centrifuge equipment
- Measurement of dynamic and cyclic properties of soils Resonant column, Cyclic Simple Shear, Cyclic Triaxial)
- Measurement of static mechanical properties of soils



Geohazards and foundation system for floating platforms in deepwater.

Key experimental facilities:

Cyclic simple shear

Resonant column

Centrifuge
(Image courtesy of Actidyn Sistemes).

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