Mexican Petroleum Institute Products, Services and Technologies: providing solutions for the petroleum industry

January, 2018
IMP purpose is to generate technical and technological capabilities for the O&G industry

• We cover all the operational part of the value chain of the oil and gas industry (from upstream to downstream).

• We focus on generation of economic value to our clients

• We solve high impact technological problems in order to achieve business goals
IMP, with more than 52 years has a large installed capacity with experience and results in the Oil and Gas industry

**Installed Capacity**

- 2,520 researchers, specialists and technicians
- 28% with Master and PhD degrees
- 1.8 MM Engineering man power
- 21 training centers
- 12 Laboratory groups
- 1,250 Assays and services
- 11 Pilot plants
- 94 Products and services
  - E&P
  - Engineering
  - Talent development
- 257 Specialized software
- Library with the greatest oil and gas information in Mexico

**Experience**

- Atlas of Petroleum Basins of Mexico
- Ku-Maloob-Zaap integral model
- 119 Productivity studies on shore and Cantarell fields
- EOR process characterization
- 21 Geomechanic characterization fields in Mexico
- Monitoring of 500 fracking operations in 7 years
- 80 Offshore platforms
- 55 Oil/gas pipelines (2,160 km)
- 230 Downstream plants

**Results**

- 927 patents, 3,122 copyrights and 232 brands up to day
- 22 patents, 143 copyrights, 142 refereed publications per year
- Off shore facilities contribute with 1.5 MMbpd oil production
- Application of 25,000 ton IMP chemical products for Pemex per year
- Postgraduate 64 PhD, 76 masters, since 2001
- 1,300 new talents: Geophysics, Geology, Petroleum Engineering (5 years)
In order to support oil and gas companies in Mexico, the IMP has facilities located in the major O&G areas of the country.
IMP has 52 years providing technologies and technological products and services for the O&G industry in Mexico and other countries.

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Upstream and Downstream Laboratory Services
IMP Exploration and Production area has 45 products and services that are sold separately or as integrated solutions.
Services that are focused primarily on assessing and modeling the sedimentary basins, define the physical and chemical characteristics of the rocks and its evolution in time and space, with the aim of identifying, mapping and rank the areas more likely to accumulate of hydrocarbons in the subsurface.

Products and services aimed to estimate the HC’s potential and the geographical and stratigraphic distribution of Plays. In addition, areas of best opportunity are proposed, assessing the elements of the oil system and its potential, estimating and quantifying the geological risk associated.

Services aimed at the definition and study of the geological, petrophysical, and dynamic characteristics that control the accumulation and production of reservoirs, and the quantification of hydrocarbon volumes in such reservoirs. Included here, are the development and evaluation of strategies and options to optimize exploitation and increase reserves or production.
Studies for supporting secondary and improved hydrocarbon recovery processes in oil reservoirs, aimed to increase the recovery factor. The objective is to increase the value of the assets in terms of production.

Studies aimed at restoring, maintaining or increasing the production of hydrocarbons in the integral reservoir-well-surface facilities system.

Studies for diagnosis, design, evaluation and optimization of production wells and surface facilities. Includes improvement in handling, conditioning, transport, metering of fluids and real time optimization of production processes. It also provides technical assistance in submarine systems and production facilities and support for the certification of laboratories and accreditation of tests.
Solutions in exploitation:
Lines of business and products

Well drilling, completion and maintenance

Products targeted at the planning, design, evaluation and optimization of processes for the development of the oil fields in timely and cost-effective manner.

Systems and tools for acquisition and processing of information of wells and facilities

Products aimed at the development, evaluation and integration of technologies, tools and systems for the acquisition and processing of technical information from wells and facilities.
Hydrocarbon potential evaluation

- Basin analysis and petroleum systems modeling
- Structural modeling
- Paleontology and biostratigraphy
- Organic geochemistry and petrography
- Stratigraphy and sedimentology
- Geologic play assessment
Reserves incorporation

- Potential fields and electromagnetic prospecting methods
- Pore pressure prediction
- Shallow hazards determination
- AVO studies, inversion and seismic multi-attributes
- Time processing of seismic data
- Depth processing of seismic data
- Exploration of unconventional resources
Well Tools and Systems

Drilling, termination and maintenance of wells

- Well planning and drilling design
- Design and evaluation of control fluids, hydraulic fracturing fluids and well cementing
- Planning and design of completion and maintenance of wells
- Geomechanics and wellbore stability
- Planning and design of drilling and completion in deepwater wells

Systems and tools for the acquisition and processing of information of wells and facilities

- Tools for wells and facilities
- Services of reengineering of tools for wells and facilities
The IMP is currently building the Deepwater Technology Center (CTAP) conceptualized for qualification and development of technologies for deepwater oil fields operations.

Technological areas and laboratories:

- **CTAP**
- **Drilling**
  - Fluids for Well Drilling, Completion, and Cementation
  - Mechanics for Well Drilling and Completion
- **Risks**
  - Flow Assurance
  - Geotechnical and Ground-Structure Interaction
  - Numerical Simulation of Metaoceanic and Hydrodynamic Phenomena
- **Equipment and systems**
  - Technology Qualification
  - Components of Submarine Equipment
  - Control Systems
  - Process Equipment
  - Marine Structures
  - Test of Systems Integration
  - Hydrodynamics: Oceanic Tank

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

- Solutions for production stops in facilities as the result of inadequate performance of pumps or compressors as a consequence of an 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.

High-pressure loop for real-scale tests
Objective: To conduct research and technological development on hydrocarbon flow assurance to avoid and/or mitigate the formation and deposit of organic and inorganics solid phases. This will allow to ensure the safe and economic transportation of oil and gas from the reservoir to the storage facilities.

- Studies and services for thermodynamic and physicochemical characterization of hydrocarbons as well as the hydrocarbon transport under static and dynamic conditions. This is focused to ensure the continuity of production in wells.
- Simulation models of scenarios of hydrocarbons production and transport associated to flow assurance.
- Integrated technological solutions to control, solve or mitigate flow assurance problems.
Objective: To develop control fluids and cementing materials to build wells with hole quality, operational safety, and environmental friendliness for deep water oil fields.

- Development and innovation of robust systems of drilling fluids, well completion and cementing taking into account the 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.
Objective: To design, to evaluate and to innovate technologies for foundation systems and pipelines in deep-water zones with regards to geohazards.

- Geotechnical and structural analyses of foundations for floating and submarine systems and pipelines utilizing physical modeling.

- Experimental methodologies to determine mechanical properties of the soil under deep-water conditions.

- Experimental services for quality control of the offshore geotechnical work for petroleum exploration.
Objectives: To characterize metoceanic phenomena in order to evaluate the hydrodynamic behavior and design floating production systems (FPS), moorings, pipelines and risers under harsh conditions.

- Implementation and validation of meteorological and oceanographic models.
- Climatologic studies of atmospheric and oceanographic phenomena that occur in the Gulf of Mexico.
- Development, validation and implementation of hydrodynamic models for assessing the behavior of FPS, moorings and risers.
- Generation of virtual reality systems for simulation of natural phenomena and human resources training.
## Engineering services during a project’s life cycle

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<td>Project Development Plan FEL II</td>
<td>(Political, Economical, social aspects)</td>
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<td>Technical Assistance during testing and start-up</td>
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<td>Permits &amp; Licenses Plan</td>
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<td>Geophysical, Geotechnical and Topography studies</td>
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<td>Conceptual and complementary Engineering</td>
<td>Class III Cost Estimate</td>
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<td>Class IV Cost Estimate</td>
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<td>PDP for FEL III</td>
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<td>Project Administration</td>
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</table>
• Preliminary studies for the location of Deepwater facilities on seabed, based on available 3D geophysical information typically used for oil exploration.

• Planning and specification of high-resolution site geophysical and geotechnical investigation necessary for final location and facilities foundation design.

• Geotechnical site exploration in conjunction with Norwegian Geotechnical Institute (NGI) and IMP.
Geotechnical characterization of the soils of the Campeche Sound and the availability of the most complete geophysical and geotechnical database that allows us to provide immediate solutions to the problem of foundations of marine pipelines and platforms.
Evaluation of the seismic response

Generation of dynamic design criteria of fixed marine platforms from conventional static tests, without the use of dynamic tests reducing the cost of execution of the geotechnical studies required for the design

Some earthquakes in the Gulf of Mexico

Seismic response spectra at the depth of maximum interaction of the foundation
**Capabilities:** specialists in the areas of physical oceanography, maritime hydraulic and civil engineering with experience in modeling and treatment of metocean assessment. Access to cluster for computation parallelized.

**Needs:** there will be the possibility of having reliable

- Information metocean that minimize the risks of environmental contingencies (wind, waves and sea current)
- Historical Information (hindcast) of meteorological assessment and oceanographic for the planning and development of infrastructure, which implies the definition of dangers metocean
- For activities of exploration drilling and field development requires a simulation system of spills

**Products and results:**

- Statistical services of conditions metocean (waves wind and sea current) for movement of drilling equipment
- Definition of dangers metocean infrastructure design
- Regionalization of metocean assessment, of the Gulf of Mexico for infrastructure
- Mesoscale modeling and regional wave
- Mesoscale forecasting systems and regional waves
Type of offshore facilities

Drilling

Production

Housing

Link

Comunications
Engineering in APC, easily adaptable to different water straps, soil types and gravitational loads

Straps from 15 m up to 100 m, in 4 weeks
IMP experience in marine and land pipelines

Related to the design of marine pipelines, the IMP is the most experienced national group, since of the 3,600 km of existing pipelines in the Campeche Sonda, the IMP has designed around 60%.

For land pipelines, the IMP has designed 1,148 km. The most important was the Bicentennial Pipeline (including 36“ pipeline, 18“ pipeline and 14“ pipeline), and the Neuquén-Bahía Blanca pipeline of 353 km, located in Argentina.
• Conceptual and FEED design for FPSO.

• Conceptual and FEED design for deep water production pipelines, jumpers and risers.
The IMP has the experience and technological infrastructure for the selection of the site, considering the topics: environmental, regulatory framework, socioeconomic and social responsibility, required by ASEA and SENER.
Capabilities of the IMP

The IMP has personnel (researchers, specialists and technicians) to carry out the tasks (coordination and implementation) associated with the characterization needed to establish environmental baselines.

- The IMP completed their capacities to collaborate with other companies to count with the boat required to perform the work of field. The majority of the laboratory analysis can be performed on the IMP and the remaining are performed through the shipment of samples to other laboratories as well.

Necessity

- In México for the award of the blocks companies must provide to the ASEA the Base Line Environmental, within a period of 90 days.

Products and Results

- The NOM-149-SEMARNAT-2006 lays down the specifications for environmental protection that should be observed in the activities of well drilling, maintenance and abandonment in the Mexican marine areas and the need to characterize physical, chemical and biologically any area of the ecosystem of interest, including sampling and analysis on the tie rod of water and sediment from the seabed.

- The IMP has conducted studies in the area of Dos Bocas and the diffuser marino associated, as well as in Campeche sound and can identify if any item could be representative.

- Environmental Baseline of two areas (Limonaria and Galaxia).
Transport of free particles on the vector field of currents, obtained from a model of numerical simulation of currents of the Gulf of Mexico. It considers degradation and precipitation of the transported particles

Example of information to be produced
Process risk analysis for offshore oil and gas installations

IMP can carry out studies of analysis and risk assessment of marine facilities

These studies consist of the following basic stages:
- Hazard Identification
- Frequency assessment
- Consequence assessment
- Risk evaluation
- Environmental Impact Assessment

The main objective of these studies is to reduce, eliminate or manage the hazards and risks associated with the production of oil and gas.

Some of the major potential hazards associated with offshore operations are:
- Drilling operations such as: ring operations, materials handling, personnel safety, etc.
- Production operations such as: Equipment-related hazards, Process-related hazards, Well-related hazards, air and marine transport, etc.
Nowadays, the main focus of the international oil and gas industry never have an oil spill, and the industry takes extensive precautions to prevent spills from occurring. However, if a spill occurs, an action plan must be activated to effectively control the spill.

The IMP joined with globally recognized companies can develop this plan through the following stages:

- Oil Spill Trajectory Modelling
- Environmental Risk Assessment
- Oil Spill Response Analysis
- Oil Spill Response Plan

Using international specifications
The IMP transfers specialized knowledge through three major areas of specialty: Knowledge management, talent management and learning and development.

**Transfer the key knowledge in the hydrocarbon sector**

**Learning and Development**
- Specialized training programs (graduates)
- Learning solutions focused the oil industry (courses)

**Talent Management**
- Skills design and management
- Technical career paths
- Attraction of technical talent

**Knowledge Management**
- Specialized Technical Services Solutions
- Technological and competitive intelligence for the oil Industry
- Technological and talent diagnostics
- Technology road maps for the hydrocarbons sector
There is a program of specialized training in the hydrocarbons sector

**IMP© Specialization Product Maps**

**Learning and Development**

**Advanced Level**
- Diploma in Seismic characterization of oil fields
- Diploma in Modeling and characterization of Mexican fractured carbonated reservoirs
- Diploma in Risk management and pipeline integrity
- Diploma in Petrophysical evaluation of formations

**Middle Level**
- Diploma in Technological project management
- Diploma in Management of technologies in the oil industry
- Diploma in Process engineering in industrial processing
- Diploma of Training and Certification of consultants for the oil industry
- Diploma in best practices for sustainable and secure operation of the oil industry

**Basic Level**
- Upgrade program for junior engineers in petroleum and geosciences engineering
- Induction program for petroleum and geosciences engineers
- Diploma in Management skills for middle managers in the oil industry
- Workshop: Knowledge of hydrocarbon sector business
- Training Program for inspectors of operational and industrial safety of the hydrocarbons sector
Infrastructure includes 12 groups of laboratories with 1,256 tests

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<td>5. Well drilling, completion and maintenance</td>
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<td><strong>Total</strong></td>
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<td><strong>Total</strong></td>
<td>888</td>
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<tr>
<td><strong>Total</strong></td>
<td>1,256</td>
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</table>
Upstream Laboratories

Tests and experimental studies

- Mechanical characterization of reservoir rocks.
- Determination of: Young Modulus, Poisson ratio, Constant Biot, module volumetric, cutter module parameter of Lame, Acoustic Attenuation, Coefficients of Friction and cohesion of the rock

- Evaluation of the porosity, permeability, capillary pressure, size of pore in reservoir rocks.
- Fluid reservoir rock studies

- Evaluation of the potential of the reservoir.
- Evaluation of the organic material and characterization of kerogen types (I-oil, II and III gas, IV mineral coal and gas).
- Isotopic characterization of gases, oils and extracts of rock

- Advanced characterization of the chemical composition and atomic structure of volume and surface of materials
Upstream Laboratories

Laboratories

PVT

Hydrocarbon production

Well drilling, completion and maintenance

Well stimulation

Tests and Pilot Studies

- PVT analysis
- Phase compositional analysis gas and liquid hydrocarbons. (pressure, volume and temperature).
- Interaction rock - oil.
- Density and viscosity to special conditions and/or reservoir.
- Surface Sampling and Downhole Fluid.

Experimental studies on the mechanisms for hydrocarbon recovery: Recovery primary, secondary recovery (injection of water or gas) and enhanced recovery (chemical processes, miscible processes, biological processes and thermal processes), under conditions of reservoir.

Quality control tests and evaluations of raw materials, finished products and systems of fluids used in the drilling, termination and maintenance of wells.

- Evaluation of chemicals and selection of techniques for the control of mineral inclusions.
- Integral service of mobile laboratory of stimulation of wells, for quality control of fluids of stimulation.
¡Thank you!