# Technical proposal for a survey of the old oil production and refining sites in Azerbaijan

**Background**

SOCAR was established in September 1992 with the merger of Azerbaijan's two state oil companies, Azerineft and Azneftkimiya. SOCAR and its many subsidiaries are responsible for the production of oil and natural gas in Azerbaijan, for operation of the country's two refineries, for running the country's pipeline system, and for managing the country's oil and natural gas imports and exports. SOCAR is party to all of the international consortia developing new oil and gas projects in Azerbaijan. The company employs 70,000 people. In January 2003, President Aliyev issued a decree calling for the re-organization of SOCAR. Under its new charter, SOCAR now owns the oil it produces, whereas previously, SOCAR relinquished ownership once the oil had been sent to processing facilities.

The national oil production increased from 15Mt/year in 2000 to 50 Mt/year in 2010 (and then started to decrease) in the mean time the national gas production increased to 25 Mt/year. The national oil & gas production is mainly due to the new giant offshore site Azeri Guneshli Chirag and Shah Deniz. The rest of the production (20% for oil and 30% for gas) comes from 40 old fields (both on- and off-shore) operated by SOCAR, many of which are considered to be in disrepair and have been artificially stimulated for years using water injection. The main one is the offshore field “shallow-water Gunashli,” located 60 miles off Azerbaijan’s Absheron Peninsula first came online in 1981, but was developed only to a maximum water depth of 400 feet owing to technological constraints. Press reports indicate that production levels are falling as equipment is in disrepair and the structure is losing reservoir pressure. The on shore production declined by 15% because the operation companies do not invest capital to maintain the oil production.

Azeri crude oil is refined domestically at two refineries (more than 60 years old) : the Azerineftyanajag refinery, with a capacity of 160 Kbl/d; and the Heydar Aliyev refinery, which has a capacity of 200 Kbl/d. Heating oil accounts for roughly half of output at Azeri refineries, followed by diesel fuel, gasoline, motor oil, kerosene, and other products. Both of the country's refineries are in need of modernization

The Absheron Peninsula is heavily polluted due to nearly 150 years of oil production that has left some 10,000 hectares of oil-contaminated land. The Caspian Sea has also been affected due to poor practices which include oil and wastewater spilling and pouring out onto the ground at drilling sites. Cleaning up already polluted land, as well as reducing on-going pollution from oil-production and from people themselves by conforming to good international environmental and safety practice are key priorities of the **Environmental State Program** (ESP). The Absheron Rehabilitation Program was the key element of the ESP 2006-2010. The purpose of this program was to support the Government of the Republic of Azerbaijan in improving environmental conditions in the Absheron Peninsula by support for a selected set of priority investments to address both historic pollution and on-going pollution.

While SOCAR has invested 45 billion $ from 1994, benefiting from 32 PSA signed with 53 oil & gas companies representing 20 countries, and has even decided to invest 10 billion $ in Petkim (Turkish refinery and chemical plants) as well as in house oil refinery, gaz processing

unit, chemical & fertilizer plants, ship building yard…, one should consider that it would be worthwhile to look at the old oil production and refinery plants to improve there the oil & gas recovery, to secure the refineries and to improve the environment protection. To address it, a group of 3 specialized oil service companies, members of the Association des Consultants Pétroliers www.acp-france.org (ICAT www.icat-amo.com for production optimization, P+I www.pplusi-conseil.com for refinery maintenance, inspection and process safety survey, AETS/APAVE www.aets-consultants.com for environment control) is offering a combined and focused survey with the following rationale and objectives :

**Rationale and objectives for the oil & gas Recovery survey**

The Caspian Sea area is the setting for some of the world's oldest oil developments. Sustainable development for re-launching the production of the ageing fields is nowadays perceived as a fundamental aspect of sound business management. The purpose of this appraisal's mission is to review available field(s) data, provide suggestions/recommendations identifying possible actions for maximizing the remaining oil & gas recovery through new concepts in production for both immediate and long-term corrective actions, and indicate resources needed for their implementation. The proposal should take into consideration the cost-effectiveness of the projects so to get a sustainable cost/recovery ratio.

Eventually, this appraisal on improved oil & gas recovery potential will help investors decide if an activity should be financed and, if so, the way in which related issues should be addressed in planning, financing, and implementation.

This preliminary diagnosis will consider six main parts:

- Assessment of geophysical and geological data;
- Assessment of formation rock, fluids, and rock-fluid compound properties;
- Assessment of information from drilling activities;
- Assessment of dynamic data (production performance; reservoir, bottom-hole, and well-head pressure; gas and/or water injection; etc.);
- Assessment of surface production/injection facilities (possibly a site visit will be helpful);
- Recommendations on corrective actions to improve oil & gas recovery.

Particular care will be given to secondary/tertiary recovery past performance (if any), and analysis of possible further implementation/improvement of these recovery techniques.

Accessibility to comprehensive set of field's data is required, so as continuous interactive discussion with Azeri geoscientists and engineers in order to acquire additional information or comments as deemed appropriate for a better understanding of the potential of the field(s), and to compare our ideas/proposed solutions with their ones with the aim of assessing the local viability of our proposals.

The following list outlines the main information that will be appraised (please note, this list is not exhaustive, but quotes only the main points needed for a few-day review. Additional information could be asked for on site):

- Geophysical and geological data, formation rock properties:
  - field structural maps, cross-sections;
  - logging and coring data;
  - formation rock description;

- fracture systems, main orientation of fractures.

- Fluid properties:
  - PVT analysis;
  - gas composition.
- Rock-fluid compound interactive properties:
  - relative permeabilities;
  - rock wettability.
- Drilling data:
  - drilling parameters, circulation mud losses, borehole completion;
  - maps with well locations (surface and bottom hole).
- Dynamic data:
  - producing intervals;
  - oil, gas, and water production rate history (total field, and on well by well basis), bubble maps with main production parameters;
  - reservoir pressure evolution, isobar maps;
  - build-up, fall-off data;
  - history of workovers, well stimulations (acid job, acid frac, hydraulic frac), change of producing intervals, servicings;
  - gas and/or water injection rates;
  - production logging;
  - artificial lifting;
  - secondary/tertiary recovery studies and implementation;
  - list of current well status (dry wells, active producers, shut-in producers, active injectors, shut-in injectors, reasons for shut-in).
- Surface installations:
  - flowlines network;
  - flowstations;
  - treatment centers (equipments, capacity, etc.);
  - gas / water injection facilities;
  - gas for gas-lifting (if any).

**Rationale and objectives and methodology for the refinery Maintenance, Inspection and Process Safety survey**

Total refinery reliability is paramount for a safe and productive performance. The benefits derived from increased plant availability and from a safer and more reliable operation totally offset an eventually optimized or increased maintenance cost. Increasing each mechanical equipment and overall plant reliability and availability through adequate maintenance and

inspection is one of the principal opportunities for improving the financial performance and the safety records of a refinery.

Effective implementation of such methods such as Risk Based Maintenance (RBM), Risk Based Inspection (RBI) and Reliability Centered Maintenance (RCM) are the cornerstone for the creation of a risk-based decision-making culture. Specific programs for optimizing turnaround and routine maintenance activities, as well as the development of effective and proactive asset care policies (including inspection, preventive and predictive maintenance plans) are key tools for increasing the overall reliability and operability of the refinery, and therefore its economic performance and profitability.

The aim and the objective of the Process Safety Management (PSM) are the prevention and the minimization of the consequences of accidental releases of toxic, flammable or explosive hydrocarbons. This stipulates a proactive, methodic and systematic identification, analysis and control of potential hazards in refineries.

This Maintenance, Inspection and Process Safety survey done through a preliminary questionnaire on the Baku refinery operation and maintenance issues, discussed during a five days on site visit with a refinery Process Maintenance and Inspection consultant, with detailed discussion and analysis of each item of the questionnaire with the SOCAR refinery management in Baku.

The Maintenance Inspection and Process Safety questionnaire is structured in two parts

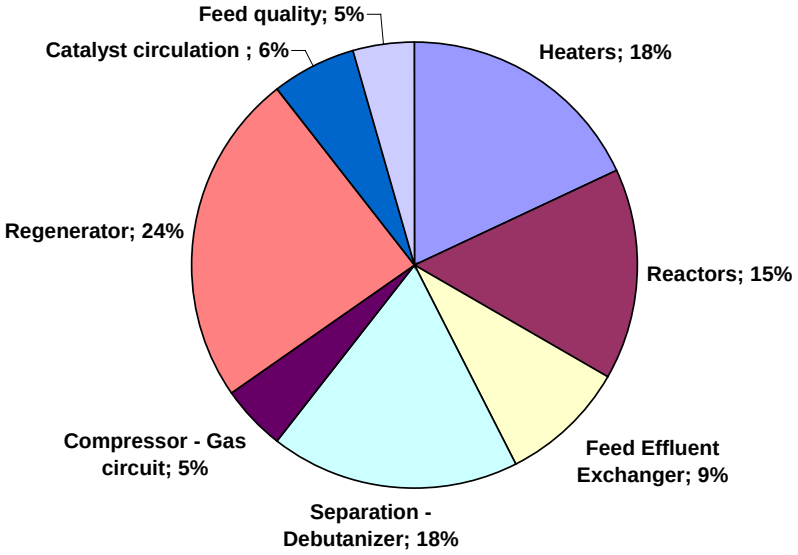
- The qualitative part of this questionnaire is the identification of all operations, maintenance and process safety issues, problems and consequences related to the SOCAR refinery.
- The quantitative part of the benchmarking process will define measure and compare Key Performances Indicators (KPI's), with focus on key issues such as reliability, OEE Overall Equipment Effectiveness, and maintenance related costs for these units.

The key issues resulting from the discussion about the Maintenance, Inspection and Process Safety questionnaire (both qualitative and quantitative) are classified (with Failure Mode and Effects Analysis)

- Failure
- Mode : Causes
- Effect : Consequence, Impact
- Mitigation actions : Best practices

An example is given below from a reliability and availability diagnosis of a refinery Continuous Catalytic Reforming (CCR) process unit.

**Criticity of issues (CCR sections)**




## Rationale and objectives for the environment survey

Nowadays, modern oil companies are committed to promoting "environmentally sound and sustainable development" in the full range of their activities. Sustainable development is perceived as a fundamental aspect of sound business management. However this transition is not yet achieved in developing economies such as Azerbaijan. The purpose of this appraisal's mission is to check in which extent Baku Oil Refinery is involved in such environmental process and committed to work with the authorities and stakeholders to ensure the environmental, social and economic sustainability of the Industrial Basin of Absheron peninsula.

Eventually, this environmental appraisal will help investors decide if an activity should be financed and, if so, the way in which environmental issues should be addressed in planning, financing, and implementation.

The environmental performance will be assessed in order to identify non-compliance with EU environmental regulations and non-conformance with the ISO 14001 environmental performance standard; provide suggestions for both immediate and long-term corrective actions and Indicate resources needed for implementation.

This preliminary diagnosis will comprise six main parts:

- Assessment of Environmental management performance;
- Assessment of water resources, energy resources and chemical substances entering the plant and consumed with an evaluation of subsequent environmental impacts on natural resources and ecosystems;
- Assessment of impacts on ecosystems made through atmospheric emissions and aquatic releases based on a normal way of operation;

- Assessment of impact risks on ecosystems made through atmospheric emissions, aquatic releases and soil spillages during incidental or accidental events in storage and transfer;
- Assessment of waste management;
- Recommandation on corrective actions.

Amongst other pollutants with environmental impact the following will be appraised:

- Major polluting substances emitted into the atmosphere by the refinery operation, such as :
    - So2 emissions: Sulphur is a found naturally in crude oil. When crude oil goes through the refining processes, a portion of the sulphur is released as H2S in a gas form. The H2S is scrubbed from the gas and the H2S concentrated stream is routed to the Sulphur plants for the recovery and production of elementary sulphur. The un-recovered H2S in the sulphur plant is incinerated to SO2 and released via the stacks to atmosphere;
    - Nox emissions: Nitrogen Oxides (NOx ) is mainly produced from the fuel burning appliances such as furnaces and steam generators. Nitrogen comes as part of the crude and is released via hydro treating process in the form of N2 . The Nitrogen ends up in the refinery fuel gas that is used as fuel in the fuel burning appliances such as process heaters and steam generation boilers. The nitrogen is oxidised to NO2 when combusted and the extent of oxidation depends on the type of burners used in the fuel burning appliances and the way in which the fuel burning appliances are operated;
    - Particulate Matter: The Fluidised Catalytic Cracker Unit is the only major source of particulate emissions in the refinery after the refinery stopped firing fuel oil and switched to firing fuel gas in all its fuel burning appliances. Particulate matter from the FCCU stems from the nature of the process used where powder like catalyst circulates between two chambers, one being the regeneration section and the other being the reaction section. In the process of catalyst circulation there is catalyst attrition that results in fine particulate matter escaping with the gas to the atmosphere via the stack after the cyclones;
    - Volatile Organic Compounds: Sources of Volatile Organic Compounds (VOC) from the refinery include point and non-point sources. Point sources are emissions that exit stacks and flares and thus, can be monitored and treated. Non-point sources are “fugitive emissions” which are more difficult to locate and capture. Fugitive emissions occur throughout the refinery and arise from the thousands of valves, pumps, tanks, pressure relief valves, flanges, etc. While the individual emissions are small the sum of all fugitive emissions at a refinery can add up;
    - Greenhouse Gases: Carbon dioxide emissions coming from the combustion process and Methane emissions;
    - Smoke Emissions: Smoke from the refinery is mainly from the flare system which occurs when there is insufficient hydrocarbon combustion at the flare;
    - Other pollutants (gas and liquid chemicals): such as Benzene, Methyl Cyclopentadienyl Manganese Tricarbonyl (MMT), Hydrogen Sulphide; furfural.

- Major polluting substances emitted into the water, such as :
    - Cooling waters from production units are not considered as polluted by harmful substances (except if leaks). The only parameter considered is the temperature elevation of 8°C;
    - Sewage produced by the water treatment to regeneration of demineralisation and filtering systems. This sewage contains Ca, SO4 , MgSO4, Na2SO4 and sulphuric acid;
    - Sewage from mazut heated by steam at the storage level. Steam is used to lower the viscosity of heavy fuels in storage facilities and pipes. Water condensates contain hydrocarbons which are first recovered by simple flotation techniques and are either aerated or not aerated;
    - Other sewage.
- Major polluting substances discharged through waters, such as :
    - Hydrocarbons from heavy fuels and oils;
    - Chemicals used in the process.
- Major Solid waste polluting substances et waste streams that are recycled and reused in the Refinery such as:
    - Spent catalysts;
    - Oil sludges / slops;
    - Scrap Metal;
    - Nominally Empty Drums;
    - Uncontaminated Pallets and;
    - Limited amounts of Paper / Cardboard.
- Noise and odour

**Organization of the mission of the oil & gas Recovery survey**

On the basis of five working days in-situ plus two home-based working days, the suggested work programme is as follows:

- Day 1. Meeting with Azeri Company representatives: they should give a brief introduction to field(s) main characteristics, past performance, and production constraints. Discussion on the list of required information to properly fulfil the task. Start of data collection and analysis.
- Days 2 and 3. Thorough review and analysis of archieved information. Site visit of the production plants would be helpful.
- Day 4. Preparation of a preliminary short note outlining comments and proposals for enhanced oil & gas recovery from the studied field(s). Debriefing upon findings and preliminary discussion with Azeri engineers in order to confirm the actual feasibility of proposed actions..
- Day 5. Meeting with Azeri Company management. Conclusions and recommendations of the field review will be presented and discussed.
- Day 6 and 7 (home-based): editing of appraisal report and recommendations.

**Organization of the mission of the refinery Maintenance, Inspection and Process Safety survey**

A preliminary Maintenance, Inspection and process Safety questionnaire is sent to the Baku refinery management previously to the on-site mission, in order to introduce the data required for the survey, and for the Baku Management to assemble the corresponding information.

On the basis of five working days in-situ plus two home-based working days, the suggested work program is as follows:

- Day 1. Meeting with Baku Oil Refinery representatives (Production manager + Process manager + Maintenance manager + Inspection manager): they should give a brief introduction to the refinery characteristics, past performance, and production constraints. Based on the Maintenance, Inspection and Process Safety questionnaire, discussion on the list of required information to properly fulfill the task. Start of data collection and analysis.
- Days 2. Discussion with the Maintenance manager. Thorough review and analysis of data collected and field visit of the plant.
- Days 3. Discussion with the Inspection manager. Field visit of the plant and appraisal of environmental performance
- Days 4. Field visit of the plant and debriefing upon findings
- Day 5. Meeting with Baku Oil Refinery management. Preliminary conclusions and recommendations resulting from the Maintenance Inspection and Process Safety Survey will be presented and discussed.
- Day 6 and 7 (home-based): drafting of appraisal report and recommendations

One expert: A senior refinery Maintenance Inspection and Process Safety Expert.

**Organization of the mission of the environment survey**

On the basis of five working days, the suggested work program is as follows:

- Day 1. Meeting with Baku Oil Refinery representatives: they should give a brief introduction to field(s) characteristics, past performance, and production constraints. Discussion on the list of required information to properly fulfill the task. Start of data collection and analysis of the legal environmental framework.
- Days 2. Thorough review and analysis of data collected and field visit of the plant.
- Days 3. Field visit of the plant and appraisal of environmental performance
- Days 4. Field visit of the plant and debriefing upon findings
- Day 5. Meeting with Baku Oil Refinery management. Conclusions and recommendations of the field review will be presented and discussed.
- Day 6 and 7 (home-based): drafting of appraisal report and recommendations

Two experts: A senior Environmental International Expert / a local Environmental Expert.

**CURRICULUM VITAE of ICAT consultant for oil & gas Recovery survey**

ROSAZZA-GIANIN Giorgio born 1943, Italian

University : Degree in Petroleum Engineering - Polytechnic of Turin (April 1971)

Italian (mother tongue), Fluent in English, French, Portuguese

Member SPE (Society of Petroleum Engineers)

Main Areas of Experience:

- Broad experience in definition and assessment of field development/enhancement plans for new and mature oil & gas fields, economic evaluation, elaboration of feasibility studies, follow up and coordination of multidisciplinary activities in the execution of major development projects.
- Monitoring and evaluating reservoir performance, assessing policies required to optimise production, recommending production and pressure tests, preparing production forecasts, recommending drilling locations, evaluating well performance and identifying candidates for workover. Advising whether they are optimally managed accordingly to meet agreed objectives, budgets and time tables, also establishing long-term mutual relationship with external consultants and contractors.
- Acquisitions & portfolio management operations. Valorisation of company assets. Evaluation of new discoveries/ventures and risk ranking.
- Training of local personnel in reservoir and petroleum engineering.
- Gas opportunities determination and gas projects definition, upstream and downstream. Gas marketing and gas storage management.

The exposure to different Countries and Cultures, as well as the interaction with National Oil Companies and leading E&P International Oil Companies in several Joint Ventures, enhanced his natural attitude to teamwork and problem solving, even under difficult circumstances and challenging environment.

PROFESSIONAL EXPERIENCE:

**2002 to date : SERPRO/ICAT Senior Consultancy Petroleum/Reservoir Engineer**
In the period given general consultancy for different Italian and International Consulting Groups, for studies, analyses, training, and texts and programs revisions/preparation. In particular:

-Technical Advisor providing Petroleum-Reservoir Engineering Consultancy for the giant oil field of Hassi Messaoud **SONATRACH**. Tasks include:

- Review of existing dynamic modelling and management plans, making recommendations for modifications / improvement as required
- Evaluate the efficacy of gas and water injection to determine its effectiveness in improving oil recovery, providing input and advice for operational activities, well operation planning and reservoir management policy
- Supervise water-alternating-gas (WAG) injection pilot project, providing surveillance and optimization for data gathering requirements and process evaluation.

- Identify other production technologies which may improve oil recovery (e.g. horizontal/short radius wells).
- Provide engineering support to integrate reservoir characterization with reservoir management, and follow-up field implementation in the application of the well remediation programs.

-Teacher of Basic Reservoir Engineering and Reservoir Monitoring Techniques to ENI field operators, Deep revision & teaching of **Agip KCO's** Text Book for the Training Special Project Intermediate Hydrocarbons Production Courses (**Kazakhstan**), Reservoir Engineering Teacher for Agip KCO . **E.N.I. Corporate University**

-Petroleum-Reservoir Engineering Consultant Teknica Overseas Ltd PEMEX (Dos Bocas – Mexico), development of offshore fields complex, carbonate reservoirs, locally fractured. The study includes geophysical and geological interpretation, petrophysical formation characterization, engineering evaluation and field development proposal.

**1982 – 2002 : PetroFina / TotalFinaElf Reservoir Engineering Manager**

TOTALFINAELF (Milan) Reservoir Engineering manager -Ensure that adequate resources are available and appropriate work conducted, to protect and enhance the value of the Fina Italiana oil & gas fields (Reservoir Management and Integrated Project Development). Organisation and supervision of the Tempa Rossa reservoir studies (including 3D model), being responsible for the Reservoir Engineering Management; Organisation and supervision of the design and interpretation of the production and interference tests of Tempa Rossa wells. -Ensure the planning of the reservoir engineering strategy and production control of the gas fields (including secondary recovery projects by water and gas injection, related planning and construction of piping and surface facilities, oil storage, and shipping terminal & SBM).

FINA ITALIANA (Milan) Technical/Operation Manager, responsible for drilling, projects, production and reservoir engineering concerning Fina Italiana activities both onshore and offshore. Responsible for surface facilities design and construction

PETROFINA (Brussels) Sub-Director - Area Reservoir Engineer Responsible for Africa - Mediterranean Basin Section within the Reservoir Division. In-house reservoir modelling, reservoir / petroleum engineering oversight of overseas operations, review / initiation of development projects (including evaluation of proposal for acquisition of shares in producing fields or projects under development) and technical support to Exploration Dpt. for the evaluation of New Ventures.

FINAPETRO (Angola) Chief of Reservoir Engineering and Planning Division. Co-ordination of projects and studies concerning reservoir engineering studies and planning. Replacement of the Petroleum Engineering Department Manager when on leave.

**1971 – 1982 Agip / ENI Group** Started the professional career as reservoir engineer in a major Exploration & Production Oil Company, growing professionally from reservoir engineer, petroleum engineer to reservoir management, both in Italy and abroad, in Oil Operating Companies.

Agip /SITEP (Tunisia) Area Reservoir Engineer, Reservoir Department. Projects and studies concerning the AGIP activities. Follow-up of IFP/Franlab three-dimensional numerical model for the El Borma field, with special interest for the water injection project

Agip NAME (Libya). Relations with NOC (Libyan National Oil Company) and Consultants for the definition of development plans for oil and gas structures and follow up of Bu Attifel field performances under secondary recovery.

SIRIP (Iran) Senior Reservoir Engineer, head of Reservoir Eng. Section. Reservoir study on the Nowrouz oil field. Scheduling of the workovers and intervention campaign on offshore field wells, and onshore field development (Zagros Mountains)

SITEP (Tunisia) Reservoir Department, co-operation with SITEP Reservoir Department for reservoir studies and survey of the field performance in water injection project and assist Sitep engineers in meeting with consultants.

PETROBEL (Egypt) participated in the working group for the revision of the reservoir studies of Petrobel's fields,

NAOC (Nigeria) Petroleum Engineer. Iinvolved in reservoir engineering, completion, workovers, well testing, production. Assistance in co-ordination and data gathering for reservoir studies (IFP/Franlab). Experience in relations with the Ministry of Petroleum

AGIP Assigned to the Reservoir Department. New reservoir techniques. Expert on mathematical elaboration, preparing, in particular, reservoir study programs. Taught Reservoir Engineering Techniques to Libyan engineers at ENI Training Centre. Participation in the working group investigating recovery factor increase for Agip's oil reservoirs by secondary and/or tertiary recovery.

## CV of P+I consultant for refinery Maintenance, Inspection and Process Safety survey

LENOEL Michel born 1948, French

Ecole Polytechnique France (1968 to 1971)

ENSPM Ecole Nationale Supérieure du Pétrole et des moteurs (1971 to 1972)

French (mother tongue) fluent in English

Functional knowledge of information systems and applications (Refineries and process industries modelization and simulation, ERP Enterprise Resources Planning, Supply Chain Management)

Consulting in Operational Strategy and Innovation Management - Petroleum and Petrochemicals

Strong experience in refinery improvements surveys, opportunity and feasibility studies.

Strong experience of refinery management and organisations.

Strong experience in refinery environmental studies.

Professional experience:

**2001 to date P+I Performance + Innovation** Aix en Provence - France – Management Consulting for Process Industries. Founder, Managing Partner

AXENS for a Client in Cuba (2010): Environmental study for a new and revamped refineries

AXENS for a Client in Nicaragua (2010): Environmental study for a new refinery and petrochemical plant.

AXENS for a Client in Malaysia (2010): Site selection and environmental study for a new refinery and petrochemical plant.

AXENS for a Client in Ivory Coast (2010): Environmental study for a petroleum storage

AXENS for a client in Ivory Coast (2009-2010)Site localization and environmental impact assessment for a new refinery.

CAMEROON - SNH (2009-2011)Project Management Consultant for gas pipeline (Gas to Power Project)

PERENCO - Peru (2009) Scoping study and technology selection for Extra Heavy Oil Upgrader (Peru)

CAMEROON - SNH (2009-2011) Project Management Consultant for gas pipeline (Gas to Power Project)

CAMEROON - SNH (2008-2009) Process conceptual study, pre sizing and cost estimates for a Gas Processing Facility and NGL plant.

AXENS (IFP group) (2009) Environmental and Risk Assessment studies for a refinery in Cuba

AXENS (IFP group) (2009) Environmental and Risk Assessment studies for a refinery in Vietnam

AXENS (IFP Group) (2008 – 2009) Benchmarking (MRO : Maintainability, Operability and Reliability) in refining processes : Continuous Catalytic Reformer.

AXENS for a Client in South East Asia (2008-2009) Bankable Feasibility Study for a new refinery : Project management, market survey, process configuration study, preliminary environmental impact assessment, financial study.

AXENS for a client in Central America (2008) Site localization and environmental impact assessment for a new refinery, petrochemical complex and marine terminal.

AXENS for a Client in South East Asia (2008) Preliminary Environmental Impact Assessment and Hazard Analysis for a new refinery.

BENIN (2008) Feasibility study (market study, project economics and profitability) for a new refinery project.

BENIN (2008) Site localization and environmental impact assessment for a new refinery and marine terminal.

AXENS for a Client in Central Asia (2008) Preliminary Environmental Impact Assessment and Hazard Analysis for a refinery revamp with deep conversion.

BENIN (2007) Preliminary configuration and project appraisal and scoping for a new refinery and marine terminal in Benin.

AXENS for SLOVNAT (Slovakia) – 2006 Feasibility study for a deep conversion project.

JPRC (Jordan) : Restructuring, performance improvement of the Jordanian petroleum refining Company in a competitive, free market environment (end of concession).

AXENS for a Client in South East : Market and opportunity study for a new refinery project

AXENS (IFP Group) Benchmarking (MRO : Operability and Reliability) in petrochemical processes

VEOLIA : Opportunity study for a new process for industrial wastes recycling

**1998 – 2000 PEA Consulting** Paris – Consulting in Supply Chain Management and new technologies. Director of Business Unit, process industries (Energy)

- COGEMA – R&D Management (nuclear fuel reprocessing)

- EDF: Benchmarking of process performance
- EDF: Risk management (year 2000 compliance)
- TOTALFINA ELF – Human Resources management and competencies in refineries
- BP Amoco – Project management. Benchmarking of projects performance.
- SUEZ-LYONNAISE: Industrial and business plan, standard equipment branch.

**1995 to 1998 TECHNOGRAM** Paris – Consulting in management and organisation Director – Associate Partner

- EDF Industrial branch – Project management and business development, R&D management.
- LEROY SOMER : Diagnosis and recommendation for an ERP system (Enterprise Resource Planning)

**1983 to 1995 DANONE Group – Kronenbourg breweries** Nancy and Strasbourg – France Director of TEPRAL – Danone Group, Beer division, Research & Development Centre.

- Management of Innovation and R&D
- Technology foresight, research strategy
- Coordination of technology R&D for the DANONE Group
- Development and industrialization of new technologies
- Managing of European R&D (Fr, DK, NL) projects

**1972 to 1983 TOTAL Group** Le Havre (Gonfreville Refinery) – France – Compagnie Française de Raffinage. **Process Engineer, Operation Engineer**

Operation Engineer and Manager for refining units (topping, hydrodesulfurization, claus plant)

- Technical and process optimisation of refining units.
- Engineering and project management for refinery projects.
- Opportunity and Feasibility studies - Business case for Capital Expenditure improvement projects.
- Process design and construction, technical assistance and troubleshooting.
- Process control and supervision:

- Owner Engineer. Starting up and commissioning of new refining units : Hydrodesulfurization and Claus Plant
- Starting up and commissioning of new hydrodesulfurization unit and Hydrogen PSA unit in Germany.

Process development engineer (catalytic units : Catalytic Reforming, Hydrodesulfurization and Hydrotreating, Claus plants)