MARTINEZ LLAURADO, LUIS ALBERTO

Position: TURBOMACHINERY- SENIOR SPECIALIST- LEVEL III (EXPERT)

Location: Mexico, DF / Tlf. (Cel.55-37428787)

Email: llauradoluisalberto@gmail.com
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albertomtzllaurado@reciprocatingcompressors-consulting.com

Education / University: - LOS ANDES UNIVERSITY (ULA)
(MERIDA, VENEZUELA) 1978-1983
MECHANICAL ENGINEER

- SIMON BOLIVAR UNIVERSITY (USB)
(CARACAS, VENEZUELA) 1988-1990
ROTATING EQUIPMENT SPECIALIZATION

Languages: SPANISH / ENGLISH (Fluent)

Age: 61 years old (1961)

SUMMARY EXPERIENCE:

Experience as Mechanical & Turbomachinery Engineer until 2023.

40 years as Mechanical Engineer (in countries such as Venezuela, Spain, Mexico) in different industrial areas (OIL, GAS, POWER GENERATION) such as they are mentioned as follow:

2 years in Predictive, Preventive, Proactive & Corrective for HVAC Systems, in the Main Administrative Building in Planta Centro – CADAFE Company (Carabobo State, Venezuela, 1983/1985).

17 years as Rotating Equipment Engineer, responsible for all the equipment in LAGOVEN Company (PDVSA) for the AMUAY Oil (Falcon State, Venezuela, 1985/2002).

4 years as academic instructor (contracted for partial time) in the Universidad Experimental Francisco de Miranda (UNEFM) located in Falcon state, Venezuela, 1996/2000). The subjects given were:

-Thermodynamic (for Chemical Engineers)
-Thermodynamic Applied for Mechanical Engineers.
-Energy Conversion (for Industrial Engineers)
-Analysis and Diagnostics about malfunctions in Rotating Machinery (Mechanical Engineer).

19 years being responsible as Industrial Projects (Specialist in Rotating / Dynamic equipment) since 2002 to the current date), labored as follow:

- 1 year in FOSTER WHEELER IBERIA Company (in Madrid, Spain) as Senior Engineer of the Engineering Management – Mechanical Area, 2002/2003.

- 1.5 year in FLUOR S.A. ESPAÑA Company (in Madrid, Spain), as Senior Engineer for Engineering Management – Mechanical Area, 2003/2004.

- 18 years in ICA-FLUOR S.A. de C.V. – MEXICO (in DF, Mexico) as Senior Turbo-machinery Specialist of the Engineering Management – Mechanical Area, 2004 / to the current date 2023. Technical Expert since 2015. Retired in 2022.

SPECIFIC EXPERIENCE:

EXPERIENCE AS TURBOMACHINERY ENGINEER IN OIL REFINERIES:

VENEZUELA

The scope as an engineer for the Rotating equipment area from 1985 to 2002 (as an engineer responsible for industrial plants being located within the Amuay Oil Refinery - PDVSA) covered the following functions/activities:

- Advisor/Consultant for the Managements of Operations / Technical / Maintenance (Routine and Major Repairs (Overhaul)) in the Rotating Equipment areas such as: Turbo-machinery, Turbo-generators (steam/gas), centrifugal compressors / reciprocating compressors (gas/air), pumps (for hydrocarbons / water boilers / process / cooling tower / salt water / liquid sulfur /slurry, etc), steam turbines (General/ Special Purposes), Gas turbines, Blowers (air/gas), fin fan coolers, gearboxes of special purposes, industrial electric motors (synchronous/induction type), etc.

- Review of technical specifications, Failure analysis reports, Technical Recommendations to workshops located internal & external to PDVSA, Reliability studies (MTBR, MTTF and MTTR), Review of spare parts and its operational interchangeability, Inspection & Testing Inspector (national/international) at the Supplier's Factories in the Rotating Equipment area for PDVSA, preparation/implementation of the Maintenance schedule (for preventive/predictive/corrective/proactive) in Rotating Equipment.

- Assistance as an exhibitor to conferences / Symposiums / technical meetings, in the Rotating equipment area (national/international).

- Leader of Planning and Repair about Rotating equipment (Maintenance Management – Routine Area) in the workshops and at site in the Plants for the Amuay's Oil Refinery (1991/1992).

EXPERIENCE IN THE INDUSTRIAL PROJECT AREAS:

In the Project area I have performed as a Specialist in the Rotating equipment area (Dynamic area), being responsible for main equipment as a Mechanical Coordinator/Leader in many projects since 2002 to 2022:

SPAIN

FOSTER WHEELER IBERIA (2002 / 2003):

Project: "LAST GENERATION OF ULTRA LOW SULFUR IN FUELS FOR THE BP's OIL REFINERY, IN CASTELLON, SPAIN".

Location/Client: Process Plant Makfiner, Scanfiner and Hydrogen, for the BP Oil Refinery, (BRITISH PETROLEUM Company), in Castellón de La Plana, Valencia.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the compression package (gas centrifugal compressors and gas reciprocating compressors) with the following technical features:

1 GAS CENTRIFUGAL COMPRESSOR, Mfr: MAN TURBOMACHINEN (Germany/Switzerland),

4 GAS RECIPROCATING COMPRESSORS, Mfr: NUOVO PIGNONE (Italy),

This project was estimated in 15 MM of Euros.

FLUOR S.A. – ESPAÑA (2003/2004)

Project: "EXTENSION OF GAS COMPRESSION STATION IN TIVISSA – TARRAGONA, SPAIN".

Location/Client: Node to supply gas through the stations in Valencia-Alicante-Bilbao-Barcelona, in Spain / ENAGAS

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the turbo-compressor packages (gas centrifugal compressors and gas turbines) with the following technical features:

3 NATURAL GAS COMPRESSORS, CENTRIFUGAL TYPE, **Mfr: SOLAR (USA)**,

3 GAS TURBINES, Mfr: SOLAR TURBINES (USA),

This Project was estimated in 20 MM Euros.

FLUOR S.A. – SPAIN (2004)

Project: "SYSTEM FOR THE CAPTURE OF COKE EMISSIONS IN THE DRY PAST PLANT IN THE ALCOA's ALUMINUM MELTING, IN AVILES, SPAIN."

Location/Client: Aluminum Melting Plant in Aviles – Asturias / ALCOA.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement and the scope for site works as mechanical, civil, electrical, in

order to collect the emissions of Coke for the Dry Pasta Plant, and the treatment of these gases through a catalytic unit for reducing pollutant emissions to the atmosphere.

The contract was estimated in 1 MM Euros, being handled in conjunction with a Denmark company (Catalytic Abator Unity).

FLUOR S.A. – SPAIN (2004)

Project: "TECHNICAL ASSISTANCE FOR MULTIPLE FAILURES IN THE GAS RECIPROCATING COMPRESSORS OF THE HYDRO-DESULPHURISATION PLANT IN THE TARRAGONA's OIL REFINERY (REPSOL)" - SPAIN.

Location/Client: Hydro-desulphurization Plant (area 615), Oil Refinery at Tarragona / REPSOL.

Position/Activities: Technical Assistance (Consultant) for the study about different failures occurred in 3 reciprocating compressors, mfr. NUOVO PIGNONE; Model 2HD/1 (also-called K-1, K-2 and K-3; located in the area 615, Hydro-desulphurization Plant). Equipment driven by electric motors of 365 RPM and power rated in 1000 HP each.

It was submitted a final report with the causes of the failures, the conclusions and the recommendations. They were implemented in the short and long term. The reliability was highly improved for these gas compressors in a short term.

MEXICO

ICA FLUOR S.A. de C.V. (OCT-2004 / FEB-2006)

Project: "DEVELOPMENT OF ENGINEERING, PROCUREMENT OF EQUIPMENT AND MATERIALS, CONSTRUCTION, INSPECTION AND TESTING, TRAINING, STARTING UP PREPARATION, START-UP AND PERFORMANCE TESTS, FOR THE AUXILIARY FACILITIES UNITY, FOR THE OIL REFINERY RECONFIGURATION "GENERAL LAZARO CARDENAS" in MINATITLAN, VERACRUZ, MEXICO"

Location/Client: Minatitlan, Veracruz, Mexico / PEMEX

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

1 STEAM TURBINE (BACK PRESSURE TYPE) to drive a Synchronous Electrical Generator of 45 MW, (**Mfr: SIEMENS**, Germany & Brazil).

1 SYNCHRONOUS GENERATOR, MFR. SIEMENS. 45 MW, 3600 RPM.

The estimated cost for the Turbo-generator and the accessories was of 20 MM$.

3 CENTRIFUGAL COMPRESSORS FOR INSTRUMENT & PLANT AIR (**Mfr: ELLIOTT**, **USA**),

4 FORCED AIR BLOWERS (**Mfr: HOWDEN BUFFALO, USA**), driven by 2 Steam Turbines (mfr: ELLIOTT, USA), and by 2 electric motors (Mfr: GENERAL ELECTRIC, USA).

The total estimated cost for these Blower packages was 5 MM$.

6 STEAM TURBINES (GENERAL PURPOUSE, API-611) (Turbines **Mfr: ELLIOTT, USA**; Pumps Mfr: SULZER, Mex.),

The total cost estimated was in 2 MM$.

ICA FLUOR S.A. de C.V. (MAR-2006 / ENE-2007)

Project: "DEVELOPMENT OF ENGINEERING, PROCUREMENT OF EQUIPMENT AND MATERIALS, CONSTRUCTION, INSPECTION AND TESTING, TRAINING, STARTING UP PREPARATION, START-UP AND PERFORMANCE TESTS, FOR THE LINE # 2 AND FOR THE SPLITTER REVAMP FOR THE POLYPROPILENE AREA AT INDELPRO S.A. DE C.V. (INDUSTRIA DEL PROPILENO), IN ALTAMIRA, TAMAULIPAS, MEXICO".

Location/Client: Altamira, Tamaulipas, México / INDUSTRIA DEL PROPILENO (INDELPRO S.A. de C.V.),

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

1 CENTRIFUGAL GAS COMPRESSOR (**Mfr: ATLAS COPCO; Germany**),
The cost of this package was in 6 MM$.

1 RECIPROCATING GAS COMPRESSOR (**Mfr: BURCKHARDT; Switzerland**), The estimated cost was 3 MM$.

1 RECIPROCATING GAS COMPRESSOR (**Mfr: BURCKHARDT; Switzerland**), The cost for this package was 3 MM$.

4 RECIPROCATING GAS COMPRESSORS (**Mfr: SIAD MI; Italy),** driven by 4 electric motors, Mfr.: SIEMENS (Germany),
The total cost for these 4 packages in 3 MM$.

2 CENTRIFUGAL AIR COMPRESSORS, FOR INSTRUMENT AIR, (**Mfr: ELLIOTT, USA**),

The estimated cost for the 2 packages in 1 MM$.

2 GAS BLOWERS, ROTATING PISTON TYPE, (**Mfr: AERZEN; GERMANY**); driven by 2 electric motors (Mfr: ABB),
The estimated cost for the 2 packages in 1 MM$.

1 RECIPROCATING GAS COMPRESSOR, COMPRESOR RECIPROCANTE (**Mfr: BLACKMER; USA**); driven by 1 electric motor, Mfr: RELLIANCE),

The estimated cost in 0.5 MM$.

ICA FLUOR S.A. de C.V. (ENE-2007 / ABR-2007)

Project Proposal: "WORKS AND INTEGRATED SERVICES FOR THE EXPLOTATION OF HYDROCARBON DEPOSITS IN THE PALEOCANAL CHICONTEPEC II" – BASIC & DETAILED ENGINEERING FOR THE COMPRESSION STATION, FOR PEMEX (EXPLORATION & PRODUCTION), IN PUEBLA / VERACRUZ, MEXICO.

Location/Client: Modules of the Gas Compression Station in Chicontepec II, Puebla, Veracruz, Mexico / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering, for the following equipment packages:

Three (3) GAS TURBO-COMPRESSORS (**Mfr: SOLAR COMPRESSORS; U.S.A**),

Three (3) GAS TURBINES (Mfr: SOLAR TURBINES): with the following specifications:

1 Turbine, Model CENTAURO 50 @ 4364 kW (ISO), 13300 RPM.
1 Turbine, Model (CENTAURO 40 @ 3074 kW (ISO), 15500 RPM.
1 Turbine, Model SATURNO 20 @ 1108 kW (ISO), 22300 RPM

The total cost was estimated in 8 MM $.

Ten (10) GAS MOTOCOMPRESSORS (**Mfr: AJAX, CAMERON, USA**).

The total cost for these ten packages is around 18 MM$.

ICA FLUOR S.A. de C.V. (ABR-2007 / OCT-2007)

Project: "DEVELOPMENT OF BASIC & DETAILED ENGINEERING, THE PERMISSIONS, PROCUREMENT OF MATERIALS, CONSTRUCTION, INSPECTION AND TESTING, TRAINING, STARTING UP PREPARATION, START-UP, PERFORMANCE TESTS AND THE DELIVERY OF DOCUMENTATION FOR THE CRIOGENIC MODULAR PLANTS 5 & 6, AND THE PRODUCT STORAGE INSTALLATIONS, AUXILIARY FACILITIES AND THE INTEGRATION AT CPG BURGOS, IN REYNOSA, TAMAULIPAS"

Location/Client: CPG Burgos, in Reynosa, Tamaulipas, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

Five (5) GAS TURBOCOMPRESSORS (**Mfr: DRESSER RAND; U.S.A.**),

Five (5) GAS TURBINES, (**Mfr: SOLAR TURBINES, U.S.A.):**

The total cost of the five packages (turbo compressors) in 40 MM$

1 TURBO-GENERATOR (**Mfr: KATO, Germany**), driven by a gas turbine Mfr. by SOLAR TURBINES (USA).

1 GAS TURBINE (**Mfr: SOLAR TURBINES, U.S.A**):

The total cost of this gas turbine/turbo-generator package exceeds 8 MM$.

3 CENTRIFUGAL AIR COMPRESSORS, for instrument & Plant Air, (**Mfr: ATLAS COPCO**), driven by Electric Motors (Mfr.: SIEMENS, U.S.A.).

The total cost for these packages in 1 MM$.

7 CENTRIFUGAL PUMPS, for the water system against fire, (Mfr: SIX (6) **FAIRBANK-MORSE (U.S.A**.) and ONE (1) **MANN** (México)),

The total cost for these pump packages in 1 MM$.

ICA FLUOR S.A. de C.V. (NOV-2007 – MAR-2008)

Project Proposal: "ENERGY CENTER OF THE AMERICAS (CELA), LOCATED IN THE PANAMA REPUBLIC (AMONG THE ATLANTIC & PACIFIC COASTS".

Location/Client: Cd. De Panamá / CONSORCIO DE EMPRESAS PRIVADAS (ENERGIAS).

Position/Activities: Engineer responsible / Mechanical Coordinator for Basic Engineering, particular specifications, P&IDs, data sheets for all the pumps in its first phase (such as the crude oil and the crude oil transfer, MGO, MDO, gasoline, diesel, jet, fuel oil, purines, cutter, distilled products, MTBE, oxygenated, clean products and contaminated, transfer of clean products, the chemical injection pumps, etc., driven by electric motors), the cooling water (with river water on the Pacific side and with salt water on the Atlantic side; including electric motors), air compressors for Plant and instrumentation (with air dryers, regenerative type) as well as the emergency diesel generator and the water pump systems against fire (driven by diesel and electric motor) and the pressure pump, Jockey type., to form part of an industrial park (oil), the largest in America, being located in Panama Republic.

The total cost of the project in its first phase (in the case of be executed) is expected to be in the order of 1000 MM$.

ICA FLUOR S.A. de C.V. (ENE-2008 – MAY-2008)

Project Proposal: "INCREASING IN THE ETHYLENE PRODUCTION FROM 600 MTA TO 850 MTA FOR THE ETHYLENE PLANT AT PEMEX, LOCATED IN THE MORELOS PETROCHEMICAL COMPLEX, AT COATZACOALCOS, MEXICO"

Location/Client: Coatzacoalcos, México / PEMEX.

Position: Engineer responsible as Mechanical Coordinator for the Basic Engineering, for the following equipment packages:

3 GAS TURBOCOMPRESSORS, FOR LOADING, Mfr: ELLIOTT (Japan), NUOVO PIGNONE-GE (Italy), DRESSER RAND (USA), Siemens (Germany), HITACHI (Japan), centrifugal type, multi-stages, driven by steam turbines (Condensation type) Mfr by ELLIOTT (Japan), SIEMENS (Germany) and NUOVO PIGNONE-GE (USA).

The total estimated cost was 60 MM$.

2 GAS TURBOCOMPRESSORS, FOR REFRIGERATION TERTIARY GAS, Mfr: ELLIOTT (Japan), NUOVO PIGNONE-GE (Italy), DRESSER RAND (USA), SIEMENS (Germany), HITACHI (Japan), centrifugal type, multi-stages, driven by steam turbines (Condensation type), Mfr by ELLIOTT (Japan), Siemens (Germany) and NUOVO PIGNONE-GE (USA).

The total estimated cost was 25 MM$

ICA FLUOR S.A. de C.V. (FEB-2008 / MAR-2009)

Project: "DEVELOPMENT OF THE ENGINEERING, PROCUREMENT, CONSTRUCTION, INSPECTION AND TESTING, TRAINING, COMMISSIONING, PERFORMANCE TEST, AND THE DELIVERY OF DOCUMENTATION FOR THE NITROGEN INJECTION PROJECT AT THE REGASIFICATION LNG PLANT (BY COSTA AZUL ENERGY), AT BAJA CALIFORNIA. MEXICO"

Location/Client: La Ensenada, Baja California, México / COSTA AZUL ENERGY (SEMPRA).

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

3 AIR COMPRESSORS (**Mfr.: ATLAS COPCO (USA**); driven by electric motor (Mfr: SIEMENS (USA)).
The total cost of these (3) three air compression packages reaches 5 MM$.

3 NITROGEN COMPRESSORS (**Mfr: BURCKHARDT (Switzerland**); driven by electric motor (Mfr: TECO / WESTINGHOUSE (USA)).
The total cost of these (3) three compressor packages reaches 8 MM$.

ICA FLUOR S.A. de C.V. (JUL-2008 / DIC-2008)

Project Proposal: "CHIHUAHUA EXPANSION PIPELINE – PROPOSAL FOR FRONT-END ENGINEERING DESIGN AND BID PACKAGE DEVELOPMENT" – (PROPOSAL DEVELOPMENT FOR THE BASIC ENGINEERING, OFFER TYPE PACKAGE, FOR THE EXPANSION OF THE GAS COMPRESSION STATION AND THE GAS PIPING BETWEEN THE EL PASO AND CHIHUAHUA CITY, AT CHIHUAHUA, MEXICO".

Location/Client: Chihuahua, México / GASODUCTO DE CHIHUAHUA (GDC).

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering for the following equipment packages:

2 NATURAL GAS COMPRESSORS (**Mfr: SOLAR (USA**); driven by GAS TURBINES (Mfr: SOLAR TURBINES).

The total cost of these 2 packages was estimated in 12 MM$.

2 CENTRIFUGAL GAS COMPRESSORS MODIFIED (changed in the number of impellers, **Mfr: SOLAR TURBINES**), driven by 2 GAS TURBINES, MODIFIED (increased in power rated, **Mfr: SOLAR TURBINES**).

The total cost for these modifications (upgrade) in both packages reached 1.2 MM$.

ICA FLUOR S.A. de C.V. (DIC-2008 / MAR-2009)

Project Proposal: "PROPOSAL FOR THE BASIC AND DETAILED ENGINEERING DEVELOPMENT, FOR A CRYOGENIC PLANT OF 200 MMPCD, INCLUDING THE PROCUREMENT OF MATERIALS, CONSTRUCTION, INSPECTION & TESTING, TRAINING, PRE-START UP TESTING AND PERFORMANCE TEST, LOCATED AT THE CPG IN POZA RICA, MEXICO"

Location/Client: Poza Rica, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering for the following equipment packages:

Three (3) GAS TURBO-COMPRESSORS (**Mfr: DRESSER RAND; U.S.A**), centrifugal type, driven by GAS TURBINE each, Mfr: SOLAR TURBINES (U.S.A).

Three (3) GAS TURBINES (**Mfr: SOLAR TURBINES, U.S.A**.). The Gas Turbines are double shaft type, Model TAURUS 70),

The total estimated cost was 22 MM$

Three (3) CENTRIFUGAL AIR COMPRESSORS, FOR INSTRUMENT & PLANT AIR, (**Mfr. ATLAS COPCO**), driven by Electric motors (Mfr: SIEMENS, U.S.A.)

The total estimated cost was 2 MM$.

ICA FLUOR S.A. de C.V. (FEB-2009 / MAY-2009)

Project Proposal: "PROPOSAL FOR THE ENGINEERING, PROCUREMENT AND CONSTRUCTION OF THE PROCES UNIT FOR NAPHTA REFORMING AND LOW PRESSURE (CCR PLATTFORMING) FOR THE AROMATIC TRAIN 1, INCLUDING THE CCR REGENERATION AT THE CPG IN CANGREJERA, COATZACOALCOS, VERACRUZ, MEXICO".

Location/Client: Coatzacoalcos, Veracruz, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering for the following equipment packages:

1 CENTRIFUGAL GAS COMPRESSOR (RECYCLE GAS)

Proposals from GE (USA), ELLIOTT (USA), HITACHI (Japan), Siemens (USA) were evaluated technically.

The estimated cost of this package reaches 12 MM$

1 CENTRIFUGAL GAS COMPRESSOR (NET GAS)

Proposals from GE (USA), ELLIOTT (USA), HITACHI (Japan), Siemens (USA) were evaluated technically.

The estimated cost of this package reaches 18 MM$.

2 CENTRIFUGAL AIR COMPRESSORS, GEARBOX INTEGRATED, INSTRUMENT & PLANT AIR, INCLUDING THE AIR DRYERS.

Proposals from ELLIOTT (USA) and GRACO (Mfr: COMPAIR-HYDROVANE - USA) were evaluated technically.

The estimated cost of these packages (including the dryers) reaches 1 MM$.

2 SCREW AIR COMPRESSORS (FOR PROCESS AIR)

Proposals from ATLAS COPCO (USA) and COPIISA (USA) were evaluated.

The estimated cost of these package reaches 0.6 MM$.

1 CENTRIFUGAL BLOWER (LIFT GAS)

Proposal from SUNDYNE (USA) was received.

The total estimated cost is 2 MM$.

1 CENTRIFUGAL BLOWER (REGENERATION GAS)

Proposals were received from ROBINSON (USA) and FLAKT (USA).

The total cost was estimated in 0.5 MM$.

1 CENTRIFUGAL BLOWER (GAS COOLING)

Proposals were received from ROBINSON (USA) and FLAKT (USA).

The total cost was estimated at 0.4 MM$.

1 CENTRIFUGAL BLOWER (DUST REMOTION)

Proposals were received from ROBINSON (USA) and FLAKT (USA

The total cost was estimated in 0.3 MM$.

ICA FLUOR S.A. de C.V. (MAY-2009 / AGO-2009)

Project Proposal: "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF DESULPHURISATION PLANT IN THE CATALYTIC GASOLINE 1, AUXILIARY FACILITIES AND THE INTEGRATION, FOR THE OIL REFINERY "ENG. HECTOR R. LARA SOSA" AT CADEREYTA, N. L. " and "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF DESULPHURISATION PLANT IN THE CATALYTIC GASOLINE 1 AND 2, AUXILIARY FACILITIES AND THE INTEGRATION FOR THE OIL REFINERY "FRANCISCO I. MADERO", AT CD. MADERO, TAMPS."

Location/Client: Cadereyta, Nuevo León, and Cd. Madero, Tamaulipas, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering for the following equipment packages:

See the details for the compressor packages shown in the Projects for Cadereyta & Madero.

ICA FLUOR S.A. de C.V. (SEPT-2009 / ENE-2010)

Project Proposal: "DEVELOPMENT OF THE ENGINEERING, PROCUREMENT AND CONSTRUCTION OF CATALYTIC GASOLINE DESULPHURISATION PLANTS, REGENERATIVE AMINE UNITS, COMPLEMENTARY SYSTEMS, AUXILIARY FACILITIES AND INTEGRATION IN THE REFINERY "GRAL. LAZARO CARDENAS", IN MINATITLÁN, VERACRUZ, and DEVELOPMENT OF ENGINEERING, PROCUREMENT AND CONSTRUCTION OF CATALYTIC GASOLINE DESULPHURISATION PLANTS, REGENERATIVE AMINE UNITS, COMPLEMENTARY SYSTEMS, AUXILIARY FACILITIES AND INTEGRATION IN THE REFINERY "ENG. ANTONIO DOVALÍ JAIME, IN SALINA CRUZ, OAXACA."

Location/Client: Minatitlán, Veracruz y Salina Cruz, Oaxaca, México**.**

Position/Activities: Engineer responsible as Mechanical Coordinator for the Basic Engineering for the following equipment packages:

See the details for the compressor packages shown in the Projects for Minatitlan & Salina Cruz.

ICA FLUOR S.A. de C.V. (MAY-2009 / ENE-2010)

Project: "DEVELOPMENT OF THE BASIC & DETAILED ENGINEERING FOR A CRYOGENIC PLANT OF 200 MMSCFD, INCLUDING THE PROCUREMENT OF MATERIALS, CONSTRUCTION, INSPECTION & TESTING, TRAINING, COMMISSIONING, AND PERFORMANCE TEST, LOCATED AT CPG IN POZA RICA, MEXICO"

Location/Client: Poza Rica, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

Three (3) GAS TURBOCOMPRESSORS (**Mfr: DRESSER RAND; U.S.A**),

Three (3) GAS TURBINES (**Mfr: SOLAR TURBINES, U.S.A.).**

The total cost of the package (turbo compressors) exceeds 30 MM$.

Three (3) SCREW AIR COMPRESSORS (FOR INSTRUMENT & PLANT AIR) (**Mfr: ATLAS COPCO)**, driven by electric motors (Mfr: SIEMENS, U.S.A.)

The total cost of these air packages exceeds 0.8 MM$.

ICA FLUOR S.A. de C.V. (SEPT-2009 / FEB-2012)

Project: "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF THE DESULPHURISATION PLANT AT THE CATALYTIC GASOLINE 1, AUXILIARY FACILITIES AND THE INTEGRATION, FOR THE OIL REFINERY "ENG. HECTOR R. LARA SOSA" IN CADEREYTA, N. L. "

Location/Client:. Cadereyta, Nuevo León, México / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

4 RECIPROCATING GAS COMPRESSORS (API-618)

2 Reciprocating Compressors, **Mfr. NEUMAN & ESSER (Switzerland),**

The estimated cost for these packages reaches 4 MM$.

2 Reciprocating Compressors, **Mfr. NEUMAN & ESSER,**

The estimated cost for these compressor packages reaches 4 MM$.

1 CENTRIFUGAL GAS COMPRESSOR, GEARBOX INTEGRATED, (API-617)

1 Centrifugal compressor, 1 stage, **Mfr. by SUNDYNE (USA)**,

The estimated cost of these packages reaches 2 MM$.

2 SCREW AIR COMPRESSORS (API-619), 2 AIR DRYERS.

2 screw compressors, **Mfr. KOBELCO (USA),**

2 Air dryers, with double pre-filters & post-filters, heatless type. Mfr. by PNEUMATECH.

The estimated cost of these packages (including the dryers) reaches 1 MM$.

ICA FLUOR S.A. de C.V. (SEPT-2009 / FEB-2012)

Project: "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF THE DESULPHURISATION PLANT AT THE CATALYTIC GASOLINE 1 & 2, AUXILIARY

FACILITIES AND THE INTEGRATION, FOR THE OIL REFINERY "FRANCISCO I. MADERO, AT CD. MADERO TAMPS".

Location/Client: Cd. Madero, Tamaulipas, Mexico / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

6 RECIPROCATING GAS COMPRESSORS (API-618)

4 Reciprocating gas Compressors, **Mfr. NEUMAN & ESSER (Switzerland**),

The estimated cost of these packages reaches 8 MM$.

2 Reciprocating Compressors, **Mfr NEUMAN & ESSER**,

The estimated cost of these packages reaches 4 MM$.

2 CENTRIFUGAL GAS COMPRESSORS, GEARBOX INTEGRATED (API-617)

2 Centrifugal compressors, 1 stage, **Mfr SUNDYNE-USA**,

The estimated cost of these 2 packages reaches 4 MM$.

3 SCREW AIR COMPRESSORS (API-619), 2 AIR DRYERS.

3 screw compressors, **Mfr KOBELCO-USA**,

The estimated cost of these packages (including the dryers) reaches 2 MM$.

ICA FLUOR S.A. de C.V. (APR-2010 / MAY-2012)

Project: "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF THE DESULPHURISATION PLANT AT THE CATALYTIC GASOLINE, URA UNIT (AMINE REGENERATION UNIT), COMPLEMENTARY SYSTEMS, AUXILIARY FACILITIES AND THE INTEGRATION, FOR THE OIL REFINERY "GRAL LAZARO CARDENAS" IN MINATITLAN, VERACRUZ, MEXICO".

Location/Client: Minatitlan, Veracruz, Mexico / PEMEX.

Position/Activities: Engineer responsible as Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

2 RECIPROCATING GAS COMPRESSORS (API-618)

2 Reciprocating Compressors, **Mfr NEUMAN & ESSER (Switzerland),**

The estimated cost of these packages reaches 4 MM$.

1 CENTRIFUGAL GAS COMPRESSOR, GEARBOX INTEGRATED (API-617)

1 Centrifugal compressor, 1 stage, **Mfr SUNDYNE-USA**,

The estimated cost of these packages reaches 2 MM$.

5 SCREW AIR COMPRESSORS (API-619), 5 AIR DRYERS.

2 Screw Compressors, **Mfr KOBELCO-USA**,

5 Air dryers, with double pre-filters & post-filters, heatless regeneration type, Mfr PNEUMATECH.

The estimated cost of these packages (and air dryers) reaches 2 MM$.

ICA FLUOR S.A. de C.V. (APR-2010 / MAY-2012)

Project: "ENGINEERING, PROCUREMENT AND CONSTRUCTION OF THE DESULPHURISATION PLANTS AT THE CATALYTIC GASOLINE, URA UNIT (AMINE REGENERATION UNITS), COMPLEMENTARY SYSTEMS, AUXILIARY FACILITIES AND THE INTEGRATION, FOR THE OIL REFINERY "ENG. ANTONIO DOVALI JAIME, AT SALINA CRUZ, OAXACA, MEXICO".

Location/Client: Salina Cruz, Oaxaca, México / PEMEX.

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

8 RECIPROCATING GAS COMPRESSORS (API-618)

4 Reciprocating Compressors, **Mfr NEUMAN & ESSER (Switzerland)**,

The estimated cost of these packages reaches 8 MM$.

4 Reciprocating Compressors, **Mfr NEUMAN & ESSER**,

The estimated cost of these packages reaches 8 MM$.

2 CENTRIFUGAL GAS COMPRESSORS, GEARBOX INTEGRATED (API-617)

2 Centrifugal compressors, 1 stage, **Mfr SUNDYNE-USA**,

The estimated cost of these 2 packages reaches 4 MM$.

2 SCREW GAS COMPRESSORS (OIL FLOODED) (API-619)

2 Screw Compressors, flooded type, **Mfr KOBE STEEL-Japan**,

The estimated cost of these packages reaches 5 MM$.

2 CENTRIFUGAL AIR COMPRESSORS (API-672), 2 AIR DRYERS.

2 Centrifugal Compressors, **Mfr ELLIOTT-USA**,

The estimated cost of these packages reaches 2 MM$.

ICA FLUOR S.A. de C.V. (MAY-2012 / JUL-2012)

Project: "OBRAS Y SERVICIOS INTEGRADOS PARA LA EXPLOTACION E LOS YACIMIENTS DE HIDROCARBUROS EN EL PALEOCANAL DE CHICONTEPEC II"

Location/Client: Veracruz, México / PEMEX.

Position/Activities: Responsible engineer for the Gas Engine Electrical Generator for continuous service about the Engineering, Procurement, Construction, Inspection and Testing.

Place: BATERIA DE SEPARACIÓN - REMOLINOS III (VERACRUZ, MEXICO)

1 GAS ENGINE-ELECTRICAL GENERATOR, 150 kW, **Mfr. CUMMINGS-USA**

The estimated cost for this package is 250 M$.

Place: BATERIA DE SEPARACION - FURBERO I (VERACRUZ, MEXICO)

1 GAS ENGINE-ELECTRICAL GENERATOR, 150 kW, **Mfr. CUMMINGS-USA**

The estimated cost for this package is 250 M$.

Place: BATERIA DE SEPARACION - COYOL II (PUEBLA, MEXICO)

2 GAS ENGINE-ELECTRICAL GENERATORS, 150 kW, **Mfr. CUMMINGS-USA,**

The estimated cost for these two packages was 500 M$.

The total estimated cost for this Project regarding the gas engine-generators is 1 MM$.

ICA FLUOR S.A. de C.V. (MAY-2012 / JUL-2012)

Project: "**OFFSHORE PLATTFORM named as TEMPORAL PB-LITORAL-T**"

Location/Client: Tabasco, México / PEMEX.

Position/Activities: Responsible engineer for the Diesel Engine Electrical Generators for the continuous & Emergency services about the Engineering, Procurement, Construction, Inspection and Testing, to be mounted on a Pemex's offshore platform.

2 DIESEL ENGINE-ELECTRICAL GENERATORS, 800 KW, Mfr. CUMMINGS-USA, includes the transfer cabinet and all the accessories.

The estimated cost for these two packages is 2 MM$.

ICA FLUOR S.A. de C.V. (JUL-2012 / SEP-2012)

Project Proposal: "**PRESTACIÓN DE SERVICIO DE TRANSPORTE DE GAS NATURAL A TRAVES DE UN GASODUCTO EN LOS SEGMENTOS DE SASABE-GUAYMAS (SINALOA) Y GUAYMAS-EL ORO (SONORA), PARA LA COMISION FEDERAL DE ELECTRICIDAD (CFE)"**

Location/Client: Sonora y Sinaloa, México / CFE - SEMPRA

Position/Activities: Responsible Engineer / Mechanical leader for the proposal about the Basic & Detailed engineering for the turbo-compressor packages. Besides, leader for all the mechanical equipment (static & dynamic) being mounted in the compression stations. Positioned as the Mechanical Supervisor in this proposal. The scope includes in total two (2) compression stations in the gas pipeline route (more than 900 kms).

In the SASABE-GUAYMAS section (in Sinaloa), 500 kms, is needed one (1) turbo-compressor station. It will be in Caborca town. The final scope is as follow:

3 GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL MARS 90S,

3 CENTRIFUGAL GAS COMPRESSORS, MFR: SOLAR TURBINES-USA, MODEL C51

The final scope, as follow:

4 GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL TAURUS 60

4 CENTRIFUGAL GAS COMPRESSORS, MFR: SOLAR TURBINES-USA, MODEL C33E

The total cost for the seven (7) turbo-compressor packages, including the accessories and the auxiliary systems also defined as balance of plant (such as the gas coolers, motorized valves, air compressor packages, the heat recovery unit, etc) was estimated in 50 MM$.

ICA FLUOR S.A. de C.V. (JUL-2012 / SEP-2012)

Project Proposal: "**NATURAL GAS PIPELINE SYSTEM FROM FRONTERA (USA) TO AGUASCALIENTES (MEX)**"

Location/Client: Tamaulipas, Guanajuato, San Luis Potosí, Querétaro, Aguascalientes, México / PEMEX – TAG PIPELINES

Position/Activities: Responsible Engineer / Mechanical leader for the proposal about the Basic & Detailed engineering for the turbo-compressor packages. Besides, leader for all the mechanical equipment (static & dynamic) being mounted in the compression stations. Positioned as the Mechanical Supervisor in this proposal. The scope includes in total five (5) compression stations in the gas pipeline route (more than 1000 kms).

Technical description and the scope for these turbo-compressor packages are as follow:

21 GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL TAURUS 70,

17 CENTRIFUGAL GAS COMPRESSORS, MFR: SOLAR TURBINES-USA, MODEL C45,

4 CENTRIFUGAL GAS COMPRESSORS, MFR: SOLAR TURBINES-USA, MODEL C40,

The total cost for the twenty-one (21) turbo-compressor packages, including the accessories and the auxiliary systems also defined as balance of plant (such as the gas

coolers, motorized valves, air compressor packages, the heat recovery unit, etc) was estimated in 300 MM$.

ICA FLUOR S.A. de C.V. (OCT-2012 / ENE-2013)

Project Proposal: "**ENGINEERING, PROCUREMENT AND CONSTRUCTION OF GAS COMPPRESSION SYSTEMS (LOW & MEDIUM PRESSURE) AT THE PEMEX'S OFFSHORE OIL PLATFORMS, CB-LITORAL-A**"

Location/Client: Tabasco, Mexico, PEMEX (at 67 km, offshore, close to the LNG Dos Bocas terminal, in the Bahia de Campeche).

Position/Activities: Responsible Engineer / Mechanical Coordinator for all the turbo-compressor packages and gas engine electrical generators being mounted in the Pemex's offshore oil platform named CB-Litoral-A (low pressure gas compression at the platform Litoral-A). The scope includes the basic engineering for the offshore oil platform regarding the turbo-compressor packages as follow:

- Regarding the Low-pressure gas system in the platform, it's required the following:

4 GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL: CENTAURO 50,

8 CENTRIFUGAL GAS COMPRESSORS, MFR: SOLAR TURBINES-USA, MODELS: C-505 (4) AND C-336 (4), BEING MOUNTED IN TANDEM,

The total estimated cost for these turbo-compressor packages in the low-pressure gas system was estimated in 26 MM$.

- Regarding the Medium pressure gas system in the platform, it's required the following:

3 GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL: CENTAURO 40

3 CENTRIFUGAL GAS COMPRESSORS (MFR: SOLAR TURBINES-USA, MODEL: C-336),

The total estimated cost for these turbo-compressor packages in the low-pressure gas system was estimated in 24 MM$.

- Regarding the electrical power generation system inside the platform, it was required the following scope:

3 ELECTRICAL GENERATORS (MFR: HYUNDAI, MODEL: SAB), DRIVEN BY GAS TURBINES, MFR: SOLAR TURBINES-USA, MODEL: MARS 100, 11.3 MW (ISO) EACH.

The total estimated cost for these turbo-generator packages (and the heat recovery units), was estimated in 18 MM$.

- Regarding the acid gas system for the platform, it's required the following scope:

1 RECIPROCATING GAS COMPRESSOR, FOUR (4) STAGES, MFR: NEUMAN & ESSER-Switzerland, MODEL: 4S-VL 130,

1 ELECTRICAL MOTOR (1000 HP), **MFR: HYUNDAI, MODEL: HNQ3, INCLUDING A VARIABLE FREQUENCY DRIVE (300 @ 600 RPM), MFR: TEMEI,**

The total estimated cost for this acid gas compression package is 11 MM$.

The total estimated cost for all the packages mentioned above for this proposal (about the gas compressors and electrical turbo-generators) is 80 MM$.

ICA FLUOR S.A. de C.V. (FEB-2013 / JUN 2013)

Project Proposal: PAQUETE 1 (DIESEL ULTRA BAJO EN AZUFRE) - "**DESARROLLO DE LA INGENIERÍA, PROCURA DE EQUIPOS Y MATERIALES, CONSTRUCCIÓN, PRUEBAS, CAPACITACIÓN, PREPARATIVOS DE ARRANQUE, ARRANQUE Y PRUEBAS DE COMPORTAMIENTO PARA LAS UNIDADES: PLANTA HIDRODESULFURADORA DE DESTILADOS INTERMEDIOS NO. 4 "U-800-2", PLANTA DE TRATAMIENTO DE AGUAS AMARGAS NO. 9 y PLANTA RECUPERADORA DE AZUFRE NO. 7, ASÍ COMO LA INTEGRACIÓN Y LOS SERVICIOS AUXILIARES FUERA DEL LÍMITE DE BATERÍA (OSBL) DE LAS PLANTAS, N.L.**"

Location/Client: REFINERÍA "ING. HÉCTOR R. LARA SOSA" EN CADEREYTA JIMÉNEZ, Nuevo León, México / PEMEX

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

1 CENTRIFUGAL GAS COMPRESSOR (H2 RECIRCULATION SERVICE)

Proposals from ELLIOTT, MAN TURBO, DRESSER RAND and GE were evaluated technically.

The total estimated cost was around the 10 MM$.

3 GAS RECIPROCATING COMPRESSORS (HYDROGEN SERVICE)

Proposals from NEUMAN & ESSER, DRESSER RAND and BURCKHARDT were evaluated technically.

The total estimated cost was around the 8 MM&.

1 GAS RECIPROCATING COMPRESSOR (SOUR GAS SERVICE)

Proposals from NEUMAN & ESSER and DRESSER RAND were evaluated technically.

The total estimated cost was around the 1 MM$.

2 COMBUSTION AIR BLOWERS (For the Sulfur Recovery Plant # 7)

Proposals from HOWDEN, GARDNER & DENVER and GE were evaluated technically.

The total estimated cost for this package was around the 2 MM$.

ICA FLUOR S.A. de C.V. (FEB-2013 / JUN-2013)

Project Proposal: PAQUETE 3 (DIESEL ULTRA BAJO EN AZUFRE)–"DESARROLLO DE LA INGENIERÍA, PROCURA DE EQUIPOS Y MATERIALES, CONSTRUCCIÓN,

PRUEBAS, CAPACITACIÓN, PREARRANQUE, ARRANQUE Y PRUEBAS DE COMPORTAMIENTO PARA LA NUEVA PLANTA GENERADORA DE HIDRÓGENO No. 2, ASÍ COMO LA TERMINACIÓN DEL GASODUCTO DE 12" DE DIAMETRO PARA TRANSPORTAR GAS NATURAL DE ALTA PRESIÓN, DESDE EL RAMAL RAMONES-ESCOBEDO HASTA EL INTERIOR DE LA REFINERÍA "ING. HÉCTOR R. LARA SOSA".

Location/Client: REFINERÍA "ING. HÉCTOR R. LARA SOSA" EN CADEREYTA JIMÉNEZ, Nuevo León, México / PEMEX

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

2 COMBUSTION AIR BLOWERS (for the Hydrogen Plant # 2)

Proposals from HOWDEN, HOFFMAN and CHICAGO BLOWERS were evaluated technically.

The total estimated cost for this package was around the 2 MM$.

2 GAS RECIPROCATING COMPRESSORS (for H2 recycle service)

Proposals from NEUMAN & ESSER, LMF and SIAD, were evaluated technically

The total estimated cost was around the 1 MM$.

1 CENTRIFUGAL GAS COMPRESSOR (for N2 to Start-Up)

Proposal from SUNDYNE was evaluated technically.

The total estimated cost was around the 1 MM$.

ICA FLUOR S.A. de C.V. (SEP-2013 / NOV-2013)

Project Proposal: "INGENIERIA DE DETALLE, PROCURA, CONSTRUCCION Y PUESTA EN MARCHA DEL ACONDICIONAMIENTO DE PLANTA ENDULZADORA-ESTABILIZADORA DE CONDENSADOS Y PLANTA FRACCIONADORA DE HIDROCARBUROS EN EL CPG CACTUS Y EN NUEVO PEMEX, PARA SUMINISTRO DE ETANO REQUERIDO EN EL PROYECTO ETILENO XXI, ETAPA 2"

Location/Client: CACTUS Gas Facility, CHIAPAS, MEXICO / PEMEX

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

1 RECIPROCATING GAS COMPRESSOR (SOUR GAS)

Proposals from NEUMAN & ESSER, BURCKHARDT, LMF and SIAD, were evaluated technically.

The total estimated cost was around the 3 MM$.

1 RECIPROCATING GAS COMPRESSOR (SWEET GAS)

Proposals from NEUMAN & ESSER, BURCKHARDT, LMF and SIAD, were evaluated technically.

The total estimated cost was around the 4 MM$.

ICA FLUOR S.A. de C.V. (SEP-2013 / JUL-2014)

Project: "OBRA ELECTROMECÁNICA E INTERCONEXIONES PARA EL SISTEMA DE COMPRESION DE GAS PROCEDENTE DEL OLEOGASODUCTO DE 36" Ø X 77 KM DE LA PLATAFORMA ENLACE LITORAL (LÍNEA 5), CON INFRAESTRUCTURA EXISTENTE DE PROCESO, EN LA TERMINAL MARÍTIMA DOS BOCAS"

Location/Client: Paraíso/Villahermosa, Tabasco, México / PEMEX

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

3 TURBO-COMPRESSOR PACKAGES (Sour Gas Service)

3 GAS TURBINES, MFR. SOLAR TURBINES-USA, MODEL TAURUS 70, 10802S,

6 GAS CENTRIFUGAL COMPRESSORS (2 PER TRAIN), MFR. SOLAR TURBINES-USA, MODELS C33-6 (COMP. 1) & C33-6 (COMP. 2),

The total estimated cost including the gas turbines and gas compressor was around the 25 MM$.

3 RECIPROCATING GAS COMPRESSOR PACKAGES (Fuel Gas Booster Service), MFR. GE-USA, MODEL A352, GEMINI

The total estimated cost for Booster fuel gas system was around the 2 MM$.

3 RECIPROCATING GAS COMPRESSOR PACKAGES (Natural Gas for Dry Seal Gas System), MFR. GE-USA, MODEL A352, GEMINI,

The total estimated cost for DGS system was around the 1 MM$.

3 DRY GAS SEAL CONDITIONING UNITS (for Natural Gas Service to DGS on each Gas Compressor in the train), MFR. JOHN CRANE-USA,

The total estimated cost was around the 2 MM$.

ICA FLUOR S.A. de C.V. (NOV-2013 / MAR-2014)

Project Proposal: "ELABORACION DE LA INGENIERIA BASICA DE LA PLANTA DE ARRIBO DE LA ESTACION DE ACONDICIONAMIENTO DE GAS LAKACH (EAGL)"

Location/Client: Veracruz, Mexico / PEMEX

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

2 TURBO GENERATOR PACKAGES (13.5 MW Service)

Proposals from PRATT&WHITNEY (MITSUBISHI), SIEMENS, SOLAR TURBINES, ABB and GE were evaluated technically.

2 SYNCHRONOUS GENERATORS, MFR. ABB, MODEL AMS 1120LK 4A BSNT,

2 GAS TURBINES, MFR. SOLAR TURBINES, MODEL TITAN 250 – 30000S,

The total estimated cost including the gas turbines and synchronous generators was around the 25 MM$.

1 GAS RECOVERY PACKAGE (for Sour gas service)

Proposals from NEUMAN & ESSER, SIAD, ARIEL were evaluated technically. Tagged as PA-200 (GB-200). This package consists of reciprocating gas compressor, electric motor, suction scrubber, process valves (suction, discharge, recycle) and other accessories mounted on a common skid.

1 RECIPROCATING GAS COMPRESSOR, MFR. NEUMAN & ESSER-Switzerland, MODEL 1SES20,

The total estimated cost was around the 2 MM$.

ICA FLUOR S.A. de C.V. (FEB-2014 / DEC-2015)

Project: "Los Ramones Phase II South, Natural Gas Pipeline Project" – Natural Gas Compression station.

Location/Client: San Luis Potosí, México / TAG PIPELINES

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

3 TURBO-COMPRESSOR PACKAGES (for Natural Gas Service)

3 GAS TURBINES, MFR. SOLAR TURBINES-USA, MODEL TITAN 130-20502S,

3 CENTRIFUGAL GAS COMPRESSORS, MFR. SOLAR TURBINES-USA, MODEL C65,

The total estimated cost including the gas turbines and gas compressors was around the 35 MM$.

ICA FLUOR S.A. de C.V. (ABR-2014 / MAR-2015)

Project: "PANUCO II, EXPANSION COGENERATION PROJECT"

Location/Client: Altamira, Tamaulipas, México / TRACTEBEL

Position/Activities: Responsible Engineer and Mechanical Coordinator for the Engineering, Procurement, Construction, Inspection and Testing, for the following equipment packages:

1 TURBO GENERATOR PACKAGE (to generate 28.5 MW @ 33°C and 60 Ton/hr of steam)

1 GAS TURBINE, MFR. GE-USA, MODEL LM2500 G4,

1 SYNCHRONOUS GENERATOR, MFR. BRUSH-UK, MODEL BDAX 71-193ER

The total estimated cost including the gas turbines and synchronous generators was around the 15 MM$.

ICA FLUOR S.A. de C.V. (DIC-2014 / FEB-2016)

Project: "SPECIALIZED TECHNICAL ASSISTANCE IN PHASE I "PROJECT MANAGER CONTRACTOR – PMC" FOR MONITORING & CONTROL REGARDING THE PROJECT QUALITY FOR THE CLEAN DIESEL IN THE OIL REFINERY "LAZARO CARDENAS", IN MINATITLAN, VERACRUZ, MEXICO"

Location/Client: Minatitlan, Veracruz, Mexico / PEMEX

Position/Activities: Responsible Engineer about the review of Engineering, Procurement, Equiment Manufacturing, Inspection & Testing of dynamic equipment, package type, being responsible directly by Spain Company "TECNICAS REUNIDAS" in charge of CLEAN DIESEL Project for the Mexican Oil Refinery in Minatitlan (owned by PEMEX).

The scope in this 1st phase has as the main subject to estimate the class II costs (+/- 10% of final cost) in order to buy the whole mechanical equipment (dynamic & static) as required in the Project. I was involved in the rotating equipment (such as pumps in critical services, centrifugal & reciprocating compressors, in addition to others as oil mist systems, air-coolers, etc; as requested to each new Plant in this project. The new Plants were:

- Hydro-desulphuration Plant U-25000.
- Hydrogen Plant U-21000.
- Sulfur Recovery Plant U-22000
- Revamp for the Hydro-desulphuration Plant U-100
- Auxiliary Services and Integration Plants - Outside Battery limits (OSBL).

The activities include:

Reviewing all technical documents, such as the mechanical equipment datasheets (dynamic / rotating) for different Process Licensers (Haldor Topsoe, Axens, CBI, etc) as emitted by TECNICAS REUNIDAS (from Spain), technical specifications, requisitions for

quotation, the P&IDs, technical lists of equipment, purchase requisitions, the delivery time, 3D electronic model reviews, the man-hours being required to complete the basic and detailed engineering for this project, to define what technical documents should be delivered in order to monitoring & control the complete scope during the basic & detailed engineering in the different phases and new plants to this project.

As part of the technical assistance by ICAFluor, there were emitted technical reports (more than 150 in rotating & dynamic equipment) in the 1st phase, such as it was agreed with Pemex by Contract.

ICA FLUOR S.A. de C.V. (MAR-2016 / MAR 2018)

Project: "APROVECHAMIENTO DE RESIDUALES EN REFINERIA MIGUEL HIDALGO, TULA, MEXICO"

Location/Client: Tula, Hidalgo, México / PËMEX

Position/Activities: Specialist Engineer in Turbomachinery, being responsible to determine the estimated cost, class II (+/- 10%), as part of the Basic Engineering for the whole rotating equipment (package type) related with the new Plants in the Project "Aprovechamiento de Residuales" for the Oil Refinery in TULA at Hidalgo State, Mexico.

There were 2 phases, the scope of 1st phase (basic engineering) covers the emission and review of each technical specification and datasheets as provided by the Process Licensers (UOP, Jacobs, Axens), in addition to the preparation for the technical requisitions and datasheets for rotating equipment and to review the different proposal as prepared by the Vendors. There were different meetings, conference calls, agreements, technical clarifications, etc, in order to prepare the technical evaluation tabs to comply with all the specs and requirements (by client and Process Licensers) to this project. In this phase ICA-Fluor delivered the technical evaluation tabs for each equipment as requested in the new Plants. I had 4 engineers in charge to cover these activities for the complete project.

Some other resources were used by ICA-Fluor in order to cover this phase such as the cases of engineers given assistance from Fluor-USA, Fluor-Spain & Fluor-India.

In the 2nd phase (2017) the actions are to continue with the technical clarifications with the Process Licensers (changing the scope in some new Plants, new location of equipment, etc), with the new clarifications with the Vendors about mechanical equipment such as requested, in order to define the best estimated cost for the Project in TULA.

Regarding the new Plants where I have been involved directly are the following:

Coker Naphta Hydrotreating Unit– HDNC - U-401
Naphta Reformer Unit – CCR - U-402
Alkylation & Butane and Pentane Isomerization Unit – ISOC4/C5/C6 - U-403/405
Sulfur Recovery Unit – PRA - U-407
Gasoil Hydrotreater Unit – HDGO - U-408
Fluid Cracking Catalytic Unit – FCC3 - U-409
Compressed air Systems – U-615

Technical data for mechanical equipment being reviewed in these two phases are:

Coker Naphta Hydrotreating Unit– HDNC - U-401

1 Centrifugal Compressor (GB-61001),

2 Reciprocating compressors (BC-61001 A/B),

Naphta Reformer Unit – CCR - U-402

1 Centrifugal Compressor (GB-71001),

1 Centrifugal Compressor (GB-71001).

4 Centrifugal compressors (BV-71103 A/B and BV-71105 A/B),

4 Centrifugal Blowers (BV-71101, BV-71102, BV-71104, BV-71106),

2 Reciprocating Compressors (BC-71050 A/B),

1 Screw Compressor, Oil Flooded (BC-SPE-71002),

Alkylation & Butane and Pentane Isomerization Unit – ISOC4/C5/C6 - U-403/405:

2 Reciprocating Compressors (BC-23001 A/B),

Sulfur Recovery Unit – PRA - U-407

4 Centrifugal Blowers (BV-81001 A/B, BV-82001 and BV-83001),

6 Centrifugal Blowers (BV-82001 A/B, BV-82002 A/B and BV-82003 A/B).

3 Air Compressors, Screw Type (BT-84001 A/B/C) and 1 Air Dryer (SA-84001)

Gasoil Hydrotreater Unit – HDGO - U-408

1 Centrifugal Compressor (GB-40001),

2 Reciprocating compressors (BC-40001 A/B),

Fluid Cracking Catalytic Unit – FCC3 - U-409

1 Axial Air Compressor (GB-21001),

1 Centrifugal Air Compressor (GB-21002),

1 Centrifugal Gas Compressor (GB-21201),

1 Centrifugal Gas Compressor (GB-21401),

Compressed air Systems – U-615:

4 Air Compressors, Screw Type (BT-06001 A/B/C/D) & 3 Air Dryers (SA-06001 A/B/C)

3 Air Compressors, Screw Type (BT-06002 A/B/C)

ICA FLUOR S.A. de C.V. (NOV-2016 / FEB-2017)

Project Proposal: "NUEVA CENTRAL DE CICLO COMBINADO JORGE LUQUE (CCCJL) PARA GENERACIÓN DE POTENCIA DE 1500 MW +/- 10%"

Location/Client: Edo. de México, México / GENERACIÓN FENIX

Position/Activities: Preparing technical specifications, turbo-machinery datasheets and technical requisitions for quotation in order to select two (2) trains to generate 1500 MW (+/- 10%) in total (i.e. two modules generating electrical power in 750 MW each). The scope of supply and estimated costs (class II) in a 1st phase. In a 2nd phase, the intention is to develop the Engineering, Procurement and Construction to this Project for the following machines.

2 TRAINS OR MODULES (ELECTRICAL GENERATION TRAINS) THROUGH 2 GAS TURBINES, 1 STEAM TURBINE AND 3 SYNCHRONOUS GENERATORS ON EACH TRAIN, ESTIMATED IN 750 MW EACH.

4 GAS TURBINES from GE to get 4 gas turbines in 270 MW each (ISO conditions), for the model 7H.02 (last generation).

2 STEAM TURBINES. from GE to get 2 steam turbines, high steam pressure, industrial type, multi-shafts, 3600 RPM, separated in three sections or casings (high pressure in 165 barg, 585 °C, intermediate pressure in 4 barg, and low pressure in 0.09 bara), with a power output in 270 MW each.

6 SYNCHRONOUS GENERATORS. from GE, cylindrical rotors, cooled with Hydrogen, two poles, 3600 RPM, 60 Hz, 270 MW (each in the scope of supply the Supplier also includes 4 Heat Recovery Steam Generators.

ICA FLUOR S.A. de C.V. (NOV-2017 / DEC-2017)

Project Proposal: ""BASES DE CONCURSO PARA INSTALACIÓN DE DOS NUEVOS TURBOCOMPRESORES Y UN SISTEMA DE REGULACIÓN, MODERNIZACIÓN DE SISTEMAS DE MEDICIÓN, SISTEMAS ANTI-SURGE, COMPRESORES CENTRÍFUGOS Y SISTEMAS DE CONTROL EN LA ESTACIÓN DE COMPRESIÓN CEMPOALA"

Location/Client: Municipio Actopan, Veracruz**,** México

Position/Activities: Preparing design bases, estimated costs, project execution plan, mechanical equipment datasheets, technical specs (dynamics), detailed eng., drawings and technical issues related with the existing facilities and for project scope.

UPRATED OR REVAMP FOR EXISTING CENTRIFUGAÑL COMPRESSORS.

- **GAS TURBINES – GE (LM2500 / 27500 HP=**
- **CENT. COMPRESSORS – COOPER BESSEMER (RF-BB-36)**

UPGRADE FOR ANTI-SURGE SYSTEMS (EXISTING)

EVALUATION OF TWO (2) NEW TURBO-COMPRESSORS (GAS TURBINES & CENT. COMPRESSORS).

ICA FLUOR S.A. de C.V. (MAR-2018 / JUN-2018)

Project Proposal: "RED DE DISTRIBUCIÓN ELÉCTRICA DE MEDIA TENSIÓN (23 KV), SUBESTACIONES Y RED E CABLEADO ESTRUCTURADO"

Location/Client: New International Airport in México City (NAICM), Texcoco, México / GRUPO AEROPORTUARIO DE LA CD DE MEXICO (GAICM)

Position/Activities: Preparing the requisition for purchase (purchase orders) in order to proceed with the detailed engineering, procurement and construction about new Emergency Electric Generator sets (in low voltage, 480 V), driven by engines using diesel as fuel.

69 (SIXTY-NINE) EMERGENCY GENERATOR SETS, IN LOW VOLTAGE, WITH DIESEL, POWERS AMONG 60 KW AND 2250 KW.

ICA FLUOR S.A. de C.V. (MAY-2018 / JUN-2018)

Project Proposal: "PLANTA DE ENERGÍA "EL CLERIGO", CCGT, CICLO COMBINADO, PARA ENTREGA DE 560 MW "

Location/Client: San Luis Potosí, México.

Position/Activities: Preparing the technical issues for the engineering in order to procure, construct, erect, install, commissioning and testing about an Electric Power Generation of 560 MW, including the supply´s scope (also the Balance of Plant services), the division of responsibilities and the estimated cost as a result.

MODULE OF POWER GENERATION USING A SINGLE SHAFT TRAIN (STEAM TURBINE – GENERATOR – GAS TURBINE), MFR. By GE, OPERATING IN ISLAND MODE.

GAS TURBINE: GE, MODEL 1 x 1 7HA.02.SS, 60 Hz.

STEAM TURBINE: GE, MODEL D650, ARRANGEMENT TYPE "STAG", THREE (3) CASINGS (HP, IP, LP), CONDENSATION TYPE.

POWER GENERATOR: GE, MODEL H84 (SHAFT ON BOTH SIDES), COOLED BY H2, 24 KV, 60 Hz, 560 MW.

BALANCE OF PLANT: AUXILIARIES AND ACCESSORIES REQUIRED AS PART OF THE GENERATION PACKAGE.

ICA FLUOR S.A. de C.V. (JUL-2018 / OCT-2018)

Project Proposal: "CONSTRUCCIÓN DE LAS PLANTAS CENTRALES DE SERVICIOS (CUP "A" y CUP "B"), DEL NUEVO AEROPUERTO INTERNACIONAL DE LA CIUDAD DE MÉXICO"

Location/Client: New International Airport in México City (NAICM), Texcoco, México / GRUPO AEROPORTUARIO DE LA CD DE MEXICO (GAICM)

Position/Activities: Preparing the requisition for purchase (purchase orders) in order to proceed with the detailed engineering, procurement and construction about new Emergency Electric Generator sets (in medium voltage 4.16 kV and low voltage 480 V), driven by combustion engines using diesel as fuel.

6 (SIX) EMERGENCY GENERATOR SETS, IN MEDIUM VOLTAGE (4.16 KV), DIESEL TYPE, WITH POWER IN 2750 KW.

4 (FOUR) EMERGENCY GENERATOR SETS, IN LOW VOLTAGE (480 V), DIESEL TYPE, WITH POWER IN 1500 KW & 2000 KW.

ICA FLUOR S.A. de C.V. (AUG-2018 / NOV 2018)

Project: "UPGRADE OF CADEREYTA´s OIL REFINERY (PEMEX)"

Location/Client: Refinería "Ing. Héctor Lara Sosa", Cadereyta, Nuevo León, México.

Position/Activities: Preparing the estimated cost for rotating equipment in the following cases: Replacing / upgrading or Maintenance for the mechanical equipment (dynamics) in the Oil Refinery at Cadereyta. This applies for the Process Plants in gas centrifugal & reciprocating & screw (oil flooded) compressors, screw / centrifugal air compressors, in Utilities Plants (air services and in the Maintenance for one Steam Turbine Turbo-generator). Preparing requisitions for purchase in new equipment to replace the existing machines, considering the supply´s scope on each case, emitting technical quotations, including drawings, general arrangements, equipment datasheets, doing the technical comparative tabs (for different Suppliers), evaluating technically each offer, selecting the better Supplier, in order to get the better estimated cost. Also, the corrective maintenance for some reciprocating compressors and the Preventive/Corrective actions (for 50000 operating hours in the case of one Turbo-generator).

14 (FOURTEEN) PROCESS GAS COMPRESSOR PACKAGES (SOME OF THEM, CENTRIFUGAL, SCREW – OIL FLOODED, RECIPROCATING), IN SERVICES SUCH AS HIDROGEN, PROPYLENE, TAIL GAS AND FEED GAS IN PSA PLANT, ETC.

1 (ONE) TURBO-GENERATOR IN 32 MW, DRIVEN BY STEAM TURBINE, CONDENSATION TYPE (MFR. By SIEMENS, MODEL EK-1800, POWER GENERATOR MFR. SIEMENS, MODEL 1 DM 3851 – 3DF 01.

20 (TWENTY) INSTRUMENT & PLANT AIR COMPRESSOR PACKAGES (CENTRIFUGAL TYPE WITH INTEGRALLY GEARED, AND OIL FREE SCREW TYPE), DRIVEN by ELECTRIC MOTORS & STEAM TURBINES, POWER AMONG 150 HP TO 900 HP.

ICA FLUOR S.A. de C.V. (JAN-2019 / APR-2019)

Project: "FIELDWOOD – TUMUT A / ICHALKIL DEL 2 / POKOCH DEL 1 - OFFSHORE PLATFORMS PROJECT"

Location/Client: Offshore platforms located on Campeche Bay, Mexico Gulf, Mexico / FIELDWOOD ENERGY.

Position/Activities: Preparation for Ichalkil & Pokoch Platforms about the Engineering in order to define the design basis, particular specifications (mechanical equipment), datasheets, requisition for quotation, technical clarifications with each Supplier, evaluation tab (technical-economical), technical dictamen and final requisition for purchase (purchase order) for the Electrical Diesel Generators to power the platforms, and for the instrument and plant air compressor packages (including the air for the pneumatic pumps, for maintenance in equipment inside each platform. Each air package includes two compressors, prefilters and postfilters, and one air dryer, as part of the scope in this 1st phase, resulting in the estimated cost for the total mechanical equipment (and platforms), class II, to be approved by the Client "Fieldwood Energy". The logistic for the Procurement, construction at site, commissioning, inspection and testing, and erection is part of ICAFluor, made in our own shop at Mata Redonda, in Veracruz, México.
In the case for TUMUT A platform, we have prepared the specifications for mechanical equipment (Diesel Generators and air compressor package), also the technical tab for the bids received from Suppliers, including the technical dictamen, to get the estimated cost and the future purchase order of them. This platform now exist, where the plan is to disassembly the old equipment and to assembly (by modules) the new mechanical equipment at Mata Redonda, to follow with the engineering, procurement, construction, erection, commissioning, inspection and testing at site.

TUMUT A:
3 Electrical Power Diesel Generators (2 main / 1 Spare), 90 kW each, 480 V, 3 ph, 60 Hz, PRIME mode service (24 hrs per day, variable load), including the monitoring, control and protections for the engines, synchronous generators, with an enclosure specified with a firefighting system (with CO2), including the local control panel via PLC with HMI, communication MODBUS TCP-IP protocol with the Client onshore control Room (via Scada).
1 Air compressor package (two compressors, screw type, oil free, two stages, air cooled, 210 SCFM, 150 psig, 50°C discharge temperature (aftercooler), 60 HP (main motor, TEFC, 3560 RPM, 480 V), 2 prefilters, 2 postfilters (cartridge type, 1 micron, 2 coalescing type and two particulates type), one air dryer, Regenerative Heatless type, two towers, where the dew point is -40°C (dry air), 150 psig, including the auxiliaries (inter/after air-oil coolers, starting syst., oil system, cooling system (water with Radiator), Governor controller, Fuel Diesel system, exhaust system, engines, etc), a local PLC, HMI, a common structural skid, drip pan, as part of the main scope.

ICHALKIL DEL 2 / POKOCH DEL 1:

3 + 3 Electric Power Diesel Generators (1 + 1 main of 4.16 kV / 2 + 2 Main / Spare of 480 V). The 4.16 kV of 1000 kw, 3 ph, 60 Hz, PRIME Service (24 hrs per day), including the monitoring, control and protections for the engines, synchronous generators, with an enclosure specified with a firefighting system (with CO2), including the local control panel via PLC with HMI, communication MODBUS TCP-IP protocol with the Client onshore control Room (via Scada).
1 + 1 Air compressor packages. Each platform (with two compressors, screw type, oil free, two stages, air cooled, 210 SCFM, 150 psig, 50°C discharge temperature (aftercooler), 60 HP (main motor, TEFC, 3560 RPM, 480 V), 2 prefilters, 2 postfilters (cartridge type, 1 micron, 2 coalescing type and two particulates type), one air dryer, Regenerative Heatless type, two towers, where the dew point is -40°C (dry air), 150 psig, including the auxiliaries (inter/after air-oil coolers, starting syst., oil system, cooling system (water with Radiator), Governor controller, Fuel Diesel system, exhaust system, engines, etc), a local PLC, HMI, a common structural skid, drip pan, as part of the main scope.

The total estimated cost for this Project about the Electric Generators and the air compressor packages (instrument & plant, including the accessories, auxiliary systems internally), it could be around the 15 MM Dollars.

ICA FLUOR S.A. de C.V. (JUN-201 9 ***/ SEPT-201 9)***

Project: "TECHNICAL SERVICES **TO ADDRESS THE PROBLEM BY HIGH VIBRATION IN EXTRUSION TRAINS U-51 AND U-52 IN THE HDPE (HIGH DENSITY POLYETHYLENE) PLANT OF BRASKEM-IDESA, IN VERACRUZ, MEXICO"**

Location/Client: High Density Polyethylene Industrial Plant, Veracruz, Mexico

Position/Activities: As part of the maintenance contract between the companies STORK (Mexico) and Braskem-Idesa, specialized technical assistance was requested as support (by contract with ICAFLUOR) to address the problem of high vibration existing in the extrusion areas of HDPE (U-51 and U-52 plants in HDPE) after the development of the project and in its start-up process, causing various repetitive failures of the main equipment and components of the mechanical trains, including the high structural vibration in the building where the extruders are.
I worked as a mechanical vibration specialist where a critical action plan was developed and implemented (preliminary) in conjunction with the Civil Engineering group (Geotechnical / Structural / Surveying area) to determine the causes of the problem.
A work plan was finally delivered with details of the required scope, where multiple tests and physical and rotodynamic analyzes had to be carried out on site for both trains, which included an estimate of the cost and the expected response time with the preparation of a technical report associated with the problems including action plan, root cause, claclusions and recommendations to be implemented
The execution time of the work was estimated at 600 hours of engineering (mechanical and civil plan) and an estimated cost by the Engineering in the order of 60 M $ (Dollars). The estimate for the repairs and the corrective measures to be applied in the plant were in the order of 0.6 MM$ in a period of 3 months.

ICA FLUOR S.A. de C.V. (JAN-20 20 / DIC-20 21)

Project: "DEVELOPMENT IN THE PACKAGES 1, 3 AND 4B THAT INCLUDE THE CATALYTIC PLANTS, DELAYED COKE (PKG. 1), ALKYLATION AND ISOMERIZATION PLANTS (PKG. 3) AND SULFUR, HYDROGEN RECOVERY AND GAS TREATMENT AND RECOVERY PLANTS (PKG. 4), IN THE NEW OIL REFINERY LOCATED IN DOS BOCAS, PARAISO, TABASCO, MEXICO"

Location/Client: New Dos Bocas Oil Refinery in Paraiso town, in Tabasco, Mexico

Position/Activities: Coordinator in Rotating Equipment, reciprocating compressors and Turbomachinery included for the packages 1, 3 and 4 inf the New Dos Bocas Oil Refinery, and to be responsible for the realization of basic engineering (preparing technical specifications, data sheets, technical documentation, technical scopes, technical quotations, RFQ) and detail engineering (purchase order requisition, scope of the supplier's technical documentation, inspection and testing plan review, and factory support, material certification review, equipment release to the site, etc.), corresponding to all rotating equipment mentioned in the project (i.e. centrifugal gas compressors, reciprocating compressors, oil-flooded screw compressors, in addition to process and combustion air blowers, also about the critical pumps in the Alkylation plant, including their respective accessories and the auxiliary systems that conform the package equipment in each case, among some other additional minor equipment (like oil mist lubrication system, etc.) for the Alkylation Plant.

In a brief technical description, the scope of this equipment (as part of the packages), is as follows:

PACKAGE 1:

1 CENTRIFUGAL WET GAS COMPRESSOR TRAIN (MFR. By BHGE), 2-STAGE COMPRESSION (DRIVEN BY 1 ELECTRIC MOTOR AND ITS HYDRAULIC SPEED DRIVE – VOITH). The required power in the main motor was 15 MW, with gas flows in 120 M Nm3/h, with atmospheric pressures up to 16 Kg/cm2a, and molecular weight among 29 and 36. The equipment includes a conditioning system for the dry gas seals (double type), as well as a lubrication oil system and control through an oil hydraulic speed variator (water-cooled), with a control and anti-surge system protection, a washing injection system fed with naphtha at the inlet section (to clean the dirty gas), with its PLC (remote location) and its local control panel (with HMI, vibration monitoring), among other critical accessories as part of the package, in order to operate continuously in reliable form for 5 years, for 20 years useful cycle life.
The cost in this compressor train was estimated at about 10 MM$, with a delivery time at site after 18 months after the purchase order.

PACKAGE 3:

42 HORIZONTAL CENTRIFUGAL PUMPS (TYPE OH2/OH1/BB2, API-610) MFR. FLOWSERVE/SULZER, IN HF ACID OR HYDROCARBON SERVICES IN THE REACTION AND CRACKED SECTIONS, IN THE ALKYLATION PLANT (DRIVEN BY ELECTRIC MOTOR, WITH MECHANICAL SEAL DUAL TYPE, PRESSURIZED OR DEPRESSURIZED (AS PLAN 32 AND 52/53 AND 54 DEPENDING THE CRITICAL CASES), BEING POWER BY ELECTRICAL INDUCTION MOTORS UP TO 1000 HP).
The equipment cost (including motor and auxiliary equipment) was estimated in the order of 8.5 MM$

6 CHEMICAL INJECTION CONTROLLED VOLUME PUMPS, API-675, ELECTRIC MOTOR DRIVEN, DOUBLE DIAPHRAGM TYPE.

6 VERTICAL TYPE PUMPS (API-610, TYPE VS4, SUBMERGED), DRIVEN BY VERTICAL ELECTRIC MOTORS.

2 GAS COMPRESSORS, DIAPHRAGM TYPE, MFRD. By HOFER / NEWMAN & ESSER, API-618 (PARTIAL), IN HYDROGEN GAS REPLACEMENT SERVICE, GAS FLOW IN 25 IM3/HR, AT 35 KG / CM2A, DRIVEN BY BANDS, WITH AN ELECTRIC INDUCTION MOTOR, TRIPLE DIAPHRAGM, CONTROL WITH PROTECTION BY DIFFERENTIAL PRESSURE BETWEEN SUCTION & DISCHARGE, WHICH INCLUDES A RECIRCULATION GAS COOLER AND A PRESSURE CONTROL VALVE SYSTEM, ALSO A GAS LEAK DETECTION SYSTEM, PRESSURE LUBRICATION AND HYDRAULIC SYSTEMS, OPERATION CONTROL THROUG A PLC (REMOTE LOCATION) AND WITH A LOCAL CONTROL PANEL (WITH HMI AND VIBRATION MONITORING SYSTEM), AND ITS ACCESSORIES AND AUXILIARY SYSTEMS MOUNTED ON THE STRUCTURAL SKID.
A cost was in the order of 3 MM$ and a delivery time in 12 months, as estimated.

PACKAGE 4:

SULFUR RECOVERY PLANT.

7 CENTRIFUGAL BLOWERS, IN COMBUSTION AIR SERVICES (3) AND IN OXIDATION AIR SERVICES (4), MFR. BY HOWDEN (SPECIFIED AS PER API-617 & API-673 (SPECIAL PURPOUSE)), WITH A GEARBOX SEPARATED FROM THE AIR BLOWER (IN CASE OF COMBUSTION), DRIVEN BY ELECTRICAL INDUCTION MOTORS (3000 HP – COMBUSTION AND 800 HP – OXIDATION), WITH AN AIR FLOW OF 75000 NM3 / HR AND 45000 NM3 / HR, WITH A RPM IN 8090 AND 1800 IN CASE OF COMBUSTION AND OXIDATION BLOWERS, WITH INLET GUIDE VANES AT THE SUCTION SIDE AND ALSO WITH A VARIABLE GUIDE VANES AT DIFFUSER SIDE, WITH A MINIMUM FLOW CONTROL THROUGH A BLOWOFF SYSTEM (ANTISURGE) WITH CONTROLLED MODULATION, ALSO VIBRATION MONITORING AND PROTECTION, NON-RETURN LOUVRE SYSTEM AT THE OUTLET, AN INDEPENDENT PLC (REMOTE LOCATION) AND INDEPENDENT LOCAL CONTROL PANEL (WITH HMI), LABYRINTH TYPE SEALS, BABBITT TYPE BEARINGS, FORCED LUBRICATION SYSTEM (AS PER API-614), FLANGED TYPE BELLOWS IN SUCTION AND DISCHARGE, AIR SILENCERS IN SUCTION SIDE, DISCHARGE SIDE AND BLOWOFF SIDE, ANTI-NOISE ENCLOSURE IN A HOUSING, ALSO INCLUDING AIR DUCTS IN THE INLET AND OUTLET OF THE PLANT, MADE IN HOT-DIP GALVANIZED STEEL MATERIAL, AMONG OTHER CRITICAL ACCESSORIES AND AUXILIARY SYSTEMS AS PART OF THE STRUCTURAL SKID MOUNTED ON EACH BLOWER PACKAGE.
The delivery time was estimated at 12 months, with a total cost of the 7 air blowers in the order of 12 MM$.

HYDROGEN PLANT.

2 RECIPROCATING COMPRESSORS (API-618), MFR. BY SIEMENS, IN A HYDROGEN RECYCLE SERVICE, SINGLE STAGE, GAS FLOW IN 130 KG / HR, AT 40 KG / CM2A, POWERED BY ELECTRICAL MOTOR IN 50 HP (EACH), WITH FORCED LUBRICATION SYSTEM INTEGRATED TO THE SKID, THE ELECTRIC MOTOR WAS COUPLED TO THE COMPRESSOR WITH A DIRECT

COUPLING (NO BANDS), WITH A THERMOSIPHON COOLING SYSTEM, INCLUDING A DIFFERENTIAL PRESSURE CONTROL VALVE (WITHOUT UNLOADERS), A NITROGEN SEALING SYSTEM, DOUBLE ACTION TYPE, 514 RPM, INCLUDING CONTROL THROUGH THE DCS AND ALSO WITH A LOCAL CONTROL PANEL WITH HMI. IT ALSO INCLUDED A RECIRCULATING GAS COOLER WITH ITS DIFFERENTIAL PRESSURE CONTROL VALVE, ALSO PULSATION DAMPENERS AT THE INLET AND OUTLET SIDES, IN ADDITION TO CRITICAL ACCESSORIES AND AUXILIARY SYSTEMS, MOUNTED ON A STEEL STRUCTURAL SKID.

1 RECIPROCATING COMPRESSOR (API-618), MFR. BY SIEMENS,, IN A NITROGEN SERVICE, SINGLE STAGE, GAS FLOW DESIGNED FOR 19500 KG / HR TO 12 KG / CM2A, POWERED BY ELECTRICAL MOTOR IN 600 HP AT 450 RPM (BY INDUCTION MOTOR, TEAAC), DIRECT COUPLING MOTOR / COMPRESSOR, WITH FORCED OIL LUBRICATION SYSTEM IN A SEPARATED CONSOLE, COOLING THE COMPRESSOR CYLINDERS BY THERMOSIPHON SYSTEM, PULSATION DAMPENENRS IN SUCTION & DISCHARGE SIDES, AND INCLUDING A TECHNICAL REPORT ABOUT THE PULSATIONS DESIGNED AS PER DA2 TYPE (DESIGN APPROACH 2), WITH A CAPACITY CONTROL MADE THROUGH A DIFFERENTIAL PRESSURE CONTROLLED BY A VALVE (PCV) AND A RECIRCULATION PIPELINE WITH TUBE AND SHELL COOLER TYPE (WITHOUT CYLINDER UNLOADERS), WITH A PLC (REMOTE LOCATION) AND A LOCAL PANEL (HMI), IN ADDITION TO CRITICAL ACCESSORIES AND AUXILIARY SYSTEMS, MOUNTED IN A STEEL STRUCTURAL SKID WITH EXTERNAL MOTOR MOUNTRED ON CONCRETE FOUNDATION.

It was estimated for the 3 reciprocating compressors in this package, a delivery time of 12 months, as well as a total cost for the 3 compressor packages, estimated in the order of 6 MM$.

GAS TREATMENT AND RECOVERY PLANT (PTRG).

1 CENTRIFUGAL COMPRESSOR (API-617, AS PER CHAPTER 2), MFR. BHGE, WITH 9 COMPRESSION IMPELLERS OR STAGES (MOUNTED IN 1 SECTION IN THE CASING), BARREL CASING TYPE, DRIVEN BY ELECTRICAL INDUCTION MOTOR (3500 HP, 3600 RPM, TEAAC), WITH HYDRAULIC OIL VARIABLE SPEED DRIVE (VOITH), WITH A GAS FLOW DESIGN IN 35000 NM3/HR, WITH PRESSURES GOING FROM 9 TO 30 KG/CM2A, WITH A MOLECULAR WEIGHT BETWEEN 8.7 TO 11 (LIGHT H2 & AND H2S SERVICE), WITH A STEEL CONSOLE FOR THE DRY SEAL GAS CONDITIONING SYSTEM ACCORDING TO API-692, WITH A PLC (REMOTE) AND LOCAL CONTROL PANEL (HMI), WITH FORCED LUBRICATION SYSTEM (CONSOLE INTEGRATED TO THE CASING MODEL VVH, VOITH), WITH ITS OIL RUNDOWN TANK (EMERGENCY), SEPARATE OIL LUBRICATION COOLERS AND OIL CONTROL (FOR VARIABLE SPEED) COOLERS (SHELL AND TUBES TYPE), WITH ITS ANTI-SURGE CONTROL VALVE, A RECYCLE COOLER LOOSE (BEING BY OTHERS), IN ADDITION TO ITS CRITICAL ACCESSORIES AND AUXILIARY SYSTEMS REQUIRED IN A STRUCTURAL STEEL SKID MOUNTED ON A TRAIN INSIDE A COMPRESSOR BUILDING IN THE PLANT.

The delivery time was estimated at 20 months, with a cost in the order of 8 MM$.

1 SCREW GAS COMPRESSOR, FLOODED IN OIL (AS PER API-619), AS PART OF THE PSA UNIT IN THE PTRG, MFR BY TECHNICAL AMERICA (PREVIOUSLY KOBE STEEL-JAPAN), DRIVEN BY 1500 HP, 3600 RPM ELECTRICAL INDUCTION MOTOR, TEAAC, FOR A GAS FLOW DESIGN IN 7500 NM3/HR, FROM 0.3 TO 7.5 KG/CM2A, WITH A MOLECULAR WEIGHT AMONG 12.5 TO 16.5 (PSA TAIL GAS SERVICE, 40% TO 50% H2 + 30% CH4 + 20% CH6), WITH 10-100% GAS FLOW

CONTROL BY SLIDE VALVE, INCLUDINGA FORCED LUBRICATION SYSTEM FOR COMPRESSOR AND FOR THE ELECTRICAL MOTOR (SEPARATELY), INCLUDING 2 PROCESS GAS OIL SEPARATORS, ALSO INCLUDING A GAS AFTERCOOLER, CONTROLLED BY PLC (REMOTE) AND LOCAL CONTROL PANEL (HMI), WITH ANTI-NOISE ENCLOSURE ON THE COMPRESSOR, DOUBLE MECHANICAL SEAL SYSTEM (PLAN 53), LIQUID SEPARATOR DRUM AT THE TAIL GAS OUTLET, WITH VIBRATION MONITORING & PROTECTION SYSTEM, IN ADDITION TO THE CRITICAL ACCESSORIES AND AUXILIARY SYSTEMS REQUIRED IN A STRUCTURAL STEEL SKID FOR THE COMPLETE SCOPE FOR THIS EQUIPMENT.

Delivery time was estimated in 18 months, with a cost around 6 MM$.