NEW SULFURIC ACID PLANT
TO TREAT THE
COPPER SMELTER OFF-GASES

DOE RUN PERU S.A.
LA OROYA
PERU

FCII Contract No. 450

June 6, 2005

Prepared by
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CONFIDENTIAL

The technical and commercial information contained in this proposal is proprietary to Fleck Chemical Industries Inc. (hereinafter referred to as FCII) and is not to be revealed to any third party or utilized except for the evaluation of the contents of this study by The Doe Run Company (hereinafter referred to as DRP).
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1.0 PREAMBLE

The Doe Run Peru (DRP) smelter site in La Oroya is located about 4 hours drive from Lima at an elevation of 3,720 m. The first copper smelter on this site was commissioned in 1922. Today the site has smelters and refineries for copper, lead and zinc and a small sulfuric acid plant serving the fluidized bed zinc roaster. In 1999 DRP purchased the complete smelter site and its operations from Centromin - a government owned mining organization.

Recent negotiations between the Government of Peru and DRP have resulted in a commitment by DRP to reduce the SO$_2$ emissions from its smelter operations in La Oroya to achieve an equivalent 83% fixation of sulfur values. At the present time the off-gases from both the copper and lead smelting operations are exhausted to atmosphere without capture of sulfur values. One approach under consideration is to build two new sulfuric acid plants. One acid plant would treat the off-gas from the Lead Sinter Machine and the other the off-gas from the copper smelting operations. This proposal presents FCII's offer to undertake the conceptual engineering and development of a capital cost estimate for a new acid plant to treat the off-gases from the copper smelting operations. Currently, these smelting operations utilize a reverberatory furnace, however the plan is to replace this furnace with a Fusion Injected Reactor and operate with two Pierce Smith Converters. With this arrangement the new acid plant would be required to treat up to 84,700 Nm$^3$/h of off-gases containing 9.09% SO$_2$ (wet basis).
2.0 COMPANY BACKGROUND

Fleck Chemical Industries Inc. (FCII) was founded in 1988 with a business commitment
to providing engineering services and proprietary products to its customers in the
sulfuric acid industry. Today, FCII is recognized as one of the leading consultants to
this industry and can include as its clients many of the major acid producers in North
America.

The proprietary equipment developed by FCII includes:

- Stainless Steel Catalytic Converters
- Dry, Intermediate and Final Absorption Towers and Associated Pump Tanks
- SO2 Scrubber Towers
- Acid Distributors
- Gas/Gas Heat Exchangers
- Start-up Pre-heaters and Process Gas Heaters
- Quench Towers and Venturi Scrubbers
- Gas Cooling Towers

Each item of equipment is designed to provide reliable and efficient service throughout its
operating life. Design features and the selective specification of materials of construction
based on the feedback from field experience assure a reliable and extended life for the
equipment.

Other services offered by FCII to the sulfuric acid industry include:

- Detailed Engineering Design of Complete System Upgrades and Expansions
- Plant Inspections
- Operator Training
- Plant Simulations
- Plant Evaluations
3.0 DESIGN BASIS

The future Copper smelting operations at La Oroya will comprise a new Fusion Injected Reactor plus two Pierce Smith Converters. The gas leaving both the Reactor and the Converters will be cleaned and spray cooled before being combined into a single stream in the Mixing Chamber. The gas leaving the Mixing Chamber then flows to the Gas Cleaning Section where it will be cooled and cleaned before entering the Contact Section of the acid plant.

The design conditions for the new acid plant are set out below.

Gas conditions exit the Mixing Chamber:

Flow: 90,000 Nm$^3$/h
Temperature: 340°C
Pressure: -25 mm WC

Composition (by vol.):
- SO$_2$: 9.09%
- SO$_3$: 0.09%
- O$_2$: 12.80%
- N$_2$: 76.42%
- CO$_2$: 0.50%
- H$_2$O: 1.10%

Dust content: 0.45 g/Nm$^3$

These are the design limiting gas flow conditions that will prevail for approximately 65% of the time. For the remainder of the time the plant will be required to maintain stable operation with a much reduced gas flow and variable SO$_2$ content. These transitory conditions are summarized in Appendix 1 - Smelter Operation.

SO$_2$ conversion in Contact Section: 97.0%
Cooling water temperature: 15°C
Plant elevation above sea level: 3,720 m
Atmospheric pressure: 639.2 mbar
4.0 BATTERY LIMITS

4.1 EQUIPMENT

The following equipment is included within the scope of this study.

4.1.1 Gas Cleaning Section

(i) Gas Mixing Chamber
(ii) Quench Tower
(iii) Retention Tower
(iv) Venturi Scrubber
(v) Gas Cooling Tower
(vi) Primary Wet Electro-Static Precipitator (WESP)
(vii) Secondary WESP
(viii) Gas Condenser.

4.1.2 Weak Acid Section

(i) Quench Tower Pump Tank
(ii) Quench Tower Circulation Pumps
(iii) Weak acid circulation pumps
(iv) Weak Acid Coolers
(v) Weak Acid Pump Tank
(vi) WESP Flush Tank
(vii) WESP Flushing Pump
(viii) Effluent Stripper
4.1.3 Contact Section

(i) Main Blower
(ii) Cold Heat Exchanger
(iii) Intermediate Heat Exchanger (Located inside Converter)
(iv) Hot Heat Exchanger (Located inside Converter)
(v) Converter (including catalyst beds 1, 2, 3 & 4)
(vi) 3/4 Interpass Cooler
(vii) SO3 Cooler
(viii) Preheater Furnace
(ix) Preheater Exchanger

4.1.4 Strong Acid Section

(i) Dry Tower
(ii) Dry Tower Pump Tank
(iii) Dry Tower Pump
(iv) Dry Tower Acid Cooler
(v) Absorber Tower
(vi) Absorber Tower Pump Tank
(vii) Absorber Tower Pump
(viii) Absorber Tower Acid Cooler
(ix) Product Acid Cooler
4.2 TIE POINTS

The following tie-point definitions are provided to further clarify the scope of this study:

(i) Inlet gas At inlet to Gas Mixing Chamber.
(ii) Exhaust gas At outlet from Absorber Tower.
(iii) Sulfuric acid At discharge from Product Acid Cooler.
(iv) Weak acid At discharge from Effluent Stripper.
(v) Cooling water At nozzles on equipment.
(vi) Electrical power At terminals for electrical drives.
(vii) Instrumentation At the connection to the field element

4.3 EXCLUSIONS

For further clarity, the following is not included in the estimate:

(i) Slack
(ii) All electrical work except motor drives
(iii) Foundations (FCII will provide criteria only)
(iv) Platform access, ladders and structural steel (FCII will provide notional drawings only)
(v) Instrumentation other than the field elements
(vi) Site preparation
(vii) Sub surface drains and piping
(viii) Control room
5.0 SCOPE OF WORK

The proposed Scope of Work includes the following activities.

5.1 HOME OFFICE ENGINEERING

(i) Preparation of Process Flowsheets for the following Sections of the plant:

(a) Gas Cleaning Section
(b) Weak Acid Section
(c) Contact Section
(d) Strong Acid Section

The process flowsheets will show for each stream the gas temperature, pressure, composition, and flow rate.

These flowsheets will also show in simplified form the principal control loops.

(ii) Preparation of preliminary drawings and/or data sheets for all new equipment.

(iii) Preparation of General Arrangement and Plot Plan drawings. These drawings will show only the major equipment items and the gas ducts.

(iv) Preparation of foundation criteria for major equipment. Design and estimation of the cost for the foundations will be by DRP.

(v) Preparation of notional drawings showing structural steel and platform access for major equipment. Design and estimation of the cost for the ladders, platforms and structural steel will be by DRP.

(vi) Preparation of drawings and specifications to enable DRP to obtain an estimate for the field construction cost to install the equipment, ducting and piping.

(vii) Preparation of capital cost estimate (±25%) for the acid plant. This price will be developed based on the vendor pricing obtained for the (±15%) capital cost estimate prepared by FCII for a new acid plant to treat the off gas from the Lead Sinter Machine.
(viii) Preparation of formal report (2 copies) which will include:
   (a) Process Flow Diagrams
   (b) Layout and elevation drawings
   (c) Sketches and/or data sheets of major equipment
   (d) Process description
   (e) Complete tabulation of cost estimate

5.2 Visit with DRP

At the request of DRP, FCII will be pleased to present its final report to DRP personnel in Peru. However neither time nor travel costs for this meeting have been included in the Lump Sum Fee. It is proposed that the incremental cost for the time and travel would be charged in accordance with Appendix II – Reimbursable Cost Schedule.

5.3 DRP Obligations.

In order to complete the cost estimation for the acid plant, DRP will estimate the following local costs:

(i) Cost of site preparation, drainage and finishing.
(ii) Design and cost of foundations based on criteria to be provided by FCII.
(iii) Field construction cost to install the equipment, ducting and piping specified by FCII
(iv) Cost of structural steel, ladders and platform access based on notional drawings to be provided by FCII
(v) Cost of MCCs and all electrical connections to motors.
(vi) Cost of area lighting
(vii) Cost of all instrumentation other than the field measuring elements, control valves and gas dampers.
(viii) Cost of insulation based on specification of insulation requirements provided by FCII.
6.0 SCHEDULE

Following Contract Award and confirmation of the design data, FCII will commence the design of the Acid Plant.

During the execution of the work the documents listed below will be issued to DRP:

(i) Process Flow Diagrams - 6 weeks following Contract award
(ii) Sketches of major equipment - 9 weeks following Contract award
(iii) Layout and elevation drawings - 12 weeks following Contract award
(iv) Final report and estimate - 16 weeks following Contract award
7.0 COMMERCIAL SUMMARY

7.1 Remuneration

The lump sum fees for the engineering services described in Section 5 - Scope of Work Sections is:

$37,200 US Funds
(Thirty seven thousand, two hundred US Dollars)

7.2 Reimbursable Engineering Services

For any additional engineering services not included in Sections 5, FCII will undertake such additional work on a reimbursable or lump sum basis at the rates set out in Appendix II - Reimbursable Cost Schedule.

7.3 Taxes

The fees quoted in this proposal are exclusive of all taxes, including withholding taxes, imposed by any authority in Peru.

7.4 Schedule of Payment

15% Due on Contract award
40% Due on submission of flowsheets and equipment sketches.
45% Due on submission of final report.

7.5 Terms of Payment

All invoices shall become due and payable net 30 days following receipt of invoice.

7.6 Limit of Liability

FCII's total limit of liability for any errors or omissions shall be limited to the cost of rectifying its drawings or specifications. In no event shall FCII's total liability exceed the fees received by FCII under the terms of this contract.

7.7 Consequential Damages

Notwithstanding anything contained in any contract between DRP and FCII, neither party shall in any case be liable to the other party for any special, indirect
or consequential damages including without limitation, damages for lost profits, lost business, lost savings or other economic or business loss.

7.8 Validity of Proposal

The prices quoted in this proposal shall remain valid for acceptance until June 30, 2005 following which date FCII reserves the right to amend the prices quoted and the schedule proposed to reflect the circumstances prevailing at that time.

7.9 Contract Terms

The terms set out in this Section 7 are an integral part of the offering and unless specifically agreed to the contrary shall persist in effect in any future contract.
APPENDICES
FLECK Chemical Industries Inc.

APPENDIX I

SMELTER OPERATION
<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>FIR (1)</th>
<th>PSC (2)</th>
<th>FIR - PSC (3)</th>
</tr>
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<tbody>
<tr>
<td>Flow Rate (wet) 1</td>
<td>Nm³/h</td>
<td>49 700</td>
<td>35 000</td>
<td>14 700</td>
</tr>
<tr>
<td>Pressure</td>
<td>mm WC</td>
<td>-20.7 -25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>350</td>
<td>330</td>
<td>50</td>
</tr>
<tr>
<td>Gas Vol % (wet)</td>
<td>Vol %</td>
<td>10.08</td>
<td>7.7</td>
<td>2.35</td>
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<tr>
<td>SO₂</td>
<td></td>
<td>0.10</td>
<td>0.07</td>
<td>0.03</td>
</tr>
<tr>
<td>SO₃</td>
<td></td>
<td>12.3</td>
<td>13.5</td>
<td>1.2</td>
</tr>
<tr>
<td>O₂</td>
<td></td>
<td>75.2</td>
<td>78.0</td>
<td>2.8</td>
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<td>N₂</td>
<td></td>
<td>0.9</td>
<td>0.0</td>
<td>0.9</td>
</tr>
<tr>
<td>CO₂</td>
<td></td>
<td>1.4</td>
<td>0.71</td>
<td>0.7</td>
</tr>
<tr>
<td>H₂O</td>
<td></td>
<td>99.996</td>
<td>99.98</td>
<td>0.01</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>99.996</td>
<td>99.98</td>
<td>0.01</td>
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<tr>
<td>Contaminants (wet)</td>
<td>g/Nm³</td>
<td>0.6</td>
<td>0.1</td>
<td>0.45</td>
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</tbody>
</table>

Note:
NSAP : New Sulfuric Acid Plant
1: Normal Conditions are defined at 1 atm and 0°C
FIR : Fusion Injected Reactor
PSC : Pierce Smith Converter
SM : Lead Sinter Machine
TBC : To Be Confirmed
CTA : Client To Advice

(1) The FIR will emit process gas almost all the day (93% of daily time), 70% of this period will operate in simultaneous with 1 PSC and the other 30% only with gases from FIR, with a flow of 50 000 Nm³/h, rest with gases of only the glass.

(2) The condition in which only gas is fed from PSC to the acid plant will give in short intervals of time in which the FIR stops and continues blowing the converter, what estimatively will occur in a 5% of the daily time with a volume of 35 000 Nm³/h.

(3) The normal condition of acid plant operation will occur when is operating simultaneously the FIR and one PSC in blowing, this will take place by almost 65% of the daily time, with a total gas volume of 84 700 Nm³/h as nominal value and 90 000 Nm³/h as maximum value of acid plant design.
APPENDIX II

REIMBURSABLE COST SCHEDULE
ENGINEERING SERVICES
REIMBURSABLE COST SCHEDULE

The rates and charges described in this schedule apply to all reimbursable engineering services provided by FCII. Reimbursable engineering services will only be commenced by FCII following the receipt and formal acceptance of instructions requesting such services to be performed.

The engineering services of all engineers, designers, draughtsmen and other personnel directly engaged in performing the engineering services shall be reimbursed in accordance with the following schedule:

1 Charge-out Rates

The following charge-out costs shall apply for work executed in 2005:

1.1 Home Office

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers</td>
<td>$124.00 US/hour</td>
</tr>
<tr>
<td>Designers / Draughtsmen</td>
<td>$100.00 US/hour</td>
</tr>
<tr>
<td>Secretarial</td>
<td>$52.00 US/hour</td>
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</table>

1.2 Site Work

Site work is charged for each calendar day at a rate in accordance with the following schedule:

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineers</td>
<td>$1,240.00 US/day</td>
</tr>
<tr>
<td>Designers / Draughtsmen</td>
<td>$1,000.00 US/day</td>
</tr>
</tbody>
</table>

1.3 Travel Time

Travel time will be charged at the rates set out in the schedules 1.1 above.

The above charge-out rates include the following:

(i) Direct costs of salary, salary benefits, office rental, stationary, equipment rental, payroll and other direct charges.

(ii) Overhead costs of administration, development costs, marketing costs, accounting and general office expenses, etc.

(iii) Profit.

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2 **GENERAL COSTS**

These are defined as:

(i) Costs of outside reproduction and duplicating services.

(ii) Courier costs

(iii) Such other expenditures as may be reasonably charged and which have been agreed to by the parties.

These costs will be charged at cost plus 20% to cover administration.

3 **TRAVEL AND LIVING EXPENSES**

Travel costs include all travel, hotel and living allowances of personnel incurred while travelling in connection with the work. The living allowances shall be charged at a flat rate of $70 per day for meals and other incidentals. These costs will be charged at cost.

4 **TOTAL CHARGE-OUT EXPENSE**

This shall be an amount equal to the sum of items (1)+(2)+(3)

5 **TERMS OF PAYMENT**

All payments shall become due and payable net 30 days following receipt of invoice.
APPENDIX III

REFERENCE LIST
MAJOR EXPANSION PROJECTS

PHELPS DODGE MIAMI

Claypool, Arizona.

PROCESS SPECIFICATION:  

<table>
<thead>
<tr>
<th></th>
<th>Previous Operation</th>
<th>Modified Operation</th>
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</thead>
<tbody>
<tr>
<td>GAS FLOW:</td>
<td>137,000 scfm</td>
<td>165,000 scfm</td>
</tr>
<tr>
<td>SO2 CONCENTRATION:</td>
<td>7.0% (by Vol.)</td>
<td>10.5% (by Vol.)</td>
</tr>
<tr>
<td>PRODUCTION:</td>
<td>1,875 stpd</td>
<td>3,395 stpd</td>
</tr>
<tr>
<td>CONVERSION:</td>
<td>99.5%</td>
<td>99.7%</td>
</tr>
<tr>
<td>PROCESS CONFIGURATION:</td>
<td>Double Absorption</td>
<td>Double Absorption</td>
</tr>
</tbody>
</table>

SCOPE OF WORK:

(i) Redesign of process from a Double Absorption 2:2 to a Double Absorption 3:1 configuration.

(ii) New 48 ft diameter stainless steel 4 bed converter with internal hot heat exchanger and hot reheat exchanger.

(iii) New carbon steel SO3 cooler and associated air blower.

(iv) New preheater and furnace.

(v) Make up charge of Topsoe VK38 Vanadium Pentoxide catalyst.

(vi) New dry, intermediate and final absorber towers and their associated pump tanks complete with new acid circulation pumps.

(vii) New gas ducting, cast iron acid piping and instrumentation.

(viii) New cooling tower.

(ix) New product acid cooler.

(x) New cold reheat and cold heat exchangers with integral guard bundles.

Proposal 450 – June 2008
MAJOR EXPANSION PROJECTS
NORANDA CHILE SA – Fundicion Altonorte
La Negra - Chila.

PROCESS SPECIFICATION:

<table>
<thead>
<tr>
<th></th>
<th>Previous Operation</th>
<th>Modified Operation</th>
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<tbody>
<tr>
<td>Gas Flow:</td>
<td>102,700 Nm³/h</td>
<td>127,500 Nm³/h</td>
</tr>
<tr>
<td>SO₂ Concentration:</td>
<td>8.3% (by Vol.)</td>
<td>11.4% (by vol.)</td>
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<tr>
<td>Production:</td>
<td>906 mtpd</td>
<td>1,480 mtpd</td>
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<tr>
<td>Conversion:</td>
<td>99.8%</td>
<td>97.0%</td>
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<tr>
<td>Process Configuration:</td>
<td>Double Absorption</td>
<td>Single Absorption</td>
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</tbody>
</table>

SCOPE OF WORK:

(i) Replace existing intermediate and final absorber towers with new single absorber tower.

(ii) New stainless steel 2 bed converter with internal hot heat exchanger and make-up charge of vanadium pentoxide catalyst.

(iii) Two new humidifying towers, weak acid coolers and weak acid circulation pumps.

(iv) New absorber tower acid pump.

(v) New air blower for SO3 cooler.

(vi) Modify dry tower and install new acid distributor.

(vii) New absorber tower including new acid distributor.

(viii) Re-arrange existing plate type acid coolers.

(ix) New product acid cooler.

(x) New water cooling tower and two new cooling water pumps.

Proposal 450 - June 2005
MAJOR EXPANSION PROJECTS

ENAMI
Las Ventanas, Chile.

PROCESS SPECIFICATION:  | PREVIOUS OPERATION | MODIFIED OPERATION |
---|---|---|
GAS FLOW: | 105,000 Nm³/h | 125,000 Nm³/h |
SO₂ CONCENTRATION: | 8.0 % (by Vol.) | 10.5 % (by Vol.) |
PRODUCTION: | 931 mlpd | 1,370 mlpd |
CONVERSION: | 98.0 % | 99.5 % |
PROCESS CONFIGURATION: | S. A. | D. A. |

SCOPE OF WORK:

(I) Redesign of process from Single Absorption to a 3:1 Double Absorption configuration.

(II) New 11.1 meter diameter stainless steel 1st and 2nd bed converter with internal hot heat exchanger.

(III) Beds 1 & 2 and Beds 3 & 4 of original converter twinned to become the new Beds 3 and 4 respectively.

(V) New carbon steel heat exchangers with stainless steel sacrificial sections for both the cold and the cold reheat duties.

(VIII) New carbon steel SO₃ Cooler.

(VIII) New intermediate absorber tower and associated acid pumps, acid coolers and cast iron piping.

(V) New gas cooling tower and associated weak acid pumps, weak acid cooler and piping.

(V) Make-up charge of BASF catalyst.

Proposal 450 – June 2005
MAJOR EXPANSION PROJECTS

NORANDA INC - BRUNSWICK SMELTER

Belledune, New Brunswick

<table>
<thead>
<tr>
<th>PROCESS SPECIFICATION</th>
<th>PREVIOUS OPERATION</th>
<th>MODIFIED</th>
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<tbody>
<tr>
<td>Operation</td>
<td></td>
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<tr>
<td>Gas Flow:</td>
<td>120,000 Nm³/h</td>
<td>180,000 Nm³/h</td>
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<tr>
<td>SO₂ Concentration:</td>
<td>4.7 % (by Vol.)</td>
<td>5.5 % (by Vol.)</td>
</tr>
<tr>
<td>Production:</td>
<td>610 mtpd</td>
<td>780 mtpd</td>
</tr>
<tr>
<td>Conversion:</td>
<td>98.0 %</td>
<td>99.5 %</td>
</tr>
<tr>
<td>Process Configuration:</td>
<td>S. A.</td>
<td>S. A.</td>
</tr>
</tbody>
</table>

SCOPE OF WORK:

(i) NEW 12.5 METER DIAMETER STAINLESS STEEL 3 BED CONVERTER WITH INTERNAL HOT HEAT EXCHANGER.

(ii) NEW CARBON STEEL INTERMEDIATE HEAT EXCHANGER.

(iii) NEW CARBON STEEL SO₃ COOLER, CARBON STEEL COLD HEAT EXCHANGER WITH STAINLESS STEEL SACRIFICIAL SECTION COMBINED INTO A SINGLE UNIT.

(iv) NEW TOPSOE VK38 VANADIUM PENTOXIDE CATALYST IN BEDS 1 & 2. NEW TOPSOE VK58 CAESIUM PROMOTED CATALYST IN BED 3.

(v) NEW AIR BLOWER FOR THE SO₃ COOLER.

(vi) ALL NEW GAS DUCTING AND INSTRUMENTATION FOR THE CONTACT SECTION.

Proposal 450 – June 2005
MAJOR EXPANSION PROJECTS
REFINERÍA DE PETRÓLEO CONCON SA
Concón Chile

PROCESS SPECIFICATION: | PREVIOUS OPERATION | MODIFIED OPERATION |
------------------------|--------------------|--------------------|
PRODUCTION:             | 15 mlpd            | 25 mlpd            |
CONVERSION:             | 98%                | 99.5%              |
PROCESS CONFIGURATION:  | Single Absorption  | Double Absorption  |

SCOPE OF WORK:

(i) Redesign of process from a Single Absorption to a Double Absorption configuration.

(ii) New stainless steel 2 bed converter with integral Hot Heat Exchanger and Hot Reheat Exchanger.

(iii) New charge of Topsoe VK38 Vanadium Pentoixide catalyst.

(iv) New Main Blower.

(v) New Preheater and Furnace.

(vi) New SO3 Cooler and associated fan.

(vii) New Cold Reheat Exchanger.

(viii) New Intermediate Absorber Tower and associated Pump Tank, Acid Pumps and Acid Cooler.

(ix) New gas ducting, cast iron acid piping and instrumentation.

(x) New Weak Acid Scrubber Cooler

Proposal 450 – June 2005
June 6, 2005

Sr. Braulio Rojas
General Manager
Abastecimientos Internacionales S.A.C.
Av. Canada 4084
Urb Villa Jardin
Lima 30
PERU

Dear Braulio,

Re: Basic design and estimate for a new Sulfuric Acid Plant to treat the Copper Smelter off-gases

Please find enclosed for your records a copy of our proposal sent to Mike Sankovitch for the above referenced feasibility study.

Best regards,

[Signature]
David Harrison
Marketing Manager