

CONTRACT FOR
800 TPD INTERPASS ABSORPTION
SULFURIC ACID PLANT
AT

ASARCO, Incorporated's Lead and Copper Smelter Plant at El Paso, Texas.

THIS AGREEMENT, made as of the ____ day of _____, 1977, by and between Monsanto Enviro-Chem Systems, Inc., whose address is Corporate Square Office Park, P. O. Box 14547, St. Louis, Missouri 63178 (hereinafter called the "Contractor") and ASARCO, Incorporated, a corporation of the State of New Jersey, whose address is 120 Broadway, New York, New York 10005 and P. O. Box 1111, El Paso, Texas, (hereinafter called the "Owner").

W I T N E S S E T H:

WHEREAS, Owner desires to have Contractor provide or perform certain engineering, procurement and construction services for the construction of a sulfuric acid plant to be erected at Owner's plant site at El Paso, Texas, (hereinafter called the "Plant"); and

WHEREAS, Contractor desires to provide or perform such services under the terms and conditions herein provided;

NOW THEREFORE, Contractor and the Owner, for the considerations hereinafter named, agree as follows:

Article 1 - Scope of the Work

(a) Except as otherwise specifically set forth in this Agreement or the exhibits which are a part hereof, Contractor shall provide all personnel, supervision, services, field labor, materials, tools, equipment and supplies and do all things necessary for the proper design, engineering, procurement, construction and commissioning of the Plant (hereinafter called the "Work"). The Work shall be performed in accordance with this Agreement, the attached "General Provisions" and the following documents attached hereto and made a part hereof:

1. Exhibit A - Specification 2102 dated October 29, 1976, as amended in Contractor's letter of November 19, 1976 (Revision I to original Proposal of October 29, 1976).
2. Exhibit B - Cost of the Work
   a. Schedule of St. Louis Office Reimbursable Costs
   b. Schedule of Reimbursable Erection Costs
3. Exhibit C - Completion and Testing
4. Exhibit D - Project Coordination Procedure
5. Exhibit E - Fee Schedule

The word "commission" or "commissioning" as used in this Agreement shall mean the completion of testing and checking of equipment as described in Paragraph A.2 of Exhibit C. Commissioning excludes any startup, initial operation, and performance testing of the Plant.

(b) All procurement and construction for the Plant shall be in accordance with drawings and specifications to be prepared by Contractor in accordance with the design premises, performance requirements and other criteria set forth in Exhibit A. This Agreement, the General Provisions, and Exhibits A, B, C, D, and E shall constitute the "Contract". In the event of conflicts in the Contract documents, they shall take precedence and control in the following order: this Agreement, the General Provisions, the Exhibits.

Article 2 - Time of Completion

Contractor estimates that construction of the Plant shall be completed on or before July 22, 1978. Contractor agrees to perform or provide the work with all due diligence consistent with good engineering, procurement and construction practices.

Article 3 - The Contract Price

(a) In consideration of the performance of the Contract and except as otherwise provided hereinafter, the Owner agrees to pay or reimburse the Contractor for all expenses incurred by the Contractor which are a part of the "Cost of the Work" as defined in Exhibit B and to pay the Contractor a fixed fee of Seven Hundred Ninety Thousand Dollars ($790,000), as adjusted as hereinafter provided. The Contractor guarantees that

the actual Cost of the Work, excluding the fee, will not exceed Eleven Million Eight Hundred Thirty Thousand Eight Hundred Dollars ($11,830,800), as adjusted as provided in Paragraphs (f) and (g) of this Article 3. Said amount of $11,830,800, as adjusted, is hereinafter referred to as the "Guaranteed Maximum Cost". If the actual Cost of the Work shall be less than the Guaranteed Maximum Cost, the Contractor's fee shall be increased by an amount equal to twenty-five percent (25%) of the difference between the Guaranteed Maximum Cost and the actual Cost of the Work or Two Hundred Thousand Dollars ($200,000), whichever is less. If the actual Cost of the Work shall exceed the Guaranteed Maximum Cost, Contractor shall pay such excess.

(b) The Cost of Work shall reflect such discounts on invoices as may be obtainable provided that the Owner advances sufficient funds to pay the invoices within the discount period. There shall be credited against the Cost of the Work the salvage value of materials, tools or equipment charged as part of the Cost of the Work to the Owner and taken over by Contractor by agreement with the Owner for Contractor's use or sale at the completion of the Work, and any rebates, refunds, returned deposits or other allowances received by the Contractor.

(c) The Cost of the Work shall not include, and Contractor shall not be reimbursed for, the cost of any of the following items incurred by Contractor:

1. Overhead or general expenses of any kind, except as these may be expressly included in Exhibit B.
2. Interest on capital employed either in plant or in expenditures on the Work.
3. Contributions, bad debts, entertainment expense.
4. Any items of cost or expense not expressly included in Exhibit B, or in this Agreement or in the General Provisions, unless by mutual agreement between Owner and Contractor.

(d) Owner shall furnish without cost to Contractor, the services, facilities and information as specified in the section titled "Items and Services by Others" of Exhibit A.

(e) Owner shall provide a clear, level site for the Plant free from all subsurface obstructions, except as otherwise indicated in Exhibit A. Foundations for the Plant shall be designed on the basis of criteria furnished by Owner as set forth in the Design Basis Section of Exhibit A. Owner shall furnish soil borings, subsurface data, and loading characteristics for the site. If surface or subsurface obstructions or subsurface conditions are encountered which vary from those indicated and which require work varying from the work which would have been required based on the design defined above, this shall be deemed to be a change in the Work under Article 12 of the General Provisions.

(f) The Guaranteed Maximum Cost shall be increased by

(i) the actual cost incurred by Contractor as a result of any of the following described events:

1. An event of force majeure as defined in Article 4 of the General Provisions.
2. Any increase in sales and use tax rates which becomes effective subsequent to the effective date of this Agreement and the imposition of any tax subsequent to the effective date of this Agreement which is required to be paid by Contractor with respect to the Work or with respect to the Cost of the Work and/or fee other than a tax on net income of the Contractor and/or Contractor's employees.
3. Interference by Owner with the performance of the Work by Contractor and its sub-contractors and/or failure of Owner to perform its obligations in a timely and proper manner, providing such actions result in an actual increase in cost to the Contractor.
4. Interference with, or delay in, the performance of the Work caused by the acts or omissions of separate contractors employed

by Owner and of subcontractors of such contractors, providing such actions result in an actual increase in cost to the Contractor.

5. Work performed on an overtime or premium time basis if requested or approved by Owner. The actual cost of such overtime or premium time for the purpose of this Paragraph (f) shall include the premium portion of salaries and wages, the applicable percentage charges with respect to overtime set forth in Exhibit B, and, with respect to field labor wages, the items of costs set forth in A.3.b, c and d of the Schedule of Reimbursable Erection Costs of Exhibit B.

6. Any costs in excess of $12,000 for vendor service engineers.

7. Any costs in excess of $17,000 for Contractor's start-up engineers.

and by (ii) the amount of the following costs:

1. Any costs paid by Contractor with respect to Material and Equipment Guarantees in Part II of Article 6 of this Agreement which

are not the result of Contractor's negligence.

2. Any costs for which Contractor is to be reimbursed pursuant to Paragraph I (d) of Article 6 of this Agreement and Article 5 of the General Provisions.

3. If Owner shall disapprove a proposed vendor or subcontractor pursuant to Article 7 hereof, the amount by which the bid price of the subcontractor or vendor approved by Owner exceeds the bid price of the proposed subcontractor disapproved by Owner.

(g) The Guaranteed Maximum Cost shall be increased or decreased by the agreed upon estimate of the increase or decrease in the Cost of the Work as provided in Paragraph (b) of Article 12 of the General Provisions or on the basis of the actual cost of a change involving additional work as provided in Paragraph (c) of said Article 12.

Article 4 - Progress Payments

(a) Fifteen (15) days prior to each monthly accounting period, Contractor shall advise Owner, with adequate supporting detail, as to the amount of money that Contractor expects to spend during such accounting period. Notwithstanding the estimate, Owner shall advance funds either weekly or semi-monthly

for payment of the Cost of the Work during such period, as such funds are required. In making requests for advance funds, Contractor shall make adjustments for previous advances received from Owner and disbursements made by Contractor under this Agreement.

(b) Shortly after the end of each monthly accounting period, Contractor shall invoice Owner for all disbursements made in connection with the Work and not previously invoiced. Each invoice shall itemize the reimbursable costs and be prepared so that ready reference can be made to supporting documents. Credit memoranda will be issued to adjust for any correction or unsupported charges as disclosed by audit or otherwise. Contractor shall furnish a statement, monthly, to the effect that the amounts received on account for the preceding month's invoices for payments to be made to subcontractors and suppliers have been paid or otherwise accounted for. The invoice shall contain a statement of (1) advances made pursuant to Paragraph (a) above during the accounting period covered by the invoice, (2) the extent to which such advances were used to pay such disbursements, and (3) the balance of such advances remaining unexpended as of the end of the accounting period. Within ten (10) days of the receipt of each invoice, Owner shall pay Contractor the excess of the total amount of the invoice over the total of such advances used to pay such disbursements.

(c) Owner shall pay the fixed fees due under this Contract to Contractor in accordance with the fee schedule attached hereto as Exhibit E and made a part hereof. The Owner may withhold ten percent (10%) of each said payments. Such withheld amounts shall be paid in full upon acceptance of the Plant in accordance with Article 5 of this Agreement.

Article 5 - Acceptance and Final Payment

Final inspection and acceptance of the Work shall be in accordance with Exhibit C. Owner shall make final payment of the fixed fees due under this Agreement to Contractor as follows:

(a) The balance of the fixed fee due with respect to the Plant shall be paid within thirty (30) days after: (1) performance guarantees have been fulfilled or after the performance guarantees shall be deemed to have been fulfilled as provided in Article 6 hereof, and (2) the Plant is accepted by Owner.

(b) Prior to payment of the balance of the fixed fee pursuant to Paragraph (a), Contractor shall furnish a statement to the effect that all payrolls, material bills, and other indebtedness connected with the Work have been paid, and that the Work is free of all mechanics liens. In the case of disputed indebtedness or liens, the Contractor may submit, in lieu of evidence of payment, a surety bond satisfactory to the Owner, guaranteeing

payment of all such disputed amounts when adjudicated or settled.

Article 6 - Guarantees

I. Performance Guarantees

(a) Contractor guarantees that the Plant will fulfill the performance guarantees set forth in the Performance Guarantee & Tests Section of Exhibit A during a performance test conducted in accordance with the procedure set forth ~~in~~ Exhibit C.

(b) Owner shall cooperate with Contractor in the testing and operation of the Plant in accordance with the provisions in Exhibit C and shall, without implied limitation, supply such personnel and utilities, and operate the Plant under reasonable conditions specified by Contractor.

(c) The obligation of Contractor to demonstrate the performance guarantees is subject to the following conditions:

1. Owner shall furnish a constant and adequate supply of raw materials and feedstock of the analysis specified and necessary utilities, all as specified in Exhibit A.
2. Owner shall furnish adequate supervision and labor.

3. Owner shall comply with Paragraph (b) above.

4. Owner shall operate the Plant in accordance with Contractor's written operating instructions which are to be furnished ninety (90) days prior to start-up.

5. Owner shall furnish all off-site facilities and storage necessary for the operation of the Plant.

6. Owner shall use Monsanto Enviro-Chem Systems, Inc. Vanadium Catalyst in the Plant during the performance tests.

7. Owner shall furnish the necessary labor, equipment and laboratory facilities for determination of opacity, sulfuric acid mist and sulfur dioxide content in the exit stack and sulfur dioxide and oxygen in the feed gas.

8. The plant shall be in steady state operation during the performance test.

In the event that a failure to fulfill one or more of the performance guarantees shall be attributable to failure to comply with any of the foregoing conditions and Owner fails to correct such conditions within a reasonable time after written notification by Contractor, the Contractor shall be relieved from its obligation to fulfill such guarantee and such guarantee or guarantees shall be deemed to have been fulfilled.

(d) If initial operation or making a performance test of the Plant shall be delayed after Contractor shall have notified Owner in writing that the Plant is ready for initial operation or a performance test, as the case may be, and the delay is due to any act or omission of the Owner or the inability of the Owner to supply feedstock, materials, supplies, utilities or personnel and not due to the fault or negligence of Contractor, Owner shall be responsible for all costs incurred in performing work deemed necessary by Contractor to put the Plant in the condition it was in when such notice was given by Contractor. In addition, if, during or after the performance tests, problems arise or are encountered with the Plant, which are caused by or contributed to by deterioration of or damage to the Plant during the period of delay, Owner shall be responsible for the expense involved in correcting such deterioration of or damage to the Plant, provided that Owner shall not be responsible for such expense to the extent that such deterioration or damage shall be attributable to defective design furnished by Contractor or negligence on the part of Leonard's permanent field supervisory personnel. Owner shall reimburse Contractor for all additional costs incurred, including holding personnel at the site of the Plant or returning personnel to the site due to the fact that the initial operation and/or testing of the Plant was delayed as aforesaid. If initial operation of the Plant or the making of the first performance test shall be delayed as aforesaid for a

period of ninety (90) days after Contractor shall have requested Owner to commence initial operation or to make a performance test or thirty (30) days after written request with respect to a performance test other than the first performance test, as the case may be, then Contractor shall be relieved of its obligations with respect to performance guarantees and the performance guarantees shall be deemed to have been fulfilled.

(e) If any of the performance guarantees are not met during a performance test for reasons other than those which are beyond the control and responsibility of Contractor, Contractor shall make such changes or modifications to the Plant as Contractor shall deem necessary to enable the performance guarantees to be met and a new performance test or tests shall be made as provided in this Article 6 and Exhibit C promptly thereafter. Subject to the provisions of the last sentence of Paragraph (a) of Part III of this Article 6 and of Paragraph (b) of said Part III, Contractor shall furnish the necessary engineering services and shall make the necessary changes and modifications to the Plant without cost to Owner.

(f) When Contractor shall have demonstrated the ability of the Plant to fulfill the performance guarantees, Contractor shall have met its obligation and shall have no further liability with respect to performance guarantees.

II. Material and Equipment Guarantees

Contractor shall incorporate in every request for quotations for the purchase of material or equipment a requirement that the manufacturer thereof shall repair at vendor's expense or replace F.O.B. shipping point any material or equipment found to be defective or which fails under design operating conditions, if the defect is observed within one year from the date such material or equipment is placed in use, or eighteen (18) months from the date such equipment or material is shipped, whichever occurs first, and will use reasonable efforts to procure such guarantees for the benefit of Owner and Contractor and will enforce such guarantees short of litigation. Contractor shall have no liability with respect to material and equipment not manufactured by Contractor, and guarantees obtained from vendors shall be Owner's sole protection as to such material and equipment.

III. Workmanship and Design Guarantees

(a) For a period of twelve (12) months after the Plant is accepted or fifteen (15) months after the Plant is ready for start-up as provided in Paragraph A-3 of Exhibit C, Completion and Testing, whichever occurs first, Contractor shall make such changes or modifications in the design of the Plant and repair or replace any part of the Plant failing as a result of defective

field labor workmanship furnished by Contractor or its subcontractors or as a result of defective design furnished by Contractor, provided Owner shall notify Contractor in writing promptly after discovery of any such failure. Contractor shall not be liable under this Agreement for failures or defects due to ordinary wear and tear, corrosion or erosion, or as a result of improper operation, improper maintenance or operating conditions more severe than, or different from, those contemplated in the original design. Subject to Paragraph (b) hereof, Contractor shall furnish engineering services and shall make changes or modifications to the Plant necessary to correct defective design furnished by Contractor without cost to Owner provided that Owner shall pay for any such changes and modifications made prior to the time the Plant is ready for start-up as provided in Paragraph A-3 of Exhibit C and which are not attributable to Contractor's negligence as part of the Cost of the Work as defined in Exhibit B. Defective design shall not be deemed to include minor defects normally inherent in the engineering of a process plant of the type to be furnished hereunder and which can be readily corrected during the course of construction. Owner shall reimburse Contractor for the actual cost, as defined in Exhibit B, incurred by Contractor in making repairs, replacements or changes in the Plant necessary to correct defective field labor workmanship providing such is not attributable to Contractor's negligence.

(b) Contractor shall not be responsible for the cost of engineering services and the cost of making changes and modifications under Paragraph (a) of this Part III and under Paragraph (e) of Part I of this Article 6 in an aggregate amount in excess of $1,000,000, less the amount of any payment by Contractor which shall be chargeable against the limit of liability set forth in Paragraph (a) of Article 9 hereof. The limit of liability set forth in Paragraph (a) of Article 9 hereof shall be reduced by the aggregate amount of such costs.

IV. Catalyst Guarantees

The Monsanto Enviro-Chem Systems, Inc. Vanadium Catalyst incorporated in the Plant is guaranteed in accordance with the provisions of the "Catalyst Guarantee" set forth in Exhibit A.

V. Guarantees Exclusive

The foregoing guarantees are exclusive. Contractor's obligations with respect to errors or failures in the design, construction and operation of the Plant, or any part thereof, shall be limited to the guarantees provided in this Article 6 and shall be subject to the limitation of liability provided in Article 9 hereof.

Article 7 - Subcontracting

It is understood Contractor may employ the services of its

wholly owned subsidiary, Leonard Construction Company ("Leonard"), to administer and perform the field construction of the Plant. Leonard shall not be entitled to a fee in addition to that paid to Contractor for any work performed pursuant to this Article 7. Leonard, in turn, shall have the right to subcontract with advance notice to Owner, such portions of the construction of the Plant as it shall determine. Leonard shall not contract with any subcontractor objectionable to the Owner. The subcontracting of any portion of the Work shall not relieve Contractor of responsibility for the proper performance of the Work, as provided herein.

Article 8 - Insurance

(a) Contractor shall provide and maintain during the progress and until completion of the Work the insurance set forth below. Contractor will furnish certificates evidencing that such insurance is in force and will make every reasonable effort to provide that ten (10) days prior written notice be given to Owner in the event of material change or cancellation.

1. Workmen's Compensation Insurance - Workmen's

2. Employer's Liability Insurance - Employer's

3. Public Liability Insurance - Bodily Injury

4. Public Liability Insurance - Property Damage

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on account of any one occurrence.

5. Automobile Liability Insurance - Such insurance

(b) All Risk Insurance - Owner agrees to carry All Risk Insurance fully protecting Owner, Contractor and Leonard, as their interests may appear, against all physical loss or damage to the Plant or any part thereof and to all labor, materials, equipment and other items incorporated into or intended for incorporation into any part of the Plant while at the site, during erection and until completion and acceptance of the Plant by Owner or until termination of this Contract, whichever shall first occur. Owner shall provide a waiver of subrogation in favor of Contractor and Leonard under such insurance. Owner also agrees to carry additional insurance to cover materials,

equipment, and other items incorporated into, or intended for incorporation into, any part of the Plant while in transit to the site.

Article 9 - Limitation of Liability

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Work over the Guaranteed Maximum Cost and any amount paid by Contractor pursuant to Article 7 of the General Provisions shall be excluded in determining Contractor's aggregate liability as aforesaid. Said aggregate limit of liability shall be reduced by the aggregate amount of costs paid by Contractor pursuant to Paragraph (e) of Part I and Paragraph (a) of Part III Article 6 of this Agreement.

(b) Except to the extent covered by insurance carried by Contractor pursuant to Article 8 hereof, Contractor and Leonard shall not be liable to Owner under this Agreement or otherwise for loss of use, loss of profits, business interruption, or other consequential, indirect or incidental damages, however the same may be caused, including but not limited to, patent

infringement and the negligent acts or omissions of Contractor and Leonard.

Article 10 - Environmental Standards; Permits; Safety Laws

(a) Owner has furnished Contractor with the emission, effluent and other criteria applicable to operation of the Plant and such criteria are defined or set forth in Design Basis Section of Exhibit A. Contractor shall be entitled to rely on the accuracy and completeness of such criteria. Contractor guarantees that operation of the Plant will comply with the criteria described in the performance guarantees set forth in the Performance Guarantee and Tests Section of Exhibit A. If operation of the Plant shall be required to comply with any new or different criteria, this shall be the basis for a change in work in accordance with Article 12, Changes in the Work of the General Provisions.

(b) Contractor shall use reasonable efforts to design the Plant so that as constructed it will comply with applicable standards issued pursuant to the Federal Occupational Safety and Health Act prior to the completion of the detailed design and engineering of the Plant. Contractor shall make such changes in the detailed drawings and specifications as Owner may show, prior

to commencement of construction, are reasonably required to comply with such standards.

(c) Owner shall pay the cost of all licenses and permits necessary for the construction and operation of the Plant and shall procure, with the assistance of Contractor, all such licenses and permits.

Article 11 - Applicable Law

This Contract shall be construed and enforced in accordance with the laws of Missouri.

Article 12 - Catalyst

Contractor will supply the initial quantity of Monsanto Enviro-Chem Systems, Inc. Vanadium Catalyst required for operation of the Plant at the prices in effect at the time of delivery.

Article 13 - Entirety Clause

The Contract constitutes the entire agreement between the parties and except as may be specifically set forth herein no changes can be made herein except by an agreement in writing duly executed by the parties or their duly authorized agents, as provided for in Article 12 of the General Provisions and in

Section IX of the Project Coordination Procedure, Exhibit D.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement and initialled the first and last pages of the General Provisions as of the day and year hereinabove written.

(Seal) ASARCO, Incorporated

Attest: _____ By: _____
Secretary Vice President

(Seal) MONSANTO ENVIRO-CHEM SYSTEMS, INC.

RCR

Attest: _____ By: _____
Secretary Vice President

This is to certify that policies of insurance as described below have been issued to the insured named below and are in force at this time. If such policies are canceled or changed during the periods of coverage as stated herein, in such a manner as to affect this certificate, 10 days written notice will be mailed to the party designated below for whom this certificate is issued.

1. Name and address of party to whom this certificate is issued	2. Name and address of insured
ASARCO, Inc. P. O. Box 1111 El Paso, Texas 79912 Attn: Lindsey Greene	Monsanto Enviro-Chem Systems, Inc P. O. Box 14547 St. Louis, Missouri 63178

3. Location of operations to which this certificate applies

4. Coverages For Which Insurance is Afforded	
Workmen's Compensation and Employers' Liability in the state named in item 3 hereof	$
Bodily Injury Liability —except automobile In cluding Protective	
Property Damage Liability —except automobile In cluding Protective	
Bodily Injury Liability —automobile	$ $
Property Damage Liability —automobile	$ $
Liability (Bodily Injury and Property Damage)	$ $
Catastrophe or Excess	$ $ $,000 deductible amt.

*Absence of an entry in these spaces means that insurance is not afforded with respect to the coverages opposite thereto.
**Policy is effective and expires at 12:01 A.M., standard time at the address of the named insured as stated herein.

Description of Operations or Automobiles to which the policy applies:

V

CC:

The insurance afforded is subject to all of the terms of the policy, including endorsements, applicable thereto.

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Office

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Secretary, Casualty-Property Department

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GENERAL PROVISIONS
OF
CONTRACT BETWEEN
ASARCO, INCORPORATED
AND
MONSANTO ENVIRO-CHEM SYSTEMS, INC.
DATED AS OF _____, 1977

ARTICLE 1 - Definitions

As used herein, "Agreement" shall refer to the Agreement between ASARCO, INCORPORATED ("Owner") and MONSANTO ENVIRO-CHEM SYSTEMS, INC. ("Contractor") dated as of _____, 1977. Reference is made to Article 1 of the Agreement for the definition of certain terms and exhibits referred to herein.

ARTICLE 2 - Notice

Written notice shall be deemed to have been duly served if delivered by hand or sent by registered mail, in each case to the address or addresses of each party set forth below:

To Contractor:

Monsanto Enviro-Chem Systems, Inc.
Corporate Square Office Park
P. O. Box 14547
St. Louis, Missouri 63178

Attention: Mr. D. L. Chapman
Vice President

To Owner:

ASARCO, Incorporated
120 Broadway
New York, New York 10005

Attention: Mr. William A. Bennis
Director of Purchases

Both parties agree to acknowledge in writing the receipt of any notice delivered in person.

ARTICLE 3 - Order of Completion; Schedules; Estimates of Expenditures

Contractor will furnish to the Owner progress reports and statements of estimated expenditures in accordance with Exhibit D.

ARTICLE 4 - Force Majeure

Either party shall be excused for delays and failures to perform to the extent that the performance is delayed or prevented by a cause reasonably beyond the control of the party whose performance is affected and is not due to the fault or negligence of that party, including but not limited to, acts of God or the public enemy, war, insurrection, riot, civil commotion, fire, flood, explosion, hurricane, tornado, windstorm, epidemic, strikes and other concerted acts of workmen, lockouts or injunction (provided that neither party shall be required to settle a labor dispute against its best judgment), and compliance with orders of governmental authority. Such causes shall not excuse performance if the party whose performance is affected fails to use all reasonable diligence and efforts to remove the

cause and remedy the situation. The affected party shall give written notice to the other party as soon after becoming aware of the force majeure delay as is reasonably possible.

If force majeure above is invoked by either party, this contract is not terminated but is suspended for the force majeure period. As soon as the delay due to force majeure is terminated, both parties are obligated to continue performance of the contract. The terms of performance of the contract shall be extended by the delay time necessitated by force majeure.

ARTICLE 5 - Materials and Temporary Facilities

Owner shall supply utilities required for construction purposes as provided in Items and Services By Others Section in Exhibit A. Where such items are not supplied by the Owner, they shall be furnished by Contractor at Owner's cost.

Contractor shall construct and maintain all necessary temporary facilities for the completion of the Work. Upon completion of the Work all such facilities shall, unless the Owner shall otherwise direct, be removed from the premises and the site cleared. Should the Owner wish to change the type and character of the facilities to conform to continued usage thereof in other construction or operation, it shall be its prerogative to change and retain any such facilities.

ARTICLE 6 - Employees of Contractor

If for any reason Contractor or any of Contractor's subcontractors' employees or agents acquire a status imposing liability on the Owner for employer's contributions or taxes under the Federal Insurance Contributions Act, the Federal Unemployment Tax Act, any State Unemployment Tax Act, or any other Act, Contractor, subject to its right to payment for such contributions and taxes pursuant to Exhibit B, shall be liable for, and shall indemnify the Owner against, the same and agrees to comply with all such laws and regulations so as to relieve the Owner from any and all liability therefore and from the responsibility of making reports or keeping records with respect thereto.

Contractor shall at all times enforce strict discipline and good order among his employees, and shall seek to avoid employing on the Work any unfit person or anyone not skilled in the work assigned to him.

Adequate sanitary facilities shall be provided and maintained by the Contractor during the course of the Work. Contractor shall make no representation or indication to its employees or anyone else, that they will be employed or have any preference in employment by the Owner at the Plant where the Work is undertaken or at any other plant of the Owner.

ARTICLE 7 - Patent Protection

Contractor shall at its own expense defend any suit or proceeding brought against Owner to the extent that it is based upon a claim that the Plant as completed hereunder or the operation thereof for the production of sulfuric acid in accordance with Contractor's written operating instruction or the sale in the United States, Mexico and Canada of the sulfuric acid so produced in such Plant, infringes any patent and shall pay any award or damage assessed against Owner in such suit, provided Owner gives Contractor prompt notice in writing of any such claim of infringement and of the institution of any such suit or proceeding and is given authority, information, and assistance, at no cost to Owner, for the defense of the same; provided, however, that the Dollar limitation of Paragraph (a) of Article 9, Limitation of Liability, of the Agreement shall not apply to this Article 7. It is agreed that Owner shall have the right to be represented at its expense in any such suit or proceeding by advisory counsel of Owner's choosing. If the Plant as completed hereunder or the operation thereof in accordance with Contractor's written operating instructions is in such suit held to constitute infringement and further operation of the Plant as completed hereunder is enjoined, or if Contractor deems it advisable because of such suit or threat thereof, Contractor shall at its expense and at its election,

either procure for Owner the right to continue operation of the Plant, replace the catalyst originally supplied or such components of the Plant as may be required to avoid such claim of infringement provided such replacement, as reasonably determined by Owner, does not adversely affect the performance of the Plant, or modify the Plant or its mode of operation to avoid such claim of infringement provided such modification, as reasonably determined by Owner, does not adversely affect the performance of the Plant; provided, however, that, before attempting to make any such replacement or such modification, Contractor shall first attempt in good faith, to obtain for Owner said right to continue operation of said Plant.

ARTICLE 8 - Surveys, Permits and Regulations

Base lines, coordinates, benchmarks for the design of the Plant and permits, licenses of a temporary and permanent nature necessary for the prosecution of the Work and operation of the Plant shall be secured by the Owner as provided for in the Items & Services Section of Exhibit A.

Control lines and levels and all general layout work necessary for the design and construction of the Plant will be the responsibility of Contractor. Contractor shall endeavor to preserve and maintain these controls throughout the life of the

Contract.

Except as otherwise provided in Article 10 of the Agreement, Contractor shall comply with all laws, ordinances, rules and regulations bearing on the conduct of the Work.

ARTICLE 9 - Protection of the Public and of Work and Property

Contractor shall provide and maintain all necessary watchmen, barricades, red lights and warning signs and take all reasonable precautions for the protection and safety of its employees on the Work, of all other authorized persons and of adjacent private and public property. Contractor at all times shall maintain adequate protection of the Work from damage and shall protect the Owner's property and all authorized persons thereon from injury, damage or loss by reason of any act or omission of Contractor or its subcontractors.

In an emergency affecting the safety of life, or of the Work or of adjoining property, Contractor is, without special instructions or authorization from the Owner, hereby authorized to act at Contractor's discretion to prevent such threatened loss or injury. Contractor shall also so act if so instructed by the Owner.

ARTICLE 10 - Inspection of Work

Owner and its authorized representatives shall at all times have access to the Work. Contractor shall provide safe and proper facilities for access and for inspection required in the performance of the Work.

If the specifications, the Owner's instruction, laws, ordinances, or any public authority require any item of material, equipment or work to be specially tested or approved, Contractor shall give the Owner timely notice in writing consistent with Item VIII of Exhibit D of its readiness for inspection, and if the inspection is by another authority than the Owner, of the date fixed for such inspection. Inspections by the Owner shall be promptly made, and where practicable at the source of supply.

ARTICLE 11 - Contractor's Covenants, Supervision, Superintendence and Employees

(a) Contractor recognizes the relationship of confidence established between Contractor and the Owner by this Contract which is based on a guaranteed maximum cost plus fixed fee arrangement. Contractor covenants to use its best skill and judgment in performing the Work, to do such Work at the lowest cost practicable, and to perform all such Work in a workmanlike manner with efficiency and diligence.

(b) Contractor shall maintain a competent staff at all times to supervise the Work. Contractor shall submit to the Owner for review, prior to the time Contractor begins performance of the Work, a complete organization chart of all key personnel that Contractor proposes to employ at the site. Contractor shall keep on the Work, during its progress, a qualified superintendent, necessary assistants, and so far as reasonably possible, a sufficient number of skilled workmen to diligently pursue the Work.

(c) Contractor shall use its best judgment and skill in dealing with labor matters, and take all reasonable steps to avoid labor disputes. In the event of any strike or threat of strike, slowdown, featherbedding, or other like practices, Contractor shall apprise the Owner of all relevant facts and implications of the particular labor problems involved, and shall consult in good faith with the Owner in an endeavor to reach a mutually satisfactory solution to such labor problem and, so far as reasonably possible, to protect the Owner against delays or increases in the Cost of the Work or damage or losses to its other operations.

(d) Leonard and its subcontractors shall only employ union labor in performing the construction work.

ARTICLE 12 - Changes in the Work

(a) As used in this Article 12, "changes" shall include additional work or reduction in work.

(b) Contractor will make such changes in the Work as Owner may request and shall be compensated for such changes by an adjustment in the fixed fee, as hereinafter provided, and in accordance with Exhibit B hereof and the Guaranteed Maximum Cost shall be adjusted by an agreed upon increase or decrease therein; provided, that Contractor shall not be required to make changes in the Work, including changes contemplated under Article 10 of the Agreement, which, in the opinion of Contractor, would adversely affect the ability of the Plant to fulfill the guarantees provided by Contractor hereunder unless the guarantees are appropriately modified to Contractor's satisfaction, except as provided in Paragraph (c) below, as to which the parties shall not have agreed in writing on the adjustments, if any, to be made in the estimated engineering manhours as hereinafter provided with respect to the Plant, the adjustment to the Guaranteed Maximum Cost and the estimated completion date. Studies and evaluations made for proposed changes shall be deemed to be changes for the purpose of compensation and adjustment of the fixed fee and Guaranteed Maximum Cost pursuant to the provisions of this Article 12 whether or not the proposed change is made or performed.

(c) In the event it is impossible or impractical to establish a firm increase to the Guaranteed Maximum Cost for additional work prior to performing such work because the extent of the additional work cannot be fully defined at the time, or for the purpose of expediting such additional work during critical periods or in emergency situations, then, upon and after mutual written agreement between the parties in each case, such additional work shall be performed under a segregated account and the appropriate adjustment shall be made in the Guaranteed Maximum Cost by change order executed at the earliest feasible date.

(d) The fixed fee for the Plant shall be adjusted on the basis of the net increase or decrease in estimated engineering manhours as a result of changes in the Work with respect to the Plant which involves engineering design by Enviro-Chem. At the time a change is proposed, the parties shall agree upon an estimate of the additional or decreased number of engineering manhours which will be required because of the proposed change. After completion of construction of the Work, the net increase or decrease in estimated engineering manhours for changes and total actual engineering manhours shall be determined. The increase or decrease in the fixed fee for the Plant shall be determined by the application of the following formula:

$$\frac{\text{Net increase or decrease in estimated engineering manhours on account of changes to the Plant}}{\text{Total engineering manhours for the Plant - net increase or decrease in estimated engineering manhours on account of changes to the Plant}} \times \text{fixed fee for the plant}$$

If the percentage of the fixed fee determined by the application of the foregoing formula shall be less than Five Percent (5%), there shall be no increase or decrease in the fixed fee. If such percentage of the fixed fee shall exceed Five Percent (5%), the fixed fee shall be increased or decreased, as the case may be, by an amount equivalent to the percentage determined by the application of the above formula.

(e) Where changes in the Work do not involve engineering by Enviro-Chem, the fixed fee shall be adjusted by Four and one-half (4.5%) Percent of the estimated increase or decrease in the cost of the work as agreed to by the parties, provided that the fixed fee will not be adjusted if the aggregate cost of the changes in the Work covered by this paragraph do not exceed One Hundred Thousand Dollars ($100,000). If the aggregate cost of such changes shall exceed One Hundred Thousand Dollars ($100,000), then the fee adjustment shall be computed on such aggregate cost.

(f) If the Contractor, in the course of the Work, finds any discrepancy between the site plans and information and the physical conditions encountered or any errors or omissions in site plans or in the layout as given by survey points and instructions, the Contractor shall immediately inform the Owner, in writing. After such discovery no work shall be done by the Contractor involving such discrepancy, error or omission until authorized by the Owner.

ARTICLE 13 - Termination for Default

(a) Owner may terminate Contractor's performance under this Contract, upon five (5) days advance written notice to Contractor in the event that:

1. Contractor shall materially breach this Contract (including, without limitation, persistently or repeatedly materially failing to maintain current agreed schedules for the progress of the Work unless excused under Article 4 of the General Provisions) and shall fail or refuse to initiate adequate measures to remedy such breach within ten (10) days after receipt of notice thereof from Owner, stating Owner's intent to invoke the provisions of this Article 13; or,

2. Contractor shall make a general assignment for the benefit of creditors, or a receiver shall be appointed on account of Contractor's insolvency, or Contractor shall become the subject of any proceeding commenced under the Federal Bankruptcy Act or under any state insolvency statute or law for the relief of debtors and Contractor shall fail to take prompt action to vacate such appointment or stay such proceeding.

(b) In the event of termination pursuant to Paragraph (a) above, Contractor shall be paid the Cost of the Work and fixed fee due to the date of such termination. Owner shall also pay

Contractor all costs incurred in effecting such termination and Owner shall either assume, or pay all cancellation charges with respect to, all outstanding commitments of Contractor and Leonard incurred in the course of the performance of this Contract.

(c) In the event of termination pursuant to this Article 13 and only in such event, Owner shall have the right to complete Contractor's plans, specifications and other documents and information furnished by Contractor herein, provided Owner makes a reasonable effort in good faith to cause the person or persons, if any, employed by Owner to complete Contractor's Work to execute an agreement in form and substance satisfactory to Contractor binding such person or persons to maintain the confidentiality of such plans, specifications, documents and information. In the event of termination pursuant to this Article, the license granted under Article 24 shall survive termination.

ARTICLE 14 - Termination for Convenience

(a) Owner for its convenience, may terminate further performance of this Agreement at any time by five (5) days written notice to Enviro-Chem. In the event of such termination, Owner shall pay Enviro-Chem the total of: (i) the cost of the Work

defined in Exhibit B to the date of termination; (ii) all costs as defined in Exhibit B incurred by Enviro-Chem in effecting such termination, including the cancellation of all outstanding commitments of Enviro-Chem or Leonard incurred in the course of performance of this Agreement; (iii) all cancellation charges incurred by Enviro-Chem or Leonard in cancelling such outstanding commitments under (ii) above; and (iv) such portion of the fixed fee due pursuant to Article 3 of the Agreement as the portion of the Work performed prior to the date of termination bears to the entire Work. Owner, at its election, may assume all outstanding commitments of Enviro-Chem or Leonard.

(b) In the event of such termination, the license granted under Article 24 of these General Provisions shall terminate and Owner shall return to Enviro-Chem all plans, drawings, specifications, operating instructions and technical data furnished by Enviro-Chem hereunder and all copies thereof.

ARTICLE 15 - Survival of Obligations

The provisions of Article 13, Termination for Default; Article 14, Termination for Convenience; Article 24, Security Provisions and Licenses; of these General Provisions, and Article 9, Limitation of Liability, of the Agreement, shall

survive termination, whether for default or convenience, and shall continue in full force and effect.

ARTICLE 16 - Removal of Equipment

In the case of termination of this Contract before completion for any cause whatever, the Contractor shall promptly remove any part or all of the Contractor's equipment and supplies from the property of the Owner, failing which the Owner shall have the right to remove such equipment and supplies at the expense and at the risk of the Contractor, without liability of the Owner for any damage to, or loss of the same.

ARTICLE 17 - Payments Withheld

The Owner may withhold all or part of any progress or final payment to the extent necessary to protect the Owner from loss or damage on account of:

1. Damaged or defective work not remedied provided that Contractor is responsible for such remedial work as elsewhere provided in the Contract.
2. Failure of the Contractor to make payments properly to subcontractors or for material or labor.

as those set forth in this Article 24. The provisions of this Subparagraph (a) shall not apply to any Information, and Owner shall be free to disclose to others and to use in any manner any Information, (I) which was in Owner's possession prior to receipt hereunder of the Information directly or indirectly from Contractor; or (II) which is or hereinafter becomes public knowledge through publication or otherwise other than by acts or omissions of Owner, its officers, employees, subcontractors, or agents; provided, however, that Owner shall be free to disclose and use, to the extent permitted, at any time, by a third party, any and all Information which is furnished or made known to Owner by such third party as a matter of right. Nothing in this agreement shall (1) prevent Owner from taking third parties, other than competitors of Contractor, through the Plant, or (2) prevent Owner from using the operating procedures and techniques employed in the Plant, in other sulfuric acid plants and chemical plants operated by Owner so long as said Information is held in confidence for the period ending September 5, 1989, or (3) prevent Owner from seeking patent protection upon any invention owned by Owner or which Owner has a right to own or (4) prevent Owner from disclosing any Information deemed by it to be necessary to satisfy federal, state or local government inquiries in the United States; provided, however, as to

any such inquiry, that Owner shall advise the recipient making such inquiry, of the confidential nature of the Information and that Owner shall advise Contractor at Owner's earliest opportunity, of the request and of the action taken by Owner with respect to it. The parties hereto agree, as to any such inquiry, to cooperate to maintain the confidentiality of such Information, provided that such cooperation shall not include non-disclosure in response to an inquiry, where non-disclosure is, or would be prejudicial to Owner.

(b) All said Information, insofar as such Information is now or remains confidential under the provisions of Subparagraph (a) of this Article 24, is and shall, to said extent, remain Contractor's property and shall be used by Owner only as licensed under Paragraph (c) of this Article 24. Except as provided in Article 13 of these General Provisions of the Contract, all such Information which remains confidential, including any copies thereof made by Owner, its employees, subcontractors or agents, shall be returned to Contractor in the event this contract is terminated. Except as provided for in Paragraph (a) of this Article 24 and except as may be necessary to facilitate operation, maintenance, repair and rebuilding of the Plant as provided for herein, no such

Information, to the extent it remains confidential, shall be duplicated or the contents thereof disclosed to others except that Owner may furnish copies of such confidential information to contractors or subcontractors as may reasonably be required in the construction, maintenance, repair, or rebuilding of the Plant, provided Owner, in each instance, shall obtain from the contractor or subcontractor an agreement in writing binding such contractor or subcontractor to security obligations at least as strict as those set forth in this Article 24. Equipment and material vendors and purchases therefrom (except for equipment which is designed by Contractor) are excluded from this obligation of Owner to obtain such security agreements. Contractor will provide a vendor listing of sources approved by it for supplying contractor designed equipment from whom Owner may purchase or to whom Owner may disclose, without requesting such security obligations.

(c) Contractor hereby grants to Owner, a paid-up and irrevocable and non-exclusive license to use all technology of any kind (including but not limited to said Information) which is supplied to Owner pursuant to this agreement, for the purposes of the construction, operation, maintenance, repair or other maintenance or rebuilding of the Plant and otherwise to use said technology as provided for elsewhere under this Article 24. Contractor agrees, on behalf of itself and Monsanto

Company and Leonard, not to assert any proprietary rights, other than patent rights, it or they may have anywhere in the world, which would prevent the unrestricted use and sale by Owner or its customers of the sulfuric acid produced in the Plant as constructed hereunder and operated in accordance with Contractor's written operating instructions; provided, however, that, except for patent and patent rights of Contractor, nothing herein shall prevent Owner from making any change in the Plant or from using without restriction any improvement which, at any time, is or has been made, or conceived by or on behalf of Owner or which, at any time, is or has been disclosed to Owner by Contractor or others, or prevent the unrestricted use and sale by Owner or its customers of the sulfuric acid or other product produced in accordance with any such change or improvement. Owner shall have a non-exclusive, paid-up and irrevocable license under any and all patents and patent rights now or hereafter owned by Contractor or Leonard or Monsanto Company or which Contractor or Leonard or Monsanto Company has a right to own, or grant licenses, to construct, operate, maintain, repair or otherwise maintain or rebuild the Plant as constructed hereunder and in accordance with Contractor's operating instruction for the same and to use and sell anywhere in the world the goods produced in the Plant in accordance with such instructions.

(d) Contractor represents and warrants that it has the right to enter into this agreement and that it owes no duty of confidence to any third party with respect to any information disclosed or disclosable hereunder by Contractor to Owner.

ARTICLE 25 - Audit

Owner, or its duly authorized representative, shall have access at all reasonable times, to all books, records, correspondence with vendors and subcontractors, instructions, receipts and vouchers pertaining to the Work under the Agreement for the purpose of auditing the Cost of the Work paid to Contractor. Contractor shall preserve all the above mentioned documents for a period of one year after the acceptance or cessation of the Work.

ARTICLE 26 - Cleaning Up

The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish caused by Contractor's employees or the Work, and at the completion of the Work, Contractor shall remove all the Contractor's rubbish from and about the site and all the Contractor's tools, scaffolding and surplus materials and shall leave the Work "Broom-clean" or its equivalent, unless more exactly specified.

ARTICLE 27 - Structural Steel Prices

If fabricated steel is purchased on a per pound basis, it shall be based on certified scale weights as received at the Plant except where mixed shipments make it impracticable to segregate items having different unit prices, in which case the American Institute of Steel Construction (AISC) rules and practices shall be followed.

ARTICLE 28 - Purchase and Rental of Material and Equipment

Purchase and rental of material and equipment used for construction purposes shall be in accordance with Exhibit B, Schedule of Reimbursable Erection Costs, and Exhibit D. In addition, Contractor agrees to:

(a) Secure in advance where practical the Owner's specific written approval of the final complete form of any rental agreement before renting, or using on a rental basis, any construction equipment other than Contractor's. The Contractor shall endeavor to secure rental agreements from equipment firms that will permit the Owner, at its option to purchase the equipment during the construction period or at its termination, at a price (to be set forth in the agreement), less rental paid (after deducting the amounts, if any, expended by the

lessor for maintenance or repairs during the period the equipment was under rental on this work);

(b) Purchase no tools, equipment or materials used for construction purposes in excess of $5,000 without Owner's prior approval. On each such order, invitations for bids must be extended to a reasonable number of responsible competitive suppliers and purchase is to be made only upon the basis of the most favorable terms offered with respect to price, quantity and delivery, except as otherwise agreed by both parties;

(c) Take reasonable advantage of all discounts, rebates and allowances, including cash discounts, etc., for the benefit of the Owner;

(d) Submit inquiries for proposals and prices to all applicable vendors as listed on the vendors list. Additions or deletions will be by mutual agreement between Contractor and Owner;

(e) Give preference to the Owner's surplus equipment, if available and satisfactory.

ARTICLE 29 - Transportation

If necessary the Owner will confer with the Contractor on

matters of transportation to establish the lowest freight rates for the mutual benefit of both.

GENERAL PROVISIONS

ASARCO, INCORPORATED

and

MONSANTO ENVIRO-CHEM SYSTEMS, INC.

November 19, 1976

Mr. W.A. Bennis
Director of Purchases
New York Purchasing Department
ASARCO, Incorporated
120 Broadway
New York City, New York 10005

SPECIFICATIONS DATED JULY 23, 1976
800 TPD SULFURIC ACID PLANT
EL PASO, TEXAS
EA-26-EP
CE 76-EP-48

MONSANTO ENVIRO-CHEM SPECIFICATION 2102
REVISION 1 TO ORIGINAL PROPOSAL OF 10/29/76

Dear Sir:

Based on our meeting in Salt Lake City with ASARCO technical personnel November 11, 1976, we are pleased to submit the following amendments requested by ASARCO to our proposal dated 10/29/76 for the subject 800 TPD acid plant:

Amendment No. 1

Delete product acid cooler.

Deduct: $69,000 from guaranteed maximum cost.

Amendment No. 2

Move control building inside battery limits.

Deduct: $64,000 from guaranteed maximum cost.

Note: This is the cost difference due to changing the location of the building. A closer examination and better understanding of ASARCO's requirements allows us to reduce the control building size to 20 foot by 70 foot. The cost reduction due to the change in building size is included in Amendment No. 3.

Amendment No. 3

Amend plant per our meeting minutes, (copy attached) excluding Item #2 which is discussed separately below and excluding Items #14 and #4 which correspond to Amendments No. 1 and No. 2 above.

Add: $52,400 to guaranteed maximum cost.

Note: Some of the more significant cost items included in this amendment are Item #3 - Provide pipe trestle on south battery limits; Items #10, #22 and #33 - Add additional cast iron piping for special situations; Item #4 - Reduce size of control building.

Thus our guaranteed maximum cost (exclusive of fee) including Amendments No. 1, No. 2, and No. 3 and including as requested by ASARCO, Alternate No. 1 to our original proposal (recycle type preheater), is:

$11,830,800.

Our fixed fee remains unchanged per our original proposal.

We also confirm that our proposed plant complies without exception to ASARCO's electrical specifications as amended.

As a separate item we have estimated the cost of bussing construction craft personnel over about a half mile distance (Item #2 in the minutes) as opposed to having car parking space available within 500 feet per our proposal. Our

experience has shown this to be a significant cost item not only due to the cost of operating and maintaining busses but also due to the lost time and inefficiencies involved. The estimated cost is $157,000.

ASARCO has agreed to allow us to firm up this number later when exact details are resolved should ASARCO choose to go this route. We are prepared to discuss the development of this estimated cost with ASARCO to assist in making the decision on transporting construction personnel.

In our meeting we discussed briefly the use of H.E.S. Acid Proof Mortar versus Vitrex Mortar. There is no measurable difference in installed cost on this project and so either type may be used.

Under a separate cover we are providing to the ASARCO Central Engineering Department the vendor performance guarantee on the Brink Mist Eliminator with respect to acid mist emissions from the final tower.

An appointment has been set for 9:00 A.M. Monday, November 22 in Salt Lake City to review this revision to our proposal.

Very truly yours,

MONSANTO ENVIRO-CHEM SYSTEMS, INC.

Paul R. Minbiole
Sales Manager

Enclosure

PRM:jb

cc Mr. E.H. Haug
Director of Engineering
ASARCO, Incorporated
500 Crandall Building
Salt Lake City, Utah 84101

Mr. A.O. Marsh
Chief Design Engineer
ASARCO, Incorporated
500 Crandall Building
Salt Lake City, Utah 84101

Mr. L.C. Travis
General Manager
Western Department
ASARCO, Incorporated
120 Broadway
New York City, New York 10005

Mr. W.R. Kelly, Manager
ASARCO, Incorporated
P.O. Box 1111
El Paso, Texas 79999

Mr. A.J. Kroha, Manager
Sulfuric Acid Operations
ASARCO, Incorporated
P.O. Box 5747
Tucson, Arizona 85703

MEETING MINUTES
FOR
NOVEMBER 11, 1976 MEETING IN SALT LAKE CITY
PROPOSED PLANT FOR ASARCO, EL PASO

ASARCO	MONSANTO
W.T. Sweat	C.H. Schwarting
J.R. Shaw	R.M. Fries
W.R. Mahoney	Paul Minbiole (Author)
E.S. Godsey	Douglas R. Hansen
C.J. Terry	
L.F. Scott	
A.J. Kroha	
A.O. Marsh, Jr.	
J.M. Turner	
E.H. Haug (Part Time)	

Note: These minutes were sent to ASARCO Central Engineering Department for review 11/12/76. Monsanto has received tentative verbal agreement on the items as stated.

Footnotes have been subsequently added where required to clarify the basis for Revision 1 dated 11/19/76 to Monsanto's base proposal dated 10/29/76.

PRM
11/19/76

MEETING MINUTES

1. ASARCO wants to know how much lower than the Texas Standards our mist emissions will be. Monsanto will send this in the form of a performance guarantee on the HP Brink Mist Eliminator. Monsanto typically expects less than 1 mg/cubic foot mist and an essentially clear stack.

2. Car parking space will not be available for construction personnel within 500 feet. Bussing will be required over about a half mile distance. It was noted further that laydown area will be somewhat limited, and so good scheduling of deliveries is desired.

3. The pipe trestle[1] on the south battery limits should be provided by Monsanto and have a 24' clearance.

4. Monsanto to provide revised price with control room relocated between towers and water cooling tower. Control room size to be determined by Monsanto to meet ASARCO's stated requirements.[2]

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1 Bent spacing is 25 foot.

2 New size is 20 foot by 70 foot, including provision for 15 foot ASARCO gas cleaning plant control panel and approximately 600 square feet for gas cleaning plant electrical equipment, etc. as before.

5. Delete item by others #28 -- Monsanto will supply lead materials.

6. Regarding main blower

   a) Oil filters should be replacement cartridge type and not cuno self-cleaning type.

   b) Local instruments should be installed in a weatherproof, sunshaded enclosure,[1] not on the blower itself.

   c) Cooling water piping for motors should include a Y-type strainer.

7. Acid gate valves to be Alloyco or Stockham.

8. The gas-to-gas heat exchanger sizes were reviewed.

9. The conversion in each bed was reviewed at 4% and 6% SO_2.

10. The pump tank bottom drains should be tied into the inlet of the product acid transfer pumps so the pump tanks can be emptied into storage.

11. It was confirmed that the storage tanks have bottom plugs.

---

1 Protected from rain, sun, etc.-Closed on 3 sides, open in front.

12. The proposed spare acid pump arrangement is accepted with one starter per pump tank.

13. ASARCO will confirm the material of construction on the acid coolers (and check existing El Paso coolers).

14. Monsanto to give a deduct for deletion of product acid cooler.

15. Monsanto to give additional cost for two more strong acid pump motors. All six acid pumps to be installed initially for testing.

16. Product acid transfer pumps should be Durco, in-line pumps. Pump head is 70' TDH.

17. Acid cooler drain pump is also Durco in-line.

18. Product acid loading pumps are also Durco in-line. Increase capacity from 250 GPM to 300 GPM.

19. 3" line to storage is satisfactory (150 GPM rating).

20. Preheater should be recycle type. Monsanto to verify that recycle fan has water cooled bearings.

21. Monsanto to verify that water cooling tower basin will be sized to hold all runback, and that water strainers are included.

22. Monsanto will add an acid line from the loading pump discharge to the storage tank supply line in order to pump acid out of one storage tank into another.

23. Delete acid supply line to cooling water treatment tank.

24. Stack to be 100' above grade.

25. Delete high level probe and alarms at acid loading stations.

26. Platforming was reviewed. Many platforming decisions must be made after much of the detailed engineering is done.

27. Provide an FRP safety tub in pump tank area. Monsanto will send typical drawing to ASARCO.

28. The preferred construction of the hot (non-stainless) gas duct expansion joints was reviewed.

29. Delete the graphic control panel feature.

30. Princo density recorder controller is now recommended for 93% acid strength measurement and control rather than conductivity.

31. Transmitters for 98% conductivity recorder controllers should be located in the control room rather than outdoors.

32. Add a manually operated acid valve in 93% crossflow line to final absorber pump tank.

33. Add an acid line tying in to product line (to storage) and going to one of the pump tanks so that 98% acid can be pumped back by ASARCO from storage.(1)

34. Monsanto should itemize any exceptions to ASARCO's electrical specifications as amended. ASARCO wants a spirit of cooperation on electrical work. For example, Monsanto should check out the transformer, remove covers, etc.

35. Change SO_2 analyzer range to 0-10% SO_2.

1 Piping and tie-in from 98% product storage system by ASARCO.

36. Add panel mounted ammeters for acid circulating pumps.

37. Change HIC's on blower inlet guide vanes to a PIC,[1] based on maintaining zero inches W.C. at the inlet to ASARCO's gas cooling towers. ASARCO will bring the electrical instrument lead up to our battery limits.

38. Monsanto will include limit switches on the three gas butterfly valves in the main gas stream. A red warning light will come on whenever these valves are in a closed position. This is another "layer" of protection against preheater damage.

39. Add field mounted ammeters on product transfer pumps and product loading pumps.

40. Monsanto will investigate raising the tower outlet drain casting to trap debris in tower rather than in strainer of pump tank.

41. Vendors list items:

#8. Add Tempflex

#20. Alloyco and Stockham only

#21. Add Garseal
Delete Keystone

#29. Delete Louis Allis

#36. Add General Electric
Delete Anixter Bros.

1 PIC is an additional item. Plant will still have option to operate using HIC's on each blower. No automatic surge control included on blowers.

DESIGN BASIS (Cont'd)

E. PROCESS AND UTILITY TIE-INS

Process and utility deliveries to and from acid plant (per Drawing 2102-3-102):

	From Off-Site To	By	Tie-in By
SO_2 Feed Gas	Battery Limits	Others	Enviro-Chem
Cooling Tower Make-Up	Battery Limits	Others	Enviro-Chem
Potable Water	Battery Limits	Others	Enviro-Chem
	Control Building	Others	"
	Acid Loading Area	Others	"
Process Water	Battery Limits	Others	Enviro-Chem
Natural Gas	Battery Limits	Others	Enviro-Chem
Fuel Oil	Battery Limits	Others	Enviro-Chem
Electric Power	Control Building (4160V)	Others	Enviro-Chem
	Acid Loading Area (480V)	Enviro-Chem	"

DESIGN BASIS (cont'd.)

E. PROCESS AND UTILITY TIE-INS (cont'd.)

	From Off-Site To	By	Tie-in By
Compressed Air	Battery Limits	Others	Enviro-Chem
	Control Building	Others	Enviro-Chem
	Acid Loading Area	Others	Enviro-Chem
Fire Protection Water	Battery Limits	Others	Enviro-Chem

	From Acid Plant To	By	Tie-in By
Cooling Tower Blowdown	Battery Limits	Enviro-Chem	Others
Acid Basin Effluent	Battery Limits	Enviro-Chem	Others
Sanitary Wastes	At Control Building	Enviro-Chem	Others
Product Acid	Acid Storage/Loading Area	Enviro-Chem	Enviro-Chem

DESIGN BASIS (cont'd.)

F. SPECIFIC DESIGN CRITERIA

1. Meteorological Data

Dry bulb temperature, °F: 106 maximum

Dry bulb temperature, °F: -5 minimum

Wet bulb temperature, °F: 72
(Cooling Tower Design)

Barometric pressure: 25.8" Hg absolute

2. Elevation

Plant site is at 3800 feet above sea level.

3. Seismic Data

Plant is located in Seismic Zone No. 2.

4. Wind Data

Wind design conforms to Uniform Building Code with lateral wind pressure for the appropriate elevations as follows (base wind pressure 25 psf):

Elevation	Wind Load, PSF
0-30 Ft.	20
31-50 Ft.	25
51-99 Ft.	30
100-and over	40

5. Foundations

ASARCO will remove top 10' to 20' of slag in existing area of proposed acid plant down to level of existing acid plant and rough grading will be provided.

DESIGN BASIS (cont'd.)

F. SPECIFIC DESIGN CRITERIA (cont'd.)

5. Foundations (cont'd.)

The following is the recommendation of our specialist based on evaluation of Sargent, Hauskins & Beckwith soil reports provided by Owner, actual foundation experience in the immediate area, and discussions with construction personnel having many years of working experience in the same general area of the ASARCO plant:

Remove existing fill to a depth of 2' below base of footings. Any zones of loose fill will be removed. Compact cut surface with vibratory roller to densify any loose zones, then bring area to required elevation with properly compacted fill.

All structures will be supported on shallow spread type or mat type foundations designed for a safe soil bearing pressure of 2,500 PSF for dead plus live load condition.

Excavate to native soil in acid storage tank area and replace with engineered fill. Tanks will have a ring foundation with compacted fill designed for a safe bearing pressure of 4,500 PSF.

6. Structural

Concrete is minimum 3000 psi, 28 day strength Portland Cement, Type I.

Steel meets ASTM A-36 requirement, latest revision. Other is as required by design details for equipment.

DESIGN BASIS (cont'd.)

F. SPECIFIC DESIGN CRITERIA (cont'd.)

7. Safety Laws

Occupational Safety and Health Standards, as given in the Federal Register, Volume 37, Title 29, Chapter XVII, Part 1910, dated October 18, 1972.

ITEMS AND SERVICES BY OTHERS

The following are to be furnished by others:

1. Furnish necessary acid, labor, supervision, utilities, raw materials, laboratory facilities and supplies for starting up, testing and operating the plant.

2. Furnish as required the necessary labor, supervision, equipment, laboratory facilities and supplies for the determination of sulfur dioxide content, sulfuric acid mist content and opacity of the exit stack.

3. Provide coordinates, benchmarks and base lines for the design of the plant.

4. Provide field office space and services for Contractor's start-up personnel after contractor's construction is completed.

5. Rough grade plant site prior to start of construction to approximate plant grade.

6. Site for the permanent plant and temporary construction area free and clear of all obstructions above and below grade as required for construction of the plant.

7. Adequate area adjacent to battery limits for temporary construction facilities such as office, warehouse, parking, personnel buildings and material storage.

8. Adequate surface drainage from the site during construction of the plant.

9. Provide a separate construction gate and a guard and maintain adequate access road to the construction and permanent plant areas for passenger vehicles, truck and construction equipment.

ITEMS AND SERVICES BY OTHERS (cont'd)

10. Car parking space for construction personnel within 500 feet of the plant site.

11. Use of railroad siding together with car switching service.

12. Provide topographic and other site data as required.

13. Furnish permanent plant site roads outside battery limits, railroad tracks, and fences.

14. Furnish required 460 volt, 3-phase, 60 Hz electrical power for construction purposes to fused switches located at plant battery limits. Approximate requirement is 600 Amps.

15. Furnish to one point at plant battery limits, water required for construction testing purposes.

16. Furnish a supply of potable water for Contractor's construction forces adjacent to plant site.

17. Unload, store and safeguard materials and equipment as may arrive prior to establishment of Contractor's field organization at the site.

18. Furnish all site permits, licenses, easements, right-of-way and real property for construction and operation of plant.

19. Provide permanent telephone and communication systems.

20. Furnish site fill required.

21. Furnish and install process, utility and related service lines in accordance with the "Design Basis - Process Utilities and Tie-Ins" section of this specification.

ITEMS AND SERVICES BY OTHERS (cont'd)

22. Provide the facilities outside the battery limits related to operation of the plant, including SO_2 supply, handling of product acid at loading docks, and disposal of liquid and sanitary effluents.

23. Furnish spare parts except as specified herein as furnished by contractor.

24. Pipe rack adjacent to south acid plant battery limit for piping, instrument tubing, and wiring as required.

25. Support system for instrument tubing and wiring between south acid plant battery limit and control building.

26. Existing acid pipe trestle suitable for lateral extention by Enviro-Chem for acid product line and electrical feeder from acid plant to acid loading area.

27. Existing acid pipe crossover rack from storage tank area to existing acid loading platform suitable for lateral extention by Enviro-Chem for acid line to new loading platform.

28. ASARCO, Incorporated shall supply for purchase all sheet lead, lead piping, tubing and burning bar, as required.

29. Furnish the following electrical equipment items for acid plant operation (installed by contractor):

    A. One 1500 KVA 4160 volt/480 volt load center unit substation with 200 amp, 4160 volt load break switch (not to be confused with 1500 KVA load center unit substation for gas cleaning plant, etc. to be provided by ASARCO and installed by others in acid plant control building).

ITEMS AND SERVICES BY OTHERS (cont'd)

29. (cont'd)

B. One 5 KV starter line-up consisting of the following motor starter sizes (to be confirmed with final vendor):

(1) Main compressor C01 A, 3500 HP
(2) Main compressor C01 B, 3500 HP
(3) Water cooling tower pump P13A, 400 HP
(4) Water cooling tower pump P13B, 400 HP

NOTE: In addition to these 5 KV motors, the 5 KV starter line-up will include other 5 KV motor starters as required by ASARCO for the gas cleaning plant, etc., supplied by ASARCO and installed by others.

C. One 480 volt motor control center consisting of the following (to be confirmed with final vendor):

- Six No. Size 5 starters
- One No. Size 4 starter
- Twelve No. Size 1 starters

DESCRIPTION OF PLANT

The plant is described in the following subsections (red tabs):

- PROCESS DESIGN
- EQUIPMENT
- INSTRUMENTATION
- UTILITY SUMMARY
- DESIGN STANDARDS,

and is shown on the following descriptive drawings (under the yellow tab marked "Drawings"), subject to those revisions determined advisable by contract as detailed engineering drawings are made:

	Drawing No.	Dated
Plant Layout	2102-3-101	10/15/76
Site Plan	2102-3-102	10/15/76
Gas Flow Diagram	2102-3-103	10/15/76
Strong Acid Flow Diagram	2102-3-104	10/15/76

DESCRIPTION OF PLANT
- PROCESS DESIGN

A general description of the process and plant is as follows:

The process consists of three (3) principle steps:

1. Drying of the sulfur dioxide gas from the gas purification system.

2. Conversion of sulfur dioxide gas to sulfur trioxide gas.

3. Absorption of the sulfur trioxide gas in sulfuric acid.

Sulfur dioxide bearing gases from the gas purification system are received at the drying tower inlet. The process gas has been purified and cooled by equipment designed by the Owner and is to be relatively free of solids and acid mist.

The process gas passes through the packed drying tower countercurrent to a flow of 93% H_2SO_4 to remove water vapor contained in the gas. Sufficient acid is circulated over the tower so that the water vapor removed does not significantly reduce the strength of the acid in a single pass over the tower. Entrained acid in the gas is removed by an externally removable mist eliminator pad installed in the top section of this tower.

Gas from the drying tower is compressed in the main compressors and forced through the remainder of the plant. From the main plant compressors, the gas flows through a mist eliminator vessel where any agglomerated acid mist is removed with a teflon mesh pad, and through the shell side of two gas heat exchangers arranged in series (cold heat exchanger and hot heat exchanger) where the gas is heated to that temperature required for the catalytic conversion of SO_2 to SO_3 in the converter.

DESCRIPTION OF PLANT
- PROCESS DESIGN (cont'd.)

The gas which is at the proper temperature for the catalytic conversion of SO_2 to SO_3 then flows to the first converter pass where the sulfur dioxide is partially converted to sulfur trioxide in the presence of Monsanto Enviro-Chem's vanadium pentoxide catalyst. The conversion reaction consumes oxygen and produces heat.

Hot gas leaving the first converter pass splits and flows to the tube sides of the hot and hot interpass heat exchangers, where it is cooled by the SO_2 gas passing through the shell sides, and then recombines and flows to the second converter pass.

In the second converter pass, additional conversion of sulfur dioxide to sulfur trioxide takes place, accompanied by the generation of additional heat.

Hot gas leaving the second converter pass is then cooled by passing through the tube side of the cold interpass heat exchanger. The gas then goes to the interpass absorption tower where the SO_3 is absorbed. The process gas with acid mist then passes through a High Efficiency Brink Mist Eliminator located in the top of the interpass absorbing tower. The acid mist particles present in the gas are almost completely removed by the mist eliminator. The gas then passes back through the shell side of first the cold interpass heat exchanger and then the hot interpass heat exchanger before entering the third converter pass. On leaving the third converter pass, the gas flows through the tube side of the cold heat exchanger where it is cooled.

After leaving the tube side of the cold heat exchanger, the SO_3 gas passes to the final absorbing tower. The gas passes through the packed absorbing tower countercurrent to a flow of 98% H_2SO_4 which absorbs the SO_3 contained in the process gas. Sufficient acid is circulated over the tower so that the SO_3 absorbed does not significantly increase the strength of the acid in a single pass over the tower.

DESCRIPTION OF PLANT
- PROCESS DESIGN (cont'd.)

After the absorption has been completed, the process gas passes through a High Performance Brink Mist Eliminator. The acid mist particles present in the gas are almost completely removed by the mist eliminator.

The gas now passes through a duct to an offset stack and then to the atmosphere.

In order to allow autothermal operation down to 4% SO_2 gas strength without drip acid formation in the cold and cold interpass heat exchangers, the plant is designed with an interpass bypassing feature. With this feature, a portion of the SO_3 gas leaving the second pass bypasses the interpass heat exchanger and absorbing tower and mixes directly with the other portion of gas that passes through the interpass system. The combined gas flow then enters the third pass for the final conversion step. This results in reduced external heat loss to the interpass acid coolers and reduced interpass heat exchanger size. Due to the bypassing of some of the SO_3 into the third (final) conversion pass, additional catalyst is required in the third pass to achieve the required SO_2 emission level.

The start-up preheater is connected into the system between the main compressor and the cold heat exchanger. By opening the valves to the preheater, air can be pulled through the drying tower and heated so it can preheat the catalyst in the converter and the converter heat exchangers. Once these systems are up to the temperature required for the catalytic conversion of SO_2 to SO_3, the preheater can be shut down and valved off for normal operations. The preheater may also be used to supplement the heat requirements of the converter system if an operating upset or low SO_2 gas strength reduces the heat available from the conversion reaction. The preheater is designed for high efficiency to minimize fuel consumption. Ducts are provided to supply preheated air directly to the first and third passes.

DESCRIPTION OF PLANT
- PROCESS DESIGN (cont'd.)

Bypass systems are provided in the converter heat exchanger system to control the inlet temperatures to the individual converter passes.

The strong acid circulating systems used to dry the SO_2 gas from the purification system and to absorb the SO_3 gas from the converter system are separate systems, each with a pump tank, circulating pump, coolers and piping system. They are interconnected to permit control of drying and absorbing acid concentrations.

The acid circulated over the drying tower is weakened by the water vapor removed from the SO_2 gas, while the acid circulated over the interpass and final absorbing towers is strengthened by the absorption of the SO_3 gas. To control these strengths, acid interchange is necessary between the 93% acid and 98% acid systems. Interpass absorber acid is pumped to the drying acid pump tank and drying acid flows by gravity to the interpass and final absorbing acid pump tanks. The interpass and final acid pump tank are connected by an underflow so acid flows from the final tank to the interpass tank as acid is produced in the final absorbing tower. Additional water is added as necessary directly to the final absorbing tower acid pump tank.

The dilution of the drying acid by the water vapor from the process gas and the addition of 98% acid to the drying acid pump tank raises the temperature of the acid. To reduce the temperature, the drying acid is circulated through coolers where cooling tower water removes the heat.

In the interpass and final absorbing towers, the SO_3 does not combine directly with water; but must be combined indirectly by absorbing it in sulfuric acid where the SO_3 reacts with water in the acid. The temperature of the 98% acid circulated over the towers increases due to the heat of formation and the sensible heat of the gas stream entering the towers. Acid from the bottom of the towers is circulated through coolers and returned to the top of the towers.

DESCRIPTION OF PLANT
- PROCESS DESIGN (cont'd.)

Product 93% acid is removed from the drying tower acid circulating loop, and is introduced into the top of the product acid stripper. Residual SO_2 is stripped out by air as the acid passes down through the tower packing. The air-SO_2 exhaust stream goes to the stack and the 93% product acid is pumped through the 93% product acid cooler to storage.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION

NO. REQUIRED	EQUIPMENT & DESCRIPTION
2	MAIN COMPRESSOR

Each compressor is a single stage centrifugal type with 4160 volt, 3 phase, 60 Hz water cooled motor drives. Combined capacity of the two (2) compressors operating in parallel is 103,500 SCFM of gas at inlet conditions of 120°F and -26" w.c. and discharge pressure of 217" w.c. The above conditions represent a combined volume capacity 15% greater than design plant volume capacity and discharge pressure 30% greater than clean plant requirement. When operated alone, each compressor handles 54,000 SCFM of gas, which is 60% of plant design volume capacity.

Compressor system complies with ASARCO "Motor Driven Blower" Specification, Appendix "A" of Sulfuric Acid Plant Specification dated 7/23/76, to include main compressors (blowers), drive motor, gear drive, common base plate and support frame for components, oil lubricating system (separate for each blower with two pumps, one shaft driven and one electric motor driven), protective systems, all necessary accessories for complete integrated unit and inlet guide vanes adjustable from the main control panel.

Motor and oil coolers are water cooled, with backwash system for washing out motor cooling coils. Protective system for compressor includes both local alarm panel and remote alarm on the control room main panel.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
	MAIN COMPRESSOR (cont'd.) Isolation gate valves on the inlet and discharge of each blower and removable spool piece in the suction line of each blower are provided to facilitate maintenance. Detailed vendor information required in ASARCO Appendix "A", Section 7.0 and Exhibit Form "A", is available.
1	COLD HEAT EXCHANGER Two (2) vertical heat exchanger shells in series with steel shell and A-178 steel tubes. Colder shell is 13'9" diameter, single pass with 2" O. D. by 17' long 10 gauge tubes. Warmer shell is 17'0" diameter, three (3) pass with 1.5" O. D. by 33' long 10 gauge tubes. Top vestibule of warmer shell is metallized.
1	HOT HEAT EXCHANGER A single vertical, heat exchanger with steel shell and alonized A-178 steel tubes. Shell is 12'3" diameter, single pass, with 2" O. D. by 19' long tubes. Top and bottom vestibules are metallized.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	COLD INTERPASS EXCHANGER Two vertical, heat exchanger shells in series with steel shell and A-178 steel tubes. Each shell is 13'3" diameter, 2 pass, with 1.75" O. D. by 29' long 10 gauge tubes. Top vestibule of warmer shell is metallized.
1	HOT INTERPASS EXCHANGER A single vertical heat exchanger with steel shell and alonized A-178 steel tubes. Shell is 8'0" diameter, single pass, with 1.5" O. D. by 14' long tubes. Top and bottom vestibules are metallized.
1	CONVERTER Vertical, cylindrical steel vessel, 39'0" I. D. shell, Monsanto Enviro-Chem 3 pass design, with a solid welded steel division plate between the 2nd and 3rd passes. The first pass catalyst is supported on Meehanite Type HR grids while all other layers are supported on Meehanite GE-30 grids. The first and second catalyst passes have a 4-1/2" thick high temperature firebrick lining inside the steel shell from the catalyst support grid to 6" above the top of the catalyst bed. The division plate betwen the first and second passes is also brick lined.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
	CONVERTER (cont'd.)
	All internal steel surfaces except behind the brickwork and on the bottom plate are metallized. Shell plate steel in high temperature area of first pass is A-515 grade 70 steel.
	Catalyst loading of Monsanto Enviro-Chem vanadium catalyst is as follows:
	1st pass: 74,300 liters, Type 210 2nd pass: 78,500 liters, Type 210 3rd pass: 112,400 liters, Type 11 Total 265,200 liters
	All catalyst layers will have 2" layers of quartz pebbles on top and bottom.
	Access platforms and ladders are provided at all manholes on the converter shell. Extra large manholes are provided for easy accesss - two 4 foot diameter manholes on top and seven 3 foot diameter manholes on the side wall.
1	DRYING TOWER
	Vertical, acid brick-lined, steel tank, 22'6" I. D. brick. Tower packing consists of a bottom support layer of 6" ceramic cross partition rings, a 12' section of dumped 3" ceramic Intalox saddles, and

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
	DRYING TOWER (cont'd.)
	a packed spray catcher section above the acid distributor points with 6" of 3" Intalox saddles, 4" of 2" Intalox saddles, and 6" of 1-1/2" Intalox saddles. Packing is supported on Aludur grid bars. Acid is distributed through cast iron weir troughs above the packing with submerged discharge through closed downspouts.
	A Pecora mastic and teflon lining is provided between the steel shell and acid brick. The tower has a dished bottom with 7-1/2" thick brick lining and bottom acid outlet with vortex breaker.
1	DRYING TOWER MIST ELIMINATOR
	Teflon woven mesh, single stage mist eliminator pad, 6" thick, housed in a reduced diameter top section of the tower. The mesh pad assembly is specially constructed to allow removal and replacement of the mesh pad sections through openings on opposite sides of the housing with no entry into the housing required. The top dome of the housing and gas outlet elbow is 304 SS to minimize sulfate dropping onto the horizontal mesh pad.
1	INTERPASS ABSORBING TOWER
	Vertical acid brick-lined steel tank, 18'3" I. D. brick. Tower packing, acid distributor, and packing support are similar to drying tower described above.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
	INTERPASS ABSORBING TOWER (cont'd.) A Pecora mastic and teflon lining is provided between the steel shell and acid brick. The tower has a dished bottom with 7-1/2" thick brick lining and bottom acid outlet with vortex breaker.
1	INTERPASS ABSORBING TOWER MIST ELIMINATOR High Efficiency Brink Mist Eliminator consisting of 32-10' long inverted cylindrical type glass fiber packed elements fabricated of 316 SS and mounted on a 316 SS tube sheet in the top of the interpass absorbing tower.
1	FINAL ABSORBING TOWER Vertical, acid brick-lined steel tank, 20'6" I. D. brick. Tower packing, acid distributor, and packing support is similar to the interpass absorbing tower described above, except 14' instead of 12' of 3" dumped ceramic Intalox saddles are provided. A Pecora mastic and teflon lining is provided between the steel shell and acid brick. The tower has a dished bottom with 7-1/2" thick brick lining and bottom acid outlet with vortex breaker. The tower has an offset outlet gas connection to the tail gas stack.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	FINAL ABSORBING TOWER MIST ELIMINATOR High Performance Brink Mist Elininator consisting of 14-6' long inverted cylindrical type glass fiber packed elements fabricated of 316 SS and mounted on a 316 SS tube sheet in a reduced diameter section at the top of the final absorbing tower.
1	PRODUCT STRIPPING TOWER Vertical cast iron tower 3'0" I.D. shell. Tower packing consists of 14' of 2" dumped ceramic Intalox saddles and a packed spray catcher section above the acid distributor points with 12" of 1-1/2" Intalox saddles. Packing is supported on a proprietary Aludur support plant and acid is distributed by a cast iron pipe type distributor. A 6" thick teflon mesh pad mist eliminator is provided in top of the tower.

NOTE: An acid resistant curbed basin is provided under all four above towers with a drain to an effluent collection sump to localize and collect spills. A strainer with Alloy 20 screen is provided at the acid outlet of the three main towers to protect the circulating pumps and coolers from drainage by brick and packing chips. A wash-out spool and drain elbow for wash-down are included for the drying tower piping system.

DESCRIPTION OF EQUIPMENT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	MIST ELIMINATOR VESSEL Vertical, cylindrical tank, 15'5" I. D. brick, with dished bottom and domed top. Bottom portion up to mist eliminator is acid brick-lined steel while upper portion above mist eliminator and outlet elbow is 304SS . Unit is installed after blower discharge to remove any acid droplets before gas enters cold heat exchanger.
1	MAIN BLOWER DISCHARGE SPRAY CATCHER Single stage, woven teflon mesh pad, 8" thick, mounted on Alloy 20 supports inside the above mist eliminator vessel.
1	DRYING TOWER PUMP TANK Vertical, acid brick-lined steel closed tank, 14'10" I.D. brick by 12' high with externally stiffened flat roof and dished bottom. Tank has ample capacity to hold contents of the acid cooler, drying tower hold-up, and piping system on top of the normal operating liquid level. A Pecora mastic and teflon lining is provided between the steel shell and acid brick.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	INTERPASS ABSORBING TOWER PUMP TANK Vertical, acid brick-lined steel closed tank 13'0" I.D. brick by 12' high with externally stiffened flat roof and dished bottom. Tank has ample capacity to hold contents of the acid cooler, interpass absorbing tower hold-up, and piping system on top of the normal operating liquid level. A Pecora mastic and teflon lining is provided between the steel shell and acid brick.
1	FINAL ABSORBING TOWER PUMP TANK Vertical, acid brick-lined steel closed tank, 14' 10" I. D. brick by 12' high with externally stiffened flat roof and dished bottom. Tank has ample capacity to hold contents of the acid cooler, final absorbing tower hold-up, and piping system on top of normal operating liquid level. A Pecora mastic and teflon lining is provided between the acid brick and steel shell.

NOTE: All three above pump tanks are mounted on concrete footings to allow visual inspection and access for repair. An acid resistant curbed basin is provided under all three pump tanks with a drain to an effluent collection sump to localize and collect spills.

All three pump tanks have spare pump mounting nozzle, pipe connection, valves and electrical connection to allow complete installation of the spare pump without shutdown of the operating pump.

CONTRACT AGREEMENT

BETWEEN

ASARCO, INCORPORATED

and

MONSANTO ENVIRO-CHEM SYSTEMS, INC.

for

NUMBER TWO SULFURIC ACID PLANT

EL PASO, TEXAS

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EXHIBIT A

SPECIFICATION 2102

ASARCO - El Paso

800 Ton/Day Plant

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DESIGN BASIS

A. PLANT PERFORMANCE

The design basis capacity of the plant is 800 short tons per day of H_2SO_4 (100% basis) when supplied with 90,000 SCFM (dry basis) of process gas containing approximately 4.5% SO_2 (dry) at the drying tower inlet.

The maximum design capacity of the plant is 1050 short tons per day of H_2SO_4 (100% basis) when supplied with 90,000 SCFM of process gas containing 6.0% SO_2 (dry) at the drying tower inlet.

The acid plant is designed to operate autothermally at 90,000 SCFM (dry basis), 4% SO_2 on a continuous basis.

The exit gas contains less than 500 ppm SO_2 (including SO_2 in exhaust air from product stripper) when supplied with a maximum of 90,000 SCFM (dry) of gas containing from 4% SO_2 and 13.5% O_2 to 6% SO_2 and 10.5% O_2 (all on dry basis).

The exit gas under the above conditions has maximum opacity of 15% and a maximum acid mist emission of 51 pounds per hour H_2SO_4. (This is based on our calculation of Texas Regulation II - Control of Air Pollution from Toxic Compounds adopted January 26, 1972 and amended January 30, 1975 as reported in Environment Report, published by the Bureau of National Affairs).

B. RAW MATERIALS

Feed to the acid plant consists of lead sinter plant, copper roaster plant, and copper converter gases containing 4% to 6% SO_2 volume and 13.5% to 10.5% O_2 by volume (dry basis).

Feed gas is delivered after gas purification to the inlet of the drying tower at the following conditions:

DESIGN BASIS (cont'd.)

B. RAW MATERIALS (cont'd.)

Temperature	90°F
Water Vapor Content	5.6% H_2O (wet basis) - Saturated
Dust Content	Negligible
Impurities	Negligible
Pressure	-10" H_2O

C. PRODUCT ACID

Black 93% sulfuric acid at less than 60 ppm SO_2 and 110°F.

D. UTILITIES

Plant design is based upon a constant adequate supply by Owner of the following utilities:

1. Cooling Tower Make-Up

From Owner's main at required pressure and a maximum temperature of 90°F. Typical analysis:

Calcium Hardness as $CaCO_3$	24-28	ppm
Mg Hardness as $CaCO_3$	6-68	ppm
Phenolphthalein Alkalinity as $CaCO_3$	0-20	ppm
Methyl Orange Alkalinity as $CaCO_3$	74-70	ppm
Sulfate as Na_2SO_4	82-270	ppm
Chloride as NaCl	50-150	ppm
Silica as SiO_2	31-17	ppm
pH	8.1-8.7	ppm

2. Potable Water

From Owner's main at required pressure.

DESIGN BASIS (Cont'd)

D. UTILITIES (Cont'd)

3. Process Water

From Owner's main at required pressure.

4. Fuel

Natural Gas with 1050 BTU/SCF HHV at 15 psig and No. 2 fuel oil at 125 psig.

5. Electric Power

Three phase, 60 Hz, 4160 volt protected at its source.

6. Effluent Treatment

As required to treat cooling tower blowdown and plant drainage.

7. Compressed Air

From Owner's main at 90 psig.

8. Fire Protection Water

From Owner's main at required pressure.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	DRYING TOWER ACID COOLER Horizontal, anodically protected, shell and tube heat exchanger with 316 SS shell and tubes. Cooler is designed to cool 2800 gpm of 93% H_2SO_4 to 120°F using cooling tower water supplied at 80°F.
1	INTERPASS ABSORBING TOWER ACID COOLER Horizontal, anodically protected, shell and tube heat exchanger with Alloy 20 tubes and 304L SS shell. Cooler is designed to cool 2650 gpm of 98% H_2SO_4 to 180°F using cooling tower water supplied at 80°F.
1	FINAL ABSORBING TOWER COOLER Horizontal, anodically protected, shell and tube heat exchanger with Alloy 20 tubes and 304L SS shell. Cooler is designed to cool 2900 gpm of 98% H_2SO_4 to 175°F using cooling tower water supplied at 80°F.
1	93% PRODUCT ACID COOLER Horizontal, anodically protected shell and tube heat exchanger with 316L SS shell and tubes. Cooler is designed to cool 150 gpm of 93% product acid to 110°F using cooling tower water supplied at 80°F.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
2	DRYING TOWER ACID PUMP Vertical, centrifugal, corrosion resistant, submerged pump, Lewis size 8, with capacity of 2900 gpm of 93% H_2SO_4 at approximately 70' TDH. Pump is driven by 460 volt TEFC motor. One pump is an uninstalled spare.
2	INTERPASS ABSORBING TOWER ACID PUMP Vertical, centrifugal, corrosion resistant, submerged pump, Lewis size 8, with capacity of 2650 gpm of 98% H_2SO_4 at approximately 70' TDH. Pump is driven by 460 volt TEFC motor. One pump is an uninstalled spare.
2	FINAL ABSORBING TOWER ACID PUMP Vertical, centrifugal, corrosion resistant, submerged pump, Lewis size 8, with capacity of 2900 gpm of 98% H_2SO_4 at approximately 70' TDH. Pump is driven by 460 volt TEFC motor. One pump is an uninstalled spare.

NOTE: All three above pairs of acid circulating pumps have stray current grounding systems, Teflon shaft sleeves, and cap nuts. A monorail system with electric hoist is provided for maintenance of all the above pumps and for installing any of the spare pumps combined with the one common spare motor.

All six Lewis pumps are identical (type, size, material specification, motor horsepower, impeller, etc.)

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
2	PRODUCT ACID TRANSFER PUMP Horizontal, Alloy 20 corrosion resistant centrifugal pump with reliable mechanical shaft real. Capacity is 120 gpm of 93% H_2SO_4 at 140' TDH. One pump is an installed spare. Pump transfers product acid from product stripper to product storage tanks.
1	ACID COOLER DRAIN PUMP Horizontal, Alloy 20 corrosion resistant, centrifugal pump with capacity of 100 gpm of acid at 50' TDH. Pump drains all strong acid coolers. Operation is intermittent.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
2	COOLING TOWER WATER PUMP Vertical, submerged turbine pump, with capacity of 11,200 gpm at approximately 110' TDH. Pump circulates cooling water from cooling tower through all acid plant and gas purification coolers back to the top of the tower. One pump is an installed spare. Pump is driven by 4160 volt TEFC motor.
3	PRODUCT LOADING PUMP Horizontal, Alloy 20 corrosion resistant, centrifugal pump with capacity of 250 gpm at 60' TDH. One pump supplies product acid from storage to tank cars, one pump supplies tank trucks, and one pump is a common installed spare.
2	EFFLUENT PUMP Vertical, submerged, corrosion resistant sump pump with capacity of 30 gpm at 50' TDH. Pumps are installed in duplex arrangement and controlled by stepped float switches with alternator. Pumps transfer effluent collected from curbed basins around acid pump tanks and towers to effluent treatment tanks.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	PRODUCT STRIPPER FAN Centrifugal fan with capacity to deliver 1300 ACFM of atmospheric air to the product stripper at 12" w. c. discharge pressure.
4	ACID STORAGE TANKS Vertical mild steel tanks 60' diameter by 39' high with a capacity of 6000 tons each, for 93% acid storage. Tanks are erected on ring type foundations.
1	PREHEATER Indirect fired, shell and tube heat exchanger with 75% to 80% overall thermal efficiency. Exchanger tubes are 304 SS. Unit has capacity to heat 22,500 SCFM (25% of acid plant design capacity) of start-up air or 0 to 6% SO_2 process gas from 100°F to 950°F using natural gas or No. 2 fuel oil. The burner system is equipped with safety "flame out" protection and complies with Factory Mutual Association standards. Exit stack discharges at least 6 feet above the nearest heat exchanger. Turndown capability is approximately 10 to 1 on gas and 6 to 1 on oil. Preheater has shutdown interlock for low process gas flow.
ALTERNATE	Alternate preheater is the same duty and construction as above, except a combustion gas recycle fan system is added to increase overall thermal efficiency to 87%.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	WATER COOLING TOWER Mechanical, indirect draft of counterflow, two-cell cooling tower capable of cooling 11,200 gpm of cooling water from 110°F to 80°F with 72°F maximum wet bulb temperature. Tower capacity includes 3000 gpm or 750,000 BTU/minute heat load at design water temperatures for the gas purification system. Cooling tower equipment, materials and construction are in accordance with ASARCO cooling tower specification, Appendix "B" of Sulfuric Acid Plant Specifications dated 7/23/76, using treated Douglas Fir lumber alternate, and based on ASARCO verbal approval of the following features: single cement asbestos board casing to prevent leakage, fiberglass fan blades for corrosion resistance, and 30 mil coal tar epoxy coating of exposed steel.
1	COOLING WATER TREATMENT SYSTEM Package system, consisting of four stainless steel feed tanks and pumps for addition of non-toxic corrosion inhibitor, dispersant, and caustic/sulfuric acid for pH control. Caustic/sulfuric addition is automatically controlled with high/low pH alarm in control room. Treatment is based upon review with the existing consultant used by ASARCO at El Paso for this purpose.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	ACID PLANT STACK Offset steel stack, 9'0" I. D., mounted on platform between interpass and final absorbing towers, discharging 85' above grade. An EPA sampling station and platform is provided on the stack. An acid drip line is installed to return acid to absorption tower pump tank.
1	ACID LOADING PLATFORM A new walkway is installed from the existing loading platform to a new platform with one additional truck and four additional car loading stations. Both cars and trucks can be loaded simultaneously. All tank car loading stations are provided with a probing device to warn when cars are about full (warning light for each station and common horn).
1	INSTRUMENT AIR DRYER Two (2) bed dessicant regenerative type dryer with capacity to dry 100 scfm of plant compressed air at 90 psig and 100°F to -40°F dewpoint. Unit includes an upstream oil absorber. Unit is to supply all instrument air required for the new acid plant.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

NO. REQUIRED	EQUIPMENT & DESCRIPTION
1	EFFLUENT SUMP 5' long by 4' wide by 7' deep rectangular acid brick lined concrete pit with FRP cover. Sump collects drainage from acid pump tank and tower basins.
	PLATFORM & STAIRS Platforms, stairs, ladders, handrails and walkways are provided to permit easy and safe access to all portions of the plant frequented by operators. Design conforms to latest OSHA requirements.
	SAFETY Safety showers and eyewash stations are located at acid pump tanks on platforming, at ground level, on acid tower platforms, and on acid loading platform.
	FIRE PROTECTION SYSTEM A fire hydrant is supplied in the vicinity of the water cooling tower, along with fire hose and accessories. Four permanent portable fire extinguishers are also provided.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

EQUIPMENT & DESCRIPTION

INSULATION

Outer surfaces of the converter, all gas heat exchangers and interconnecting main and bypass ducts for these vessels are insulated with mesh reinforced mineral wool blanket. Insulation is covered with metallic strapped aluminum jacketing.

YARD LIGHTING

Yard lighting for acid plant, including cooling tower area, along with auxiliary circuits are provided. Luminaires for walkways, platforms, safety shower locations, stairways and general plant areas are mercury lamps similar to Crouse-Hinds low voltage mercury lamp fixtures or high pressure sodium vapor lighting where economic. Lighting is designed to avoid "spot lighting" even if this results in an illumination level higher than required. Yard lighting is at a level of approximately 15 foot candles.

SITE SURFACING

Site surfacing consists of 4 inch crushed stone within acid plant battery limits.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

EQUIPMENT & DESCRIPTION

METALLIZING

The following items are metallized with a 6-10 mil aluminum coating:

1. Vessels

   a. Exposed interior of converter shell except bottom plate.

   b. Inlet and outlet vestibules of hot and hot interpass heat exchangers.

   c. Top vestibule of cold and cold interpass heat exchangers, hotter shells.

2. Ducts

   a. Hot heat exchanger outlet to converter inlet.

   b. First pass converter outlet to hot exchanger inlet.

   c. Hot exchanger outlet to second pass converter inlet.

   d. First pass converter outlet to hot interpass exchanger inlet.

   e. Hot interpass exchanger outlet to second pass converter inlet.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

EQUIPMENT & DESCRIPTION

METALLIZING (cont'd.)

2. Ducts (cont'd.)

f. Second pass converter outlet to cold interpass exchanger inlet.

g. Hot interpass exchanger outlet to third pass converter inlet.

h. Third pass converter outlet to cold exchanger inlet.

DUCTS

All major ducts are 6'0" I.D. and of welded steel plate. Ducts operating at temperatures of 1000°F or higher are A-515 Grade 70 plate. All other gas ducts are 1/4" A-36 plate.

Butterfly type gas valves are of Enviro-Chem design for the required temperature service and designed to minimize gland corrosion and sulfation.

Adequate expansion joints are provided to permit duct movements without severe reactions into the plant vessels. Expansion joints are welded with insulation and rain shields (as required). High temperature expansion joints (above 850°F) are welded flanged with spool pieces provided in ductwork to allow ease of replacement, otherwise stainless steel bellows type are used in severe service.

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd.)

EQUIPMENT & DESCRIPTION

ACID PIPING & VALVES

Cast iron acid piping is centrifugally cast pipe. All the general quality and metallurgical provisions of the U. S. Government Federal Specification WWP-421C, ASA-A-21.6 and ASTM A377 will apply. Wall thickness complies with AWWA Specification of 1908, Class B. Pipe fittings are B16.1-1948, or latest revision. Valves are flanged FA-20, Subscript "A" Alloy valves with OS&Y construction, flanged and faced with teflon packing and teflon bonnet gaskets equipped with splash shields. Flange joints are shrouded with plastic to prevent pressure leak hazards. Asbestos gaskets to be Garlock 7021 and 900 Series or equal. All butterfly valves are Garseal or Centerline or have equivalent face-to-face dimensions to be compatible with existing El Paso site spares (2" to 12" sizes).

DESCRIPTION OF PLANT
- EQUIPMENT DESCRIPTION (cont'd)

EQUIPMENT & DESCRIPTION

CONTROL BUILDING

A 30 foot by 80 foot concrete block building is provided to house an instrument control room, motor control and electrical equipment room, lab testing area, and toilet facility. The instrument control room has space for an additional 15 foot extension of the panel system for additional instrumentation serving the gas purification system. Space (approximately 30 foot by 20 foot) is also provided for gas cleaning plant electrical equipment furnished by others, including 1500 KVA load center unit substation, a motor control center, and four electrostatic precipitator control panels. The instrument control room and the electrical equipment room are air conditioned.

DESCRIPTION OF PLANT
- INSTRUMENTATION

Instrumentation is furnished to simplify and facilitate plant operations. Instrumentation is pneumatic (with some electric motor operated gas control valves) and generally as shown on the Gas and Strong Acid Flow Diagrams.

Plant is designed for remote operation from the main control room located approximately 100' south of the acid plant battery limits.

Instrumentation is installed on a free standing graphic panel. New panel allows for a 15' extension for placement of the gas purification system instruments. Temperatures are indicated and recorded in °C units. All instruments have linear scale readout.

The following description applies to the instrumentation system for this project:

1. Panel Mounted Instruments on Central Control Panel

TR - Multipoint, potentiometric, strip chart temperature recorder with range of 0° to 650°C.

Point No.	LOCATION
1	Gas entering 1st pass converter
2	Gas leaving 1st pass converter
3	Gas entering 2nd pass converter
4	Gas leaving 2nd pass converter
5	Gas entering 3rd pass converter
6	Gas leaving 3rd pass converter
7	Cooling water supply
8-12	Spare

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1. Panel Mounted Instruments on Central Control Panel (cont'd.)

TI - Multipoint, digital temperature indicator, range 0 to 700°C with selector switches

Point No.	LOCATION
1	Gas entering 1st pass converter
2	Gas leaving 1st pass converter
3	Gas entering 2nd pass converter
4	Gas leaving 2nd pass converter
5	Gas entering 3rd pass converter
6	Gas leaving 3rd pass converter
7	Gas leaving hot heat exchanger tube side
8	Gas leaving hot interpass heat exchanger (tube side)
9	Gas leaving preheater heat exchanger
10	Gas leaving main compressor
11	Gas leaving cold interpass heat exchanger tube side
12	Gas leaving cold heat exchanger tube side
13	Gas leaving cold interpass heat exchanger shell side
14	Gas leaving cold interpass heat exchanger shell side
15	Acid entering drying tower
16	Acid entering interpass absorbing tower
17	Acid entering final absorbing tower
18	Acid entering product stripper
19	Spare
20	Spare

CRC - Interpass absorbing tower acid concentration recorder: continuous recording strip chart, with a range of 96.5 to 99.5%, complete with a Teflon lined conductivity cell. Controls flow of drying tower crossflow acid to interpass absorbing system.

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1. Panel Mounted Instruments on Central Control Panel (cont'd.)

CRC - Final absorbing tower acid concentration recorder: continuous recording strip chart, with a range of 96.5 to 99.5%, complete with a Teflon lined conductivity cell. Controls flow of dilution water to final absorbing system.

CRC - Drying tower acid concentration recorder and controller: continuous recording strip chart; with a range of 92 to 95%, complete with a Teflon lined conductivity cell. Controls flow of absorbing tower acid to drying tower pump tank.

LIC - Interpass absorbing tower acid pump tank level indicator and controller, differential pressure type, with dip tube submerged in acid to be measured. The range shall be 4 inches to 144 inches. Instrument indicates level in interpass tower and final absorbing tower pump tanks also since both pump tanks are connected by underflow pipe. Controls flow of drying tower cross flow acid to interpass and final tower pump tanks.

LIC - Drying tower pump tank level indicator and controller, differential pressure type, with dip tube submerged in acid instrument indicates level to be measured. The range shall be 4 inches to 144 inches in drying tower pump tank. Controls flow of 93% product acid to storage.

TIC - Final absorbing tower acid inlet temperature indicator and controller, controlling final tower acid cooler bypass flow. The range is 0 to 120°C.

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1 Panel Mounted Instruments on Central Control Panel (cont'd.)

TIC - Converter 1st pass inlet gas temperature indicator controller, controlling cold quench gas bypass valve. The range is 0 to 700°C.

LI - Acid storage tanks level indicator (one for each of four tanks), differential pressure type, with drip tube submerged in acid. The range is 4 inches to 480 inches.

FI - Acid flow indicator: flow meter for acid to drying tower with adjustable range pressure switches for alarm on low acid flow. The range is 0 to 4,000 gal/minute of acid.

FI - Acid flow indicator: flow meter for acid to interpass absorbing tower with adjustable range pressure switch for alarm on low acid flow. The range is 0 to 4,000 gal/minute of acid.

FI - Acid flow indicator: flow meter for acid to final absorbing tower with adjustable range pressure switch for alarm on low acid flow. The range is 0 to 4,000 gal/minute of acid.

FR - Gas flow recorder - flow meter for process gas from main compressor. Range is up to 120,000 scfm of process gas.

PI - Pressure indicator, main compressor discharge, range 0 to 250 inches w. c.

PI - Pressure indicator, main compressor inlet, range minus 40 to 0 inches w. c.

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1. Panel Mounted Instruments on Central Control Panel (cont'd.)

LIC - Cooling tower cold well, pressure differential type, with dip tube submerged in water to be measured. The instrument indicates level to be measured and controls make-up water flow to the cooling towers.

AR (SO_2) - SO_2 gas analyzer: sampling, analyzing and recording system with totallizing integrator. The recorder has a range of 0 to 15%.

II - Current indicator: ammeter

Main Compressors CO_1 A and B

ARC (pH) - Cooling tower water, controlling caustic/ sulfuric acid feed.

AR (Stack SO_2) - SO_2 gas analyzer: sampling, analyzing and recording system. The recorder shall have a range of 0 to 1000 ppm.

HIC - Hand indicating controller: to control gas and acid valves:

Point No.	LOCATION
1	By-pass for cold interpass heat exchanger
2	Entrance to cold heat exchanger
3 & 4	Main compressor discharge gate valves
5 & 6	Main compressor suction gate valves and
7 & 8	Main compressor inlet guide vanes
9	By-pass for hot interpass heat exchanger
10	By-pass for cold heat exchanger
11	By-pass for hot heat exchanger

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1. Panel Mounted Instruments on Central Control Panel (cont'd.)

Point No.	LOCATION
12	Interpass tower pump tank water supply
13	Interpass tower acid cooler by-pass
14	Drying tower acid cooler by-pass
15	Hot heat exchanger tube side inlet
16	Hot interpass heat exchanger tube side inlet

Annunciator Alarm Sub-Panel

a. Low acid flow to drying tower.
b. Low acid flow to interpass absorbing tower.
c. Low acid flow to final absorbing tower.
d. Low oil pressure on main compressor lubricating pump.
e. Acid level in interpass absorbing tower pump tank low-high level.
f. Acid level in the drying tower pump tank: low-high level.
g. Main compressor (C01 A and B) vibration alarm high.
h. Main compressor (C01 A and B) lube oil high temperature.
i. Main compressor (C01 A and B) lube oil high pressure.
j. Main compressor (C01 A and B) differential pressure (inlet to discharge)
k. Main compressor (C01 A and B) current low
l. Main compressor (C01 A and B) system problems alarm.
m. Water level in cooling tower cold well, low-high level.
n. Cooling tower water pH, high-low alarm.

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

1. Panel Mounted Instruments on Central Control Panel (cont'd.)

Interlock System (Minimum)

Main compressor shuts down on:

a. Low discharge pressure from lubrication oil pump on main compressor.
b. High lube oil temperature on main compressor.
c. Low acid flow to final absorbing tower.
d. High compressor or gear bearing temperature.
e. High motor stator temperature.

2. Panel Mounted Instruments on Main Compressors Alarm Panel

Protective system in accordance with Sections 12 and 13, Appendix A, ASARCO "Specification for Motor Driven Blowers", July 23, 1976. System is complete with free standing alarm panel with outside alarm horn. Circuit checking and alarm silencing are provided. Preset deviations shut down unit for conditions, as established by Owner, in addition to those covered in interlock system above. Following main compressor conditions are monitored:

a. Current indicator - ammeter
b. Temperature motor bearings
c. Temperature gear speed changer bearings (if required)
d. Temperature blower bearings
e. Temperature motor windings (6)
f. Oil temperature to bearings
g. Oil temperature inlet oil cooler
h. Blower discharge temperature
i. Differential pressure across blower (inlet to discharge)
j. Oil pump discharge pressure
k. Bearing oil supply pressure

DESCRIPTION OF PLANT
- INSTRUMENTATION (cont'd.)

2. Panel Mounted Instruments on Main Compressors Alarm Panel (cont'd.)

l. Motor vibration
m. Gear speed changer vibration (if required)
n. Blower vibration
o. Blower rotor axial position

Vibration and axial position are monitored by "Bentley Nevada" or approved equal equipment.

3. Field Mounted Instruments

FI - Flow indicator for dilution water flow to interpass absorbing tower and final absorbing tower acid pump tank, range 0 to 5 gal/minute.

DI - Pipe line mounted hydrometer and hydrometer tube for measuring specific gravity of 93% acid.

PI - Pressure gauge, cooling water supply, range 0 to 100 psig.

PI - Pressure gauge, cooling water return, range 0 to 100 psig.

PI - Manometer, main compressor suction.

PI - Manometer, main compressor discharge

PI - Manometer, pressure differential, for all mesh pads and mist eliminators.

LAH - High acid level alarm at each of four tank car loading stations, including electrical type probes.

DESCRIPTION OF PLANT
- UTILITY SUMMARY

A. POWER

A list of estimated power requirements is as follows:

	No.	HP Each	HP Connected	HP Operating
4,160 Volt Motors				
Motor Driven Compressor	2	3500	7000	5450 (a 90,000 SCFM dirty plant)
Cooling Tower Water Pump	2	400	800	375
460 Volt Motors				
Combustion Air Fan	1	60	60	Intermittant
Hot Gas Recycle Fan*	1	200	200	Intermittant
Interpass Absorbing Acid Pump	1	125	125	121
Final Absorbing Acid Pump	1	125	125	123
Drying Acid Pump	1	125	125	123
Acid Cooler Drain Pump	1	5	5	Intermittant
Product Acid Transfer Pump	1	10	10	10
Product Acid Loading Pump	3	10	30	Intermittant
Effluent Pumps	2	5	10	Intermittant

*For Alternate Recycle-type Preheater Only

DESCRIPTION OF PLANT
- UTILITY SUMMARY

A. POWER (Cont'd)

	No.	HP Each	HP Connected	HP Operating
460 Volt Motors (Cont'd)				
Product Stripper Fan	1	5	5	5
Compressor Lube Oil Pump	2	10	20	Intermittant
Cooling Tower Fan	2	125	250	248
TOTAL			8,765	6,455

Other Electrical		
Lighting	70	KVA
Instrumentation, Misc.	25	KVA
Lube Oil Heaters For Compressors	20	KVA
C.I.L. Coolers	25	KVA

B. NATURAL GAS OR NO. 2 FUEL OIL

Demand is variable from 0 during normal operations up to 600 standard cubic feet per minute of natural gas or 4.5 GPM of No. 2 fuel oil during a converter heatup period. (Somewhat less with alternate recycle preheater.)

C. COOLING TOWER MAKE-UP

Estimated make-up water for cooling tower is 350 GPM.

DESCRIPTION OF PLANT
- UTILITY SUMMARY

D. POTABLE WATER

Estimated total usage for lab sink, drinking water and safety showers is 15 GPM.

E. PROCESS WATER

Estimated total usage for process water and hose stations is 30 GPM.

F. COMPRESSED AIR

Estimated total usage is 100 SCFM.

DESCRIPTION OF PLANT
- DESIGN STANDARDS

Electrical design, structures, concrete and foundation, painting, and piping are in accordance with Contractor's past practices and standards, except as noted otherwise in this specification.

Steel meets ASTM-36 requirement, latest revision. Other is as required by design details for equipment. Use of high strength, low allow steels is used wherever savings and possible design efficiency increase.

General electrical design complies substantially with ASARCO "Electrical Design Criteria", (Appendic "C") dated July 23, 1976, "Specifications for Electrical Motors", No. CE-1-MOT, dated August 18, 1975 and "Specifications for Electrical Motors 250 Horsepower and Larger", No. CE-2-MOT, dated August 18, 1975.

PERFORMANCE GUARANTEES AND TESTS

A. PERFORMANCE GUARANTEES

1. Enviro-Chem guarantees that the acid plant shall be capable of operating at a gas handling capacity of 90,000 SCFM (dry basis) when supplied with 4 - 6% SO_2 gas as defined in the Design Basis section of this specification.

2. Enviro-Chem guarantees that the plant shall be autothermal when operated at 45,000 to 90,000 SCFM (dry basis) containing not less than 4.0% SO_2 and 13.5% O_2 at the inlet to the converter.

3. Enviro-Chem guarantees that when the plant is operated at not more than 90,000 SCFM (dry basis) of gas containing not more than 6% SO_2 and not less than 10.5% O_2 at the inlet to the converter, the process gas leaving the final absorption tower of the plant, including product stripper exhaust, shall average not to exceed:

    a. 500 parts per million (ppm) SO_2 by volume

    b. 51 pounds per hour H_2SO_4 mist

    c. 15% opacity

    NOTE: At 4% SO_2 the O_2 content shall be not less than 13.5% SO_2, and at gas strengths between 4% and 6%, the corresponding minimum O_2 content shall be proportionately between 10.5% and 13.5% by volume.

B. PERFORMANCE TESTS

Plant shall be tested over an operating period of three (3) substantially consecutive days, during which time performance guarantess will be demonstrated.

For the first operating period of two (2) days, the plant shall be operated at or as close as possible to maximum design capacity, or as mutually agreed. For the following one (1) day

PERFORMANCE GUARANTEES AND TESTS

B. PERFORMANCE TESTS (cont'd.)

period the gas strength shall be reduced to 4% SO_2 (90,000 SCFM) to demonstrate the capability of the plant to operate without the use of the preheater, or as mutually agreed.

C. PERFORMANCE VERIFICATION

1. Capacity

The gas handling capacity of the plant shall be determined from periodic gas strength measurements and acid production measurement, or as mutually agreed. The gas flow recorder and the SO_2 gas analyzer/recorder may be used for reference when their accuracy is substantiated by gas strength and acid production measurement, or as mutually agreed.

The gas strength measurements shall be by "Reich Test" as described in the Catalyst Warranty section of the specification, or as mutually agreed.

Acid production shall be determined by inventory in product storage tanks adjusted for changes in pump tank levels.

Product acid storage tank and pump tank levels shall be measured at the start of the test, every 24 hours thereafter, at the end of the test period, and as required throughout the test period.

The product acid storage tank level will be determined by a dip stick measurement of innage or an outage measurement determined with a steel tape. Pump tank levels will be determined by a dip stick measurement.

During the period between storage tank measurements suitable precautions shall be taken to prevent transfers from the tank such as inserting a slip blank in the outlet piping or chaining and locking the tank outlet valve.

PERFORMANCE GUARANTEES AND TESTS

C. PERFORMANCE VERIFICATION (cont'd.)

1. Capacity (cont'd.)

Tonnage of acid in the tanks shall be determined by converting the volume increase during the test period to tons. The specific gravity corrected for temperature as stated in sulfuric acid tables published by the Manufacturing Chemists' Association will be used to convert volume to weight. The solution weight is then converted to 100% H_2SO_4 using the average strength of acid produced during the test period.

2. Autothermal Operation

Gas flow and analysis conditions shall be established by setting of the blower inlet and upstream dilution air (by owner) in the owner's gas supply system. The plant shall then operate without use of the preheater.

3. Sulfuric Acid Mist

The acid mist loading concentration in the process gas leaving the final absorption tower shall be determined using "Modified Monsanto Company Technique for Sampling Sulfuric Acid Mist" as described in the U.S. Department of Health, Education and Welfare Bulletin "Atmospheric Emissions from Sulfuric Acid Manufacturing Processes" 999-AP-13, page 61.

The flow rate, temperature and velocity profile of the process gas leaving the final absorption tower shall be determined in accordance with Method 1 (Sample and Velocity traverses for Stationary Sources) and Method 2 (Determination of Stack Gas Velocity) given in the Federal Register, Vol. 36, No. 247, pgs 24882-24885, dated December 23, 1971, or as mutually agreed.

PERFORMANCE GUARANTEES AND TESTS

C. PERFORMANCE VERIFICATION (cont'd.)

4. Sulfur Dioxide

The sulfur dioxide concentration in the process gas leaving the final absorption tower shall be determined by continuous monitoring in accordance with the Federal Register, Vol. 41, No. 10 pg 2340, dated January 15, 1976, or as mutually agreed.

The concentration of SO_2 entering the converter system shall be measured using the "Reich Test" as described in the Catalyst Warranty section of this specification.

The concentration of O_2 entering the converter system shall be measured using a standard three bulb Orsat to measure SO_2, CO_2, and O_2 in that order.

5. Opacity

Opacity of the process gas leaving the final absorption tower shall be determined by observation of the Owner's representative and Enviro-Chem's representative. In the event a mutual agreement that the opacity guarantee has been met cannot be reached, the opacity shall be determined by an observer mutually acceptable to Owner and Enviro-Chem in accordance with Method 9 in the Federal Register, Vol. 36, No. 247 pg 24895, dated December 23, 1971.

NOTE: For all of the above except Capacity & Autothermal:

> "Each performance test shall consist of three repetitions of the applicable test method. For the purpose of determining compliance with an applicable standard of performance, the average of results of all repetitions shall apply."

If one sample analysis is significantly outside the average of the other two analyses and causes the average of the three to exceed the contractor guarantee limits, then Owner and Contractor shall mutually agree to repeat either the single analysis or the entire three analyses. Failing agreement, the triple analyses shall be repeated.

PERFORMANCE GUARANTEES AND TESTS

D. CONDITIONS OF PERFORMANCE GUARANTEES

1. Owner shall cooperate with Contractor in the testing and operation of the plant and shall provide necessary operating personnel, supervision, materials, product storage, services and utilities and take other reasonable and appropriate action as Contractor may require in order to enable Contractor to demonstrate the performance guarantees.

2. Plant is in steady state operation during the performance test.

3. Owner shall furnish necessary utilities and an adequate supply of raw materials and feedstock as specified in the Design Basis section of this specification.

4. Plant is operated by Owner in accordance with Contractor's written operating instructions.

5. Monsanto Enviro-Chem Systems, Inc. vanadium catalyst shall be used in the plant during the performance test.

6. Owner shall furnish the necessary labor, equipment and laboratory facilities for determination of opacity, sulfur dioxide and acid mist content in the exit stack and SO_2, and O_2 in the feed gas.

7. Catalyst Warranty as given in that section of this specification is in effect.

Speed Letter.

To W. FERRELL - HS. CO
3422 SOUTH 700 WEST
SALT LAKE CITY, UTAH 84119

From C.V. - GLASER
EL PASO

Subject MONSANTO ACID PLANT

– No. 9 & 10 FOLD

MESSAGE

ENCLOSED ARE COPIES OF THE PERFORMANCE GUARANTEES & TESTS THAT YOU REQUESTED.

Date 7-9-81 Signed C.V. Glaser

REPLY

– No. 9 FOLD

– No. 10 FOLD

Date Signed

WilsonJones
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CATALYST WARRANTY

WARRANTY

The catalyst provided herein is warranted to achieve a conversion from SO_2 to SO_3 sufficient to meet a maximum SO_2 content in the exit gas leaving the final absorption tower of 500 parts per million by volume (including product stripper exhaust) when the plant is operated at its design capacity and the converter inlet gas contains not more than 6.0% SO_2 by volume and not less than 10.5% O_2 by volume, subject to the provisions contained hereinafter.

For a period of one year immediately following the installation of the catalyst, Monsanto Enviro-Chem Systems, Inc. will add to or replace in part or in full as Enviro-Chem deems necessary the catalyst FOB Avon, California, if it fails to achieve the conversion of SO_2 to SO_3 sufficient to meet the SO_2 content in the exit gas specified above, subject to the provisions contained hereinafter. This warranty is limited to one total replacement of the new catalyst supplied under this agreement.

CONDITIONS OF CATALYST WARRANTY

The warranty is based upon and is subject to the following conditions:

Sources of Gas

Lead sinter gas, copper roaster gas, and copper converter gas combined.

Converter Inlet Gas Composition

SO_2 - 6.0% maximum by volume

O_2 - 10.5% minimum by volume

CATALYST WARRANTY (cont'd.)

CONDITIONS OF CATALYST WARRANTY (cont'd.)

Design Capacity of Plant

90,000 SCFM (Dry Basis) gas handling capacity

Operating Conditions

The plant is to be operated in accordance with Monsanto Enviro-Chem operating instructions.

EXCLUSIONS

This warranty is voided if the following abnormal conditions occur:

a. The gas passed through the converter is sufficiently high in content of fluorine, hydrogen fluoride or other fluorine compounds so that etching occurs on a glass rod kept constantly in the gas stream prior to the gas entering the converter. The rod shall be examined once per year.

b. The condition of the converter system (including converter interpass cooling equipment) shows evidence of improper maintenance, such as leaks or by-passing of the gases; gas leaks in the heat exchanger equipment; excessive scaling; or improper insulation.

c. Lowered conversion results from deposition of dust, or damage resulting from the presence of excessive moisture, water, acid mist or acid in the catalyst.

d. The volume of active catalyst in service in any layer has been reduced by more than 5% of the volume originally supplied.

CATALYST WARRANTY (cont'd.)

EXCLUSIONS (cont'd.)

e. Operation of the plant has been substantially outside the design conditions of plant capacity, gas strength, and converter temperatures to the extent that the vanadium content of the catalyst as originally supplied, shown on test reports furnished with the catalyst, has been reduced by 10% or more.

f. The catalyst has been exposed to excessive temperatures for prolonged periods of time.

ACCESS TO THE PLANT

Under claim of replacement, Monsanto Enviro-Chem's representative shall be allowed free access to any operating parts of the plant necessary for the investigation of that claim. Monsanto Enviro-Chem shall have the right to make, or cause to be made, such investigation before furnishing additional catalyst. If Monsanto Enviro-Chem finds that the claim is not substantiated, the time and all expenses of this representative from point of departure until return thereto shall be borne by the Owner of the catalyst.

PERFORMANCE TEST

The concentration of SO_2 entering the converter system and leaving the final absorber shall be measured using Reich Test for sulfur dioxide as described below.

Both the entrance gas and exit gas concentration shall be analyzed at least two times per 8 hour shift during a performance test of not less than three consecutive 24 hour days with the plant operating under steady state, design conditions.

CATALYST WARRANTY (cont'd.)

PERFORMANCE TEST (cont'd.)

Duplicate analyses shall be run, one immediately following the other during the test period. If the two results agree within 10%, they shall be averaged and recorded as valid result. Otherwise, an additional analysis shall be run immediately and if two of the three analyses do not agree within 10%, all three of the results shall be discarded, the analytical equipment and procedure shall be checked and the duplicate analyses repeated. At the end of the test, all "valid results" shall be averaged to determine if guaranteed conversion of % SO_2 in the stack gas has been met.

The production rate during the performance test shall be held at the guarantee level as measured by accurate measurement of inventory change (or other mutually acceptable method).

The Owner shall be responsible for the operation of the plant and shall provide the necessary labor, equipment, reagents, and laboratory facilities for conducting the tests as provided herein.

The entrance and exit gas analyses should be run according to the attached test procedure, "Attachment 'G' SO_2 Gas Tests".

LIMITATION

The foregoing warranty is expressly made by Enviro-Chem and accepted by Owner in lieu of all other warranties. Except as otherwise expressly provided herein, Enviro-Chem MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER MATTER WITH RESPECT TO THE CATALYST. Enviro-Chem's aggregate liability under the foregoing warranty shall in no event exceed the total replacement of the new catalyst furnished under the agreement of which this warranty is a part. Enviro-Chem shall not be liable for any incidental special or consequential damages resulting from the performance or non-performance of the catalyst nor from any defects therein, whether Owner's claim is in contract, negligence or otherwise.

ATTACHMENT "G"

SO_2 GAS TESTS

In connection with the following, refer to Monsanto Standard Drawings 100-6-8 and 100-6-9.

Entrance Gas Test

The sample line should be flushed thoroughly with gas before proceeding with the test in order to be certain of getting a sample representative of operation at the time that the test is being made.

Fill the shaker bottle approximately two-thirds full of water and add about 5 ml. of starch solution. Add 10 ml. of N/10 iodine to the bottle by means of the pipette, after first bringing the solution to a faint blue color by adding one or two drops of iodine solution. It is preferable to use the same water with starch indicator in the shaker bottle for a number of determinations. New water in the shaker bottle should either be acidified with two drops of acid or the first determination should be repeated to obtain a good reading.

With all clamps and stopcocks closed, place the rubber stopper in the test bottle. Adjust the water level in the 250 cc. burette to the "zero mark" by raising the water bottle with the glass stopcocks at the top and bottom of the burette open. Then close the top stopcock and place the water bottle back on the table. Make sure that all connections in the apparatus are tight.

Open the clamp on the sampling tube, adjusting it so that the gas bubbles pass slowly through the solution in the bottle. Shake the bottle continuously when gas is bubbling in to insure complete SO_2 absorption. Continue until the solution has changed to the same faint blue color which was obtained before adding the 10 ml. of iodine solution. Be careful not to overrun the end point.

Close the clamp on the sampling line tightly when the end point has been reached. Raise the water bottle so that the water level in it is balanced against the water level in the burette, and then note the amount of air that has been displaced in the burette. Note the temperature on the thermometer. Refer to

the "Entrance Gas" section of Drawing 100-6-9 and to the column headed by the temperature nearest that noted during the test. Follow down this column until that number is found which is nearest to the measured volume of air in the cylinder. Then read the corresponding % SO_2 from the table. For example, if the temperature were 30°C and the measure volume were 145 ml., then the strength of the gas would be 8.0%.

Exit Gas Test

The water aspirator which maintains a suction on the exit gas sampling line should be left running at all times in order to insure a representative sample of gas. If gas is flowing through the line, a slight suction will show on the manometer.

Now, in the Exit Gas Test apparatus, repeat the procedure used for the "Entrance Gas Test" except use 1 ml. of N/100 iodine solution instead of N/10 iodine solution. Note the volume of air displaced and the temperature as before, then refer to the "Exit Gas" section of Drawing 100-6-9 for the % SO_2.

Conversion Efficiency

For the percentage conversion efficiency, refer to Drawing 100-6-8. For example, if the entrance gas were 8.5% and the exit gas were 0.05%, the conversion efficiency would be 99.5%.

Solutions

The solution of N/100 iodine solution may be prepared with sufficient accuracy by measuring 100 ml. of the standardized N/10 iodine solution in a graduated cylinder and then diluting this with water to 1000 m. in a 1000 m. graduated cylinder.

All iodine solutions should be kept in brown bottles and in a cool place. Always replace the glass stoppers as soon as possible.

Starch solution sours quickly due to bacterial and mold growth, and then will turn the iodine solution brown instead of blue so that a clear end-point is not obtained. Fresh starch solutions should be prepared weekly or even oftener in warm weather. However, if the starch solution is prepared as follows, it will keep for months without deterioration or sensitivity loss.

ATTACHMENT "G" (Cont'd)

2% Stabilized Starch Indicator Solution

Ingredients:

1) Soluble indicator starch, Mallinckrodt Cat. No. 8188, or equivalent material.

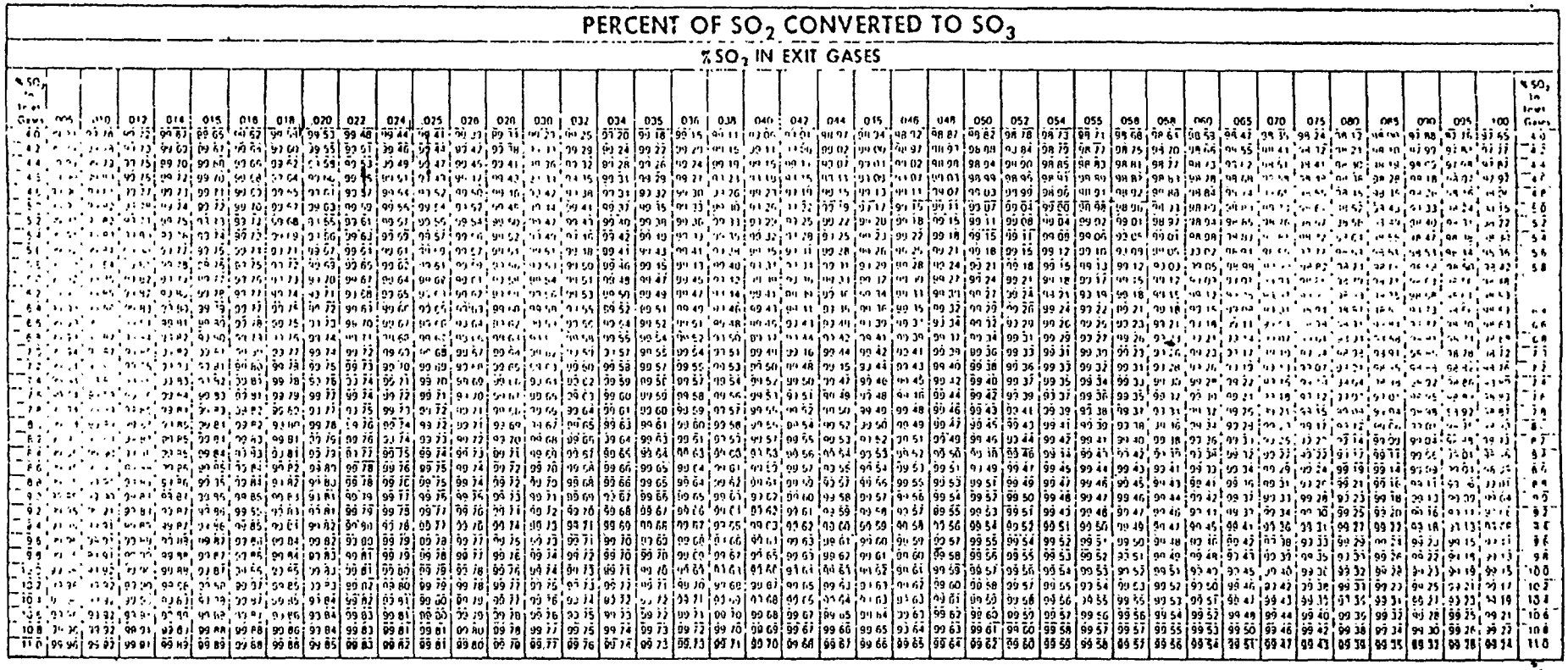
2) Glycerine, AR, Mallinckrodt, Cat. No. 5100, or equivalent material.

To a vigorously boiling mixture of 100 ml. of distilled water and 100 ml. of glycerine, add a thick paste consisting of 4 grams of starch in a minimum of distilled water. Boil for 3 minutes and allow to cool.

To prepare a smaller amount of indicator solution, reduce quantities in proportion.

PERCENT OF SO_2 CONVERTED TO SO_3

% SO_2 IN EXIT GASES



CALCULATION

$$\%\ \text{CONVERSION} = 100 \times \frac{(\%\ SO_2)_{IN} - (\%\ SO_2)_{OUT}}{(\%\ SO_2)_{IN} - \frac{1.5\,(\%\ SO_2)_{IN}\,(\%\ SO_2)_{OUT}}{100}}$$

Monsanto Enviro-Chem Systems Inc.

SO_2 CONVERSION CHART

CUST					PO
DRAWN	BY GES	DATE 5-75	APPROV	DATE	JOB NO
CHECKED					DWG NO 100-6 B
SCALE					

TABLE NO 1 ENTRANCE GAS

PERCENT SO_2 CORRESPONDING TO GAS VOLUME AT 1°C USING 10CC $\frac{N}{10}$ IODINE

MM Hg	5°	10°	15°	20°	25°	30°	35°	40°
660	224	227	231	234	238	241	245	248
665	225	228	232	235	239	242	246	249
670	226	229	233	236	240	243	247	250
675	227	230	234	237	241	244	248	251
680	228	231	235	238	242	245	249	252
685	229	232	236	239	243	246	250	253
690	230	233	237	240	244	247	251	254
695	231	234	238	241	245	248	252	255
700	232	235	239	242	246	249	253	256
705	233	236	240	243	247	250	254	257
710	234	237	241	244	248	251	255	258
715	235	238	242	245	249	252	256	259
720	236	239	243	246	250	253	257	260
725	237	240	244	247	251	254	258	261
730	238	241	245	248	252	255	259	262
735	239	242	246	249	253	256	260	263
740	240	243	247	250	254	257	261	264
745	241	244	248	251	255	258	262	265
750	242	245	249	252	256	259	263	266
755	243	246	250	253	257	260	264	267
760	244	247	251	254	258	261	265	268
765	245	248	252	255	259	262	266	269
770	246	249	253	256	260	263	267	270
775	247	250	254	257	261	264	268	271
780	248	251	255	258	262	265	269	272
785	249	252	256	259	263	266	270	273
790	250	253	257	260	264	267	271	274
795	251	254	258	261	265	268	272	275
800	252	255	259	262	266	269	273	276

TABLE NO. 2 EXIT GAS

PERCENT SO_2 CORRESPONDING TO GAS VOLUME AT 1°C USING 1CC $\frac{N}{100}$ IODINE

MM Hg	5°	10°	15°	20°	25	30°	35°	40°
660	146	149	153	157	160	164	167	171
665	147	150	154	158	161	165	168	172
670	148	151	155	159	162	166	169	173
675	149	152	156	160	163	167	170	174
680	150	153	157	161	164	168	171	175
685	151	154	158	162	165	169	172	176
690	152	155	159	163	166	170	173	177
695	153	156	160	164	167	171	174	178
700	154	157	161	165	168	172	175	179
705	155	158	162	166	169	173	176	180
710	156	159	163	167	170	174	177	181
715	157	160	164	168	171	175	178	182
720	158	161	165	169	172	176	179	183
725	159	162	166	170	173	177	180	184
730	160	163	167	171	174	178	181	185
735	161	164	168	172	175	179	182	186
740	162	165	169	173	176	180	183	187
745	163	166	170	174	177	181	184	188
750	164	167	171	175	178	182	185	189
755	165	168	172	176	179	183	186	190
760	166	169	173	177	180	184	187	191
765	167	170	174	178	181	185	188	192
770	168	171	175	179	182	186	189	193
775	169	172	176	180	183	187	190	194
780	170	173	177	181	184	188	191	195
785	171	174	178	182	185	189	192	196
790	172	175	179	183	186	190	193	197
795	173	176	180	184	187	191	194	198
800	174	177	181	185	188	192	195	199

Formula used in making calculations using 10 cc $\frac{N}{10}$ I Solution

$$X = \frac{1094.4}{C\left[\frac{8\,W}{760(1 + 0.003661t)}\right] + 10.944}$$

Formula used in making calculations using 1cc $\frac{N}{100}$ I Solution

$$X = \frac{10.944}{C\left[\frac{8\,W}{760(1 + 0.003661t)}\right] + 0.10944}$$

In these formulae:
B = Barometer MM Hg
C = CC Gas Collected
t = Temperature of Gas °C
W = Aqueous Vapor Pressure at Temperature t (m.m. Hg)
X = % SO_2 in Gas

TABLE NO 3 BAROMETRIC CORRECTION FACTOR

TEMP. C°

MM Hg	5°	10°	15°	20°	25°	30°	35°	40°
660	.974	.951	.917	.910	.887	.863	.837	.809
665	.965	.939	.919	.898	.875	.851	.825	.797
670	.958	.928	.907	.886	.863	.840	.814	.786
675	.935	.916	.895	.873	.851	.828	.802	.774
680	.922	.902	.882	.861	.839	.816	.790	.763
685	.903	.889	.870	.849	.827	.803	.779	.751
690	.897	.877	.857	.837	.815	.792	.767	.739
695	.932	.913	.895	.875	.853	.830	.805	.778
700	.970	.952	.932	.912	.891	.869	.844	.817
705	.997	.971	.950	.930	.909	.779	.757	.732
710	.944	.926	.907	.887	.867	.845	.821	.795
715	.955	.936	.916	.896	.876	.854	.830	.804
720	.912	.893	.875	.855	.835	.814	.791	.766
725	.930	.912	.893	.874	.854	.833	.809	.784
730	.948	.930	.911	.892	.872	.850	.827	.801
735	.966	.947	.928	.909	.889	.867	.843	.817
740	.983	.964	.945	.926	.906	.884	.860	.833
745	.999	.980	.961	.942	.922	.900	.876	.849
750	.956	.937	.918	.899	.879	.857	.833	.807
755	.972	.953	.934	.915	.895	.873	.849	.823
760	.988	.969	.950	.931	.911	.889	.865	.838
765	.945	.926	.907	.888	.868	.846	.822	.796
770	.960	.941	.922	.903	.883	.861	.837	.811
775	.975	.956	.937	.918	.898	.876	.852	.826
780	.990	.971	.952	.933	.913	.891	.867	.840
785	.947	.928	.909	.890	.870	.848	.824	.798
790	.961	.942	.923	.904	.884	.862	.838	.812
795	.975	.956	.937	.918	.898	.876	.852	.826
800	.989	.970	.951	.932	.912	.890	.866	.839

Tables Nos. 1 and 2 were calculated for a Barometric Pressure of 760mm

If a correction for Barometric Pressure is desired, find the factor in Table No 3 corresponding to the temperature and barometric pressure of the test under consideration; choose the factor in the 760mm line closest to it numerically and find the correct % SO_2 in Tables No. 1 and 2, using as the temperature of test, the temperature corresponding to the factor in the 760 mm line.

Barometer, mm = Barometer, Inches x 25.4

If percentages of SO_2 are desired, which are not listed in Tables No 1 and 2 They may be easily calculated by using the factor (K) given in Table No. 3 in the Formula

When 10, CC's $\frac{N}{10}$ I are used

$$X = \frac{1094.4}{CK + 10.944}$$

When 1cc $\frac{N}{100}$ I is used

$$X = \frac{10.944}{CK + 0.10944}$$

In These Formulae
X = % SO_2
C = CC Gas Collected
K = Factor to be used from Table No. 3

Where more accurate results are desired for the value of (K) then to the nearest 10mm Barometric Pressure and Nearest 5°C, Interpolate in Table No. 3.

TABLE NO. 4

NORMAL BAROMETER READING FOR VARIOUS ALTITUDES

Altitudes Feet	Baro MM Hg
0	760
500	734
1000	707
1500	681
2000	657
2500	632
3000	609
3500	587
4000	564
4500	544
5000	523
5500	503
6000	484
6500	465
7000	447
7500	430
8000	413
8500	397
9000	381
9500	366
10000	351

Dynatec Enviro Chem Systems Inc

INTERPASS ABSORPTION PLANT

REICH TEST FOR SO_2

	BY	DATE	REVISION	
DRAWN	JLO	3/75	1	5
DESIGN CONTR.	GLS	11/75	2	6
DETAILED CONTR.			3	7
APPROVED			4	8
SCALE				

DWG. NO. 100-6-9

PRM
12/27/76

EXHIBIT B
COST OF THE WORK

SCHEDULE OF ST. LOUIS
OFFICE REIMBURSABLE COSTS

A. HOME OFFICE PERSONNEL

1. Salaries and wages of the following categories of Enviro-Chem employees for the time employed on the Work based upon monthly salaries for 168 hours per month per person.

   a. Department Directors, Managers and Supervisors;

   b. Process Engineers;

   c. Design Engineers, Designers, and Draftsmen;

   d. Home Office Construction Managers, Engineers and Labor Coordinators;

   e. Project Managers and Project Engineers;

   f. Purchasing Agents, Buyers, Expeditors and Inspectors;

   g. Project Accounting, Order and Billing Personnel, Accounts Payable Personnel, Key Punch Operators;

   h. Project Schedulers and Schedule Analysts;

   i. Cost Engineers and Estimators;

   j. Secretarial, Stenographic, Reproduction and Clerical Personnel associated with the above activities.

   The above list is intended to indicate the General Classification of people to be charged, recognizing that specific job titles may vary.

2. Salaries for overtime required for the Work, providing such overtime is approved by Owner.

SCHEDULE OF ST. LOUIS
OFFICE REIMBURSABLE COSTS

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A. HOME OFFICE PERSONNEL (Cont'd.)

3. Employee benefits including group insurance; group hospital and medical benefits; pension; holidays; vacations; sick leave and excused absences; payroll taxes including unemployment insurance, FICA, and Workmen's Compensation at the rate of 33% of salaries and wages set forth in Item A-1 above, and 8% of overtime salaries set forth in Item A-2 above. These rates are firm for 1977 and will be reviewed and revised as necessary for actual cost changes on an annual basis upon 30 days written notice to the Owner.

B. APPLIED OVERHEAD

An amount equal to 70% of the total cost under Paragraph A above (except Paragraph A-2) to cover indirect costs and overhead.

C. GENERAL COSTS

1. Cost of outside consulting and professional services as approved by Owner.

2. Actual cost of reproductions, including prints, photographs, and photostats.

3. The cost of contract engineers, draftsmen and other personnel working in Enviro-Chem's Home Office for the time employed on the Work plus 35% of such cost to cover indirect costs and overhead.

4. Actual cost of telegraph, teletype and long distance telephone charges in connection with the Work.

5. Transportation and living expenses of all personnel incurred while traveling in connection with the Work.

6. Computer and computer related services in accordance with costs actually charged by the Monsanto Management Information Systems Department.

7. Cost of outside inspection services, laboratory tests and expenses related thereto.

8. Such other expenditures that may reasonably be charged as part cost of the Work, and as may be approved by Owner.

SCHEDULE OF
REIMBURSABLE ERECTION COSTS

A. DIRECT COSTS

1. Net cost of material, equipment, and supplies procured or furnished by Enviro-Chem including packing, loading, freight, demurrage, unloading and cartage costs.

2. Net cost of all subcontracts.

3. Cost of all craft labor employed in all phases of the Work including foremen, general foremen, and craft superintendents, including:

   a. Salaries and wages;

   b. Payroll taxes and insurance, such as Unemployment Insurance and FICA at prevailing rates;

   c. Workmen's Compensation Insurance at 90% of the Manual rates updated monthly during the life of the project.

   d. Payments for health and welfare funds, apprentice funds, pension funds, and other assessments and costs required by local and national labor agreements.

B. FIELD ADMINISTRATION & SUPERVISION

Cost of Enviro-Chem's Field Supervisory and Non-Manual Employees including but not limited to Construction, Engineering, Accounting, Cost Control, Safety, Purchasing, Expediting, and Clerical Personnel as follows:

1. Salaries and wages for the time employed on the Work, based upon monthly salaries for 168 hours per month per person.

2. Salaries for overtime required for the Work, providing such overtime is approved by Owner.

B. FIELD ADMINISTRATION & SUPERVISION (Cont'd.)

3. Employee benefits including group insurance; group hospital and medical benefits; pension; holidays; vacations; sick leave and excused absences; payroll taxes including Unemployment Insurance, FICA, and Workmen's Compensation at the rate of 33% of salaries and wages set forth in Item B-1 above, and 8% of overtime salaries set forth in Item B-2 above. These rates are firm for 1977 and will be reviewed and revised as necessary for actual cost changes on an annual basis upon 30 days written notice to the Owner.

4. An amount equal to 25% of the total cost under Items B-1 and B-3 above to cover indirect costs and overhead.

5. Travel, moving and temporary living expenses for permanent supervisory and non-manual employees procured for and assigned to the job site, in accordance with Enviro-Chem policy, as amended from time to time with prior notice to the Owner.

6. Subsistence allowance to Enviro-Chem's permanent supervisory and non-manual employees at the job site in accordance with Enviro-Chem policy, as amended from time to time with prior notice to the Owner.

C. TEMPORARY FACILITIES

1. Cost of installation of construction utilities furnished by Enviro-Chem and cost of such utilities to Enviro-Chem.

2. Cost of providing, maintaining, and removing temporary facilities required for construction purposes, including but not limited to warehouse, office, sheds, shops, fabrication facilities, change houses, roads, parking lots, railroads, and fencing.

3. Field office costs, including office supplies, fixtures, equipment, vehicles for local transportation, postage, telephone, telegraph, and other miscellaneous expenses for the Work. (Some such costs may involve rental charges, depreciation charges, or purchase-cost-less salvage value.)

D. CONSTRUCTION EQUIPMENT, TOOLS, & SUPPLIES

1. Cost of rental and operation of equipment, including insurance, as may be necessary for proper execution of the Work. Rental costs for construction equipment owned by Enviro-Chem shall be at 75% of current Association of Equipment Dealer (AED) rates or equal to the prevailing local rates, whichever is lower. All rental costs shall include the cost of transportation into and out of the job site.

2. Cost of small hand tools not owned by workmen, and other construction supplies and equipment purchased by Enviro-Chem for the Work, which remain the property of the client, or cost-less-salvage value of such items which the client does not retain.

3. Cost of consumable materials and supplies.

E. GENERAL COSTS

1. Cost of inspection surveys, and testing services including qualification of welders.

2. Transportation and living expense incurred by job site personnel traveling in connection with the Work.

3. Premiums on all insurance and bonds provided by Enviro-Chem. Premiums for Comprehensive Liability Insurance shall be paid at the rate of $1.35 per $100 of payroll for the first $500,000 of coverage per annum.

4. Specified building permits, licenses, and surveys required of Enviro-Chem for construction of the Plant.

5. Cost and related expenses of equipment manufacturers' service engineers furnished by Enviro-Chem.

6. Sales, use, gross receipts, and other related taxes, but excluding corporate and personal income tax.

E. GENERAL COSTS (Cont'd.)

7. The costs defined in this schedule of making modifications to defective workmanship as necessary to complete the Work in accordance with contract requirements and to enable the performance guarantees to be fulfilled, providing same is not the result of contractor's negligence.

8. Losses, and expenses, not compensated by insurance sustained by Enviro-Chem in connection with the Work, provided they have resulted from causes other than the fault or neglect of Enviro-Chem. Without limitation, such losses and expenses shall include costs incurred as a result of default by subcontractors and vendors and costs, including attorneys' fees and premiums for bonds, incurred in discharging, protecting Owner against, liens for which Owner or its property might be liable.

9. Such other expenditures that may reasonably be charged as part of cost of the Work and as may be approved by the Owner.

Reference is made in this schedule to Enviro-Chem, but the costs defined in this schedule shall be reimbursable whether such costs are incurred by Enviro-Chem or Leonard.

EXHIBIT C
COMPLETION AND TESTING

A. PROCEDURE

Individual equipment items and/or portions of the Plant may be completed, ready for start-up operation, before the entire Plant is ready for start-up. To minimize delays in placing the Plant into operation, construction work may be inspected and checked in stages. The methods of completion, testing, start-up, initial operation and performance testing shall be in accordance with the following standard procedures:

1. Completion of Construction

The work involved in this stage of completion includes:

a. Visual inspection of equipment, vessels, piping, etc., to insure final installation in accordance with drawings and specifications.

b. Flow sheet check for completeness of lines, connections, fittings, valves, controls, and materials of construction.

c. Complete installation of safety equipment and facilities.

d. Removal of debris from vessels and ducts.

e. General cleanup of mechanical equipment.

f. Checkout of electrical circuits to insure proper physical installation.

g. Checkout of instruments, hookups and leads to insure proper physical installation.

h. Flushing or blowing of those lines which are possible to clean before actual start-up operation begins.

i. Lubricate, align and check installation of mechanical equipment in accordance with vendors' instructions, and when vendors' service engineers are present, in accordance with their recommendations and directions.

2. Commissioning

As physical construction is completed, equipment shall be tested and checked to insure process operability. This work shall include:

a. Pneumatic pressure tests on vessels, piping and equipment where required or specified.

b. Hydrostatic tests on vessels, piping and equipment where required or specified.

c. Check rotation of rotating equipment.

d. Checkout and calibration of instrumentation.

e. Checkout of electrical system.

When construction and commissioning of the Plant is completed in accordance with Paragraph A-1 and Paragraph A-2 of this Exhibit C, Enviro-Chem shall give notice thereof to the Owner. Within ten (10) days after delivery or mailing thereof, Owner shall accept the work by written notice to Enviro-Chem or set forth in writing its reasons for not accepting it. Upon correction of all defects indicated by Owner, or in the event Owner fails to accept the work and does not give its reasons for not accepting it within such ten (10) day period, Owner shall be deemed to have accepted the Plant.

3. Start-Up

As equipment items or portions of the Plant are tested, start-up and process operations shall be started. This work will include:

a. The running of pumps, compressors and other mechanical equipment.

b. Circulation of water or other liquids in liquid handling systems, and the circulation of air or gas in gas handling systems to the extent the same may be performed before Plant is placed into operation.

3. Start-Up (cont'd)

   c. Adjusting and calibration of control valves, placing of instruments into operation, and making final control calibrations and adjustments.

   d. Inspection and adjustments of packing seals, bearings, lubrication systems and other similar work required for operating mechanical equipment.

   e. Drying out of refractory linings in preheaters, combustion chambers and other similar equipment and heating of the converter system.

4. Initial Operation

   The Plant shall be ready for initial operation when start-up and process simulation operations are complete. Owner shall commence operation of the Plant and operate the Plant during such periods and under such conditions as Enviro-Chem shall request to enable Enviro-Chem to determine whether the performance guarantees will be demonstrated during a performance test or what adjustments, if any, may be necessary to enable the performance guarantees to be demonstrated.

5. Performance Tests

   As soon as possible after initial operation of the Plant has begun and at Enviro-Chem's written request, Owner shall conduct one or more performance tests under the conditions required by the performance guarantees and in accordance with Enviro-Chem's instructions to demonstrate the performance of the Plant. Operation of the Plant for a period of three (3) substantially consecutive days shall satisfactorily demonstrate performance requirements. In the event that there are interruptions during the performance test, operating time for guarantee demonstration shall be accumulated by mutual agreement. In determining the ability of the Plant to meet the performance guarantee, all charge rates, production rates and utility consumption shall be averaged over the entire test period.

B. PLANT TURNOVER

All work under Paragraph A-1 and Paragraph A-2 of this Exhibit C shall be performed by Enviro-Chem's personnel and witnessed by Owner, if Owner desires to do so. Notice of the time when such work shall be performed shall be given to the Owner by Enviro-Chem. The work to be performed under Paragraphs A-3, A-4, and A-5 shall be performed by Owner's operating personnel. During this stage the actual operation of all equipment and turning of valves will be done by Owner's personnel and Owner shall be responsible for all maintenance, adjustments, calibrations, and the furnishing of supplies, feedstock and chemicals other than those required to be furnished by Enviro-Chem.

EXHIBIT D

PROJECT COORDINATION PROCEDURE

FOR

800 TPD SULFURIC ACID PLANT

FOR

ASARCO, INCORPORATED

AT

EL PASO, TEXAS

PROPOSAL NO. 2102

Prepared By

MONSANTO ENVIRO-CHEM SYSTEMS, INC.

Corporate Square Office Park

Box 14547

St. Louis, Missouri 63178

Revised
12/27/76
PRM

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IX..... CHANGES IN SCOPE

X..... PROGRESS REPORTS

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APPENDIX

ATTACHMENT A..... REQUEST FOR CHANGE IN WORK (FORM)

VARIATION ORDER (FORM)

I. OWNER'S REPRESENTATIVE, ENVIRO-CHEM REPRESENTATIVE

Owner (ASARCO, INC.) will assign a Project Manager as its representative who will have and exercise the authority to act on behalf of the Owner during the progress of the work. Owner's decisions concerning reviews, comments, procedural methods, etc., will be made promptly. During the engineering phase of the work, Owner's Project Manager will be assigned, part-time, to Enviro-Chem's engineering office in order to facilitate Enviro-Chem's completion of the work.

Similarly, Enviro-Chem will assign a Project Manager as its representative, who will have and exercise the authority to act on behalf of Enviro-Chem during the progress of the work. Directions given or agreements made with any other representatives of the Enviro-Chem project team shall not be binding on Enviro-Chem.

II. ENGINEERING MEETING

Prior to start of Enviro-Chem's production engineering work, the Owner's Project Manager and Enviro-Chem shall meet in Enviro-Chem's office to review the layouts, flow diagrams, instrumentation diagrams, and other such details, so as to avoid changes and delays after engineering work is started.

III. OWNER'S REVIEW OF ENGINEERING

It is understood that the basic plot plan, outline drawings, flow diagrams and narrative descriptions which are part of Proposal Specification 2102 form the basis for Enviro-Chem's price. Any major rearrangement of the layout, the addition or deletion of equipment and other basic changes requested by the Owner shall be considered a change in scope.

III. OWNER'S REVIEW OF ENGINEERING (cont'd)

The Owner shall furnish supplemental drawings as may be required to clarify the contract drawings. These supplemental drawings shall not enlarge or decrease the scope of the work.

Owner's review and/or approval of any portion of Enviro-Chem's engineering work shall be for conformance to contract specification requirements, and not for the establishment of techniques of presentation and the details on the drawing.

Owner's formal comments or approval will be required for plant layout, engineering flow diagrams and electrical single line diagram. Three (3) copies of each drawing in these categories shall be submitted to Owner's Project Manager with a request to return one (1) signed copy to Enviro-Chem marked "Approved" or "Approved as Noted" within ten (10) working days, unless otherwise noted.

In the event Owner's written comments are not given within the ten day period, the items are deemed approved by Enviro-Chem.

As a general practice, preliminary drawings and specifications will not be issued by Enviro-Chem; however, there may be occasions when, in the opinion of Enviro-Chem, Owner's comments on preliminary copies of design drawings and specifications may expedite completion of the work. On such occasions, three (3) preliminary copies of such documents will be furnished for Owner's Project Manager as they are completed for review and comments.

IV. FINAL DRAWINGS AND SPECIFICATIONS

Three (3) copies of Enviro-Chem's drawings, bills of material, and specifications marked "Released For Fabrication" will be furnished to Owner's Project Manager for Owner's review and comment as they are completed during the course of the design work. Owner's comments, if any, will be made promptly. Procurement and construction based on these documents will not be held up pending Owner's comments.

One set of the reproducible drawings will be furnished at the completion of the work, corrected to show "As Built" changes to underground systems, instrument loops, light and power wiring, flow diagrams including utility flow diagrams, and plant layout.

V. DESIGN PROCEDURES

All drawings and specifications will be prepared using Enviro-Chem's standard drafting procedures, drawing numbering system, equipment item numbers, piping line designations, and instrument symbols. All drawings shall be prepared on Enviro-Chem's standard drawing paper or cloth (22" x 34" sheets) containing the Enviro-Chem nameplate and confidentiality clause.

VI. VENDOR'S DRAWINGS AND DATA

Three (3) final prints of vendors' certified drawings and specifications, spare parts lists, data sheets, and instruction books shall be issued to the Owner's Project Manager as they are received from vendors as the work progresses.

Where obtainable, reproducible transparencies, duPont "Mylars" or approved equal, of Vendor's final "as built" certified outline drawings will be provided.

VI. VENDOR'S DRAWINGS AND DATA (cont'd)

Three (3) copies of erection, installation and operation manuals, lubrication instruction and a spare parts inventory list with unit prices for each equipment item of standard manufacture to be installed in the project will be furnished Owner's Project Manager at completion of Enviro-Chem's purchasing activity. In addition, Enviro-Chem will furnish Owner's Project Manager equivalent information for each main non-standard item which may be installed in the project.

VII. OPERATING MANUAL

Five (5) bound and indexed copies of Enviro-Chem's operating manual shall be provided to Owner's Project Manager three (3) months prior to start-up of the plant. The manual will contain process description, start-up procedures, P & I diagrams, plot plan, operating procedures, and emergency shutdown procedures.

VIII. PURCHASING

A Vendors List mutually acceptable to the Owner and Enviro-Chem will be finalized after contract award prior to starting the solicitation of bids. Enviro-Chem will solicit bids for all equipment, materials, and subcontracts required for the erection of the plant. Purchase of field supplies and rental equipment required for construction will be by Enviro-Chem.

Enviro-Chem will solicit bids only from vendors that are listed on the mutually acceptable Vendors List.

VIII. PURCHASING (cont'd)

Enviro-Chem's price is based on Enviro-Chem's selection of Vendors from the attached Vendors list, based on the lowest technically responsive bids received. Any deviation from Enviro-Chem's selection requested by the Owner which results in an increase in cost will be considered a change in scope, and the net additional cost will be added to the Guaranteed Maximum price.

Purchase orders having a value in excess of $10,000 will require Owner approval prior to award. When Owner's approval of purchase orders is required, it will be Enviro-Chem's standard practice to make a technical evaluation of only the low bid Enviro-Chem recommends as being technically satisfactory and submit this technical evaluation, with the commercial evaluation of all bids to the Owner, requesting approval to purchase. In the event Owner's approval to purchase is not received by Enviro-Chem in ten (10) days, Enviro-Chem will proceed to place the purchase order with the vendor it has recommended as being satisfactory.

VIII. PURCHASING (cont'd)

Enviro-Chem's standard purchase order form and numbering system shall be used.

Three (3) copies of all Enviro-Chem's purchase orders (priced) will be provided to Owner's Project Manager as they are issued.

Enviro-Chem will provide normal expediting and inspection services covering materials and equipment purchased by Enviro-Chem.

Where any item of material, equipment, or work requires specific testing or approval, Enviro-Chem shall give the Owner's Project Manager timely notice of its readiness for inspection, and if the inspection is to be made by Enviro-Chem, of the date fixed for such inspection. Where the Owner indicates a desire for personal inspection, it shall be promptly made and, where possible, at the source of supply. Three (3) copies of inspection reports, pencil rubbings of code stampings for all code stamped vessels, and mill test papers will be furnished to Owner's Project Manager as they are received from vendors.

IX. CHANGES IN SCOPE

Every design change requested by the Owner shall be recorded by Enviro-Chem on a "Change Request" form. Before any proposed change requested by Owner is made, Enviro-Chem shall assess the cost and effects of the change, and shall advise the Owner accordingly. In the event a request for change by Owner is evaluated by Enviro-Chem, but is not approved by Owner and is not incorporated into the plant, Enviro-Chem shall be reimbursed for the evaluation on the basis of the contract under "Changes in Work". The definition of design change in this paragraph includes study and estimate work requested by Owner.

IX. CHANGES IN SCOPE (cont'd)

Owner shall signify approval of changes in writing, and shall sign Enviro-Chem's "Contract Variation Order" form (attached) describing the change and its effect upon the contract.

It is to be noted that Enviro-Chem's Construction Superintendent is specifically prohibited from making any design changes that are in variance with the contract or contract documents. Field modifications requested by the Owner's Project Manager must be processed on a "Contract Variation Order" form (attached).

X. VENDORS LIST

Enviro-Chem's price is based on quotations from selected vendors on the attached Vendors List. Any Owner deviation from the mutually acceptable Vendors List published after contract award, may be considered a change in scope.

XI. PROGRESS REPORTS

Three (3) copies of the following Progress Reports will be issued monthly to the Owner's Project Manager, showing the current status of the project:

A. A project status report covering progress during the past month and plans for the next month in the design engineering, procurement, and construction phases of the project.

B. A bar chart, time-grid network schedule based on Enviro-Chem's CPM will be prepared at the beginning of the work to cover Enviro-Chem design, purchasing, and construction activity. This schedule will be revised monthly, if required, until the plant is mechanically complete.

XI. PROGRESS REPORTS (cont'd)

C. A material and equipment status report covering the purchasing and delivery status of all purchases until all purchases made by Enviro-Chem have arrived at the job site.

D. A construction progress report consisting of an overall construction progress curve.

E. An Enviro-Chem computerized cost report covering the project, comparing the accumulated cost to date, and the projected final cost, against the proposal estimate (plus approved variation orders) submitted with Enviro-Chem's project bid. Once initiated, the cost report will be issued monthly until the plant has been demonstrated and accepted by the Owner.

F. A project cost analysis (PCA) will be issued as necessary to explain itemized deviations in project cost.

Monsanto Enviro-Chem

CHANGE REQUEST

THIS IS A REQUEST – NOT AN AUTHORIZATION

Cost Code Nos. _____

Contract No. _____

Change Request No. _____

PREPARED BY _____ DATE _____

PROC. APPR'L. _____ DATE _____

DES. ENG. APPR'L. _____ DATE _____

CONST. APPR'L. _____ DATE _____

BUS. DIV. APPR'L. _____ DATE _____

REQUESTED BY:

REFERENCE (ALL REQUESTS FOR CHANGE IN SCOPE MUST BE IN WRITING)

DESCRIPTION OF CHANGE – DETAIL SUFFICIENTLY TO PERMIT ACCURATE COST ESTIMATE BY ESTIMATOR, ATTACH SKETCHES. DRAWINGS .VENDOR DATA, ETC., IF NECESSARY. IF ESTIMATING DETAIL IS NOT IMMEDIATELY AVAILABLE, ISSUE THIS REQUEST WITH THE STATEMENT THAT ADDITIONAL INFORMATION WILL BE FURNISHED LATER:

HOME OFFICE MANPOWER REQUIREMENTS (MANHOURS) AND (TRAVEL)

Design Engineering		No. of Trips	Process Design		No. of Trips
Mech.			Technology		
Instr.			Project Mg'mt.		
Piping			Purchasing		
Struct.			Constr. Mg'mt.		
V & P			Field Constr. Supv.		
Elec.			Field Office Mg'mt.		
Model			Est., Sched.,		
P. E.			Cost Control		
Adm.			Office Services		
Total D.E.			Total Support Services		

EC-68 REV. 9/76 (SEE OVER FOR INSTRUCTIONS) CONTINUE ON SEPARATE BLANK SHEET(S)

Monsanto Enviro-Chem

CONTRACT VARIATION ORDER

VARIATION ORDER NO: _____ DATED _____

TO: CONTRACT BETWEEN MONSANTO ENVIRO-CHEM SYSTEMS INC.

AND _____

MONSANTO ENVIRO-CHEM SYSTEMS INC. CONTRACT NO. _____ DATED _____

PROJECT
LOCATION

The following described variations are authorized and accepted in accordance with Article of the contract and the contract is hereby amended accordingly.

Variation order cost basis

Cost of variation

Effect on contract price

Effect on contract schedule

AUTHORIZED:

By _____ Date _____

ACCEPTED:

MONSANTO ENVIRO-CHEM SYSTEMS, INC.

By _____ Date _____

EC-69 REV. 9/76

LIST OF PROPOSED VENDORS OF MATERIAL AND EQUIPMENT

1.	MAIN BLOWER & DRIVE	Allis Chalmers Dresser Elliott Company
2.	CATALYST	Monsanto Enviro-Chem
3.	STEEL PLATE VESSELS & LARGE EXCHANGER	Nooter Chicago Bridge & Iron Chattanooga Boiler Continental Boiler Cyprus Specialty Steel Marathon Steel Mark Steel
4.	STEEL DUCTWORK	Modern Welding Partner Steel Cyprus Specialty Steel Alpine Steel Production Steel Grand Junction Steel Valley Steel Products Marathon Steel Mark Steel
5.	STEEL DUCT BUTTERFLY VALVES (FRISCH TYPE)	Frisch Corporation Mosser, Inc. MEA, Inc. Dally Engineering
6.	STEEL BUTTERFLY VALVES	Keystone Fisher-Governor Grinnell Rockwell Duriron

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

7.	STEEL DUCT GATE VALVES	American Darling Atwood & Morill Co. Crane - Chapman Div. Patterson - Ludlow Gas Machinery
8.	STEEL DUCT EXPANSION JOINTS	Zallea Brothers Pacific Bellows Solar Division Pathway Bellows U. S. Bellows Tempflex
9.	PREHEATER COMBUSTION CHAMBER AND CONTROLS	Thermal Transfer John Zink Company Todd-CEA Air Preheater Co. Coen Company Tran Thermal Smalling Eng. & Equip. Co.
10.	GRAPHITE COOLERS & PUMPS	Carborundum Company Carbone Company Union Carbide Company Kelonite
11.	FANS	American Standard Westinghouse Electric Zurn Industries Garden City Chicago Blower Company New York Blower Company Harrington Industrial Plastics
12.	MIST ELIMINATORS (BRINK)	Monsanto Enviro-Chem

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

13.	MIST ELIMINATOR (MESH PAD)	York ACS Industries Koch Engineering
14.	VERTICAL STRONG ACID PUMPS	Chas. S. Lewis
15.	HORIZONTAL ACID & WATER PUMPS	Gould Worthington Duriron Wilfley Fairbanks-Morse Ingersoll Rand Peerless Pumps Sethco Deming Galigher Byron Jackson
16.	CAST IRON CASTINGS (TOWER INTERNALS)	Banner Iron Works Steel Products Corp.
17.	CAST IRON PIPE & FITTINGS	Clow Corporation U. S. Pipe American Alabama Pipe
18.	TOWER PACKING	Norton Company Maurice A. Knight Mass Transfer Koch Engineering
19.	QUARTZ PEBBLES	Southern Products & Silica
20.	A-20 ACID VALVES (GATE, GLOBE, PLUG)	Stockham Aloyco (Walworth)

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

21.	ACID VALVES (BUTTERFLY)	Duriron Fisher Controls Mosites Jamesbury Hills-McCanna Garseal
	(Must have same face-to-face thickness as Centerline)	
22.	ACID PROOF BRICK	Hanley Harbison-Walker A. P. Green Belden Brick
23.	ACID PROOF CEMENT	Pennwalt Atlas Mineral Products
24.	ACID PROOF MASTIC	Pecora
25.	FIREBRICK: INSULATING FIREBRICK & MORTAR	C. E. Refractories (Walsh) Babcock & Wilcox Company Harbison-Walker Kaiser Refractories H. K. Porter A. P. Green
26.	FABRICATED STRUCTURAL STEEL SUPPORTS, PLATFORMS, ETC.	Banner Iron Works Grand Junction Steel Mississippi Valley Konsler Steel Modern Welding Titan Steel McNally Mountain States Western Steel Marathon Steel Mark Steel

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

27.	INSULATION MATERIALS	Eagle-Picher Owens-Corning Pittsburgh Corning Forty-Eight Insulations Baldwin-Ehret-Hill Philip Carey Johns Manville
28.	MOTOR CONTROL CENTERS	Square "D" Cutler Hammer Westinghouse General Electric ITE Imperial Allen Bradley Allis Chalmers
29.	ELECTRIC MOTORS	General Electric Westinghouse Allis Chalmers Reliance U. S. Electrical Electrical Machinery
30.	INSTRUMENTATION	Leeds & Northrup Beckman Fischer & Porter DuPont Fisher Controls Honeywell Foxboro Taylor Republic Scam
31.	STRONG ACID COOLERS	Chemetics
32.	EXCHANGERS, PLATE & SPIRAL TYPE	American Heat Reclaiming APV Co., Inc.

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

33.	VERTICAL WEAK ACID PUMPS	Goulds Pumps Galigher Fybroc
34.	INSTRUMENT PANELS	Panelmatic Utility Control Corp. Gismo Lake Erie Electric Instructor, Inc. Buffalo Electric
35.	FRP VESSELS, DUCT & VALVES	Heil Process Ershig's Justin Corban Industries Chemical Proof Jones & Hunt
36.	POWER CABLE	Anaconda Wire & Cable Co. Okonite Company Phelps-Dodge General Electric
37.	TRANSFORMERS	General Electric Westinghouse Allis Chalmers ITE Imperial
38.	INSTRUMENT AIR DRYER	Kellogg-American Ingersoll-Rand Henderson Pall-Trinity
39.	PLANT AIR/INSTRUMENT AIR COMPRESSOR	Kellogg-American Ingersoll-Rand Gardner-Denver

LIST OF PROPOSED VENDORS OF MATERIAL & EQUIPMENT

40.	VERTICAL COOLING WATER PUMPS	Goulds Johnston Worthington Peerless
41.	WATER COOLING TOWERS	Ecodyne Marley Lilie-Hoffman

EXHIBIT E

FIXED FEE PAYMENT SCHEDULE *

SULFURIC ACID PLANT

ASARCO, INCORPORATED
El Paso, Texas

2102

DATE	FEE	CUMULATIVE
February 1, 1977	45,400	45,400
March 1, 1977	43,800	89,200
April 1, 1977	43,800	133,000
May 1, 1977	43,800	176,800
June 1, 1977	43,800	220,600
July 1, 1977	43,800	264,400
August 1, 1977	43,800	308,200
September 1, 1977	43,800	352,000
October 1, 1977	43,800	395,800
November 1, 1977	43,800	439,600
December 1, 1977	43,800	483,400
January 1, 1978	43,800	527,200
February 1, 1978	43,800	571,000
March 1, 1978	43,800	614,800
April 1, 1978	43,800	658,600
May 1, 1978	43,800	702,400
June 1, 1978	43,800	746,200
July 1, 1978	43,800	790,000

* Each monthly payment subject to 10% withholding by Owner. Such withheld amounts to be paid in full upon acceptance of the plant in accordance with Article 5 of the Contract Agreement.

PRM
1/14/76 Rev.