

ENGINEERING DESIGN SEMINAR

SEPTEMBER 6, 1994 – NOVEMBER 11, 1994

PROJECT ENGINEERING

ENGINEERING DEPARTMENT

The Department is composed of three main groups which function as follows:

Process Design Engineering

This group is responsible for producing the Process Specifications. These specifications include the following:

- Material or mol balance
- Heat and weight balance
- Reactor volumes
- Fractionator sizes and tray layouts
- Heater duties
- Compressor duties
- Enthalpy curves
- Process flow diagrams with all control instrumentation

Project Design Engineering

This group which includes the Off-Sites Department is responsible for producing the Schedule "A" engineering. They are also responsible for issue of all ancillary specifications, such as the project schedule and distribution specifications which do not go into the Schedule "A" Book. The Schedule "A" Package for a licensed process unit contains some of the following:

- Heaters
- Vessels
- Exchangers
- Pumps and Compressors
- Instruments
- Piping
- Piping and Instrumentation Drawings (P and I D's)

The Off-Sites Department functions in a manner similar to the process unit project group except their Schedule "A" engineering contains some of the following:

- Utility P and ID's
- Steam balances
- Tankage
- Electrical switchgear
- Fuel systems
- Loading systems
- Cooling water systems
- Waste disposal systems

Engineering Services

This section includes the following specialty and support groups which assist in preparation of the Schedule "A" engineering:

Instrument Department. This Department is responsible for preparing all instrument specifications and for reviewing the relief valve specification.

Heat Transfer and Hydraulics. This Department is composed of the Heater, Exchanger and Pump/Compressor Groups.

Project Management. This Department provides assistance on UOP projects when requested by customer.

Metallurgical. This group is responsible for assisting other areas with metallurgy selection.

Design and Planning. This group handles all structural and pressure vessel and related design work and also prepares the piping specifications.

Engineering Drafting. This group is responsible for preparation and checking of all P and ID's and for vessel drafting. They also do all detail drafting when UOP does the detailed engineering on a job.

CADD System. This group is responsible for all drafting work to be done on the CADD System. This includes the preparation of all process flow diagrams.

Cost and Utility Estimating. This Department prepares cost estimates for all work done by the Marketing and Engineering Departments. They also estimate the required man-hours and engineering costs for all engineering and sales projects when initiated. This is not normally done for Service projects. The Utilities group is a part of the Engineering Services department.

UOP PROJECT MANAGEMENT SERVICES

UOP's Construction Project Management group provides services to assist refiners in implementation of a project from the basic engineering design specifications to a completed plant, ready for commissioning. During this period, the activities which must be carried out include detailed engineering, procurement of equipment and materials and construction of the plant. Refiners typically engage the services of an engineering, procurement and construction (EPC) contractor to perform these functions. UOP's project management services are provided to assist refiners in planning the project, selecting a competent EPC contractor and monitoring the contractor's work.

The refiner must maintain an active role in the project during the implementation phase (either directly or by the appointment of a project management consultant) to assure that the objectives of constructing a quality plant at a reasonable cost and in a timely manner will be achieved. The refiner contracts to the EPC contractor the responsibility to engineer, procure and construct the plant in accordance with the basic engineering design specifications, generally for a fixed price and within a specified time of completion. The EPC contractor must develop the procedures, plans and resources by which he intends to carry out the work. He must also demonstrate to the

refiner that he is in compliance with the contractual requirements. The role of the refiner (or his project management consultant) is to establish clearly at the outset, the EPC contractor's obligations and to interpret and clarify these obligations as necessary during implementation of the project. He should evaluate the EPC contractor's proposed implementation plans and monitor the EPC contractor's activities until, ultimately, the refiner accepts the completed plant. These functions require considerable attention on the refiner's part to ensure a successful project.

UOP's project management services are available to refiners who require a qualified third party to act on the refiner's behalf during project implementation. The selection of UOP reflects a desire on the refiner's part to utilize UOP's qualifications and resources as process licensor and designer to implement a high quality project. A particular advantage to a refiner of UOP's project management services is the ready access to resources within UOP's organization such as design engineering, cost estimating, mechanical design, equipment specialists, inspection, etc. These are coordinated by the Construction Project Management group when their participation in the project management services is appropriate.

The scope of UOP's project management services depends on the specific project and the refiner's own resources. UOP may undertake total project management on the refiner's behalf, supply experienced personnel to supplement the refiner's project management organization, or perform spot consultancy services during the implementation of projects. Typical project management activities of the owner or his project management consultant include the following:

PROJECT MANAGEMENT ACTIVITIES

EPC Contractor Selection

- Qualification of Bidders
- Preparation of Invitation to Bid Documents
- Conducting Bidder's Meeting
- ITB Clarifications and Addenda
- Evaluation of Contractor's Bids
- Negotiations and Recommendation for Award

Contract Administration

- Conduct Project Kickoff Meeting
- Review and Implement Coordination Procedures
- Verify Contractor's Invoicing

Quality Assurance

- Review Contractor's Quality Assurance Plan
- Audit QA Documentation for Compliance with Contract Requirements
- Perform Shop Inspections of Selected Equipment

Cost Estimating and Control

- Prepare Cost Estimate for Appropriation and Control Purposes
- Implement Procedures to Report and Control Owner's Costs
- Review Contractor's Cost Control Procedures
- Evaluate Contract Change Orders

Schedule Control

- Prepare Overall Summary Project Schedule
- Review Contractor's Detailed Project Schedule
- Review Contractor's Plans for Mobilization of Resources
- Review Contractor's Procedures for Reporting Actual Project Status
- Review Contractor's Periodic Status Reports
- Review Contractor's Schedule Recovery Plans

Monitor Contractor's Detailed Engineering Activities

- Provide Resident Engineer(s) in Contractor's Design Office
- Provide Clarification of the Basic Engineering Design Specifications
- Review and Approve Selected Contractor Engineering Documents
- Review Engineering Manning Levels and Progress against Schedule

Monitor Contractor's Procurement Activities

- Review Vendor Lists
- Review Selected Requisitions and Purchase Orders
- Review Order Status Reports for Compliance with Project Schedule
- Review Vendor Drawings for Selected Equipment
- Review Contractor's Expediting Reports
- Establish Spare Parts Requirements and Ensure Compliance

Monitor Contractor's Construction Activities

- Provide Resident Construction Advisor and Inspectors
- Monitor Contractor's Field Inspections
- Audit Contractor's Field QA Documentation
- Review Contractor's Construction Status Reports
- Audit Construction Progress and Resource Levels against Schedule
- Coordinate Contractor's and Owner's Precommissioning Activities
- Recommend on Owner's Acceptance of the Completed Work

PROJECT ENGINEERING

Role of Project Engineer

Manage the Job

- Plan
- Organize
- Control
- Communicate

Produce Schedule A Design

Begin with:

Process Specification

- Process Flow Diagram**
- Heat and Weight Balances**
- Equipment Process Requirements**

Basic Engineering Design Questionnaire

- Introduction**
- Instructions**
- General Information**
- Coordination Procedures**
- Design Philosophy**
- Utility Information**
- Mechanical Equipment Information**
- Site Information**
- Miscellaneous Information**

Scope of Schedule A Design

- General Specifications**
- Fired Heaters**
- Vessels**
- Heat Exchangers**
- Pumps and Compressors**
- Instruments**
- Electrical**
- Piping**
- Miscellaneous**
- Piping and Instrumentation Diagram**
- Drawings**
- Standard Specifications**

Specific Duties of Project Engineer

Prepare Schedule

Bar Chart Project Engineer's Time

Bar Chart (and coordinate) Specialty Groups

Prepare Basic Engineering Design Data Sheets

Review Metallurgy

Calculate Line Sizes

Calculate Hydraulics - Set Design Conditions

Calculate Recycle Gas Circuit Hydraulic Profile

Calculate Charge Pump Hydraulics

Control Valve - 3 cases

Pump Head - 3 cases

Produce Piping and Instrumentation Diagram

Purpose of P&ID

Coordination of Information

Basic Arrangement of Equipment and Piping

Notes and Details not in Project Specifications

Control, Monitoring, Alarm and Shutdown

Instrumentation

Equipment and Piping Requirements

Heaters

Vessels/Reactors

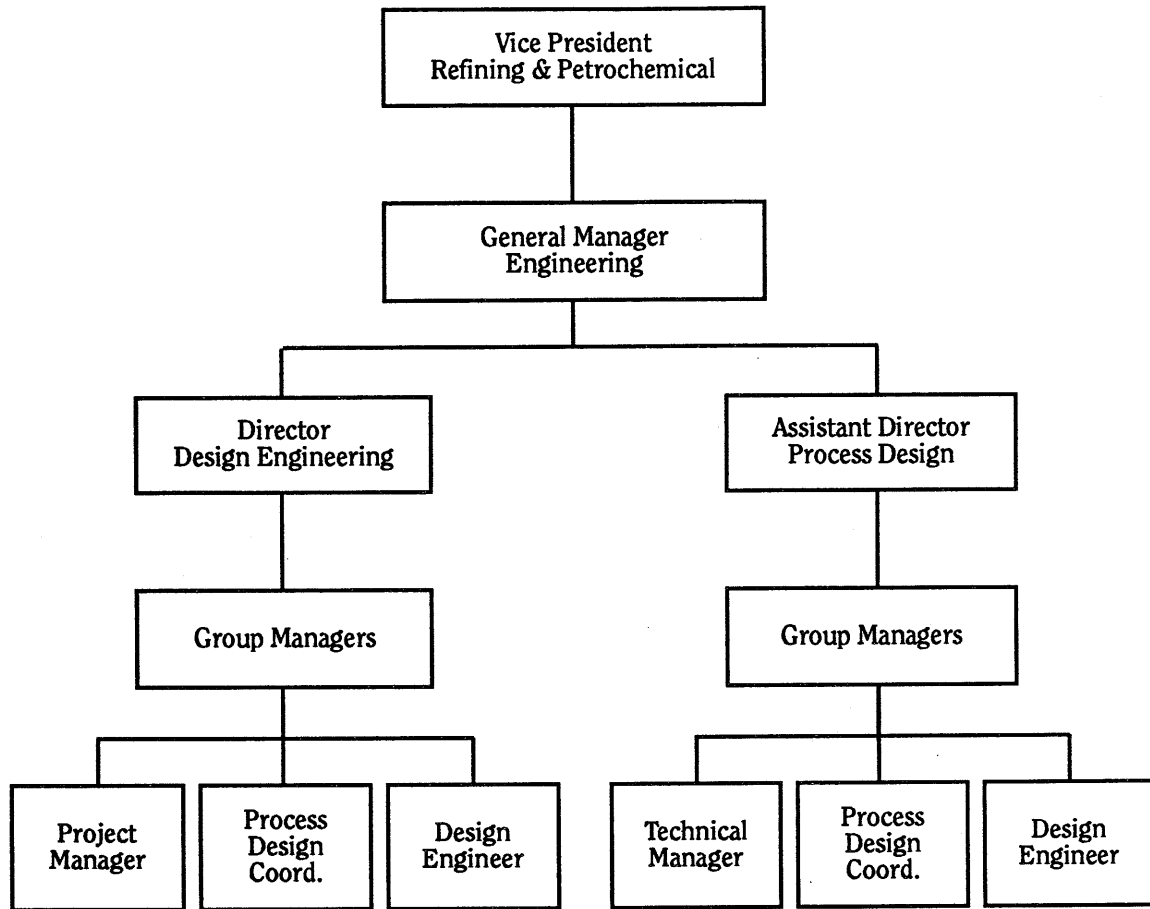
Exchangers
Condensers
Pumps
Compressors
Piping
Relief Valves

Instrumentation Requirement

Temperature
Pressure
Flow
Control Valves
Level
Special Type Instruments

Review Documents Requested in Specification 111

UOP Functional Organization Chart



EDS-R00-3120

ENGINEERING DEPARTMENT

Process Engineering

Design Engineering

Project Engineering

Off-Sites Engineering

Engineering Services

Process Engineering

Mol or material balance

Heat and material balance

Reactor volume

Fractionator, Size and Trays

Heater duty

Compressor duty

Enthalpy Curves

Process flow diagram

All control instruments

Design Engineering

Project Engineer

Heater

Vessels/Reactors

Exchangers/Air coolers

Pumps/Compressors

Instruments

Piping/Relief Valves

P & I Diagrams

Design Engineering

Off-Site Engineer

Utility P & I Diagrams

Steam balances

Boiler specifications

Electrical systems

Fuel systems

Loading systems

Tankage

Cooling tower

Waste disposal systems

Safety systems

Fire-fighting equipment

Engineering Services

Design and planning

CADD system

Engineering drafting

Heat transfer and hydraulics

Instrument department

Cost and utility estimating

Metallurgical

Project management

Project Engineering

Role of the Project Engineer

- Manage job**

- Produce Schedule "A" design**

Specific Duties

- Schedule job**

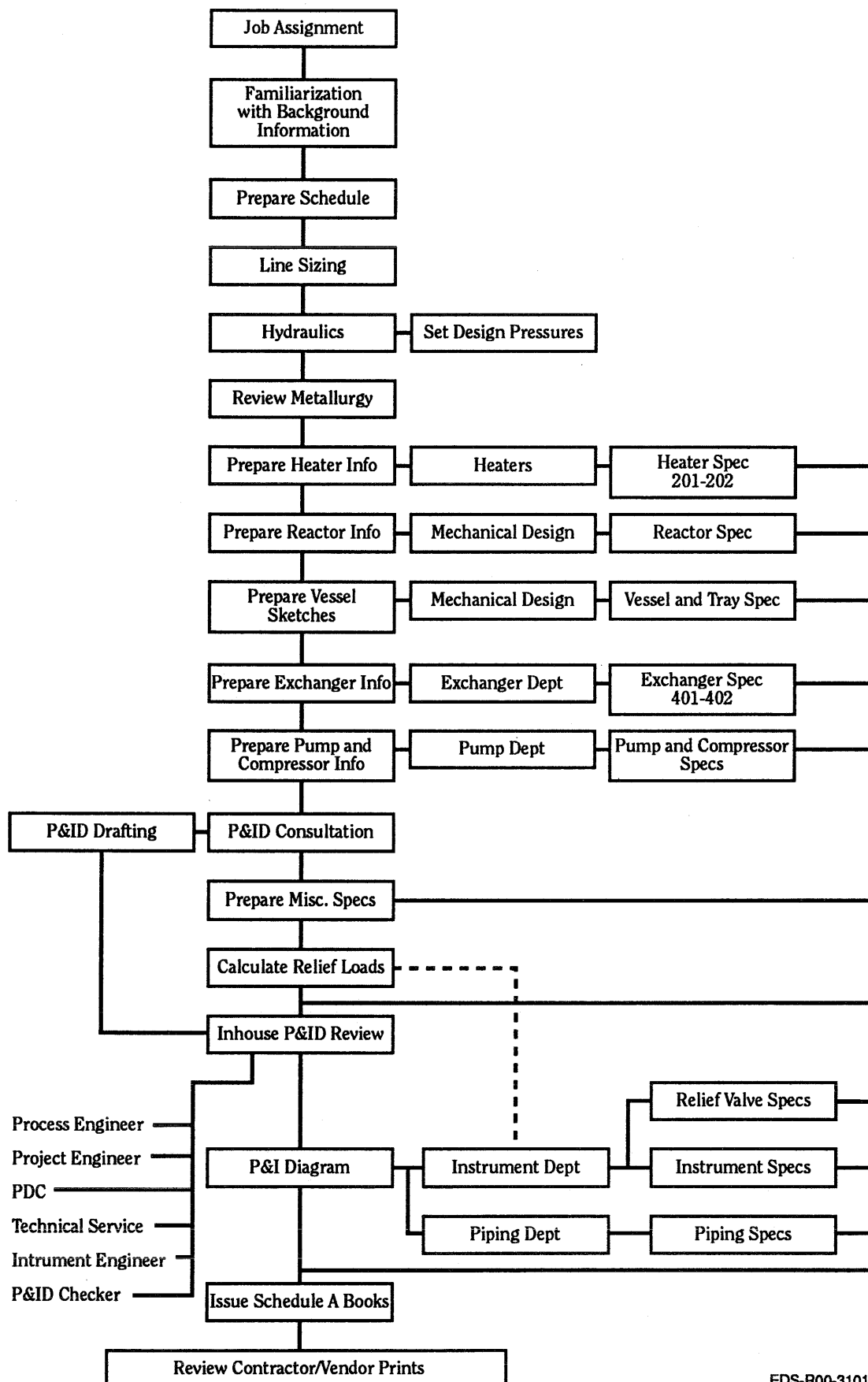
- Hydraulic calculations**

- Set design conditions**

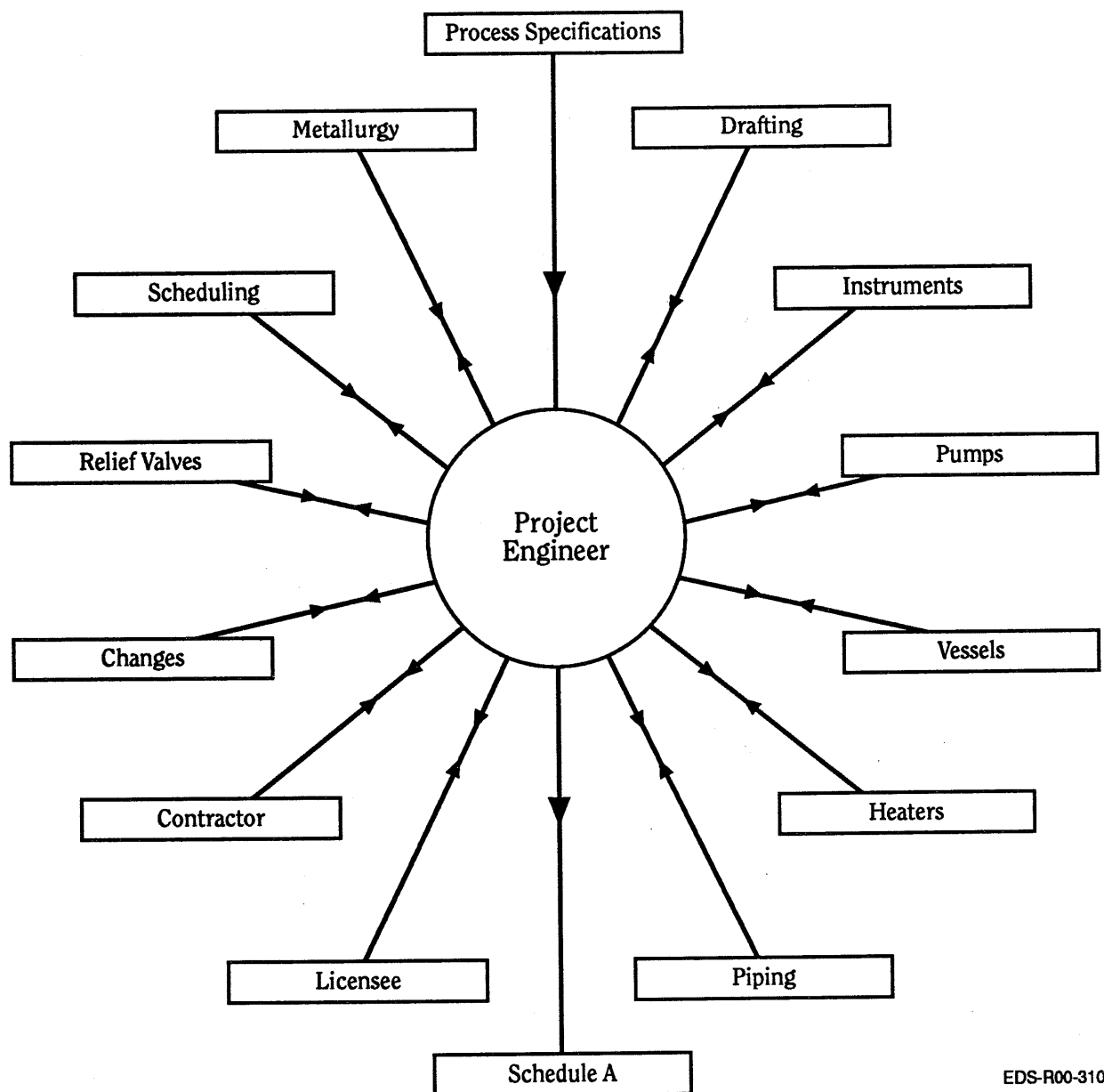
- Coordinate specialty groups**

- Coordinate development of P & I D**

A look at hydraulics



EDS-R00-3101



EDS-R00-3102

MANAGE THE JOB

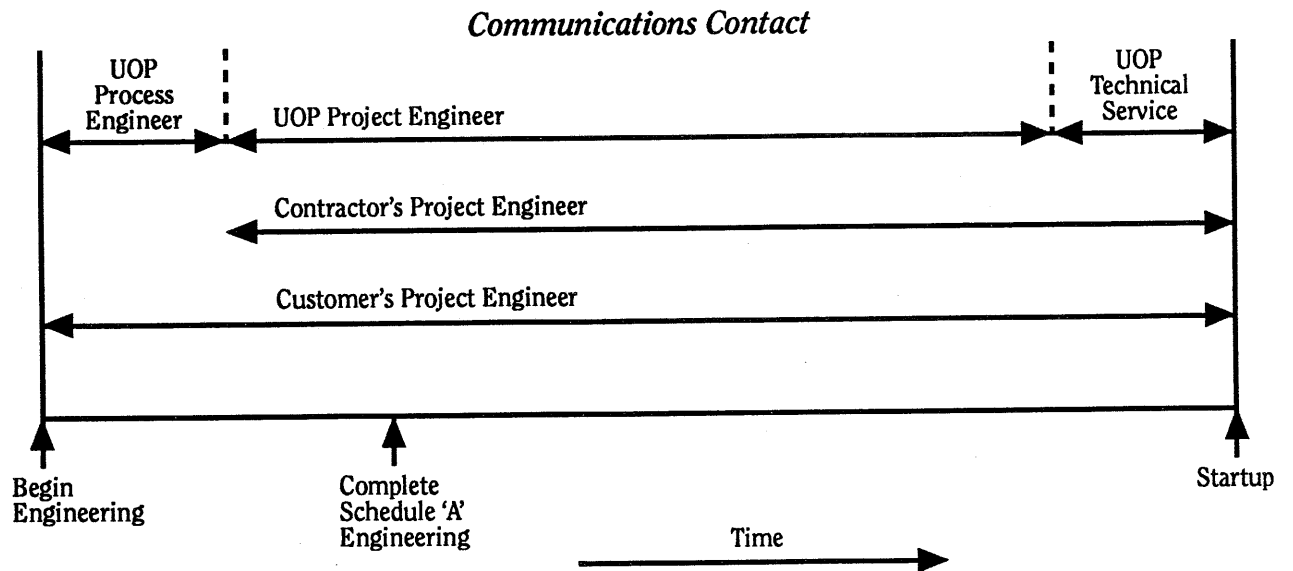
Plan

Organize

Control

Communicate

Communications Contact



EDS-R00-3103

PRODUCE SCHEDULE "A" DESIGN

Start With:

Design basis

Pre-Job correspondence

Process specifications

B E D Q

Engineering Agreement

CRUDE DISTILLATION PROCESS UNIT PROCESS SPECIFICATIONS

Description

An Atmospheric Crude Distillation Unit to produce unstabilized gasoline, kerosene, diesel, atmospheric gas oil and reduced crude.

Design Basis

1. L. G. Herning memo, 8-6-80 (meeting of 8-4/5-80).
2. Schedule B of Engineering Agreement (received 8-25-80).
3. Customer telex to L. G. Herning, 9-5-80.
4. L. G. Herning memo to R. J. Van de Cotte, 9-25-80.
5. Customer telex to L. G. Herning, 9-25-80.

Charge Stock

100000 bpsd of spiked Prudhoe Bay crude.

Process Flow Diagram No.

107758-NX

Note: These process specifications are for design purposes only and, while useful as a guide in operations, do not necessarily represent exact operating conditions or guarantees.

CRUDE DISTILLATION UNIT PROCESS SPECIFICATIONS
"ESTIMATED" YIELDS

Nominal Cuts	°API	UOP K	mol wt	bpsd	lb/h	mph	LV-pct
Crude	27.6	11.70	241.600	99100	1286063	5324.01	100.00
Est'd Yields							
C ₃	—	14.70	44.094	387	2863	64.92	0.39
i-C ₄	—	13.81	58.120	149	1221	21.01	0.15
n-C ₄	—	13.50	58.120	515	4394	75.60	0.52
i-C ₅	—	13.05	72.146	386	3523	48.84	0.39
n-C ₅	—	13.03	72.146	644	5932	82.22	0.65
S.R. Naphtha	51.5	11.64	112.000	16560	186826	1668.09	16.71
Kerosene	40.4	11.56	156.000	5688	68317	437.93	5.74
Diesel	35.0	11.56	193.000	10098	125219	648.80	10.19
Atmos. Gas Oil	29.9	11.57	248.000	11922	152503	614.93	12.03
Red. Crude (1)	16.6	11.67	442.500	52751	735265	1661.67	53.23
Spiked Crude	28.2	11.70	235.900	100000	1292558	5478.92	100.90
Est'd Yields							
C ₂	—	18.81	30.068	120	718	23.88	0.12
C ₃	—	14.70	44.094	1167	8640	195.95	1.17

Notes: (1) Properties reflect "Lt Ends" being included.

	Crude	SRN	Kero	Diesel	AGO	Reduced Crude
wt-pct S	1.02	0.009	0.1000	0.2500	0.670	1.56
wt-pct N	0.19	—	0.0001	0.0005	0.018	0.33
Pour Pt., °F	25.00	—	-67.0000	-26.0000	22.000	65.00
Newt. No. mg KOH/gm	0.40	—	0.0400	0.0400	0.060	—



25 East Algonquin Road
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HEAT AND WEIGHT BALANCES

Design Engineering Seminar

Crude Distillation Unit

PAGE NO. 4

DATE 9-4-80

PROJECT 8632

BY RJV

ENGINEERING DEPARTMENT

Crude Exchange Train

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STREAM	°API (LB/GAL)	K	MW	FLOWING SP. GR. (LB/CF)	°F	PSIG (MM HG ABS)	BPSD @ 60°F (10 ⁶ SCF/D)	FLOWING GPM (CFS)	MOLS PER HR.	LB/HR	BTU/ LB	10 ⁶ BTU/HR
Spiked Crude to Napahtha PA Exchange	28.2	11.7	235.9	0.868	75		100,000	2,978		1,292,558	6	7.94
Crude - Napahtha PA Exchange Duty												61.50
Crude to Kerosene Product Exchange	28.2	11.7	235.9	0.823	183		100,000	3,141		1,292,558	54	69.44
Crude - Kerosene Product Exchange Duty												5.89
Crude to Diesel Product Exchange	28.2	11.7	235.9	0.820	191		100,000	3,152		1,292,558	58	75.33
Crude - Diesel Product Exchange Duty												16.52
Crude to AGO Product Exchange	28.2	11.7	235.9	0.810	215		100,000	3,191		1,292,558	71	91.85
Crude - AGO Product Exchange Duty												26.33
Crude to No. 1 Diesel PA Exchange	28.2	11.7	235.9	0.792	255		100,000	3,264		1,292,558	91	118.18
Crude - No.1 Diesel PA Exchange Duty												17.35
Crude to Desalter	28.2	11.7	235.9	0.781	280		100,000	3,310		1,292,558	105	135.53
Desalter Water to Brine Exchange	(8.327)		18.0	0.994	100		5,000	147		72,949	40	2.91
Desalter Water - Brine Exchange Duty												8.06
Water to Desalter	(8.327)		18.0	0.960	210		5,000	152		72,949	150	10.97
Total to/from Desalter					275	110(1)	105,000			1,365,507		146.50
Brine to Desalter Water Exchange	(8.327)		18.0	0.931	275		4,763	149		69,494	216	15.00
Desalter Water - Brine Exchange Duty												8.06
Brine to Cooler	(8.327)		18.0	0.978	160		4,763	142		69,494	100	6.94
Brine Cooler Duty												4.17
Brine to Disposal	(8.327)		18.0	0.994	100		4,763	140		69,494	40	2.77
Note: (1) minimum pressure required to prevent Flashing.												



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HEATER SUMMARY (ENGLISH)

Crude Distillation Unit

PAGE NO.

17

DATE

9-26-80

PROJECT

8632

BY

RJV

SERVICE	ITEM NO. HEATER NAME				
		Crude	Alternate ⁽¹⁾ Crude		
COMPUTER DATAFILE ID					
STREAM NUMBER IN/OUT					
CHARGE TO HEATER	LB/HR	1,138,808	1,183,217		
* RELATIVE DENSITY @ 60°F	°API				
* MOLECULAR WEIGHT					
* UOP (K)					
** HEAT ABSORPTION	10 ⁶ BTU/HR	186.78	194.27		
INLET CONDITONS					
TEMPERATURE	°F	522	520		
ESTIMATED PRESSURE	PSIG	145	145		
WEIGHT % VAPOR		0	0		
LIQUID DENSITY @ FLOWING TEMP	LB/CF	44.38	43.80		
VAPOR DENSITY	LB/CF				
VAPOR MOLECULAR WEIGHT					
*** VISCOSITY LIQ/VAP	CP				
*** SPECIFIC HEAT LIQ/VAP	BTU/LB—°F				
*** THERMAL COND. LIQ/VAP	BTU/HR—FT—°F				
ENTHALPY	BTU/LB	253	251		
MOL % HYDROGEN IN VAPOR					
MOL % H ₂ S IN VAPOR					
WEIGHT % SULFUR IN LIQUID		1.02	1.02		
OUTLET CONDITIONS					
TEMPERATURE	°F	709	701		
ESTIMATED PRESSURE	PSIG	20	20		
WEIGHT % VAPOR		35.13	38.38		
LIQUID DENSITY @ FLOWING TEMP	LB/CF	43.56	50.26		
VAPOR DENSITY	LB/CF	0.535	0.517		
VAPOR MOLECULAR WEIGHT					
*** VISCOSITY LIQ/VAP	CP				
*** SPECIFIC HEAT LIQ/VAP	BTU/LB—°F				
*** THERMAL COND. LIQ/VAP	BTU/HR—FT—°F				
ENTHALPY	BTU/LB	417	415		
HEATER TYPE (If Preference)					
FUEL TYPE (If Restrictive)					
DESIGN PRESSURE					

NOTES:

- * FOR CASES WHEN CHARGE IS 100% LIQUID
- ** IF A CONTINGENCY IS ADDED TO NORMAL HEAT ABSORPTION, PROVIDE DESIGN CONDITONS AND INFORMATION IN A SEPARATE COLUMN
- *** NOT NECESSARY IF COMPUTER DATAFILE AVAILABLE

Note: (1) Alternate Operation with Vacuum Unit Down.



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PROJECT SPECIFICATION

— 307 —

SHEET

TRAYS AND PACKING (RANDOM AND STRUCTURED)

REV	DATE	BY	APP'D	REV	DATE	BY	APP'D

SERVICE Crude Column

ITEM NO

Tray Data

Type of Unit Crude Distillation

Tray Identification (Tray Numbers)

	1-3	4-16	17-27	28-30
Vessel ID, ft-in (min)	19-6	19-6	19-6	19-6
Operating Pressure, psig	11	11	12	12
Operating Temperature, °F	330	350	410	490
Structural Design Temperature, °F				
Fluid Description	Naphtha	Naphtha	Kerosene	Diesel
Foam Derating Factor	1.0	1.0	1.0	1.0
Vapor - Flow Rate, lb/h	495,269	650,237	601,470	605,914
Density, lb/ft ³	0.268	0.285	0.290	0.303
Liquid - Flow Rate, lb/h	686,370	408,758	293,520	451,304
Density, lb/ft ³	42.43	41.81	41.93	41.93
Viscosity, cP	0.27	0.27	0.26	0.27
Surface Tension, dynes/cm	13	13	13	13

Type of Tray

For Sieve Trays

Weir Height, M, in	2	2	2	2
Downcomer Clearance, N, in	1.5	1.5	1.5	1.5
Total Number of Holes	12,575	13,995	13,995	12,575
Hole Diameter, in	0.5	0.5	0.5	0.5
Hole Area/Bubbling Area x 100	7.6	7.1	7.1	7.6
Tray Spacing, S, in (For exceptions see Project Specification 301 Vessels)	30	30	30	30

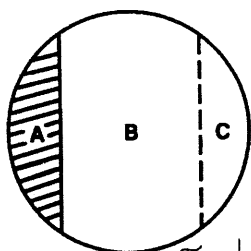
Notes (1) Loadings Shown are Vapor to Tray; Liquid from Tray

(2) Trays must operate satisfactorily at 60% of Loadings Shown.

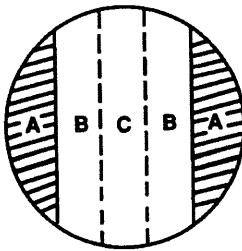
Tray Layout

Number of Passes	4	2	2	4
A, in	14.5	14.5	14.5	14.5
B, in	41.75	97.75	97.75	41.75
C, in	12.5	9.5	9.5	12.5
D, in	41.73			41.75
E, in	13			13
F, in				
G, in				

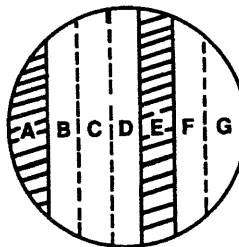
1-Pass Tray



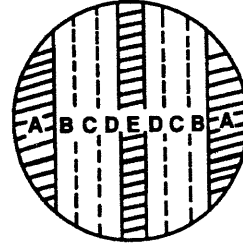
2-Pass Tray



3-Pass Tray



4-Pass Tray



Maximum allowable overall pressure drop for vessel is 5 psi

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PROJECT SPECIFICATION

— 307 —

SHEET

TRAYS AND PACKING (RANDOM AND STRUCTURED)

REV	DATE	BY	APP'D	REV	DATE	BY	APP'D

SERVICE Crude Column

ITEM NO

Tray Data

Type of Unit Crude Distillation

Tray Identification (Tray Numbers)

	31-37	38-40	41-46	47-52
Vessel ID, ft-in (min)	19-6	19-6	19-6	9-6
Operating Pressure, psig	13	14	14	15
Operating Temperature, °F	510	575	595	675
Structural Design Temperature, °F				
Fluid Description	Diesel	AGO	AGO	Red. Crude
Foam Derating Factor	1.0	1.0	1.0	1.0
Vapor - Flow Rate, lb/h	714,550	957,108	1,080,798	92,558
Density, lb/ft ³	0.317	0.385	0.396	0.1766
Liquid - Flow Rate, lb/h	284,747	1,358,319	502,468	810,216
Density, lb/ft ³	41.31	42.106	41.50	44.43
Viscosity, cP	0.27	0.28	0.28	0.4
Surface Tension, dynes/cm	13	13	13	16

Type of Tray

For Sieve Trays

Weir Height, M, in	2	2	2	2.25
Downcomer Clearance, N, in	1.5	1.5	1.5	1.75
Total Number of Holes	13,995	15,725	17,490	2,250
Hole Diameter, in	0.5	0.5	0.5	0.5
Hole Area/Bubbling Area x 100	7.1	9.5	8.9	7.2

Tray Spacing, S, in (For exceptions see Project Specification 301 Vessels)

30	30	30	30
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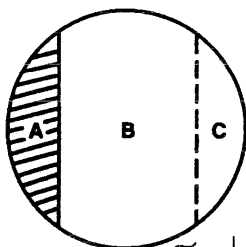
Notes (1) Loadings Shown are Vapor to Tray; Liquid from Tray

(2) Trays must operate satisfactorily at 60% of Loadings Shown.

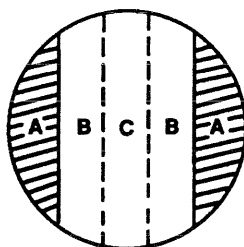
Tray Layout

Number of Passes	2	4	2	3
A, in	14.5	14.5	14.5	12.75
B, in	97.75	41.75	97.75	21.0
C, in	9.5	12.5	9.5	12.75
D, in		41.75		21.0
E, in		13		12.75
F, in				21.0
G, in				12.75

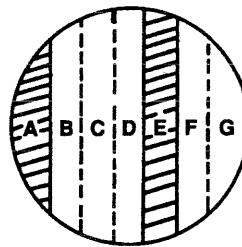
1-Pass Tray



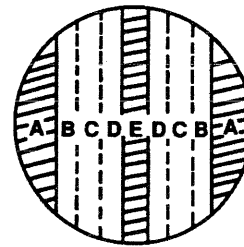
2-Pass Tray



3-Pass Tray



4-Pass Tray



Maximum allowable overall pressure drop for vessel is 5 psi

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PROJECT SPECIFICATION

— 307 —

SHEET

TRAYS AND PACKING (RANDOM AND STRUCTURED)

REV	DATE	BY	APP'D	REV	DATE	BY	APP'D

SERVICE Crude Tower Sidecut Strippers

ITEM NO

Tray Data

Type of Unit Crude Distillation

Tray Identification (Tray Numbers)

	AGO Stripper 1-6	Diesel Stripper 1-6	Kerosene Stripper 1-6
Vessel ID, ft-in (min)	5-6	5-0	4-0
Operating Pressure, psig	14	13	12
Operating Temperature, °F	555	500	425
Structural Design Temperature, °F			
Fluid Description	AGO	Diesel	Kerosene
Foam Derating Factor	1.0	1.0	1.0
Vapor - Flow Rate, lb/h	20,410	16,874	9,272
Density, lb/ft ³	0.181	0.176	0.172
Liquid - Flow Rate, lb/h	168,938	138,726	75,693
Density, lb/ft ³	42.06	41.93	41.93
Viscosity, cP	0.28	0.27	0.26
Surface Tension, dynes/cm	13	13	13

Type of Tray

For Sieve Trays

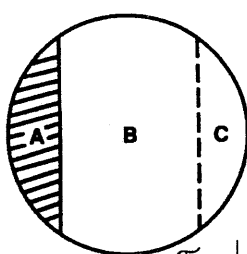
Weir Height, M, in	2	1.75	1.75
Downcomer Clearance, N, in	1.75	1.5	1.5
Total Number of Holes	490	410	230
Hole Diameter, in	0.5	0.5	0.5
Hole Area/Bubbling Area x 100			
Tray Spacing, S, in (For exceptions see Project Specification 301 Vessels)	24	24	24

- Notes (1) Loadings Shown are Vapor to Tray; Liquid from Tray
 (2) Trays must operate satisfactorily at 60% of Loadings Shown.
 (3) Consider Stacking Sidecut Strippers

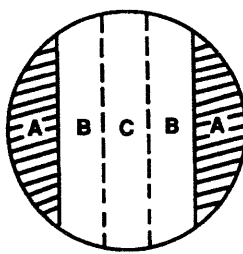
Tray Layout

Number of Passes	2	2	1
A, in	10.25	9.25	11
B, in	17.5	16	26
C, in	10.5	9.5	11
D, in			
E, in			
F, in			
G, in			

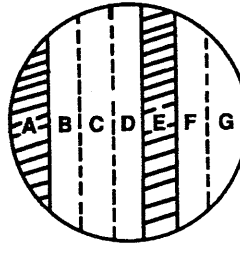
1-Pass Tray



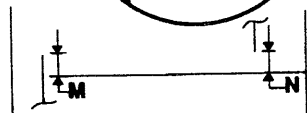
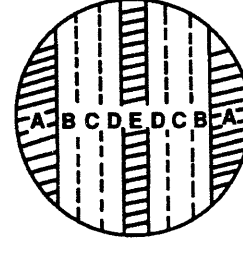
2-Pass Tray



3-Pass Tray



4-Pass Tray



Maximum allowable overall pressure drop for vessel is 1.0 psi

EDS-R00-3108

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COMPRESSOR SUMMARY (ENGLISH)

Crude Distillation Unit

PAGE NO: 21

DATE: 9-26-80

PROJECT NO: 8632

CUSTOMER:

UNIT:

BY: RJV

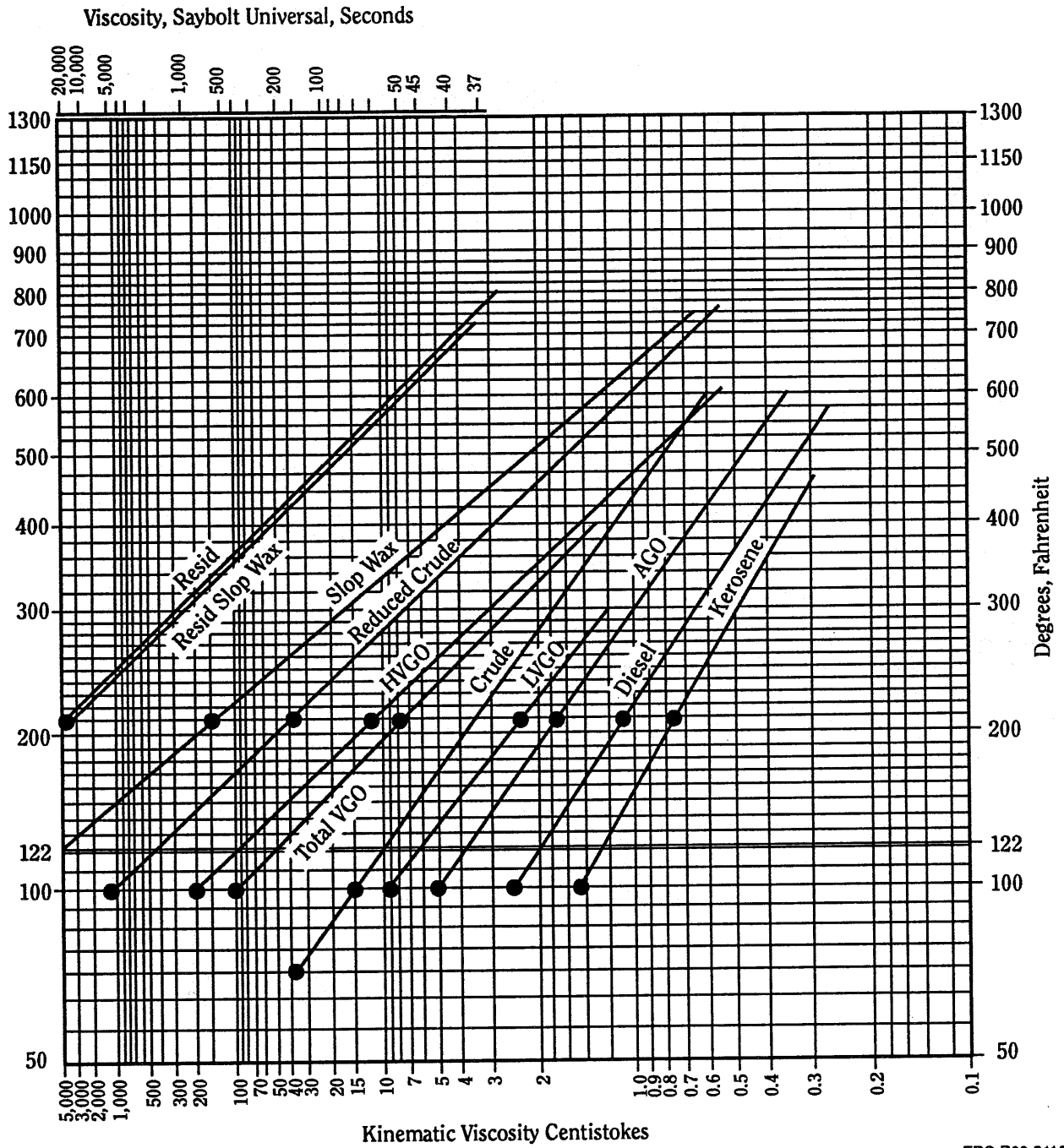
[illegible]

Notes:

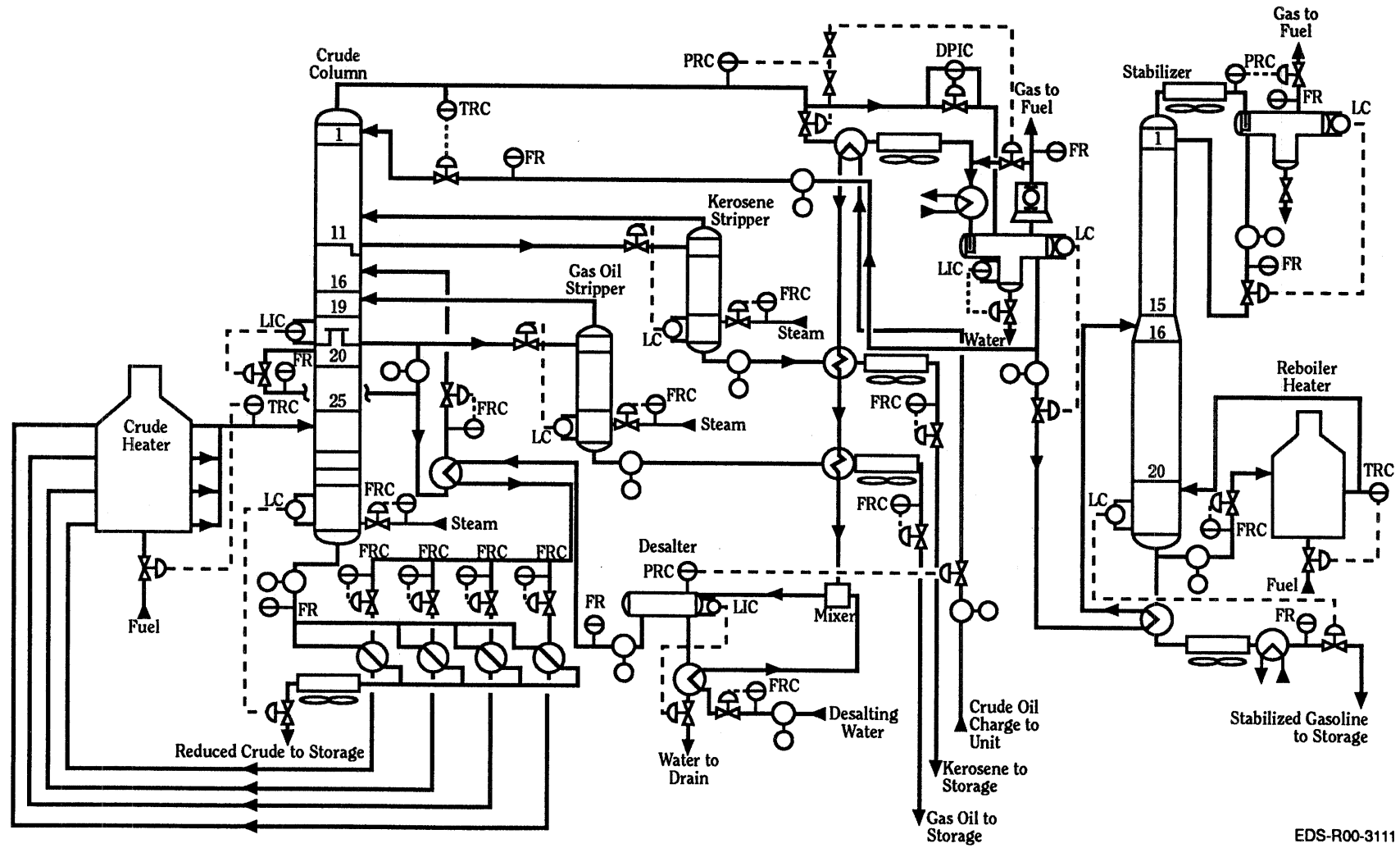
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EDS-R00-3109

Viscosity Chart $C_p = S_p Gr \times C_s$



Process Flow Diagram of Crude Distillation Unit



EDS-R00-3111

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BEDQ
SHEET NO.

BEDQ
SHEET NO.

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NOTE: Sheet is revision 0 unless indicated otherwise.



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BASIC ENGINEERING DESIGN QUESTIONNAIRE

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I. Introduction

The Basic Engineering Design Questionnaire (BEDQ) is intended to provide UOP with the technical information required to complete the Engineering Design Specifications on a once-through basis, with a minimum of revisions or time delay. The Engineering Design Specifications will be prepared in accordance with UOP engineering design practices, as indicated in Article 1.(a) of the Engineering Agreement, unless indicated otherwise in Schedule B of the Engineering Agreement. UOP engineering design practices and philosophy are presented, in part, in this Basic Engineering Design Questionnaire. Owner standards that are more detailed than those covered in this document should be implemented by the Detailed Design Contractor as he incorporates all standards in order to properly implement the project. External distribution of the BEDQ, beyond communication with the Owner, will not be made by UOP. However, UOP encourages the Owner to include the BEDQ along with his detailed standards and additional instructions which are given to the Detailed Design Contractor.

II. Instructions

The information requested in this Basic Engineering Design Questionnaire will enable UOP to complete the Engineering Design Specifications with proper consideration for Owner's preferences and specific technical instructions. The requested information should be provided by appropriate technical personnel within the Owner's organization by filling in or checking the blanks and by crossing out alternatives that do not apply. All items are to be answered as completely as possible. If no data is available, indicate "No Data". If the item is not applicable to the scope of work, indicate "NA". If no preference or criteria exist, indicate "UOP to specify". Use additional sheets if more space is required.

BEDQ information shall be provided as early as possible and must be finalized before the start of UOP's engineering design work. If the Owner's instructions deviate considerably from the terms of Article 1.(a) and Schedule B of the Engineering Agreement, additional charges will be assessed. Significant changes in the BEDQ received after the start of a project may result in a change in represented schedule and/or additional engineering charges.



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III. General Information

A. Name and Location

Indicate Owner's name, plant location and any other specific information as they should appear on project specifications and/or drawing title blocks.

NAME

LOCATION

B. Scope of Facilities

Indicate the process units and offsite facilities to be included in this project. UOP will assign and indicate below appropriate project numbers for each process unit and offsite facility.

C. Standard Specifications, Codes and Practices

UOP engineering design incorporates UOP Standard Specifications and the governing codes or standard practices of the United States. Adaptation of the UOP engineering design to local specifications, codes and practices will be done by the Detailed Design Contractor. If the Engineering Agreement between our two companies requires the inclusion of other specifications, codes, or practices, list the required specifications, codes, and practices and provide two copies of each (in English) as part of this questionnaire.



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III. General Information (Continued)

D. System of Measurement

UOP Engineering Design Specifications will be prepared in accordance with the requirements of the Engineering Agreement. Engineering Design Specifications will be issued in the chosen system of measurement with the exception of piping sizes, pipe classes, UOP Standard Specifications, and UOP Standard Drawings which will use the English system of measurement.

Choose one of the following systems of measurement:

_____English _____mks _____SI

The following table indicates the internationally accepted dimensional units for common properties in each system of measurement. If special instructions relating to the chosen system of measurement are required, these instructions must be clearly marked on the appropriate table below. However, no alteration will be permitted to the internationally defined base conditions for liquids and gases.

	<u>ENGLISH</u>	<u>mks</u>	<u>SI</u>
Temperature	°F	°C	°C
Pressure (gauge)	psig	kg/cm ² (g)	kPa(g)
Pressure (absolute)	psia	kg/cm ² (a)	kPa(a)
Mass	lb	kg	kg
Length	ft-in	m-mm	m-mm
Liquid Relative Density	sp gr T°F/60°F	sp gr T°C/15°C	sp gr T°C/15°C
Liquid Absolute Density	°API or lb/gal at 60°F	kg/m ³ at 15°C	kg/m ³ at 15°C
Vapor Flowing Density	lb/ft ³	kg/m ³	kg/m ³
Flowing Quantities			
Mass	lb/h	kg/h	kg/h
Vapor	ft ³ /s	m ³ /h	m ³ /h
Liquid	US gpm	m ³ /h	m ³ /h
Standard Quantities			
Vapor	10 ⁶ std ft ³ /day at 60°F and 14.696 psia	normal m ³ /h at 0°C and 1.033 kg/cm ² (a)	std m ³ /h at 15°C and 101.325 kPa(a)
Liquid	bpd at 60°F	std m ³ /h at 15°C	std m ³ /h at 15°C
Enthalpy	Btu/lb	kcal/kg	kJ/kg
Heat Rate	10 ⁶ Btu/h	10 ⁶ kcal/h	MW
Viscosity	cP	cP	mPa • s



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III. General Information (Continued)

E. Unit, Equipment and Instrument Numbering

UOP's unit, equipment and instrument numbering system will normally be used. If Owner has an equipment numbering system preference, check here _____ and provide two copies of detailed instructions (in English) defining the system.

Owner's numbering system can be incorporated only at the start of the project. If a numbering system is established after the start of the project then the conversion from one system to the other shall be adapted by the Detailed Design Contractor.



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BASIC ENGINEERING DESIGN QUESTIONNAIRE

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IV. Coordination Procedures

A. Contractual Correspondence

Contractual correspondence relating to this project shall be directed as follows:

To the Owner:

Name _____

Address _____

Attention _____

Telephone _____

Extension _____

Telex _____

Fax _____

To the Contractor:

Name _____

Address _____

Attention _____

Telephone _____

Extension _____

Telex _____

Fax _____

To UOP:

UOP

25 East Algonquin Road

Des Plaines, Illinois 60017-5017 USA

Attention _____

Telephone

708-391-

Telex

211-442

Fax

708-391-2253



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BASIC ENGINEERING DESIGN QUESTIONNAIRE

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IV. Coordination Procedures (Continued)

B. Technical Correspondence

Technical Correspondence relating to this project shall be directed as follows:

To the Owner:

Name

Address

Attention

Telephone

Extension

Telex

FAX

To the Contractor:

Name

Address

Attention

Telephone

Extension

Telex

Fax

To UOP:

UOP

25 East Algonquin Road

Des Plaines, Illinois 60017-5017 USA

Attention

Telephone 708-391-

Telex

211-442

Fax

708-391-2253



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IV. Coordination Procedures (Continued)

C. Correspondence Numbering and Copies

If technical correspondence between Owner and UOP, or Contractor and UOP is to be numbered, indicate if letters, telexes and faxes should be numbered under one consecutive numbering system ____ or under separate numbering systems _____. Numbering system should be as follows:

	Letters	Telexes	Faxes
From Owner to UOP			
From UOP to Owner			
From Contractor to UOP			
From UOP to Contractor			

Indicate any special instructions relating to originals, number of copies, etc.

D. Notes of Meetings

All decisions and instructions resulting from technical meetings held in UOP offices will be recorded as "Notes of Meetings" by UOP. Meetings held outside UOP offices will be recorded by others. Distribution of "Notes of Meetings" shall be made to the attending parties and shall be covered by a transmittal letter numbered in accordance with the correspondence numbering instructions contained in Item C above. If further requirements relating to "Notes of Meetings" are to be considered, indicate below:

E. Telephone Notes

Telephone calls between Owner and UOP or Contractor and UOP shall be confirmed in writing with telex, fax or letter by the originating party.



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IV. Coordination Procedures (Continued)

F. Distribution of Specifications

In accordance with the standard terms of Schedule A of the Engineering Agreement, UOP will furnish up to ten piecemeal copies and up to ten bound copies of the Engineering Design Specifications plus one reproducible set. Piping and Instrument Diagrams included in these piecemeal and bound distributions will be reduced size copies (1/2 width by 1/2 length), except that the recipient of the one reproducible set will receive a full size reproducible transparency plus one full size copy of the Piping and Instrument Diagrams. Indicate below how the piecemeal and bound copies should be distributed and whether the Owner or the Contractor should receive the one reproducible set. Also indicate if additional copies beyond the standard maximum are required.

No. of copies required	Piecemeal	Bound	Reproducible
From UOP to Owner			
From UOP to Contractor			

As provided by the Engineering Agreement with UOP, one copy of each electronically prepared datafile of the Process Flow Diagram and Piping and Instrument Diagrams may be provided upon Owner's request.

If electronically prepared datafiles are required, please indicate when this one time distribution is to be made:

- ____ Along with initial release of Piping and Instrument Diagrams.
____ Along with bound copies of Engineering Design Specifications.

If electronically prepared datafiles are required, please select the medium and file format to be used. The following alternatives are available:

MEDIA:

- ____ Standard Magnetic 1/2 inch Computer tapes (up to 2400 foot length, 1600 BPI)
____ DC6150 (by 3M) 150 Megabyte 1/4 inch Data Cartridge
____ 8mm, 2.3GB Exatape (by Exabyte) Data Cartridge
____ 3 1/2 inch DSHD Floppy Disk



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IV. Coordination Procedures (Continued)

F. Distribution of Specifications (Continued)

FILE FORMAT:

- ☐ Intergraph's Microstation (DGN file format)
- ☐ DXF (Data Exchange Format)
- ☐ IGES (Initial Graphics Exchange Specification)

The UOP CADD System utilizes UNIX computers. Common UNIX backup utilities can be used to write the datafiles on the media types listed above. The UOP CADD System computers can write files to be read by VAX computers and can also write files to DOS formatted floppy disks. Please indicate below what operating system/backup utility preferences you have for the data exchange.

Address for delivery of specifications:

To the Owner:

Name

Address

Attention

To the Contractor:

Name

Address

Attention

Note that delivery of information by courier requires a specific street address and not just a post office box number.



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BASIC ENGINEERING DESIGN QUESTIONNAIRE

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V. Design Philosophy

A. Critical Service Rotating Equipment

Critical service steam or power driven equipment is defined as equipment in that service which must be maintained in the event of power failure in order to protect personnel, equipment, or catalyst. UOP Engineering Design Specifications for drivers of rotating equipment will follow this definition in so far as possible. If further critical driver considerations are required, indicate below.

B. Vacuum Design

UOP Engineering Design Specifications will indicate a vacuum design condition for all equipment that normally operates under vacuum conditions, or is subject to startup, shutdown and/or regeneration evacuation. Vacuum design will also be specified for vessels which normally operate liquid full and that can be blocked in and cooled down, and for fractionators and associated equipment that can undergo a vacuum condition through the loss of heat input. UOP does not design for vacuum due to blocking in after steamout or any other operator misoperation. If further requirements for vacuum design should be considered, indicate below.

C. Tankage

The requirement for gas blanketing of feed storage tanks will be indicated in UOP Engineering Design Specifications where required to eliminate oxygen contamination. Offsite tankage will be the responsibility of the Detailed Design Contractor except when noted in the Engineering Agreement as being within UOP's scope.



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V. Design Philosophy (Continued)

D. Heat Recovery

UOP engineering design may incorporate steam generation and heat recovery facilities based upon process and economic considerations.

If there are special requirements that may influence UOP decisions, indicate below.

E. Proposed Plot Plan

UOP Engineering Design Specifications for new process units will usually include a Proposed Plot Plan indicating a suggested arrangement of process equipment. Indicate available plot area dimensions (with plant North indicated) and provide appropriate drawings including access roads, control room location (if outside the unit), direction from which the piping enters/leaves the unit, and adjacent equipment such as heaters, central stacks or tankage that may affect the plot plan. Also indicate existing equipment that will remain in place as well as major above or below grade obstructions that are to be considered. Indicate if a new control room will be required or show location of existing control room which will be used. The UOP Proposed Plot Plan will be based upon, and will incorporate, only the information provided.

F. Unit Turndown

UOP will review unit hydraulics and fractionator tray layout for short term operation at 60% of unit design throughput. If a different turndown requirement is desired, indicate percent of unit design throughput. ____% Indicate if anticipated turndown operation is short term or long term.



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V. Design Philosophy (Continued)

G. Aromatics Handling

UOP Engineering Design Specifications will incorporate the below-listed design and equipment provisions in order to reduce emissions of benzene, a known carcinogen, and other potentially hazardous aromatics.

1. The design requirements presented below shall be applicable for all process streams containing 1% (wt) or more benzene or 25% (wt) or more C₆ through C₉ aromatics. These requirements are:
 - A. Closed, flow-through sample containers are to be used.
 - B. A closed, aromatics collection system is required, to which the following are to be piped:
 - Vessel drains;
 - Control valve drains;
 - Gauge glass/level instrument drains;
 - Pump drains;
 - Other equipment where sparing and/or valving are provided for routine maintenance and equipment removal.
 - C. Pumps are to be equipped with dual seals and suitable barrier fluid systems. Seals will be double or tandem depending upon process requirements.
2. Water streams saturated with aromatics are to be directed to suitable locations within the process whenever possible or otherwise to appropriate other processing or treating facilities in order to minimize aromatic emissions to the environment.

Several factors may influence the aromatics exposure levels encountered in a processing facility and cause them to differ from location to location, even though the same process design is utilized. For example, maintenance, sampling, and "housekeeping" practices, as well as governmental regulatory requirements, may vary from plant to plant. Furthermore, compliance with environmental and occupational exposure regulations for subject facility is the responsibility of the Owner, and not UOP. Consequently, if Owner has special regulatory constraints, or has relevant aromatics emission or exposure monitoring data, or other basis, to justify different design provisions and desires deviation from UOP policy, please submit such a request and clearly delineate those different design provisions by separate written communication signed by the Project Manager or designated authority. UOP shall reply promptly to this request; however, this does not imply that UOP will automatically accept such deviations to UOP policy.



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V. Design Philosophy (Continued)

H. Noise Level Limitations

The Engineering Design Specifications for equipment and the final plant layout can be impacted by personnel noise level exposure limitations. In general, UOP is guided in this area by applying commonly accepted USA practices and guidelines provided by the Occupational Safety and Health Administration (OSHA). The Detailed Design Contractor must be responsible for final purchased equipment noise levels.

I. Metallurgy

Metallurgy specified will be based upon that required for process considerations. Indicate any special metallurgy requirements.



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VI. Utility Information

A. Steam System

Provide the information requested for each steam pressure level or each independently controlled steam system.

Systems may be identified in general terms such as High Pressure (HP), Medium Pressure (MP), Low Pressure (LP), etc., or as nominal pressure levels such as 600 psig, 150 psig, etc., or in any other suitable terms.

Definitions

MINIMUM describes the lowest steam pressure and temperature expected in the process area header during normal operation.

NORMAL describes the average or typical steam pressure and temperature expected in the process area header during normal operation.

MAXIMUM describes the highest steam pressure and temperature expected in the process area header during normal (non-relieving) operation.

DESIGN describes the steam pressure and temperature to be considered for mechanical design.

How This Information is Used

Steam consuming equipment connected to a steam header will in general be specified based upon the minimum steam conditions and reviewed for satisfactory operation anywhere between the maximum and minimum steam header conditions.

Normal steam conditions will be used for utility estimates, heat and weight balances, etc.

Steam generating equipment connected to a steam header will in general be specified based upon the maximum steam conditions and reviewed for satisfactory operation anywhere between the maximum and minimum steam header conditions.

Design conditions will be considered to establish relief valve set pressures and mechanical design.



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VI. Utility Information

A. Steam System (Continued)

I. Process Area Header Conditions

These are the conditions expected to exist during normal operation in the process area.

Design pressures and temperatures are the conditions specified for the mechanical design of piping and equipment - excluding steam generation equipment designed under the provisions of the ASME Boiler and Pressure Vessel Code, Section I. These conditions are particularly important if matching existing equipment or design is done by others.

SYSTEM IDENTIFICATION	PRESSURE _____				TEMPERATURE ° _____				INCREMENTAL VALUE \$/ _____
	MIN	NORM	MAX	DESIGN	MIN	NORM	MAX	DESIGN	

2. Provide any appropriate comments on the limitation or availability of steam.



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VI. Utility Information (Continued)

B. Condensate Return Systems

Provide the information requested for two phase (unpumped) and/or all liquid (pumped) condensate return systems.

SYSTEM IDENTIFICATION	PROCESS AREA GRADE LEVEL BATTERY LIMIT PRESSURE _____	TWO PHASE OR ALL LIQUID	INCREMENTAL VALUE \$/ _____



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VI. Utility Information (Continued)

C. Feedwater

1. Provide the following information for the supply of process area boiler feedwater. The process area feedwater may be supplied from the boiler area feedwater systems or systems providing treated and deaerated feedwater exclusively to the process areas; these systems are considered to be part of the offsite facilities.

SYSTEM IDENTIFICATION	PROCESS AREA GRADE LEVEL BATTERY LIMIT PRESSURE _____			TEMPERATURE ° _____			INCREMENTAL VALUE \$/ _____
	MIN	NORM	DESIGN *	MIN	NORM	DESIGN	

*Design pressure is the discharge pressure of the feedwater pump at shutoff with maximum suction pressure.

2. UOP will specify a 1" nozzle and 3/4" plugged valve on process unit(s) steam generating vessels for chemical injection systems provided by others.
3. Is the boiler feedwater of sufficiently high quality (maximum total dissolved solids of 5 ppm or conductivity below 20 micromhos/cm at 20°C) so that it can be used for direct contact steam desuperheating?



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VI. Utility Information (Continued)

D. Cooling Water

Provide the following information:

DESCRIPTION	ONCE THROUGH COOLING WATER	CIRCULATING COOLING WATER	
Source		Cooling Tower	
*Supply Pressure, _____ At Process Battery Limits at Grade			
*Return Pressure, _____ At Process Battery Limits at Grade			
Exchanger Inlet Water Temperature, ° _____			
Exchanger Outlet Water Temperature, ° _____ max.			
Exchanger Water Side Design Temperature, ° _____			
Exchanger Water Side Design Pressure, _____			
**Metallurgy of Existing System			
Incremental Value-Dollars/ _____			
Flow Rate Available over Present Use, _____			

- * These conditions are not necessarily the conditions at the inlet or outlet connections of equipment.
- ** See Section VII. Mechanical Equipment Information, D. Shell and Tube Heat Exchangers, Item 6 & 7.



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VI. Utility Information (Continued)

E. Process Water

Provide the following information for waters that may be used for chemical solution preparation and/or injection into process streams:

DESCRIPTION	CONDENSATE*	DEAERATED TREATED BOILER FEEDWATER		
Supply Pressure, _____ at Process Battery Limits at Grade				
Supply Temperature, ° _____				
Design Pressure, _____				
Design Temperature, ° _____				
Metallurgy of Existing System				
pH				
Total Hardness as CaCO ₃ , wt ppm				
Calcium as CaCO ₃ , wt ppm				
Total Alkalinity as CaCO ₃ , wt ppm				
Chlorine, wt ppm				
Chloride as Cl, wt ppm				
Iron as Fe, wt ppm				
Total Dissolved Solids, wt ppm				
Suspended Solids, wt ppm				
Conductivity, _____				

* Must be from a service where the potential of hydrocarbon contamination is nil.



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VI. Utility Information (Continued)

F. Fuel System

1. Liquid Fuel System

The Contractor is responsible for the circulating oil header design. UOP's responsibility is limited to individual heater supply and return lines. UOP's design is based on the following requirements: fuel oil header temperature is maintained at a temperature consistent with a burner supply viscosity of 200 SSU (43 CS), estimated fuel oil temperature drop is 10°F (5°C) in individual heater supply lines within UOP's scope, fuel oil supply header is controlled at a minimum pressure of 140 psig (10 kg/cm²g), and fuel oil has been passed through a strainer 0.03 inch (0.76 mm) screen size.

2. Liquid Fuel Data

Provide the following data for the liquid fuel to be used for normal operation or alternate operations, including startup.

PROPERTY	OPERATION MODE			
Net Heating Value, _____				
Gross Heating Value, _____				
Sulfur, wt%				
Nitrogen, wt ppm				
Vanadium, wt ppm				
Sodium, wt ppm				
Nickel, wt ppm				
Iron, wt ppm				
Ash, wt%				
Other Impurities:	_____ wt% or (wt ppm)			
	_____ wt% or (wt ppm)			



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VI. Utility Information (Continued)

F. Fuel System (Continued)

2. Liquid Fuel Data (Continued)

PROPERTY		OPERATION MODE			
°API					
Viscosity, CS @ _____ ° _____					
CS @ _____ ° _____					
Vapor Pressure, _____					
Flash Point, ° _____					
Pour Point, ° _____					
Supply Header Operating Pressure- _____	Maximum				
	Normal				
	Minimum				
Return Header Operating Pressure- _____	Maximum				
	Normal				
	Minimum				
Supply Header * Operating Temperature- ° _____	Maximum				
	Normal				
	Minimum				
System Mechanical Design	Pressure- _____				
	Temperature- ° _____				
Incremental Value, \$/ _____					
Flow Rate Available over present use, if used for firing requirements _____					

*Supply header temperature should be set to obtain a viscosity at the burner of 200 SSU (43CS) or less.



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VI. Utility Information (Continued)

F. Fuel System (Continued)

3. Fuel Gas Data

Provide the following data for fuel gas to be used for normal operation and for alternate operations, including startup. Provide the properties of pilot gas if not supplied from the refinery fuel gas header.

PROPERTY		OPERATION MODE			
Specific Gravity (Air = 1.00)					
Net Heating Value, _____					
Gross Heating Value, _____					
Flowing Temperature - ° _____	Maximum				
	Normal				
	Minimum				
Header Operating Pressure - _____	Maximum				
	Normal				
	Minimum				
System Mechanical Design	Pressure _____				
	Temperature ° _____				
Total Sulfur, _____					
Chloride, wt ppm					
Other Impurities:	_____ Vol % or _____				
	_____ Vol % or _____				
Incremental Value, \$/ _____					
Flow Rate Available over present use, _____					



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VI. Utility Information (Continued)

F. Fuel System (Continued)

3. Fuel Gas Data (Continued)

COMPOSITION (VOLUME %)	OPERATION MODE			
H ₂ O				
O ₂				
N ₂				
CO				
CO ₂				
H ₂ S				
H ₂				
C ₁				
C ₂ =				
C ₃				
C ₃ =				
C ₄				
C ₄ =				
iC ₄				
nC ₄				
C ₅ =				
iC ₅				
nC ₅				
C ₆ +				
TOTAL	100%	100%	100%	100%

Indicate if local fuel gas liquid knockout drums are required for each heater____, each process unit____, or not required____.

If local fuel gas liquid knockout drums are not required, indicate if fuel gas lines should be heat traced. _____



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VI. Utility Information (Continued)

G. Electrical Power

1. Provide the following electrical characteristics for motors:

MOTOR POWER RANGE*		NAMEPLATE VOLTAGE	PHASE	FREQUENCY (HERTZ)
FROM	THROUGH			

*Indicate if motor power range is horsepower or kilowatt. _____

Motors less than 1 horsepower (0.75 kW) shall be single phase 120 volts (60 hertz systems) or 220 volts (50 hertz systems). If this is not acceptable, indicate characteristics to be used.

2. UOP specifications are based on a reliable electrical power system. If the system is not considered reliable, indicate the average number of power failures per year.

Indicate any special provisions needed to compensate for the lack of system reliability.

3. Should motor enclosures and insulation be suitable for any unusual environmental considerations, such as tropical, salt, low/high ambient temperatures, dust, etc.? _____ If yes, indicate the conditions to be considered.

4. Indicate the incremental value of electrical power. _____ cents per kW-h.

5. Electrical power information for the instrument power distribution system is provided in Section VII., G. Instruments.



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VI. Utility Information (Continued)

H. Air

1. Provide the following information relating to instrument and plant air systems:

	Plant	Instrument
Available Extra Capacity, _____		
Will System Furnish Oil-Free Air?		
System Header Pressure, _____		
Dew Point, ° _____	XXXX	

2. Does the existing air system consist of combined plant and instrument air systems? _____

I. Nitrogen

1. Is nitrogen available from a refinery header _____

2. Header Pressure

Minimum _____
Normal _____
Maximum _____
Design _____

3. Composition (Volume %)

N ₂	
O ₂	
CO	
CO ₂	
Chloride	
H ₂ O	
Noble Gases	
Total	100%



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VI. Utility Information (Continued)

J. Caustic

Provide the following information for caustic supplied by others:

CAUSTIC STRENGTH				
Process Area Grade Level Battery Limit Pressure, _____				
Process Area Grade Level Battery Limit Temperature, ____ ° _				
System Mechanical Design Pressure, _____				
System Mechanical Design Temperature, ____ ° _				
Flow Rate Available over Present Use, _____				



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VII. Mechanical Equipment Information

A. Heaters

1. In services such as hydrodealkylation, hydrogen reforming, Platforming, Oleflex, Cyclar, high pressure Unibon/Hydrotreating, coking, thermal cracking, visbreaking or small duties (less than 5 MMBtu/hr), UOP may restrict the selection to gas firing only and select the type of burners and firing arrangement.
However, for general service, indicate your preference:
 - a. Gas burners only, without provision for the future installation of oil burners.

 - b. Gas burners initially, with provision for the future installation of oil burners.

 - c. Gas burners for onstream operation, with oil burners for startup and standby purposes. _____
 - d. Oil burners only. _____
 - e. Combination oil and gas burners. _____
 - f. Indicate if low NOx burners are required. _____
2. Indicate any firing arrangement preference.
 - a. For fuel oil firing
Horizontal _____
Vertical _____
 - b. For fuel gas firing
Horizontal _____
Vertical _____
 - c. UOP to specify _____
3. A pilot burner will be specified for each burner. Indicate any additional instructions to be followed.

4. When fuel oil firing is specified, UOP will select a steam pressure level sufficient to provide a minimum atomizing steam supply pressure of 140 psig (10 kg/cm²g) at battery limits. If other atomizing provisions are to be considered, indicate additional instructions to be followed.

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VII. Mechanical Equipment Information

A. Heaters (continued)

5. Indicate type of tubes to be used in convection sections.

	Gas Firing Only	Oil or Combination Firing
Finned Tubes		
Studded Tubes		
Bare Tubes Only		

6. When fuel oil firing is specified, fully retractable soot blowers will be specified for convection sections with finned or studded tubes.

For bare tube convection sections with fuel oil firing or for gas fired heaters, provision will be made for the future installation of soot blowers. Shall the initial installation of soot blowers be specified? _____

7. Reasonably attainable heater efficiencies will vary with service, size of heater and quality of fuel. Based on the net heating value of fuel, indicate the target heater calculated efficiency for design. ____%

For this efficiency, UOP uses 25% excess air for oil firing and 15% excess air for gas firing.

Comments:



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VII. Mechanical Equipment Information (continued)

A. Heaters (continued)

7. (continued)

To achieve the target heater efficiency, which of the following shall be considered for recovery of waste heat from flue gas?

a. Steam Generation

Pressure Level

Quantity (if not max)

b. Air Preheat

Preheater Type: UOP will normally specify the recuperative (stationary) type air preheater.

Combustion Air: UOP considers combustion air to be supplied by a fan even when the air preheater is bypassed. Fan failure will result in shutdown of the heat. UOP will not specify provisions for automatic switchover to natural draft burner operation. A spare combustion air fan will be specified. A cold air bypass will be provided for stack temperature control and for heater operation at 100% of normal duty with the air preheater bypassed.

Draft: UOP will not specify a spare induced draft fan since the stack is considered to serve the purpose of a spare. If the induced draft fan fails, the air preheater bypass will open to divert flue gas to the stack.

If this policy is not acceptable, provide instructions below:

Is it acceptable to combine more than one heater service in a common air preheat system?

Indicate any other instructions relating to air preheat systems.



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VII. Mechanical Equipment Information (continued)

A. Heaters (continued)

c. Other Heat Recovery Systems

8. Individual stacks supported from each heater will normally be specified.

Indicate the required minimum stack height above grade. _____

If individual stacks are not acceptable, indicate any special requirements for specifying stacks or a common central stack.

If either combined stacks or a common central stack is required, indicate the probable height in order to facilitate the specification of proper draft control provisions.

9. Indicate any special requirements relating to flue gas emissions such as NO_x, SO_x, etc.



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VII. Mechanical Equipment Information (continued)

A. Heaters (continued)

10. UOP practice permits the use of ceramic fiber insulation for heater internal linings in the radiant section and ducts to convection section. Indicate if ceramic fiber insulation is acceptable for gas firing ____? for oil firing ____?

11. UOP will specify knife-edge skin thermocouples only on Unicracking, Unibon, Hydrotreating, Oleflex, coking, thermal cracking and visbreaking charge heater coils. If skin thermocouples are desired in any other heater service, provide additional instructions.

12. UOP specifications for fired heaters will include the following instrument connections:

- Draft gauge connections: at burners, below convection section and above and below stack damper.
- Flue gas sampling connections: below convection section and below stack damper.
- Oxygen analyzer connection: below convection section.
- Temperature measurement connections: below convection section and below stack damper.

Indicate quantity and location of any additional connections required for equipment to be specified by others. _____

13. Indicate any other special instructions relating to fired heaters.

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VII. Mechanical Equipment Information (Continued)

B. Vessels

1. Vessels will be dimensioned to inside diameter. Drop legs (drawoff boots) of vessels will be dimensioned to outside diameter. ASME 2:1 elliptical heads will normally be specified. Hemispherical heads will be considered for catalyst containing vessels and high pressure services. If this is not acceptable, provide additional instructions.

2. Indicate any known diameter or length limitations for shipping clearances of shop fabricated vessels. Indicate any height limitations for erected vessels.

3. Connections on vessels will be flanged. For Class 2500 rating, ring joint flanges will be specified. Large diameter connections may be bevelled for welding. Minimum connection size will be 1 inch. If this is not acceptable, provide additional restrictions.

4. Thermowell nozzles on vessels will be flanged and will be 1 inch minimum inside diameter. Alloy lined thermowell nozzles will be of larger nominal diameter to ensure 1 inch minimum inside diameter of lining. Indicate if larger nozzles are desired.



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VII. Mechanical Equipment Information (Continued)

B. Vessels (Continued)

5. For vessels constructed in accordance with a pressure vessel code, UOP normally specifies Class 150 flange rating as a minimum in 3" or smaller connection sizes, except for level instrumentation pipe columns and pressure relief valve connections which are specified with a Class 300 minimum flange rating. If there is a different minimum flange rating restriction for small diameter nozzles, indicate this minimum class and the largest nozzle size to which it is to be applied.

Should the above minimum flange rating class be applied to additional equipment other than vessels: Shell and tube exchangers_____ Air cooled exchangers_____ Fired heaters_____. Indicate any additional special requirements:

6. Steamout connections will be provided on vessels which are to be steamed out as part of the normal startup or shutdown operation. Steamout nozzles shall be the same size as vent and drain nozzles. The minimum size steamout nozzle will be 2" and will include a gate valve and blankoff. Steamout nozzles 3" and larger will be hard-piped and will include a gate valve, blind, 3/4" plugged drain valve, check valve, and gate valve. Steamout nozzles will be located on the head of horizontal vessels and in the bottom section of vertical vessels. If alternate steamout provisions are required, provide additional information including a sketch showing proper P & ID representation.

7. The minimum manway size will be 18 inches inside diameter (of lining where applicable). Vessels less than 3'-0" (900 mm) inside diameter may be specified with flanged heads. Larger size manways will be specified if required to accommodate internals. In trayed columns, manways will be provided in the top head, below the bottom tray, at the feed tray, at any other tray at which removable internals are located, and at intermediate points so that the maximum spacing of manways in the trayed section does not exceed 60 feet (18 meters). If an alternate minimum manway size is desired, indicate if manway size is inside diameter or nominal. Indicate any additional more stringent instructions relating to manways.



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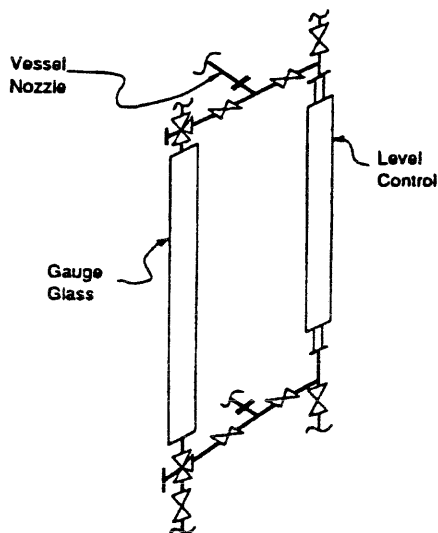
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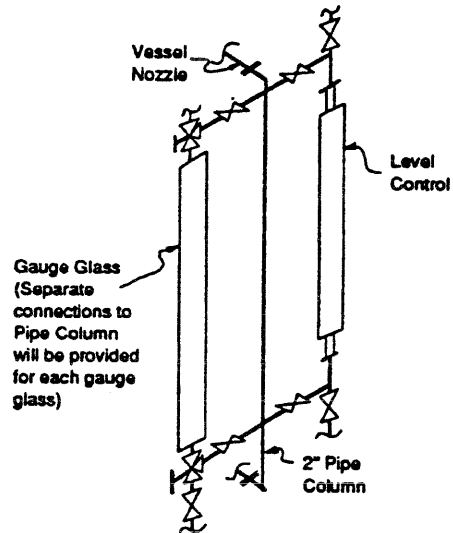
VII. Mechanical Equipment Information (Continued)

B. Vessels (Continued)

8. In general, nozzles on vessels will be provided for the installation of external displacement (float) type level instruments and gauge glasses as follows:
- For controlled and viewed liquid level ranges of 5 feet (60"/1524 mm) or less, two 1-1/2 inch unlined or 2 inch lined flanged nozzles will be provided for the connection of a bridle installation for the external displacement type level instrument and gauge glass as indicated below. The maximum span between vessel nozzles for a bridle installation will be 9 feet (2700 mm).
 - For controlled and viewed liquid level ranges greater than 5 feet (60"/1524 mm) or for installations requiring multiple gauge glasses, two flanged nozzles with a minimum Class 300 flange rating will be provided for the installation of a 2 inch pipe column for spans between vessel nozzles up to and including 15 feet (4600 mm). Multiple pipe columns will be provided for spans greater than 15 feet. The external displacement type level instrument and gauge glasses will be installed on the 2 inch pipe column as indicated below.



BRIDLE INSTALLATION



PIPE COLUMN INSTALLATION

If the above is not acceptable, indicate further instructions.



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VII. Mechanical Equipment Information (Continued)

B. Vessels (Continued)

9. Vessels (or adjacent piping) will normally be provided with vents and drains in accordance with the following table:

<u>Vessel Diameter</u>	<u>Vent and Drain Size</u>
15'-0" (4500 mm) and less	2"
Over 15'-0" through 20'-0" (6000 mm)	3"
Over 20'-0" (6000 mm)	4"

If alternate vent and drain sizes should be considered, provide additional instructions.

10. On unlined horizontal vessels, a manway will be provided on the side of the vessel at or below the horizontal centerline. If the bottom half of the horizontal vessel is lined, the manway will be located on the upper side or the top of the vessel. Additionally, on horizontal vessels 10 feet (3000 mm) or over in tangent length, a blanked off ventilation nozzle will be provided on the top of the vessel near the end opposite the manway. The ventilation nozzle will be sized as follows:

<u>Vessel Tangent Length</u>	<u>Nozzle Size</u>
10'-0" (3000 mm) through 15'-0" (4500 mm)	4"
Over 15'-0" (4500 mm) through 25'-0" (7500 mm)	6"
Over 25'-0" (7500 mm)	8"

Indicate any additional provisions required.



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B. Vessels (Continued)

11. Indicate any additional instructions relating to vessels.

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VII. Mechanical Equipment Information (Continued)

C. Trays and Packing

1. When appropriate, sieve trays will be specified for fractionation service. Alternately, UOP may elect to specify MD (multiple downcomer) trays, valve trays or packing for specific services. Indicate if other requirements are to be followed.

2. Trays will be numbered from top to bottom. If this is not acceptable, provide additional instructions.

3. Carbon steel trays will be specified except where corrosive conditions during normal operation warrant the use of alloy trays. Indicate if other requirements are to be followed.

4. Fractionator trays will generally be designed for the same turndown as indicated for the process units. However, in some services, the reflux rates and reboiler duties may not be turned down in proportion to the unit turndown when higher tray loadings are required to maintain desired efficiency. If above is not acceptable, provide additional instructions.

5. Three pass and four pass trays will be specified where deemed appropriate. If this is not acceptable, provide additional instructions.

6. Indicate any additional instructions relating to trays.



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VII. Mechanical Equipment Information (Continued)

D. Shell and Tube Heat Exchangers

1. UOP design is normally based upon a nominal straight tube length of 20 feet (6.1 meters). For U-tube exchangers, the maximum nominal length (from tube ends to bend tangent) will be limited to the straight tube length. If this is not acceptable, provide additional instructions.

2. For carbon steel and low alloy (up to and including 5 Cr-1/2 Mo) tubes, indicate:

- a. Preferred diameter _____
- b. Minimum wall thickness _____

3. For high alloy (above 5 Cr-1/2 Mo and up through austenitic stainless steel) tubes, indicate:

- a. Preferred diameter _____
- b. Minimum wall thickness _____

4. For non-ferrous (Admiralty, Cu-Ni, etc.) tubes, indicate:

- a. Preferred diameter _____
- b. Minimum wall thickness _____

5. Based on available bundle pulling and lifting equipment, indicate the following:

- a. Maximum allowable bundle weight _____
- b. Maximum allowable bundle diameter _____

6. For treated and inhibited fresh cooling water service, carbon steel material will normally be specified. For other fresh water cooling services, Admiralty material will normally be specified.
- If this is not acceptable, indicate preferred metallurgy.



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D. Shell and Tube Heat Exchangers (Continued)

7. For sea water or brackish water cooling service, materials such as aluminum brass, 90-10 CU-NI, 70-30 CU-NI or titanium will normally be specified. Indicate if you have a material preference in this cooling water service.

8. Fouling factors of $0.0015 \text{ hr-ft}^2\text{-}^\circ\text{F/Btu}$ ($0.0003 \text{ hr-m}^2\text{-}^\circ\text{C/kcal}$) for fresh water cooling and $0.002 \text{ hr-ft}^2\text{-}^\circ\text{F/Btu}$ ($0.0004 \text{ hr-m}^2\text{-}^\circ\text{C/kcal}$) for sea or brackish water cooling will normally be specified. If this is not acceptable, provide additional instructions.

9. UOP will specify U-tubes when the fouling factor on the tubeside is less than $0.002 \text{ hr-ft}^2\text{-}^\circ\text{F/Btu}$ ($0.0004 \text{ hr-m}^2\text{-}^\circ\text{C/kcal}$). U-tubes will also usually be specified if required by the process fluid on the shell side, such as hydrogen and HF acid services. For fouling services and cooling water services in the tube side, floating head construction will normally be specified. If this is not acceptable, provide additional instructions.

10. Square pitch will normally be specified when the shell side fouling factor is $0.002 \text{ hr-ft}^2\text{-}^\circ\text{F/Btu}$ ($0.0004 \text{ hr-m}^2\text{-}^\circ\text{C/kcal}$) or greater. Triangular pitch may be specified for certain services when the shell side fouling factor is less than $0.002 \text{ hr-ft}^2\text{-}^\circ\text{F/Btu}$. If this is not acceptable, provide additional instructions.

11. UOP will specify double pipe or multitube type exchangers where appropriate. If this is not acceptable, provide additional instructions.



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VII. Mechanical Equipment Information (Continued)

D. Shell and Tube Heat Exchangers (Continued)

12. UOP will select stabbed-in, vertical thermosyphon, horizontal thermosyphon, or kettle type reboilers where appropriate. Indicate if there are any restrictions on the use of above types of reboilers.

13. UOP normally provides a valve on the cooling water inlet piping. Indicate below, by sketch, any additional cooling water piping requirements.

14. Indicate any additional instructions relating to shell and tube exchangers.



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VII. Mechanical Equipment Information (Continued)

E. Air Cooled Heat Exchangers

1. Indicate the dry bulb temperature that is not exceeded more than 5% of the time during the four warmest months of the year. ____ Should this temperature be used for air cooled exchanger sizing? ____ If not, indicate the higher temperature in the process area to be used for air cooled exchanger sizing. ____
2. Where process considerations allow, is air cooled heat exchange preferred over water cooled heat exchange? ____ Indicate if there is a preferred process temperature breakpoint to be used in the decision to use all air cooled exchange. ____ Indicate if there is a preferred process temperature breakpoint between air and water cooling for services when air cooled exchange is followed by water cooled exchange. ____
3. UOP design is normally based upon a nominal tube length of 30 feet (9.15 meters). Small air cooled exchanger duties will be combined if possible. When appropriate, tube lengths shorter than the nominal length will be allowed for separately mounted, independent air coolers. If this is not acceptable, provide additional instructions.

4. When winterizing is required, UOP will normally specify louvers plus steam coil, or for more severe cases, internal or external air recirculation plus steam coil. If this procedure is not acceptable, provide additional instructions.

5. Indicate if a preference exists for forced draft or induced draft fans.

6. When required to help control the process fluid outlet temperature or justified to conserve electrical power, 50% of the fans in the air bay will be specified with auto-variable (AV) type blade pitch control. If this is not acceptable, provide additional instructions.

7. Indicate any additional instructions relating to air cooled exchangers.



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VII. Mechanical Equipment Information (Continued)

F. Pumps and Compressors

1. Motor drivers will normally be specified for pumps. Steam turbine drivers will be specified as required for critical services (see Section V. Design Philosophy, Item A). Indicate any additional instructions relating to the requirements for steam turbine drivers.

2. Most process pump services will be specified with installed spares. However, intermittent pump services may not be specified with installed spares. If this is not acceptable, provide additional instructions.

3. Pumps in the process area will be specified to conform to API 610 standards. UOP permits the use of pumps in accordance with other standards for light duty, non-hydrocarbon services which normally occur outside the process area. If this is not acceptable, provide additional instructions.

4. For certain low flow, high head services, UOP will normally specify vertical, high speed, single stage pumps. If this is not acceptable, provide additional instructions.

5. UOP will specify single mechanical pump seals except for specific services such as high temperature, dirty service, light hydrocarbon, and environmentally hazardous or toxic service (see Section V. Design Philosophy, Item G). Indicate any additional instructions relating to these specific services.



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VII. Mechanical Equipment Information (Continued)

F. Pumps and Compressors (Continued)

6. Centrifugal compressors will be specified to conform to API Standard 617 whenever suitable. Axial compressors will be specified to conform to applicable sections of API Standard 617 for large air blower services. Due to their high reliability, centrifugal and axial compressors will not be spared, but a spare rotor will be specified. Driver selection will be evaluated for each application based upon process requirements, critical service, utilities, capital costs and customer preference if any. In addition, UOP project specifications for axial or centrifugal compressors will specify an appropriate shop test. Indicate any additional instructions.
-
-

7. Reciprocating compressor services will be specified to conform to API Standard 618 with sufficient spare capacity to permit maintenance of one machine w/ the plant remains on stream. Motor drivers will normally be specified. Indicate any other criteria to be considered, such as preferred number of machines or percentage of total service to be specified for each machine.
-
-

8. Screw compressors will be specified in special instances when determined to be advantageous over alternate choices. Screw compressors will be specified to conform to API Standard 619. Due to their high reliability, screw compressors will not be spared, however a spare set of rotors will be specified. Driver selection will be the same as indicated in above Item 6. If the above is not acceptable, provide additional instructions.
-
-

9. Indicate any preference for air or water cooling for turbine exhaust steam surface condensers.
-
-

10. UOP specifies bearing temperature and vibration monitoring equipment for m/ large size rotating equipment. Indicate any additional instructions.
-
-



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VII. Mechanical Equipment Information (Continued)

F. Pumps and Compressors (Continued)

11. Air blowers and air compressors will be specified in accordance with climatic conditions indicated in Section VIII, Climatic Data.
12. Specifications for pumps will anticipate unsheltered, outdoor installation. Specifications for compressors will anticipate unheated, sheltered outdoor installation. Indicate any additional instructions.

13. Indicate any additional instructions relating to pumps or compressors.



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VII. Mechanical Equipment Information (Continued)

G. Instruments

1. UOP requirements for the performance of process control systems can be satisfied by use of various types and combinations of instrumentation. Please select ONE of the following classes of equipment to be specified.

- ☐ a. Micro-processor-based control system with shared cathode-ray tube (CRT) displays, using digital data storage and retrieval techniques and associated peripheral and interconnecting equipment.
- ☐ b. Dedicated single loop control system (analog or microprocessor based) with electronic transmission of signals between field and control center.
- ☐ c. Analog control system with pneumatic transmission of signals between field and control center.

2. Temperature measurement points for process monitoring and control will be specified by UOP and represented on the Piping and Instrument Diagram with item numbers. UOP will inform the Detailed Design Contractor of Owner's requirements for exchanger performance temperature measuring equipment in the Project Specifications, however UOP will not assign item numbers or locate this equipment on the Piping and Instrument Diagram. The specific location and assignment of item numbers will be done by the Detailed Design Contractor. Indicate the extent of exchanger performance temperature measuring equipment desired.

- ☐ a. None
- ☐ b. For each heat exchanger shell
- ☐ c. For each heat exchanger service

Indicate the type of heat exchanger temperature measuring equipment desired.

- ☐ a. Thermowells only
- ☐ b. Local Thermometers
- ☐ c. Board Temperature Indicators



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VII. Mechanical Equipment Information (Continued)

G. Instruments (continued)

3. UOP Project Specifications for Instrumentation generally will not include details or item numbers for minor equipment such as local pressure gauges, sight flow indicators, restriction orifices, and gauge glass type level gauges. However, these items will be indicated in proper location on the Piping and Instrument Diagram. The Detailed Design Contractor will be responsible for selection of this equipment. The UOP Project Specifications will include general information which the Contractor is expected to use as a guide. Where special metallurgy, special accessories, or other circumstances dictate, additional details will be included in the UOP Specifications.
4. The flow rates of process charge and product streams will be measured and provided with data storage and retrieval equipment. Additional equipment which may be considered necessary for totalization purposes is not required by UOP.

If the Owner has requirements for totalization of process streams, the specifics of these requirements must be supplied to UOP in order for UOP to properly inform the Detailed Design Contractor. UOP will not specify this equipment, but will transmit its understanding of the Owner's requirements to the contractor via informational notes in the Project Specifications.

Details: Include type of primary device, any requirements for compensation, means of data storage and retrieval, etc.

General: _____

Specific: _____

Liquid Feed Streams _____

Liquid Major Products _____

Liquid By-Products _____

Vapor-Phase Input Streams _____

Vapor-Phase Output Streams _____



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VII. Mechanical Equipment Information (Continued)

G. Instruments (continued)

5. UOP will not identify or specify instrumentation for unit or complex utility headers. This instrumentation will be the responsibility of the Detailed Design Contractor.
6. UOP will specify continuous stream analyzers where required by UOP for process monitoring and control. Any additional continuous stream analyzers required by the Owner will be shown on the Piping and Instrument Diagram with a note "By Others" and the Detailed Design Contractor shall be responsible for selection of the specific instrumentation, vendor, and incorporation of the analyzer into the process.

Indicate the specific services and analysis type for which additional continuous stream analyzers are desired.

7. Indicate the units of measurement to be used for control center display instrumentation. The UOP instrument project specifications will use these units of measurement where appropriate:

Temperature _____

Steam Flow _____

Pressure _____

Chemicals Flow _____

Liquid Flow _____

Water Flow _____

Vapor Flow _____

Viscosity _____

For liquids choose either:

_____ specific gravity

_____ density

For gases choose either:

_____ specific gravity (air = 1.0)

_____ molecular weight

The base conditions used in the UOP instrument project specifications for volume flow measurement will be in accordance with accepted international standards defined in Section III., D. System of Measurement of this document. Non-standard base conditions will not be used in the UOP instrument specifications.



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VII. Mechanical Equipment Information (Continued)

G. Instruments (continued)

8. UOP will specify range calibrations of differential instruments for flow measurement in inches of water for the English system and in millimeters of water for the mks and SI systems, unless instructed otherwise below.

9. UOP will specify ISA Type E thermocouples for general services and ISA Type K thermocouples for high temperature services, unless instructed otherwise below.

10. For most services, UOP will specify external displacement type level instruments having lengths of up to 120 inches (3048 mm) and differential type level instruments for longer lengths, unless instructed otherwise below.

For the installation of external displacement type level instruments and gauge glasses on vessels, see Section VII., B. Vessels, Item 8.

11. UOP will use 1 1/2 inch Class 150 connections as a minimum on external displacement type level instruments, unless instructed otherwise below.

12. UOP will use 1 inch inside diameter as a minimum for thermowell nozzles on vessels and piping, unless a larger nozzle size is indicated below.

Vessels _____ Piping _____

Vessel nozzle size must be consistent with Section VII., B. Vessels, Item 4. of this document.



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VII. Mechanical Equipment Information (Continued)

G. Instruments (continued)

13. UOP will use Class 150 flanges as a minimum for thermowells, unless a higher flange class is indicated below.

Vessels _____ Piping _____

14. UOP will use Class 300 connections as a minimum on control valve bodies, unless a higher flange class is indicated below.

15. Indicate the normal AC power available to supply the instrument power distribution system (instrumentation uninterruptible power supply).

Volts _____ Phase _____ Hertz _____

Indicate the normal regulated single phase AC voltage for instrument power supplies, alarm systems, analytical devices, etc. (instrumentation U.P.S. output).

Volts _____ Hertz _____

UOP will use 125 VDC for process shutdown system power, unless instructed otherwise below (Alternating current is not recommended for shutdown system power).

16. Indicate below any unusual environmental considerations for field instrumentation such as tropical, salt, dust, low/high ambient temperatures, etc.

17. If Owner's standard practices require specific or unusual metallurgy for instrumentation, details of these requirements must be supplied to UOP as an attachment to this document.

18. Indicate any additional instructions relating to instruments.



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VII. Mechanical Equipment Information (Continued)

H. Pressure Relief Valves

1. A single pressure relief valve will be specified for each service unless the required capacity cannot be provided in a single valve, or if multiple valves are preferred for a particular service. In steam service dual valves will be specified in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section I. Indicate any additional instructions.

2. Spare pressure relief valves will normally not be specified. If installed spare pressure relief valves are preferred, UOP will provide inlet and outlet block valves, except for steam service governed by the ASME Boiler and Pressure Vessel Code, Section I:
 - a. Indicate which services should be spared.

 - b. UOP will normally provide separate inlet and outlet piping connections for multiple pressure relief valves (including spares) located either on a vessel, or on the process piping. If an alternate inlet and outlet piping configuration is preferred, provide additional information including a sketch showing proper P & ID representation.

3. Isolating inlet and outlet block valves will normally not be specified for non-spared pressure relief valves. If this is not acceptable, indicate which services should be provided with locked open inlet and/or outlet block valves.

4. Pilot operated pressure relief valves may be specified for services where significant inlet pressure losses are expected; where the process operating pressure is close to the relief valve set pressures; where the valve set pressure is below 15 psig; or when a specific application requires design features unique to a pilot operated relief valve. Indicate any restrictions or instructions related to the use of pilot operated pressure relief valves.



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VII. Mechanical Equipment Information (Continued)

H. Pressure Relief Valves (Continued)

5. Electrical power failure with the resultant loss of cooling water will normally be one of the considerations in the specification of pressure relief valve requirements. If this is not necessary, provide justification.

6. Process unit pressure relief valves in vapor service, with exceptions such as steam and air, will normally discharge to a closed relief header routed to a knockout drum and flare. Pressure relief valves in liquid services, with exceptions such as water, will normally discharge into the same closed relief header used for pressure relief valves in vapor service. If other provisions are to be considered, provide additional instructions.

7. Pressure relief capacity will be determined assuming that the valve is wide open and flowing at full capacity. Since built-up back-pressure may affect valve selection, UOP assumes that the relief header system (tailpipe, subheaders, and main header) will be sized to assure that the maximum back pressure at the relief valve will not exceed 10% of valve set pressure for a conventional (non-balanced) type valve or 30% of valve set pressure for a balanced bellows type valve. Indicate if a specific relief header back-pressure should be used when determining valve capacity.

8. Indicate any additional instructions relating to pressure relief valves.



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VIII. Site Information

A. Climatic Data

1. Winterizing Temperature

The extent of winterizing protection depends upon the severity of the local climatic conditions for a particular site. The extreme case of the lowest minimum temperature is not normally selected. In general, a winterizing temperature is selected for protection after rejection of a percentage of the lowest hourly temperature recordings in the coldest month or a percentage of the daily minimum temperature recordings for a year. Recordings are normally based on a period of years and not those of a single year. This temperature will be used to determine the objective heat tracing requirements for pour point and freeze protection. At a winterizing temperature of 32°F (0°C) or lower, protection for water freezing will be provided.

Winterizing Temperature _____°

2. Low Ambient Temperature

The low ambient temperature is defined as the lowest mean atmospheric temperature for a 24 hour period. This temperature will be used for mechanical design considerations including determination of the Minimum Design Metal Temperature (MDMT) as required by the ASME Boiler and Pressure Vessel Code, Section VIII., Division I. The MDMT may affect the final material selection, equipment design, and impact testing requirements. The MDMT must appear on the stamp or nameplate of all equipment that carries an ASME U-1 stamp.

Low Ambient Temperature _____°

3. Provide the following information for air blower and air compressor design:

Relative humidity _____%

Dry bulb temperature _____°

4. Provide a wind graph or wind rose summary indicating the wind direction and frequency. An acceptable alternate is a listing of compass directions (a minimum of eight equally spaced increments) and the percentage of time the wind originates from each direction. Information shall be provided with this questionnaire.



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VIII. Site Information (continued)

A. Climatic Data (continued)

5. Provide the following information for Fluid Catalytic Cracking Units only:

- a. For units located within the U.S.A., wind pressures used in design shall be in accordance with the latest edition of the UNIFORM BUILDING CODE (International Conference of Building Officials). If the UNIFORM BUILDING CODE is not to be used or if the location is outside of the U.S.A., wind pressures shall be as specified in the _____ code and one English language copy shall be provided with this questionnaire.
- b. For units located within the U.S.A., earthquake forces to be used in design shall be in accordance with the UNIFORM BUILDING CODE. UOP considers Zone 1 to be the minimum seismic zone for earthquake design. UOP also utilizes an importance factor of 1.0. If a higher importance factor is desired, indicate the factor to be used _____. (Note: Use of a higher importance factor increases the magnitude of the design seismic loads that must be resisted.) If the UNIFORM BUILDING CODE is not to be used, or if the location is outside the U.S.A., earthquake forces shall be as specified in the _____ code and one English language copy shall be provided with this questionnaire.

B. Unit Elevation

1. Indicate the elevation of the refinery site above sea level.

2. UOP hydraulic design will be based upon a base line 6" (150 mm) above high point of finished grade.



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IX. Miscellaneous Information

A. Battery Limit Requirements

Provide the following temperature and pressure information for streams entering or leaving the battery limits of the process unit(s) defined in Section III. General Information, Item B. of this Basic Engineering Design Questionnaire. Temperatures are particularly important for incoming streams and for rundown streams to facilities outside the scope of this project. Pressures should be adjusted to the conditions at battery limit and at grade.

1. Indicate the following battery limit information for streams, including hydrocarbon and chemicals, supplied to these process unit(s) by others. If this information is not available, UOP will indicate the required battery limit pressure on the Piping and Instrument Diagram for streams from facilities outside the scope of this project.

INCOMING STREAM	SOURCE	UOP UNIT BATTERY LIMIT CONDITIONS	
		PRESS. _____	TEMP. ° _____

2. Indicate the following battery limit requirements for vapor streams from the process unit(s).

OUTGOING STREAM	DESTINATION	PRESS. _____	TEMP. ° _____



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IX. Miscellaneous Information (continued)

A. Battery Limit Requirements (continued)

3. Liquid streams from the process unit(s) will normally be provided with battery limit pressures after control valve and at grade of 50 psig (3.5 kg/cm²g) or 50 psi (3.5 kg/cm²) above the flowing vapor pressure. This pressure is assumed to be adequate for a rundown stream to a destination with no change in grade elevation. Based upon normal operating flow, it is assumed to provide for 30 psi (2.1 kg/cm²) flowing friction pressure drop in a rundown line having an assumed length of 1500 equivalent feet (460 meters) plus a static head differential pressure ranging from 2 psi (0.14 kg/cm²) at the minimum destination liquid level to 20 psi (1.4 kg/cm²) at the maximum destination liquid level. Temperatures provided at battery limits will normally range between 100 to 175° F (38 to 80°C) depending upon the pour points, flash points, vapor pressure and viscosities of the materials. High pour point materials requiring temperatures over 175°F (80°C) will be discharged at a temperature of 250°F (120°C) or greater. If additional consideration of downstream processing, plant layout, elevation, destination pressure, etc., require other pressure and temperature provisions, indicate below.

OUTGOING LIQUID STREAM	DESTINATION	UOP UNIT BATTERY LIMIT		ESTIMATED FRICTION *PRESSURE DROP
		PRESSURE _____	TEMP. ° _____	

*The frictional pressure drop between the UOP process unit and the destination is used to optimize control valve hydraulics.



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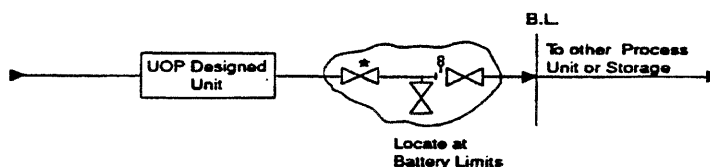
Date

IX. Miscellaneous Information (continued)

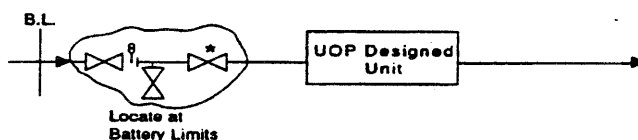
B. Battery Limit Isolation

UOP will provide means to double block, blind and bleed process lines between process units and/or storage. As a minimum, block valve, blind and bleed will be provided at battery limits when a second valve is located within the process unit. If the second block valve is not present within the process unit, a double block, blind and bleed will be provided at the battery limits. The following are UOP's standard practices for specifying battery limit isolation:

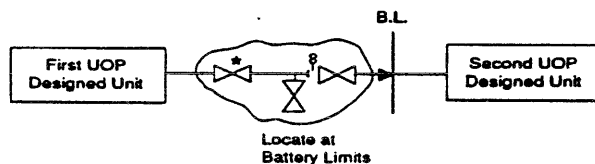
1. UOP will specify battery limit isolation for all process lines leaving a UOP designed unit.



2. Process lines arriving at a UOP designed unit, from facilities or process units outside UOP's scope of design, will be specified with battery limit isolation.



3. Process lines arriving at a UOP designed unit, from another UOP designed unit, will have no battery limits isolation shown since isolation valving will be located in the upstream unit.



4. UOP will apply above isolation policies to chemical and hydrogen lines entering or leaving a UOP designed unit.

*This valve may be available as part of a control valve assembly or provided for other process reasons and would be used as part of isolation system.



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IX. Miscellaneous Information (continued)

B. Battery Limit Isolation (continued)

5. Indicate any instructions relating to battery limit grouping of units (if other than individual process units) for isolation and shutdown purposes.

6. Battery limit isolation requirements for utilities will be the responsibility of the Detailed Design Contractor.

7. Indicate any other instructions relating to battery limit isolation.

C. Wastewater Collection

1. UOP assumes separate systems for oily process water and rainwater runoff. All process drain funnels are assumed to discharge to the oily process water sewer unless otherwise noted. Separate chemical sewer systems will be indicated if required.

2. UOP Engineering Design Specifications will incorporate process drain funnels having a water seal control or an optional closed drain system with closed venting to an emission control device per US Environmental Protection Agency (EPA) regulations, in order to reduce volatile organic compound emissions from wastewater collection systems.

3. Indicate any comments related to wastewater collection systems.



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IX. Miscellaneous Information (continued)

D. Fireproofing

UOP will issue a Standard Specification for fireproofing of process vessel skirts and supporting structural steelwork in fire potential areas up to a minimum height of 35 feet (11 meters) above grade. The vertical members and first level of horizontal members of pipe racks will be fireproofed if within 50 feet (15 meters) of fire potential equipment. Fireproofing is based upon a 3-hour rating.

E. Insulation

UOP will issue Standard Specifications for insulating hot and cold services as applicable. The Standard Specifications will indicate insulation requirements for energy conservation and will provide instructions regarding insulation for personnel protection.

ENGINEERING AGREEMENT

Schedule "A"

What UOP will produce

Schedule "B"

Design Basis – Feed
Capacity
Products

Schedule "C"

Contractor/vendor information to be reviewed by UOP

Schedule "D"

Terms of payment and payment schedule

PRODUCE SCHEDULE "A" DESIGN

Scope of Schedule "A" Design

100 General Specifications

200 Fired Heaters

300 Vessels & Internals

400 Heat Exchangers

500 Pumps & Compressors

600 Instruments

700 Electrical

800 Piping

900 Miscellaneous

P & I Diagrams

Drawings

Standard Specifications



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PROJECT SPECIFICATION

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Unit: UOP NAPHTHA HYDROTREATING PROCESS UNIT
Company: NATIONAL AROMATICS AND PETROCHEMICALS CORPORATION LIMITED
 (AROCHEM) Madras, India

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100 GENERAL INFORMATION

560363-100	0	Revision Tabulation Section 100
560363-101		Index
560363-103		Basic Engineering Design Data-Included with P. 560362
		Utility Summary
560363-105		Winterizing-Included with P. 560362
560363-106		Catalyst
560363-107		Chemicals
560363-108		Inhibitor
560363-111		Mill Scale Removal
560363-112		UOP Review of Detailed Design
		Equipment List

200 FIRED HEATERS

560363-200	0	Revision Tabulation Section 200
560363-202		Non-UOP Heaters

300 VESSELS

560363-300	0	Revision Tabulation Section 300
560363-301		Vessels
560363-304		Reactors
560363-307		Trays and Packing (Random and Structured)
560363-309		Mesh Blankets
560363-312		Ceramic /Alumina Balls
		Stud Bolts and Gaskets-Included with P. 560362

400 HEAT EXCHANGERS

560363-400	0	Revision Tabulation Section 400
560363-401		Tubular Exchangers
560363-402		Air Cooled Exchangers

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560363-503		Proportioning Pumps and Drivers
560363-509		Reciprocating Compressors and Drivers

600 INSTRUMENTS

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560363-601		Instrument General Notes
560363-602		Pressure Gauges
560363-603		Pressure Instruments
560363-604		Differential Instruments
560363-606		Thermocouples and Wells
560363-608		Thermometers
560363-612		Level Instruments (Displacement Type)
560363-616		Control Valves
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560363-623		Control Center Equipment
560363-630		Oxygen Analyzers
560363-641		Heater Tube Skin Thermocouple Assemblies
560363-643		Solenoid Valves
560363-661		Draft Gauges
560363-663		Static Power Supplies
		Sight Flow Indicators-Included with P. 560362
		Gauge Glasses-Included with P. 560362

ELECTRICAL AND MISCELLANEOUS OFFSITES

Electrical Specifications-Included with P. 560362

800 PIPING

560363-800	0	Revision Tabulation Section 800
560363-801		Piping
560363-806		Strainers

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Closed Sampling System-Included with P. 560362

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560363-902 Material Handling Equipment
560363-903 Safety Equipment
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C39057-X 0 Piping and Instrument Diagram of Oxygen Stripper Section
C39058-X 0 Piping and Instrument Diagram of Reactor and Heater Section
C39059-X 0 Piping and Instrument Diagram of Separator Section
C39060-X 0 Piping and Instrument Diagram of Exchanger and Recycle Compressor Section
C39061-X 0 Piping and Instrument Diagram of Stripper Section
C39062-X 0 Piping and Instrument Diagram of Sour Water Stripper Section
C39063-X 0 Piping and Instrument Diagram of Heater Firing Section
C38056-X 2 Process Flow Diagram
C34268-D 0 Typical Plot Plan

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112359-C 0 Assembly of Dense Loaded Catalyst Handling Equipment
C23047-F 0 Catalyst Unloading Spout for 4", 6", 8" and 10" Nozzles
C34446-A 0 Bubble Cap Trap 900 Diameter

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3-120-2	Distributor Basket Arrangement
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3-123-0	Vortex Breakers
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3-150-2	Distributors - 2 Pass Side Entry (Side DC One Elevation)
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6-116-3	Orifice Meter Piping Assemblies (Steam or Flowing Liquid. Meter Located Near Orifice)
6-129-0	Instrument Name Plates
6-145-0	Typical Arrangements of Control Valve Assemblies
6-153-0	Knife Edge Type Heater Tube Skin Thermocouple Installation
7-101-0	Grounding Details
7-102-0	Grounding Details
8-135-1	Pump Vent and Drain System
8-137-1	Pump Drain System
8-138-1	Control Valve Piping Assemblies Vent and Drain Systems

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25 East Algonquin Road • Des Plaines, Illinois 60017-5017 • USA.

PROJECT SPECIFICATION

560363 -101- O Sheet 5

REV	DATE	BY	APP'D	REV	DATE	BY	APP'D
0	12/1/93	DF					

INDEX

Drawing or Spec	Rev.	Description
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UOP STANDARD DRAWINGS CONT'D

8-139-1		Level Instrument Vent and Drain System
8-141-1		Level Instrument Drain System
9-112-2		Emergency Shower and Eyewash

UOP STANDARD SPECIFICATIONS

1-13-1	Chemical Cleaning
2-12-1	Fired Heaters
3-11-2	Pressure Vessels Carbon Steel
3-12-2	Pressure Vessels Alloy Steel
3-18-5	Trays and Packing (Random and Structured)
3-28-2	Storage Tanks-Low Pressure
4-11-0	Heat Exchangers Shell and Tube Type
4-12-0	Heat Exchangers Hair Pin Type
4-13-0	Heat Exchangers-Air Cooled
5-11-2	Centrifugal Pumps
5-13-2	Proportioning Pumps
5-14-0	Reciprocating Compressors and Engines
5-18-0	Pulsation Suppression Devices
5-21-0	General Purpose Centrifugal Pumps
6-11-0	Instruments
6-12-0	Indicating Pressure Gages
6-13-0	Thermocouples, Wells, Protecting Tubes, Thermowells
6-14-0	Control Valves
6-15-0	Pressure Instruments
6-16-0	Float Type Liquid Level Instruments
6-18-0	Flow Meter Instruments
6-19-0	Control Boards
7-11-0	Electrical
7-12-1	Electric Motors
8-11-5	Piping
8-12-2	Fabrication of Ferrous Piping
9-11-1	External Thermal Insulation
9-19-6	Safety Equipment
9-33-0	Hydrogen Sulfide Monitoring System
9-34-0	Laboratory
9-51-0	Typical Plot Plan Procedures

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SPECIFIC DUTIES

- Prepare schedule
- Prepare BEDD sheets
- Review metallurgy
- Calculate line sizes
- Calculate hydraulics (set design conditions)
- Complete equipment calculations (as required)
(supply appropriate data to specialists)
- Produce P & I Diagram
- Review and approve specifications prepared by specialists
- Manage P & I check conference
- Review documents requested in Spec. 111

UOP 25 East Algonquin Road – Des Plaines, Illinois 60017–5017 USA				PROJECT SPECIFICATION			
SCHEDULE				560508	–2– 0	SHEET 1	
				REV	DATE	BY	APP'D
				0	9/2/93	SSS	SSS
UNIT: Amsac Xylene Isomerization Process Unit				COMPANY: Singapore Aromatics Company Pulau Ayer Chawan, Singapore			
		Eng Release	Specialty Start	Specialty Release	Mail Date	Remarks	Rev
Process Flow Diagram		–	–	–	–		
Metallurgical Review		09/03/93	–	09/17/93	–	Do Not Index	
P&I Diagram Consultation		10/11/93	10/11/93	–	–	Do Not Index	
P&I Diagram		10/11/93	10/12/93	11/19/93	11/30/93	MAIL DATE = 12/17/93	
P&I Check Conference		10/26/93	10/26/93	–	–	Do Not Index	
P&I Mailing Memo		–	–	–	11/30/93	Do Not Index	
Vessel Consultation		09/07/93	09/07/93	–	–	Do Not Index	
P&I Diagram Pipe Class Revision		–	–	–	–		
Hydraulic Tabulation		11/19/93	–	–	–	Do Not Index	
Hydraulic Flow Diagram		11/19/93	–	–	–	Do Not Index	
Proposed Plot Plan		NR	NR	NR	NR		
APC Functional Design		NR	NR	NR	NR	Do Not Index	
Design Basis	1	–	–	–	–		
Schedule	2	09/02/93	–	–	–		
Distribution	3	–	–	–	–		
Project Specifications Book	4	–	–	–	03/07/94	PENALTY DATE = 3/7/94	
Process Specification	5	–	–	–	–		
Index	101	–	–	09/15/93	09/22/93		
Basic Engineering Design Data	102	–	–	–	–		
Utility Summary	103	–	12/30/93	01/06/94	01/13/94		
Winterizing	104	–	–	–	–		
Catalyst	105	11/19/93	–	–	11/30/93		
Chemicals	106	11/19/93	–	–	11/30/93		
Mill Scale Removal	108	11/19/93	–	–	11/30/93		
UOP Review of Detailed Design	111	11/19/93	–	–	11/30/93		
Equipment List	112	11/19/93	–	–	11/30/93		
Electric Heaters	209	NR	NR	NR	NR		
Vessels	301	09/21/93	09/27/93	11/05/93	11/12/93	MAIL DATE = 12/17/93	
Reactors	304	09/14/93	09/16/93	10/25/93	11/01/93	MAIL DATE = 12/17/93	
Atmospheric Storage Tanks	306	NR	NR	NR	NR		
Trays and Packing (Random and Structured)	307	09/21/93	09/27/93	11/05/93	11/12/93		
Mesh Blankets	309	09/21/93	09/27/93	11/05/93	11/12/93		
Ceramic/Alumina Balls	312	–	09/16/93	10/25/93	11/01/93		
Studbolts and Gaskets	313	–	–	–	–		
Tubular Exchangers	401	09/30/93	10/06/93	10/15/93	10/22/93	MAIL DATE = 12/17/93	
Air Cooled Exchangers	402	09/30/93	10/06/93	10/15/93	10/22/93	MAIL DATE = 12/17/93	
Centrifugal Pumps and Drivers	501	10/05/93	10/06/93	10/15/93	10/22/93	MAIL DATE = 12/17/93	
Proportioning Pumps and Drivers	503	NR	NR	NR	NR		
Centrifugal Compressors and Drivers	508	10/05/93	10/06/93	10/15/93	10/22/93	MAIL DATE = 12/17/93	
Reciprocating Compressors and Drivers	509	NR	NR	NR	NR		
Pulsation Suppression Devices	521	NR	NR	NR	NR		
Instruments	600	–	11/08/93	12/03/93	12/10/93		
Sight Flow Indicators	676	11/19/93	–	–	11/30/93		
Gauge Glasses	695	–	–	–	–		
Electrical Specifications	701	–	–	–	–		
Piping	801	–	12/06/93	12/22/93	12/31/93	Line Index	
Strainers	806	–	12/06/93	12/22/93	12/31/93		
Pressure Relief Valves	807	11/19/93	–	12/10/93	12/17/93		
Ejectors	809	11/19/93	–	–	11/30/93		
Special Valves	810	NR	NR	NR	NR		
Closed Sampling System	835	–	–	–	–		
Material Handling Equipment	902	–	09/16/93	10/25/93	11/01/93		
Safety Equipment	903	11/19/93	–	–	11/30/93		
Fireproofing	906	–	–	–	–		
Insulation	907	–	–	–	–		
Coalescers	913	NR	NR	NR	NR		
Laboratory Requirements	934	09/30/93	–	11/10/93	11/17/93		
Conservation Vent	989	11/19/93	–	–	11/30/93		
Hydrogen Purification System	993	NR	NR	NR	NR		
Typical Plot Plan	999	09/30/93	–	–	10/07/93		

EDS-R00-3118

cc: C.F. DMF WBB SKW GTH DPK DNM VAC MJW RGF DLG CAC RAK SSM DBE Utilities Group Manager Project Manager Design Engineer



SYMBOLS TO BE USED
(SEE E-A-11-5)

↔	PROJECT ENG'S. SCHEDULED START AND RELEASE
////	PROJECT ENG'S. ACTUAL TIME
→	SPECIALITY SCHEDULED RELEASE
////	SPECIALITY ACTUAL RELEASE

PROJECT NUMBER

560515

CUSTOMER

UNIT

SULFOLANE

PROJECT ENG.

R. J. ANDRE

[illegible]

SICK

PIPING AND INSTRUMENT DIAGRAM

Purpose

1. Coordination of information
2. Basic arrangement of equipment, piping and instrumentation
3. Notes and details not in project spec's
4. Review start-up, normal and shutdown operations

Equipment and Piping Requirements

1. Heaters
2. Vessels/Reactors
3. Exchangers
4. Condensers
5. Pumps
6. Compressors
7. Piping
8. Relief Valves

Instrumentation Requirements

1. Temperature
2. Pressure
3. Flow
4. Control Valves
5. Level
6. Special type instruments

Additional Duties

1. Time and cost control
 2. Meet with client (and contractor)
 3. Post Schedule "A" involvement
 - A. Reply to client/contractor questions
 - B. Conduct client/UOP P & I review (if required)*
 - C. Advise client of UOP's position on contractor requested deviations
 - D. Participate in contractors model review (if required)*
- * May be extra cost item.