



Training Services

INTRODUCTION

IPD-2004/INTRO-1

Process/Project Engineering

IPD-2004/INTRO-2

Process/Project Engineering Overview

- Introduction
- Project Definition
- Process Engineering
- Project Engineering

IPD-2004/INTRO-3

Introduction

- UOP's basic engineering design package known as the Schedule A.
- Engineering work is typically divided into two basic parts: "Process Engineering" and "Project Engineering."
- Although the responsibilities for the "Process Engineer" and "Project Engineer" might vary for Licensors, Contractors and Refiners, the tasks required to execute a project tend to be the same.

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Objectives

- Discuss best practices in setting up the Project Definition
- Proceed through the various steps of Process and Project Engineering to see how these topics come together

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Project Definition

- Process and Project Engineering is required for any project requiring design and construction
 - Grass roots refinery installation with multiple processes and utilities
 - Addition of a complex of new process technologies in an existing facility
 - Addition of a single process unit
 - Addition to or revamp of an existing process unit
 - Troubleshooting an existing unit or piece of equipment, with subsequent changes



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Project Definition

- **Scope Definition**
- **Design Basis**
- **Basic Engineering Design Data**
- **Project Schedule**

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Scope Definition

- **The Scope for each involved party must be defined:**
 - **Who is involved – licensor, detailed engineering and construction company, management consultants, subcontractors, vendors**
 - **Responsibilities?**
 - **Where do various parties responsibilities end and another party's begin?**
 - **Basic Engineering Design Data & Design Basis**
 - **Project Schedule**

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Setting the Design Basis

- A well-defined Design Basis is a critical part of the Project Definition
- Design Basis is set in:
 - Design basis meeting(s)
 - Legal agreements
 - Yield estimates

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Setting the Design Basis

- Set Unit Capacity
 - Based on feed or product rates
 - Based on on-stream efficiency (example: 330 days/year)
 - Turndown requirements or future capacities
- Feed Definition
 - Limited number of feed cases
 - Define compositions
 - Define contaminant limitations
- Product Specifications
 - Recovery
 - Purity
 - Contaminant limitations
 - Other specifications
- Identify specific process flow configuration
- Identify specific design decisions for major equipment

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Basic Engineering Design Data

- **General Information**
 - Customer Names and Addresses
 - Official Unit Name, Especially if Licensed
 - Units of Measurement
 - Turndown Requirement
- **Utility Information**
 - Steam Identification and Condition
 - Cooling Water Battery Limits
 - Fuel Oil Impurities
 - Fuel Gas Pressure and Impurities
 - Fuel for Fired Heaters
- **Site Conditions**
 - Winterizing Temperature
 - Unit Elevation
- **Battery Limit Temperatures and Pressures**

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Process Engineering

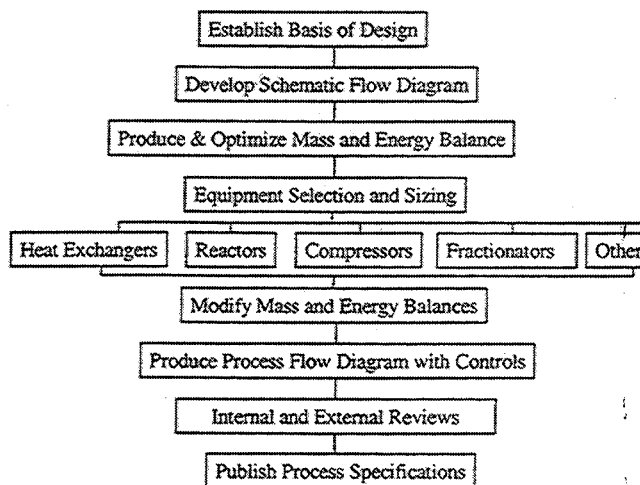
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Process Engineering

- Produce stream properties that are needed to specify the process unit equipment

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Process Engineering Design Steps



Recycle From Any Point May Be Needed For
Design Optimization

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Design Basis - Yield Estimate

- Feed Definition
- Products
 - Yields — *reactor performance*
 - Properties
- Reactor Conditions
 - Temperature
 - Pressure
 - Space velocity or cat / oil
 - Makeup and recycle gas rates
 - Heat release
 - Deactivation rates or catalyst cycle length

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Mass and Energy Balance in Process Design

- Yield estimate is the basis for producing detailed
- At UOP, generated by in-house simulation package
- Various property packages available
- Determines hydraulic profile
- Provides information for equipment specifications

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Select Property Package

- The accuracy of physical properties is critical to design processes and equipment
- Some understanding is needed in this area to insure that appropriate choice of property package is made

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Typical Heater Pressure Drops

	<u>psi</u>	<u>kg/cm²</u>
■ Crude Heaters	125	8.80
■ Vacuum Heaters	75	5.25
■ Hydrotreating Heaters	20-60	1.40-4.20
■ Platforming (per Heater)	3-20	0.20-2.0
■ Thermal Crackers	200	14.0

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Typical Heater Pressure Drops *(continued)*

	<u>psi</u>	<u>kg/cm²</u>
■ Coker Heaters	300	21.0
■ Visbreakers	250	17.5
■ Hot Oil Heaters	20-40	1.4-2.8
■ Fired Reboilers	50	3.5
■ Fractionator Charge	40	2.8

**Preliminary Pressure Drops - Must Be Confirmed or
Corrected Based on Final Heater Design**

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Fractionator Pressure Drops

- Allow 0.05 to 0.2 psi per tray
- (0.0035 to 0.014 kg/cm²)
- 0.12 psi per tray is typical (0.008 kg/cm²)
- Most simulators use theoretical stages, so make
the appropriate adjustment for the actual
number of trays

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Typical Heat Exchanger Pressure Drops

Service	Tube Side kg/cm ²	Shell Side kg/cm ²
General Service	0.35 – 0.70	0.35
Horizontal CFE 4-8 Shells < 300 psig	0.28 – 0.35 per shell	0.20 – 0.35 per shell
Vacuum or Atmospheric Distillation	0.70	0.035- 0.070
Air Condenser/ Water Cooler	0.28 – 0.35	

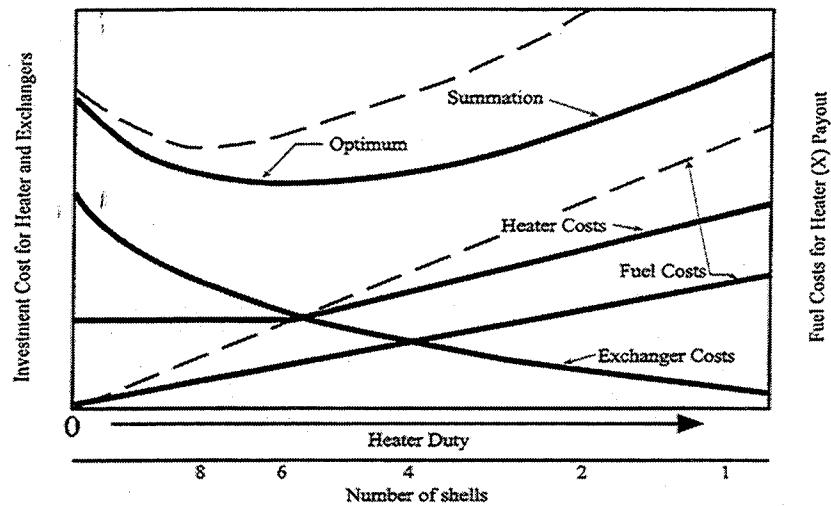
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Optimize Flow Scheme

- Consider other heat exchange schemes
- Consider other separation sequences
- Systematic approaches to optimization – for example, pinch analysis, steam-power, LP

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Exchanger Optimization



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Process Flow Diagram

- The PFD provides an easy to understand view of the unit
 - major equipment
 - stream dispositions and stream information
 - control system

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Project Engineering Outline

- **Hydraulics**
- **Line Sizing**
- **Equipment Design Pressures**
- **Equipment Design Temperatures**
- **Material Selection**
- **Flange Ratings**
- **Equipment Specifications**
- **Standard Specifications & Drawings**

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Project Engineering Outline

- **P&I Diagrams**
- **Plot Plan**
- **Instrument Specifications**
- **Piping**
- **Relief Valve Specifications**
- **Use of Project Information**
- **Transition into Detailed Design**

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Project Engineering Definition

- A UOP definition of “Project” Engineering
 - Engineering work related to the specification of the equipment
 - Starts after the “process” engineering
 - Leads into the detailed design work
 - An organized workflow to deliver the specifications for the project in an efficient schedule
 - Many organizations consider the production of a Schedule A as “process” work, while “project” work is the detailed design (equipment layout and purchase, piping isometrics, civil engineering, etc.)

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Project Specifications

- The UOP Schedule A includes the typical deliverables that define the requirements of a design data book for the process
 - 100 General Specifications
 - 200 Fired Heaters
 - 300 Vessels and Internals
 - 400 Heat Exchangers
 - 500 Pumps and Compressors
 - 600 Instruments

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Project Specifications

■ The UOP Schedule A (continued)

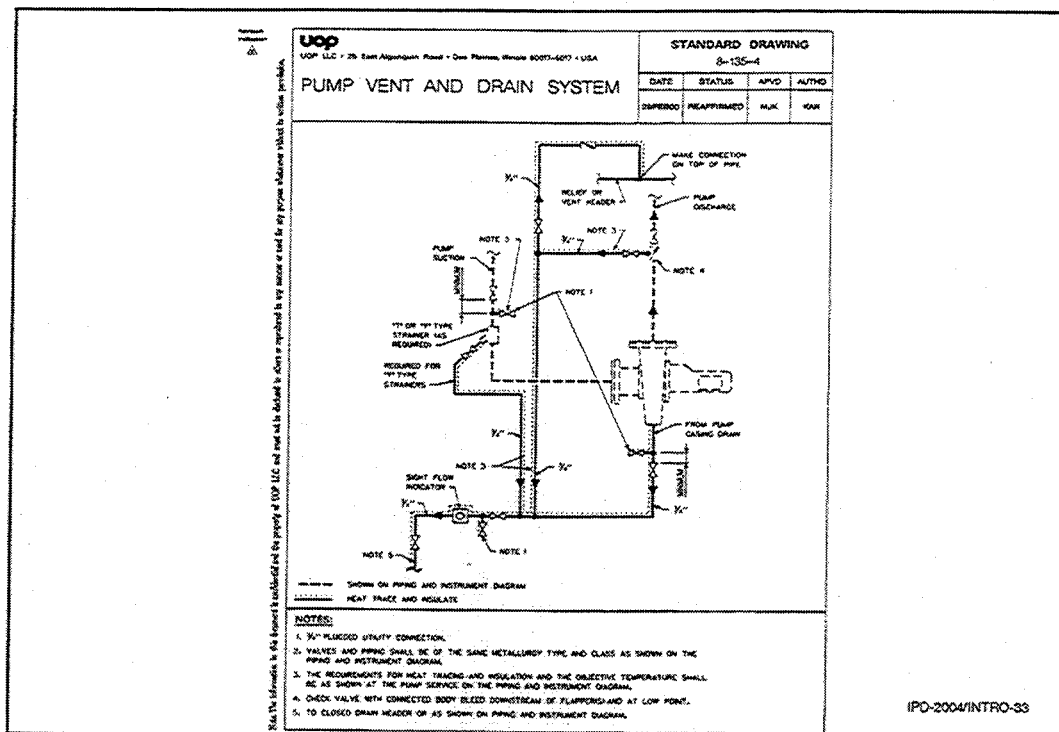
- 700 Electrical
- 800 Piping
- 900 Miscellaneous
- 1000 P&I Diagrams
- Drawings
- Standard Specifications and Drawings
- Typical or Proposed Plot Plan

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Standard Drawings and Specifications

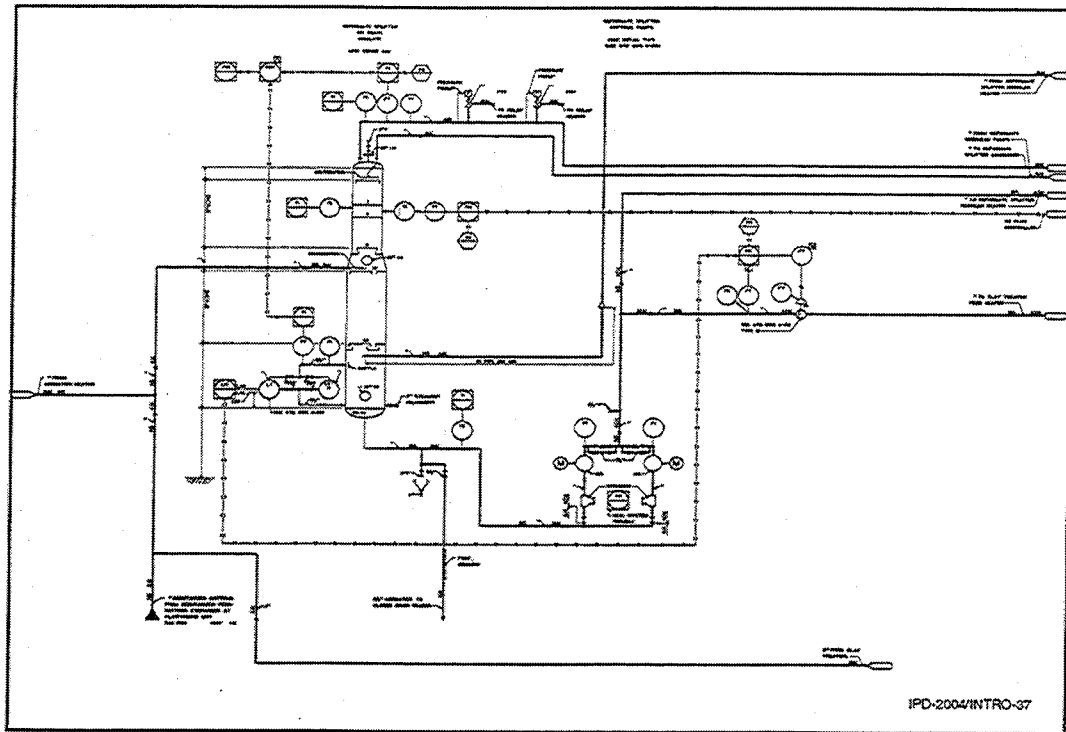
- Related to equipment types
- Provide general specifications that are not influenced by the process type
- Referenced by Project Specifications
- Reflect operating experience and industry practice
- Provide consistency across the different refinery units
- Overridden by specific Project Specifications

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Piping and Instrument Diagrams



Equipment Layout - Plot Plan

- **General Plot Plan Considerations**
 - **Fired Heaters Remote & Downwind from Process Area**
 - **Access for Vessel Loading/Unloading**
 - **Clearance to pull Exchanger Bundles**
 - **Minimize long runs for alloy piping**
 - **Pumps along outside of Pipe Racks**

