

Lecture 4

WRI Technology Lectures

Plant Design

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PLANT DESIGN

CONTENTS:

- Chemical Engineering Plant Design
- Sequence of Steps in Developing a Project
- Plant Location
- Plant Layout
- Storage of materials
- Materials Handling
- Utilities

Plant Design

The general term **plant design** includes all engineering aspects involved in the development of either a new, modified, or expanded industrial plant. In this development, the plant engineer will be making economic evaluations of new processes, designing individual pieces of equipment, or developing a plant layout.

Plant Location

The geographical location of any industrial establishment has strong influence on the success of the project. Considerable care must be exercised in selecting the plant site, and many different factors must be considered. Primarily, the plant should be located where the minimum cost of production and distribution can be obtained, but other factors, such as room for expansion and safe living conditions for plant operators as well as the surrounding community, are also important.

Plant Location Factors

1. **Raw materials availability**
2. **Markets**
3. **Energy availability**
4. **Climate conditions**
5. **Transportation facilities**
6. **Water supply**
7. **Waste disposal**
8. **Labor supply**
9. **Taxation and legal restrictions**
10. **Site Characteristics**
11. **Flood and fire protection**
12. **Community factors**

Plant Layout

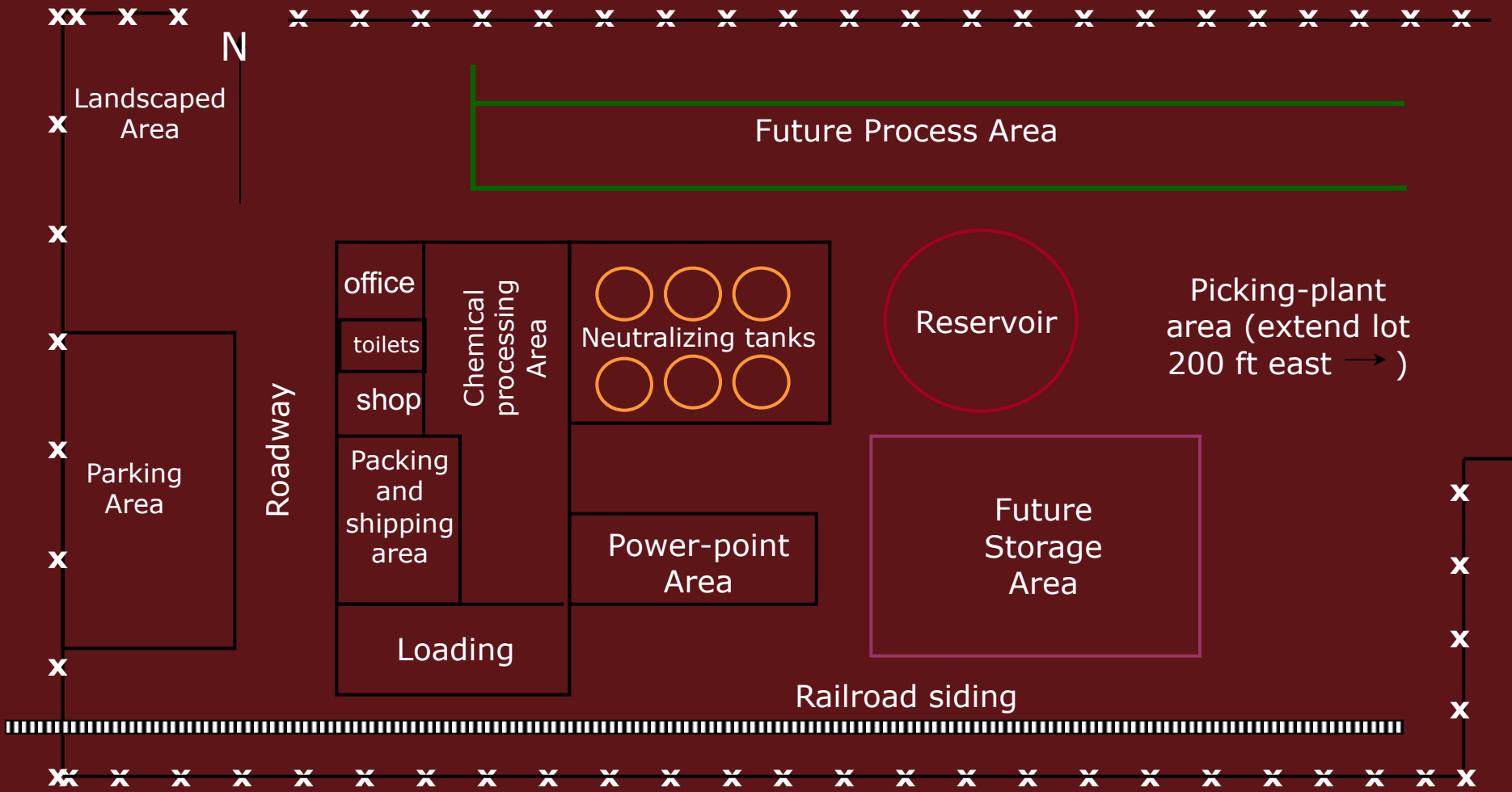
After the process flow diagrams are completed and before detailed piping, structural, and electrical design can begin, the layout of process units in a plant and the equipment within these process units must be planned.

The layout plays an important part in determining construction and manufacturing costs, and thus must be planned carefully with attention being given to future problems that may arise. Since each plant differs in many ways and no two plant sites are exactly alike, there is no one ideal plant layout. However, proper layout in each case will include arrangement of processing areas, storage areas, and handling areas in efficient coordination and with regard to such factors as:

Plant Layout Factors

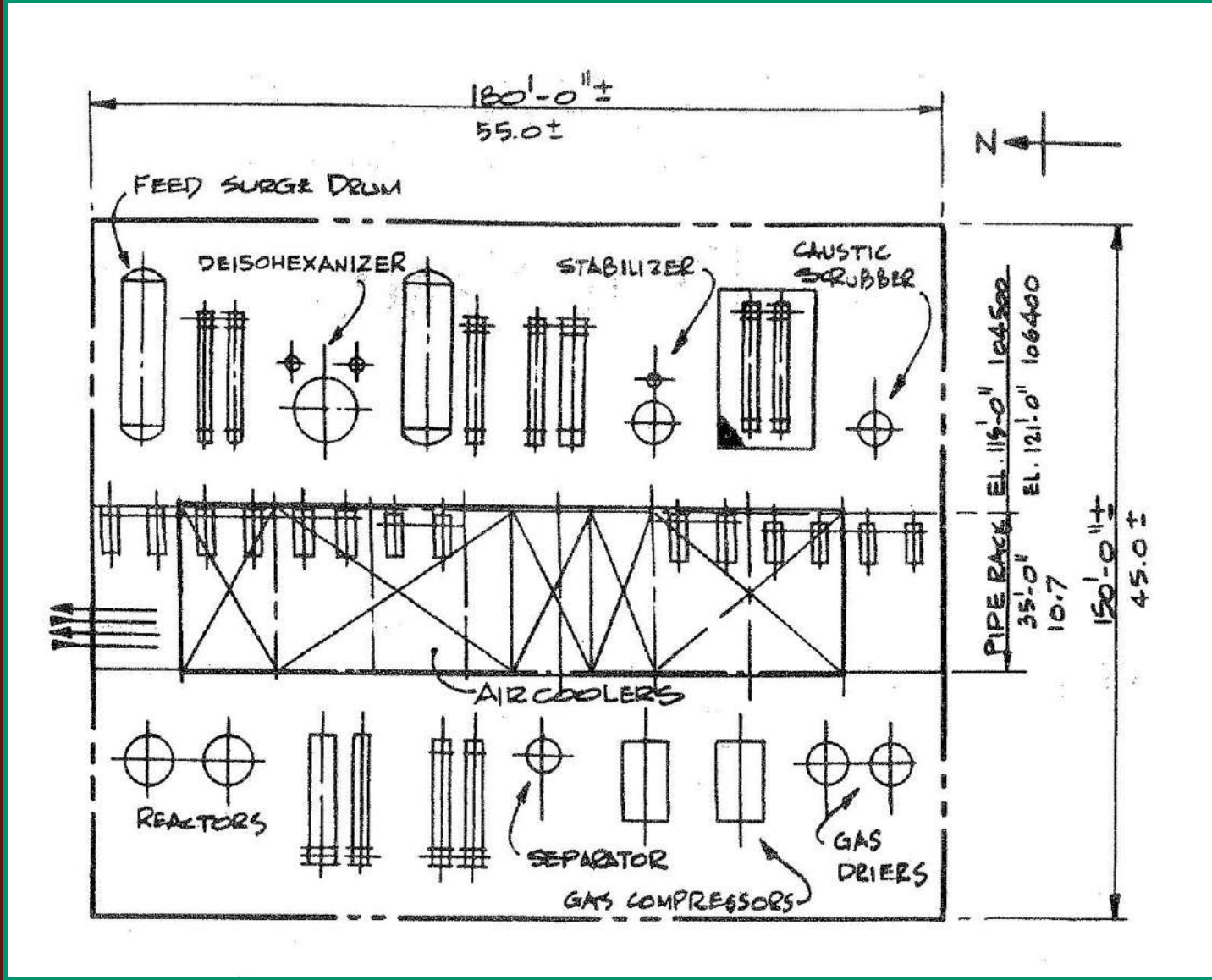
1. New site development or addition to previously developed site
2. Type and quantity of products to be produced
3. Type of process and product control
4. Operational convenience and accessibility
5. Economic distribution of utilities and services
6. Type of buildings and building-code requirements
7. Health and safety considerations
8. Waste-disposal requirements
9. Auxiliary equipment
10. Space available and space required
11. Roads and railroads
12. Possible future expansion

Typical Master Plot Plan

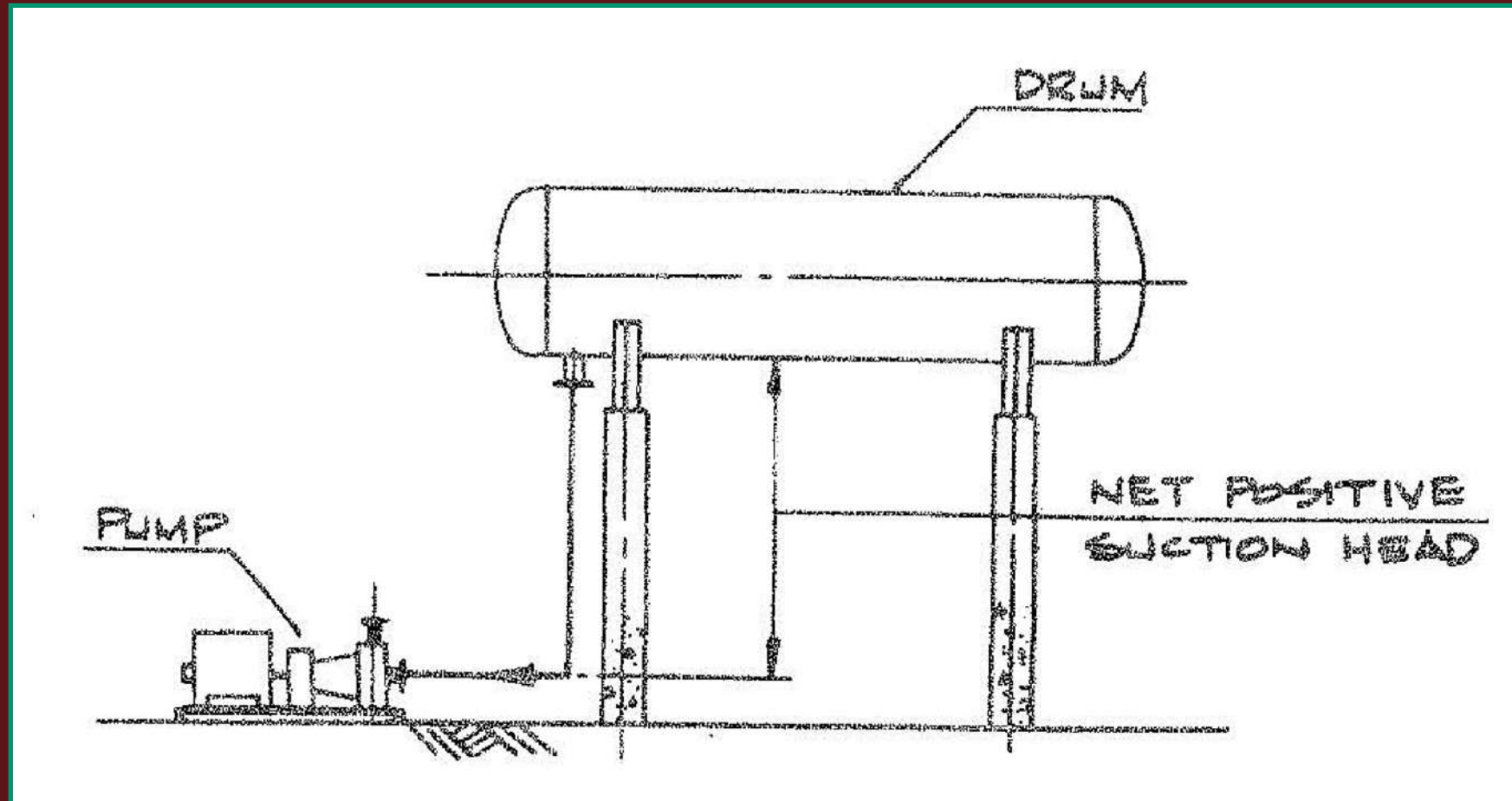


**ISCO Chemical Company
Ferrous Sulfate Recovery Plant
Master Plot Plan: Scale 1/2" = 10 ft**

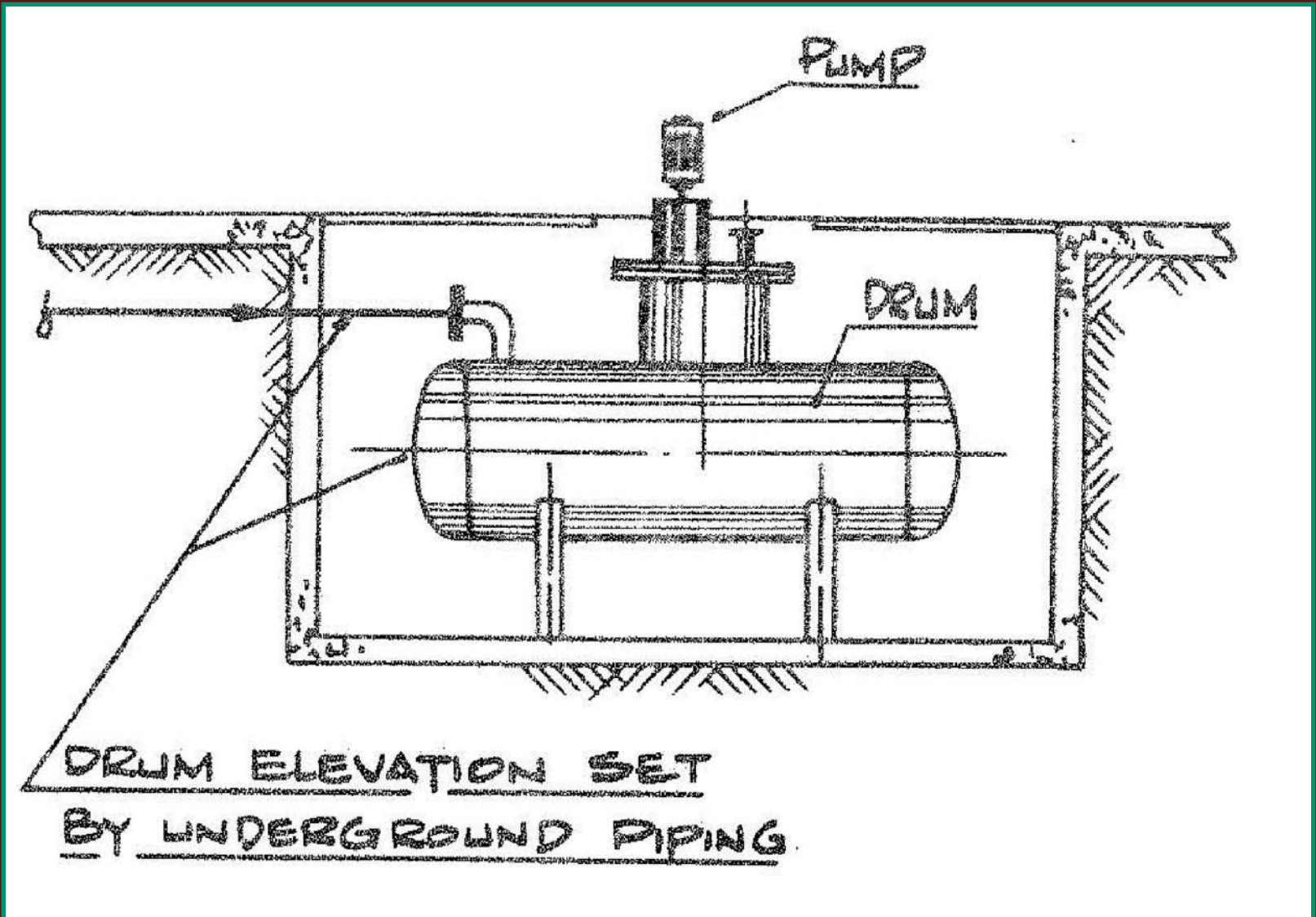
Example: plot plan of an industrial unit



Example: Elevation of overhead storage tank



Example: Elevation of an underground storage tank





Materials Handling

Materials-handling equipment is logically divided into continuous and batch types, and into classes for the handling of liquids, solids, and gases. Liquids and gases are handled by means of pumps and blowers; in pipes, flumes, and ducts; and in containers such as drums, cylinders, and tank cars. Solids may be handled by conveyors, bucket elevators, chutes, lift trucks, and pneumatic systems. The selection of materials-handling equipment depends upon the cost and the work to be done. Factors that must be considered in selecting such equipment include:

Materials Handling Cont'd

1. Chemical and physical nature of material being handled
2. Type and distance of movement of material
3. Quantity of material to be moved per unit time
4. Nature of feed and discharge from materials-handling equipment
5. Continuous or intermittent nature of materials handling

Utilities

- Compressed Air: Plant and Instrument
- Natural Gas
- Fire Protection
- City and Process Water
- Wastewater
- Hot Water
- Steam and Condensate
- Fuel Handling: Gasoline, Diesel, ...
- Cooling Water
- Motor/Hydraulic/Cutting Oil
- Electrical power supply