

**DESIGN PHILOSOPHY OF
BASIC DESIGN****JGS 210-120 1-02E**

Rev. 2 DATE FEB. - 28 - '97

CONTENTS

	<u>PAGE</u>
1. SCOPE.....	2
2. WORK PROCEDURE.....	2
3. DESIGN PHILOSOPHY.....	2
3.1 Objectives of Basic Design.....	2
3.2 Basis of Design.....	2
3.3 Basic Design Information.....	2
3.4 Responsibility.....	3
3.4.1 Guarantees.....	3
3.4.2 Plant Cost.....	4
3.5 Design Preconditions.....	4
3.5.1 Continuous Operating Period.....	4
3.5.2 Considerations for Unusual Conditions.....	4
3.5.3 Emergency Operation.....	4
3.5.4 Turndown Ratio.....	5
3.5.5 Design Life.....	5
3.5.6 Pump and Compressor Spares.....	5
3.5.7 Driver for Pump and Compressors.....	5
3.5.8 Design Allowances.....	6
3.5.9 Combination Design.....	6
3.5.10 Onstream Maintenance.....	6
3.5.11 Aromatics Handling.....	7
3.5.12 Heavy Oil Remaining in Vessel.....	7
4. RELATED DOCUMENTS.....	7
5. APPENDIX PDPI.....	A-1 - A-23



1. SCOPE

- (1) This practice covers the philosophies of basic design concerning the objective, basis, grade, responsibilities and preconditions of the basic design engineering.
- (2) The best design shall be investigated, confirming the basic design philosophy indicated hereunder.

2. WORK PROCEDURE

- (1) Basic Design should be conducted based on the following design information.
 - BEDD
 - Project Specification
 - Client's Standard
 - Design Basis
 - Design Philosophies
- (2) The Design Philosophies should be confirmed prior to engineering start.
- (3) Attached is one example of PDPI (Process Design Philosophy and Information) that requires the owner's philosophy and requirements for process design to process licensor(s).
PDPI will be useful to establish Basic Design Philosophies.

3. DESIGN PHILOSOPHY**3.1 Objectives of Basic Design**

The basic design will be conducted for one of the following objectives.

- (1) Preparing the design document and data for the proposal or feasibility study.
- (2) Preparing the "Front-End Engineering Document, FEED" as requested in the Contract.
- (3) Preparing the design documents specified in the Contract and preparing the design information for use in the subsequent detailed engineering.

3.2 Basis of Design

- (1) Basic design work shall be performed on the basis of the following technical data.
 - (a) Design basis; refer to JGS 210-120-1-10E for more detail.
 - (b) Basic engineering design data; refer to JGS 210-120-1-04E for more detail.
 - (c) Applicable codes and standards; refer to JGS 210-120-1-05E for more detail.
- (2) These data shall reflect the client's design philosophy, which must be fully understood. If more economical and practical alternatives are found, they shall be proposed to and discussed with the client before starting the basic design work.

3.3 Basic Design Information

The basic design information for proposal or other study purposes such as planning, evaluation, feasibility studies, etc., is different from actual jobs, where some gradation in the level of design is necessary. Hence, the following grades of design for proposal or other study shall be taken as satisfying the minimum requirements for study purposes.

- (1) Design Calculation
Maximize use of slide calculations based on experimental data and estimation engineering method so as to minimize process calculations.
- (2) Design information :
The design information shown in Table 3.3 shall be prepared. The necessary information, minimized for study purposes is acceptable. The grade of estimation is classified as follows;

DCE : Definitive Cost Estimate

PCE : Preliminary Cost Estimate
 OME : Order of Magnitude Estimate

Table 3.3 Information for Proposal or Study

Information	DCE	PCE	OME	Reference
1 Block Flow Diagram	O	O	O	Include tankage flow diagram.
2 Process Flow Diagram	O	O	X	JGS 214-125-1-01E
3 Utility Summary	O	O	O	Form 806, JGS 210-120-1-16E
4 Catalyst and Chemicals	O	O	O	Form 2217, JGS 210-120-1-53E
5 Equipment List	O	O	X	Form 1474
6 Vessel Data Sheet	O	X	X	Form 437/438
7 Heat Exchanger Data Sheet	O	X	X	Form 506
8 Fired Heater Data Sheet	O	X	X	Form 1496
9 Pump and Compressor Data Sheet	O	X	X	Form 1473
10 Package Unit Data Sheet	O	X	X	
11 Instrument Data Sheet	X	X	X	-
12 Piping Data Sheet	X	X	X	-
13 P&I Diagram	O	X	X	JGS 214-131-1-03E
14 Plot Plan	O	X	X	JGS 214-110-1-01E

3.4 Responsibility

Basically, basic design shall be responsible for process performance and plant cost, as successful project execution depends on well-thought-out and evaluated basic design.

3.4.1 Guarantees

Usually, JGC has responsibility for performance of the designed plant under the contract with the client. Guarantee items should be minimized, depending upon the contract type, such as EPC, EP or E-project. For example, if JGC's scope is limited to the Engineering(E) work, no guarantee of the process performance or utility guarantee will be given.

The guarantee items are listed as follows;

(1) Process performance guarantee :

Basic design engineers should be generally responsible for process performance until client's acceptance has been given to JGC, having satisfied the guarantee figure resulting from performance test operations, except for units designed and guaranteed by Licensers.

(2) Utility guarantee :

Further, the basic design engineers should have the responsibility for utility consumption, except for units designed and guaranteed by Licensers.

(3) Mechanical guarantee :

Except for detailed design, fabrication and construction, the basic design engineers should be responsible for information specified in the basic design package. However, the vendors shall have mechanical responsibility for their equipment.

Refer to JGS 210-120-1-14E "PERFORMANCE GUARANTEE" for more detail.

3.4.2 Plant Cost

As the major part of plant erection costs is referred to the basic design information, over-design is to be discouraged and minimum cost design is encouraged.

- (1) The plant shall satisfy the client's requirements for the performance and safety according to recent industrial standards. Therefore, plant costs shall not be reduced at the sacrifice of performance or safety.

However, where incremental costs additional to this minimum cost reduce the total operating cost of a plant, the following design options may be adopted.

- (a) Economical design : Economical design where investment cost will be minimized.
- (b) Optimum design : Optimum design where sum of investment and operation costs will be minimized. The operation cost is proportional mainly to energy consumption.
- (c) Energy conservation : Energy conservation design where operation cost will be minimized.

- (2) As to optimum design, care shall be taken that plant cost increases do not affect client's competitiveness and/or cause target cost overruns.

Therefore, this design policy shall have the formal approval of the project manager before implementation.

3.5 Design Preconditions

Unless otherwise specified in the client's requirements and applicable standards, the following design preconditions shall be considered.

3.5.1 Continuous Operating Period

Process facilities should be capable of operating continuously for one calendar year without unscheduled shutdown. Material and equipment selection shall take this requirement into account.

Generally more than one calendar year is uneconomical since general rotary machines (e.g. gas turbine) should be inspected and maintained once per 8,000 hours.

3.5.2 Considerations for Unusual Conditions

In addition to normal operating conditions, the plant shall be provided with the necessary facilities for startup, shutdown, emergency and alternative operations. Specifically, testing, purge and sampling connections ; flushing precautions ; vent and drains ; circulation lines ; plugging prevention ; catalyst regeneration and decoking facilities, etc., shall be considered.

3.5.3 Emergency Operation

In the event of a complete power failure, all processing facilities shall be capable of shutdown by a minimum operating staff in an orderly manner without damage to facilities or equipment or injury to personnel.

Basically, a plant shall be designed with fail safe considerations for any failure, providing necessary warning devices, pressure relieving, cooling, temperature runaway protection and emergency shutdown devices, etc.

No depressuring valve should be necessary when the above provisions are incorporated in the design.

3.5.4 Turndown Ratio

Process facilities should usually be capable of operations at 60% of their design throughput capacities. This turndown ratio shall be derived from startup and shutdown procedures as described in the operating instructions.

3.5.5 Design Life

Major equipment shall be designed for an operating life as listed in JGS 210-120-1-19E "MATERIAL SELECTION IN BASIC DESIGN".

3.5.6 Pump and Compressor Spares**(1) Pumps :**

The policy for providing spares shall take into consideration the following kinds and degrees of possible damage in ensuring safe plant operation, as shown in Table 3.5.6.

Table 3.5.6 Pump Spares

Damage	Spare
Minor loss of throughput	Common
Major loss of throughput	Full
Damage to equipment	Full
Damage to personnel	Full

(2) Compressors :

Because of their high reliability and expensive cost, centrifugal compressors need not be provided with spares.

In the case of reciprocating compressors in continuous process service, minimum one spare is necessary, as compressors require shutdown for maintenance.

Spares for instrument air compressors will normally be fully provided.

3.5.7 Driver for Pump and Compressors**(1) Electric power failure :**

Spare pumps specifically required for power failure shall be of steam turbine driven type.

(2) Economical choice :

For large drivers requiring power over 100 kW, type selection shall be made by calculation of power balance and comparing the investment and operating cost of turbines and motors.

3.5.8 Design Allowances

The design allowances shall be acceptable for design purposes, as per calculation results based on Table 3.5.8.

Table 3.5.8 Design Allowance

Equipment	Purpose	Ratio of design capacity to normal capacity
Vessel	Maximum operation range	1.0
	Residence time	1.0
	Tray performance	1.0
	Packing performance	1.0
	Catalyst volume	1.0
Heat exchanger	Heat-duty	1.0
	Surface area	1.0
Fired heater	Heat absorbed	1.1
	Heat flux	1.0
Pump	Differential head	1.0
	Capacity Charge from storage	1.0
	Charge from upstream process unit	1.1
	Products pump	1.1
	Reflux pump	1.2
Compressor	Differential head	1.0
	Capacity	1.1

3.5.9 Combination Design

- (1) Services and auxiliary functions may be combined where practical and economical.
- (2) Combination of process equipment shall be maximized where process performance and operability are not a problem.
- (3) Combination of process plants shall be considered where service factors and operating flexibility are not influenced significantly. However, requirements for separate operation and maintenance of each process shall be checked with clients and must be finally decided with the approval of the client. A stand-by cooler and intermediate storage tanks, etc., shall be provided if process combinations are adopted.
- (4) The layout of processes may be combined where maintainability allows.

3.5.10 Onstream Maintenance

Facilities may be incorporated to allow onstream maintenance of the following equipment as shown in Table 3.5.10.

Table 3.5.10 Equipment Maintenance Reasons

Equipment	Predicted Reasons	Provisions
Critical heat exchanger	Heavy fouling	Bypass
Control valve for small size	Plugging	Block and bypass
Strainer	Cleaning	Spare
Utility supply system	Mechanical failure	Spare

3.5.11 Aromatics Handling

Emissions of benzene, a known carcinogen, and other potentially hazardous aromatics shall be avoided.

- (1) The design requirements presented below shall be applicable for all process streams containing 1% (weight) or more benzene or 25% (weight) 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 of non seal type or to be equipped with dual seals and suitable barrier fluid systems. In the latter case 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 to other appropriate processing or treating facilities in order to minimize aromatic emissions to the environment.

3.5.12 Heavy Oil Remaining in Vessel

Heavy oil remaining in vessels during shutdown should be drawn out as far as possible to a slop oil tank, by the process pumps. After this draw out operation, it is better to extract heavy oil still remaining in the vessels, in order to maintain the performance of waste water treatment system, by the following provision;

- (1) Draw out heavy oil by gravity to an exclusive drum. Oil may be pumped out from the drum to the slop oil tank.
- (2) Otherwise a temporary pump may be used to extract heavy oil from the vessel to the slop oil tank directly.

4. RELATED DOCUMENTS

The following publications constitute a part of this standard practice. Unless otherwise specified, refer to the latest edition. Applicable publications for the Project will be specified in each of the Project Specifications.

JGS (JGC Standard Practice)

JGS 210-120-1-04E	Basic Engineering Design Data
JGS 210-120-1-05E	Application of Codes and Standards
JGS 210-120-1-10E	Design Basis
JGS 210-120-1-14E	Performance Guarantee
JGS 210-120-1-19E	Material Selection in Basic Design



5. APPENDIX PDPI

PROCESS DESIGN PHILOSOPHY AND INFORMATION

(PDPI)

JGC CORPORATION

CONTENT

1. GENERAL
 - 1.1 Introduction
 - 1.2 Common information
2. PROCESS DESIGN PHILOSOPHY AND INFORMATION
 - 2.1 PFD
 - 2.2 Unit turndown
 - 2.3 Heat recovery
 - 2.4 Design margin
 - 2.5 Design pressure
 - 2.6 Design temperature
 - 2.7 Hazardous component handling
 - 2.8 Holding time
 - 2.9 Tankage
 - 2.10 Utility conditions for process design
 - 2.11 Metallurgy
 - 2.12 Standard Corrosion allowance
 - 2.13 Vacuum design
 - 2.14 Requirements for plot plan
 - 2.15 Critical service rotary machinery
 - 2.16 Other process design requirements
3. EQUIPMENT & INSTRUMENT DESIGN PHILOSOPHY & INFORMATION
 - 3.1 Vessels
 - 3.2 Trays & packing
 - 3.3 Tanks
 - 3.4 Shell & tube heat exchangers
 - 3.5 Air cooled heat exchangers
 - 3.6 Heaters
 - 3.7 Pumps
 - 3.8 Compressors
 - 3.9 Instruments
 - 3.9.1 General
 - 3.9.2 Temperature instrument
 - 3.9.3 Flow instrument
 - 3.9.4 Level instrument
 - 3.9.5 Pressure instrument
 - 3.9.6 Control valve
 - 3.9.7 Analyzer
 - 3.10 Pressure relief (safety) valves (PSV) and Flare Load
 - 3.11 Machinery
4. OTHER INFORMATION
 - 4.1 Battery limit requirements
 - 4.2 Battery limit (B.L.) isolation
 - 4.3 Process waste water and liquid collection
 - 4.4 Waste gas collection
 - 4.5 Tracing of piping