

ENGINEERING STANDARD

FOR

PLANT OPERATING MANUALS

FIRST EDITION

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FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the "Company" where this standard is a part of direct purchaser order by the "Company", and the "Contractor" where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the "Company" rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

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0. INTRODUCTION

The Standard Practice Manuals titled as "Fundamental Required for the Project Design and Engineering" is intended for convenience of use and a pattern of follow-up and also a guidance.

These Standard Engineering Practice Manuals, also indicate the check points to be considered by the process engineers for assurance of fulfillment of prerequisites at any stage in the implementation of process plant projects.

It should be noted that these Iranian Petroleum Standards (IPS), as Practice Manuals do not profess to cover all stages involved in every process project, but they reflect the stages that exist in general in process projects of oil, gas and petrochemical industries of Iran.

These preparation stages describe the following and related standard three main phases which can be distinguished in every project & include, but not be limited to:

Phase I) Basic Design Stage (Containing Seven Standards)

<u>STANDARD CODE</u>	<u>STANDARD TITLE</u>
<u>IPS-E-PR-150</u>	"Basic Design Package & Recommended Practice for Feasibility Study"
<u>IPS-E-PR-170</u>	"Process Flow Diagram"
<u>IPS-E-PR-190</u>	"Layout and Spacing"
<u>IPS-E-PR-200</u>	"Basic Engineering Design Data"
<u>IPS-E-PR-230</u>	"Piping & Instrumentation Diagrams (P&IDs)"
<u>IPS-E-PR-250</u>	"Performance Guarantee"
<u>IPS-E-PR-308</u>	"Numbering System"

Phase II) Detailed Design, Engineering and Procurement Stages (Containing Two Standards)

<u>STANDARD CODE</u>	<u>STANDARD TITLE</u>
<u>IPS-E-PR-260</u>	"Detailed Design, Engineering and Procurement"
<u>IPS-E-PR-300</u>	"Plant Technical and Equipment Manuals (Engineering Dossiers)"

Phase III) Start-Up Sequence and General Commissioning Procedures (Containing Two Standards)

<u>STANDARD CODE</u>	<u>STANDARD TITLE</u>
<u>IPS-E-PR-280</u>	"Start-up Sequence and General Commissioning Procedures"
<u>IPS-E-PR-290</u>	"Plant Operating Manuals"

This Engineering Standard Specification covers:

"PLANT OPERATING MANUALS"

1. SCOPE

This Engineering Standard covers the minimum requirements of format, in preparing process and/or utility units operating manuals, including essential instructions and points of noteworthy.

The purpose of this Manual is to standardize the content and format of operating manuals which shall be prepared by the Contractor. Although operating manuals differ to some extent from process to process, the basic philosophy and general aspects shall conform to the concepts of this Standard.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Feb. 2001. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 137 on Feb. 2001. These modifications are included in the present issue of IPS.

Note 2:

This is a revised version of this standard, which is issued as revision (1)-2015. Revision (0)-1996 of the said standard specification is withdrawn.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-PR-150	"Basic Design Package & Recommended Practice for Feasibility Study"
IPS-E-PR-170	"Process Flow Diagram"
IPS-E-PR-260	"Detailed Design, Engineering and Procurement"
IPS-E-PR-725	"Process Design of Plant Waste Water Sewer Systems"

3. DEFINITIONS AND TERMINOLOGY

- **"Company or "Employer"/"Owner"**: Refers to one of the related affiliated companies of the petroleum industries of Iran such as National Iranian Oil Company (NIOC), National Iranian Gas Company (NIGC), National Petrochemical Company (NPC), National Iranian Oil Refinery and Distribution Company (NIORDC), etc., as parts of the Ministry of Petroleum.

- **"Contractor"**: Refers to the persons, firm or company whose tender has been accepted by the "Employer", and includes the contractor's personnel representative, successors and permitted assigns.

- **"Project"**: Refers to the equipment, machinery and materials to be procured by the "Contractor" and the works and/or all activities to be performed and rendered by the "Contractor" in accordance with the terms and conditions of the contract documents.

- "Unit" or "Units": Refer to one or all process, offsite and/ or utility units and facilities as applicable to form a complete operable refinery/and or plant.

4. SYMBOLS AND ABBREVIATIONS

Symbol/Abbreviation	Description
API	American Petroleum Institute
BFW	Boiler Feed Water
BHP	Break Horsepower
BKW	Break Kilowatt
BPSD	Barrel per Stream Day (bbl/sd)
Cond	Condensate
DN	Diameter Nominal, (mm)
FBP	Final Boiling Point
h	hour
HP	High Pressure
IBP	Initial Boiling Point
Kg	kilogram
kJ	kilojoule
kW	kilowatt
L	Liquid
LHV	Low Heating Value
LLP	Low Low Pressure
LP	Low Pressure
ppm (wt)	parts per million, (mg/kg)
MP	Medium Pressure
PFD	Process Flow Diagram
P & IDs	Piping & Instrumentation Diagrams
PONA	Paraffinic, Olefinic, Naphthenic, and Aromatic
RVP	Reid Vapor Pressure
s	second
sd	stream day
Sp Gr	Specific Gravity (Relative Mass Density)
UOP K	Universal Oil Products Factor
Vol	Volume

5. UNITS

This standard is based on international system of units (SI), as per [IPS-E-GN-100](#) except where otherwise specified.

6. FORMAT

6.1 General

In principle, a separate operating manual shall be prepared for each process and/or utility unit. However, in the case of short volumes, operating manuals for two or maximum three units can be integrated into one book upon approval of the Company. The compiled operating manuals should consist of related units, where possible.

6.2 Covers and Size

6.2.1 Language

"The ruling language" shall be the English language. However from time to time the 'Company' may instruct that certain correspondence etc. shall be in both Farsi and English.

The format of operating manuals shall essentially conform to company requirements:

Note: The quality of operating manual (binding, cover, paper etc.) shall be approved by the company.

For covers, type and size and color of titles and any other characters, shall be approved by company.

6.3 Titles

6.3.1 The manual shall be named as:

"Operating Manual"

6.3.2 The titles on the front cover shall include:

- a) Company name and logo.
- b) Project name.
- c) Printing of "Operating Manual".
- d) Plant or unit name.
- e) Plant or unit number.
- f) Contractor (s) name and Logo.
- g) Contract number.
- h) Document number.
- i) Date, it shall be referred to the month and year of the plant commissioning date.

6.3.3 A typical arrangement of the front cover titles is illustrated in Appendix A.

6.3.4 The titles on the bottom cover shall include all requirements as outlined in 6.3.2 above. Appendix A presents a typical arrangements of the bottom cover titles.

6.4 Dividers

Dividers should be provided to separate each chapter with appropriate designations of the concerned subject.

7. BASIC CONSIDERATIONS IN PREPARING OPERATING MANUALS**7.1 Non-licensed Processes****7.1.1 Purpose**

The purpose of an operating manual is not only to help the operation engineers and staff at the customer side to operate the plant safely, but also to present all detailed procedures for the plant start-up and shut down in the various operation cases.

7.1.2 Extent of description

7.1.2.1 Operating manuals should contain all operating procedures, guidances, hints, cautions and trouble shooting guides necessary for plant safe and correct operation.

7.1.2.2 The detailed operation procedures should also include the sequence of valve operation, time schedule, etc.

7.1.2.3 The Contractor should carefully study the past history of troubles experienced and countermeasures, employed in similar processes and provide the latest instructions.

7.1.2.4 Abnormal levels of operating variables (temperature, pressure, flow rate, fluid level in vessel, etc.) together with appropriate countermeasures should be listed in the operating manual as far as possible to avoid similar troubles.

7.1.3 Final check of operating manual

7.1.3.1 Operating manual should be checked carefully against project design document latest revision.

7.1.3.2 The operation philosophy or operation notes which was prepared at the early stages of the basic design shall be reviewed.

7.1.3.3 The necessary facilities, equipment, instruments and lines, etc., for each operation mode (namely start-up, normal shut down, emergency, regeneration, maintenance, etc.) must be taken into consideration.

7.2 Licensed Processes

7.2.1 Detail designer shall prepare an operating manual for the Licensed Unit in accordance with the conditions stipulated in this Standard for non-licensed Units and based on the contents of operating manual furnished by the Licensor. All modifications/changes resulted from the detailed engineering activities should be reflected in the final revision of the operating manuals.

7.2.2 Before making any unavoidable modifications/changes by the Contractor, it is necessary to obtain the approval of the process licensor.

8. NOTEWORTHY POINTS

8.1 General

8.1.1 Generally, the necessary documents providing a guide to operation comprise:

- a) Operating manual.
- b) Analytical manual.
- c) Vendor's instruction manuals.
- d) Safety manual.

Vendor's Instruction Manuals have priority over the operating manual prepared by the Contractor in order to place the responsibility for maloperation on the Vendors.

8.1.2 The following figures and tables to be inserted in the operating manual for the operator's convenience and easy comprehension.

a) Figures:

- (i) Trip sequence (flow) diagram.
- (ii) Simplified flow scheme of plant heat-up.
- (iii) Simplified flow scheme of catalyst reduction, activation, oxidation and regeneration (generally, for Licensed Units).
- (iv) Simplified flow scheme of feed cut-in, shut-down and other operation modes.
- (v) Furnace drying curve.
- (vi) Other charts as needed.

b) Tables:

- (i) Pressure relief valves load summary tables.
- (ii) Setting point list for instruments (especially alarm and trip elements).
- (iii) Analytical schedule.
- (iv) Utility summary tables.
- (v) Heat and material balance tables.
- (vi) Major Equipment Specification Summary.

9. CONTENTS OF OPERATING MANUAL

9.1 In order to standardize the quality of the operating manual, the chapters which shall be included in the operating manual, are listed in Appendix C.

9.2 Some of the items specified in Appendix C may be modified and/or changed depending upon the particular process and shall be approved by the Company.

9.3 Chapter II (Design Basis)

9.3.1 Sections A, B, C

9.3.2 Sections A, B, C (plant design, normal and turn down capacity), (feed characteristics), (product and by-product specifications)

9.3.2.1 Type and source of feed and unit different operating modes to be specified.

9.3.2.2 The characteristics of feed, products and by-products (if necessary) shall be specified. The typical feed and product characteristics for refinery are presented in Appendix C.

For Chapter I "Introduction" see Appendix C.

9.3.3 Section D (utility conditions)

Utility conditions shall cover operating pressure and temperature as well as application of each type for all utilities concerned in the plant. The typical utility summary table for refinery are presented in Appendix F.

9.3.4 Section E (heat and material balance tables)

Heat and Material Balance Tables including the following characteristics of each stream as marked on the relevant process flow diagram to be covered in this section. A typical refinery Heat and Material Balance Table is demonstrated in Appendix D.

Enthalpy basis (datum level) for all fluids to be identified.

9.3.5 Section F (utility summary tables)

Utility Summary Tables shall cover the following requirements where applicable (typical Utility Summary tables are presented in Appendix F):

- Item number.
- Service.
- Load BKW (BHP), kW.
- Electrical power, kW.
- Steam, 1000 kg/h.
- HP steam, pressure in, bar (ga).
- MP steam, pressure in, bar (ga).
- LP steam, pressure in, bar (ga).
- LLP steam, pressure in, bar (ga).
- Condensate, 1000 kg/h
- Cold Cond., Pressure in, bar (ga).
- HP hot Cond., Pressure in, bar (ga).
- LP hot Cond., Pressure in, bar (ga).
- LLP hot Cond., Pressure in, bar (ga).

- BFW, 1000 kg/h
- Pure demineralized water, 1000 kg/h.
- Loss (steam, condensate, BFW, ...), 1000 kg/h.
- Cooling water.
 - Tempered water, m³/h.
 - Fresh water, m³/h.
 - Temperature rise, °C.
- See Water, 1000 kg/h
- Fuel (LHV)
 - Oil, 1000 kJ/s.
 - Gas, 1000 kJ/s.
- Nitrogen, Nm³/h.
- Air, Nm³/h.
 - Instrument
 - Plant.
- Plant water, m³/h.
- Potable water, m³/h.
- Inert gas, Nm³/h.
- Natural gas, Nm³/h.

Utility Summary Tables shall be provided separately for summer and winter operating cases when the unit is operated under design flow rate. Additional cases may (such as start of run and end of run for catalytic units) be included upon the Company's request.

9.3.6 Section G (effluent summary)

9.3.6.1 Effluent summary shall cover all unit effluents except those streams considered as the unit products/byproducts as presented in section C.

9.3.6.2 The effluent summary shall include the following streams where applicable:

- Sour water.
- Oily water.
- Spent caustic solution.
- Chemical sewer.
- All other disposed liquid and solid wastes.

9.3.6.3 The following characteristics for each effluent shall be specified.

- Quantity, kg/h and/or m³/h.
- Impurities such as H₂S, NH₃, Oil, Cl⁻, Na⁺, etc. in ppm (wt), (mg/kg)
- Sources including all equipment involved.
- Destinations such as oily water sewer, non oily water sewer, chemical sewer, etc.

Any health, environmental or safety hazard associated with the effluent.

Note:

All waste items disposed to environment shall comply to [IPS-E-PR-725](#).

9.4 Chapter III (Process Description)**9.4.1 Section A (nature of process)**

The following requirements shall be included under the "Nature of Process".

- Introduction.
- Characteristic of the process.
- Chemistry of the process (if where applicable).
- Typical reactions (If any).
- Reaction rates and heats of reaction.

9.4.2 Section B

Detailed line up of the process flow separately for each section of the unit to be provided.

9.5 Chapter IV (Operating Variables and Controls)**9.5.1 Section A (control points)**

This section embodies the main process features and is prepared to help the plant operators overcome troubles not mentioned in the next chapters (start-up and shut-down procedures). Any operating variable such as pressure, temperature, chemical additions, feedstock properties, hydrogen to hydrocarbon ratio (if any), and etc. which has a significant effect on the unit operation and main product specifications shall be mentioned.

9.5.2 Section B (effect of operating variables)

Any significant deviation in product quality and/or unit operation resulting from any changes of operating variables shall be elaborated in this section.

9.5.3 Section C (troubleshooting guide)

Special attention should be paid to specify all the possible troubles which the unit operators may face during the operation. The causes, preventative actions and troubleshooting guides for any trouble shall be clearly demonstrated.

9.6 Chapter V (Auxiliary Systems)

The following sections shall be included with full operation description and useful operating guidelines where applicable:

- A)** Tempered water system.
- B)** The ram pump.
- C)** The flushing oil circuit.
- D)** Soot blowers.
- E)** Fuel oil and fuel gas systems.

- F) Chemical injection systems.
- G) Chloride and/or condensate injection to the reactor system.
- H) Any other auxiliary system as applicable.

9.7 Chapter VI (Utility System operating manual):

This section describes in detail the operation philosophy and data for utility facility. The items should be description of utility of process for easy understanding and operation guidelines. Utility systems which supplement the main process should be described as a separate sub-section. Wherever possible, process description should be supplemented by simple sketches showing the major equipment and process control for a particular unit /utility operation. This enhances the understanding of the utility requirement data and consumption.

The following section shall be included with full description of operating guidelines for utility in process plant where application. The UFD drawing and UFD consumption list shall be prepared during detail of engineering phases and attached to the manual.

In some cases licensor shall be submitted utility data and consumption.

Some of utility systems as below:

1. Steam Boiler System
2. Power Generation System
3. Fuel Gas System
4. Cooling Water System
5. Instrument/utility Air and Nitrogen Package
6. Flare and blow down system
7. Fire fighting system
8. Diesel Generator package
9. Etc.

9.8 Chapter VI (equipment operation)

The detailed start-up, operation and inspection prior to operation for all main equipment and relevant accessories as well as packaged units to be outlined in this section. Reference to the operating and maintenance instructions prepared by the equipment manufacturer for each item shall be given. Main operating points and all useful operation guidelines shall also be pointed out. Machinery equipment auxiliary systems such as anti surge system, lube oil ,sealing system, tempered water, etc. and fired heater burners, forced draft and induced draft fans operations should be explained in detail and all possible troubles and their relevant troubleshooting guide of such systems to be described.

9.9 Chapter VII (Instrumentation and Control)

9.9.1 Simplified logic diagrams for the unit, plant and equipment with step-wise operation guide-line shall be given.

9.9.2 Main features of the advanced control systems and optimization to be specified where applicable. Reference to the relevant specifications shall be made.

9.9.3 Set points of all alarms and shut down switches shall be listed.

9.10 Chapters VIII-X (Start-Up and Shut-Down)

9.10.1 Several operating activities shall be conducted at the same time during the start-up and shut-down period. So, all such activities which shall be performed in parallel for a safe and reliable start-up and shut-down operation shall be described.

9.10.2 Special attention shall be made to the Vendor's or Licensor's instruction manuals and the operating manual shall be reviewed carefully to be in congruent with the Vendor's or Licensor's instructions.

9.10.3 All start-up and shut-down procedures shall be prepared in detailed step-wise activities which will be performed by the operators with simplified start-up/shut-down sketches.

9.11 Chapter XI (Emergency Shut-Down Procedure)

9.11.1 Safeguarding systems and equipment provided to protect the plant during emergency cases such as emergency shut-down plant depressurizing shall be elaborated as defined Appendix B in section XI.

9.11.2 The minimum requirement for load summary data of pressure relief valves shall be specified as shown in Appendix F.

9.11.3 Since measures to be considered in an emergency vary according to the type, degree and duration of the emergency encountered, determining measures to be taken into account during commissioning and performance test period. This should be emphasized in the operating manual.

9.11.4 Steps to be taken in each emergency case shall be outlined in full description such that to help operators to recognize and act upon immediately.

9.12 Chapter XII (Miscellaneous Procedures)

9.12.1 Miscellaneous procedures called by the nature of unit process and/or special equipment operation not included in the other chapters shall be covered as required.

9.13 Chapter XIII (Health, Safety & Environment System operating manual):

This section describes the HSE aspects of the facility that need to be considered for HSE operating manual

- **Health:**

This operation relates to the health of the people and working in the plant or living in the vicinity of the plant whose health should be a concern for the management of the plant. This should also address the health and well being of animals and other living organisms present in the vicinity of the plant, for e.g. marine life in any water body which would be affected by the operations of the plant.

A brief description of toxicity of the chemicals used in the plant / unit, acceptable noise levels for humans and other animals, magnitude of injuries due to fire and explosion, first aid measures for treating injuries etc. should be provided.

- **Safety:**

This section relates to the safe start-up, operation and shutdown of the plant during its entire lifetime. This section should address the normal hazards those are encountered in day-to-day operations of the plant. This section should also address the safety measures available to prevent any accident. Some of the normal hazards could be loss of containment of any hazardous fluid due to overflow, leak or rupture, static electricity build-up, accidental fall from heights, burns due to exposure to hot surfaces, exposure to toxic fluids while collecting samples and piling up of flammable solid waste (wood, paper, cloth etc.).

- **Environment:**

This section describes the limits for discharge of hazardous solid, liquid and gaseous effluents to the environment based on local laws and regulations and procedures for compliance to them.

9.14 Chapter XIV (Analytical Tests)

The analytical plan shall comprise the following requirements:

- Stream name.
- Test name.
- Test number (Analytical methods).
- Sampling point.
- Normal sampling frequency.
- Start-up sampling frequency.

Detailed analytical procedures shall be prepared separately in the form of Analytical Manual.

9.15 Chapter XV (Catalysts, Chemicals, Packing, lubricant oil, filters and ...)

Summary of catalysts, chemicals, packing, lubricant oil, filters and, minimum requirements comprising of the following information shall be tabulated.

- Description of the catalyst/chemical/packing/lubricant oil, filters and ...
- Manufacturer name and type.
- Quantity required for initial charge, m³ or kg.
- Equipment number/where used.
- Equipment name.
- Estimated consumption rate [daily (d) and /or yearly (y)], m³ or kg.

Typical Summary table of catalyst/ chemical/ packing requirements shown in Appendix G.

9.16 Chapter XVI (Drawings)

9.16.1 An equipment item index shall be provided to show at least the following requirements in section A for the operator's easy reference:

- Equipment category (e.g., tower, vessel, heat exchanger, pumps, compressors, etc.).
- Equipment number.
- Equipment service name.
- Quantity.
- Referenced P & IDs.

9.16.2 A project general legend diagram, process flow diagram (PFD), process and instrument diagram (P&ID), material flow diagram (MFD), utility flow diagram (UFD), shall be inserted in this section.

APPENDICES

APPENDIX A

TYPICAL FRONT COVER TITLE

 NIOC <i>Iranian Offshore Oil Company</i> <i>Islamic Republic of Iran</i> <i>Ministry of Petroleum</i>		
National Iranian oil company		
Location : <p style="text-align: center;">Dorood Project Onshore Facilities & New Plant</p>		
Document Title. : <p style="text-align: center;">Plant Operating Manual</p>		
Document No. :		
Plant Section /Name: <p style="text-align: center;">Separation Unit (Unit-100)</p>		
Contractor logo	Contractor logo	Contractor logo
Petrofac –Agip Job No. :		
Project Code:		
Contract no.:		
Date : June-2005 Volume-I		

**APPENDIX B
CONTENTS OF OPERATING MANUAL**

I. INTRODUCTION**II. DESIGN BASIS**

- A) PLANT DESIGN, NORMAL AND TURN DOWN CAPACITY
- B) FEED CHARACTERISTICS
- C) PRODUCT (AND BY-PRODUCT) SPECIFICATIONS
- D) UTILITY CONDITIONS
- E) HEAT AND MATERIAL BALANCE TABLES
- F) UTILITY SUMMARY TABLES
- G) EFFLUENT SUMMARY AND ENVIRONMENTAL CONSIDERATION
- H) CHEMICAL CONSUMPTION TABLE

III. PROCESS DESCRIPTION

- A) NATURE OF PROCESS
- B) PROCESS OF FLOW

IV. OPERATING VARIABLES AND CONTROLS

- A) CONTROL POINTS
- B) EFFECT OF OPERATING VARIABLES
- C) TROUBLESHOOTING GUIDE

V. AUXILIARY SYSTEMS**VI. UTILITY SYSTEM****VII. EQUIPMENT OPERATION**

- A) MACHINARIES
- B) HEAT EXCHANGERS
- C) FIRED HEATERS
- D) TOWERS, VESSELS AND REACTORS
- E) PACKAGE UNITS
- F) TANK AND STORAGE FACILITIES

VIII. INSTRUMENTATION AND CONTROL

- A) GENERAL
- B) ADVANCED CONTROL SYSTEMS AND OPTIMIZATION
- C) SETTING POINT LIST

(to be continued)

APPENDIX B (continued)**IX. START-UP PROCEDURES****A. INITIAL START-UP PREPARATION**

- A.1 PLANT INSPECTION AFTER COMPLETION OF MECHANICAL SIDE**
 - A.1.1 FIELD CHECKING**
 - A.1.2 COMMISSIONING OF UTILITIES**
 - A.1.3 MECHANICAL RUNNING TEST OF ROTARY MACHINERY**
- A.2 CLEANING AND WASHING OF PIPING SYSTEM**
- A.3 HEATER INSPECTION AND DRY-OUT**
- A.4 SYSTEM DRYING**
- A.5 CHEMICAL CLEANING AND PREPARATION OF CHEMICALS**
- A.6 CATALYST LOADING**
- A.7 LEAKAGE AND PRESSURE TEST**
- A.8 PURGING**

B. INITIAL START-UP PROCEDURE

- B.1 GENERAL**
- B.2 PREPARE UNITS FOR CHARGING**
- B.3 STEAM OUT AND PURGE**
- B.4 PRESSURIZE SYSTEMS**
- B.5 REDUCTION AND ACTIVATION OF CATALYST**
- B.6 ESTABLISH GAS CIRCULATION THROUGH CATALYTIC REACTOR SECTIONS**
- B.7 FEED IN AND CIRCULATION**
- B.8 HEATING UP OF PLANT**
- B.9 ESTABLISH OPERATION**
- B.10 START CHEMICAL INJECTION**
- B.11 LINE OUT**

C. NORMAL START-UP PROCEDURE

- C.1 GENERAL**
- C.2 RE-START-UP AFTER SHORT SHUT-DOWN DURATION (HOT START)**
- C.3 RE-START-UP AFTER LONG SHUT-DOWN DURATION (COLD START)**

(to be continued)

APPENDIX B (continued)**X. NORMAL OPERATION**

- A. GENERAL
- B. NORMAL OPERATING CONDITIONS
- C. CHECK POINTS AND ADJUSTMENTS
- D. REDUCED OPERATION

XI. NORMAL SHUT-DOWN PROCEDURE

- A. GENERAL
- B. LOAD DOWN
- C. SHUT-DOWN PROCEDURE

XII. EMERGENCY SHUT-DOWN PROCEDURE

- A. GENERAL
- B. SAFEGUARDING SYSTEMS AND EQUIPMENT
 - B.1 TRIP SEQUENCE SYSTEM
 - B.2 SAFETY RELIEF VALVES LOAD SUMMARY TABLE
- C. CAUSES OF EMERGENCY SHUT-DOWN
 - C.1 FEED FAILURE
 - C.2 POWER FAILURE
 - C.3 STEAM FAILURE
 - C.4 COOLING WATER FAILURE
 - C.5 INSTRUMENT AIR FAILURE
 - C.6 FUEL FAILURE
 - C.7 MACHINE (MECHANICAL) FAILURE
 - C.8 EXPLOSION, FIRE, LINE RUPTURE, SERIOUS LEAKS
 - C.9 OTHER FAULTS AND FAILURES

XIII. MISCELLANEOUS PROCEDURES

- A. CATALYST OXIDATION
- B. CATALYST REGENERATION
- C. CATALYST UNLOADING
- D. DECOKING
- E. NEUTRALIZATION

(to be continued)

APPENDIX B (continued)**XIV. SAFETY**

- A. GENERAL
- B. SAFE PLACE TO WORK
- C. HAZARDS AND HAZID (HAZARD IDENTIFICATION)
- D. GOOD HOUSEKEEPING
- E. REQUIREMENTS FOR WELDING PERMITS
- F. HAZARDOUS CHEMICALS
- G. FLAMMABLE GAS/AIR MIXTURE
- H. FIRE-FIGHTING EQUIPMENT

XV. ANALYTICAL TESTS

- A. MANUAL SAMPLING
- B. ONLINE ANALYZER

XVI. (CATALYSTS, CHEMICALS, PACKING, LUBRICANT OIL, FILTERS AND ...)**XVII. DRAWINGS**

- A. GENERAL
- B. PROCESS FLOW DIAGRAMS
- C. PIPING AND INSTRUMENT DIAGRAMS
- D. UTILITY FLOW DIAGRAMS
- E. PLOT PLAN.
- F. ELECTRICAL SINGLE LINE DIAGRAMS
- G. MATERIAL FLOW DIAGRAM (MFD)

APPENDIX C**TYPICAL FEED AND PRODUCT CHARACTERISTICS****C.1 Characteristics of Feed and Products:**

- Molecular weight and composition.
- Sulfur and/or mercaptane [in mass% or mass ppm (mg/kg)].
- Any specific characteristic (e.g., PONA test) of feed for Licensed Units.
- Vol % on feed (for products).
- ASTM distillation curve (IBP through FBP)
- API (Sp Gr at 15.6°C) for oils and/or relative mass density for non-oils.
- UOP K.
- etc.

C.2 Characteristics of Products (in Addition to Item D.1 Above) Where Applicable:

- RVP, kPa (abs.).
- Flash point, °C.
- Viscosity at two temperatures, Pa.s.
- Pour point, °C.
- Conradson Carbon, Ash Content (in mass%) for heavy oils
- etc.

APPENDIX D
TYPICAL HEAT AND MATERIAL BALANCE TABLE

CONTRACTOR NAME	N I O C		H E A T A N D M A T E R I A L										M I O C		REV.	
	REFINERY NAME		B A L A N C E S (C A S E - I)										CON PROJ. NO.			UNIT NO.
	UNIT NAME		CON.SPEC. NO.										SR. OF			
	CRUDE/VACUUM UNIT		APZ (SP. GR) @ 15.6C (Plant. Heat. Input)	K	M W	TEMP. °C	PRESS. barg(M) (mllgabs)	FLOWING SP. GR. (Kg/m3)	FLOWING (kg/s)	FLOWING (m3/s)	MS/ H @ 15.6C (M3/S)	MS/H	KE/H	KE/KE		KJ/S
100	CRUDE FROM STORAGE		31.7	13.9	209.4	32	25.30	0.8578	1.008.0	998.7	4,129.2	854.594	231.1	80,314		
	HC LIQUID				223.0	32	25.30	0.8572	1.003.0	993.7	3,854.3	859.739	231.8	80,130		
	WATER				18.0	33	25.30	0.9950	5.0	5.0	275.0	4.935	134.0	184		
101	WATER FROM E-127				18.0	97	35.20	0.9803	15.5	14.9	827.1	14,900	406.2	1,681		
102	CRUDE TO E-103				177.5	34	25.17	0.8565	1.037.0	1,013.6	4,956.6	879,594	233.7	61,995		
	HC LIQUID				223.0	34	25.17	0.8558	1.007.0	993.7	3,854.3	859,738	236.3	61,210		
	WATER				18.0	34	25.17	0.9944	20.0	19.9	1,102.1	19,855	142.4	783		
	E-103 EXCH. DUTY													3,115		
103	CRUDE TO E-154				177.5	40	24.06	0.8324	1.031.9	1,013.6	4,856.6	879,594	266.5	65,110		
	HC LIQUID				223.0	40	24.06	0.8496	1.011.9	993.7	3,854.3	859,739	268.8	64,187		
	WATER				18.0	40	24.06	0.9923	20.0	19.8	1,102.1	19,855	167.4	923		
	E-154 EXCH. DUTY													11,634		
104	CRUDE TO E-106				177.5	63	22.51	0.8367	1.031.3	1,013.6	4,856.6	879,594	314.1	78,744		
	HC LIQUID				223.0	63	22.51	0.8359	1.031.1	993.7	3,854.3	859,739	315.3	78,280		
	WATER				18.0	63	22.51	0.9815	20.2	19.9	1,102.1	19,855	263.6	1,434		
	E-106 EXCH. DUTY													13,737		
105	CRUDE TO E-107				177.5	90	21.76	0.8110	1.075.3	1,013.6	4,956.6	879,594	370.3	90,481		
	HC LIQUID				223.0	90	21.76	0.8111	1.034.7	993.7	3,854.3	859,739	370.2	88,403		
	WATER				18.0	90	21.76	0.9831	20.6	19.9	1,102.1	19,855	378.9	2,078		
NOTES:																
		2							5							
		1							4							
		0							3							
		REV	DESCRIPTION	DATE	BY	APPR	REV	DESCRIPTION	DATE	RY.	APPR					

* CON = Contractor

APPENDIX E
TYPICAL UTILITY SUMMARY TABLE

CONTRACTOR NAME	N I O C REFINERY NAME		CRUDE/VACUUM UNIT UTILITY SUMMARY	OPERATION MODE		WISC NO.		REV.
	UNIT NAME	CSU/MSU		REGULAR OPE.	PEAK OPE.	WISC PROJ. NO.	CONC/PROJ. NO.	
UNIT NO.	LOAD @ 100% (kW)	TELEC. POWER (kW)	STEAM CONDENSATE (lb/hr)	CONDENSATE TEMP (°F)	WATER TEMP (°F)	COOLING WATER TEMP (°F)	LOSS (lb/hr)	SIL OF
E-120A/B VACUUM COL. SLOP GAS OIL COOLER								
E-123A-G VACUUM TOR COOLER								

NOTES:
 • INDICATES QUANTITY GENERATED
 - INDICATES QUANTITY CONSUMED
 { } INDICATES SPARE OR INTERMITTENT USE, NOT INCLUDED IN TOTALS.
 [] INDICATES AUTO-STARTING EQUIP.

(to be continued)

APPENDIX F

TYPICAL PRESSURE RELIEF VALVES LOAD SUMMARY TABLE

ITEM	CONTRACTOR NAME	N I O C		PRESSURE RELIEF VALVES										REV.				
		ARAK REFINERY PROJECT		LOAD SUMMARY											UNIT NO.			
		UNIT NAME	CRUDE/MACHINE UNIT	COOLING WATER FAILURE		FIRE		ENH. ELEC. POWER FAIL.		OTHER CAUSES		CONTR. NO.	SUB. OF					
PROTECTED EQUIPMENT	SITE AND TYPE (DIM)	SET (BAR)	DISCONNECT TO	MP	kg/h	°C	AREA	MP	kg/h	°C	V	MP	kg/h	°C	CAUSE	NOTES		
PSV-1010	D-01-107	V-101	3.5" x 2.5" (400 x 400)	5.5	FLARE	-	72.2	1.766	103.0	-	-	-	-	-	-	-		
PSV-1015	D-01-112	V-102	6" x 6" (150 x 150)	2.1	FLARE	53.0	106.5	101.287	188.3	67.9	91.174	155.0	V	88.9	103.658	175.4	REFLUX FAIL E-102 FAIL	
PSV-1017	D-01-113	V-115	6" x 6" (150 x 150)	20.7	FLARE	-	88.4	15.585	215.5	-	-	-	-	-	-	-		
NOTES:																		
1																		
2																		
3																		
REV	DESCRIPTION		DATE	BY	APPR	REV	DESCRIPTION	DATE	BY	APPR	DATE						BY	APPR

**APPENDIX G
CHEMICAL CONSUMPTION LIST**

ITEM NO.	TAG. NO. P&ID References	Descriptipn	Injection Location	Injection Rate	Initial Filling	Injection Temp. (°C) / Press. (Barg)	Injection Status	MESC Code No.
1	PK-100	Corrosion inhibitor	Flow line inlet	15-30 PPM (Note 1)	BY THE CLIENT (Note 2)	45 / 38	Continuous Injection	
2	PK-101	Hydrate inhibitor (Methanol)	Sludge catcher	8-15 L/Hr	BY THE CLIENT (Note 2)	35 / 60	Non Continuous Injection	
3	PK-102	Reactor Catalyst	Hydrocracker	7.5 m ³	7.5 m ³	25 / 35	Cyclic (Depend Of Reactor Performace & Vendor Suggestion)	

Notes:

1. The rate depend on type of corrosion inhibitor
2. Chemical packages are note in the scope of Flow Lines & Gas Transmission EPC Project.
3. MESC code no. Shall be submitted by procurement section
4. Vendor shall be proposed type of chemical and dosage of injection based on his experience and proposed cyclic life of chemical /catalyst and