

ENGINEERING STANDARD**FOR****PROCESS FLOW DIAGRAM****ORIGINAL EDITION****JAN. 1996**

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2000(1) and Dec. 2011(2). The approved modifications are included in the present issue of IPS.

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 Manual titled as "Fundamental Requirements 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 fulfilment of prerequisites at any stage in the implementation of process plant projects.

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

These preparation stages describes the following three main phases which can be distinguished in every project & includes, but not limited to:

- Phase I)** Basic Design Stages (containing Seven standards).
- Phase II)** Detailed Design, Engineering and Procurement Stages (containing two Standards).
- Phase III)** Start-up Sequence and General Commissioning Procedures (containing two Standards).

The process engineering standards of this group includes the following 11 Standards:

<u>STANDARD CODE</u>	<u>STANDARD TITLE</u>
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I) Manuals of Phase I (Numbers 1-7)

IPS-E-PR-150	"Basic Design Package"
IPS-E-PR-170	"Process Flow Diagram"
IPS-E-PR-190	"Layout and Spacing"
IPS-E-PR-200	"Basic Engineering Design Data"
IPS-E-PR-230	"Piping & Instrument Diagrams (P&IDs)"
IPS-E-PR-250	"Performance Guarantee"
IPS-E-PR-308	"Numbering System"

II) Manuals of Phase II (Numbers 8 & 9)

IPS-E-PR-260	"Detailed Design, Engineering and Procurement"
IPS-E-PR-300	"Plant Technical and Equipment Manuals (Engineering Dossiers)"

III) Manuals of Phase III (Numbers 10 & 11)

IPS-E-PR-280	"Start-up Sequence and General Commissioning Procedures"
IPS-E-PR-290	"Plant Operating Manuals"

This Engineering Standard Specification covers:

"PROCESS FLOW DIAGRAM"

1. SCOPE

This standard manual specifies the minimum general and specific requirements for the contents of process flow diagram (hereinafter called PFD) which shall be used throughout OGP project. However, further requirements may be requested by the company to fulfill specific project requirements.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2000. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No. 130 on Dec. 2000. These modifications are included in the present issue of IPS.

Note 2:

This standard specification is reviewed and updated by the relevant technical committee on Dec. 2011. The approved modifications by T.C. were sent to IPS users as amendment No. 2 by circular No. 317 on Dec. 2011. These modifications are included in the present issue of IPS.

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.

ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)

ISO 7000-1984 (E/F), "Graphical Symbols for Use on Equipment-Index and Synopsis"
1st. Ed. 1984-03-15

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-GN-100	"Engineering Standard for Units"
IPS-E-PR-230	"Engineering Standard for Piping & Instrument Diagrams (P&IDs)"
IPS-E-PR-290	"Engineering Standard for Plant Operating Manuals"
IPS-E-PR-308	"Engineering Standard for Numbering System"

3. DEFINITION OF PROCESS FLOW DIAGRAM (PFD)

Process flow diagram mainly defines:

- a) A schematic representation of the sequence of all relevant operations occurring during a process and includes information considered desirable for analysis.
- b) The process presenting events which occur to the material(s) to convert the feedstock(s) to the specified products.
- c) An operation occurring when an object (or material) is intentionally changed in any of its physical or chemical characteristics, is assembled or disassembled from another object or is arranged or prepared for another operation, transportation, inspection or storage.

4. PURPOSE OF PFD

The purpose of PFD is generally as follows:

a) Plant design basis

PFD shows the plant design basis indicating feedstock, product and main streams flow rates and operating conditions.

b) Scope of process

PFD serves to identify the scope of the process.

c) Equipment configuration

PFD shows graphically the arrangement of major equipment, process lines and main control loops.

d) Required utilities

PFD shows utilities which are used continuously in the process.

5. CONTENTS OF PFD

5.1 Inclusive

PFD shall comprise but not limited to the following items:

- 1) All process lines, utilities and operating conditions essential for material balance and heat and material balance.
- 2) Utility flow lines and their types which are used continuously within the battery limits.
- 3) Equipment diagrams to be arranged according to process flow, designation, and equipment number.
- 4) Simplified control instrumentation pertaining to control valves and the likes to be involved in process flows.
- 5) Major process analyzers.
- 6) Operating conditions around major equipment.
- 7) Heat duty for all heat transfer equipment.
- 8) Changing process conditions along individual process flow lines, such as flow rates, operating pressure & temperature, etc.
- 9) All alternate process and utility lines operating conditions.
- 10) Material balance table for essential streams.

5.2 Exclusive

The following items are generally not be shown on PFD, except in special cases:

- 1) Minor process lines which are not usually used in normal operation and minor equipment, such as block valves, safety/relief valves, etc. unless otherwise specified.
- 2) Elevation of equipment.

- 3) All spare equipment.
- 4) Heat transfer equipment, pumps, compressor, etc., to be operated in parallel or in series shall be shown as one unit.
- 5) Piping information such as size, orifice plates, strainers, and classification into hot or cold insulated or jacket piping.
- 6) Instrumentation not related to automatic control.
- 7) Instrumentation of trip system.
- 8) Drivers of rotating machinery except where they are important for control line of the process conditions.
- 9) Any dimensional information on equipment, such as internal diameter, height, length, and volume. Internals of equipment shall be shown only if required for a clear understanding of the working of the equipment.

6. UNITS

This Standard is based on International System of Units (SI), as per [IPS-E-GN-100](#) except where otherwise specified.

7. GENERAL DRAFTING INSTRUCTIONS

7.1 Scale

PFDs should not be drafted to scale. However, their size should be compatible with that of equipment drawings.

7.2 Flow Direction

As a rule, PFDs should be drawn from the left to the right in accordance with process flows.

7.3 Process and Utility Lines in General

The main process flow shall be accentuated by heavy lines.

Process utility lines shall be shown only where they enter or leave the main equipment unless otherwise specified.

Pipe lines shall not be identified by numbers.

Valves, vents, drains, by-passes, sample connections, automatic or manual control systems, instrumentation, electrical systems, etc. shall be omitted from the schemes.

The direction of the flow shall be indicated for each line.

7.4 Kind of Lines

As a rule, Process lines, utility lines, and loop lines for instrument should be drawn according to [IPS-E-PR-230](#) as follows:

a) Main process lines

Thickness = 0.8 mm



b) Secondary process lines and utility line

Thickness = 0.5 mm



c) All electrical, computer and instrument signals

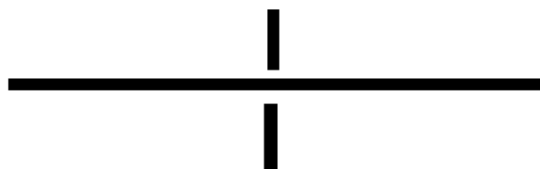
Thickness = 0.3 mm



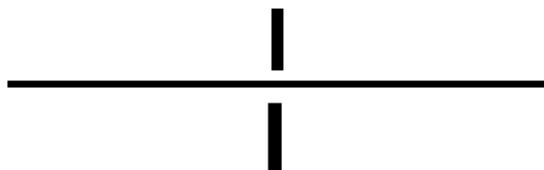
7.5 Line Crossover

Where two lines cross each other, the horizontal line should be drawn as a continuous line in all cases. This shall not apply to loop lines for instruments.

a) Where two main process lines cross



b) Where one main line crosses one secondary process and utility lines



c) Where one main line crosses one loop line for an instrument

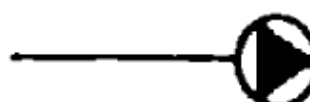
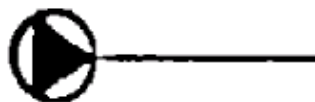


7.6 Denotation of Lines at Battery Limit Tie-In Points

a) Process lines

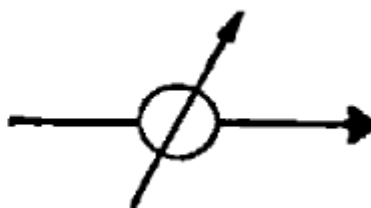
From Item No. and/
or Dwg. No.

To Item No. and/
or Dwg. No.



Where a PFD consists of two or more divided sheets, drawing numbers should be indicated.

b) Utility lines



COOLING WATER

Names of fluids should be given in parentheses above the utility lines.

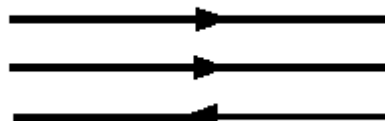
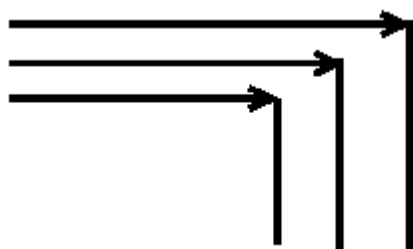
Names of these fluids should be as abbreviations defined according to [IPS-E-PR-308](#).

7.7 Direction of Flow

The direction of flow should be indicated by arrows. In principle all flow lines should be denoted by arrows located at the inlet of equipment, at merging points, and at the corners of the lines. Where a process line is long, however, the process flow may be denoted by arrows located at intermediate points.

The number of arrows used to denote one process flow line is not restricted. However, care should be taken not to clutter the drawing with excessive arrows.

Arrows at corners may be suitably omitted.



7.8 Division of PFD

Where a PFD must be divided into two or more sheets, it should be divided at portions where division is easiest from the process standpoint and each divided section should be drawn on a separate sheet.

7.9 Other Trains

Where there are two or more identical trains of process flows, one representative train may be given in the PFD and the others omitted. However, notations pointing out such omissions must be clearly indicated in the titles of all relevant PFDs to avoid confusion.

7.10 Base Line

As a rule, base lines should not be drawn. Similar items of equipment, however, should be aligned at the same level as far as possible.

7.11 Title

The title should be given in the title block at the lower right-hand corner of the PFD. A typical title block is shown in Appendix A.

7.12 Legend

The legend may be given in separate schematic drawing to which reference shall be made if necessary.

7.13 Size

The size of PFD should normally be A1 (594 mm × 841 mm). The reduced size to A3 shall be legible.

8. IDENTIFICATION AND NUMBERING OF EQUIPMENT

8.1 Process Equipment

8.1.1 Letter of group

Each item of equipment shall be identified by an identifying or a tag number composed of letter as given in [IPS-E-PR- 308](#).

8.1.2 Equipment number and name

The equipment number and name should be given in the PFD, as a rule, at the upper or the lower part of the sheet, preferably in a space close to the center line of the equipment which is to be denoted.

8.1.3 Installed spare equipment

Installed spare equipment, such as pumps, shall be indicated by a suffix letter like "A" or "B".

8.1.4 Equipment drivers

Equipment drivers shall carry the same designation as the driven equipment.

8.1.5 Instrumentation

It is not necessary to assign an identifying number in the PFD.

9. DESCRIPTION OF EQUIPMENT

9.1 Symbols of Equipment and Operating Conditions

a) As a rule, piping and equipment symbols which are common to individual processes should be unified. These are mentioned in Figs. 1.1-1.18.

Symbols to denote other equipment not specified in this standard manual shall be decided during project execution upon the company's approval.

b) Decimal numbers should be used inside the symbols mentioned in Fig. 2 to denote operating conditions.

c) The position of the operating condition denotation should be as close as possible to the point requiring indication. Where it is difficult to find space for such denotation, however, an auxiliary line should be used to indicate it.

9.2 Minimum Information Requirements for Equipment/Streams

9.2.1 Designated streams

- a) Stream numbers should be serially denoted by Decimal numbers.
- b) Fluid name.
- c) Total flow rate.
- d) Density and/or molecular mass (weight) if required.
- e) Operating pressure and temperature if required.

9.2.2 Heat exchangers

- a) Identification number and service name.
- b) Operating heat duty.
- c) Inlet and outlet temperatures on both shell and tube sides.

9.2.3 Furnaces

- a) Identification number and service name.
- b) Operating absorbed heat duty.
- c) Inlet and outlet operating temperatures on tube side.

9.2.4 Reactors

- a) Identification number and service name.
- b) Inlet and outlet operation temperature.
- c) Inlet and/or outlet pressure.

9.2.5 Columns

- a) Identification number and service name.
- b) Tray numbers, operating temperature and pressure for top and bottom trays and also for special trays such as feed and draw-off, etc.
- c) Trays shall be numbered from bottom to top.

9.2.6 Drums

- a) Identification number and service name.
- b) Operating temperature.
- c) Operating pressure.

9.2.7 Pumps

- a) Identification number and service name.
- b) Normal operating capacity and differential pressure.

9.2.8 Compressors and blowers

- a) Identification number and service name.
- b) Normal operating capacity and differential pressure.

9.2.9 Ejectors

- a) Identification number and service name.
- b) Inlet and outlet operating pressure for ejector system.

9.2.10 Tanks

- a) Identification number and service name.
- b) Operating temperature.
- c) Operating pressure.
- d) Tank capacity.

9.2.11 Filters

- a) Operating Temperature.
- b) Inlet and outlet operating pressure.

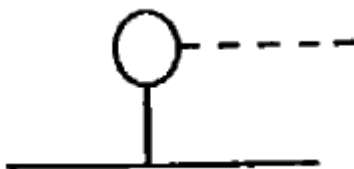
10. DESCRIPTION OF INSTRUMENTATION

Instrumentation to be denoted are instruments, measuring devices and control valves.

10.1 Instruments**10.1.1 Symbols for instrument**

- a) The symbol for an instrument is a circle which shall be connected to the line which is nearest

the point of measurement.



b) Where the instrument is a controller, a dotted line representing the control impulse shall connect the instrument circle to the controller valve.

c) The denotation of such functional symbols as "R" for recorder, "I" for indicator, and "A" for alarm, etc. should be omitted except for the functional symbol "C" for control.

- There should be no distinction as to whether instruments should be locally installed or mounted on the main instrument panel.

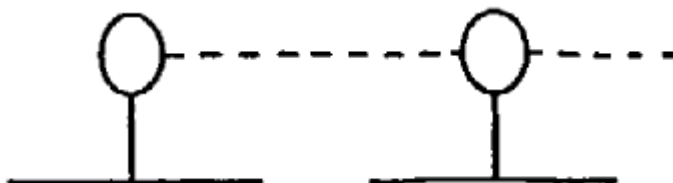
10.1.2 Functional symbols for control

The following symbols are shown inside the circle representing the instrument. For further details refer to [IPS-E-PR- 308](#).

Flow Controlling	FC
Flow Ratio Controlling	FRC
Level Controlling	LC
Pressure Controlling	PC
Pressure Differential Controlling	PDC
Temperature Controlling	TC
Temperature Differential Controlling	TDC
Speed Controlling	SC
Mass (Weight) Controlling	MC

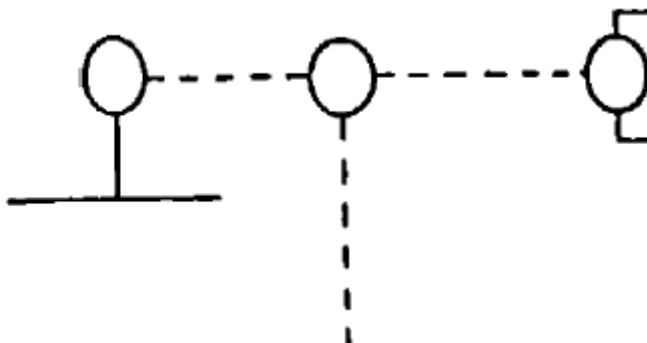
10.1.3 Cascade control

Where one controller alters the desired value of one or more other controllers, the instruments circles shall be connected by a dotted line.



10.1.4 Compound control

Where the control actions of two or more controllers combine to operate one or more control valves, the instrument circles representing the controllers shall be joined by dotted lines to the instrument circle representing the combining device.

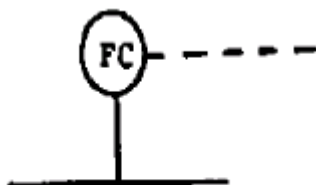


10.2 Measuring Devices

The connecting line between the circle representing the instrument and the stream line represents the measuring device such as for temperature measurement, pressure measurement, flow rate measurement, etc.

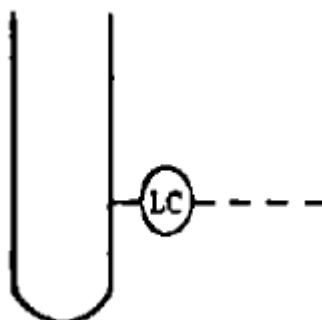
10.2.1 Flow rate measuring

Regarding flow rate measurement, definitions of apparatus type such as rotameter, pitot tube, turbine meter, Valves associated with the device need not be shown.



10.2.2 Level measuring

- a) Definitions of apparatus type such as ball float, displacement, difference pressure, etc., need not be shown.
- b) A distinction should not be made as to whether the apparatus is an internal or external type.
- c) Valves associated with the device need not be shown.



10.2.3 Measurement of pressure, temperature, etc.

- a) No distinction should be made regarding measuring type.
- b) Valves associated with measuring devices need not be shown.

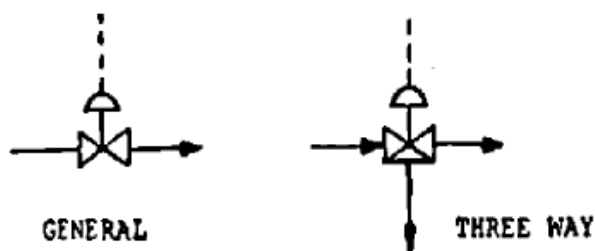
10.3 Control Valves

10.3.1 Actuator

- a) The symbol for an actuator is a half circle which shall be connected with a dotted line representing the control impulse.
- b) There should be no distinction made as to whether the actuator is a diaphragm type, electric motor type or oil cylinder type, etc.

10.3.2 Control valves

Control valves operated by instruments are shown as following:



11. MATERIAL BALANCE TABLE

11.1 Contents of Material Balance Table

A material balance table as typically shown in Table-1 shall consist of at least the following information :

11.1.1 Stream information

Stream No., name of stream, flow rate, composition.

11.1.2 Operating conditions

Operating temperature and pressure.

11.1.3 Basic physical properties

Molecular mass (weight), API gravity, Relative Mass Density (Specific Gravity) or (Sp.Gr.), etc.

11.1.4 Data concerning hydraulic calculation

Density, viscosity, etc. if required.

11.2 Denotation of Material Balance Table

In preparation of material balance Table, care should be given to the following points:

11.2.1 Position of denotation

As a rule, the material balance table should be inserted at the lower part of the PFD.

11.2.2 Number of digits of numerals and denotation of small quantities

As a rule, percentages should be expressed down to 0.01%. Where traces of components are concerned, special units, such as ppm, should be used.

11.3 Examples

A typical material balance table is shown in Table 1.

TABLE 1 - TYPICAL MATERIAL BALANCE TABLE

STREAM No.			101	102
Fluid name				
Components	mol/h or mol% or mass/h or mass%	Spec. MW and/or BP and/or MP		
A				
B				
C				
D				
E				
Total flow rate (mol/h)				
Total flow rate (mass/h), in (kg/h)				
Total flow rate (volume/h), in (m ³ /h)				
For liquids at operating conditions, and in (Nm ³ /h) for gases				
Operating pressure, in kPa (ga) or bar (ga)				
Operating temperature, in (°C)				
Molecular mass (weight), in (kg)				
Relative mass density (specific gravity) at standard conditions, dimensionless				
Mass density at operating conditions, in (kg/m ³)				
Others				
Remarks				

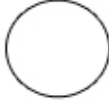
12. HEAT AND MATERIAL BALANCE SHEETS

When preparing the heat and material balance sheets in addition to material balance tables, necessary reference should be made to PFD stream numbers.

The heat and material balance sheets should be prepared as typically shown in [IPS-E-PR-290](#)

13. PIPING AND EQUIPMENT SYMBOLS (SEE APPENDIX B)

14. SYMBOLS OF OPERATING CONDITIONS

Liquid flow rate:	
Mass flow rate:	
Gas flow rate:	
Pressure:	
Temperature:	
Heat duty:	

SYMBOLS OF OPERATING CONDITIONS**Fig. 2****Note:**

Decimal numbers should be inserted inside the symbols.

APPENDICES

APPENDIX A

A TYPICAL TITLE BLOCK

A TYPICAL TITLE BLOCK

0	JULY 2010 - 17	PRELIMINARY					
REV.	ISSUE DATE	DESCRIPTION	DWN . BY	CHKD . BY	DESD . BY	CHKD . BY	APPR . BY
 OWNER : NATIONAL PETROCHEMICAL COMPANY PETROCHEMICAL INDUSTRIES DEVELOPMENT MANAGEMENT COMPANY شرکت مدیریت توسعه صنایع پتروشیمی							
PROJECT: AMMONIA AND UREA COMPLEX IN BANDAR ASSALUYEH							
CONTRACTOR : TOYO ENGINEERING CORPORATION (TEC) 							
TITLE : PRPCESS FLOW DIAGRAM (DESULFURIZATION ,REFORMING AND SHIFT CONVERTER)							
SCALE :	OWNER PROJECT NO. :		DRAWING NO :PFD-10-PR-0001				
SHEET 1:OF 16	CONTRACTOR PROJECT NO. : BAO565						

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