MANUAL

INSTRUMENTATION SYMBOLS AND IDENTIFICATION ON PROCESS ENGINEERING FLOW SCHEMES

DEP 32.10.03.10-Gen.

July 1999

DESIGN AND ENGINEERING PRACTICE

PREFACE

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The Hague, The Netherlands,

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They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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1. INTRODUCTION

1.1 SCOPE

This DEP, in conjunction with Standard Drawing S 37.000, specifies requirements and gives recommendations for:

- symbols for the graphical presentation of instrument functions used on Process Engineering Flow Schemes (PEFS); and
- identification codes of the above instrument functions on PEFS.

This DEP is a revision of the DEP of the same number dated June 1991.

1.2 DISTRIBUTION, APPLICABILITY AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this document is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group Company, and to Contractors and Manufacturers nominated by them (i.e. the distribution code is "F", as defined in DEP 00.00.05.05-Gen.).This DEP is intended for use in oil refineries, chemical plants, gas plants, exploration and production facilities and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements are more stringent than in this manual, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the authorities concerned with the object of obtaining agreement to follow this document as closely as possible.

1.3 DEFINITIONS

1.3.1 General Definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Abbreviations

DCS	Distributed control system
HMI	Human machine interface
IPF	Instrumented protective function
IPS	Instrumented protective system
MMS	Maintenance Management System(s)
PEFS	Process engineering flow scheme(s)
PFS	Process flow scheme(s)
PSFS	Process safeguarding flow scheme(s)

SIL	Safety Integrity Level, see DEP 32.80.10.10-Gen.
TSO	Tight shut off to Class V or Class VI, in accordance with IEC 60534-4

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (5).

2. SYMBOLS

The instrument symbols used on PEFS shall indicate the functionality of the loop. They shall indicate which process condition or property is being measured and controlled and what information is displayed.

NOTE: The same applies to PFS and PSFS but the presentation of instrument functions on these documents will be less extensive.

Frequently used standardised symbols are shown on Standard Drawing S 37.000.

Note: Standard drawing S 37.000 has been created to serve as a starting point for the generation of a PEFS instrumentation symbols and legend sheet on a project. It is available to the user in electronic format. For Mechanical Engineering symbols used on flow schemes, see DEP 31.10.03.10-Gen. and Standard Drawing S 02.002.

Typical examples of symbols used for instrument functions are shown in the Appendices of this DEP. The use of this DEP and Standard Drawing S 37.000 should allow most of the current process control functions to be indicated on PEFS, including those for process computers, shared display/control systems and interfaces.

The symbols used have been derived from ISO 3511, ISA S5.1 and ISA S5.3.

NOTE: The symbol presentation on PEFS as detailed in this DEP is 'loop-based', with loop components only shown where necessary to express the loop functionality. The presentation covered by ISA S5.1 and ISA S5.3 is fundamentally different as it is 'component-based'. ISO 3511 allows both presentation methods.

For most IPF and control functions it is not be possible to cover all functionality in sufficient detail on PEFS. In such cases, further details should be provided on separate documents, such as narratives, block diagrams, functional logic diagrams, flow charts or a combination of these documents.

On PEFS, the # sign is reserved to draw attention to the fact that further detailing of functionality is available on other documents. The # sign should be shown only once for a set of related functions. As an alternative for the # sign, the full drawing number of such documents may be referenced (e.g. 'refer to document R-123 456').

For operator convenience and for uniformity in calculation functions, a DCS command to increase the output should correspond with increased capacity of throttling control valves, a larger opening of louvres, increased motor speeds, increased cooling capacity of variable-pitch fans etc. Where this is not the case (e.g. for fail-open throttling control valves) the signal shall be reversed upon exiting the DCS. The reversal function is only shown on PEFS if essential for loop functionality.

The following information should not be shown on PEFS; if applicable, such information shall be provided on detail documents.

- Maintenance override switches and related status lamps, lamp test push buttons.
- Signals between the IPS and DCS for the purpose of synchronisation and controller mode/output switching and ramping.
- Facilities for testing IPF initiators and IPF final elements.
- Signals that provide information on failure of measuring instruments and instrument systems, such as crippled mode alarms, system alarms and communication alarms.
- Signals for initialisation, external feed back etc.
- Signals for remote calibration (e.g. analysers).

Where required to clarify functionality, the information flow direction shall be shown by arrows on signal line symbols.

If a loop is split across multiple PEFS drawing sheets, the following methods, in order of preference, are available for cross-referencing:

a) Route the signal lines to the left or right margin of the PEFS drawing and show the continuation details near the margin, similar to the method applied for process lines. For examples of this preferred method, see Appendix 2, item 2.1 and Appendix 3, item 3.1.

b) Apply pointers as shown on S 37.000, table 3. The pointers shall refer to the tag number, PEFS drawing number and coordinates. For an example, see Appendix 2, item 2.3. This method may be used if method a) would lead to cluttering of the PEFS. This method may

also be used for cross referencing on a single PEFS drawing, by routing signal lines from e.g. top-left to bottom-right to prevent cluttering.

3. IDENTIFICATION

3.1 GENERAL

This Section covers the identification of instrument functions on PEFS. The identification concept is based on loop functionality, whereby in principle all components and functions of the loop carry the same tag number. The numbering is unique at loop level.

To clarify the functionality of the loop, it is sometimes required to show loop components on PEFS. In such cases, the components should be presented on PEFS with unique identifications, providing that the process unit and serial number are left unchanged (e.g. in loop 110FICA-101, a transmitter may be shown as 110FT-101, a local receiving indicator as 110FI-101 and the two valves as 110FCV-101A and 110FCV-101B).

An instrument function is identified by its symbol (see Section 2 and Standard Drawing S 37.000) and its tag number (see below).

3.2 TAG NUMBERING FOR INSTRUMENT FUNCTIONS ON PEFS

3.2.1 General

Each instrument should have a tag number of the format:

abc-yz

in which:

'a'	is a two or, preferably, three digit number used to identify the process unit.
'b'	is a measured variable code: one capital letter code identifies the process condition, property measured or initiating variable. Where required, an additional modifier letter is added.
‘c’	is a function code: one or more capital letter codes identifies the function of the instrument or loop.
-	is a separation dash, used for clarity
‘y’	is a three digit serial number (i.e. from 001 through 999)
‘z’	is an optional suffix which can be used to make a loop component uniquely identifiable; only to be used if required.

3.2.2 Process unit identification 'a'

The first two or three digits of the process unit are used to reflect the process unit in the instrument tag number. The three digit system is preferred and should be used for new process units.

Table-1: Examples of the relation between process unit and process unit identification 'a'

Process unit	Identification 'a'	
	Two-digit method	Three-digit method
0100	01	010
1100	11	110
1150	11 (see note below)	115 (see note below)
7400	74	740
7420	74 (see note below)	742 (see note below)

NOTE: In the two-digit method, no tag number distinction is made between instruments in the main unit (e.g. 1100) and those in sub-units (e.g. 1150). If such a distinction is required, the three-digit method should be applied.

3.2.3 Measured variable code 'b'

This code shall indicate the process condition, property measured or initiating variable in accordance with Table 5 of Standard Drawing S 37.000. A modifier may be required to fully define the measured variable.

3.2.4 Function code 'c'

This code shall indicate the loop function in accordance with Table 5 of Standard Drawing S 37.000. Where two or more letters are required to capture the full functionality, they shall be placed in the sequence **ITBRQCSZA:** 'IBRQ' for displays, 'T' for transmitting, 'CSZ' for control/switch functions and 'A' for alarm.

For computing functions that cannot be manipulated by the operator, the letter 'Y' shall be used (e.g. FY, PY, LY, PDY, XY, UY). For computing functions that can be manipulated by the operator, the letter combination 'HY' shall be used.

3.2.5 Serial number 'y'

Serial numbers shall be unique in each group of instruments having the same combination of process unit identification ('a') and measured variable code ('b'). Serial numbers shall start at 001 and should be assigned so that projected future expansions can be accommodated. Some numbers shall be left unused to allow for unforeseen future expansions.

Example: Flow instruments in unit 1100 are tagged 110FICA-001, 110FG-002, 110FP-003, 110FIZA-005. In this example, 110F-004 is intentionally left unused to allow for unforeseen future expansions.

NOTES:

1. The practice of allocating separate number series for quality test points (QPs), restriction orifices/flow test points (RO/FPs), flow glasses (FGs), pressure gauges/test points (PGs/PPs) and temperature gauges/elements/test points (TGs/TEs/TPs) should no longer be used. This practice may however still be desired for a specific project for the purpose of maintaining consistency with existing installations or in cases where the available number series cannot accommodate all instrument functions.

2. Deviation from the above tag numbering arrangement may be required in certain cases, for which the Contractor shall submit an alternative arrangement to the Principal for approval.

3. If one process unit contains identical process trains or identical pieces of equipment, the assignment of serial number 'y' should be selected to provide a logical and recognisable numbering relation.

   Example: Process unit 1100 consists of two identical compressor sets and a future 3rd compressor is projected. Blocks of instrument serial numbers may be assigned as follows: 001-099 for the common upstream process, 100-199 for compressor one, 200 and 299 for compressor two, 300-399 reserved for compressor three and 401 and above for the downstream processes. The pressure controllers for compressors 1, 2 and 3 may be tagged as

110PICA-101/201/301 respectively.

3.2.6 Optional suffix 'z'

If a loop consists of more than one similar component, a suffix letter may be used on PEFS to make the identification of a component unique for reference purposes.

Examples:

If two (redundant) transmitters are installed in loop 110PDICA-056 for maintenance purposes and a manual selector is provided to select one of them, the transmitters should be shown on the PEFS as 110PDT-056A and 110PDT-056B.

If loop 742FIC-001 is provided with a high and low range transmitter, the transmitters should be shown on the PEFS as 742FT-001A for the high range transmitter and 742FT-001B for the low range transmitter.

NOTE: The suffix ‘z’ as specified here applies only to tag numbers used on PEFS. The tag number structures for DCS , Engineering Tools and MMS require unique tagging at component/function level, see (3.6).

3.3 TAG NUMBERING FOR FINAL ELEMENTS ON PEFS

A final element in throttling service shall be shown on the PEFS with the same tag number as the controller, with the exception of the function code (‘c’) that shall be “CV”, e.g. if 110FICA-001 is the tag number of a controller, the control valve is tagged 110FCV-001.

For the tag numbering of final elements associated with (binary) logic functions, see (3.4).

If a control loop consists of more than one final element, letters A/B/C etc. shall be used as tag number suffix ‘z’ to make the numbering of the final elements unique.

Examples:

If loop 110PIC-101 is provided with two valves in a split-range arrangement, the valves shall be shown on the PEFS as 110PCV-101A and 110PCV-101B.

If loop 742TIC-005 throttles the position of three louvres, the louvres shall be tagged 742TCV-005A, 742TCV-005B and 742TCV-005C.

3.4 TAG NUMBERING FOR (BINARY) LOGIC FUNCTIONS ON PEFS

Binary logic functions shall be identified as follows:

aKS-y for binary logic functions that are not safety related or classified as SIL a2 and below, e.g. sequential control functions, switching functions, automatic start-up functions.

aUZ-y For binary logic functions classified as SIL 1 and above, i.e. binary logic solvers for Instrument Protective Functions.

The serial number ‘y’ of the tag number for the binary logic function shall end with zero, e.g. 110KS-100, 110KS-110, 110KS-120, 742UZ-030, 742UZ-110, 742UZ-230.

For identification of the outputs from the above binary logic functions and the solenoid valves/final elements driven by that logic, the last digit shall be used. Final elements shall be tagged KSV and UZV respectively.

Examples:

Logic function 110KS-110 controls on-off valves 110KSV-111, 110KSV-112, 110KSV-113 and provides output 110KS-114 to IPF function 110UZ-180.

110UZ-180 controls the position of valve 110FCV-001 via solenoid operated valve 110UZV-181 and controls on-off valves 110UZV-182 and 110UZV-183 via solenoid operated valves with the same tag number. Furthermore, it provides output 110UZ-184 to the DCS controller 110FIC-001.

3.5 TAG NUMBERING FOR ADVANCED CONTROL FUNCTIONS ON PEFS

Functions for advanced control shall be identified as:

aUC-y

Identification of outputs and associated final elements is the same as for binary logic functions, see (3.4).

3.6 TAG NUMBERING FOR DCS, ENGINEERING TOOLS AND MMS

3.6.1 Tag number conventions

For DCS, Engineering tools and MMS, the loop-based tagging structure on PEFS is not adequate and unique numbering at component/function level shall be applied.

At the start of each project, the DCS tag number convention shall be agreed with the Principal, based on HMI requirements and the DCS requirements and limitations. Similarly, the tag number conventions for Engineering tools and MMS shall be agreed with the Principal, based on requirements and limitations of the selected tools and the intended functionality of these tools during the EPC phase and during the life cycle of the plant.

The examples in the sections below are provided only to express the importance of defining tag number conventions in an early project phase; they are not in any way intended to provide instructions on how to structure such conventions.

3.6.2 DCS tag number reduction

DCS may pose restrictions on the number of characters for a tag name. Apart from this system limitation there is a strong need for a uniform and clear operator access to tag numbers. If, for example, access to DCS function 110PICA-004 is required this should not be hampered by the omission of an 'A' for alarming or an 'I' for indication in the tag name. The following tag number reduction rules may be applied:

- The process unit identification 'a' and the measured variable code 'b' (including its modifier) shall remain unchanged. The serial number 'y' should preferably remain unchanged too, if possible.
- Reduction may be applied to the function code 'c': the dash (-), A(alarming), I(indicating) and B(status display) characters of the tag name can be omitted in this order. The C(control), Z and S (switching) shall not be omitted.

Examples of tag number reduction:

Full tag name, as shown on PEFS	DCS tag name
110PI-001	110PI001
110FIA-005	110FI005
110PICA-104	110PC104
110PDIC-202	110PDC202
110PDICA-305	110PDC305
110GBS-401	110GS401
110LSA-501	110LS501
110LISA-502	110LS502
110LZA-505	110LZ505

3.6.3 DCS tag number splitting and merging

If a single PEFS 'balloon' has multiple inputs or outputs in the DCS, each input and output shall have a unique tag name in the DCS. Conversely, multiple PEFS 'balloons' are sometimes combined into one DCS function, carrying only one DCS tag name. Examples of this tag name splitting and merging are given below for a situation where tag number reduction (see 3.6.2) is not a requirement.

Full tag name, as shown on PEFS	DCS tag name
110LIZA-001.	Split into: 110LI001 (indication), 110LZ001 (trip alarm).
110LIZA-001 (2oo3).	Split, for example, into: 110LI001A (indication from 110LT-001A), 110LI001B (indication from 110LT-001A), 110LI001C (indication from 110LT-001A), 110LZ001 (2oo3 trip alarm), 110LA001A (alarm from 110LT-001A), 110LA001B (alarm from 110LT-001B), 110LA001C (alarm from 110LT-001C).
110PCV-101A and 110PCV-101B (split range valves, see item 8.2 of Appendix 8).	Name the output to the valves after the calculation blocks: 110HY001 (to valve 110PCV-101A), 110PY101 (to valve 110PCV-101B).
110HS-023 (pump start/stop command) and 110GB-045 (pump running signal).	Merge into: 110HS-023 (combining the start/stop command and running/stopped status in one display).
110HS-024 (open/close command) and 110GB-046 (valve open/closed position).	Merge into: 110HS-024 (combining the open/closed command and open/close status in one display function).
110FY-004 (calculation block) and 110HY-005 (Auto/manual station).	Merge into: 110HY-005 (Calculation function in the DCS with Auto/manual switching).

3.6.4 Tag numbering for Engineering tools.

Engineering tools cannot handle the 'loop based' tag numbering structure that is used on PEFS; instead, they require identification at component/function level.

Engineering tools require loop components and functional elements to be uniquely identified. A loop, presented on the PEFS with one tag number, requires a split into records per component/function, each with a unique tag number.

Example: A single balloon for 110FICA-001 on a PEFS may result in the following database records:

Loop component	Tag convention 1 (see note below)	Tag convention 2 (see note below)
Orifice assembly	110FICA-101-FE	110FE-101
Transmitter	110FICA-101-TX	110FT-101
DCS input function	110FICA-101-AI	110FX-101A
DCS control and alarm function	110FICA-101-C	110FICA-101
DCS output function	110FICA-101-AO	110FX-101B
Control valve	110FICA-101-CV	110FCV-101

NOTE: Tag number convention 1 adds a suffix to the PEFS tag number, whereas convention 2 is based on the ISA S5.1 / S5.2 method of component tagging. The tag number convention to be used on a project (convention 1, 2 or other) shall be defined and be agreed upon with the Principal at the start of the project.

3.6.5 Tag numbering for Maintenance Management Systems.

Maintenance Management Systems (MMS) also require specific tag numbering structures. It is important to define the tagging structures for MMS at the same time as those for the DCS and Engineering tools to allow data conversion from the DCS/Engineering tools to the MMS at the end of the engineering phase of a project.

4. QUALIFICATION OF FUNCTIONS

If it is necessary to indicate process conditions at which action is required, such as high-high, high, low, low-low, the qualifying letters HH, H, L, LL, shall be shown (see Standard Drawing S 37.000, table 2).

NOTE: The process condition at which action is required shall be stated in the **'list of alarm and trip settings'**. For timer settings a separate document shall be made, called the **'list of timer settings'.**

If it is necessary to clarify the function, the letters Z, A, B or S, or combinations thereof, shall be put in brackets after the above-mentioned qualifying letters.

See Standard Drawing S 37.000, Table 2 for standard symbols and see the appendices of this DEP for examples.

5. REFERENCES

In this DEP reference is made to the following publications.

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Index to Standard Drawings	DEP 00.00.06.06-Gen.
Symbols and identification system - Mechanical	DEP 31.10.03.10-Gen.
Instrumentation documents and drawings	DEP 32.31.00.34-Gen.
Classification and implementation of instrumented protective functions	DEP 32.80.10.10-Gen.

STANDARD DRAWINGS

NOTE: The latest edition of Standard Drawings can be found in DEP 00.00.06.06-Gen.

Mechanical symbols for use on flow schemes	S 02.002
PEFS legend for instrument symbols and identification	S 37.000

AMERICAN STANDARDS

Instrumentation symbols and identification	ISA S5.1
Graphic symbols for distributed control/shared display instrumentation, logic and computer symbols	ISA S5.3

Issued by:
Instrument Society of America,
400 Stanwix Street, Pittsburgh,
Pennsylvania 15222, USA.

INTERNATIONAL STANDARDS

Process measurement control functions and instrumentation - symbolic representation	ISO 3511

Issued by:
International Organisation for Standardisation
1, Rue de Varembé
CH-1211 Geneva 20
Switzerland.

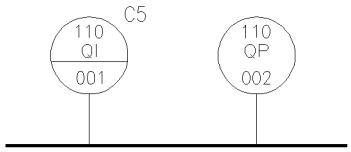
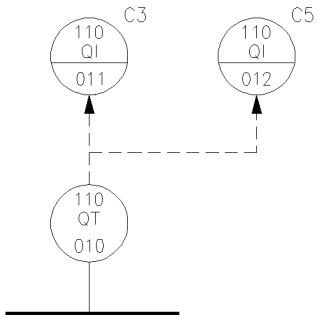
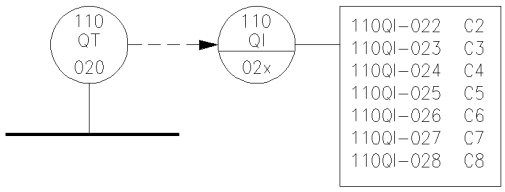
Copies can also be obtained from national standards organizations.

Industrial process control valves: Part 4: Inspection and routine testing	IEC 60534-4

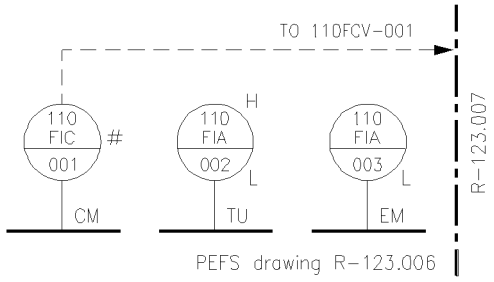
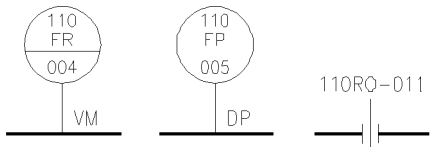
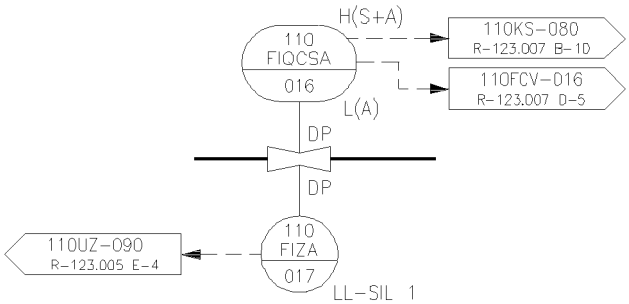
Issued by
International Electrotechnical Commission
3, rue de Varembé
CH 1211 Geneva 20
Switzerland

Copies can also be obtained from national standards organizations

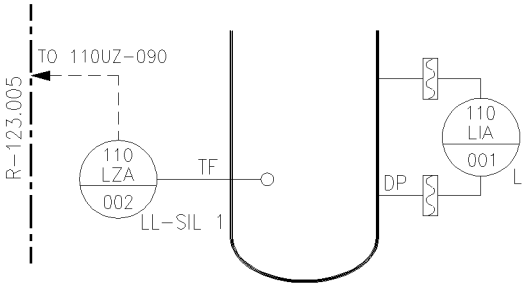
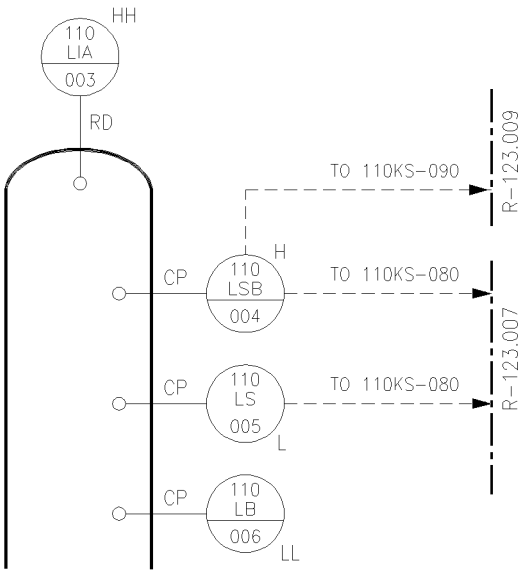
APPENDIX 1 EXAMPLES OF INSTRUMENT SYMBOLS FOR MEASUREMENT FUNCTIONS - ANALYSERS

Item	Examples	Remarks
1.1		110QI–001 : Single component analyser with indication in control room, usually in the DCS. 110QP–002 : Local analyser test point.
1.2		Dual component analyser with indications in the control room, usually in the DCS. Connection between control room and the analyser may be by serial link, but this level of detail shall not be shown on PEFS.
1.3		Multi–component analyser with indications in the control room, usually in the DCS. A table is used to prevent too great a number of squares. Connection between control room and analyser may be by serial link, but this level of detail shall not to be shown on PEFS. Numbering is related to the analyser (020 series) and to the measured component for convenience.

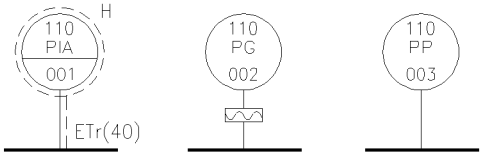
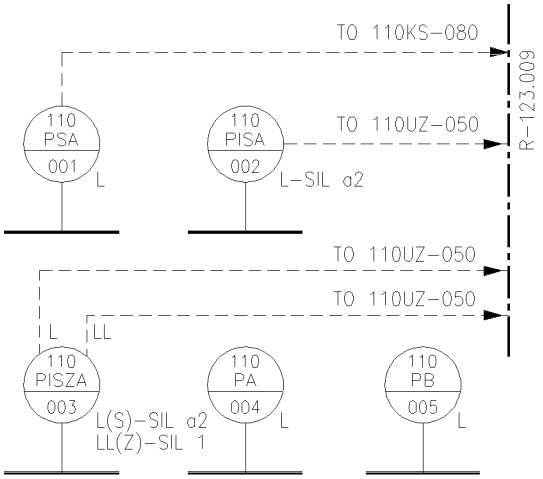
APPENDIX 2 EXAMPLES OF INSTRUMENT SYMBOLS FOR MEASUREMENT FUNCTIONS - FLOW

Item	Examples	Remarks
2.1		Different types of flow measurements, all indications and alarms in the control room, usually in the DCS. 110FIC-001 : Suffix # indicates that further details on functionality are available on other documents (e.g. in a narrative). The control valve is shown on PEFS drawing R-123.007.
2.2		110FR-004 : Flow measurement by vortex meter, permanent recording in the control room outside the DCS (recording functions in the DCS are not shown on PEFS). 110FP-005 : DP-type flow test point. 110RO-011 : Restriction orifice; the symbol is defined by Mechanical Engineering on drawing S02.002.
2.3		Venturi meter, used for 110FIQCSA-016 and 110FIZA-017. Venturi symbol is defined by Mechanical Engineering. on standard drawing S02.002. 110FIQCSA-016: Indication, totalising, control and alarm functions in the control room. An enlarged symbol is used to fit in the long tag number. H-switch output to 110KS-080 and controller output to valve 110FCV-016. The receiving pointers for 110KS-080 and 110FCV-016 are located on PEFS drawing R-123.007 at co-ordinates B-10 and D-5 respectively. 110FIZA-017: Trip initiator, acting on a low-low flow; IPF resident in 110UZ-090; flow indication and alarm status in the control room. Suffix 'SIL 1' specifies the safety integrity level for the trip initiator. The receiving pointer for 110UZ-090 is located on PEFS drawing R-123.005 at co-ordinate E-4.

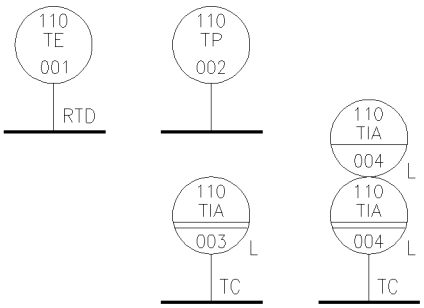
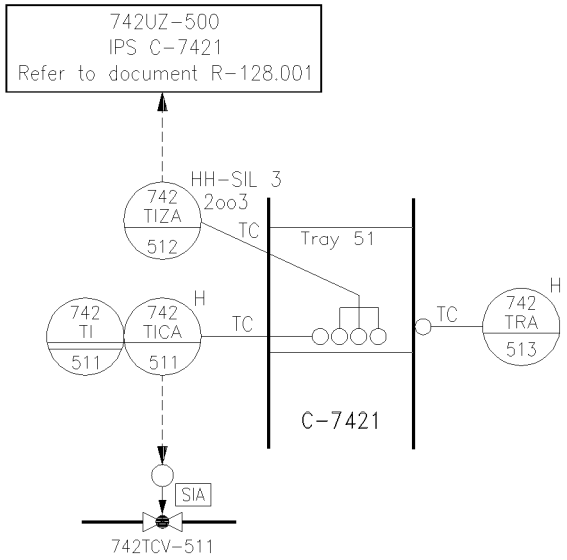
APPENDIX 3 EXAMPLES OF INSTRUMENT SYMBOLS FOR MEASUREMENT FUNCTIONS - LEVEL

Item	Examples	Remarks
3.1		110LIA-001 : Level measurement based on differential pressure instrument with diaphragm seals. Indication and alarm in the control room, usually in the DCS. 110LZA-002: Trip initiator, acting on low-low level and based on tuning fork measuring principle; IPF resident in 110UZ-090 on PEFS drawing R-123.005; alarm status is available in the control room. The tag number contains no "I" so level indication is NOT available. Suffix 'SIL 1' specifies the safety integrity level for the trip initiator.
3.2		110LIA-003: Radar level measurement with indication and alarm in the control room. 110LSB-004/ 110LS-005 and 110LB-006 are all capacitive type level measurements without indication of the measured value (no 'I' in the tag numbers). For 110LSB-004 and 110LB-006, status information ('B') is provided in the control room. For 110LS-005, status information is not available. The 'S' in 110LSB-004 and 110LS-005 represents the switching functions for input into 110KS-080/090 and to 110KS-080 respectively. The location of the switch (field or DCS) is not defined by the symbol, as it is relevant for the functionality. (PEFS are intended to cover functionality, not implementation details).

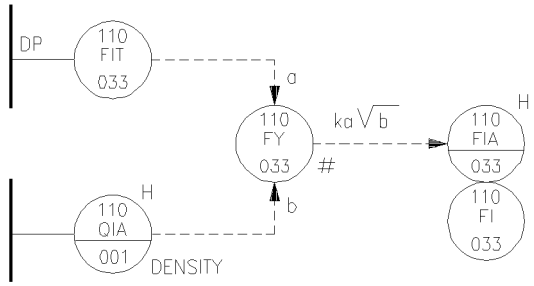
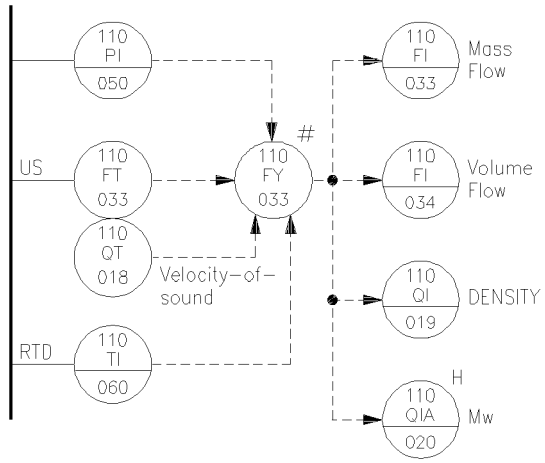
APPENDIX 4 EXAMPLES OF INSTRUMENT SYMBOLS FOR MEASUREMENT FUNCTIONS - PRESSURE

Item	Examples	Remarks
4.1		110PIA–001: Electrical tracing of impulse line and sensor at 40 degrees C. indication and alarm in the control room. 110PG–002: Local pressure gauge with diaphragm seal. 110PP–003: Pressure test point.
4.2		110PSA–001: Low pressure alarm in the control room and a low pressure output to 110KS–080. No pressure indication available (No 'I' in the tag number). As the PEFS presentation is supposed to represent the functionality, the symbol is not defining implementation aspects. This function could, for example, be implemented as a local pressure switch, as a pressure transmitter with a receiving switch in the auxiliary room or as a transmitter with switching in the DCS. Such detail is not supposed to be presented on PEFS. 110PISA–002: Indication and alarm in the control room and a low pressure output to 110UZ–050. Although IPF rules allow implementation of SIL a2 functions in the DCS, it may be more convenient to implement some of such functions in the IPS, as shown in this example. 110PISZA–003: Indication and alarms in the control room and a low ('S') and low–low ('Z') pressure output to 110UZ–050. Although the 'S' function is classified as SIL a2 (allowing DCS implementation), it is in this example implemented in the IPS for practical reasons. The 'Z' function shall be implemented in the IPS, as it is classified as SIL 1. 110PA–004: A pressure alarm is available in the control room, the measured value is not. This function could, for example, be implemented using a local pressure switch or a pressure transmitter with a receiving switch in the auxiliary room or DCS. 110PB–005: Same as 110PA–004, but in this example a low pressure is not an alarm situation, just a status (low or not–low).

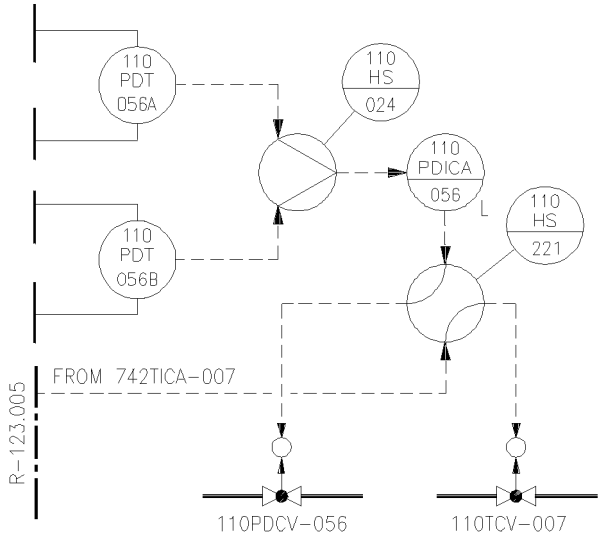
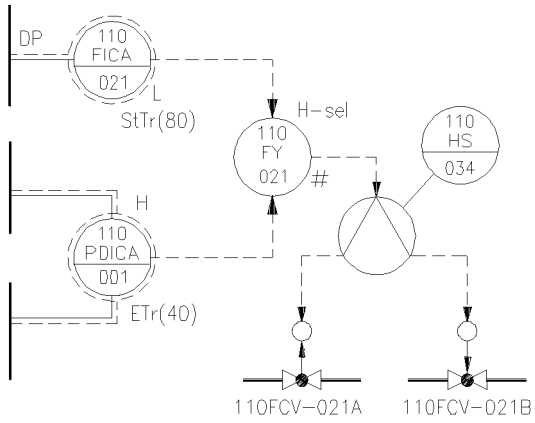
APPENDIX 5 EXAMPLES OF INSTRUMENT SYMBOLS FOR MEASUREMENT FUNCTIONS - TEMPERATURE

Item	Examples	Remarks
5.1		110TE–001: Temperature element (RTD without transmitter). 110TP–002: Temperature test point (nozzle with thermowell, no measuring element). 110TIA–003: Temperature indicator and low alarm on local panel. 110TIA–004: Temperature indicators and low alarms on local panel and in the control room.
5.2		Thermocouple–type temperature measurements associated with tray 51 of column C–7421 in unit 7420. 742TICA–511: Measuring point at a particular point on tray 51; indication on local panel; indication, control and high alarm in the control room, output to valve 742TCV–511. 742TCV–511: This valve is powered by secured instrument air (SIA). 742TIZA–512: Measuring point at a particular point on tray 51; acting on high–high temperature; IPF is resident in 742UZ–500; indication and trip alarm in the control room. Suffix 'SIL 3' specifies the safety integrity level for the trip initiators. In this example, IPF classification has resulted in a two–out–of–three (2oo3) trip initiator configuration. 742TRA–513: Column surface temperature measurement with recording in the control room outside the DCS. Alarm in the control room.

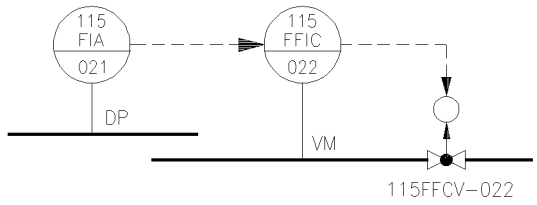
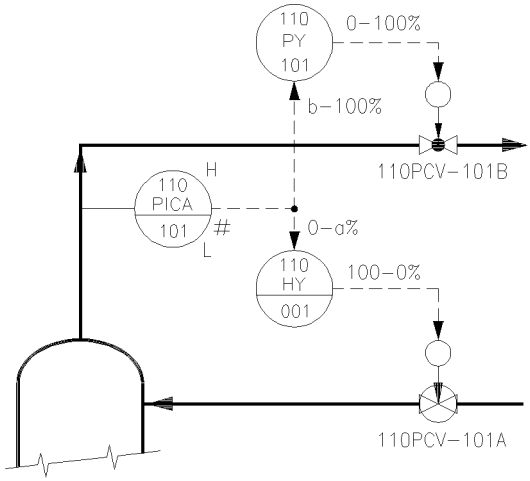
APPENDIX 6 EXAMPLES OF INSTRUMENT SYMBOLS FOR CALCULATIONS

Item	Examples	Remarks
6.1		110FY–033: Calculation function that cannot be manipulated by the operator. The PEFS symbol does not define the location of the calculation, as it is irrelevant for the functionality. Sign # indicates that further functional information is available on other documents (e.g. in a narrative). 110FIA–033 and 110QIA–001 provide indications and high–alarms of mass flow rate and density respectively in the control room. The volume flow rate as measured by 110FIT–033 is displayed locally. The square root extraction for conversion of measured DP into flow is not residing in 110FY–033 (could be in the transmitter or in the DCS input card). 110FI–033: A local indicator to display the calculated flow.
6.2		The mass flow rate, volume flow rate, density and Mw of a process fluid are calculated by 110FY–033 on the basis of input signals from ultrasonic flow meter 110FT–033 and pressure and temperature measurements 110PI–050 and 110TI–060. 110FY–033: This calculation function could be performed by a dedicated mass flow computer. It is not accessible from the control room. Sign # indicates that additional functional information is available in other documentation, for instance in a narrative.

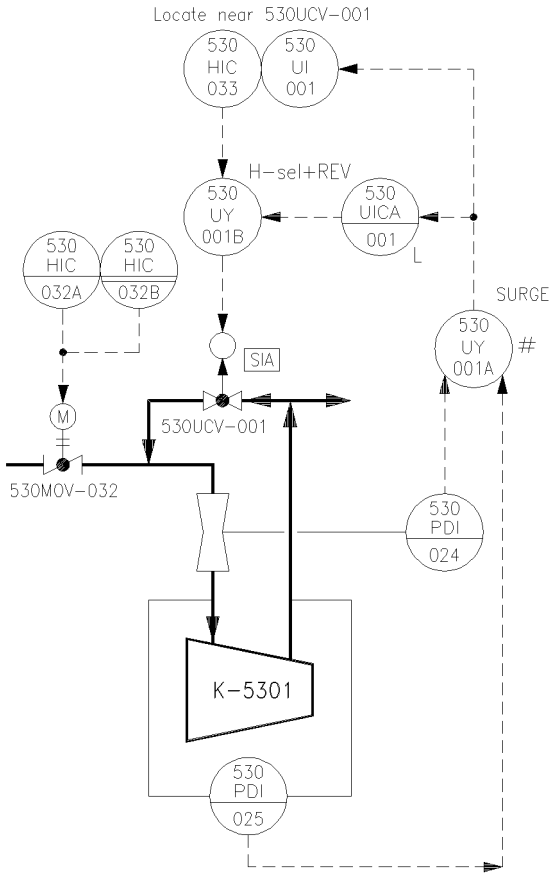
APPENDIX 7 EXAMPLES OF INSTRUMENT SYMBOLS FOR SIGNAL SWITCHING AND SELECTION

Item	Examples	Remarks
7.1		110HS-024: The measured value from either transmitter 110PDT-056A or 110PDT-056B is selected as input for 110PDICA-056 by the control room operator from 110HS-024. 110HS-221: Under normal operating conditions, 110PDICA-056 controls valve 110PDCV-056 and controller 742TICA-007 (on PEFS R-123.005) controls valve 742TCV-007. Under alternative operating conditions, 110HS-221 is used to swap the valves: 110PDICA-056 controls valve 742TCV-007 and 110TICA-007 controls valve 110PDCV-056. Synchronisation for bumpless change-over shall not be shown.
7.2		110FICA-021: Impulse lines and sensor traced by steam (StTr) at 80 degrees C. 110PDICA-001: Impulse lines and sensor traced by electricity (ETr) at 40 degrees C. 110FY-021: High selector function that cannot be manipulated by the operator. External feedback signals to prevent reset wind-up shall not be shown. Sign # indicates that additional functional information is available in other documentation, for instance in a narrative. In this example, flow is the prime variable to be controlled and differential pressure acts as a constraining factor. If differential pressure were the prime variable, 110FY-021, 110FCV-021A and 110FCV-021B would have been tagged 110PDY-001, 110PDCV-001A and 110PDCV-001B respectively.

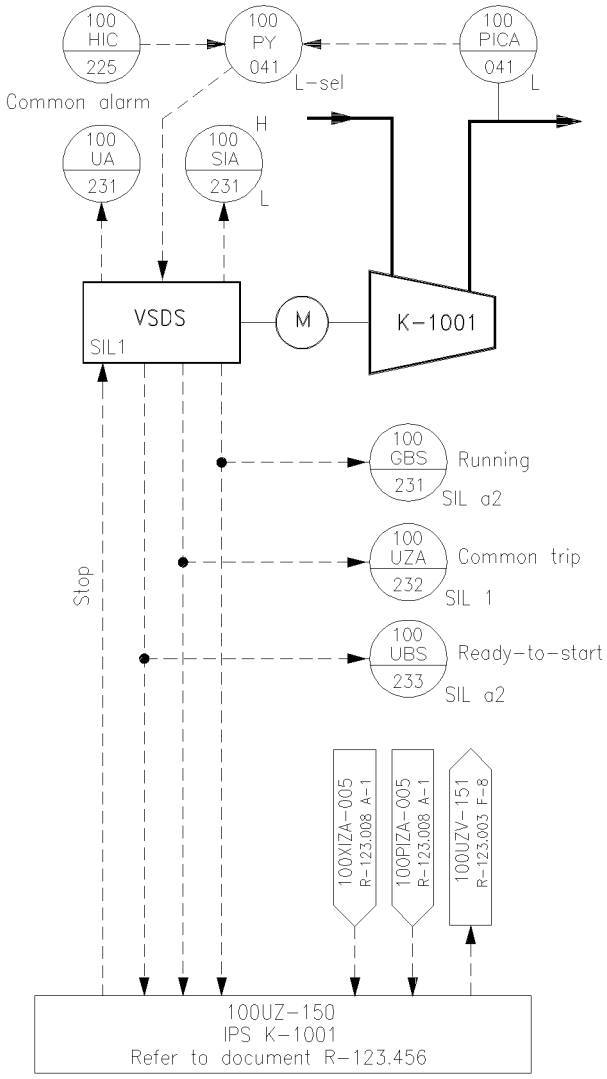
APPENDIX 8 EXAMPLES OF INSTRUMENT SYMBOLS FOR SPECIAL CONTROL FUNCTIONS

Item	Examples	Remarks
8.1		Flow ratio control
8.2		Split range control 110HY–001: Calculation function in the control room (usually in the DCS) for split range control of loop 110PICA–101. The split point is selected such, that the loop gain remains constant across the operating range. A gap is created between a controller output of 'a' % and 'b' % to prevent that globe valve 110PCV–101B starts opening before ball valve 110PCV–101A is fully closed. This calculation function can be manipulated by the operator (in this application the operator is given permission to manually set the output to 0% in order to be able to close valve 110PCV–101A). Since 'a' and 'b' are tuning parameters that are likely to change, their value shall not be shown on the PEFS. 110PY–101: Same as 110HY–001 above, but not accessible by the operator.

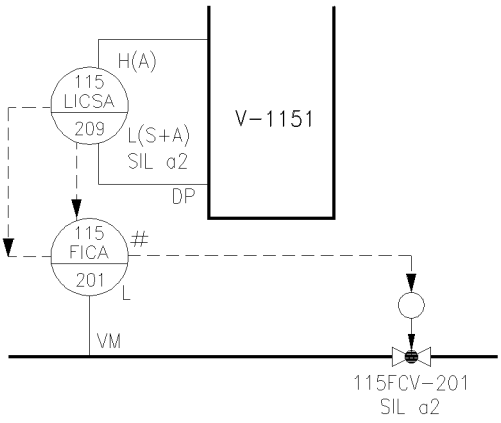
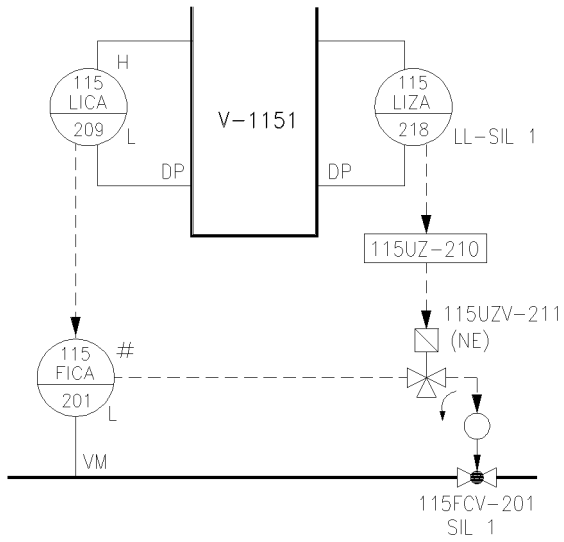
APPENDIX 8 EXAMPLES OF INSTRUMENT SYMBOLS FOR SPECIAL CONTROL FUNCTIONS (Continued)

Item	Examples	Remarks
8.3		Anti-surge control 530MOV-032: Motor operated butterfly valve; operation from both the control room and local panel; valve remains in its last position upon power failure. 530PDI-024: Venturi symbol is defined by Mechanical Engineering on standard drawing S 02.002. 530UY-001A: Suffix # indicates, that additional functional information is available on other documents, e.g. a narrative. In this case, such documentation shall specify by the formulae and backgrounds for the surge parameter calculation. 530HIC-033/530UI-001: These local instruments are to be located near the anti-surge valve and next to each other, as 530UI-001 presents the measured surge parameter, required for valve position adjustment through 530HIC-033. 530UY-001B: A high selector, selects the input that results in the largest valve opening. The signal is subsequently reversed to suit the fail-open valve. 530UCV-001: The valve is powered by secured instruments air (SIA).

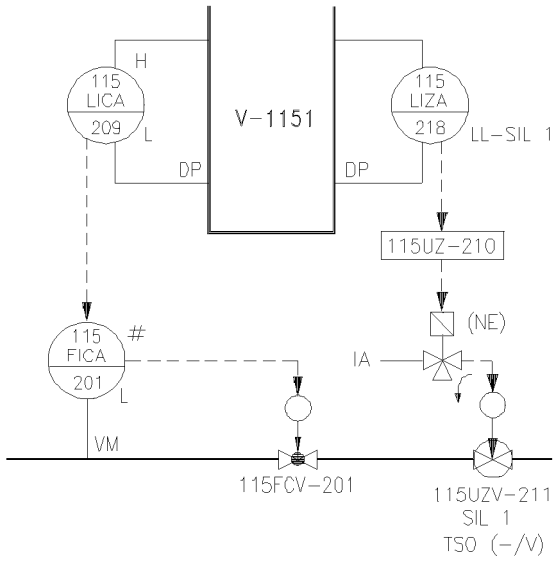
APPENDIX 9 EXAMPLES OF INSTRUMENT SYMBOLS FOR COMBINED SPEED CONTROL AND IPF

Item	Examples	Remarks
9.1		Speed control and safeguarding (VSDS = Variable Speed Drive System)

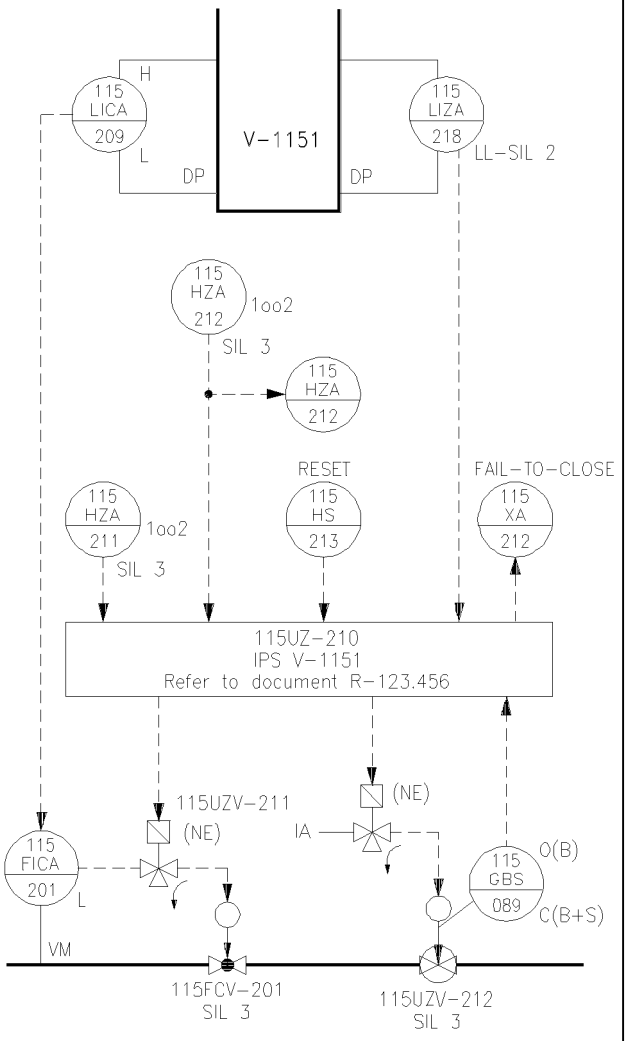
APPENDIX 10 EXAMPLES OF INSTRUMENT SYMBOLS FOR IPF

Item	Examples	Remarks
10.1		IPF implemented in the DCS 115LICSA-209: 'SIL a2' specifies the safety integrity level for the low level trip initiator. For this SIL level, DEP 32.80.10.10-Gen. allows implementation in the DCS. 115FICA-201: # indicates, that additional information is available on other documents. In this case, a narrative might specify, that a low level at 115LICSA-209 will switch DCS controller 115FICA-201 to manual and drive its output to the safe, closed position. The narrative shall also specify how to recover upon return to normal level.
10.2		IPF in the IPS, a single valve combines control and IPF. This example is similar to item 10.1, but the safety integrity level is higher and DEP 32.80.10.10-Gen. dictates implementation in the IPS. A combined control/IPF valve, is allowed for SIL 1 under certain conditions. If these conditions are not met, item 10.3 applies. 115LIZA-218: Indication and alarm in the control room. Maintenance override switch (MOS) 115LM-218 for 115LIZA-218 shall not be shown. 115UZ-210: A simplified presentation for this IPF is adequate, as its function is clear.

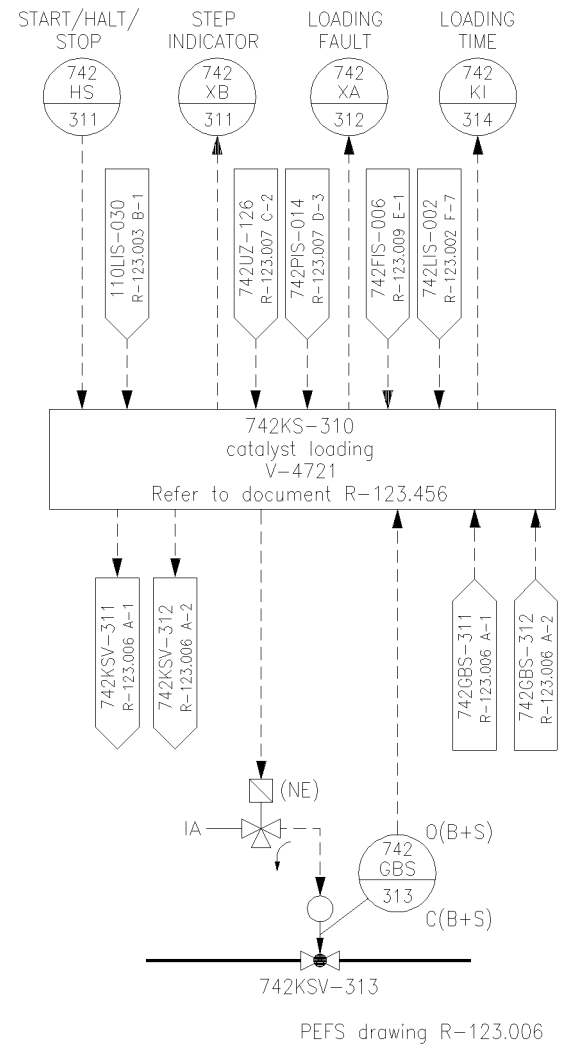
APPENDIX 10 EXAMPLES OF INSTRUMENT SYMBOLS FOR IPF (Continued)

Item	Examples	Remarks
10.3		IPF in the IPS, separate valves for control and IPF. This example is similar to item 10.2. It covers a SIL 1 application under conditions, that do not allow the use of a combined valve for control and IPF. 115UZV-211: No TSO requirement in the forward direction and TSO according to class V in the reverse direction. Powering by regular instrument air (IA). Valve and solenoid operated valve carry the same tag number.

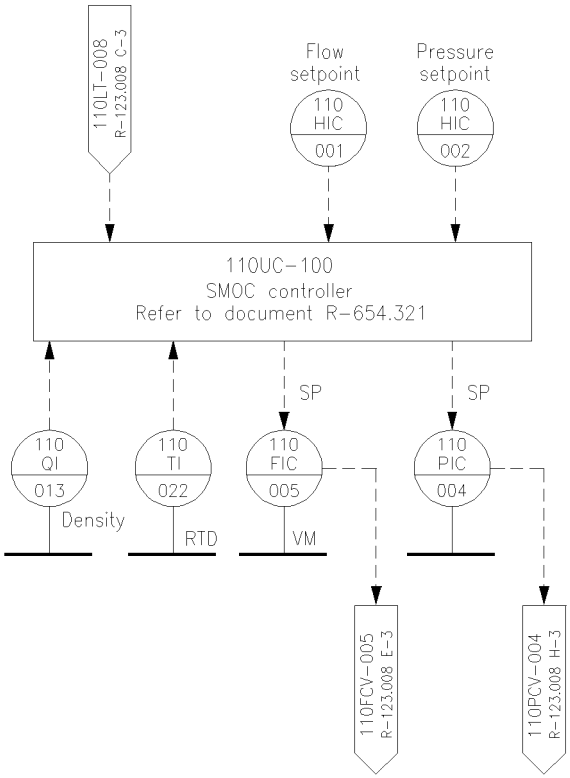
APPENDIX 10 EXAMPLES OF INSTRUMENT SYMBOLS FOR IPF (Continued)

Item	Examples	Remarks
10.4		IPF in the IPS, a separate valve for IPF in series with a combined valve for control and IPF. This example is similar to the examples in items 10.1 through 10.3, but manual trip initiators of SIL 3 are also provided. This example shows a combined control/IPF valve and a dedicated IPF valve. This valve arrangement is allowed by DEP 32.80.10.10-Gen. for SIL 3, if no TSO requirements apply. Sign # is not required, as the text in UZ-block provides the reference to detailed documentation. 115HZA-211: A manual ESD switch of SIL 3 is provided in the control room, in a 1oo2 configuration (e.g. with a double set of contacts). Alarming in the control room. The PEFS symbol does not specify the physical location of this switch within the control room. On the basis of IPF implementation rules, a hardwired switch is required. 115HZA-212: A manual ESD switch of SIL 3 is required in the field, in a 1oo2 configuration (e.g. with a double set of contacts). Alarming in the control room. 115HS-213: Manual reset from the control room. 115XA-212: Alarm in the control room, triggered if valve 115UZV-212 fails-to-close, as detected by the 'closed' signal from 115GBS-089. 115GBS-089: Open/close status ('B') is displayed in the control room. The closed position is also an input for 115UZ-210. This 'S' function has no SIL classification.

APPENDIX 11 EXAMPLES OF INSTRUMENT SYMBOLS FOR SEQUENCE CONTROL SYSTEM

Item	Examples	Remarks
11.1		Catalyst loading into V-7421 in unit 7420 is controlled by program 742KS-310. 742KS-310 : The details of the catalyst loading program are covered by drawing R-123.456. The program controls three on-off valves. 742HS-311: The loading program can be started, halted or stopped by the operator from the control room. 742XB-311: A step indicator displays the current step to the operator. This might be a simple step indicator or an elaborate set of text strings, with information and instruction fields to support the operator. 742XA-312: Control room alarm for faults during catalyst loading. This might be a single alarm point or a set of alarm messages. 742KI-314: A timer function, displaying the loading time since program start. 742KSV-313: On-off valve under control of program 742KS-310. 742GBS-313: The open and closed positions of the valve are used for status display (B) and switching (S).

APPENDIX 12 EXAMPLES OF INSTRUMENT SYMBOLS FOR ADVANCED CONTROL FUNCTIONS

Item	Examples	Remarks
12.1		SMOC controller The presentation of advanced control functions is similar to the presentation of IPF blocks (UZ-blocks) and sequential control blocks (KS-blocks).