

DEP SPECIFICATION

DCS BASIC APPLICATION STANDARD

DEP 32.30.20.15-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements, gives recommendations and describes the conventions to be applied to all DCS baselayer function block configurations. This DEP is not intended to be all inclusive as other DEPs currently exist and should be consulted for information pertaining to topics such as FOUNDATIONTM Fieldbus, Complex Loops, Process Control Domains, Human/Machine Interface, network design, etc.

The DEP is applicable and shall be followed if the DCS in question is from a Main Automation Contractor (MAC) or a non-MAC Supplier/Manufacturer. This DEP is intended to be used for development and review of toolkit typicals.

This is a revision of the DEP of the same number dated September 2013; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorisation to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP 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, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that 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 that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. 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.

The word **may** indicates a permitted option.

1.3.2 Specific definitions

Term	Definition
Characterized output	A characterized output is where the output from the BPCS controller is mapped to the input sent to the field device in a non-linear manner
Complex Loop	A complex loop is a control loop whose configuration cannot be described unambiguously and completely on a PEFS/P&ID and a loop drawing using standard instrumentation symbology. It therefore requires explanation in a Control Narrative.
DCS Trip To Manual Function (DTTM)	Non-IPF function initiated by the IPF interlock that drives the output of one or more DCS controllers to a predetermined position. Normally the function is used to preset the controller output for restart.
DEM1 DEPs	DEPs that contain Process Safety requirements.
Distributed Control System (DCS)	The system that responds to input signals from the process and generates output signals to maintain operation of the process in a desired state. The system does not perform functions assessed as SIL 1 or higher.
Fail Safe	A concept that defines the failure direction of a component or system as a result of specific malfunctions. That failure direction is towards a loss of motive power (e.g., instrument air) position and should be to a safer or less hazardous condition.
Final Element	A device or combination of devices that manipulate a process variable or attract the attention of the operator to achieve risk reduction. The Final Element includes output cards or output relays, solenoid valves and cabling. Examples are valves, switchgear (rotating equipment stop circuits), VFD, VSD, and alarms.
Hardwired signal	Single signal between the switching device (on-off) or transmitting device (analogue) that is carried by a dedicated set of wires. This excludes signals communicated serially using protocols such as HART®, FOUNDATION™ Fieldbus, Modbus, etc.
Instrumented Protective Function (IPF)	A function comprising one or more sensors, a Logic Solver and one or more Final Elements whose purpose is to prevent or mitigate hazardous situations and that have a SIL 1, 2, 3 or 4. An IPF is intended to achieve or maintain a safe state for the process, in respect of a specific hazardous event.
Logic Solver	The portion of an Instrumented Protective Function that performs the application logic function. The Logic Solver excludes trip amplifiers, input cards and output cards. Examples are electromechanical relays, solid-state/magnetic-core logic and the Central Processing Unit (CPU) section of programmable electronic systems.
MAC (Main Automation Contractor)	Manufacturer responsible for delivery of total automation solutions, comprising Distributed Control System, Instrumented Protective System, Fire and Gas System, Asset Management System, Sequence of Event Recorder and perhaps Operator Training Simulator.

Term	Definition
MAC Toolkit	Set of work processes, procedures and library of product standards and implementation configuration templates developed by the MAC. The MAC's Toolkit contains both MAC's standard documents as well as Shell specific documents, specifications and typicals.
MD^{Pro}	A Shell tool used for monitoring performance of PID controls.
NAMUR NE 43	NAMUR NE 43 is a guideline that specifies saturation and fault values for hard-wired analogue transmitters which generate 4 mA – 20 mA output signals. The guideline defines specific current levels, outside the 4 mA – 20 mA range, that allow a system to discriminate between a normal process value, a process value outside transmitter limits and a failed transmitter.
OPC	OPC (originally OLE for Process Control, now Open Productivity and Connectivity) is a series of standards specifications that address the communication of data between different control devices. Also thought of as a set of objects, interfaces and methods used to facilitate interoperability.
Sensor	A device, or combination of devices, that measures and indicates a physical value (process or equipment item). The sensor typically includes all equipment to enable the measured detection and transmission to the DCS. Examples are transmitters, manual switches, position switches and other measurement systems (including process connections, cabling, trip amplifiers or input cards etc.).

1.3.3 Abbreviations

Term	Definition
AI	Analogue Input
AO	Analogue Output
APC	Advanced Process Control
BOD	Basis of Design
BDEP	Basic Design Engineering Package
BDP	Basic Design Package
CC	Contact Closed
CO	Contact Open
CPU	Central Processing Unit
DCS	Distributed control system
DI	Digital Input
DO	Digital Output
DTTM	DCS Trip to Manual Function
FF	FOUNDATION™ Fieldbus
GC	gas chromatograph
HEMP	Hazards and Effects Management Process
HIC	Hand Indicating Controller
HMI	Human-Machine Interface
I/O	Input/Output
IPF	Instrumented Protective Function
MAC	Main Automation Contractor
MOV	Motor Operated Valve
MVC	Measurement, Validation and Comparison
NAMUR	Normenarbeitsgemeinschaft für Mess- Und Regeltechnik in der Chemischen Industrie or Standards Committee for Measurement and Control Technology in the Chemical Industry
NC	Normally Closed
NO	Normally Open

Term	Definition
P&ID	Piping and Instrument Diagram
PACE	Platform for Advanced Control and Estimation
PACO	Process Automation, Control and Optimisation
PCD	Process Control Domain, formerly known as DACA
PEFS	Process Engineering Flow Scheme
PID	Proportional, Integral, Derivative
PLC	Programmable Logic Controller
PV	Process Variable
QMI	Quality Measurement Instrument (process analyzer)
RTD	Resistance Temperature Detector
TE	Temperature element
VFD	Variable Frequency Drive
VSD	Variable Speed Drive

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section or clause number is shown in brackets (). Other documents referenced by this DEP are listed in (12).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated September 2013. The following are the main, non-editorial changes.

Section/Clause	Change
All	Clarified requirements and enforced shall/should/may normative statements.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

Shell DEPs Online (Users with access to Shell DEPs Online)	Enter the Shell DEPs Online system at https://www.shelldeps.com Select a DEP and then go to the details screen for that DEP. Click on the "Give feedback" link, fill in the online form and submit.
DEP Feedback System (Users with access to Shell Wide Web)	Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal http://swwww.shell.com/standards . Select "Submit DEP Feedback", fill in the online form and submit.
DEP Standard Form (other users)	Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at standards@shell.com .

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

1.8 NON NORMATIVE TEXT (COMMENTARY)

Text shown in *italic style* in this DEP indicates text that is non-normative and is provided as explanation or background information only.

Non-normative text is normally indented slightly to the right of the relevant DEP clause.

2. GENERAL REQUIREMENTS

2.1 CONFIGURATION TYPICALS

1. Approved toolkit typicals, shall be used as a basis for configuration standards.

2.2 COMPLEX LOOP TYPICALS

This DEP specifies basic configuration typicals. Complex control typicals are specified in DEP 32.30.20.16-Gen.

Specific requirements for the design of fired heater controls (including fuel gas density compensation, load control, and air/fuel ratio control) are provided in DEP 32.24.20.44-Gen.

3. SYSTEM ARCHITECTURE AND DESIGN CONSIDERATIONS

3.1 GENERAL

1. The project shall base its Process Automation System architecture on the reference architecture contained in the MAC Toolkit of the MAC vendor selected for the project.

A reference architecture model is presented in this section as a vehicle to specify background infrastructure requirements for baselayer control. See the PCD DEP 32.01.20.12-Gen. for details on specific system architecture design requirements.

A reference architecture model was developed by Purdue University (and has since been incorporated into IEC 62264) to provide a framework for describing process control systems. The model divides the architecture into a number of distinct but arbitrary levels. These levels may be numbered differently at times, but the most common numbering is shown below and is used as a reference for this DEP:

- *level 5: Internet, Global Communications;*
- *level 4: Desktop, IT Domain, Usually Site Wide;*
- *level 3: Process Control Network or Process Information Network;*
- *level 2: Distributed Control System, Real Time Operations Human Interface;*
- *level 1: Process Connected Sub Systems and I/O;*
- *level 0: Field Devices.*

The scope of this DEP includes Levels 2, 1 and 0.

3.2 INITIALIZATION AND BACKUP REQUIREMENTS

3.2.1 Level 2

1. The initialization of Level 2 nodes are as follows:
 - a. operator stations should initialize into operating state (auto logon);
 - b. if individual operator roles have been assigned or the stations are located in normally unattended locations, the operator stations should initialize into a view-only state where a logon is required to affect system changes;
 - c. engineering workstations and database servers should initialize into a ready state where a logon is required to cause system changes;
 - d. application nodes should initialize into an operating state;
Initialization of applications running in these application nodes depends on the Supplier/Manufacturer and the application.
 - e. the node is prepared to restart into any restart mode (hot, warm, cold) that has been identified;
 - f. initialization parameters may be necessary for each application.

Refer to DEP 32.01.20.12-Gen. for backup and restore procedures.

3.2.2 Level 1

1. The initialization of Level 1 nodes are as follows:
 - a. non-redundant nodes shall initialize with outputs in a shutdown state;
 - i. Non-redundant nodes should execute initialization code to prepare the control system for operation.
 - ii. For example, this code should force blocks whose modes are unavailable to the operator (e.g., selectors, CALC, LOGIC, sequences) to their normal modes.
 - b. redundant control nodes shall have Supplier/Manufacturer specific behaviour for hot, warm, and cold restart;
 - c. backup nodes should synchronize with active nodes rather than initialize;
 - d. for cold starts, redundant nodes should initialize like non-redundant nodes.
2. Default behaviour for input/output block initialization is specified below:
 - a. all input blocks (AI, DI, Pulse/Frequency) should initialize to their previous execution state (active or inactive);
 - b. all output blocks (AO, DO) should initialize to their previous execution state (active or inactive).
DEP 32.01.20.12-Gen. specifies requirements for backup and restore procedures.
3. Redundancy requirements for Level 1 nodes shall be as indicated in Table 1:

Table 1 Level 1 redundancy requirements

Item	Default Redundancy	Notes
Controller	Redundant	Default to non-redundant for Design Class 1 plants; consider redundancy if risk analysis shows a need for it
Foundation Fieldbus H1	See FF DEP	FF redundancy is defined in DEP 32.30.20.13-Gen.
Analogue / HART [®] input used for closed loop control	Redundant	Default to non-redundant for Design Class 1 plants; consider redundancy if risk analysis shows a need for it
Analogue/HART [®] output used for closed loop control	Redundant	Default to non-redundant for Design Class 1 plants; consider redundancy if risk analysis shows a need for it
Analogue / HART [®] input for indication only	Non-Redundant	- If Unit will require On Process upgrade (DCS Operating System update while unit is operating; e.g., Utilities) and DCS vendor requires AI to be redundant, inputs that have been identified as critical shall require redundancy. - Also consider project cost increase if all AIs are redundant (Advantages - no engineering to decide which point to connect to redundant AI and no rewiring if indicator point changed to controller by project or in the future).
Digital Input and Digital Output	Non-Redundant	- Redundant DIs / DOs may not be offered by the Vendors. - See comments regarding "Analogue / HART[®] input for indication only" - Consider redundant field devices connected to different DI or DO modules for critical applications (i.e. provide different failure mode paths)
Thermocouple / RTD TEs	Non-Redundant	- Redundant thermocouple / RTD TEs may not be offered by the Vendors. - See comments regarding "Analogue / HART[®] input for indication only" - Consider using temperature transmitters for critical points. - Consider dual TEs / RTDs connected to different input modules.

3.2.3 Level 0

1. Initialization of FF devices shall always be in the run mode.

4. FOUNDATION™ FIELDBUS

FOUNDATION™ Fieldbus is the preferred digital communication technology because of its support for Instrument Asset Management business strategies. HART® is an acceptable alternative for control system field devices and the only currently approved asset management technology for IPF transmitters. The diagnostic information from HART® capable field devices can also be provided to an Instrument Asset Management for maintenance purposes.

1. FOUNDATION™ Fieldbus instrumentation shall be configured in accordance with DEP 32.30.20.13-Gen.
2. Foundation Fieldbus shall not be used in applications:
 - a. that require very fast (less than 1 second execution frequency) system response time and
 - b. for which the control solution is executed in the DCS controller.

5. ANALOGUE INPUTS

5.1 TOOLKIT TYPICALS

1. Configuration typicals, including recommended display objects and faceplates, are available in the MAC Toolkits and shall be used for the applicable loops.
2. If an approved typical is not already available in the MAC Toolkit, the design of the analogue inputs shall be subject to the approval of the Principal.
3. If the DCS being used is not from one of the currently approved strategic MACs, the design of the analogue inputs shall:
 - a. be subject to the approval of the Principal and
 - b. follow the requirements specified in the remainder of (Section 5).
4. New typicals that are developed shall be submitted to the Shell focal point for the MAC for inclusion in the MAC Toolkits.

5.2 EXECUTION TIME

1. All analogue inputs should be executed at the basic Level 1 device scan rate (typically 0.5 second – 1 second) except as specified otherwise by the Principal.
2. Fast processing and/or execution at multiples of the base DCS execution time shall be subject to the approval of the Principal.

5.3 TAG NAMING CONVENTIONS

1. Tag name, descriptor, and engineering unit conventions shall be specified based on site standards and project basis of design (BOD/BDP/BDEP).

Refer to DEP 01.00.09.10-Gen. for guidance.