

DEP SPECIFICATION

INSTRUMENTATION FOR PACKAGED EQUIPMENT

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DESIGN AND ENGINEERING PRACTICE



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PREFACE

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TABLE OF CONTENTS

1.	INTRODUCTION	5
1.1	SCOPE	5
1.2	DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS	5
1.3	DEFINITIONS	5
1.4	CROSS-REFERENCES	10
1.5	SUMMARY OF MAIN CHANGES.....	10
1.6	COMMENTS ON THIS DEP	10
1.7	DUAL UNITS.....	10
1.8	NON NORMATIVE TEXT (COMMENTARY).....	11
2.	GENERAL	12
3.	SCOPE OF SUPPLY FOR INSTRUMENTATION	13
3.1	SCOPE OF SUPPLY OPTIONS.....	13
3.2	SPECIFICATION TABLE	15
3.3	LIMITS OF SUPPLY	18
4.	CONTROL AND INSTRUMENTED SAFEGUARDING SELECTION	18
4.1	GENERAL	18
4.2	CONSIDERATIONS FOR PEQ MANUFACTURER FURNISHED CONTROLS.....	18
4.3	REQUIREMENTS FOR PEQ MANUFACTURER CONTROL.....	20
4.4	REQUIREMENTS FOR PEQ MANUFACTURER INSTRUMENTED SAFEGUARDING	21
4.5	FIRE AND GAS DETECTION SYSTEMS	23
5.	INSTRUMENTATION	23
5.1	GENERAL	24
5.2	DEFAULT SELECTION	24
5.3	CONSIDERATIONS FOR PACKAGED EQUIPMENT MANUFACTURER INSTRUMENTS	25
5.4	GENERAL INSTRUMENT REQUIREMENTS	25
5.5	Foundation™ FIELD BUS	26
5.6	SAFETY RELATED INSTRUMENTATION	26
5.7	INLINE INSTRUMENTS	27
5.8	COMPLEX ANALYSERS.....	27
6.	PANELS AND BOXES	27
6.1	GENERAL	27
6.2	EXTERIOR PANELS	28
6.3	INTERIOR PANELS.....	28
6.4	JUNCTION BOXES	29
7.	WIRING METHODS.....	30
7.1	GENERAL	30
7.2	GROUNDING.....	30
7.3	HAZARDOUS AREA CONSIDERATIONS	30
8.	OWNER/SUPPLIER INTERFACE SIGNALS	30
8.1	GENERAL	30
8.2	INTERFACING TO THE OWNER'S SYSTEMS.....	31
9.	TUBING SYSTEMS.....	32
9.1	PROCESS TUBING.....	32
9.2	INSTRUMENT AIR SUPPLY	32
10.	INSPECTION AND TESTING	33
11.	DOCUMENTATION REQUIREMENTS.....	34
11.1	DOCUMENTATION REQUIRED WITH THE PROPOSAL.....	34
11.2	FINAL DOCUMENTATION REQUIRED	35
11.3	KEY DOCUMENTATION FOR REVIEW	36

11.4	DOCUMENT AND DATA BASE MANAGEMENT	36
12.	PACKAGING AND SHIPPING	37
12.1	GENERAL	37
12.2	DETAILS	37
13.	AFTER SALES SERVICE	38
13.1	GENERAL	38
13.2	SITE SUPPORT DURING CONSTRUCTION AND COMMISSIONING	38
14.	TRAINING.....	39
15.	REFERENCES	40

APPENDICES

APPENDIX A	SYSTEM SELECTION FLOWCHART	41
APPENDIX B	INSTRUMENT HARDWARE SELECTION FLOWCHART	53
APPENDIX C	SCOPE OF SUPPLY SKETCHES AND COMPLEX BLOCK DIAGRAM	61
APPENDIX D	DEM1 PROCESS SAFETY REQUIREMENTS FOR PEQ MANUFACTURER	66
APPENDIX E	TYPICAL PACKAGED EQUIPMENT DEM1 PROCESS SAFETY REQUIREMENTS IMPLEMENTED BY THE CONTRACTOR	68



1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for instrumentation and control systems that may be provided as part of equipment packages. It gives guidance and examples for the instrumentation and control systems scope of supply from Packaged Equipment (PEQ) Manufacturers.

The primary audience and actionable party of this DEP is the Engineering Contractor, as it is intended for use by the Contractor and Principal when preparing a specification for equipment packages to be provided by a PEQ Manufacturer.

This is a revision of the DEP of the same number dated February 2015; see (1.5) regarding the significant 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 **PEQ Manufacturer** 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
Basic Process Control System (BPCS)	A general term to describe the processing hardware and functionality that monitors, alarms and controls a process unit or PEQ. This is typically performed by a host DCS or PLC remote from the PEQ, but may be implemented in a PLC or simple logic system, installed on the PEQ - if approved by the Principal. The term BPCS is specifically used to exclude any Trip System or Safety System, which would be a secondary system to the BPCS.
Control and Instrumented Safeguarding System	A general term to describe the processing hardware and functionality that monitors, alarms, controls and/or shuts down a process unit or PEQ. This is typically performed by a host DCS or PLC remote from the PEQ, but may be implemented in a PLC or simple logic system, installed on the PEQ - if approved by the Principal.
Distributed Control System (DCS)	A configurable microprocessor based control system that typically has its controllers distributed away from the main Human-Machine Interface (HMI).
Equipment Package	See Packaged Equipment
Field Auxiliary Room (FAR)	Building/Room in or near the battery limits of a process unit containing BPCS and Instrumented Protective System (IPS) controllers and I/O equipment. The field junction box home run cables route to this Building/Room.
Functional tests	Tests carried out by simulating a process condition on the input side of the instrument to check the corresponding output 'function'. The conditions should be such that the required performance is demonstrated.
Installation Materials for Packaged Equipment Instrumentation	Miscellaneous installation items required for the instruments in the equipment packages, such as tubing, fittings, cables etc.
Instrument for Equipment Packages	Instruments necessary to operate the equipment package and are typically supplied by the PEQ Manufacturer. These may also include 'free issue items', which are those supplied free of charge to the PEQ Manufacturer by the Contractor.
Instrument Systems for Equipment Packages	Instruments systems necessary to operate the equipment package. The default for implementing these systems is in the Project or Site Host systems (BPCS/IPS). When properly justified and upon proper Principal approval, these may be supplied by the PEQ Manufacturer.

Term	Definition
Instrumented Protective Function (IPF)	A function comprising one or more Initiators, a Logic Solver and one or more Final Elements whose purpose is to prevent or mitigate hazardous situations. An IPF is intended to achieve or maintain a safe state for the process, in respect of a specific hazardous event. In IEC 61508 and IEC 61511 an IPF is referred to as a Safety Instrumented Function (SIF).
Instrumented Protective System (IPS)	The electromechanical, electronic and/or programmable electronic Logic Solver component of the Instrumented Protective Function, complete with input and output equipment. In this DEP the term Instrumented Safeguarding System is also used. In IEC 61508 and IEC 61511 an IPS is referred to as a Logic Solver. Synonymous with SSDS and SIS.
'Loops' In The Packaged Equipment	Local loops are local indication/control loops, i.e. all control components such as local control panels or receivers that are confined within the boundaries of the equipment package. Remote control loops are control loops linked to a remote control system (DCS or PLC) or Instrumented Protective System through junction boxes installed within the boundaries of the packaged equipment. The primary element, transmitter and/or final control element (control valve, etc.) are mounted inside the package and the indication, controller and alarms are in the remote DCS/PLC. Unless otherwise stated, the BPCS of a remote loop is not supplied by the Packaged Equipment Manufacturer (though the process control or IPF narratives will be supplied by the PEQ Manufacturer to allow for proper configuration in the host BPCS/IPS).
Packaged Equipment (PEQ)	Single or combined units of equipment supplied by a Manufacturer which include instrumentation and possible Control and Instrumented Safeguarding system or to which instrument requirements may apply. <i>Formerly called Equipment Package.</i>
Principal's Standards	The standards specified in the contract or purchase order.
Subsystem	A microprocessor based system configured for specific control and monitoring applications, which can operate in isolation or communicate with a BPCS.
Variety Control	The process of selecting an optimum number of different types of products, processes or services to meet prevailing needs. It rationalises the number of varieties of items used both within an operating company and among operating companies.

1.3.3 Abbreviations

Term	Definition
BPCS	Basic Process Control System
CPU	Central Processing Unit
DC	Direct Current
DCS	Distributed Control System. Also referred to as BPCS (Basic Process Control System)
DEM1	Design Engineering Manual 1
DEP	Design and Engineering Practice
DET	De Energise to Trip
DFT	Dangerous Fault Tolerance
EFA	Enterprise Framework Agreements
EMI	Electromagnetic Interference
ETT	Energise to Trip
FAR	Field Auxiliary Room
FAT	Factory Acceptance Test
F&G	Fire & Gas
FGS	Fire, Gas and Smoke detection system
GTG	Gas Turbine Generator
HVAC	Heating, Ventilation and Air Conditioning
HAZOP	Hazards and Operability Analysis
HEMP	Hazards and Effects Management Process
HMI	Human-Machine Interface
HFE	Human Factors Engineering
HH	Hi-Hi – Typically designating a Trip
HMI	Human-Machine Interface
IPF	Instrumented Protective Function, now known as SIF (Safety Instrumented Function)
IPS	Instrumented Protective System (Protective/Safety Logic Solver of an IPF), now known as SIS (Safety Instrumented System)

Term	Definition
JB	Junction Box
LL	Low-Low - Typically designating a Trip
MAC	Main Automation Contractor
MOC	Management of Change
NC	Normally Closed
NDE	Non-Destructive Evaluation
NO	Normally Open
PA	Public Address
PACO	Process Automation, Control and Optimisation
PCAD	Process Control Access Domain
PCD	Process Control Domain
PEQ	Packaged Equipment
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
QMI	Quality Measuring Instruments
QRA	Quantified Risk Assessment
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detector
RTU	Remote Transmission Unit
SI	International System
SIA	Secured Instrument Air
SIF	Safety Instrumented Function (also referred to as IPF in Shell DEPs)
SIL	Safety Integrity Level
SIS	Safety Instrumented System (also referred to as IPS in Shell DEPs)
SPEP	Shell Pre Engineered Package
SPI	SmartPlant Instrumentation
TA	Technical Authority

Term	Definition
TAMAP	Technically Acceptable Manufacturers and Products
TCoO	Total Cost of Ownership

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 (15).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a full revision of the DEP of the same number dated February 2015. The following are the main, non-editorial changes.

Section/Clause	Change
All	Restructured and clarified requirements, enforced shall/should
4.2.1	New section added on DEP and DEM1 compliance and removed similar requirements being repeated elsewhere.
All	Table numbers and titles added wherever missing, figure numbers assigned for flow charts

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://www.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

This DEP gives scope decision instruction, guidance and examples to help make the best fit for scope/supply decisions as well as design requirements and considerations.

1. The scope of supply for the PEQ shall be reviewed and agreed between the PEQ Manufacturer, Contractor and Principal.

The biggest issue regarding PEQ supplied instrumentation in recent major projects has been the failure of PEQ supplied Control and Instrumented Safeguarding systems to perform properly, or to integrate properly, into the primary project control system or the main site control system. Thus, the required selection for the Control and Instrumented Safeguarding system of PEQ's is the host BPCS (and/or the host IPS) of the overall project and site. This is the case for Design Class 2 and Class 3 projects.

2. Deviation requests to the Scope of Supply requirements/defaults listed in this DEP shall be escalated to the Principal for review and approval.
3. Contractor shall forward all referenced DEP to the PEQ Manufacturer for his review and compliance.
4. The review for deviation requests shall evaluate the following:
 - a. the types of PEQs available;
 - b. the class of project;
 - c. the integration requirements;
 - d. options for the main control systems of the project and the site.
5. The Contractor shall ensure that PEQ Manufacturers meet the following requirements:
 - a. requirements specified in this DEP;
 - b. DEM1 Process Safety requirements selected by the project and applicable to the PEQ;
 - c. requirements of other DEPs which are selected by the project and applicable to the PEQ.

DEPs mentioned in (item 5a through 5c) includes but are not limited to PACO related DEPs listed in (Appendix D) and (Appendix E).

(Appendix D) addresses requirements to be implemented by the PEQ Manufacturer and assured by the Contractor.

(Appendix E) contains requirements to be implemented by the Contractor - some via the Main Automation Contractor (MAC).

6. Deviations or waivers to requirements shall be approved and documented following a deviation process that is approved by the project.

3. SCOPE OF SUPPLY FOR INSTRUMENTATION

3.1 SCOPE OF SUPPLY OPTIONS

1. Table 1 defines different scope of supply options available for PEQ. The Default shall be Option A.

For default option A - Process Control (and any required Instrumented Safeguarding) is implemented in the Project/Site Host Control System and the field instruments are implemented according to Principals standards and the Project's Instrument Manufacturers list.

Sketches showing the Scope of Supply options are shown in (Appendix C).

2. Choice of any option other than Option A requires justification and shall be subject to approval of the Principal.”
3. Contractor shall maintain a listing of the PEQs on the project along with the Scope of Supply Option for each clearly identified:
 - a. this listing shall be updated throughout the life cycle of the project as decisions/approvals are made;
 - b. this listing shall be made available to Principal for status review.

Table 1 Scope of supply options table

Option	Scope of PEQ Manufacturer	Requirements
A	Field instruments supplied and installed according to Principal's standards referenced in Table 2 and in reference documents in (15). Functional specification, special tools, special test equipment, drawings and documents.	Contractor shall be responsible to assure that PEQ Manufacturer is competent to meet the Principal's standards. Contractor shall assure that PEQ Manufacturer meets Principal's field device standards.
B	Field instruments supplied and installed according to PEQ Manufacturer's standards. Functional specification, special tools, special test equipment, drawings and documents.	PEQ Manufacturer's instrumentation standards for the equipment package shall require prior approval by the Principal. Contractor shall assure that PEQ Manufacturer meets Principal's DEM1 Process Safety requirements for field devices.
C	Field instrumentation and Control System supplied and installed to the Principal's standards referenced in Table 2 and in reference documents in (15). The required control functionality (and if applicable - Instrumented Safeguarding) is implemented in the PEQ Manufacturer's control system. Fully functional control system, interface to the Project/Site Host system, special tools, special test equipment, drawings and documents.	Contractor shall be responsible to assure that PEQ Manufacturer is competent to meet the Principal's standards. Contractor shall be responsible to assure that PEQ Manufacturer is competent to manage all interfaces between other equipment and Manufacturer/Suppliers. Contractor shall assure that PEQ Manufacturer meets all Principal's standards for field devices and Control Systems.
D	Field instrumentation and Control System supplied and installed to the PEQ Manufacturer's standards. The required control functionality (and if applicable - Instrumented Safeguarding) is implemented in the PEQ Manufacturer's control system. Fully functional control system, interface to the Project/Site Host system, special tools, special test equipment, drawings and documents.	PEQ Manufacturer's instrumentation standards for the equipment package shall require prior approval by the Principal. Contractor shall be responsible to assure that PEQ Manufacturer is competent to manage all interfaces between other equipment and Manufacturer/Suppliers. Contractor shall assure that PEQ Manufacturer meets Principal's DEM1 Process Safety requirements for field devices and control systems.

3.2 SPECIFICATION TABLE

The specification table (Table 2) is a tabular/graphical way to describe the standards (specifications) selection to be used for the Scope of Supply options in (3.1). Effectively, Table 2 takes the single word "standards" in each of the scope of supply options and expands it into many appropriate sub-bullets, in an attempt to add clarity regarding the standards to be used and identify specific DEPs applicable.

1. The topics indicated in Table 2 shall be specified relative to the scope of supply option selected for instrumentation.

The columns A, B, C, and D refer to the scope of supply options listed in Table 1.

2. The requirements associated with the topic in the referenced section of this DEP, or in another referenced DEP, shall be specified in the requisition of the PEQ.

"S" (Specify) means that the topic is applicable to the particular scope of supply option.

V" (Vendor) means that the Manufacturer/Supplier's standard is applicable and/or acceptable for design of the PEQ.

"-" (Dash) means that the topic/section is not usually applicable to the particular option and does not need to be specified.

Table 2 Specification Table

TOPICS	Options				Referenced section of this DEP or reference to other DEP
	A	B	C	D	
GENERAL					
Limits of supply	S	S	-	-	(3.3)
Instrumentation Variety Control	S	-	S	-	(6.2)
DESIGN CRITERIA					
Hazardous area classification	S	S	S	S	(7.3) DEP 32.31.00.32-Gen.
Earthing	S	S	S	S	DEP 32.37.20.10-Gen. DEP 33.64.10.10-Gen.
Electricity supply	S	S	S	S	DEP 33.64.10.10-Gen.
Units of measurement	S	S	S	S	DEP 32.31.00.32-Gen.
Environmental conditions	S	S	S	S	DEP 32.31.00.32-Gen.
Signal transmission type	S	S	S	V	DEP 32.31.00.32-Gen.
Electrical Safety for instrumentation	S	V	S	V	DEP 32.31.00.32-Gen.
Instrument process connections	S	V	S	V	DEP 32.31.00.32-Gen. DEP 32.31.50.10-Gen.
Installation of on-line instruments	S	V	S	V	DEP 32.37.10.11-Gen.
Instrument air supply	S	V	S	V	DEP 31.37.00.11-Gen.
Instrument signal lines	S	V	S	V	DEP 32.37.20.10-Gen.
Radio frequency interference immunity	S	V	S	V	DEP 32.31.00.32-Gen.
INSTRUMENTATION DESIGN					
Instrument tag numbering	S	S	S	S	DEP 32.10.03.10-Gen.
Field instruments	S	V	S	V	DEP 32.31.00.32-Gen.
Control valves and accessories	S	V	S	V	DEP 32.36.01.17-Gen.
On/Off Valve Actuators	S	V	S	V	DEP 32.36.01.18-Gen.
Instrument nameplates	S	V	S	V	DEP 32.31.00.32-Gen.
INSTALLATION MATERIALS					
Tubing and fittings	S	S	S	S	DEP 39.01.10.11-Gen.
CONTROL SYSTEM					
BPCS	-	-	S	V	(4.3) DEP 32.01.20.12-Gen. DEP 32.80.10.14-Gen.
Instrumented Safeguarding System	-	-	S	V	(4.4) DEP 32.80.10.10-Gen. DEP 32.29.20.10-Gen. DEP 32.24.20.44-Gen.

TOPICS	Options				Referenced section of this DEP or reference to other DEP
	A	B	C	D	
					DEP 32.80.10.14-Gen.
Machine Monitoring system	-	-	S	V	DEP 32.31.00.32-Gen.
F&G System			S	S	(4.5) DEP 32.30.02.11-Gen.
Communication to the plant DCS	-	-	S	S	(8.2)
PCD Security	-	-	S	S	DEP 32.01.20.12-Gen.
QUALITY CONTROL					
Functional, performance and interface tests	S	S	S	S	(10) DEP 62.10.08.11-Gen
DRAWINGS AND DOCUMENTS					
Documentation with the quotation	S	S	S	S	(11.1)
Documentation deliverable	S	S	S	S	(12.2, 12.3, 12.4) DEP 32.10.03.10-Gen. DEP 32.31.00.34-Gen.
AFTER SALES SERVICE					
Maintenance and support services	S	S	S	S	(13.1)
Site support during construction and commissioning	S	S	S	S	(13.2)
TRAINING	S	S	S	S	(14)

3.2.1 COMPLIANCE TO SPECIFICATIONS

1. The PEQ Manufacturer shall meet all applicable DEM1 Process Safety requirements of DEPs listed in Table-2:
 - a. DEM1 requirements not applicable shall be submitted to Contractor/Principal for review and approval.
2. The PEQ Manufacturer shall submit a deviation request for all “shall” requirements contained in DEPs listed in Table-2 that are not applicable or not met, for acceptance of Contractor subject to approval by the Principal.

3.3 LIMITS OF SUPPLY

1. The Manufacturer/Supplier shall provide junction boxes, electrical connections and air supply connections at the battery limit of the skid to provide an interface for the Principal's cabling and instrument air supply.
2. The Contractor shall be responsible for the interface between the equipment package and the rest of the project/site.

4. CONTROL AND INSTRUMENTED SAFEGUARDING SELECTION

4.1 GENERAL

1. The control and instrumented safeguarding system of PEQ shall be the host BPCS and the host SIS (if Instrumented safeguarding is needed) of the overall project or site:
 - a. the required functionality shall be established by the PEQ Manufacturer (via Narratives and Cause and Effects);
 - b. that functionality shall be implemented by the Contractor in the Host Systems via a Main Automation Contractor - MAC.

Examples would be fired heaters, power boilers, waste heat boilers, fired reactors, thermal oxidisers, reactor control, compressors, compressor surge and performance control, general-purpose turbines speed control.

Note that (5.2), (5.3) and (5.4) only contain considerations and requirements associated with utilising a PEQ Manufacturer's control system.

4.2 CONSIDERATIONS FOR PEQ MANUFACTURER FURNISHED CONTROLS

4.2.1 General

1. If the Contractor proposes a PEQ Control and Instrumented Safeguarding System different from the Project/Site Host systems, the Contractor should follow the steps in (Appendix A).
2. The subsections (5.2.2) through (5.2.5) should be used to help detail the options listed in (Appendix A), assisting in proper selection of the Control and Instrumented Safeguarding system.

4.2.2 Simple replicated package

Many PEQs are relatively simple or their control is primarily discrete and the PEQ Manufacturer has proven track record for supply of this package.

If the PEQ vendor has implemented their control in the same PLC platform (hardware and software) many times, and the platform matches that of the site, then a PEQ Manufacturer supplied PLC might be a proper choice. A common example is an Air Drier PEQ.

1. The applicable DEM1 Process Safety requirements, HMI considerations and documentation requirements shall be met.

4.2.3 Complex mandated system

Some PEQ's are very complex and have been developed to work with the PEQ's Control System (BPCS and IPS) over many years of supply to many customers. Often a manufacturer of this type of PEQ mandates supplying the Control System if they are supplying a package. A common example is a Gas Turbine Generator PEQ.

1. Complex control systems requires their own HMI stations with graphics to be integrated into the project/site operations console, for which space shall be allocated on the console for the HMI stations.
2. The PEQ control system information shall be integrated into the Project/Site Host BPCS (communicate signals, points and parameters to the BPCS) for historization and potential alarming.
3. The implementation of alarm management between the PEQ control system and project/site host system shall support the project/site alarm management strategy.
4. Production/Operations shall be consulted on the HMI options and selections for complex PEQ control system.
5. Documentation requirements shall be confirmed during discussions with the PEQ Manufacturers.

The Control Systems hardware mandated by a complex PEQ Manufacturer may be satisfactory, but the documentation supplied with the systems is routinely inadequate. In particular, control narratives, cause and effect diagrams and test procedures have often proven inadequate or unavailable or have errors.

4.2.4 Human-machine interface (HMI)

1. The PEQ supplied Control and Instrumented Safeguarding system shall be integrated into the Project/Site Host system for, as a minimum, historization and alarming.
2. The Contractor shall obtain approval of the Principal on the HMI proposal for each PEQ:
 - a. the Principal's Operations/Production representative shall be part of the review and approval process.

4.2.5 Control and instrumented safeguarding platform

1. The PEQ Control and Instrumented Safeguarding platform should match the platform of the project (or site).
2. When the platform does not match, Contractor shall get prior approval from the Principal on the Control and Instrumented Safeguarding platform proposed by a PEQ Manufacturer.

If the platform does not match that of the project or site, the project will incur training costs (potentially significant and unanticipated) and may require unanticipated tools, software and licensing costs.

4.3 REQUIREMENTS FOR PEQ MANUFACTURER CONTROL

1. When approved by the Principal to use a PEQ Manufacturer's BPCS (for additional requirements pertaining to IPF/SIS - refer (4.4)), the Contractor shall assure that PEQ Manufacturer meets the following requirements:
 - a. the PLC/DCS should be the same make as the PLC/DCS of Project/Site Host system;
 - i. any alternate makes should be subject to approval by the Principal.
 - b. the PEQ Manufacturer's control system shall be capable of communicating to the Project/Site Host system, via an agreed protocol and redundancy as defined by the Principal;
 - c. the PEQ Manufacturer shall provide documentation necessary and as identified by Contractor for integrating the package control system into the Project/Site Host system;
 - d. the PEQ Manufacturer's control system shall be configured so that all of the local operator information can be made available at the Project/Site Host system HMI for as a minimum, alarm management and historization;
 - e. executive actions or control requirements within the site or project control system that is required to be integrated into the PEQ Manufacturer PLC shall be implemented as follows;
 - i. permissive and safety shutdown signals between the PEQ Manufacturer's control system and the existing site safety system (or the defined project safety system) shall be hard-wired;
 - ii. I/O wired between the PEQ Manufacturer's control system and the site or projects control and safety systems shall be sourced from the existing systems;
 - iii. if interposing relays or signal isolators are required, they shall be supplied in the packaged equipment's control system cabinets.
 - f. the PEQ Manufacturer shall define the control and configuration required for safe and proper operation of the equipment;
 - g. the PEQ Manufacturer shall be responsible for the engineering and design of the controls supplied with the equipment;
 - h. the PEQ Manufacturer shall be responsible for documentation, programming, system testing and the control philosophy;
 - i. the configuration deliverables (functional content and format) shall be subject to approval by the Principal.
 - i. the PEQ Manufacturer shall document the applicable standards used in the packaged unit design;
 - j. the PEQ Manufacturer BPCS, Central Processing Unit (CPU), power supply units and internal communication buses shall be redundant to meet the minimum availability rate defined by the Principal for the packaged unit;

Note: Redundant is the default requirement, but may not be required for some PEQs. Contractor shall request a deviation if this default requirement is not fit for purpose.

- k. the PEQ Manufacturer shall provide the Contractor with the power supply and power class required by the PEQ system;
- l. audible and visual alarms shall be provided for process or equipment conditions, which could cause process upsets or equipment failure;

- m. the Contractor shall integrate the PEQ Manufacturer BPCS Programmable Logic Controller (PLC) information (data points) into the Project/Site Host control system, as per (8);
 - i. the reliability and redundancy requirements for this communication protocol shall be assessed by Contractor subject to approval by the Principal.
- 2. Refer to (8) for requirements associated with communications with the Project/Site Host system.

4.4 REQUIREMENTS FOR PEQ MANUFACTURER INSTRUMENTED SAFEGUARDING

- 1. When the Principal approves the use of a PEQ Manufacturer's BPCS and Instrumented Safeguarding system (IPF/Safety Instrumented System), the Contractor shall assure that the PEQ Manufacturer meets the following requirements in addition to (4.3):
 - a. the PEQ Manufacturer's IPS PLC shall be the same make as PLCs of the project and/or site;
 - i. any alternate makes shall be subject to approval by the Principal.
 - b. Control and IPF (SIF) for the equipment package shall be implemented in separate systems;
 - c. PEQ Manufacturer shall be responsible for Design Review/HAZOP and SIL assessment, with participation of the Principal;
 - d. the PEQ Manufacturer's Instrumented Safeguarding system shall be capable of communicating to the Project/Site Host system, via an agreed protocol as defined by Contractor, subject to approval by the Principal;
 - e. the PEQ Manufacturer shall provide documentation necessary for the package Control System integration into the site control system;
 - f. the PEQ Manufacturer's control system shall be configured so that all the local operator information can be made available at Project/Site Host system HMI, including alarm management, test, bypass and reset functions;
 - g. executive actions or control requirements within the site or project control system that are required to be integrated into the PEQ Manufacturer PLC, shall be implemented as follows;
 - i. for signals requiring communication between the packaged units shutdown and control system, a data highway shall only be used for monitoring functions (i.e., no control or trip actions);
 - ii. permissive and safety shutdown signals shall be hard-wired between the PEQ Manufacturer's control system and the existing site safety system (or the defined project safety system);
 - iii. I/O wired between the PEQ Manufacturer's control system and the site or projects control and safety systems shall be sourced from the existing systems;
 - iv. if interposing relays or signal isolators are required, they shall be supplied in the packaged equipment's control system cabinets.
 - h. the PEQ Manufacturer shall define the IPF logic, configuration and HMI interface required for safe and proper operation of the equipment;
 - i. these configuration concepts, implementation and deliverables (functional content and format) shall be subject to approval by the Principal.