



GS 130-12

Guidance for Specification 130-12

SUPPLY OF WELLHEAD CONTROL SYSTEMS

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BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING											
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SCOPE AND PURPOSE This document specifies the minimum requirements for the design of Wellhead Control Systems. Its purpose is for the specification of fit-for-purpose Shutdown Systems at minimum cost.											
AMENDMENTS <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Amd</th> <th style="width: 15%;">Date</th> <th style="width: 20%;">Page(s)</th> <th style="width: 50%;">Description</th> </tr> </thead> <tbody> <tr> <td colspan="4" style="height: 150px;"> </td> </tr> </tbody> </table>				Amd	Date	Page(s)	Description				
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CONTENTS

Section	Page
FOREWORD	ii
1. INTRODUCTION.....	1
1.1 Scope	1
1.2 <i>Functional Specification Guidelines</i>	1
2. GENERAL	1
3. WELLHEAD CONTROL PANEL(S).....	3
4. HYDRAULIC POWER PACKAGE	5
5. UMBILICALS.....	7
6. SYSTEM HYDRAULIC ANALYSIS	7
7. TESTING	8
8. DOCUMENTATION	8
APPENDIX A.....	11
DEFINITIONS AND ABBREVIATIONS	11
APPENDIX B.....	12
LIST OF REFERENCED DOCUMENTS.....	12
APPENDIX C.....	13
FUNCTIONAL SPECIFICATION ATTACHMENTS.....	13
C1. SYSTEM DESCRIPTION	13
C2. ENVIRONMENT, AREA CLASSIFICATION AND UTILITIES	14
C3. DATA SHEETS.....	16



FOREWORD

Introduction to BP Group Recommended Practices and Specifications for Engineering

The Introductory Volume contains a series of documents that provide an introduction to the BP Group Recommended Practices and Specifications for Engineering (RPSEs). In particular, the 'General Foreword' sets out the philosophy of the RPSEs. Other documents in the Introductory Volume provide general guidance on using the RPSEs and background information to Engineering Standards in BP. There are also recommendations for specific definitions and requirements.

Value of this Guidance for Specification

This Guidance for Specification identifies the minimum requirements for the design of Wellhead Control Systems. The intention is to simplify the purchasing requirements when dealing with a known and mature supplier source.

Application

This Guidance for Specification is intended to guide the purchaser in the use or creation of a fit-for-purpose specification for enquiry or purchasing activity.

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Specification, and may discuss alternative options.

This document may refer to certain local, national or international regulations but the responsibility to ensure compliance with legislation and any other statutory requirements lies with the user. The user should adapt or supplement this document to ensure compliance for the specific application.

Specification Ready for Application

A Specification (BP Spec 130-12) is available which may be suitable for enquiry or purchasing without modification. It is derived from this BP Group Guidance for Specification by retaining the technical body unaltered but omitting all commentary, omitting the data page and inserting a modified Foreword.

Feedback and Further Information

Users are invited to feed back any comments and to detail experiences in the application of BP RPSE's, to assist in the process of their continuous improvement.

For feedback and further information, please contact Standards Group, BP International or the Custodian. See Quarterly Status List for contacts.



1. INTRODUCTION

1.1 Scope

This specification details the basic minimum requirements for the design of wellhead control systems.

For system procurement, this specification will need to be supplemented by details of the functional requirements for the specific application.

1.2 *Functional Specification Guidelines*

A functional specification should cover the following subjects:-

Introduction

Scope of Supply:-

General

Testing

Documentation

Work by Others

Commissioning

Applicable Codes, Standards and Regulations

Special Requirements

Information Required with Quotation

Price and Delivery

Quality Verification

Appendices:-

System Description (see Appendix C1)

Environment, Area Classification and Utilities (see Appendix C2)

Wellhead System Control Panel, Hydraulic Power Pack and Control

Umbilical (see Appendix C3)

2. GENERAL

2.1 The wellhead control system will consist of component parts, which may or may not be included in the scope of supply depending on application, as detailed below:-

- Control panel(s) consisting of controls for the wellhead and down hole hydraulic valve actuators for individual or multiple



wellhead installations. These are to permit local manual (for manned installations) and remote operation from a connected control system. Facilities will also be required for partial or total emergency shutdown from a shutdown system which may be included as part of the system supply or form part of a separate system outside the scope of supply of this package.

- Hydraulic power supply package consisting of electric, pneumatic or hand pumping facilities, or combinations of these, together with accumulator storage and all necessary controls for multiple pressure levels for operation of the wellhead and downhole valve actuators. The package may also be required to provide hydraulic power for additional users such as process emergency shutdown valves.
- Hydraulic umbilicals and fittings for connection between the wellhead control panel and the wellheads.

2.2 The design shall meet any requirements to gain approval of regulatory authority approval together with any testing requirements.

2.3 The Supplier shall submit his proposal for the preferred arrangement to enable the functions to be performed. The proposal shall be backed up with full justification to demonstrate optimum life of field costs, system performance, availability and minimal maintenance requirements.

It is essential to agree with the Operator during the initial design phase the required operating and maintenance philosophy.

2.4 The method of hydraulic supply and control for multi-pressure applications shall ensure that pressure build up does not occur when no hydraulic demand exists.

The use of a common pressure level with pressure let down for lower pressure applications can cause problems with pressure build up and erosion of regulator bleed-off ports. This is due to regulator seat leakage when no demand exists. The use of tight shut-off regulators can only be considered a temporary solution. Separate pumped circuits is preferred, however over pressure, back regulation or circulating bleed-off may be considered. The number of pressure levels used should be minimised as far as is practicable.

2.5 The system shall include all necessary alarms to provide warning of equipment failure, to ensure integrity of the system can be maintained

2.6 The design and layout of equipment shall be such to give free access for maintenance and repair. Repair and routine maintenance shall be possible without total system shutdown and facilities lost during any fault repair period shall be minimised. First line fault repair shall be possible using 'non-expert' multi-trade technicians.



Wellhead control panel layouts can be very congested and it needs to be ensured that access is possible to components and fittings.

2.7 The packages shall be fully assembled, piped, cabled, provided with all necessary lighting, heating, environmental protection and leakage drains. The assemblies shall be such that all purchaser connections can be made from readily accessible terminal points and termination boxes.

2.8 All field mounted equipment shall be weather proofed to [IP 55](#), [IEC 529](#) classifications as a minimum. Wellhead panel front controls shall be provided with protection from the environment whilst allowing ready access.

2.9 All materials of construction, shall be suitable for service and the environment.

For offshore applications the use of AISI 316 stainless steel is preferred for items such as control panels ,cable tray, cladding etc. Stainless steel is recommended for hydraulic reservoirs and pipework to ensure system cleanliness is maintained. Where this is not proposed, a supplier should be made to justify the alternative approach.

2.10 Cabling and panel wiring shall be flame retardant to industry standards.

2.11 Compression fittings to be used shall be agreed with the purchaser to enable uniformity of supply with other equipment.

2.12 For topsides located wellhead valves and other duties, excluding sub-sea, the system cleanliness requirement will be to [NAS 8](#). For any sub-sea valve applications specified, [NAS 6](#) shall be used as the criteria. ([Reference National Aerospace Standard 1638](#))

3. WELLHEAD CONTROL PANEL(S)

3.1 The general principle to be used for shutdown shall be for fail-safe i.e. de-energise/depressurised/contacts open to trip. Wellhead valves will be fail-safe spring action to close.

It is essential that voltages specified for solenoid valves take account of cable voltage drops.

3.2 The wellhead control panel should be built on a modular basis to allow independent servicing of individual well controls. Due regard shall be given in the design for potential requirements for modification of control from a producer to water injection or vice versa.



- 3.3 Module controls and status indications shall include, as a minimum, those requirements detailed in the data sheets and such local controls as are essential for safe production operation. These may include requirements for local control and remote facilities.

It should be ensured that non essential requirements are not specified.

Remote operation, except shutdown, should only be specified where essential for minimisation of manning reasons, rapid response is required or local control is not practical. Facilities, should be restricted to the wing valve unless facilities are unmanned and consequential leakage due to failure of connections on start up is acceptable, or remote monitoring is provided.

Remote status monitoring should be restricted to that essential for satisfactory production operations or shutdown.

- 3.4 The supplier shall include methods for minimising cabling requirements for control and status monitoring between the wellhead system and remote control facilities. Due regard shall be given to the reliability of this and methods of operation should such facilities fail. Where specified the wellhead system shall include facilities for inter-connection of other status and control functions within the wellhead and manifold area.

Consideration should be given to further cable saving by incorporation of other non critical well and flowline measurements. The choke controls could also be incorporated as failure of any such link would be fail fix, however, manual back up operation should be provided.

- 3.5 Shutdown initiation from central control facilities, or separate shutdown systems will be hard wired. The design of the wellhead controls shall be such that shutdown by-passes any control logic incorporated into the panel whilst retaining wellhead valve closure timing. Shutdown shall necessitate reset at the wellhead panel unless facilities are unmanned.

Shutdown level requirements need to be detailed by the purchaser, and will normally be at two levels, i.e.

- (i) individual well - wing and master valve
- (ii) all wells - wing, master and downhole safety valve.

- 3.6 The controls shall include wellhead shutdown valve sequence timing facilities to ensure closure of valves in the sequence - wing, master, downhole safety.

Such timing should ensure that closure of subsequent valves is not inhibited in the event of failure of the timing device.

- 3.7 Where specified as a requirement by the Purchaser, key protected inhibit facilities shall be provided, as necessary, to enable routine testing



of the system, inputs and outputs. All inhibits shall be reported to the central control equipment and indication shall not be cancelled until the inhibit has been removed. Keys shall be retained in the defeat position.

The provision of test facilities can result in excessive system complexity and cost. It is preferable, therefore, that they are not provided and that system test is carried out periodically as a total wellhead shutdown. This will probably be required by the certifying Authority as a matter of routine anyway and therefore additional test capability becomes superfluous.

4. HYDRAULIC POWER PACKAGE

- 4.1 The supplier shall propose the method for pumping to give the optimum solution for cost and reliability unless any application specific requirements are detailed by the Purchaser.

There may be restrictions on particular applications with regard to the availability and reliability of supply. This may dictate that either air or electric pumps, or combinations, should be used in which case this should be detailed by the Purchaser.

The use of manual pumping only should not be ruled out, this may be appropriate for locations where infrequent operation is likely, and where manpower is readily available for operation and regular topping up of accumulator supply. If proposed, the design of the system would need to ensure hydraulic leakage through switching valves, pumps etc. is avoided.

- 4.2 The minimum accumulator capacity shall be such to permit, as a minimum, the opening of all valves on one wellhead whilst retaining supply header pressure above minimum, independent of pump recharge action. The capacity shall also be such to prevent frequent cycling of hydraulic pumps due to system component leakage.

A minimum of two accumulators per pumped pressure level will be necessary to allow for maintenance. The calculation of accumulator capacity should take into account the adiabatic nature of the accumulator volume displacement.

- 4.3 The accumulators shall be provided with pre-charge facilities complete with any necessary bottled gas, booster pumps and all interconnecting piping, valves and fittings.

Permanently installed facilities may not be necessary where wellheads are spread out and independent small wellhead control packages are involved, such as may occur on onshore installations. For these a portable unit used for many systems may be appropriate. For wellhead clusters, such as would be experienced offshore, a permanently installed facility is more appropriate.

- 4.4 Pump recharge rate shall be such to allow the opening of the number of wellheads within a time period as detailed by the Purchaser. The supplier may propose an option of alternative rate where significant



cost savings can be achieved with reduced performance consistent with systems previously supplied.

The rate of opening of wellheads needs to be realistic. An excessive requirement can have unnecessary cost implications. The rate should be agreed with operations and should be consistent with the need for physical monitoring of opened wells for leakage before proceeding with further well operation. A maximum frequency of opening one well every three minutes is considered realistic. A similar basis for returning to production after routine shutdown, with wing valve only closing, is also considered appropriate when considered with the need for resetting chokes.

- 4.5 The reservoir shall be such that the capacity to minimum level includes total system, supply line and actuator volume, return tank volume to high level alarm, plus a contingency to allow for accumulator loss of pre-charge and leakage (supplier to detail).

A contingency of about 20% should be adequate for most applications. Any application specific special requirements need to be detailed by the Purchaser.

- 4.6 A separate return tank, with vent for entrained gas, shall be provided for the return from downhole safety valves. Means shall be provided for test of return tank contents and filtered return to the main reservoir. The tank shall be sized to permit two closing operations of all the valves before reaching high alarm level.

Consideration should be given to the possibility of contamination of hydraulic fluid from 'other' users. Any additional requirements will need to be detailed by the Purchaser.

- 4.7 The supplier shall recommend and demonstrate suitability of hydraulic fluid for use in the system. Due account shall be taken of temperatures to be experienced in downhole applications to ensure degradation of fluid does not occur. Ambient temperature conditions also need to be considered to ensure suitable viscosity for operation.

- 4.8 The supplier shall include a portable wellhead service unit to be used to permit manual intervention at the wellhead for operation of the master and downhole safety valves during well service conditions. The unit shall be complete with necessary flexible connections for making off to services and actuator control lines.

5. UMBILICALS

- 5.1 Umbilicals are to be used for connection of hydraulic control and return between the wellhead control panel and the wellheads.

The use of umbilicals is most suitable for multiple wellhead installations where hard piping is difficult and expensive. Their use on small or simple installations may be inappropriate.



- 5.2 These multi-tube bundles shall be suitable for operating pressures and temperatures and sheathed overall to provide protection for the installed environment, risk of impact damage and fire resistance. The design shall be such to maintain flexibility without flattening for installation purposes and to ensure a minimum service life of 20 years.

The need for armour will depend on the method of installation intended. The umbilicals may be subject to oil spills and specification of outer sheath needs to account for this.

- 5.3 Individual hydraulic hoses within the umbilicals shall be sized to ensure closure of wellhead valves is achieved within specified times.

- 5.4 The umbilicals shall include all connectors, mounting plates and individual hoses for connection/reconnection to the wellhead panel and individual wellhead valves.

6. SYSTEM HYDRAULIC ANALYSIS

- 6.1 The supplier shall produce a fully detailed dynamic hydraulic analysis of the wellhead control system to confirm operation capability within specification. This shall include all components within the system, including: pipework, umbilicals, drain lines, fittings, actuators, hydraulic power unit and wellhead control panel.

This is necessary to ensure elements of the system do not cause restrictions and resultant delays in valve operation times.

- 6.2 The supplier shall carry out a failure modes effects analysis of the system considering the consequences of any single component failure. This shall be used to demonstrate that a single common mode failure does not occur which can jeopardise the integrity of the system and is not revealed.

- 6.3 Any shortfalls in design found as a result of system analysis shall be rectified by the supplier before factory system test.

7. TESTING

Detailed test procedures which will demonstrate design integrity along with the correct operation of each element of the total wellhead control system shall be produced.

The test shall be performed with simulated interconnecting pipework and drain lines connected which provide equivalent restriction and pressure drop. The system test shall also include a demonstration of satisfactory operation of the wellhead valves by either use of the actual project wellhead set up or a simulation with equivalent operating conditions, back pressures and swept volumes.



The test procedure shall ensure that on-site testing and remedial work is minimised. All testing shall be recorded and such records shall be retained for inspection and audit purposes.

Electronic controls shall be demonstrated to be immune to electromagnetic interference using project specific sources for test purposes.

8. DOCUMENTATION

Documentation shall be provided to enable assessment of design. This shall be limited to that essential to verify conformance with specified functionality and as necessary to permit installation, operation, calibration and maintenance of the systems.

Requirement should be detailed in the Functional Specification and would consist typically of the following:-

(i) Information Required with Quotation

- Detailed description of proposed system.
- List of applicable Codes and Standards and any deviations from these or this specification and associated documentation.
- Accumulator and reservoir sizing and basis.
- Hydraulic oil proposals.
- Statement of capabilities and proposals for providing installation supervision (on/offshore) and testing/commissioning (on/offshore).
- Details of proposals for failure modes and effects analysis and dynamic hydraulic analysis.
- Programme for construction, testing and delivery.
- Proposals for testing and commissioning.
- Spares and test equipment proposals together with prices.

(ii) Documentation Required During Design Build and Test

Documentation must be limited to the minimum required to design the installation and to operate and maintain the equipment.

It should be recognised that it is the responsibility of the vendors to approve the detailed design drawings and not the design contractor. This is a new approach and will substantially reduce the volume of documentation required.

The specific documentation requirements will need to be defined by the design contractor for each particular application.

The prime objective is to eliminate unnecessary documentation, reformatting and approvals, thereby realising large savings in vendor and contractor costs.



As a minimum the documentation listed below shall be provided.

8 weeks after confirmation of order

- *Front of panel layout drawings.*
- *Logic diagrams (Hydraulic/pneumatic/elect.).*
- *Equipment utility load estimates.*
- *Wiring, electrical distribution, earthing and inter-connection drawings*
- *Installation and terminal point details.*
- *Equipment lists, schedules and data sheets for input to operational maintenance database systems (where specified).*
- *Interface schedules including signal state.*
- *Detailed spares and test equipment listings to cover commissioning and two year's operation.*

8 weeks prior to Factory Test

- *Detailed procedure, programme and test sheets for system testing at the factory, on site commissioning and for subsequent routine operation and maintenance. These are to include for the system and any sub-vendors or ancillary equipment.*
- *Failure mode and effects analysis with corrective actions taken.*
- *Dynamic hydraulic analysis with corrective actions taken.*
- *Equipment safety certification dossier (as applicable).*
- *Operation and maintenance manuals with all information necessary for continued operation during the life of the installation.*
- *Listing of all control and trip settings.*

On delivery

- *As built documentation*
- *Confirmed weight and Centre of Gravity (offshore only or as specified)*



DEFINITIONS AND ABBREVIATIONS

Definitions

Standardised definitions may be found in the BP Group RPSEs Introductory Volume.

Abbreviations

AISI	American Iron and Steel Institute
IEC	International Electrotechnical Commission
IP	Ingress Protection
NAS	National Aerospace Standard



LIST OF REFERENCED DOCUMENTS

A reference invokes the latest published issue or amendment unless stated otherwise.

Referenced standards may be replaced by equivalent standards that are internationally or otherwise recognised provided that it can be shown to the satisfaction of the purchaser's professional engineer that they meet or exceed the requirements of the referenced standards.

National Aerospace Standard 1638	Cleanliness requirements of parts used in Hydraulic Systems
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FUNCTIONAL SPECIFICATION ATTACHMENTS

C1. SYSTEM DESCRIPTION

C1.1 General

-- HOLD --

(Note: Description of the project, location and application.)

C1.2 System Layout

-- HOLD --

(Note: Summary of the required system, equipment component split and layout, any remote control.)

C1.3 Shutdown Hierarchy

-- HOLD --

(Note: Summary of required shutdown levels and how these are to be initiated and controlled. Include any 'hard wired' shutdown requirements. The amount of shutdown logic to be incorporated within the wellhead control system should also be detailed with due regard to well head control and requirements for submersible pumps, where installed. Use of main platform shutdown systems, where provided, for these functions is preferred.)

C1.4 System Performance Requirements

-- HOLD --

(Note: Include requirements for no of wells to be opened within time scale and subsequent recharge.)

C1.5 Operator Interface Arrangement

-- HOLD --

(Note: Detail required controls for remote and local operation.)



C1.6 Interface with other Systems

-- HOLD --

(Note: Include details of the interfaces with other systems for control, shutdown, alarm and status monitoring. Any requirements for additional status and control signals not associated directly with wellhead operation, should also be detailed here.)

C1.7 Special to Project Maintenance Facilities

-- HOLD --

(Note: Agree any special requirements with the operator.)

C1.8 Device and Equipment/Panel Tag Numbering.

-- HOLD --

(Note: Detail to fit with project philosophy.)

C2. ENVIRONMENT, AREA CLASSIFICATION AND UTILITIES

Field equipment

Field equipment will be subjected to a marine environment with a salt laden atmosphere.

Max. ambient temperature	°C
Min. ambient temperature	°C
Max. Rel. Humidity	%

Area Classification	Zone
Gas Group	II
Temperature Class	T

Central control/Field equipment rooms

The control/ equipment rooms shall be classified as a safe area and suitable for general purpose equipment such as control panels and printers.

Max. ambient temperature	°C
Min. ambient temperature	°C
Max. Rel. Humidity	%



Utilities and Services

Electrical power

1.	<i>Voltage</i>	<i>V AC</i>	<i>V AC</i>
	<i>Frequency</i>	<i>Hz</i>	<i>Hz</i>
	<i>Regulation</i>	-	VTA
	<i>Harmonic Distortion</i>	-	VTA
	<i>Switching Transients</i>	-	VTA
2	<i>Voltage</i>	<i>V DC</i>	<i>V DC</i>
	<i>Regulation</i>	-	VTA
	<i>Ripple</i>	-	VTA
	<i>Harmonic Distortion</i>	-	VTA

Instrument Air

<i>Inst. Air Pressure</i>	<i>barg. (max.)</i>	<i>barg. (min.)</i>
<i>Dew Point</i>	<i>°C</i>	

<i>Plant Air</i>		
<i>Air Pressure</i>	<i>barg (max.)</i>	<i>barg. (min.)</i>
<i>Dew Point</i>	<i>°C</i>	

VTA - Vendor to advise with submission



C3. DATA SHEETS

	WELLHEAD	CONTROL	PANEL	
No. of Wellheads				
Valves	Wing	Master	Downhole	Other
Control - Local (o/c)				
-Remote (o/c)				
Status -Local (o/c)				
-Remote (o/c)				
Shutdown Level				
Stroke Volume				
Closure Time (max.)				
Sequence Time				
Actuator Pressure (max./min. barg.)				
Panel Environment				

WELLHEAD HYDRAULIC	POWER PACK
Initial Charge Time	VTA
Wells Open/ Time	
Recharge Time	VTA
Accumulator Capacity	VTA
Reservoir Capacity	VTA
Downhole Temperature	
Hydraulic Oil	VTA
DHSV Clean-up system	
Wellhead Service unit	
System Test Facilities	
Package Environment	
System Alarms	VTA

	WELLHEAD	CONTROL	UMBILICALS
Lengths	wellhead	control panel	to wellhead:
Well No:			
Length:			
Well No:			
Length:			
Well No:			
Length:			

