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Guidance on Practice for Control Systems for Pipelines

GP 43-37

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 43-37. This document will be updated on a periodic basis to include new BP experiences and any additional mandatory requirements. This is not a standalone document; it must be used in accordance with the requirements of ETP document PR 43: Status of ETP Pipeline Documents. In addition to the requirements for this document, those of relevant BP group standards such as getting HSE right policy (gHSEr) and Process Safety/Integrity Management standard (PS/IM) must also be fulfilled.

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Introduction

Pipeline systems shall be designed from their inception with a firm understanding of how they will be controlled to give the control room operator the ability to operate the facilities in a safe and efficient manner. This technical practice provides guidance to control and pipeline engineers to enable them to facilitate the provision of control systems meeting BP's normal requirements for operated pipelines.



1. Scope

This technical practice gives guidance on critical areas of control and protective system design for single phase or multiphase pipeline systems. It is primarily for design of new and replacement pipeline control systems but can provide useful advice for modification projects.

The document is aimed at the EA and control systems engineers to ensure that they are implementing pipeline control and protective systems that follow current best practice.

One area that is excluded from this GP is oil and gas flowlines connecting wellheads to oil and gas processing facilities.

This document only relates to subsea technologies in a general way since it is understood that as these are to be the subject of a separate detailed GP.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP

GP 30-40	Guidance on Practice for Control Hardware/Process Automation.
GP 30-41	Guidance on Practice for Data Historian.
GIS 30-411	Guidance on Industry Standard for Data Historian Systems.
GP 30-45	Guidance on Practice for Human Machine Interface/Alarm Systems.
GP 30-49	Guidance on Practice for Control System Integration.
GP 30-50	Guidance on Practice for Adcon Applications.
GP 30-55	Guidance on Practice for Control Rooms.
GP 30-60	Guidance on Practice for Process Control Networks.
GP 30-75	Guidance on Practice for SIS-Management of the SIS Cycle.
GP 30-76	Guidance on Practice for SIS-Process Requirements Specification.
GP 30-80	Guidance on Practice for SIS-Implementation of Process Requirements.
GP 30-81	Guidance on Practice for SIS Operations and Maintenance.
GIS 30-801	Guidance on Practice for SIS-Design and Engineering of Logic Solvers.
GP 32-20	Guidance on Practice for Site Inspection, Testing and Pre-commissioning of New Plant.
GP 48-03	Guidance on Practice for Layer of Protection Analysis (LOPA).
GP 59-10	Guidance on Practice for Telecommunication Systems Selection for Onshore Plants and Facilities.

American Petroleum Institute (API)

API Pub 1155	Evaluation Methodology for Software Based Leak Detection Systems.
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3. Symbols and abbreviations

For the purpose of this GP, the following symbols and abbreviations apply:

CCTV	Closed circuit television
CIL	Commercial integrity level
COE	Common operating environment renamed BP Passport (BP's IT application layer for email, intranet, Maximo, etc.)
Cv	Coefficient of flow
DCS	Distributed Control System
D2D	Data to desktop
EA	Engineering Authority
EIL	Environmental Integrity Level
ESD	Emergency Shutdown
ESDV	Emergency Shutdown Valves (automated inlet or outlet valves at facilities)
E&P	Exploration and Production
HIPPS	High integrity pressure protection system or high integrity pipeline protection system
HP/LP	High pressure/low pressure
ICSS	Integrated Control and Safety System
IL	Integrity level (highest of SIL, EIL, CIL)
LC	Level controller
LDS	Leak detection system
LIDAR	Light detection and ranging
LOPA	Layer of Protection Analysis
MAOP	Maximum allowable operating pressure
MATP	Maximum allowable transient pressure (10% above MAOP for B31.4 and DNVFS101 pipeline codes). Sometimes referred to as maximum incidental pressure.
MIP	Maximum Incidental Pressure (same as MATP)
MIV	Main instrument vendor
MOC	Management of Change
NGL	Natural gas liquids



PC	Personal computer or pressure controller
PCN	Process Control Network
PIN	Process Information Network (e.g. PI, Phd, D2D)
ROW	Right of Way
SIL	Safety Integrity Level
SMYS	Specified Minimum Yield Strength
STM1	Synchronous Transmission Mode with bandwidth capacity up to 155 Mbps
TA	Technical Authority
VT	Video teleconferencing

4. Control and data acquisition systems

4.1. General

4.1.1. Name for the control system and data acquisition systems

Pipeline control systems differ from other types of control system by their very distributed nature. The name SCADA (supervisory control and data acquisition) is used widely in the pipelines business, but within the latest BP projects this has generally been replaced with the name Integrated Control and Safety Systems (ICSS), reflecting the trend towards a common operator interface for control/shutdown/fire and gas information and the evolution of distributed control systems (DCS) with much greater geographical distribution.

The control system is sometimes referred to as the Pipeline Integrity Monitoring System (PIMS), but the term PIMS should not be used, to avoid confusion with Pipeline Integrity Management Scheme (PIMS) under the IM Standard and PS/IM.

4.1.2. Control and instrumentation philosophy

- a. A control and instrumentation philosophy shall be developed as early as possible in the project. This is preferably first issued during the Select Phase and then developed during Define and Execute (see clause 16 on CVP Process later in this document).
- b. The control and instrumentation philosophy shall be developed in close liaison with the operating philosophy.
- c. Several important issues shall be addressed when defining the control and instrumentation philosophy for a pipeline, such as:

1. What level of availability is required for the pipeline? What percentage of the total unavailability can be attributed to control system failures?

Control system availability of up to approximately 99,9% may be provided by simplex systems or 99,99% by dual redundant systems. The availability of the control and communications systems should meet the requirements set in any national legislation, e.g. PFEER for UK offshore installations and the GP 59 series Telecommunications series documents.

2. What are the manning requirements now and in the future?



3. What kind of communication infrastructure is available along the pipeline and is it of sufficient availability to be useful for control and data acquisition purposes?
 4. What level of redundancy/backup is required in the communications architecture?
 5. From which locations will the pipeline be controlled, for example, source, intermediate, or receiving end pump/compressor stations?
 6. Does there need to be a facility for passing control from the normal point of control to remote facilities?
 7. What level of automation is required? For example, is auto-starting pumps/compressors/letdown systems required as the pipeline rate changes? What routine operations can be automated, e.g. pig launch/receipt, pig tracking, composition change batch tracking?
 8. What are the maximum and minimum flowrates of the pipeline? What is the turndown and how does it affect the control system?
 9. What type of data polling is required? A key consideration is how the ICSS works, e.g. routine scanning versus exception reporting. This has implications for:
 - a) Loading/sizing of comms network for the worst case event.
 - b) Time tagging at source or centrally.
 - c) Available time discrimination between events and locations.
 10. In the event of a loss of view for part of the pipeline, how critical will this be? Can the pipeline continue to operate or is a controlled shutdown the only safe course of action?
 11. Do any transient pipeline conditions place special demands on the control and/or safety system?
 12. How is the pipeline restarted after a trip? What facilities for reducing pressure in downstream systems may be required? Restart shall be done without the need for a large number of override keys in place. If overrides are unavoidable, a single override per station with automatic time out would be preferable.
 13. If the pipeline has a wide range of feeds, throughput prediction technology may be beneficial to predict composition of the delivered product and optimise the performance of receiving facilities.
- d. If possible, the design basis for major sections or nodes on a network (e.g. pump/compressor stations) shall be such that stand alone integrity is provided in the event of communications failure, loss of view, or loss of process control network.
- Gas pipelines have the tendency to be far more independent so lower communications availability may be acceptable.*
- e. If this is not possible, for example if there are surge issues or stringent LDS requirements, adequate communications system reliability shall be provided in the form of single or preferably dual optical fibre installations.
- f. If control system, voice, and COE/BP Passport applications (e.g. Maximo, Netmeeting) run in the same communications media, some form of backup systems shall be provided. These three types of applications shall be segregated as far as possible to prevent single point of failure or one of them dominating all the available bandwidth.

The design needs to reduce the likelihood of a single failure taking out control systems and voice communications at the same time. For example, if a single optical fibre bundle is installed, different fibres should be used for control system, voice, and COE/BP Passport applications.



4.1.3. Control system definition

- a. The ICSS shall comply with GP 30-40, GP 30-41, GP 30-45, GP 30-49, GP 30-50, GP 30-55, and GP 30-60. For E&P segment projects, the ICSS should also conform to the Field of the Future Automation Blueprint.
- b. The use of custom built/ non-proven equipment shall be avoided if possible. Control scheme configuration shall be via standard proven control blocks rather than high variability programming languages.

This reduces exposure to equipment becoming obsolete or vendors going out of business and dependence on a small number of expert software engineers.

- c. The control system, protective system, and fire and gas system parts of the ICSS shall use a common interface to the control room operator. Alarms and analogue readings shall be presented in a consistent manner regardless of which system they originated from.
- d. The system shall provide an engineering interface that allows configuration changes to be made online. If there are any exceptions to this, they shall be highlighted during bid clarification.
- e. The engineering interface shall provide a single-point of entry for control system modifications (e.g. a range change would be entered at one node and the system ensures the change is replicated to all other graphics and controller nodes).
- f. The ICSS shall be capable of extending to new facilities without disruption to existing parts of the pipeline, see clause 13 on design for partial start-up and extension.
 - 1. The ICSS vendor shall demonstrate how this will be done during bid clarification.
 - 2. The ease of ICSS extension shall be taken into account when judging technical suitability.
- g. ICSS system vendors shall be required to demonstrate in advance that they have:
 - 1. Sufficient resources to provide field support to provide parallel commissioning activities for extended periods (e.g. including holiday cover).
 - 2. Succession planning in place for key personnel; this shall extend at least 10 years beyond the end of the project.
 - 3. Robust document control and management of change procedures.
- h. Time synchronisation of all nodes on the ICSS shall be from a single entry at one of the workstations. Systems that require the time to be entered at multiple points for varying node types should be avoided. If the pipeline crosses over different time zones, the control system vendor shall be required to explain how this is accommodated.

Many modern systems now support GPS and/or radio clock time synchronisation. For pipelines which cross multiple time zones, the concept of a standard 'pipeline time' may be adopted. This pipeline time would be aligned normally with the time zone at the principal pipeline operating centre.

4.2. Oil/liquids (live or stabilised crude oils, NGLs, etc.)**4.2.1. Basic continuous control schemes**

- a. For intermediate pump stations with variable speed control, control shall be via suction pressure control with discharge pressure override.

This means normal control is on suction pressure, unless the discharge pressure drifts up too high, for example: if downstream systems trip or run at low throughput.

