



RP 32-6

INSPECTION AND TESTING OF IN-SERVICE INSTRUMENTATION

July 1994

Copyright © The British Petroleum Company p.l.c.

All rights reserved. The information contained in this document is subject to the terms and conditions of the agreement or contract under which the document was supplied to the recipient's organisation. None of the information contained in this document shall be disclosed outside the recipient's own organisation without the prior written permission of Manager, Standards, BP International Limited, unless the terms of such agreement or contract expressly allow.

BP GROUP RECOMMENDED PRACTICES AND SPECIFICATIONS FOR ENGINEERING			
Doc. No. RP 32-6		Issue Date July 1994	Latest Amendment Date
Document Title INSPECTION AND TESTING OF IN-SERVICE INSTRUMENTATION			
APPLICABILITY			
Regional Applicability:		International	
SCOPE AND PURPOSE			
This Recommended Practice gives general guidance for assessing the condition of operating instrument systems by focusing on their inherent and functional integrity. Its purpose is to give guidance on those requirements considered essential for assessing in-service instrumentation integrity, from which more specific requirements can be developed by site engineers.			
AMENDMENTS			
Amd	Date	Page(s)	Description
CUSTODIAN (See Quarterly Status List for Contact)			
Inspection			
Issued by:- Engineering Practices Group, BP International Limited, Research & Engineering Centre Chertsey Road, Sunbury-on-Thames, Middlesex, TW16 7LN, UNITED KINGDOM Tel: +44 1932 76 4067 Fax: +44 1932 76 4077 Telex: 296041			

CONTENTS

Section	Page
FOREWORD	iii
1. INTRODUCTION	1
2. SCOPE.....	1
3. INSPECTION ORGANISATION	2
3.1 Managements Responsibilities.....	2
3.2 Inspection Authority Responsibilities	3
3.3 Operating Authority Responsibilities	3
3.4 Inspection Staff (Inspectors)	4
3.5 External Inspection Authorities	4
3.6 Engineering Co-operation	5
3.7 Competent Personnel	5
3.8 Audit Function.....	5
4. GENERAL REQUIREMENTS	5
4.1 Introduction.....	5
4.2 Identification/ Registration.....	5
4.3 Support Documentation.....	6
4.4 Programmes and Procedures	6
4.5 Protective Systems Documentation	7
4.6 Records	7
4.7 Alteration of Trip and Alarm Settings	8
4.8 Disarming and Overriding Trips	8
5. INSPECTION AND TEST PLAN	8
5.1 Introduction.....	8
5.2 Procedures.....	9
5.2.1 Preparation	9
5.2.2 Approach	9
5.2.3 Approval.....	11
5.2.4 Review.....	11
5.2.5 Control	11
5.3 Scheduling.....	11
5.3.1 Factors Affecting Test Frequency	12
5.3.2 Review.....	13
5.3.3 Inspection and Test Deferrals	13
5.4 Reporting	14
5.4.1 Report Sheet	14
5.4.2 Management Status Review	15



6. REGIONAL ANNEX.....	16
6.1 United Kingdom	16
APPENDIX A.....	17
DEFINITIONS AND ABBREVIATIONS	17
APPENDIX B.....	21
LIST OF REFERENCED DOCUMENTS.....	21



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 Recommended Practice

This document represents the accumulated practices of the BP Group Companies for ensuring a high standard of integrity assessment of instrumentation systems on in-service plant, within the constraints for cost effective engineering.

Application

Text in *italics* is Commentary. Commentary provides background information which supports the requirements of the Recommended Practice, and may discuss alternative options. It also gives guidance on the implementation of any 'Specification' or 'Approval' actions; specific actions are indicated by an asterisk (*) preceding a paragraph number.

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.

The Regional Annexe of this document refers to national or international regulations. However, the responsibility for ensuring 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. Also listed within the annexe are documents to which reference may be made for more detailed information.

Principal Changes from Previous Edition

This Recommended Practice is a major revision of BP Engineering CP 52 - Inspection and Testing of Plant in Service which was last revised in January 1991 and which has now been split into four separate documents and updated to give more constructive guidance on the requirements for assessing the integrity of in-service instrumentation.

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

This document is one of a series of Recommended Practices, which provide guidance on the essential requirements for ensuring the integrity of all equipment within the BP group operating centres. In particular this document is aimed at the integrity assessment of instrumentation systems on plants in service.

This Recommended Practice is written as a guide to those in the operating centres with responsibility for ensuring plants are maintained in a safe and reliable condition. Although primarily written for the maintenance engineer, design engineers also need to be aware of the content in order that they may:-

- (a) provide the facilities necessary to perform these activities safely and economically, and
- (b) take account of the practices during system reliability studies and communicate recommended special requirements or departures from this code to the future operating centre.

In developing this Recommended Practice, account has been taken of guidance given in national/international codes and standards and established good industry (Petroleum/Chemical) practices.

2. SCOPE

This Recommended Practice gives general guidance for assessing the condition of operating instrument systems by focusing on their :-

- (a) Inherent Integrity, including electrical protection, suitability for use in hazardous areas and requirements for pressure containment.
- (b) Functional Integrity, for those instrument systems designed to give protection against hazardous occurrences arising within process plants (i.e. trip and alarm systems).

This Recommended Practice does not address the functional integrity of instrument control systems, safety valves, bursting discs and mechanical machinery.

Factors considered include organisation responsibilities, equipment registration, categorisation, procedures, frequency of inspection, reporting, recording and basic inspection and test requirements.

Contained in the regional annex at the rear of the practice is guidance on particular national legislation. Also contained in Appendix B is a listing of documents which may be used for reference purposes to support the recommendations of this practice.



It is of paramount importance that instrument systems installed for the protection of plant, personnel or environment will operate correctly and reliably when a potentially hazardous condition is approached. Instrument systems may remain static and not be called upon to operate for long periods of time. Also component failure and deterioration may not be apparent to operators going about normal duties. It is therefore necessary to carry out the regular programmes of inspection and test contained within this document to ensure the protective instrumentation will function correctly when called upon to do so.

Although not specifically covered by this document, it is also required that the inspection and test programme for instrumentation should satisfy the plant requirements for availability and reliability. Where the correct functioning of an instrument is critical to the operation of a plant, and plant downtime incurs significant cost penalties, the inspection and test programme for the instrument will be directed towards plant availability requirements, in addition to safety and integrity considerations.

3. INSPECTION ORGANISATION

3.1 Managements Responsibilities

It is the responsibility of management at each centre to:-

- (a) ensure that installed equipment is suited for its current service and that it is in a safe condition to operate.
- (b) have confirmed that new equipment has been designed constructed, installed and tested according to good engineering practices, and that documentation to this effect is available.
- (c) ensure compliance with national statutory regulations applicable to design, inspection, test and certification of equipment.
- (d) to have an organisation in place with responsibilities allocated for ensuring that the integrity of the facility is maintained in accordance with guidance given in this Recommended Practice and relevant statutory regulations.

The senior manager at each centre should delegate the responsibility, and the authority, for the correct application of this code and statutory regulations to those persons having the necessary competencies. These delegated responsibilities should be detailed in writing with recipients formally declaring their understanding and acceptance.

Where for organisational reasons (devolved management) the responsibilities for inspection are fragmented, and the accountability for inspection can be conflicting with operational pressures, it is advisable to delegate a person or department a monitoring and/or audit function. It is important that those given the monitoring and/or audit role are technically capable of appreciating the significance of any deficiencies and that they have direct access to senior management for the resolution of any serious conflicting issues.

3.2 Inspection Authority Responsibilities

The responsibilities of the instrument inspection authority are:-

- (a) to identify, categorise and register equipment requiring inspection and test.
- (b) to prepare appropriate procedures and schedules for the inspection and test of each item of equipment.
- (c) to ensure that appropriately detailed records of each item or system subject to inspection and test are maintained.
- (d) to ensure the compilation and updating of a trip register for all protective instruments.
- (e) to monitor the implementation of inspection and test programmes and ensure management is advised of any departures from the agreed inspection requirements for the plant.
- (f) to ensure that the inspection procedures and schedules remain appropriate following repairs, modifications, changes in operating conditions or renewals of equipment.
- (g) to be assured of the competence of persons engaged in the inspection of instrument systems.
- (h) to continually assess the effectiveness of the programmes and adjust where optimisation can be affected or deficiencies need to be addressed.
- (i) to ensure recurring deficiencies are highlighted for re-design or upgrading considerations.

3.3 Operating Authority Responsibilities

- (a) to carry out the inspection of instrumentation systems in accordance with the schedules and procedures defined by the inspection authority and to provide complete and accurate results and findings.
- (b) to provide details of any difficulties experienced in following the procedures or in achieving the test programme.



3.4 Inspection Staff (Inspectors)

For instrument systems the inspection function is normally undertaken by instrument technicians (or equivalent). These can be company employees, contractors or manufacturers employees. Which ever is employed, it is important for them to be technically and practically competent. In addition they should have high personal integrity to ensure a professional approach to the function.

Where indirect employees such as contractors are employed to perform the inspection function, it is important that contract documents clearly define:-

- (a) the requirements in terms of competency and integrity for the inspection personnel, with contract companies asked to demonstrate the compliance of their staff to the BP contract supervisor's satisfaction.
- (b) the demarcation of responsibilities with respect to who is responsible for accepting the inspection findings, recommendations, taking action and compiling reports.
- (c) Who is responsible for gaining occupation and achieving safe isolation of the systems to be inspected.

3.5 External Inspection Authorities

In some countries statutory regulations require companies to use independent inspection bodies. It is also possible for BP to elect to use such organisations.

Where an external inspection body is used, the BP Inspection Authority will normally be responsible for ensuring:-

- (a) that management is advised of all requirements for statutory inspection
- (b) that all records of the examination are made available to BP.
- (c) that recommendations for repairs, renewals and refurbishment etc. are adequately discussed and agreed with BP.

The statutory regulations express only the minimum necessary to satisfy safety requirements. The documentation supplied by an external inspection body following their examination is essentially a certificate that states that the examination has been performed and that the requirements of the legislation have been met. When the scope of the

inspection is not sufficient for BP purposes, and provided the statutory authorities have no objection, the external inspection may be supplemented by additional work, to be performed at the same time.

3.6 Engineering Co-operation

Every opportunity should be taken to optimise the use of resources and plant outage times by integrating inter discipline inspections. Therefore, organisations should be flexible to allow close links between inspection organisations.

3.7 Competent Personnel

Personnel engaged on the testing and inspection of equipment must have:-

- (a) practical and theoretical knowledge and actual experience of the type of equipment, to enable them to carry it out effectively.
- (b) an understanding of the process implications of their actions and the possible hazards involved in order that it can be done safely.
- (c) the ability to recognise when specialist advice or assistance is needed to assess the importance of serious non-conformity.

It is possible that corporate or incorporate bodies e.g. Insurance companies, manufacturers or contractors etc. may be appointed to carry out inspection and test programmes. For such organisations the above is equally applicable. Therefore, before such organisation are appointed they must be able to assure BP that their personnel can meet this level of competency. Where assurances cannot be given, training (possibly joint) may be necessary to accommodate deficiencies.

3.8 Audit Function

To ensure the approach to system integrity is satisfactory, a department with responsibility for assessment should commission independent audits.

4. GENERAL REQUIREMENTS

4.1 Introduction

This section outlines the general requirements for an inspection and test system, including documentation and records. Because of the wide diversity of operations, equipment and conditions, this practice cannot provide the test and inspection requirements in detail for all the



instrument systems likely to be encountered. It does however, set out the principles and procedures for establishing those requirements.

4.2 Identification/ Registration

A register should be compiled of equipment requiring regular inspection and test. Each item should be uniquely identified (Tagged) and registered before being taken into service.

4.3 Support Documentation

The support documentation listed below should be readily available to those engineers preparing and implementing inspection and test procedures. These are items of general plant documentation and should be verified, modified when necessary and issued in accordance with site authorisation procedures.

- (a) Instrument Data Sheets containing a detailed reference to every item of equipment forming part of the system, including:-
 - (i) Manufacturer
 - (ii) Type or Model
 - (iii) Serial numbers
 - (iv) Range and operating parameters
 - (v) Reference to special materials of construction
 - (vi) Reference to special equipment requirements (e.g. response time)
 - (vii) Date installed
 - (viii) Purchase order reference
 - (ix) Reference to hazardous area requirements
- (b) P&I drawings showing the basic arrangements of the plant control and protection systems.
- (c) Functional description and schematic diagrams providing the manner/sequence of events in which each instrument system is designed to operate, with any test override or defeat facilities highlighted.
- (d) Loop drawings showing the extent and interconnection of all elements within the loop.
- (e) Wiring diagrams, where not fully detailed on the loop drawing.
- (f) Modifications register allowing the modification history of each instrument system to be examined.

- (g) Documentation showing software links to advanced control schemes and software controls (pump autostart facilities).

4.4 Programmes and Procedures

Test programmes and procedures should be developed and maintained in accordance with the site authorisation procedures. Guidance in the preparation of test and inspection programmes and procedures is given in section 5 of this Recommended Practice, but should include:-

- (a) Test Procedures to be applied to each loop or instrument within the plant.
- (b) Test Programme which schedules the inspection and test requirements for each instrument/system on the plant by reference to the approved procedures.

4.5 Protective Systems Documentation

In particular for protective systems the following requirements apply:-

- (a) The test procedures for trips and alarms should include functional loop checking together with the inherent integrity checks.
- (b) A settings register should be compiled relating all current trip and alarm settings by tag number. A tolerance should be quoted for each setting, against which an instrument can be calibrated and subsequently tested. A verified up-to-date copy of the settings register should be readily available to the tester to supplement the appropriate testing procedures.

Initial settings will have been assigned by the designer having paid due regard to the plant design specifications and operating conditions. Once allocated, trip and alarm settings should not be altered without independent engineering analysis carried out by the relevant design authority. The settings register should be controlled in accordance with site authorisation procedures.

- (c) Cause and effect diagrams conveying the logic or functionality of the protective instrumentation.

4.6 Records

A file or other suitable record should be established for all items of equipment to be regularly tested/inspected. The record system should contain a history of all inspection, testing, modification and maintenance carried out on the system. For Category 1 and 2A protective systems in particular, this history shall provide evidence,

where necessary, to third parties or statutory bodies, that all reasonable steps have been taken to ensure the integrity of the instrumentation.

The records must be kept in a safe place and be readily available to staff responsible for operation, maintenance and inspection. Alteration and updating should be carried out in accordance with the company's site authorisation policy.

Records should be maintained in a manner that will allow subsequent reliability and availability analysis to be performed on the system or its component parts (refer to BP Group [RP 50-2](#)). This can be most effectively carried out with the aid of a computerised Maintenance Management System (MMS).

Where records are maintained on a computer based system, Category 1 and 2A documentation associated with the last test of systems or devices shall be maintained as a hard copy record, signed and dated by the competent person carrying out the Inspection and test.

As an aid to the management of the inspection and test programmes, the MMS should provide summary reporting of overdue and future inspection and test.

4.7 Alteration of Trip and Alarm Settings

Normally changes to trip and alarm settings will not form part of routine test and inspection programmes. However, where testing justifies a change, it should be subject to investigation and ratification through the sites design change procedure.

To accommodate alterations to software driven trips a procedure paying particular attention to the control and recording of such changes must also be available.

4.8 Disarming and Overriding Trips

Where disarming or override facilities are installed for maintenance purposes a procedure giving precise instructions for their use must be available to inspectors. The implementation of these procedures must be rigorously controlled to prevent inadvertent operation. For this purpose their use should be logged in and out and controlled under a permit system including check signatures.

The use of temporary disarming and override techniques (e.g. 'jumpers', 'frigs' etc.), is to be discouraged. When a temporary override is essential, its use should be approved and controlled by the operating authority, having consulted with the design authority as appropriate.

Where an override facility is required for routine testing or inspection then a correctly engineered solution should be provided.

The fitting of any trip override should be seen as a modification to the trip system.

5. INSPECTION AND TEST PLAN

5.1 Introduction

It is a fundamental requirement that all instrument systems are regularly tested and/or inspected to ensure that their inherent integrity is maintained. In addition, there is a requirement that protective instruments are regularly tested to prove their functional integrity.

The need for inherent integrity assessment is justified on the basis that functional testing alone does not normally confirm inherent integrity.

For each instrument/system there should be an Inspection and Test Plan designed to establish the required integrity on a regular basis. The main elements of the Inspection and Test Plan will be:-

- (a) Procedures - Written descriptions of the test and/or inspection work sequence necessary to establish integrity.
- (b) Schedule - A programme for arranging the regular implementation of procedures.
- (c) Reporting - A reporting system recording the results/findings.

5.2 Procedures

5.2.1 Preparation

Procedures for assessing the integrity of instrument systems must be compiled by competent persons who are familiar with the system to be assessed, its design intent, components, operating principles, process implications, environment and all factors contributing to its performance and reliability.

5.2.2 Approach

For protective instrumentation it is not necessary to include the two aspects of integrity assessment within one procedure. It is common practice to separate the trip/alarm functionality test from the inherent integrity assessment. This is particularly applicable where the function

testing intervals are relatively short compared to intervals required for assessing the inherent integrity.

Functional and inherent inspections should be combined where possible when the test requirements coincide.

Functional test procedures should detail the requirements for assessing the complete system (loop) from the initiating sensor to the final trip element. When this is not practicable, or when the sensor and final trip element have differing test intervals, then a number of procedures detailing the assessment on a sectional basis can be developed. The coverage of the sectional tests should overlap such that all 'loop' elements from sensor through to final trip element are tested with full functionality assured.

Procedures should be designed to minimise the physical disturbance of the system i.e. disconnection of impulse lines and cables etc.

The preparation of procedures should take account of:-

- (a) Manufacturers recommendations
- (b) Designer's recommendations.
- (c) Company, National or International standards or codes of practice.
- (d) Known equipment failure modes.
- (e) Criticality of duty.
- (f) Environmental and process conditions.
- (g) Detection of covert failures, which cause loss of function on demand.
- (h) Fault trees, where developed for Category 1 and 2A systems.

Guidance on the inherent integrity assessment of electrical systems can be found in the relevant document in this series, BP Group [RP 32-5](#). Although primarily written for electrical systems the essential requirements are equally applicable to instrumentation.

Procedures should be written in a standard format with information and instructions clearly and concisely stated.

Each procedure shall be comprehensive, and require minimal reference to other documents. Where reference to other data is unavoidable the source shall be clearly identified.

Procedures shall identify the need to obtain Operating Authority sanction, normally controlled by a 'permit to work' system, before commencing work. Each procedure shall identify and address safety considerations, protective clothing, test equipment requirements, isolation procedures, inhibits for on-line testing and precautions necessary to carry out the test in a safe manner.

A brief summary of the system tests shall be included to ensure the person conducting the test understands the scope of the work. Where a system or test method is complex the procedure should contain step by step instructions.

For Category 1 systems the procedures shall be established after a systematic analysis to detect covert failures, which would cause failure to act on demand (Fault trees, FMECA).

Calibration data necessary for the tests shall be included in the procedure or the source of the data clearly identified.

A report sheet should be included with the procedure, see section 5.4.1

The steps necessary and responsibility for reinstating the trip or trip system to normal operation should be identified in the procedure, including de-isolation, removal of inhibits, handover to Area Authority/Operating Authority and permit completion. The procedure should indicate who must be informed if it becomes impossible to reinstate the trip system within the expected time scale.

5.2.3 Approval

Prior to the issue and implementation of any procedure its:-

- (a) impact on operations in terms of possible interference or resource commitment must be considered and agreed by the relevant operating authority.
- (b) accuracy, practicality, purpose and fit must be checked and approved by a technically competent person. In the case of new system types where there may be no historical experience, the endorsement may first require a ratifying first test.

5.2.4 Review

Periodically, procedures need to be reviewed and the ongoing fitness for purpose established. Revisions should be approved as above and registered with a revision number. It is important that the procedure

file or MMS data base is kept up to date with revisions. A recall system for outdated procedures should be established.

5.2.5 Control

Each procedure should be allocated a unique identification number, issue number and date. The number and location of copies should be limited to the minimum required by the operating and inspection/maintenance organisations. Unofficial copying should be prohibited to prevent potential use of 'out of date' or inaccurate procedures. This requirement is most easily achieved by the use of a MMS.

5.3 Scheduling

For all instrument systems and their components, assessment must be carried out on a regular basis. For this purpose inspection procedures above must be organised into schedules.

Schedules should identify the equipment to be tested by its discrete identification number, tag or loop reference. Against each system or component the schedule should include:-

- (a) required procedure reference number,
- (b) periodic frequency
- (c) due date

During the preparation of the inspection and test schedules the Operating Authority should be consulted and the timings and their resource implications agreed.

Although paper systems can be used for scheduling, in view of the large number of systems and components together with their different inspection requirements and intervals the scheduling should be applied to computerised MMS

5.3.1 Factors Affecting Test Frequency

In designating test frequencies account must be taken of the following:-

- (a) Consequences of instrument failure and level of economic or safety risk. In particular for protective devices, the categorisation of the instrument.
- (b) Availability requirement of associated plant.

- (c) Operational history
- (d) Nature of known failure modes, in particular, whether predominate failure modes are revealed or unrevealed.
- (e) Process conditions e.g. corrosion, waxing, scale, fouling and erosion.
- (f) Environmental conditions e.g. humidity, vibration, dust etc.

Although conditions between installations can vary widely, there is nevertheless some similarity between the application and performance of the same instrument/systems at different sites. This is especially true for Instruments of conventional design, proven performance and similar process plants. In these cases, previous recorded history and failure rate data for similar instrumentation from existing operational installations can be used to assist in specifying inspection and test periods for new systems.

Table 1 gives a guide to the range of typical test intervals currently used in standard applications. They should be adjusted accordingly where any unusual circumstances apply or where process/environmental conditions are onerous. They should not be taken as a definitive guide but should be adjusted to take account of any statutory requirements and the factors listed above.

Category 1 and certain Category 2A systems require that a reliability analysis is carried out at the design stage of all new projects. The required frequency for proof tests will be stated in the analysis. Where an analysis has been carried out, the stated frequency must be adopted, and under no circumstances be extended without a full re-analysis and design authority approval.

Table 1 - Typical Test Intervals

Function	Test Intervals (Months)
Fire Detectors/Alarms	3 - 12
Gas Detectors/Alarms	3 - 4
Automatic Fire/Gas Protection Systems	6 - 12
Heat Off Systems	6 - 12
Emergency Shutdown Systems	3 - 12
Over-Speed Trips	12 - 24
Purge Failure Trips	6 - 12
Flame Failure Trips (Self Checking)	12 - 24
Flame Failure Trips (Not Self Checking)	6 - 12
Remote Shutoff or By-pass Valves	6 - 24
Thermal Runaway Protection	6 - 24
Flow, Level, Press, Temp. Trips	3 - 12
Slide Valve Trips	3 - 12
Machinery Trips	6 - 24
Other Alarms	12 - 36
Plant Instrumentation	12 - 60

5.3.2 Review

To ensure that inspection and test intervals are appropriate the effectiveness of the programmes must be continually assessed and adjusted where optimisation can be affected or deficiencies need to be addressed.

The reason and justification for a change in test frequency should be formally approved by the design and operating authorities. This enables the changes made over the lifetime of a particular installation to be identified and traced.

Plant modifications and operating condition changes must be communicated to the design authority in order that the impact on the related instrument systems and inspection programmes can be assessed.

When reviewing test frequencies, account should be taken of modifications, recorded test results and failures, comments from the testers and changes to operating conditions. Test periods may only be increased when an analysis based on a significant number of test results can demonstrate that the deterioration or failure rate of the equipment justifies the extension. The significant number of test results can take account of numbers of identical equipment items operating on similar duties, in similar environments.

5.3.3 Inspection and Test Deferrals

In the interest of safety and efficient maintenance the agreed schedules should only be deferred for operational convenience in exceptional circumstances. Should deferrals be a regular occurrence, it must be brought to the attention of the Senior Operating Manager, who should investigate and address the causes of non-conformance.

Category 1 and 2A trip testing must not be deferred or allowed to lapse.

5.4 Reporting

Reports of all inspection and tests carried out must be recorded and stored on file. In BP facilities with large inventories of instrumentation the use of computerised systems are essential for this purpose.

To facilitate accurate reporting, report sheets should be structured for assisting the recording of the information required as the test progresses.



5.4.1 Report Sheet

To provide the above information the report sheet should include:-

- (a) the plant name and/or plant code if applicable.
- (b) the tag number(s) of all instruments under test.
- (c) the date of the test and name/title of the tester.
- (d) the reason for carrying out the inspection and test. This can be a scheduled test, a test initiated due to a suspected fault or a test following an incident where the system failed to respond.
- (e) any limitations imposed on the test by the operational conditions prevailing.
- (f) a reference to the procedure used to carry out the test.
- (g) the test equipment used, noting the Serial Number and the date of its last calibration.
- (h) the test results as required by the procedure; expected and observed results should be recorded. It is important that 'as found' results are always recorded whether within specification or requiring adjustment. Similarly, where adjustment has taken place the precise 'as left' result should be recorded. Coded fault reporting should be introduced to facilitate subsequent data analysis.
- (i) the general condition of the equipment and comments on the accuracy and practicality of the inspection and test procedures.
- (j) a description of abnormalities, discrepancies or faults that led to an out of tolerance or incorrect result.
- (k) a description of remedial action taken to resolve abnormalities, discrepancies or faults.
- (l) a list of all components replaced and the reason for their replacement. The replacement component shall be identified by number, type and serial number as appropriate.
- (m) re-testing after remedial action shall be subject to all the above conditions.



- (n) the tester shall report any further action necessary to maintain the long term integrity of the system.
- (o) an estimate of the total time the system was not available because of testing, including necessary remedial work and re-test.
- (p) the number of manhours spent on inspection/testing activity.

5.4.2 Management Status Review

A management reporting programme should be implemented to provide regular monitoring of the inspection/testing functions. These reports should be produced on a regular basis, possibly at monthly intervals. Reports should give the status of inspection and test programmes against areas of responsibility.

Analysis of test results shall be carried out to establish that performance is better than the required level of systematic failures. The results should be compared with assumptions made during risk analysis of Category 1 and 2A systems. If actual performance is less than that indicated by assumptions in the analysis then functional integrity should be assessed and modification may be necessary.

Effective inspection and testing programmes are the company's assurance against equipment failures or malfunctions causing unsafe conditions, a requirement also imposed by legislation. Regular reports will give management the status of the programmes on which appropriate management actions can be taken. They may also be used as an effective demonstration to any outside bodies (e.g. Insurance assessors or statutory body inspectors) of the company's commitment to the assurance of plant/systems integrity.

6. REGIONAL ANNEX

This section supplements the foregoing international requirements, to assist with application in the particular region identified.

6.1 United Kingdom

The following standards are relevant to the inspection and testing of plant instrument systems.

[IP Model Code 14](#) Institute of Petroleum, Model Code of Practice Part 14 August 1980 Inspection and Testing of Protective Instrumentation Systems



PES	Health and Safety Executive Programmable Electronic Systems in Safety Related Applications (Parts 1 and 2).
SI 1029	Offshore Installations (Emergency Pipeline Valve) Regulations 1989
EEMUA 160	Safety Related Instrument Systems for the Process Industries (including Programmable Electronic Systems), Publication 160
SI 2169	The Pressure Systems and Transportable Gas Containers Regulations 1989.
SI 289	The Offshore Installations (Construction and Survey) Regulations 1974.
Associated guidance	document issued by the Department of Energy ‘Offshore Installations - Guidance on Design, Construction and Certification’ .



DEFINITIONS AND ABBREVIATIONS

Definitions

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

alarm	a measuring instrument connected to an annunciation system monitoring the plant conditions and bringing to the operators attention plant conditions outside pre-set operating bands.
category 1 system	an application where to meet the risk acceptability criteria it is necessary to use a Protective Instrument System and where failure of the system to act on demand is likely to lead to risk of serious permanent injury or loss of life to one or more persons and where exposure to such risks is significant and cannot be avoided.
category 2A system	an application where risks are controlled by a Protective Instrument System and where failure of the system to act on demand is unlikely to result in serious injury or loss of life. Failure may well however, result in extensive or prolonged damage to the environment, major economic risk due to loss of plant/production/product or penalty due to uncontrolled release and cannot be effectively avoided by operator intervention.
category 2B system	an application where risks are controlled by a Protective Instrument System and where failure of the system to act on demand would not result in risk as defined for Category 1 or 2A systems, but could result in undesirable disruption to operating or process conditions.
competent person	is someone having: adequate training, appropriate experience, sufficient theoretical and practical knowledge, maturity of judgement and professionalism to enable them to detect defects or weaknesses in the equipment under test or examination, assess their importance in relation

	to the strength and functions of the particular plant and seek such specialist advice and assistance as will be required to enable them to make the necessary judgement.
design authority	the person or persons appointed by the Management to be responsible for the design integrity of the facility.
functional integrity	the functional integrity of an instrument is its ability to operate in the intended manner. As an example, the intended function of a high pressure switch might be to operate when the sensed pressure reaches 50 ± 2 barg.
hazard rate	the likelihood of a specified undesirable event occurring within a specified time period. It may, depending upon the circumstances, be expressed either as a frequency (the number of events occurring in unit time) or a probability in a given time period.
inherent integrity	the inherent integrity of an instrument covers those aspects of design and condition that allow it to operate safely in a particular environment. Examples of inherent integrity requirements are electrical protection (MCB's), insulation, earthing, hazardous area protection, pressure containment capability and condition of the equipment (physical damage, corrosion etc.).
inspection	a physical examination to determine the external and/or internal condition of an item of equipment.
inspectors	those persons appointed by the Management to carry out the testing and inspection of instrumentation in accordance with the approved procedures.
inspection authority	the person or persons appointed by the Management to ensure that the instrumentation test and inspection programmes, and their implementation, satisfy the design intent of the facility and any applicable codes and standards.



management	the person or persons legally responsible for the operating facility.
modification	any change made to the protective instrument system or the plant which it is protecting. Changes to hardware, software, settings or operating conditions outside the original design envelope would all be classed as modifications.
operating authority	the person or persons appointed by the Management to be responsible for the operation of the facility. The operation of the facility will include the conduct of test and inspection programmes.
override	device for deliberately rendering a trip system inoperable for the purpose of on line testing and maintenance, or for the controlled abnormal operation of plant e.g. the start up of equipment. Such devices include defeat switches and by-pass valves.
protective instrument systems	instrumentation provided to prevent losses of all kinds, particularly in process upsets or emergencies, as distinct from instrumentation provided for normal process control. Included in this definition are trip and alarm systems.
reliability	the probability that a system will respond correctly if called upon to do so. Reliability is often expressed as the system failure probability.
reliability analysis	an analysis carried out by recognised techniques and generating a system failure probability.
software based system	(sometimes called Programmable Electronic System (PES). a system based on a computer* connected to sensors and/or actuators on a plant for the purpose of control, protection or monitoring. * Computer, as used in this definition, includes main frames, microprocessors and PLC's.
testing	the series of operations required to ensure that any installed protective instrumentation acts in



accordance with its design intent and to reveal any failures that may have occurred to the protective instrumentation system.

trip

a measuring system operating protective devices (actuators) and connected to an annunciation device. The purpose of such a system is to sense a hazardous condition, or a condition which may become hazardous if no corrective action is taken, and act to mitigate the effects of that condition.

Abbreviations

FMECA	Failure Modes, Effects and Criticality Analysis
MMS	Maintenance Management System



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.

BP Group Documents

BP Group [RP 32-5](#) Inspection and Testing of In-Service Electrical Plant
(replaces the relevant parts of BP CP 52)

BP Group [RP 50-2](#) Guide to Reliability Analysis
(replaces BP CP 62)

Useful Documents not Referenced in this Recommended Practice

BP Group [RP 30-5](#) Selection and Use of Equipment for Instrument Protection Systems
(replaces BP CP 18)

BP Group [RP 30-6](#) Process Design Guidance for Protective Instrument Systems
(replaces BP CP 48)

BP Group [RP 32-3](#) Inspection and Testing of In-Service Civil and Mechanical Plant
- Management Principles
(replaces BP CP 52)

BP Group [RP 32-4](#) Inspection and Testing of In-Service Civil and Mechanical Plant
- Technical Guidance
(replaces the relevant parts of BP CP 52)

BP Group [RP 44-1](#) Over-Pressure Protection Systems
(replaces BP CP 14)

[ISO 10418](#) Petroleum and Natural Gas Industries - Offshore Production Platforms - Analysis, Design, Installation and Testing of Basic Surface Safety Systems
(Based on API RP 14C)

[IEC/SC 65A](#) Functional Safety Of Electrical/Electronic/Programmable Electronic Systems. Generic Aspects

