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Guidance on Practice for Qualification of Technology for Subsea Projects

GP 78-06

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 78-06.

This Guidance on Practice (GP) is not a stand alone document but is part of a larger suite of ETPs that define BP integrity, reliability, quality management, design and testing philosophy for subsea projects.

This GP shall be used in accordance with other series 78 (subsea) ETPs that provide further detail necessary to undertake and execute subsea projects.

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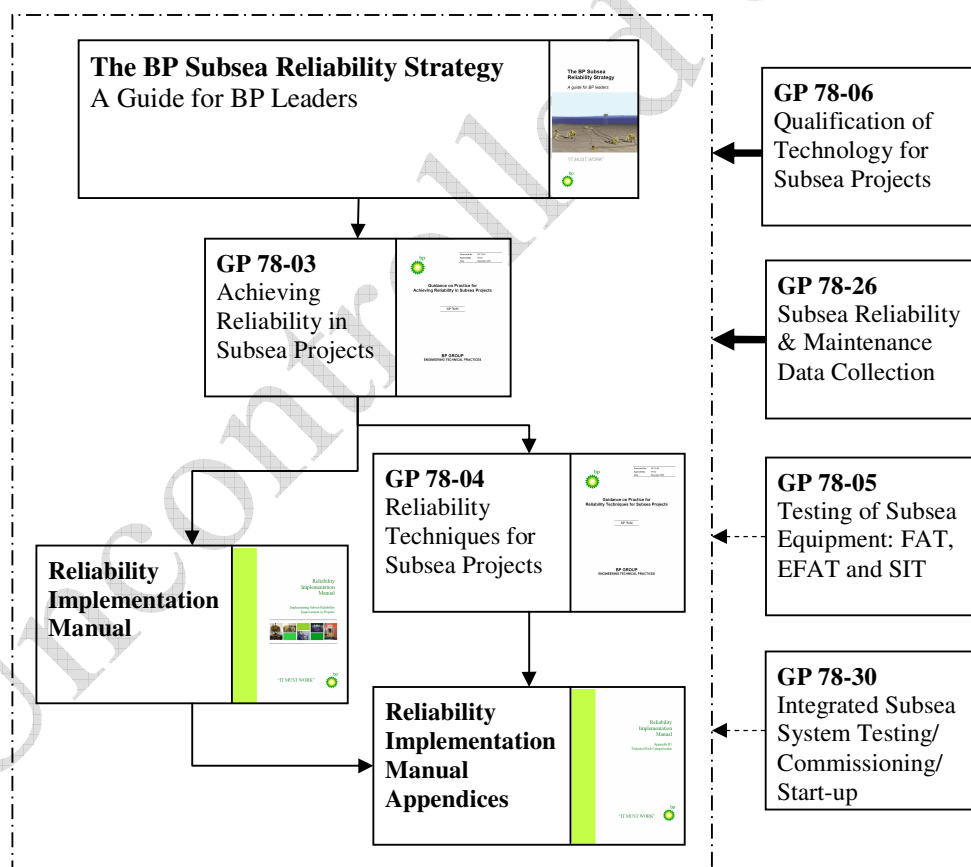


Introduction

A large portion of BP's future growth is invested in deepwater and particularly subsea equipment and operations. Exploitation of new technology in subsea field development projects as well as existing technology in new environments, such as deepwater, are vital to BP future business and demands that particular attention is given to qualification of those technologies to ensure that they are fit for purpose and meet project reliability and maintainability requirements.

The BP Subsea Reliability Strategy has been developed to manage technical risk including that introduced by the use of new technology. In 2005, the BP reliability strategy was enhanced by introduction of the Reliability Handbook. Following this, a set of subsea reliability GPs was developed in 2006 to support BP staff in implementing the reliability strategy. This GP is part of the set to help BP leaders and project engineers to understand the reliability and technical risk activities required to implement the strategy when qualification of technology is required. In response to feedback from projects using the strategy, The Reliability Handbook (2005), which has been renamed The Reliability Implementation Manual (2006), has been upgraded in electronic format to facilitate its use. These key subsea reliability documents, their hierarchy within BP and their interrelationship are shown in Figure 1.

Figure 1 – Subsea Reliability Documents



The Strategy Guide outlines the principles of the BP Reliability Strategy, its goal and expectations. GP 78-03 provides guidance on the expectations of projects and how the reliability strategy should be managed within projects. The Reliability Implementation Manual provides the necessary detail for projects to meet the requirements of GP 78-03. GP 78-04 provides guidance on the expectations of



project engineers undertaking a particular reliability task and the Reliability Implementation Manual Appendices provide additional detail and templates to satisfy the requirements of GP 78-04.

GP 78-03 and GP 78-04 require the use of this GP and GP 78-26 which have been developed to support the Reliability Strategy. In addition, GP 78-05 and GP 78-30 provide guidance on testing that will support the assurance of reliability.

1. Scope

- a. This GP provides guidance for implementation of technology qualification in subsea projects as an important part of reliability achievement and as required by GP 78-03 and GP 78-04.
- b. This GP describes the procedure for qualification of new technology development projects and field development projects.
- c. This GP is used by BP subsea projects to define qualification tasks necessary to comply with reliability strategy.
- d. This GP is used by BP project engineers and Contractors to identify and plan qualification for subsea projects as required by GP 78-03 and GP 78-04.
- e. Applicability of this GP begins at Appraise stage of major projects common process (MPcp) and continues throughout project life, including Operate stage.
- f. This GP applies to subsea projects, but may have application elsewhere.

2. References

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

2.1. Normative BP References

GP 78-03	Guidance on Practice for Achieving Reliability in Subsea Projects
GP 78-04	Guidance on Practice for Reliability Techniques for Subsea Projects
GP 78-05	Guidance on Practice for Testing of Subsea Equipment: FAT, EFAT and SIT
GP 78-26	Guidance on Practice for Subsea Reliability and Maintenance Data Collection
GP 78-30	Guidance on Practice for Integrated Subsea System Testing/Commissioning/ Start-up

By accessing the ETP website the most up to date list of the Series 78 (subsea) documents is available. The link is [List of Series 78 ETPs](#).

2.2. Informative BP References

The Strategy Guide

“BP Subsea Reliability Strategy, A guide for BP Leaders” revised 2006

This document is available as a booklet and has also been entered in the library as RD 78-003.



The Reliability Implementation Manual

“Implementing Subsea Reliability Improvement in Projects” 2006

The manual is available on CD and has also been entered in the library as set of RD documents as listed in 2.2.1 below.

Quality Management

“BP Engineering and Quality Management Guidelines” (This referenced document is planned to be entered in the ETP library as a 50 series ETP, expected 2007).

2.2.1. Reliability Implementation Manual

RD 78-400	Reliability Implementation Manual, Implementing Subsea Reliability Improvement in Projects
RD 78-401	Reliability Implementation Manual, Appendix R1 Technical Risk Categorisation
RD 78-402	Reliability Implementation Manual, Appendix R2 Defining R&M Goals and Requirements
RD 78-403	Reliability Implementation Manual, Appendix R3 Reliability Planning
RD 78-404	Reliability Implementation Manual, Appendix R4 Reliability Assurance
RD 78-405	Reliability Implementation Manual, Appendix R5 Reliability Value Analysis
RD 78-406	Reliability Implementation Manual, Appendix R6 Reliability Analysis and Modelling
RD 78-407	Reliability Implementation Manual, Appendix R7 Design and Manufacture for Reliability
RD 78-408	Reliability Implementation Manual, Appendix R8 Contractor and Supplier Selection and Contracting
RD 78-409	Reliability Implementation Manual, Appendix R9 Reliability Data Collection and Lessons Capture
RD 78-410	Reliability Implementation Manual, Appendix R10 Reliability Qualification Activities
RD 78-411	Reliability Implementation Manual, T1 Technical Risk Categorisation Template
RD 78-412	Reliability Implementation Manual, T3 Define Reliability Plan Template
RD 78-413	Reliability Implementation Manual, T3 Package Reliability Task Sheet Templates
RD 78-414	Reliability Implementation Manual, T4 Reliability Assurance Document Template
RD 78-415	Reliability Implementation Manual, T8 Reliability Specification Template
RD 78-416	Reliability Implementation Manual, T10 Qualification Matrix and Datasheet

3. Relevant National/International Codes and Standards

The following standards are directly relevant to qualification within subsea projects. Working with contractors and vendors in the application of this GP may introduce variances between the



requirements of the standards and this GP. In such an instance BP shall determine the practice to be followed with due regard to local regulatory requirements.

The list of codes and standards given below is offered for high level guidance. It is advised that the application of this GP ensures that more detailed equipment and testing specific codes and standards are identified and complied with as may be necessary.

API RP 17N	Recommended Practice “Subsea Production System Reliability & Technical Risk Management”
DNV-RP A203	“Qualification Procedures for new technology”
ISO 9001:2000	“Quality Management Systems”
ISO29001:2003	“Sector-specific Quality Management Systems”
ISO 20815:	“Production Assurance and Reliability Management”
ISO 13628	“Design and operation of subsea production systems”
IEC 62198	“Project Risk Management – Application Guidelines”
IEC 60605-3	“Equipment Reliability Testing”
NORSOK Z-016	“Regularity management and reliability technology”

4. Terms and Definitions

For the purposes of this GP, the following terms and definitions shall apply:

Component

An individual item within a sub-system e.g. Gate Valve, Tree Cap, Connector, Subsea Control Module, Sensor, etc.

Failure Mode

A description of the manner in which failure has occurred or may occur.

Element

Part of a study node.

Environment

The external and internal temperatures, operating pressures, water depths, and internal/ external fluids, for example, that an item will be exposed to during its life.

Field Development Project

A BP project which may or may not involve the use of new technology, which has the goal of hydrocarbon production (or enabling production as in the case of a water injection system) in Operate.

Function Analysis

The process by which functional and performance requirements of hardware is defined.

Item

An item is a generic term applied to a system, option, package, component or procedure.

New Technology

New technology is a practice, method or item providing a function which has not previously been used in a subsea project under the conditions appropriate to that project. This definition includes both novel



technology, in familiar application environments, and existing technology (previously used) in new application environments.

New Technology Development Project

A BP project in which new technology is developed to a required level of technology readiness but which, in the new technology Operate stage, does not directly impact hydrocarbon production.

Package

An individual subsystem within the entire subsea system, e.g. Well System (as a combination of wellhead, tree, tubing hanger, etc), Production Controls System (as a combination of Subsea Control Module, Hydraulic Power Unit, Master Control System etc.).

Project

A set of coordinated technical activities carried out by a project team to meet one or more business objectives. Projects have defined durations and consume defined resources. The project team is led by BP staff and shall normally involve other contractors and suppliers to manage and complete the necessary activities.

Qualification

The process of demonstrating that an item has reached a particular level of technology readiness, whether that involves using existing technology in a new environment or new technology.

Qualification Procedure

The set of generic qualification tasks defined in this GP to be implemented in technology development projects or field development projects which take an item from one TRL to the next TRL.

Qualification Programme

The specific work done in a field development project or a technology development project to meet qualification requirements of an item to take it from its initial TRL to the required TRL.

Reliability

The ability of an item to perform its required function under stated conditions of production environment and usage for the required time interval.

Robustness

The degree to which an item is insensitive to variation; Robust design creates performance characteristics that are very insensitive to variations in the manufacturing process and other variations such as those related to environment, usage and time.

Study Node

An interactive group of items constituting the target of a qualification programme. Study nodes are not commonly identifiable as a single block on the system breakdown tree. For example, for a high voltage connector the male and female ends of the connector will belong to different subsystem/components.

Sub-system

Part of a System.

System

An entire subsea system as a combination of well system, control system, manifold system, connection system, etc.



System Analysis

The procedure by which all system or sub-system elements are defined and provided with unique identifiers, qualification study nodes are defined and systems/sub-systems behaviour is understood.

Technology Readiness Level

The degree to which a system, package or component is ready for reliable application in a subsea project. The level of technology readiness ranges from TRL 0, corresponding to an unproven concept through to TRL 7 corresponding to fully field proven technology.

Technical Risk Category

The technical risk category is a measure of the risk and uncertainty inherent in a subsea project, a system option, a system package or a package component.

Validation

Validation is the process which substantiates whether a physical entity, a model, data, a test or assumption, within their domain of applicability, possesses a satisfactory range of accuracy consistent with the intended application. i.e. "Are we using the right data or model?", "Is it the correct test?"

Verification

Verification is the process which determines the extent to which a procedure, task, equipment item or model conforms to its specification. i.e. "Are we performing the task correctly?", "Does the valve hold pressure?"

5. Symbols and Abbreviations

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

ALT	Accelerated Life Testing
BOD	Basis of Design
CCFA	Common Cause Failure Analysis
CFD	Computational Fluid Dynamics
EA	Engineering Authority
EFAT	Extended Factory Acceptance Test
ESS	Environmental Stress Screening
ETA	Event Tree Analysis
FAT	Factory Acceptance Test
FEA	Finite Element Analysis
FMECA	Failure Mode Effects and Criticality Analysis
FTA	Fault Tree Analysis
HALT	Highly Accelerated Life Testing
HASS	Highly Accelerated Stress Screening



IM	Integrity Management
MPcp	Major Projects common process
QM	Quality Management
R&D	Research and Development
R&M	Reliability and Maintainability
RAD	Reliability Assurance Document
RAM	Reliability, Availability and Maintainability
RBD	Reliability Block Diagram
SIT	System Integration Test
SOR	Statement of Requirements
TA	Technical Authority
TRAP	Technical Risk Assurance Process
TRL	Technology Readiness Level

6. Qualification principles

6.1. Qualification and Reliability

- a. Hardware incorporating new technology or existing technology applied in a new environment significantly increases technical risk to BP projects in terms of uncertainty of reliability performance and failure consequences.
- b. Qualification is the process of demonstrating that a system, package, or component has reached a particular Technology Readiness Level (TRL) for use in projects, systems, packages, or components complying with integrity management (IM) standards and quality management (QM) requirements.
- c. The risk of not achieving the required hardware reliability shall be managed during new technology development and field development projects in order to:
 1. Comply with reliability and maintainability (R&M) goals and requirements.
 2. Minimise technical risk.
 3. Maximise project value.
- d. Qualification shall be implemented for projects if confirmation is required that hardware and software used for subsea complies with functional, performance, and reliability requirements.
- e. Reliability assurance shall include evidence of achieved qualification, with the following points considered:
 1. It is often difficult to simulate exact service conditions (i.e., environment, loads, time).
 2. Because of simulation difficulties, not all failure modes can be tested in advance of installation or operation.

