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Guidance on Practice for Reliability Techniques for Subsea Projects

GP 78-04

**BP GROUP
ENGINEERING TECHNICAL PRACTICES**

Foreword

This is the first issue of Engineering Technical Practice (ETP) BP GP 78-04.

This Guidance on Practice (GP) is not a standalone 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

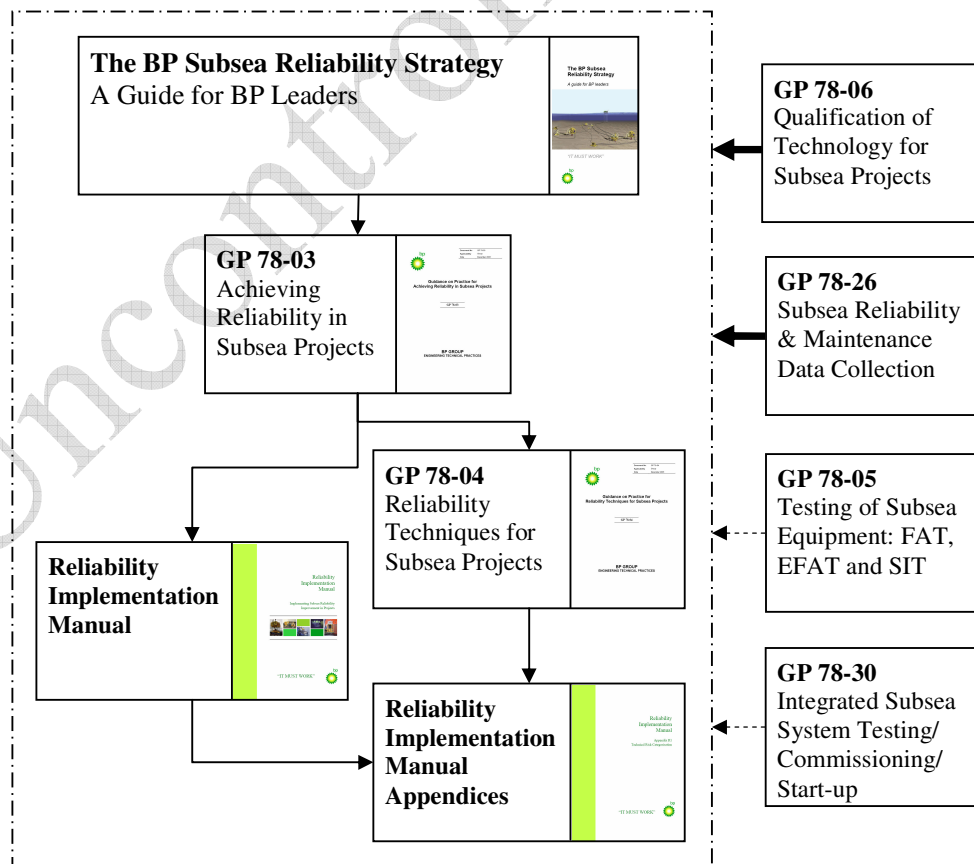
A large portion of future BP growth is invested in deepwater, particularly subsea equipment and operations. However, the reliability record for oil and gas industry subsea equipment over the last decade has in some cases been below expectations, resulting in delayed start-ups, low initial operating efficiency and higher operating costs. To combat this, BP developed a Subsea Reliability Strategy in 2003 to provide reliability improvement in projects to deliver the required equipment performance targets, increase first year operability, reduce early life failures and achieve integrity requirements.

Early life failures often have the greatest impact on reputation and value.

The BP Subsea Reliability Strategy has been developed to manage such technical risk. Importantly, a key activity to assist in improving reliability is the use of BP risk management processes to identify critical technical risks that will then be managed using the reliability techniques required by this GP.

In 2005 BP's Reliability Strategy was enhanced by publication of The Reliability Handbook and introduced to BP projects. Following on from this, a set of subsea reliability GPs were developed in 2006 to support BP staff in implementing the Reliability Strategy. At the same time, 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. This GP 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 this GP.

GP 78-03 and this GP require the use of GP 78-06 (qualification) and GP 78-26 (data collection) 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 guidelines on how to perform individual Reliability Tasks, required by GP 78-03, in terms of tools and techniques to be used within each task and how to use them.
- b. The Reliability Tasks in this GP are in addition to the project activities that form part of the Major Projects Common Process (MPcP) which establishes the minimum requirements for the execution of BP projects.
- c. **Importantly, more essential detailed guidance in the use of the tools and techniques is given in the Reliability Implementation Manual Appendices.**
- d. This GP is primarily intended for BP project engineers and reliability engineers involved in the implementation of the reliability activities in the project.
- e. The project Reliability Lead shall use this GP for specification of the required Reliability Tasks.
- f. The applicability of this document starts at the Appraise stage of MPcP and continues throughout the project life up to and including Operate.
- g. The project manager shall be accountable for implementing this GP.
- h. This GP is intended to apply specifically to subsea projects, but may have application elsewhere. The likely scope for a subsea project is shown in Annex A.
- i. The Reliability Tasks, as reflected by this GP, are intended to be part of the practical implementation of meeting existing BP IM standards and QM requirements to ensure that all equipment fully meets the design criteria and performance requirements.

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	Achieving Reliability in Subsea Projects.
GP 78-05	Testing of Subsea Equipment: FAT, EFAT and SIT.
GP 78-06	Qualification of Technology for Subsea Projects.



GP 78-26	Subsea Reliability and Maintenance Data Collection.
GP 78-30	Integrated Subsea System Testing/Commissioning/Start-up.

*The ETP website contains the most up to date list of series 78 (subsea) documents:
[List of Series 78 ETPs.](#)*

2.2. Informative BP References

Reliability Implementation

Manual Implementing Subsea Reliability Improvement in Projects.

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.

Risk Management BP Exploration and Production. Risk Management Guidelines for Major Projects.

Strategy Guide The BP Subsea Reliability Strategy, A guide for BP Leaders.

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

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

- a. The following standards are directly relevant to applying reliability techniques within subsea projects.
- b. 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.

API RP 17N	Subsea Production System Reliability and Technical Risk Management.
DNV-RP A203	Qualification Procedures for New Technology.
IEC 60605-3	Equipment reliability testing, Part 3: Preferred test conditions.
IEC 62198	Project risk management - Application guidelines.
ISO 9001:2000	Quality management systems – Requirements.
ISO 13628	Petroleum, petrochemical and natural gas industries - Design and operation of subsea production systems.
ISO 14224	Petroleum, petrochemical and natural gas industries - Collection and exchange of reliability and maintenance data for equipment.

Defines offshore reliability database (OREDA) data collection standard.

ISO 15663	Petroleum, petrochemical and natural gas industries – Life cycle costing.
ISO 20815:2006	Petroleum, petrochemical and natural gas industries - Production assurance and reliability management.
ISO 29001:2003	Petroleum, petrochemical and natural gas industries - Sector-specific quality management systems – Requirements for product and service supply organizations.
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:

Availability

The ability of an item to be in a state to perform a required function, under given conditions at a given instant in time or over a given interval, assuming that the required external resources are provided.

Component

An individual item within a subsystem (e.g. gate valve, tree cap, connector, subsea control module, sensor, etc.).

Cut sets

The combination of packages or components of a system that when failed will cause the system to fail.



Durability

The ability of an item to be in a state to perform its required function under given conditions of use and maintenance until a limiting state is reached such as the end of the useful life, unsuitability for economic or technological reasons, or it becomes unsafe, etc.

Environment

Conditions that an item will be exposed to during life (e.g. external and internal temperatures, operating pressures, water depths, and internal/external fluids).

Failure mode

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

Field availability

Overall field availability is the percentage time that the field is producing at the required production level and includes for example, individual component reliability, redundancy, production capacity, time to repair (including vessels and spares availability), scheduled shutdowns and planned production profile.

Item

Generic term applied to a system, option, package, component or procedure.

Maintainability

Ability of an item to be retained in or restored to a state in which it can perform its required function under given conditions of operation, environment and use.

Package

An individual subsystem within the entire subsea system. For example, 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 performed 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 vendors to manage and complete the necessary activities.

Qualitative

Considers characteristic by descriptive, non-numerical or semi-numerical properties.

Quantitative

Considers characteristic by numerical properties representing amount, size, probability, etc.

R&M goal

Desired reliability and maintainability (R&M) performance criterion, e.g. availability, for subsea equipment, that a project team, including contractors and vendors, endeavours to meet through implementing Reliability Tasks. An R&M goal is not a contractual requirement.

R&M Requirements

Contractual R&M requirements that form the basis of designing for reliability. These include management requirements such as process and task requirements, to be imposed e.g. via vendor reliability specification and, if necessary, hardware requirements (for example to meet required production).



Reliability

Ability of an item to perform its required function, under stated conditions of production, environment and usage for a required time interval.

Reliability plan

Integrated set of Reliability Tasks with a description of activities, inputs, deliverables and engineering resources necessary to implement the required Reliability Tasks during a project.

Specification

Document in which function, performance, and operating requirements are defined with a requirement for compliance. Specifications are normally included in purchase orders and/or tender documents.

System

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

Technical effectiveness

Includes system function and performance attributes and system R&M attributes, including, reliability, durability, maintainability and intervention logistics.

Technology readiness level

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

Validation

Process that 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

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

5. Symbols and Abbreviations

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

ALERT	Holistic early uncertainty assessment.
ALT	Accelerated life testing.
CCFA	Common cause failure analysis.
CMMIS	Computerised maintenance, management, and information system.
CTR	Cost, time, and resource.
DSP	Decision support package.
EA	Engineering authority.
ETA	Event tree analysis.

