

GENERAL SPECIFICATION

Field Operations

GS EP EXP 213

Minimum maintenance requirements

03	01/2017	Development of RBM methodology toolkits and optimized maintenance program (GMP)
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1. Scope

1.1 Foreword

This General Specification provides the basis for a project or affiliate to implement and/or optimize, in line with Company integrity standards and local / international regulations, its Maintenance Strategy. The Maintenance Strategy is risk-based as it is based on the assessment of equipment criticality.

{Rule 1:

A risk-based maintenance strategy shall be developed based on a criticality study of the assets in line with the methodology described in this General Specification.}

It is the responsibility of the Project Field Operations representative in project phase and the affiliate Field Operations representative in operations phase to ensure that this rule is applied.

Based on this general methodology, the maintenance programs are defined as follows:

- Risk-Based Maintenance (RBM) Program, allowing the optimization of Maintenance Program depending on equipment class, criticality and local conditions, using a risk assessment tool e.g. the FMEA.
- Generic Maintenance Program (GMP), defined by equipment class and criticality.

On the operated assets, it is the responsibility of the Head of Maintenance of affiliate to determine and apply the optimum level of maintenance to reach plant required availability. This General Specification provides the toolkit to assist the Head of Maintenance and his/her team to optimize their Maintenance Program through the RBM methodology.

By default, the GMP applies. The GMP is thus the minimum below which Maintenance Program does not fall in the absence of applicability and/or demonstration, by the affiliate, of an optimized Maintenance Program relying on RBM methodology.

1.2 Application

This document covers the equipment of the installations operated by the Company affiliates.

The requirements of this document apply to:

- All new projects planned, designed and constructed by and for the Company.
- All oil and gas installations, operated by the Company.

The requirements are minimum established for each class of equipment and equipment criticality; however, it is highly advisable to study and integrate manufacturer recommendations in the Maintenance Plan, in accordance with the global plant Maintenance Strategy. The requirements apply to all equipment packages (no orphan equipment).

Note: local regulations or applicable international regulations apply and are integrated into Maintenance Program:

- When more stringent,
- For any class of equipment not covered in this General specification.

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2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
EN 13306	Maintenance - Maintenance terminology
IEC 60079-17	Explosive atmosphere – Part 17: electrical installations inspection and maintenance
SOLAS	International Convention of 1974 for the Safety of Life at Sea, as modified

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP EXP 207	Installation description structure
GS EP EXP 311	Plant integrity – Minimum inspection requirements
GS EP EXP 405	Standard reliability data report
GS EP EXP 407	Implementation scheme for Identification and Management of Safety Critical Elements
GS EP SAF 216	Area classification

3. Abbreviations and definitions

3.1 List of terms and abbreviations

BK	Breakdown
Company	Refers to TOTAL
CMIMS	Computerized Maintenance & Inspection Management System
DE	Defect Order
ESD	Emergency Shutdown
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Modes, Effects and Criticality Analysis
FPSO	Floating Production Storage & Offloading
FPU	Floating Production Unit
FSO	Floating Storage and Offloading

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GMP	Generic Maintenance Program
HAE	Hazardous Area Equipment
ISER/XSER	Internal SERVICES/ eXternal SERVICES
MP	Maintenance Plan
N/A	Not Applicable
NCMP	Not Completed
PC	Preventive Conditional (Predictive Maintenance)
PF	Potential Failure
PFD	Process Flow Diagram
PID	Piping & Instrumentation Drawing
PMCR	Planned Maintenance Change Request
PMR	Preventive Maintenance Routines
PS	Systematic Preventive Maintenance
PSV	Pressure Safety Valve
RBM	Risk-Based Maintenance
RCM	Reliability Centered Maintenance
RCA	Root Cause Analysis
REL	Released
RPN	Risk Priority Number
SECE	Safety and Environment Critical Element
SWE	Suppressed/cancelled Without Execution
TECO	Technically Completed
TLP	Tension Leg Platform
UFD	Utility Flow Diagram
UPS	Uninterruptible Power Supply
VIS	Vital Important Secondary
WDF	Work Defect
WPM	Work Planned Maintenance

3.2 Maintenance types

The reference for the definitions of maintenance types and levels are contained in [EN 13306](#).

3.2.1 Corrective Maintenance

Corrective Maintenance: maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function.

Corrective maintenance involves:

- Diagnosis of the fault (detection, location, analysis).
- Immediate corrective or palliative action (restoring to perfect or to only partial working order).
- Deferred corrective action, with or without modifications.
- A functional test.

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Planned Corrective Maintenance consists in ensuring the availability of spare parts, tooling and any required resources (including competent personnel) to restore at the earliest the availability of 'Important' equipment that failed as a result of a run-to-failure maintenance plan, hence, minimizing the consequence of the failure.

It implies that failure is anticipated and prepared for so that the consequence of the failure is minimized, i.e.:

- The failure modes and causes have been identified – i.e. an FMEA has been conducted but mitigation tasks above Level 1 maintenance are not implemented.
- The corrective actions to restore the equipment to an operational condition can be performed by in-house maintenance team.
- All required spare parts and tools are readily available.

3.2.2 Preventive Maintenance

Preventive Maintenance: maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.

The preventive element relies upon the execution of maintenance tasks at periodic intervals, either calendar or running hours based. Preventive maintenance may require machine shutdown/out of service.

The Preventive Maintenance activity aims at the following:

- To guarantee the availability of the oil and gas functions necessary to perform the Production program.
- To maintain the required fitness for purpose of production installations over the field expected life.
- To contribute to the prevention of incidents which may impact on the safety of personnel, equipment or what may have serious environmental consequences.
- To optimize the Maintenance regimes so that operational costs are minimized without compromising the level of safety and integrity.

The following activities are given as examples of Preventive Maintenance:

- Measurement/checking, cleaning and greasing.
- Mechanical tests.
- Systematic replacement of parts.
- Functional tests (ESD system, fire and gas, etc.).
- Reporting of state after maintenance and analysis for optimization.

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{Rule 2:

Preventive Maintenance schedules shall be entered in the Computerized Maintenance & Inspection Management System (CMIMS) whether Systematic or Condition Based.}

3.2.2.1 Systematic Preventive Maintenance (PS)

Systematic Preventive maintenance is carried out after a predetermined interval of time, number of operations, running hours, etc.

These predefined tasks are detailed step-by-step instructions in a series of discipline specific Planned Maintenance Routines (PMR) or Written Work Instructions that are scheduled and implemented through the CMIMS.

3.2.2.2 Condition Based or Predictive Maintenance (PC)

The deterioration of material and equipment depends on real operating conditions and cannot be determined in advance. Periodic or continuous measurements of observable and significant parameters permit a better appreciation of the real state of deterioration of a piece of equipment as well as the spacing or elimination of repetitive, costly and sometimes unjustified tasks.

Condition based or predictive maintenance is based on the idea of not carrying out any maintenance on a piece of equipment until it has reached the plant defined equipment operating thresholds i.e. close to the point at which it will no longer be able to perform its required function.

Condition based or predictive maintenance, based on the objective measurement of parameters of deterioration, optimizes systematic preventive maintenance. It is founded on the extrapolation of measurements and trend lines according to the usage pattern of the equipment.

The concept of condition based maintenance assumes that the three-stage procedure described below is followed thoroughly and systematically:

- **Measurements and observations:** these are collected over a period of time, either periodically or continuously.
- **Processing of the measurements:** these are reviewed, validated and re-presented in a form ready for analysis.
- **Analysis:** this involves the close examination of the data. An explanation is provided for every evolution outside the predefined envelope, a diagnosis made and Preventive Maintenance planned.

Conditional preventive maintenance schedules are entered in the CMIMS.

These mainly involve:

- On-site sampling and oil analyses (analysis in the on-site laboratory or external).
- Vibration monitoring and analysis.
- Thermography.
- Electrical measurement.
- Equipment performance parameters monitoring.

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3.3 Maintenance levels

The definition of the Maintenance levels applicable to all equipment, and particularly to rotating equipment, permits the measurement of the technical qualifications and means required to carry out the maintenance. By definition, they apply to Preventive Maintenance.

3.3.1 Level 1 Maintenance: L1

Actions which are simple and necessary for production and maintenance operation and which are performed on easily accessible parts, without dismantling or opening the item. These actions require only minimal training.

These actions can be carried out in complete safety with the help of maintenance equipment incorporated in the item.

They may be performed by Production or Maintenance personnel.

“**Round**” (as mentioned in **Appendix 1**) refers to regular visual inspection, collection & monitoring of operating condition data and minor/simple maintenance intervention on equipment in order to improve its reliability. They are thus specific Systematic Preventive Maintenance tasks (PS), part of Level 1 Maintenance tasks.

Examples for Level 1 maintenance:

- Inspection rounds to check condition
- Daily greasing
- Manual testing of mechanical parts
- Taking readings to check condition
- Testing of control panel lights
- Draining of filtering parts

3.3.2 Level 2 Maintenance: L2

Actions which require either simple procedures or the use of easily employed maintenance equipment. This type of action is performed by qualified personnel following the detailed procedures and using the equipment specified in the maintenance instructions.

Note that an employee may be said to be qualified when he has been trained to work safely on a potentially hazardous piece of equipment, and who, given his knowledge and ability, is recognized as being capable of performing the work assigned to him.

Examples for Level 2 maintenance:

- Checking parameters on a piece of equipment in use
- Simple adjustments (alignment, change of settings, etc.)
- Checking cut-off mechanisms (sensors, circuit breakers, fuses, etc.) and safety mechanisms
- Low-frequency (e.g. monthly) greasing
- Replacement of filters which are not easily accessible

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3.3.3 Level 3 Maintenance: L3

This type of operation can be carried out by a specialized technician, either on the spot or in the maintenance workshop, using the tools specified in the maintenance instructions as well as instruments for measuring and making adjustments. Possibly, the operation may also require benches for testing and checking of the equipment, using all the documentation necessary for its maintenance as well as the parts supplied by the warehouse.

Examples for Level 3 maintenance:

- Checks and adjustments involving the use of instruments which are not part of the equipment
- Inspection of complex equipment
- Intrusive preventive maintenance activities

3.3.4 Level 4 maintenance: L4

These are activities which involve the expertise or know-how of specific techniques and technologies or the deployment of specialized maintenance equipment. This level also encompasses the adjustment of measuring devices used for maintenance, and, if need be, the verification of working standards by specialized organizations.

This kind of maintenance operation is performed by specialized technical personnel or by a specialized team using all the general and specific maintenance instructions available.

Examples for Level 4 maintenance:

- Partial or general servicing not requiring the complete dismantling of the machine
- Vibration analysis, analysis of lubricants
- Infrared thermography
- Readings of technical parameters requiring collective measurement techniques and analysis of data
- Servicing of a pump in the workshop following its preventive removal

3.3.5 Level 5 maintenance: L5

Activities requiring know-how based on the mastery of highly specialized techniques or technologies. By definition, this type of maintenance operation (overhaul, reconstruction, etc.) is carried out by the manufacturer or by a specialized service or company with expertise in the equipment and using maintenance equipment defined by the manufacturer.

Examples for Level 5 maintenance:

- General overhaul with complete dismantling of the machine
- Dimensional and geometric repair
- Major repairs or restoration carried out by the manufacturer or specialized company
- Replacement of obsolete or heavily-worn items

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3.4 Work order backlog

3.4.1 Definition

Word order backlog: time passed after the work completion due date, in case that the work is not completed by the work completion due date.

- For corrective work orders, this date is the Work Defect (WDF) basic finish date recorded at the time of the work order release
- For planned work orders, it is the Work Planned Maintenance (WPM) scheduled start date + 28 days.

Reminder:

- The WPM scheduled start date is automatically generated from the maintenance and inspection plan (from the start dates and cycles set in the plan).
- The WDF finish date is set by default with regards to the work order priority, yet it can be changed before the work order is released.

3.4.2 Exclusion

- Completed work order (TECO).
- Cancelled work order (SWE – NCMP).
- WGN / WRO (except with activity type PC).
- Operation with control key XSER, ISER.

3.4.3 Calculation in CMIMS

- On work orders having activity types: Preventive (PS, PC), Corrective (BK, DE)
- From REL status, after completion due date, the total outstanding hours on on-going or waiting for completion work orders.

4. Risk-Based Maintenance General Methodology

4.1 Objectives and general methodology

The recommended Maintenance Strategy deployed in the Company operated assets is a risk-based approach. It tends to optimize cost for operational function having low potential for loss and assure availability for function having highest potential for loss; hence, the total risk of failure is minimized across the installation in the most economical way.

The methodology involves evaluating the risk created by the loss of each process function. The risk is defined by a combination of likelihood of an equipment failure to perform the required function and the consequence of this failure. The criticality level is divided into three categories:

- **Vital**
- **Important**
- **Secondary.**