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TECHNICAL REPORT

colour inside

Analyser systems – Maintenance management

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ANALYSER SYSTEMS – MAINTENANCE MANAGEMENT

FOREWORD

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IEC TR 62010, which is a Technical Report, has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2005, This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) addition of data, examples and clarifications.

EEMUA Publication 187: 2013 – *Analyser systems: A guide to maintenance management*, has served as a basis for the elaboration of this Technical Report, with the permission of the Engineering and Equipment Users Association.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
65B/990/DTR	65B/1063/RVC

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document covers best practices for the maintenance of on-line analysers. Analysers are used in industry to measure variables which significantly contribute to safety, environmental, asset protection and profit maximisation.

Maintenance organisation, prioritising of maintenance effort, maintenance methods, correct resourcing, performance monitoring and reporting all play an important role in successful application of on-line analysers.

The ultimate effectiveness of the contribution of on-line analysers is measured by the ability to perform their functional requirements upon demand. This document gives guidance on performance target setting, strategies to improve reliability, methods to measure effective performance, and the organisations, resources and systems that need to be in place to allow this to occur.

The various subjects covered in this document are discrete items and can appear unrelated in the overall scheme of analyser maintenance procedures and strategies. The following flow path in Figure 1 ties the clauses together in a logical sequence of approach.

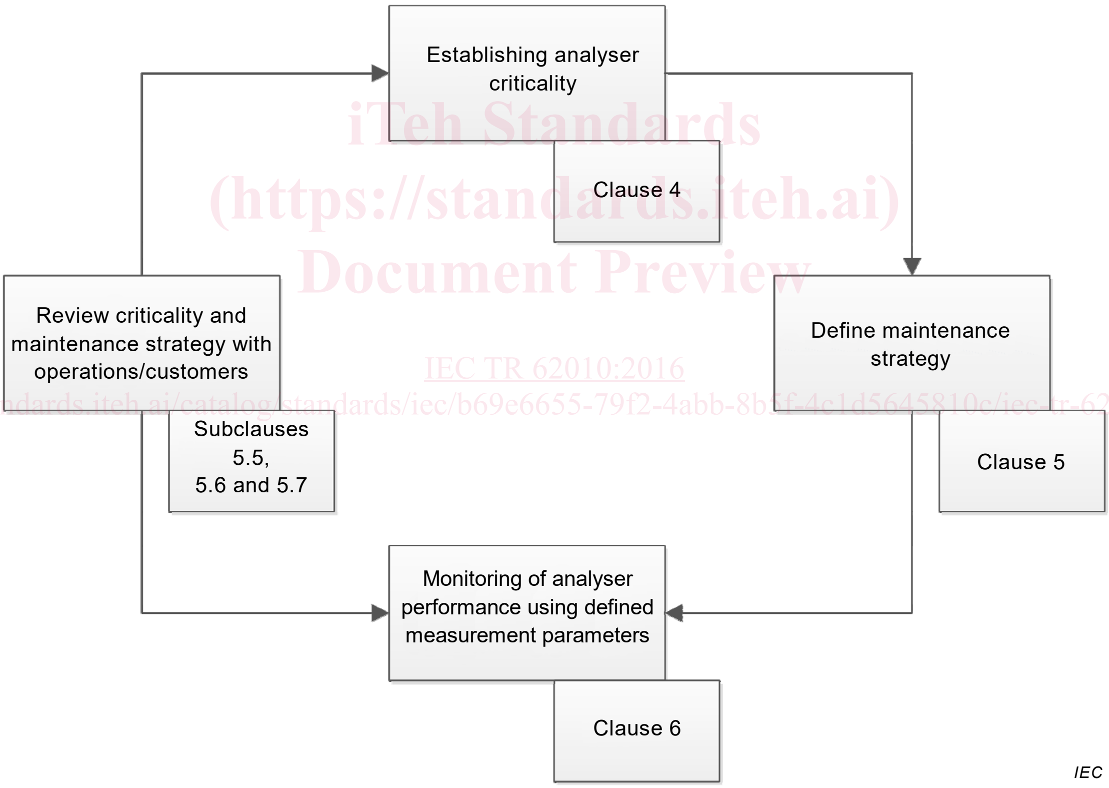

Figure 1 – Flow path detailing interrelationships of subject matter in IEC TR 62010

This document provides a mechanism by which the criticality of an analyser can be determined by means of a risk assessment. The risk assessment is based on consideration of the consequence of the loss of the analysis to the operation of a process unit, or group of process units, personnel/plant safety and the environment.

Determination of a criticality rating for the analyser allows target values for reliability to be set for each criticality classification and prioritisation for maintenance and support. Such approaches are covered in Clause 4.

A numbers strategy designed to allow the target reliabilities calculated by the risk assessments to be met are defined in Clause 5.

Finally, mechanisms for tracking analyser performance and quantifying the performance as meaningful measures are presented in Clause 6.

ANALYSER SYSTEMS – MAINTENANCE MANAGEMENT

1 Scope

1.1 Purpose

This document is written with the intention of providing an understanding of analyser maintenance principles and approaches. It is designed as a reference source for individuals closely involved with maintenance of analytical instrumentation, and provides guidance on performance target setting, strategies to improve reliability, methods to measure effective performance, and the organisations, resources and systems that need to be in place to allow this to occur.

Effective management of on-line analysers is only possible when key criteria have been identified and tools for measuring these criteria established.

On-line analysers are used in industry for the following reasons:

- **Safety and environmental**. One category of on-line analyser is those used to control and monitor safety and environmental systems. The key measured parameter for this category of analyser is on-line time. This is essentially simpler to measure than an analyser's contribution to profits but as with process analysers applied for profit maximisation, the contribution will be dependent upon ability to perform its functional requirements on demand.
- **Asset protection and profit maximisation**. On-line analysers falling into this category are normally those impacting directly on process control. They can impact directly on protection of assets (e.g. corrosion, catalyst contamination) or product quality, or can be used to optimise the operation of the process (e.g. energy efficiency). For this category of analysers, the key measured parameter is either the cost of damage to plant or the direct effect on overall profit of the process unit. Justification as to whether an analyser is installed on the process can be sought by quantifying the payback time of the analyser, the pass/fail target typically being 18 months. The contribution of the analyser to reduction in extent of damage to, or the profit of, the process unit, is difficult to measure. However, this contribution will be dependent upon the analyser's ability to perform its functional requirements upon demand.

This document focuses on the cost/benefits associated with traditional analyser maintenance organisations. Due to the complexity of modern analysers, support can be required from laboratory or product quality specialists, for example for chemometric models, who can work for other parts of the organisation. Inclusion of their costs in the overall maintenance cost is therefore important.

1.2 Questions to be addressed

When considering on-line analyser systems and their maintenance, the following key points list is useful in helping decide where gaps exist in the maintenance strategy.

- **What is the uptime of each critical analyser?** Do you measure uptime and maintain records? Do you know the value provided by each analyser and therefore which ones are critical? Do you meet regularly with operations ('the customer') to review priorities?
- **What is the value delivered by each analyser in terms of process performance improvement (i.e. improved yield values, improved quality, improved manufacturing cycle time and/or process cycle time, process safety (e.g. interlocks), environmental importance)?** Is this information readily available and agreed to in meetings with operations? Is the value updated periodically?

- **What is the utilisation of each critical analyser?** That is, if the analyser is used in a control loop, what percentage of the time is the loop on manual due to questions about the analyser data? Do you keep records on the amount of time that analyser loops are in automatic? Do you meet regularly with operations to review the operator's views about the plausibility of the analyser data?
- **Do you have a regular preventive maintenance programme set up for each analyser which includes regular calibrations?** Does the calibration/validation procedure include statistical process control (SPC) concepts – upper/lower limits and measurement of analyser variability (or noise)? Is the procedure well documented? Do you conduct it regularly, even when things are running well?
- **Do you have trained personnel (capable of performing all required procedures and troubleshooting the majority of analyser problems) who are assigned responsibility for the analysers?** Do the trained personnel understand the process? Do they understand any lab measurements which relate to the analyser results?
- **Do the trained maintenance personnel have access to higher level technical support as necessary for difficult analyser and/or process problems?** Do they have ready access to the individual who developed the application? Do they have ready access to the vendor? Can higher level support personnel connect remotely to the analyser to observe and troubleshoot?
- **Do you have a maintenance record keeping systems, which documents all activity involving the analysers, including all calibration/validation records, all repairs and/or adjustments?**
- **Do you use the record keeping system to identify repetitive failure modes and to determine the root cause of failures?** Do you track the average time-to-repair analyser problems? Do you track average time-between-failures for each analyser?
- **Do you periodically review the analysers with higher level technical resources to identify opportunities to significantly improve performance by upgrading the analyser system with improved technology or a simpler/more reliable approach?**
- **Do you meet regularly with operations personnel to review analyser performance, update priorities, and understand production goals?**
- **Do you have a management framework that understands the value of the analysers and are committed to and supportive of reliable analysers?**
- **Do you know how much the maintenance programme costs each year and is there a solid justification for it?**

Consideration of the above questions will help to identify opportunities for continuously improving the reliability of installed process analysers. Once the opportunities are identified the following clauses are intended to give guidance in achieving the solutions with the aim of:

- maximising performance and benefit of installed analysers;
- achieving full operator confidence in the use of on-line analysers;
- analyser output data becoming reliable enough to be used by operators, control systems, and other users, in order to improve plant operation versus world class manufacturing metrics to become the best process analysers possible.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
availability
ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

3.2
catastrophic failure
failure of a component, equipment or system in which its particular performance characteristic moves completely to one or the other of the extreme limits outside the normal specification range

3.3
consequence
measure of the expected effects of an incident outcome case

3.4
control system
system which responds to input signals from the process and/or from an operator and generates signals causing the equipment under control (EUC) to operate in the desired manner

3.5
diversity
performance of the same overall function by a number of independent and different means

3.6
error
discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition

[SOURCE: IEC 60050-192:2015, 192-03-02, modified — the notes have been deleted]

3.7
failure
termination of the ability of an item to perform a required function

[SOURCE: IEC 60050-603:1986, 603-05-06]

3.8
fault
state of an item characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

3.9
design fault
fault in the design caused by a mistake in the design phase of a system

Note 1 to entry: A design fault causes an error, remaining undetected in a part of the system until specific conditions affecting that part of the system are such that the produced result does not conform to the intended function. This results in a failure of that part of the system. If the conditions appear again, the same results will be produced.

3.10
undetected fault
fault which is not detected by a diagnostic check

3.11
mistake
human error
human action that produces an unintended result

3.12
failed state
condition of a component, equipment or system during the time it is subject to a failure

3.13
fault tree analysis
analysis to determine which fault modes of the sub-items or external events, or combinations thereof, may result in a stated fault mode of the item, presented in the form of a fault tree

3.14
functional safety
ability of a safety related system to carry out the actions necessary to achieve a safe state for the EUC or to maintain the safe state for the EUC

3.15
hazard
physical situation with a potential for human injury

3.16
maintainability
ability of an item under given conditions of use to be retained in or restored to a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources

[SOURCE: IEC 60050-192:2015, 192-01-27, modified]

3.17
mean time between failures
MTBF
expectation of the duration of the operating time between failures

[SOURCE: IEC 60050-192:2015, 192-05-13, modified — "operating" is omitted from the definition and the note has been deleted]

3.18
mean time to failure
MTTF
expectation of the operating time to failure

[SOURCE: IEC 60050-192:2015, 192-05-11, modified — "operating" is omitted from the definition and the notes have been deleted]

3.19
mean time to restoration
MTTR
expectation of the time to restoration

[SOURCE: IEC 60050-192:2015, 192-07-23, modified — the note has beend deleted]