

Title: **Alarm System Performance of Digital Control Systems Applied in Fossil Plant Standard**

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1. INTRODUCTION

The introduction of modern digital control systems has brought about that plant operators in various industries internationally are regularly presented with unmanageable process alarm rates. The result is an ineffective alarm system that hinders the plant operators in their task. This is especially true for Eskom presently, as highlighted by recent control system refurbishment and upgrade projects. The main reasons for this are poor alarm system design, poor control system configuration and the lack of alarm system performance indicators.

This field has received enormous international attention during the past decade and best practices have resulted from this research. The *De Facto* literature presently is the EEMUA Publication No. 191: 2007 Edition 2, and the ANSI/ISA 18.2 – 2009 Standard.

As alarm systems are critical for the safe and reliable operation of plant and equipment, it is recognised that best practice principles and proper design and maintenance strategies must be implemented to support the plant operators in performing their task.

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

The objective of this document is to set clear high level criteria required for an alarm system's functional performance in order to have Manageable Alarm Rates annunciated to plant operators.

The document thus aims to have effective and auditable Alarm Management systems implemented on all plant. This will ensure that all Process Alarms are applicable, timely and effective thus assisting operating personnel in operating plant effectively, reliably and safely.

2.1.2 Applicability

This specification is applicable to all fossil fired Power Stations in the Generation Division, and within Engineering in the Technology Division.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

The following documents contain provisions that constitute requirements of this specification. At the time of publication, the edition indicated was valid. This document is subject to revision and users are responsible to ensure that the most recent edition of the documents listed below are used.

- [1] Bill Hollifield and Eddie Habibi, *The Alarm Management Handbook, A Comprehensive Guide*. PAS, Houston, TX, 2006. ISBN: 0-9778969-0-0.

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2.2.2 Informative

Reference to the following documents will further enhance the understanding of the reader on the subject covered in this document.

- [2] *Alarm systems: A Guide to Design, Management and Procurement*, The Engineering Equipment and Material User's Association (EEMUA) Publication No. 191, Edition 2, 2007.
- [3] *Management of Alarm Systems for the Process Industries*. ANSI/ISA 18.2, 2009.

2.3 DEFINITIONS

Definition	Explanation
Alarm Floods	A burst rate of alarms which begins when the alarm rate exceeds 10 or more alarms occurring in 10 minutes, and ends when the rate drops to below 5 alarms in 10 minutes.
Alarm Management	It is a process by which alarms are engineered, monitored and managed to ensure safe and reliable plant operation.
Alarm Priority Distribution	A means to convey the seriousness of a specific process condition to the operator, and is used to drive the order of operator responses.
Controlled Disclosure	Controlled Disclosure to External Parties (either enforced by law, or discretionary).
Chattering Alarm	An alarm that come and clears at least three times in one minute
Manageable Alarm Rate	Less than one alarm per 10 minutes, per plant operator, on average.
Process Alarm	A process alarm is a mechanism for informing a plant operator of an abnormal process condition for which operator action is required. The plant operator is alerted in order to prevent or mitigate process upsets and disturbances.
Standing Alarm	An alarm that is intentionally overridden in the alarm system such that it's not visible or auditable to the plant operator.
Suppressed Alarm	An alarm in the alarm state continuously for more than 24 hours.
Target Average Process Alarm Rate	The number of Process Alarms per day as an indicator of the overall health of the alarm system.

2.4 ABBREVIATIONS

Abbreviation	Explanation
KPI	Key Performance Indicator

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2.5 ROLES AND RESPONSIBILITIES

None

2.6 PROCESS FOR MONITORING

None

2.7 RELATED/SUPPORTING DOCUMENTS

None

3. ALARM SYSTEM PERFORMANCE OF CONTROL SYSTEMS APPLIED IN FOSSIL PLANT

Alarm Management is an integral part of the Generation Business risk mitigation systems and as such due diligence and good practice must be applied in all alarm or alarm system design and implementation-phases as well as during the life cycle of the alarm system.

Alarm systems shall be designed, implemented and maintained in such a manner that:

- a. Under all reasonably foreseeable conditions, steady state and abnormal conditions, the alarm rate annunciated to the plant operator is manageable.
- b. Each individual process alarm meets the following criteria:
 - The condition must require plant operator action.
 - The alarm must be the best indicator of the condition's root cause.
 - The alarm must be resulting from an abnormal condition.
 - The plant operator must have adequate time to respond.
- c. Each individual alarm must have an associated alarm response procedure as per GGG1115; Power Station's Owner Manual, Operating function, Alarm Response Procedures, or equivalent document.
- d. Each alarm must be prioritised according to the respective Business Units priority matrix. It is recommended that three priority levels be used (Low, high and critical).

3.2 STRATEGY

Each Business Unit must monitor the performance of all the alarm systems installed on its plant and take corrective action when the alarm system's performance doesn't meet the key performance indicator (KPI) targets as set out in Table 1.

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Table 1: Recommended Alarm System Key Performance Indicators [1]

Key Performance Indicator	Interim target for systems undergoing an alarm improvement effort	Long-term target / New alarm systems, including refurbished systems
Target Average Process Alarm Rate	< 300 per day	< 150 per day
Percentage of time alarm rate exceeds Target Average Process Alarm Rate	5%	0%
Alarm Priority Distribution based on at least one week of data	~80% Low, ~15% High, ≤ 5% Critical	~80% Low, ~15% High, ≤ 5% Critical
Suppressed Alarms	Zero (Unless as part of defined Shelving, Flood Suppression, or State-based Strategy)	Zero (Unless as part of defined Shelving, Flood Suppression, or State-based Strategy)
Chattering Alarms	10 occurrences or less in a one-week period	0 per day
Standing Alarms (more than 24 hours old)	20 or less in a one-week period	0 per day
Alarm Floods (10 to 20 alarms in a 10 minute period)	≤ 5 per day	≤ 3 per day
Alarm Floods (>20 alarms in a 10 minute period)	≤ 3 per day	0 per day
Changes in Alarm Priority, Alarm Trip Point, Alarm Suppression Status, Point Execution Status	None that is unauthorized. None that are not part of a defined Shelving, Flood Suppression, or State-based Strategy.	None that is unauthorized. None that are not part of a defined Shelving, Flood Suppression, or State-based Strategy.

4. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Dieter Huppe	C&I Manager
	Document Approved by TDAC ROD 13 March 2013

5. REVISIONS

Date	Rev.	Compiler	Remarks
October 2010	0	B.B. Esterhuizen	Original Document 36-963
January 2013	0.1	N. Moodley	Draft Document for review created from 36-963
May 2013	1	P. Govender	Final Document approved

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6. DEVELOPMENT TEAM

None

7. ACKNOWLEDGEMENTS

None

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APPENDIX A : ALARM MANAGEMENT LIFECYCLE MODEL

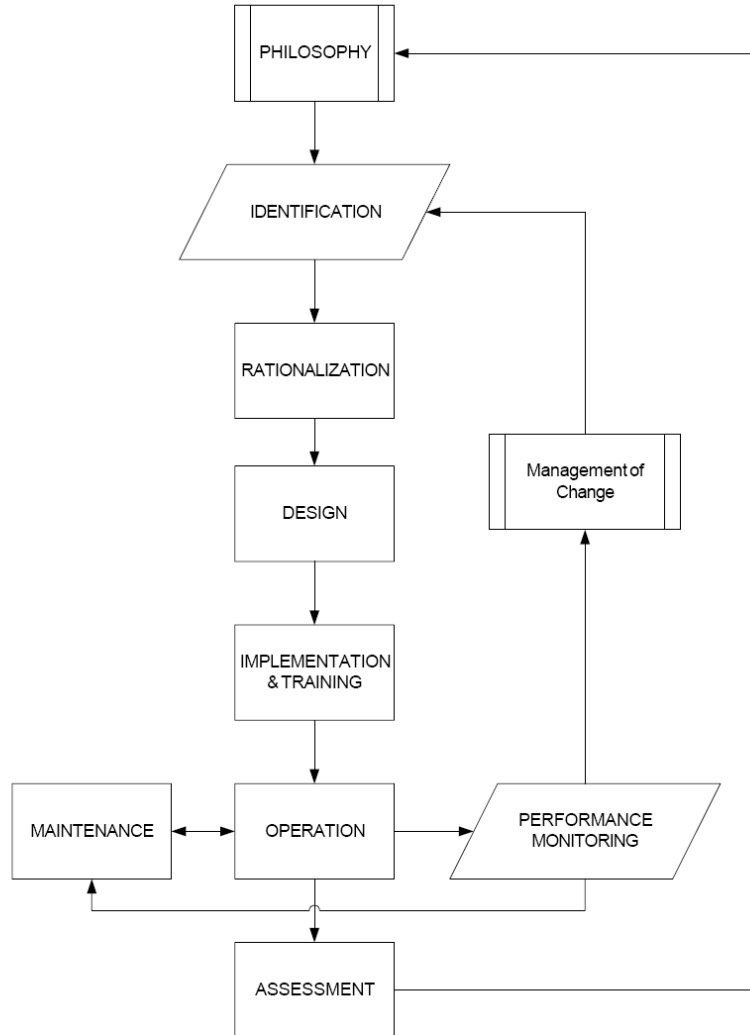


Figure 1: Alarm Management Lifecycle Model [3]

This management process can be summarised in five phases, namely;

Phase 1: Define – Establish your desired alarm philosophy

Phase 2: Measure – Assess the performance of the designed/existing alarm system

Phase 3: Analyse – Alarm performance benchmarks

Phase 4: Improve – Document and rationalise the existing alarms.

Phase 5: Control – Maintain the improved alarm system

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