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System control diagram

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National foreword

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SYSTEM CONTROL DIAGRAM

FOREWORD

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A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC PAS 63131 has been processed by IEC technical committee 65: Industrial-process measurement, control and automation.

Norsok I-005:2013/AC:2016 has served as a basis for the elaboration of this PAS. The structure and editorial rules used in this PAS reflect the practice of the organization which submitted it.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65/669/DPAS	65/672/RVDPAS

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

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 PAS is based on Norsok I-005:2013/AC:2016. Edition 1 of Norsok I-005:2013/AC:2016 was issued in 1995 and it has been widely used in the Norwegian Oil and Gas industry since then together with some international use on FPSOs and other fixed Oil and Gas installations.

The main objective for this PAS is to define a limited set of complete operational control functions (objects) and an explanatory condensed logical diagram, suitable for use in the continuous control process industry – e.g. Oil and Gas processes.

The main drivers for establishing this as a standard are the advantage of efficient engineering, implementation, and commissioning, as well as reuse of the control application across different suppliers of control systems. The diagrams give an unambiguous logical representation that is suited for data transfer.

This PAS also includes a method of documenting sequences (ref. IEC 60848) and their interaction with the control objects.

This PAS will provide the means to fill the gap between the P&ID's and the Functional requirement diagrams. (Ref IEC 61804.) The control functions definitions include required behavior descriptions of control modes, interlocking (Safeguarding), blocking and other operator commands. It gives a standardized operator interface on a functional level.

The logic diagrams carry a simplified process sketch as background, inherited from PFD/P&ID's, which enables reviews of the control applications in a multi-discipline environment.

This PAS can also be used as basis for defining a companion standard to OPC-UA (IEC 62541).

NORSOK I-005:2013 Rev. 3 was adopted as NORSOK Standard in February 2013.

Annex A, B, D and F are normative. Annex C, E and G are informative.

The success of a plant development project depends on good and efficient means of communication between the involved parties, during all phases of the project.

Present extensive use of computerized systems and 3D modeling provide efficient tools for specifying and handling of physical equipment in a standardized manner. However, the development of methods and tools to specify functional relationships has not reached a corresponding level.

During the plant development the process engineers specify the process through the development of the P&IDs. Throughout this work process the process engineers acquire a thorough understanding of the total plant behaviour. However, the P&IDs provide limited facilities for documentation of the overall functionality as well as operational aspects of the plant.

It is the control system engineer's task to design the control system so as to fulfill the process functionality required to achieve product specifications as well as the requirements imposed by the overall operating and control philosophy and manning levels. To conserve the functional relationships implicitly specified by the P&IDs, the control system engineers have to transform the process engineers understanding of plant behaviour into the control system design and implementation.

The operator's evaluation of the operational efficiency of the plant is a difficult task without any proper documentation of the overall control and monitoring functions available. Often, operational problems within the different systems cannot be identified until the system is in operation, leading to major modifications in late project phases in the worst case.

The logic and arithmetic functions available for implementing the required control system functionality are accurate, but vendor specific. In-depth system knowledge is required to understand both the available functions as well as their interconnections. There is no intuitive link between the control system functions and their interconnections, and the process flow itself. The interactions between the process and the control functions are identified through single tags only.

Due to the missing link between the functions implemented in the control system and the P&IDs defining the process flow, the process engineer’s possibility to verify that all process aspects have been properly catered for in the implementation of the control system is very limited.

The SCD approach has been introduced in order to eliminate this missing link. The SCD approach represents a structured methodology based on the development of the SCD.

This PAS consists of the definition of two elements:

- the function templates;
- the diagram.

The functional requirements are defined through Annex A "SCD Function Standard" while the drawing requirements are defined through Annex B "SCD drawing standard" and Annex D "SCD legend".

This PAS will also establish a general framework for implementation of the SCD approach in terms of Annex C "Project execution guidelines" and Annex E "Application guidelines".

Annex C "Project execution guidelines" defines a strategy for project execution and is intended for project responsible engineers. Annex E "Application guidelines" provides a basis for application design and is intended for application engineers responsible for developing SCDs.

Annex G "Readers manual" contains a simplified introduction for engineers and operators using SCDs for verification and documentation of control functionality.

Annex F "SCD Control function template behaviour" defines the functions in an unambiguous manner.

The main updated items in the 2012 edition of NORSOK I-005 standard are as follows:

- 7 new function templates have been defined;
  a) HA – analogue input command
  b) HB – binary input command
  c) KB – sequence logic interface
  d) MAS – analogue measurement acquisition from subsystems
  e) OA – analogue output
  f) SBB – breaker control
  g) SBC – coordinator for SBE
- 2 existing function templates have been deleted;
  a) CB – binary control (replaced by recommended use of MA, ref Figure E.19)

b) YA – process input calculation (replaced by recommended use of # function, ref Figure E.3)

- CA function has been expanded with a terminal for feed forward (XFF), position high feedback XGH and confirmed high/low (BCH/BCL);
- for CS function terminal name BG has been corrected to YG;
- SB function have been expanded with a terminal for external fault and OS command for suppress;
- SBE function terminals have been aligned to fit the new SBC function, following input terminals have been removed XP1H, XP2H, XP1L, XP2L, BP1, BP2, BP1F, BP2F and expanded with terminals for safeguarding high;(LSH/FSH)
- further elementary functions have been defined, NOR, NAND, XOR and Analogue select;
- Annex A function standard have been rewritten to a new format;
- Annex B drawing standard have been more firm defined and expanded by
  a) size for all symbols have been defined,
  b) layer and colour use have been defined,
  c) "dot" introduced as alternative for S split symbol,
  d) "wall" introduced for multiple I/O connections,
  e) sequence symbols are defined.
- generally this PAS has been rephrased where it has been found unclear;
- application guideline is redone in accordance with the updates in this edition;
- function template behaviour figures redone where they have been unclear or erroneous;
- for the general appearance of this PAS the IEC IECSTD format has been adapted;
- Appendix E is updated to reflect the changes in Appendix A and B.
- Appendix F is updated to include the changes in Appendix A and errors corrected.

SYSTEM CONTROL DIAGRAM

1 Scope

This PAS is intended to cover functional as well as drawing related requirements for use of SCDs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

ISO 128-20, *Technical drawings – General principles of presentation – Part 20: Basic conventions for lines*

ISO 3511 (all parts), *Process measurement control functions and instrumentation – Symbolic representation*

ISO 5457, *Technical product documentation – Sizes and layout of drawing sheets*

ANSI/ISA-5.1, *Instrumentation Symbols and Identification*

Norsk olje og gass 070, *Guidelines for the Application of IEC 61508 and IEC 61511 in the petroleum activities on the continental shelf*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1
action alarm
alarm associated with an automatic action, both the alarm and action caused by one common discrete change of state

3.1.2
actual position
feedback-position of a flow element, independent of the state of the control output

3.1.3
alarm
HMI annunciation requiring operator response, caused by a discrete change of state