IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

SISTEMA – getting started

1 Introduction

This publication describes first steps with the SISTEMA software utility (the German acronym stands for "safety of controls on machines"), with reference to the IFA's website and publications. The IFA publications referred to can all be downloaded free of charge in PDF format in English and German. A small number of the publications are also available in printed form. The majority of links stated here can be called up through SISTEMA's help menu.

2 Introduction to SISTEMA, download and installation

The SISTEMA software utility provides support during assessments of the safety of controls in accordance with ISO 13849-1. The utility, which runs on Windows, models the structure of the safety-related parts of controls based upon the "designated architectures", and calculates reliability values at various levels of detail, including that of the attained Performance Level (PL).

Risk parameters for determining the required Performance Level (PL_r), the Category, measures against common-cause failure (CCF) on multi-channel systems, the average component quality ($MTTF_D$) and the average test quality (DC_{avg}) of elements and blocks can be entered step by step. The effect of each parameter change upon the system as a whole is displayed directly and can be printed out in the form of a report.

Essential descriptions and specialist articles on SISTEMA can be found on the SISTEMA website at www.dguv.de/webcode/e34183 under "Further information". This page also provides a download button for the latest version of SISTEMA. The software components used in SISTEMA and the system requirements are also described on the SISTEMA website.

We advise users always to use the latest version of the program. Each new release contains bug fixes and improvements to functionality and usability. All installation files of the versions released to date and the occasional beta versions are available for download at: www.dguv.de/webcode/e103328. Users are not able to subscribe to the SISTEMA newsletter on the website, but can do so subsequently from within SISTEMA itself (Section 7).

Multiple versions of SISTEMA can be installed on the same PC. In this case, a separate installation folder must be specified for each version. For example:

- SISTEMA version 1.1.9 is installed in the folder C:\Program Files\SISTEMA119
- Version 2.0.4 is installed in the folder C:\Program Files\SISTEMA204

The installation folder contains a readme file. SISTEMA displays the contents of this file when the first line, "Projects", is selected in the navigation pane. Further instructions for installing and uninstalling SISTEMA can be found in the publication entitled "SISTEMA: frequently asked questions" www.dguv.de/webcode/m757980.

3 Introduction to the ISO 13849 control standard

Understanding application of the ISO 13849 series of standards is essential for work with SISTEMA. The same applies to the use of other analysis tools. Attending a suitable training course is advantageous for this purpose.

SISTEMA supports application of ISO 13849 for safety-oriented controls on machines. Information on this series of standards is available from the IFA at: www.dguv.de/webcode/e89507.

Further information, guides and numerous examples relating to the standard can be found in the IFA reports. Relevant circuit examples were calculated in SISTEMA for each report. The examples are available in the form of SISTEMA projects and can be downloaded on the web page of the report. A general introduction to the standard, containing 37 example circuits for a range of technologies, is available in the form of BGIA Report 2/2008e: www.dguv.de/webcode/e91335.

IFA Report 7/2013e specifically addresses safe drive controls employing frequency converters, and includes 15 circuit examples: www.dguv.de/webcode/e635980.

4 The engineering process in SISTEMA

The typical engineering process for calculating the probability of failure of safety-related parts of controls is described below. Procedures and tips are described in the SISTEMA cookbooks referred to below, see www.dguv.de/webcode/e109249. Essential terminology and abbreviations can be found in SISTEMA Cookbook 1, Annexes A and B.

4.1 Definition of the safety functions

In order for the probability of failure of a safety function to be calculated at a later stage, knowledge is required of which components are employed in the safety function and which are not. A precise definition of the safety functions is therefore indispensable for the subsequent steps (see SISTEMA Cookbook 6 and its examples).

4.2 Schematic circuit diagram showing functional and test channels

The schematic circuit diagram showing the relevant components is produced for each safety function. The relevant components include all components the failure of which may impair execution of

the safety function in a functional channel (redundant structures possess two functional channels). They also include all test facilities responsible for detecting such dangerous failures and bringing about a safe state. A schematic circuit diagram shows for example the electrical circuitry of position switches, programmable logic controllers (PLCs) and contactors, and the flow of current from the sensor, via signal processing, to the actuator (see SISTEMA Cookbook 1, Chapter 2 and its examples).

4.3 From the schematic circuit diagram to the safety-related block diagram

In the next step, the schematic circuit diagram is transformed for each safety function into the logical representation of the safety-related block diagram. In the course of the transformation, the components of the schematic circuit diagram are assigned to "subsystems", by means of which the safety function is modelled in SISTEMA.

In the presentation as a safety-related block diagram, the logical interrelationships are relevant, rather than the physical connections between the components. Each component within a safety function is a constituent part of a certain structure. This structure is termed a "Category" in ISO 13849-1, and grouped within SISTEMA as a subsystem. The sequences of subsystems with their corresponding Categories represent a safety function in the form of a safety-related block diagram. The sequence of the subsystems has no bearing upon subsequent calculation of the probability of failure (see SISTEMA Cookbook 1, Chapter 3 and its examples, flow chart in Annex E).

In order for the probability of failure to be determined in accordance with the simplified method of ISO 13849-1, the implementation of the control system must correspond to one of the "designated architectures" for the Categories. If this is not the case, the simplified method cannot be applied. Sometimes however, a minor – conceptual – adaptation is sufficient to permit modelling to a designated architecture. SISTEMA Cookbook 4 explains a number of such cases (see SISTEMA Cookbook 4 and its examples).

4.4 Transfer of the block diagram to SISTEMA

Not until this point are the structure (single or two-channel) and the components of the channels transferred to SISTEMA for each safety function in accordance with the block diagram. For this purpose, projects are created that in turn contain the safety functions and their components (see SISTEMA Cookbook 1, Chapter 4 and its examples).

5 Application of component libraries

Safety-related parts of controls are engineered in SISTEMA from subsystems, blocks and elements – generally commercially available components for industrial use – for which a range of parameter values and information are entered in the application. The component manufacturers state these data for example in data sheets or catalogues, but may also make them available in the form of SISTEMA libraries. The benefit in this case is that the data can be copied quickly and without error from a library into a SISTEMA project. Detailed information on creating and working with libraries can be found in SISTEMA Cookbook 5. Example libraries can also be downloaded.

A list (www.dguv.de/webcode/e92603) is available of manufacturers known to the IFA that already offer SISTEMA libraries. The list can be called up directly from the menu in the SISTEMA library

window (Help -> Manufacturers' Libraries). Manufacturers interested in making SISTEMA libraries available can also find further information in SISTEMA Cookbook 5.

Libraries of parameter values for control components are now being offered not only in the SISTEMA format, but also in that of VDMA Specification 66413, see: http://ea.vdma.org/article/-/articleview/949939 (in German).

6 Further information on SISTEMA

SISTEMA includes a reference for the program user interface and functions in the form of a help file (Help -> Help, keyboard shortcut F1).

Special technical information can be found in SISTEMA Cookbook 2, "Use of network libraries", and SISTEMA Cookbook 3, "Running several instances of SISTEMA in parallel (terminal server)".

The older SISTEMA cookbooks are also still available for legacy SISTEMA versions, see: www.dguv.de/webcode/e1008784.

The SISTEMA bug list continuously documents known bugs in the SISTEMA version in question, together with possible solutions. See: www.dguv.de/webcode/m757981.

The publication entitled "SISTEMA – frequently asked questions" is continually updated, see: www.dguv.de/webcode/m757980.

This publication, "SISTEMA – first steps", is available at www.dguv.de/webcode/m1221153.

7 Registration, updates and the SISTEMA newsletter

A newsletter on the SISTEMA software program is published periodically. It can be subscribed to when the software is downloaded, and is sent to the e-mail address specified. No further information is collected.

The newsletter provides information on new program releases and further information on the use of SISTEMA. Critical software bugs are also reported in the newsletter. Newsletter subscribers must ensure that the IFA's e-mail, sent from sistema@dguv.de, is not blocked, for example by spam filters. The user can delete his or her e-mail address from the registration database if desired after downloading the software or after receiving each edition of the newsletter.

It is also possible to subscribe to the newsletter, and to check whether a more recent version of SISTEMA is available, after beginning to use SISTEMA (in SISTEMA, Help -> Version Check/Registration menu item).

The SISTEMA newsletters published to date are available in PDF format in an archive: http://www.dguv.de/webcode/e103312.

8 Support and training

SISTEMA can be used free of charge, including for commercial purposes. The support provided by the IFA is therefore limited. Users may send questions concerning installation, report bugs, or submit suggestions for improvements, to: sistema@dguv.de.

Owing to time constraints, the IFA is not able to offer training courses for companies. Training is provided only for employees of the German Social Accident Insurance Institutions. Some of the individ-

ual accident insurance institutions offer training courses, however. An Internet search for "training", "seminar" and "SISTEMA" will return hits for several third-party providers of training courses.

9 Information on new versions of the standard and on SISTEMA 2.0

The third edition of ISO 13849-1 appeared in December 2015. Information on the changes with respect to the second edition can be found in this publication: www.dguv.de/webcode/m818850.

The extended and fully revised Version 2 of SISTEMA was released in 2016. The essential changes are described in the following publication: www.dguv.de/webcode/m1242009.

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