Failure Modes, Effects and Diagnostic Analysis

Project:
Two-pole surge arrester DEHNrail

Customer:
DEHN + SÖHNE GmbH + Co. KG.
Neumarkt
Germany

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Management summary

This report summarizes the results of the hardware assessment carried out on the two-pole surge arrester DEHNrail in the versions listed in the drawings referenced in section 2.4.1. Table 1 gives an overview of the different configurations that belong to the considered two-pole surge arrester DEHNrail.

The hardware assessment consists of a Failure Modes, Effects and Diagnostics Analysis (FMEDA). A FMEDA is one of the steps taken to achieve functional safety assessment of a device per IEC 61508. From the FMEDA, failure rates are determined and consequently the Safe Failure Fraction (SFF) can be calculated for a subsystem. For full assessment purposes all requirements of IEC 61508 must be considered.

Table 1: Configuration overview DEHNrail

DR M 2P 75	Two-pole surge arrester consisting of a base element and plug-in protection module Max. continuous operating voltage U_C: 75 VAC / 75 VDC
DR M 2P 255	Two-pole surge arrester consisting of a base element and plug-in protection module Max. continuous operating voltage U_C: 255 VAC / 255 VDC

For safety applications only the described configurations were considered. All other possible variants or electronics are not covered by this report.

The failure rates used in this analysis are from the *exida* Electrical & Mechanical Component Reliability Handbook for Profile 1.

The two-pole surge arresters DEHNrail are considered to be Type A[1] elements with a hardware fault tolerance of 0.

The following table [2] shows how the above stated requirements are fulfilled under worst-case assumptions.

[1] Type A element: "Non-complex" element (all failure modes are well defined); for details see 7.4.4.1.2 of IEC 61508-2.

[2] It is assumed that complete practical fault insertion tests can demonstrate the correctness of the failure effects assumed during the FMEDA.

Table 2: IEC 61508 failure rates

	exida Profile 1	
	Analysis 1 [3]	Analysis 2 [4]
Failure category	**Failure rates (in FIT)**	**Failure rates (in FIT)**
Fail Safe Detected (λ_{SD})	**0**	**0**
Fail Safe Undetected (λ_{SU})	**2**	**2**
Fail Dangerous Detected (λ_{DD})	**0**	**0.4**
Fail Dangerous Undetected (λ_{DU})	**10**	**9.6**
No effect	18	18
No part	0.5	0.5
Total failure rate (safety function)	**12**	**12**
SFF [5]	**---**	**---**
SIL AC [6]	**---**	**---**

A user of the two-pole surge arrester DEHNrail can utilize these failure rates in a probabilistic model of a safety instrumented function (SIF) to determine suitability in part for safety instrumented system (SIS) usage in a particular safety integrity level (SIL). A full table of failure rates is presented in section 4.4.1 along with all assumptions.

The failure rates are valid for the useful life of the two-pole surge arrester DEHNrail (see Appendix 2).

[3] Analysis 1 represents a worst-case analysis.

[4] Analysis 2 represents an analysis with the assumption that line short circuits and short circuits to GND are detectable or do not have an effect.

[5] The complete sensor or final element subsystem will need to be evaluated to determine the overall Safe Failure Fraction.

[6] The SIL AC (architectural constraints) needs to be evaluated on subsystem level. See also previous footnote.