

DIN SPEC 91461:2021-12 (E)

Stress-testing resilience of critical infrastructures exposed to cyber-physical threats; Text in English

Contents		Page
Foreword		4
Introduction.....		5
1 Scope.....		6
2 Normative references		7
3 Terms and definitions.....		7
4 Symbols and abbreviations.....		9
5 Resilience stress-testing		10
5.1 Context and definition		10
5.2 Principles.....		11
6 Resilience stress-testing framework		12
6.1 Integrating top-down and bottom-up approaches		12
6.2 Main stakeholders (“interested parties”).....		12
6.3 Basic methodology.....		15
6.4 Stress-testing criteria.....		16
6.5 Level of functionality (“vertical loss”)		16
6.6 Time (“horizontal loss”).....		17
6.7 Cumulative loss of functionality (area).....		18
7 Stress-testing workflow		19
7.1 General.....		19
7.2 Pre-testing phase.....		19
7.3 Stress-testing phases.....		21
7.3.1 Preparation phase.....		21
7.3.2 Testing phase		21
7.3.3 Closing phase		21
7.4 Post-testing phase.....		21
8 Resilience stress-testing implementation.....		22
8.1 Implementation principles		22
8.2 Stress-testing process		22
9 Resilience indicators used in stress-testing		27
10 Stress-testing reporting		27
11 Target users of the stress-testing results		28
Annex A (informative) Application Example		29
A.1 Title.....		29
A.2 Introduction		29
A.3 Virtual testbed.....		29
A.4 Application of a virtual testbed		31
A.5 Application in a case study.....		31
Bibliography.....		33

Figures

Figure 1 — The stress-testing framework: from regulation to tools	12
Figure 2 — The stress-testing process stakeholders.....	14
Figure 3 — Generic model of the functionality level of a SIP over a scenario time: the generic functionality level (FL) is defined through functional elements generally comprising resilience elements (e.g. preparedness), security elements (e.g. security protective measures), safety elements (e.g. safety protective measures) and critical functionality elements of the infrastructure (e.g. providing energy); for each element the single indicators should be defined	15
Figure 4 — Functionality level as stress-testing limit (up) and time as stress-testing limit (down)....	17
Figure 5 — Loss of functionality surface as stress-testing limit	18
Figure 6 — Comparing the FL curve with the stress-testing criteria	19
Figure 7 — Stress-testing workflow.....	20
Figure 8 — Functionality elements and indicators (an example)	24
Figure 9 — Example of the functionality level over scenario time: the example shows fast drop of the FL (down to 25 %) and then fast recovery to almost nominal level (to approx. 95 %, within hours) with the final recovery to almost 97 % for over a month.....	25
Figure 10 — The figure depicts an example of stress-test for a critical infrastructure [20] showing the functionality during an adverse event/scenario (the scenario time in days). The details of the overall scenario cycle (above) are shown below. The pink curve represents the stress-test acceptance limits, the other curves represent the functionality levels of the respective individual subsystems. All the curves, except the computer network one, are within the stress-test acceptance limits.	26
Figure A.1 — High-level organization of the virtual-testbed	31
Figure A.2 — The critical process flow of the Carmagnani Pilot.....	32
Figure A.3 — Model of the Carmagnani critical process used in the virtual-testbed.....	32

Tables

Table 1 — Functionality elements and indicators	16
Table 2 — Examples of threats providing possible basis for stress-testing scenarios: will the system/infrastructure withstand the threat and recover according the pre-specified criteria.....	23