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Digital I&C – the Analysis and Test System (AnTeS) of GRS



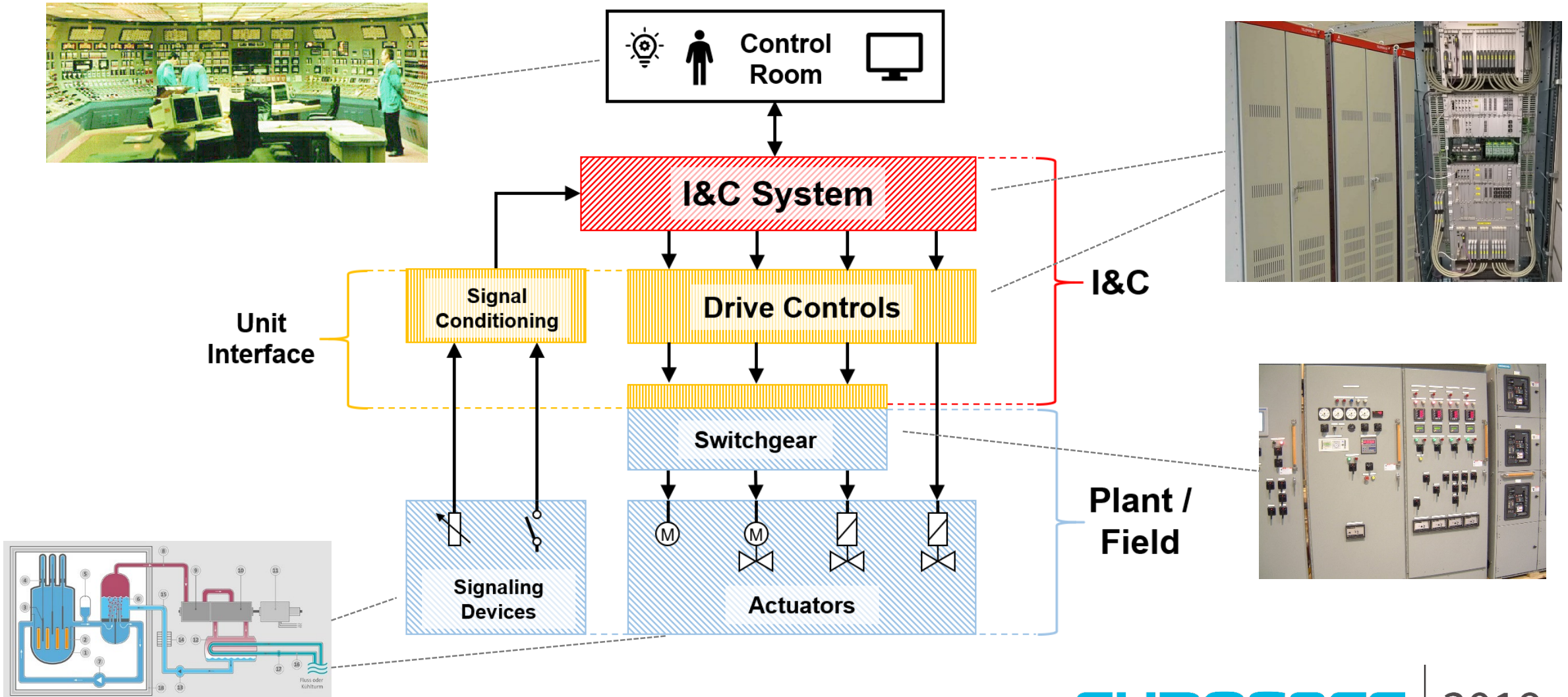
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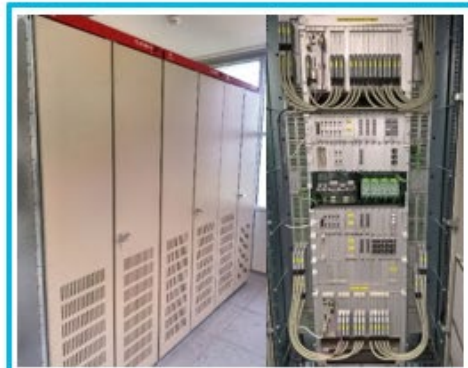
Digital I&C?



Functional Structure of the Instrumentation and Control (I&C) of a NPP



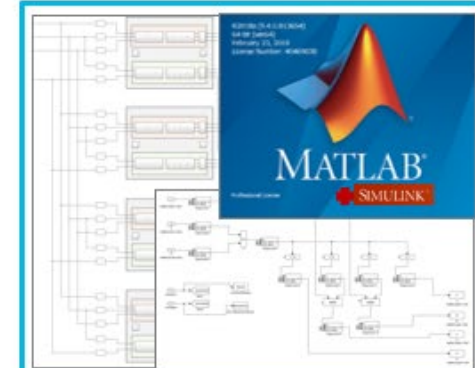
AnTeS - Analysis and Test System



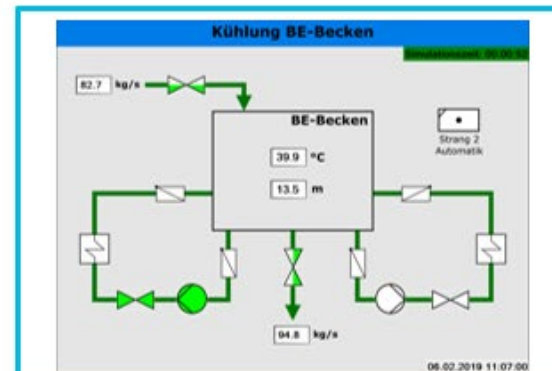
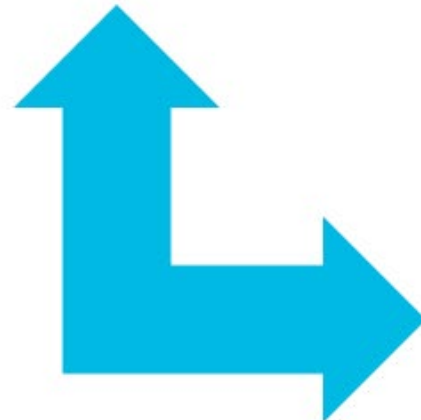
Module 1
Real I&C System



AnTeS



Module 2
Simulated I&C Systems



Module 3
Simulated Front-Line Systems
Real Front-Line Systems



AnTeS Module 1 - TXS@GRS

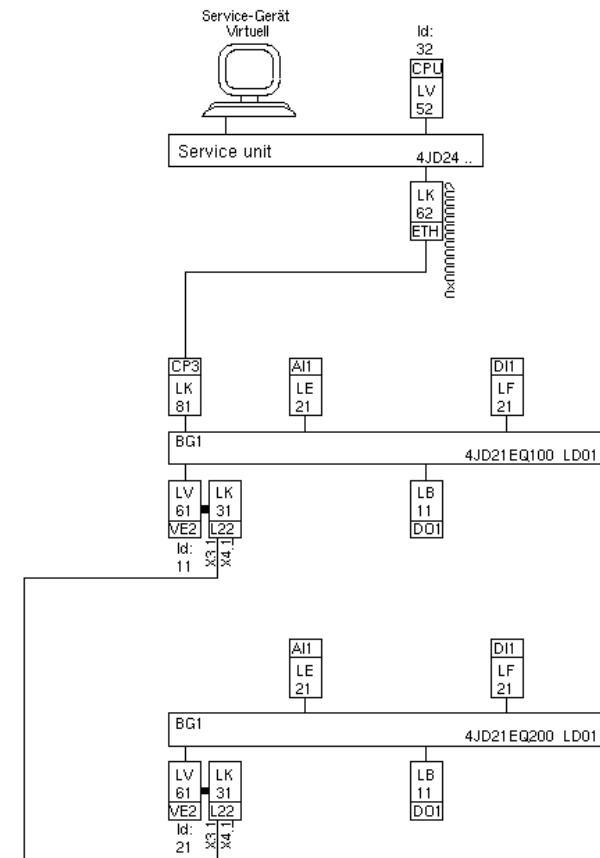
TXS Cabinets @ GRS



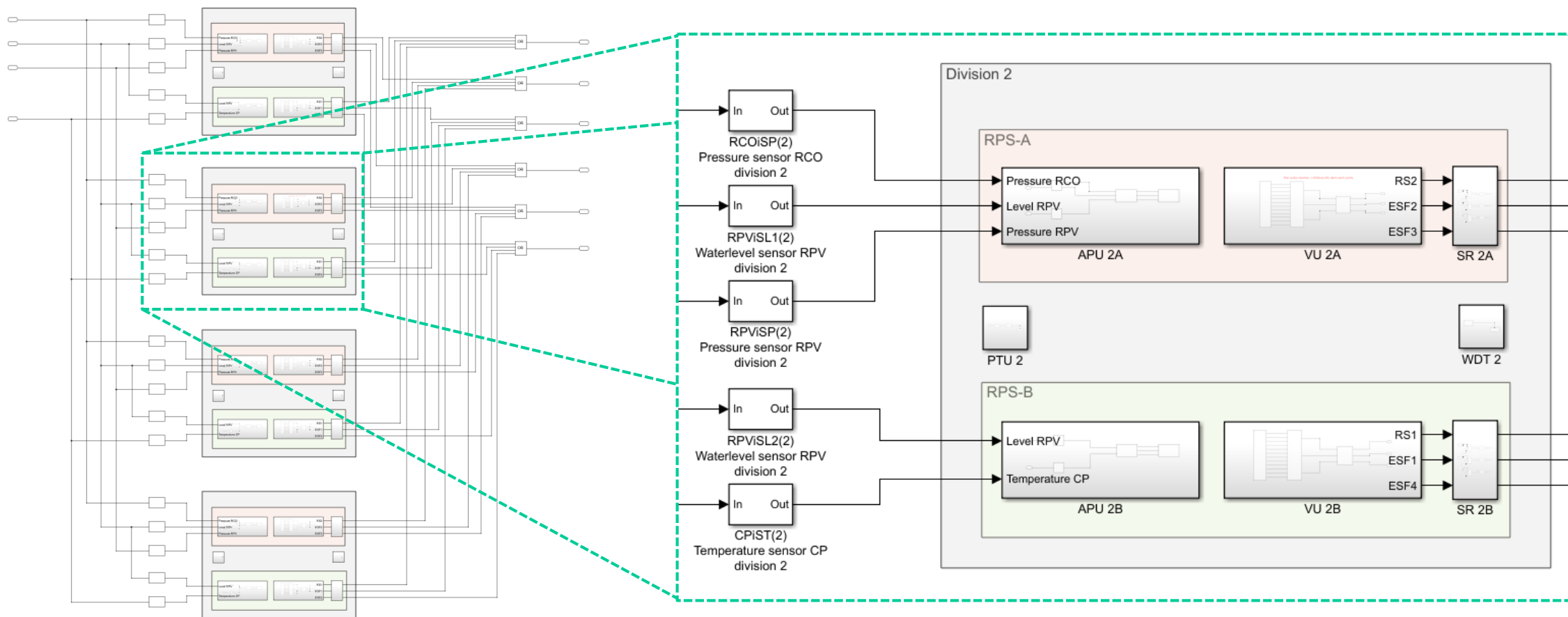
TXS Cabinet - Inside View



Diagram of the Network



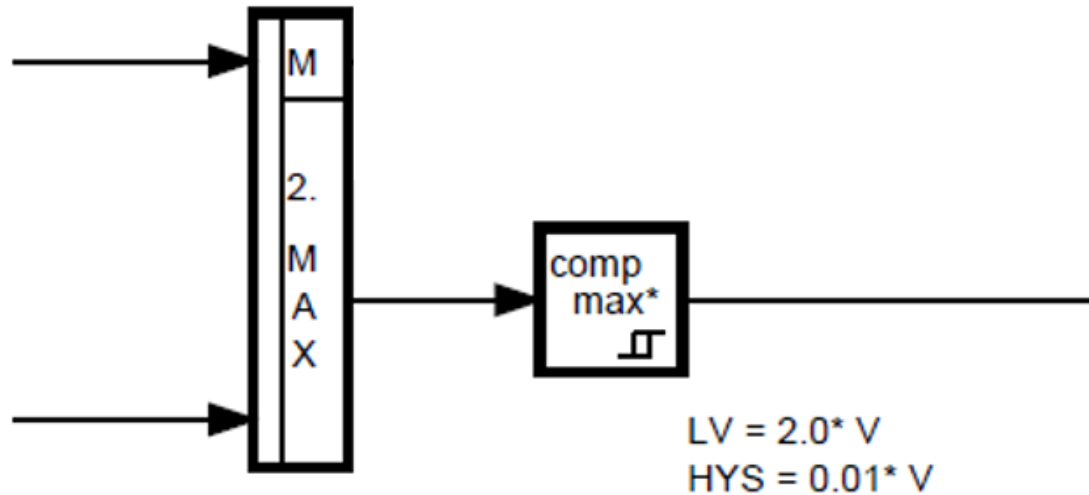
AnTeS Module 2 - Simulated I&C Systems



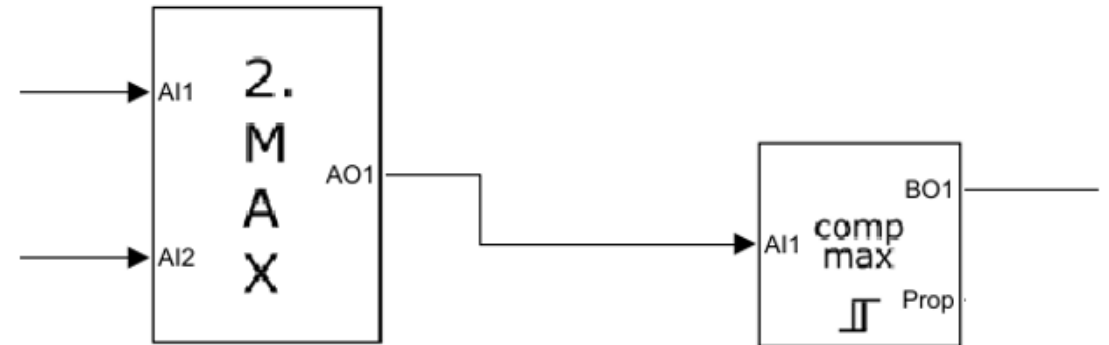
Example of Simulated I&C System with 4 Redundancies

AnTeS Module 2 - Simulated I&C Systems

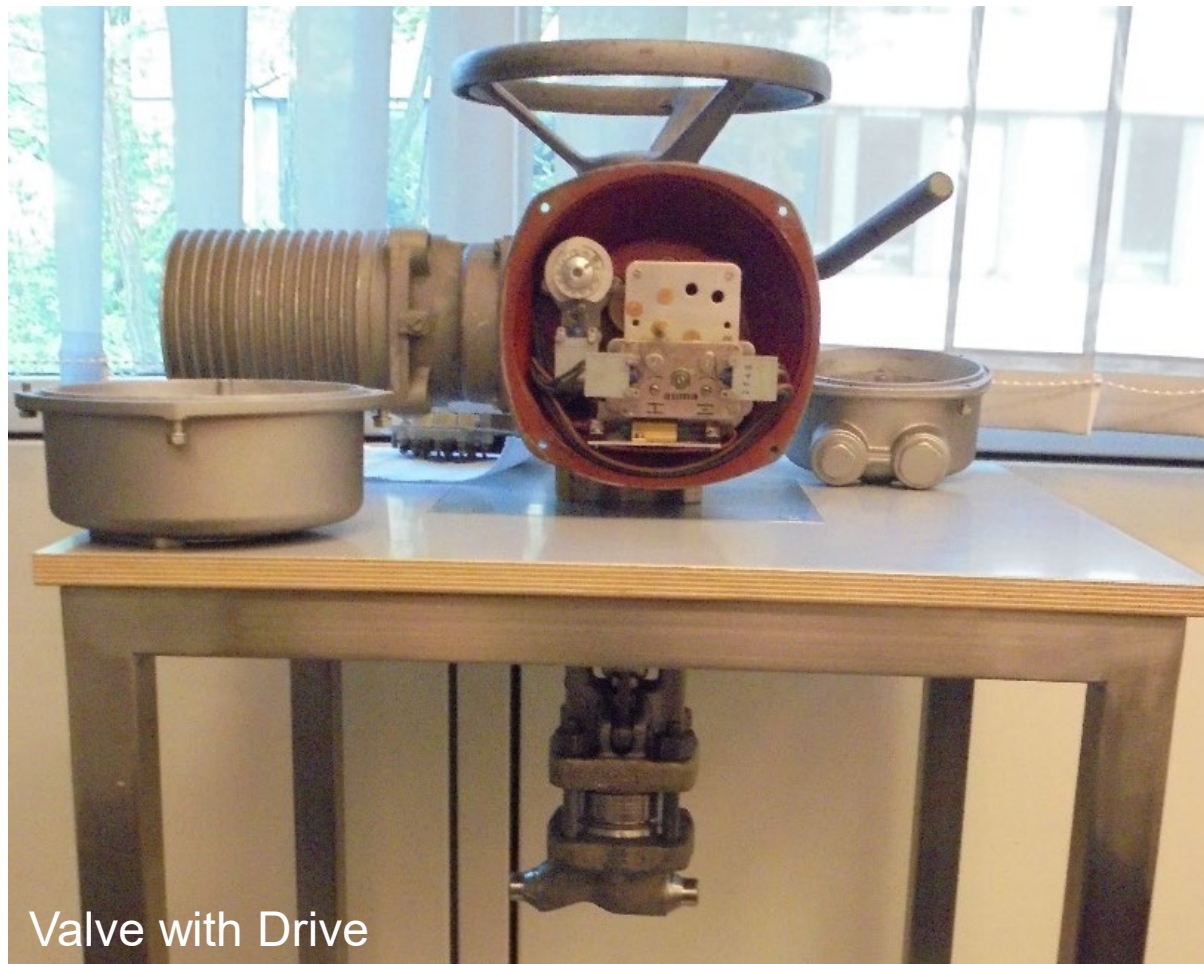
I&C Function in TXS Engineering Environment



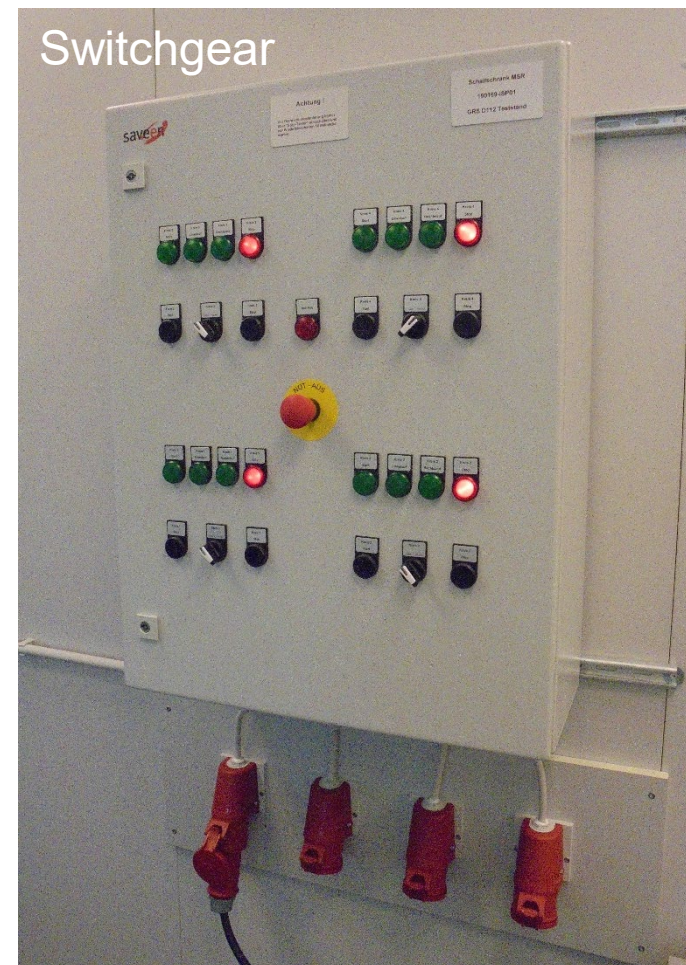
I&C Function in Simulated I&C System



AnTeS Module 3 - Real Front-Line Systems

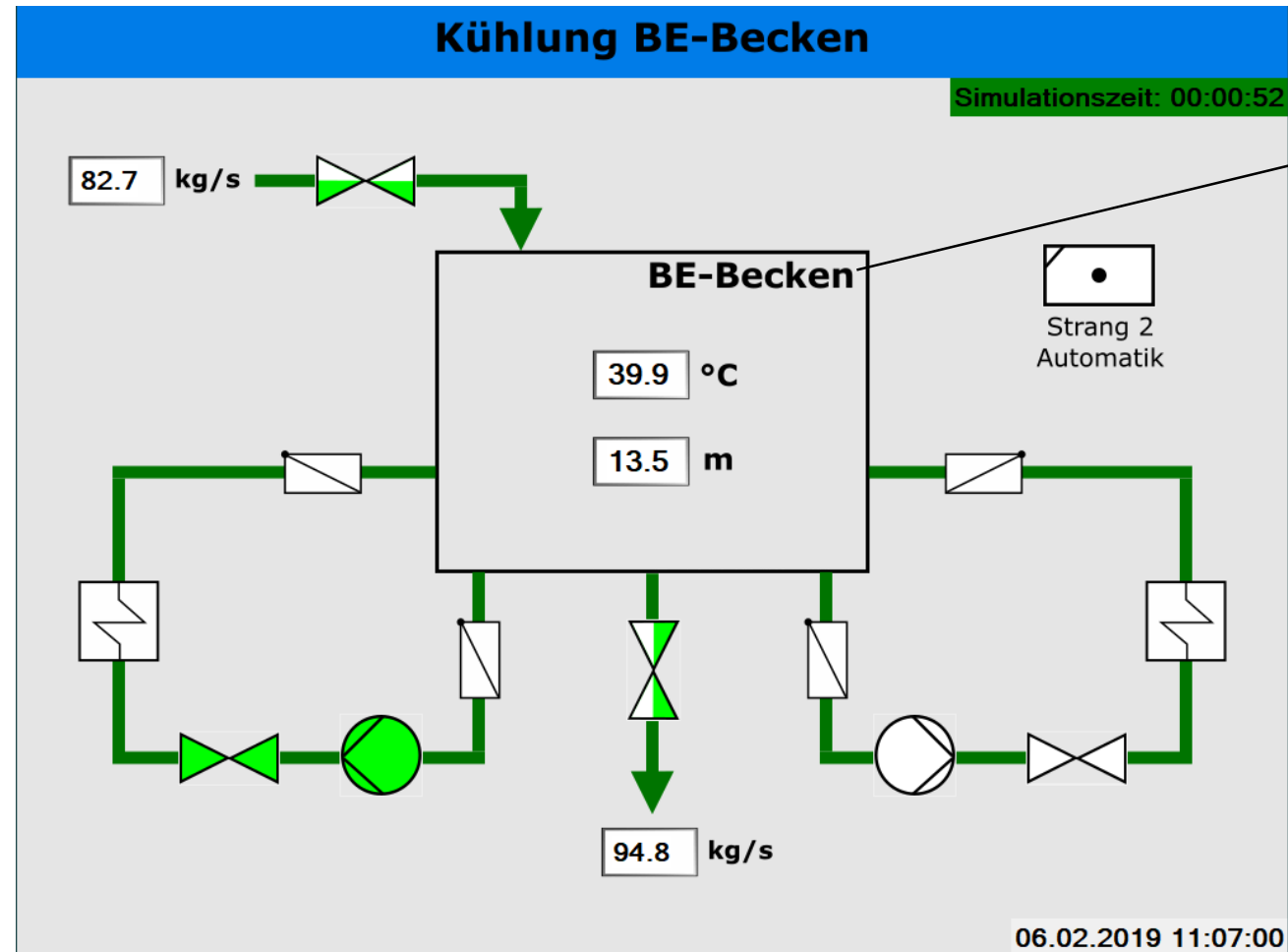


Valve with Drive



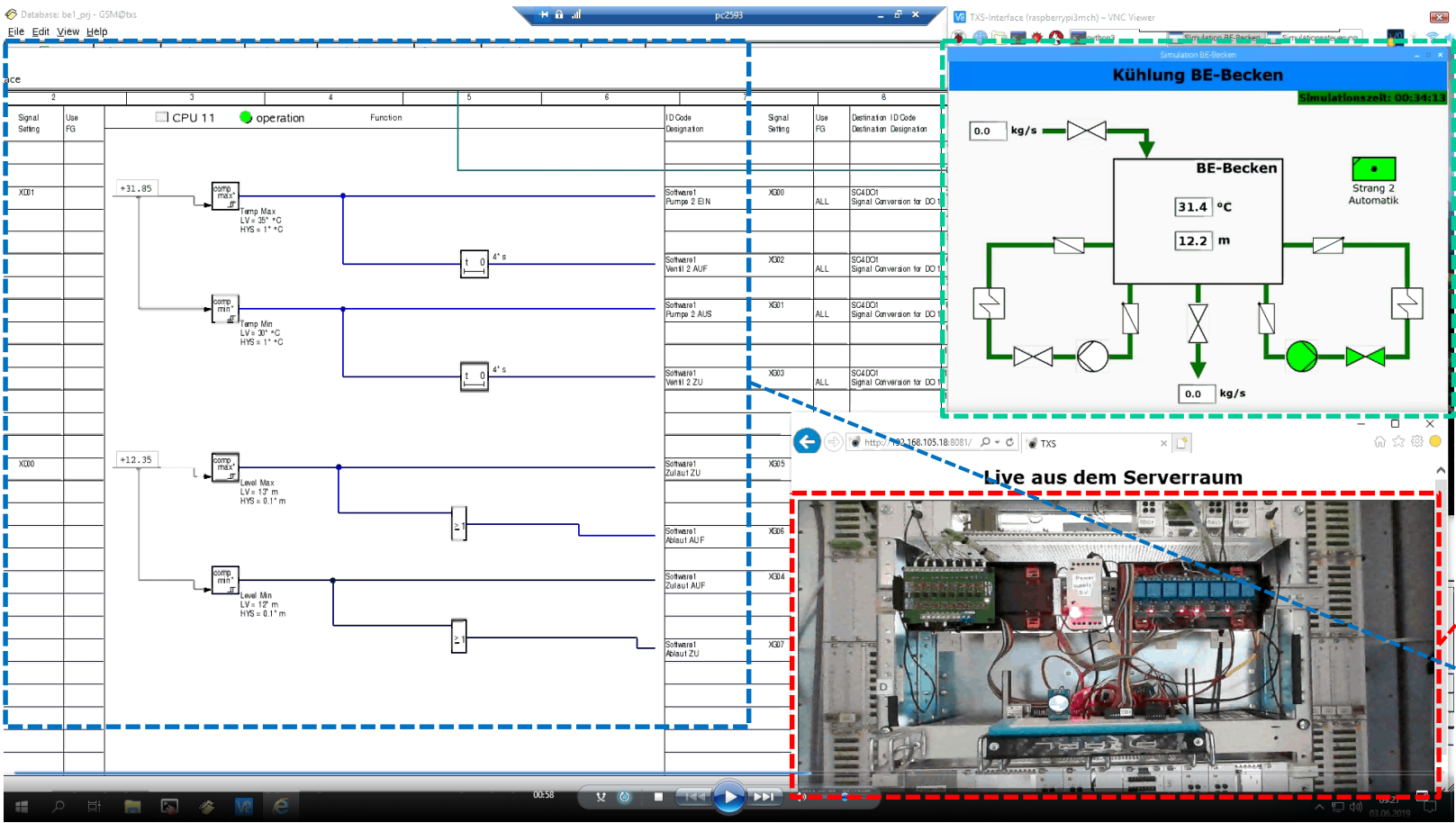
Switchgear

AnTeS Module 3 - Simulated Front-Line Systems

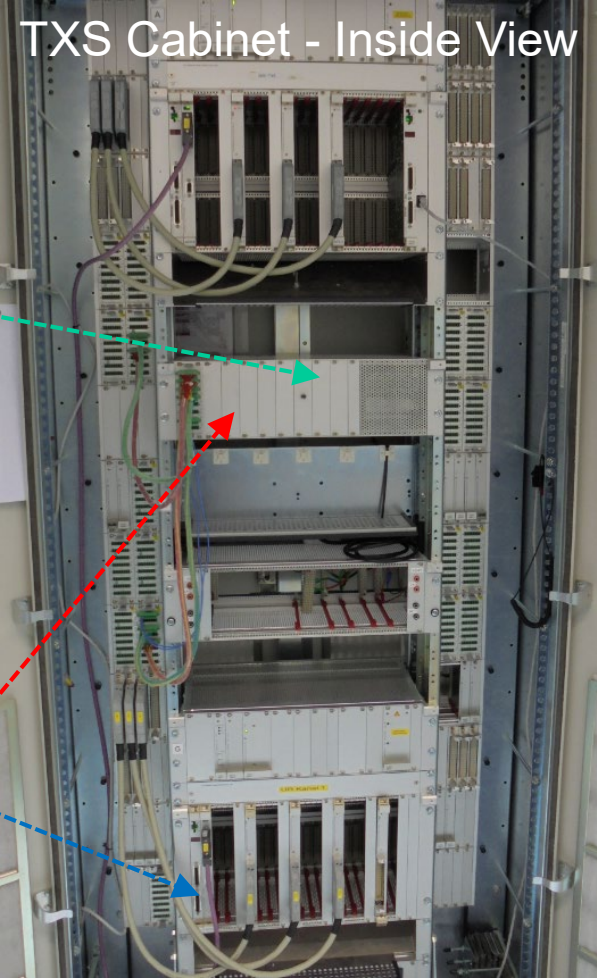


Fuel Pool

AnTeS in Action

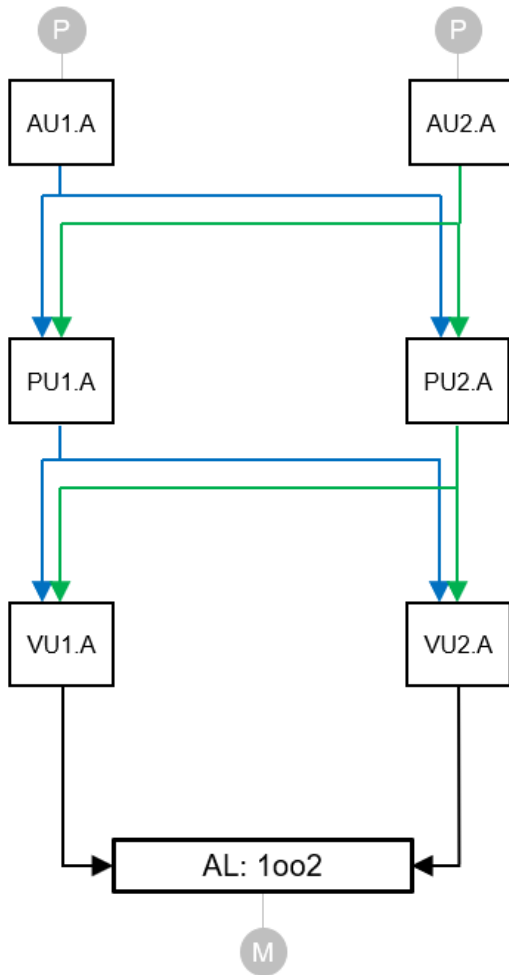


TXS Cabinet - Inside View



Example Application of AnTeS

Model System



Event 1	Event 2
AU1.A NSF	
AU2.A NSF	
CCF VU	
CCF ALL	
CCF PU	
CCF AU	
AL NSF	
AU1.A SF	AU2.A SF
PU1.A SF	PU2.A SF
PU1.A NSF	PU2.A SF
PU1.A SF	PU2.A NSF
PU1.A NSF	PU2.A NSF
VU1.A NSF	VU2.A NSF
VU1.A NSF	VU2.A SF
VU1.A SF	VU2.A NSF
VU1.A SF	VU2.A SF

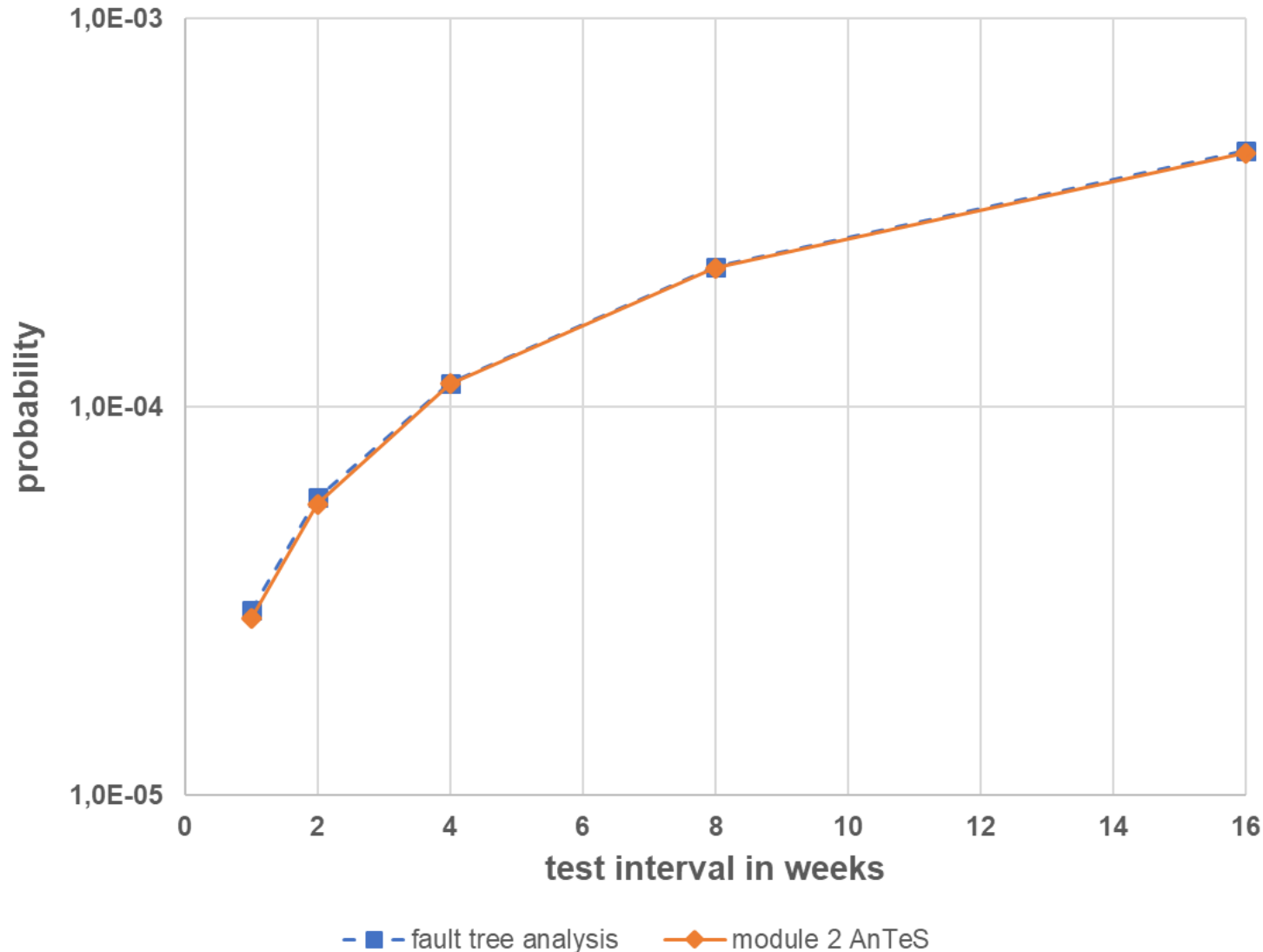
a)

Top Event probability Q = 1,151E-04				
No	Probability	%	Event 1	Event 2
1	5,60E-05	48,66	AU1.A NSF	
2	5,60E-05	48,66	AU2.A NSF	
3	7,46E-07	00,65	CCF VU	
4	7,46E-07	00,65	CCF ALL	
5	7,46E-07	00,65	CCF PU	
6	7,46E-07	00,65	CCF AU	
7	3,44E-08	00,03	AL NSF	
8	2,82E-08	00,02	AU1.A SF	AU2.A SF
9	1,58E-08	00,01	PU1.A SF	PU2.A SF
10	7,03E-09	00,01	PU1.A NSF	PU2.A SF
11	7,03E-09	00,01	PU1.A SF	PU2.A NSF
12	3,14E-09	00,00	PU1.A NSF	PU2.A NSF
13	3,14E-09	00,00	VU1.A NSF	VU2.A NSF
14	3,12E-09	00,00	VU1.A NSF	VU2.A SF
15	3,12E-09	00,00	VU1.A SF	VU2.A NSF
16	3,11E-09	00,00	VU1.A SF	VU2.A SF

b)

Minimal Cut Sets (MCS) of failures leading to a failure on demand of the model system obtained with AnTeS (a) and fault tree analysis with RiskSpectrum (b)

Example Application of AnTeS



Sensitivity analysis of the effects of different test intervals on the probability of failure on demands of a dual redundant model system using fault tree analysis and module 2 of AnTeS

Contact Information

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External Image Sources

- Slide 2:
 - TELEPERM XS - Test Field:
 - <https://www.aucotec.com/en/news-press/article/decision-in-favour-of-database-driven-engineering-system-from-aucotec/>
- Slide 3:
 - Image of Control Room:
 - http://www.nucleartourist.com/systems/control_rooms.htm
 - Image Switchgear:
 - <https://en.wikipedia.org/wiki/Switchgear>
 - Image PWR:
 - <https://www.bfe.bund.de/DE/kt/cta-deutschland/kkw/dwr/dwr.html>