

TEST CASE RESOLUTION WITH GRIF



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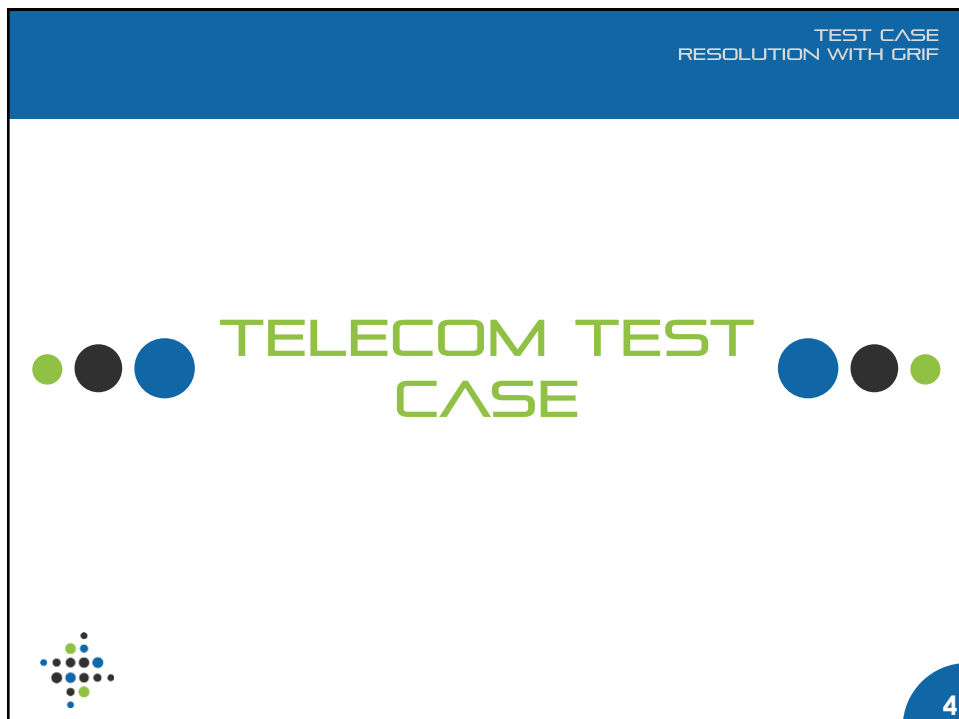
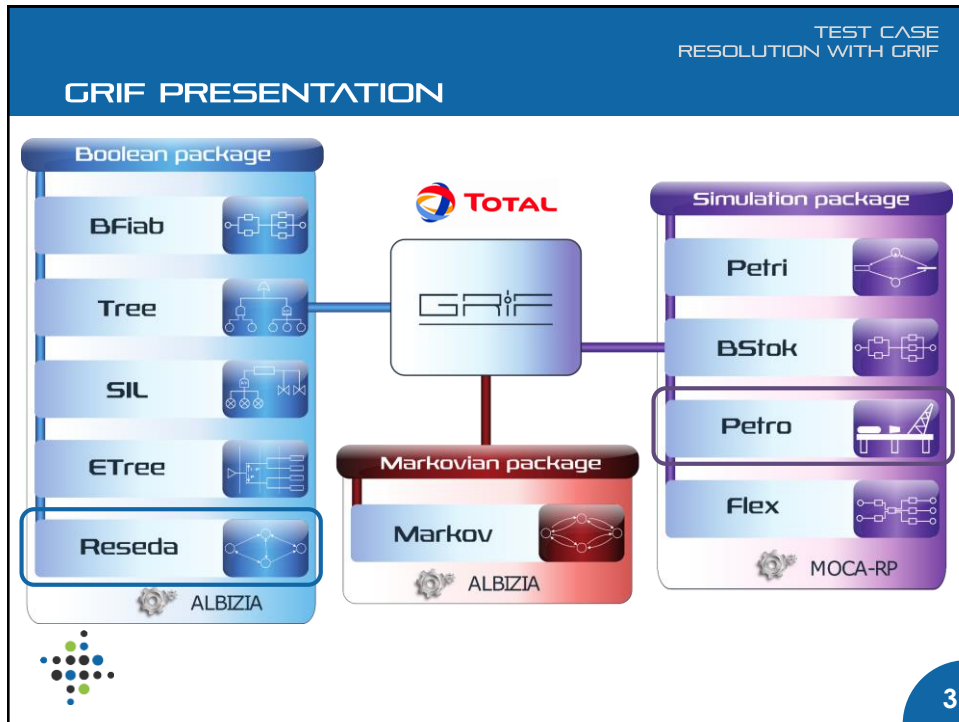
TEST CASE
RESOLUTION WITH GRIF

PRESENTATION

- In 2017, EDF proposed a benchmark on reliability of complex discrete systems.
- The aim is to solve these problems using different types of modeling.
- With this in mind SATODEV proposed to solve :
 - The telecom test case using Reseda of GRIF Workshop
 - the 6.6 kV test case using Petro of GRIF Workshop.



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PRESENTATION



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PRESENTATION



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PRESENTATION

- The aim is to answer to the following question:
 - What is the availability and reliability to connect Lille to Marseille at times: 1h, 10h, 100h, 10000h?
 - What are the most probable minimal cut sets and the most important components (give importance factors)
- Reliability data:
 - Source and Target are perfect nodes
 - All other nodes have a failure rate of $1e-5/h$ and a repair rate of $0.1/h$
 - All links have a failure rate of $1e-4/h$ and a repair rate of $0.1/h$.

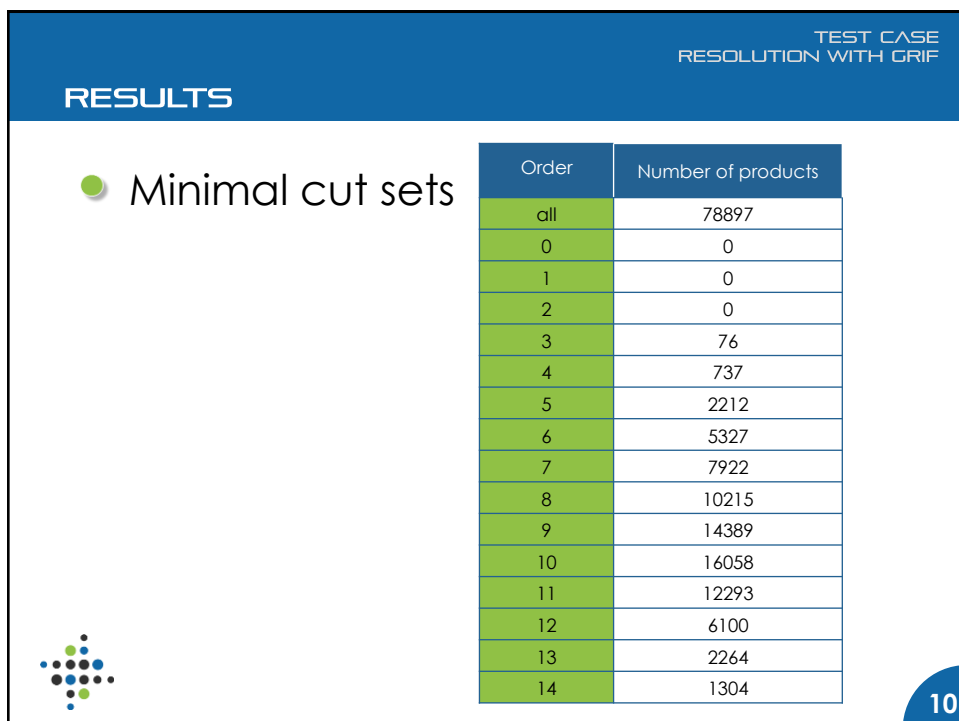
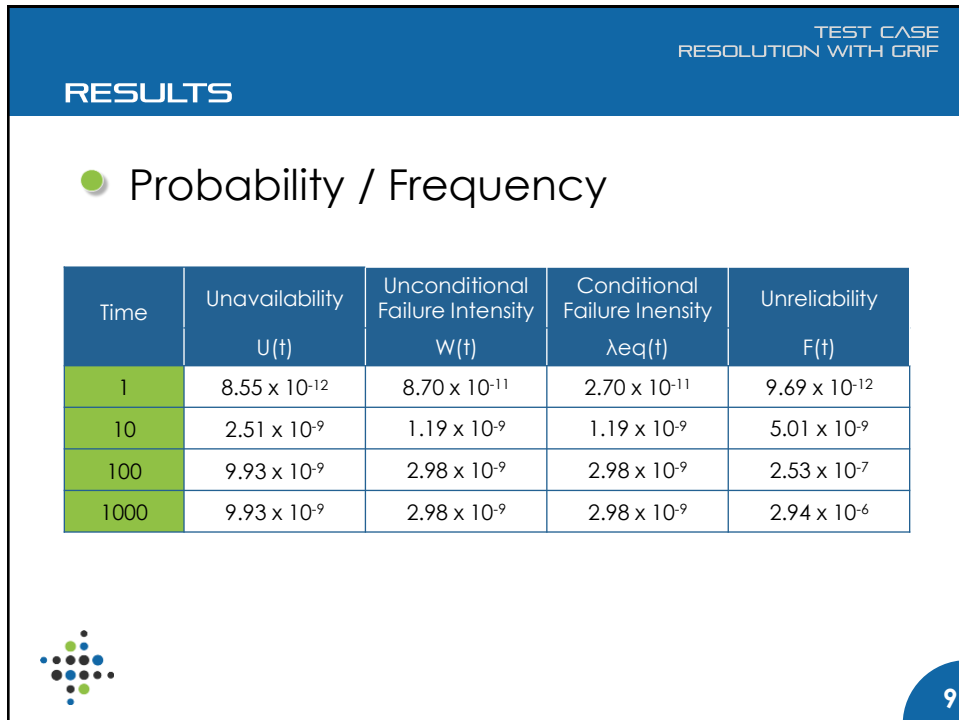


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RESULTS & CONCLUSION



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TEST CASE RESOLUTION WITH GRIF					
RESULTS					
Order	Products	Probability			
		t = 1 h	t = 10 h	t = 100 h	t = 1000 h
3	L20,L23,L37	8.61657 x 10 ⁻¹³	2.52264 x 10 ⁻¹⁰	9.96872 x 10 ⁻¹⁰	9.97006 x 10 ⁻¹⁰
	L1,L10,L13				
	L1,L10,L12				
	L1,L10,L11				
	L1,L9,L13				
	L1,L9,L12				
	L1,L9,L11				
	L23,L37,N14	8.61695 x 10 ⁻¹⁴	2.52359 x 10 ⁻¹¹	9.97768 x 10 ⁻¹¹	9.98 x 10 ⁻¹¹
	L19,L23,N17				
	L20,L23,N17				
	L18,L23,N17				
	L20,L37,N16				
	L19,L34,N17				
	L20,L34,N17				
	L18,L34,N17				
	L10,L13,N1				
	L10,L12,N1				
	L10,L11,N1				
	L9,L13,N1				
	L9,L12,N1				
	L9,L11,N1				
	L1,L13,N9				
	L1,L12,N9				
	L1,L10,N19				
	L1,L10,N20				
	L1,L10,N21				
	L1,L11,N9				
	L1,L13,N8				
	L1,L12,N8				
	L1,L11,N8				
	L1,L9,N19				
	L1,L9,N20				
	L1,L9,N21				

Results sort by
Order / Probability

72% of dominating
products

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TEST CASE RESOLUTION WITH GRIF										
RESULTS										
● Importance factors										
Time	Birnbaum		Critical		Fussel Vesely		RAW		RRW	
1	N17	6.573 x 10 ⁻⁸	L1	0.731	L1	0.7314	N17	7687	L1	3.72
	L1	6.573 x 10 ⁻⁸	L9	0.366	L9	0.3659	N1	7686	L9	1.58
	N1	6.572 x 10 ⁻⁸	L10	0.366	L10	0.3659	L1	7686	L10	1.58
10	N17	2.896 x 10 ⁻⁶	L1	0.729	L1	0.7297	N17	1156	L1	3.70
	L1	2.896 x 10 ⁻⁶	L9	0.3655	L9	0.3659	N1	1155	L9	1.58
	N1	2.895 x 10 ⁻⁶	L10	0.3655	L10	0.3659	L1	1155	L10	1.58
100	N17	7.237 x 10 ⁻⁶	L1	0.728	L1	0.7285	N17	730	L1	3.68
	L1	7.236 x 10 ⁻⁶	L9	0.3653	L9	0.3659	N1	729	L9	1.58
	N1	7.229 x 10 ⁻⁶	L10	0.3653	L10	0.3659	L1	729	L10	1.58
1000	N17	7.238 x 10 ⁻⁶	L1	0.728	L1	0.7285	N17	730	L1	3.68
	L1	7.237 x 10 ⁻⁶	L9	0.3653	L9	0.3659	N1	729	L9	1.58
	N1	7.230 x 10 ⁻⁶	L10	0.3653	L10	0.3659	L1	729	L10	1.58



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CONCLUSION

- Test case perfectly fit Reseda module
- Training time for Reseda : 0.5 day
- 10 minutes to do the modelling
- Computation time : few seconds

Algorithm :[MCFB94] J.-C. Madre, O. Coudert, H. Fraise and M. Bouissou. Application of a New Logically Complete ATMS to Digraph and Network-Connectivity Analysis. In Proceedings of the Annual Reliability and Maintainability Symposium, ARMS'94, pp 118-123, 1994.



6.6 KV
TEST CASE



● PRESENTATION



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WHY PETRO ?

- This model could be modeled using PETRI module.
- We choose PETRO to improve understanding with a model with a visual aspect.
- To demonstrate that PETRO can be used not only for Availability Studies in Petroleum industry.



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WHY PETRO ?

- PETRO was not the better choice.
- Create directly the PETRI net would have been easier to take into account Failure on demand not only in start-up phase but also in shutdown phase.
- Another point not considered in PETRO model is the CCF on demand for diesel generator.



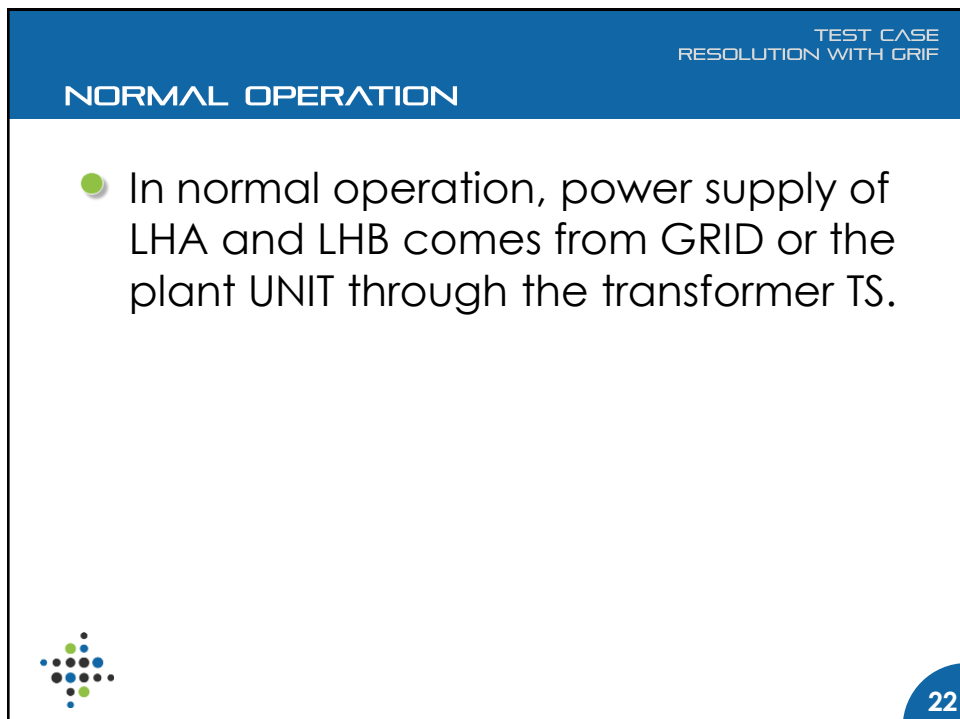
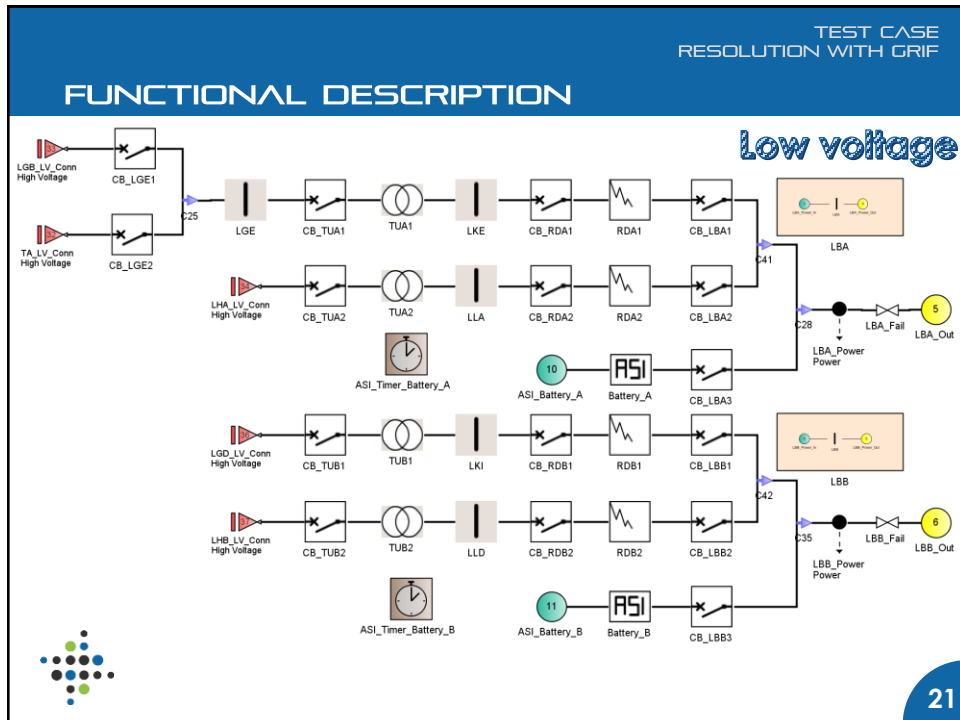
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● DESCRIPTION





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DEGRADED MODE


- In case of UNIT failure only (it means GRID works), system works in optimal way and supplies power into the GRID.
- In case of GRID failure, the power of UNIT is reduced, to feed only the plant itself. The switch to house load mode has a probability of failure at 0.2.
- In this degraded mode, failure rates of equipment in UNIT part is higher.
- If UNIT and GRID are failed, it is not possible to start UNIT if GRID is not repaired.



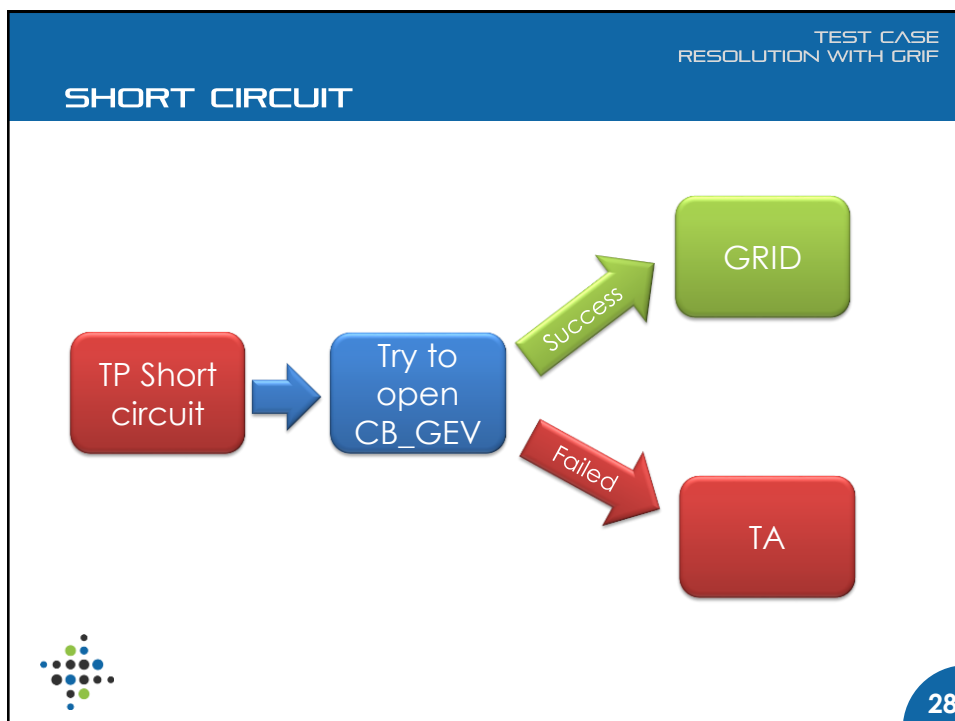
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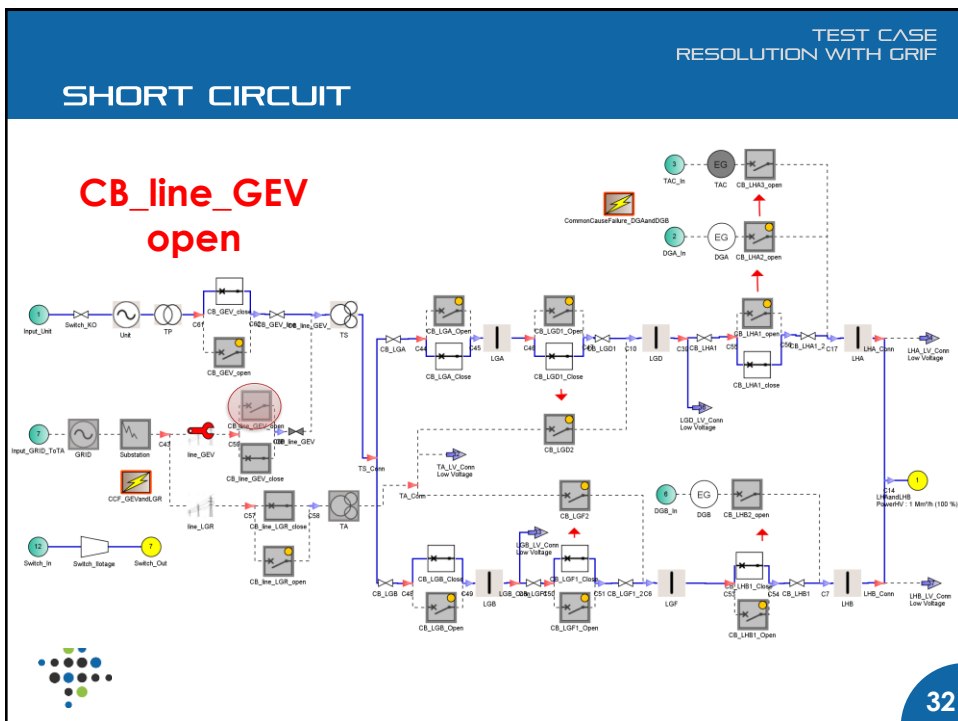
LOW VOLTAGE

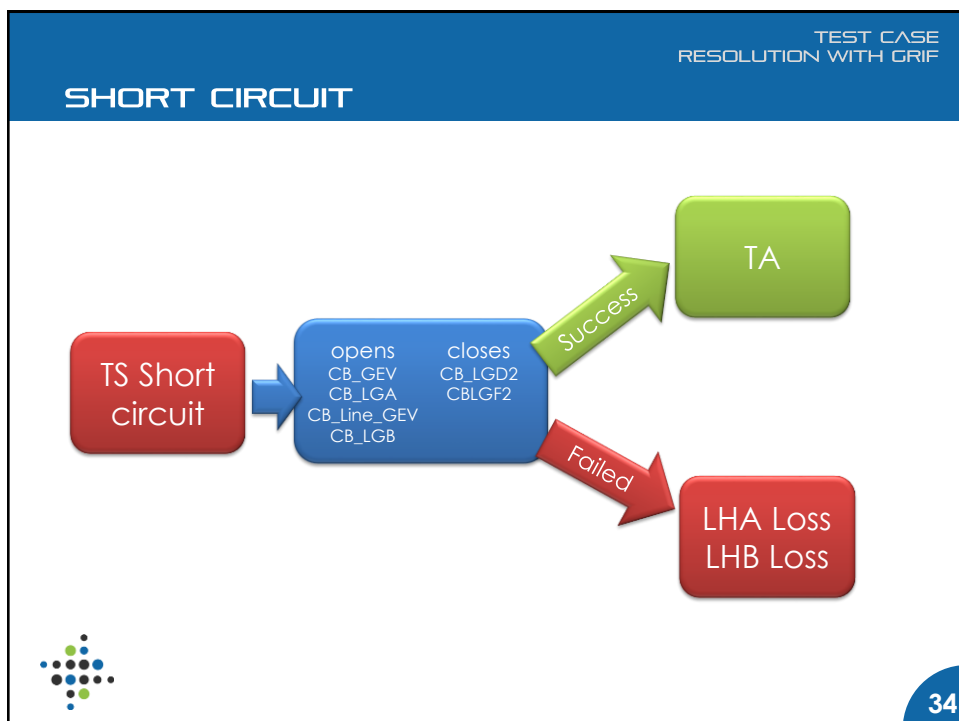
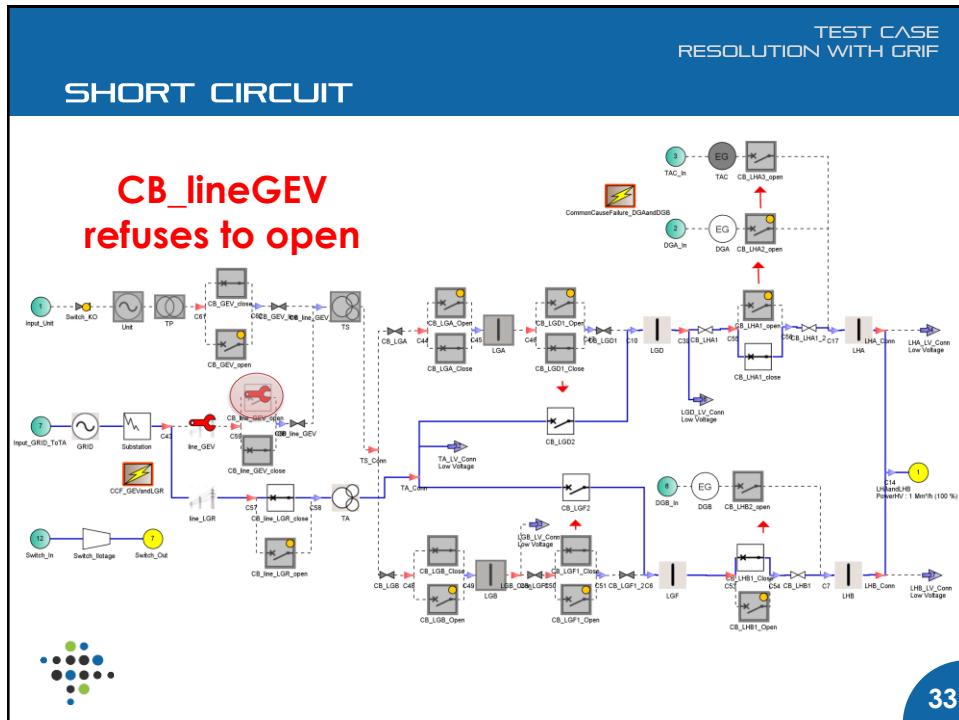
- LBA bus bar (in low voltage part) supplies the following circuit breakers:
 - CB_LGA, CB_LGB,
 - CB_LGD1, CB_LGD2,
 - CB_LGE1, CB_LGE2,
 - CB_LHA1, CB_LHA2, CB_LHA3
- LBB bus bar (in low voltage part) supplies the following circuit breakers:
 - CB_LGF1, CB_LGF2,
 - CB_LHB1, CB_LHB2
- All the others circuit breakers are considered as “perfectly powered”.

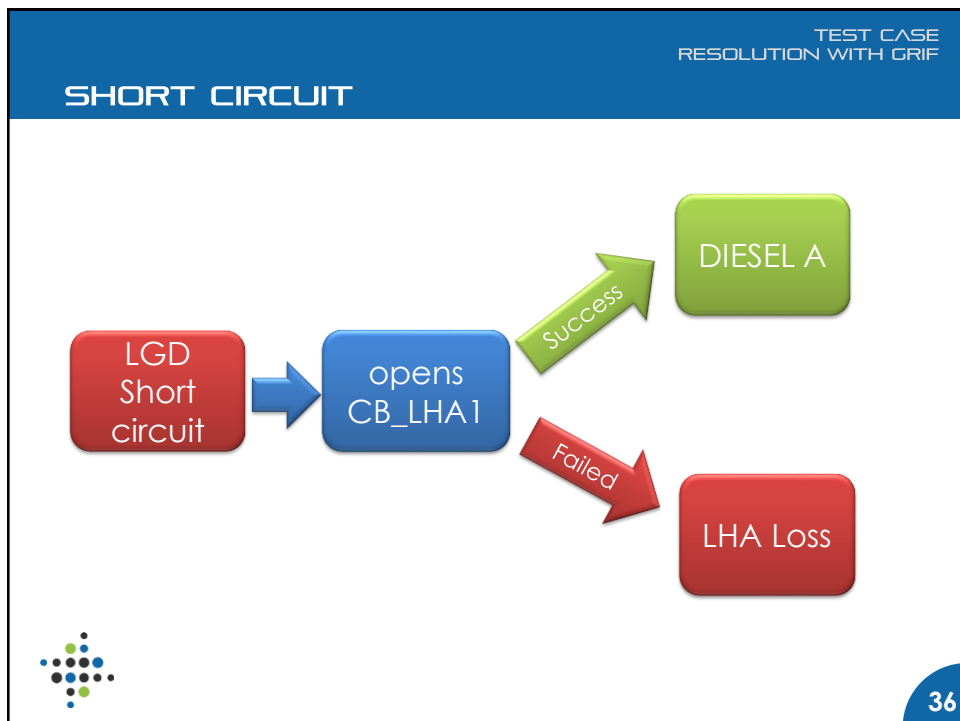
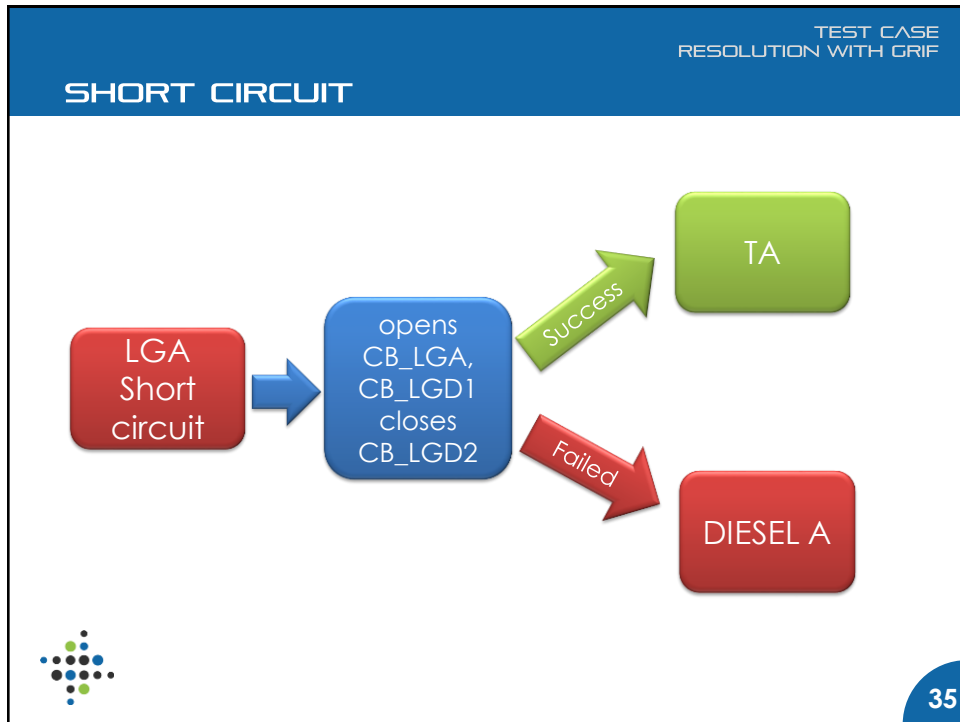


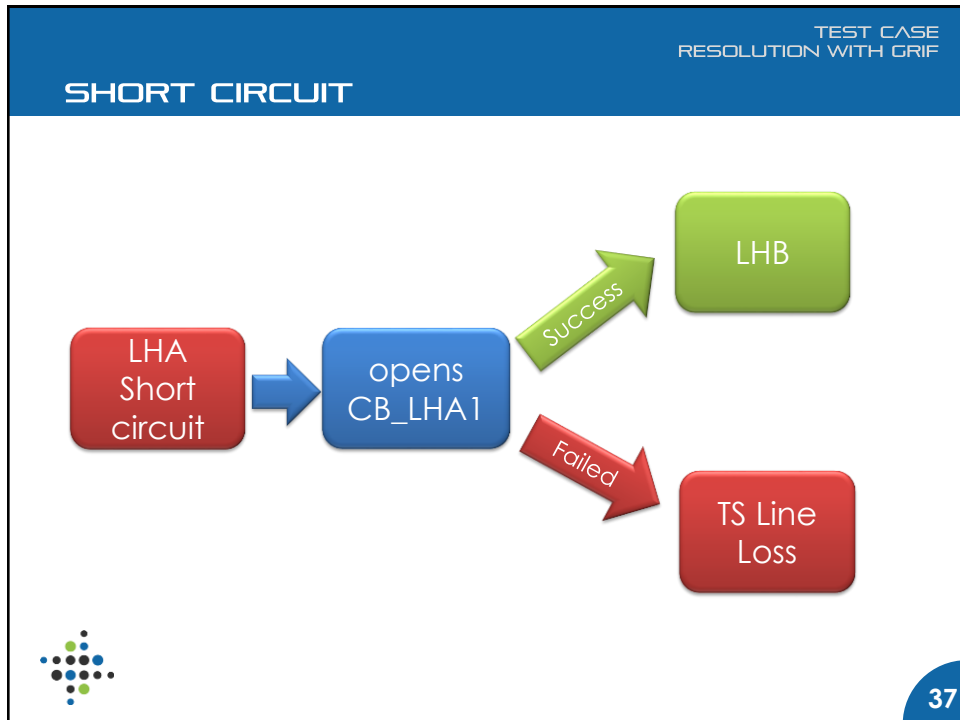
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TEST CASE
RESOLUTION WITH GRIF


- RESULTS & CONCLUSION

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TEST CASE
RESOLUTION WITH GRIF

RESULTS

- Calculations performed with 100,000 histories (at t=10,000 hours).




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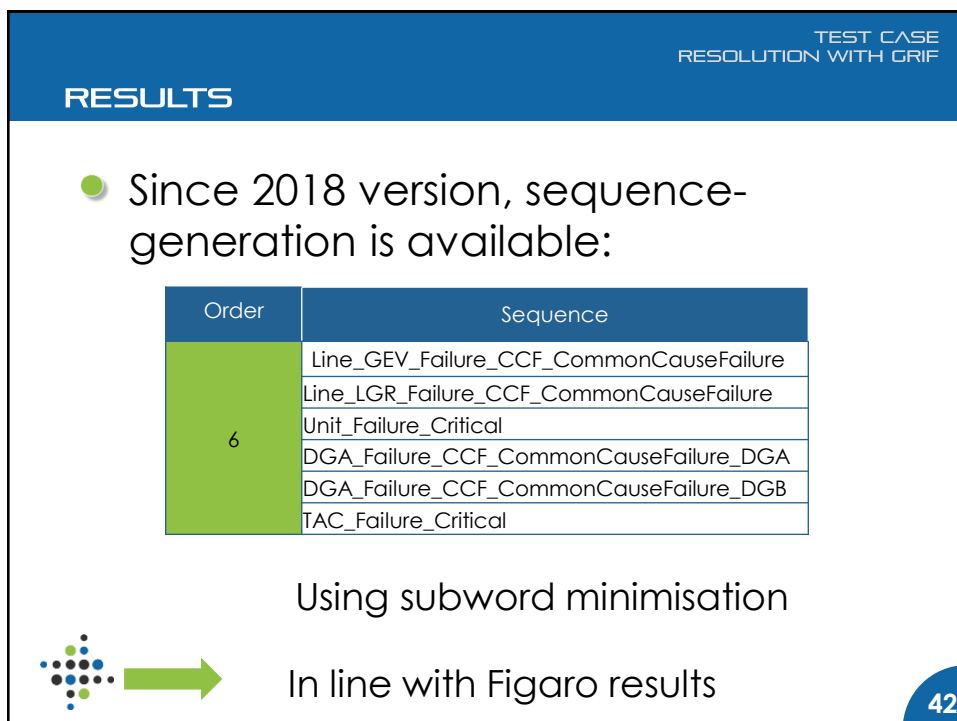
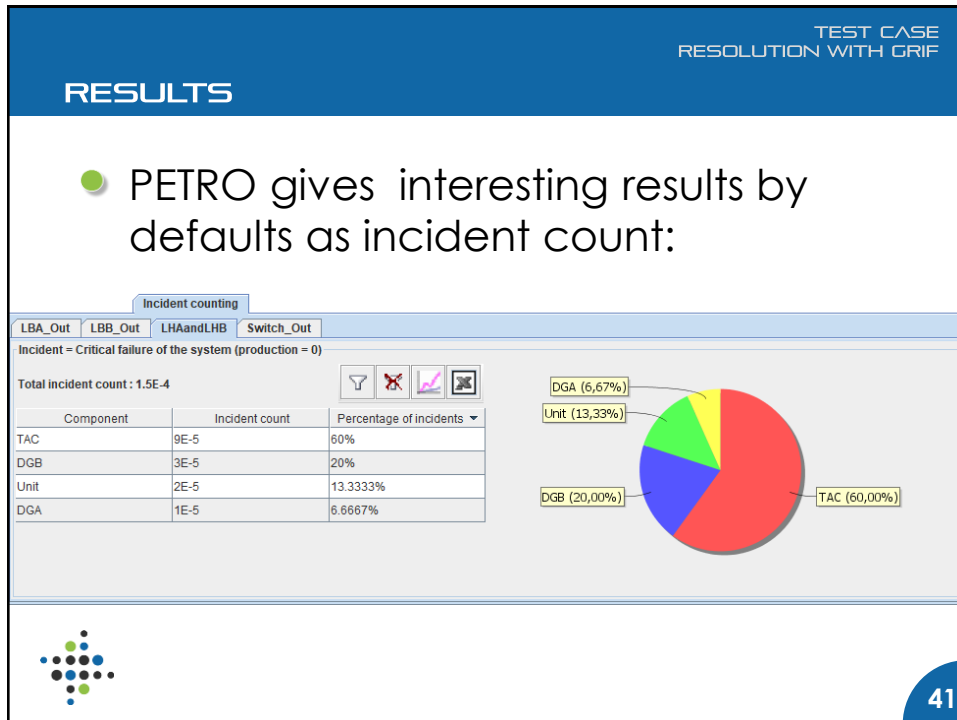
TEST CASE
RESOLUTION WITH GRIF

RESULTS

- Unreliability = 7.86×10^{-5}
 - ➔ Value not significant
- Some court circuit case are missing
- Low voltage is not fully taken into account



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CONCLUSION

- Test case not totally solved for the moment
- Training time for PETRO : 3 days
- Computation time : 91 minutes using a laptop with Core i5 6200U (4 threads).



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QUESTIONS ? 😊



SATODEV
SAFETY TOOLS DEVELOPMENT

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