

Risk Mitigation through Validation

Initialization of the validation and certification strategy for 15+MW offshore WEC

For the initialization phase of the newly developed validation and certification strategy, we have established a systematic process for risk mitigation through validation. It is based on the results of the Design FMEAs and can be executed for all components and subsystems of the turbine.

Implementation of the Process

In the FMEA all possible failure modes together with the failure effects and the potential causes are defined by the component experts. Based on experience the likelihood of a failure to occur as well as the severity of an occurrence is rated and the risk level for each failure mode is calculated.

Based on the initial risk assessment of the FMEA the share of each failure mode on the overall risk of the considered component to fail is calculated.

Item #	Assembly/Part/Function	Potential Failure Mode	Potential Failure Effects	Potential Causes	Initial Risk				
					Severity	Occurrence	Risk level	Risk cat	% of total risk
1	XXXX	YYYY	hhhh	mmmm	5	4	20	L	5,93%
2	XXXX	YYYY	hhhh	mmmm	9	7	63	II	18,69%
3	XXXX	YYYY	hhhh	mmmm	7	4	28	M	8,31%
4	XXXX	YYYY	hhhh	mmmm	8	5	40	M	11,87%
5	XXXX	YYYY	hhhh	mmmm	10	9	90	II	26,71%
6	XXXX	YYYY	hhhh	mmmm	9	6	54	II	16,02%
7	XXXX	YYYY	hhhh	mmmm	7	6	42	M	12,46%

FMEA with Risk Assessment

The validation process is divided in 5 phases:

Component validation, integration validation, system validation, prototype validation and field validation. For each failure mode it is decided in which validation phases which risk mitigation activities are recommended.

Picture credits:

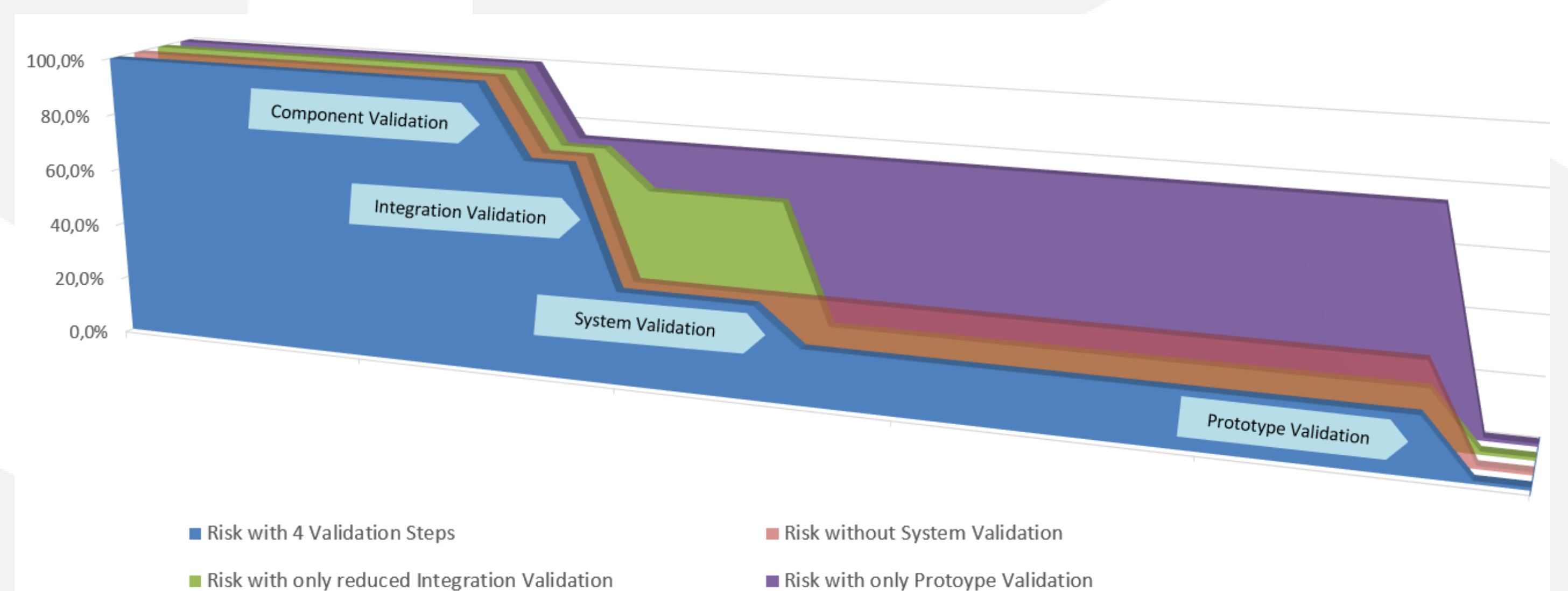
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The content of this comprehensive table is a very valuable tool for the development of the test specification as it analyses the main failure modes and its weighting to be addressed in the tests. This is likewise helpful when dealing with variants of the turbine in the future as the table only needs to be adapted to the new requirements.

ASSESSMENT			AB	AI	AP	AW	AX
Initial Risk			CV	IV	SV	PV	Risk after mitigation
Risk level	Risk cat	% of total risk	CV Remaining risk (from total)	IV Remaining risk (from total)	SV Remaining risk (from total)	PV Remaining risk (from total)	
15	M	3,70%	0,00%	0,00%	0,00%	0,00%	0,0%
48	II	11,85%	9,48%	2,37%	2,37%	0,00%	0,0%
66	II	16,30%	14,67%	8,15%	8,15%	0,00%	0,0%
12	M	2,96%	0,74%	0,74%	0,30%	0,00%	0,0%
30	II	7,41%	7,41%	7,41%	0,74%	0,37%	0,4%

Risk Mitigation in 5 phases

With the completed tables, we present the OEM the recommendations from ReaLCoE for validation including costs and a rough timeline. Possible variants can be visualized to support decision making, highlighting the advantages of validation in parallel to the development of the turbine



Exemplary visualization of risk mitigation over time for different validation possibilities

