From Hazard Assessment to Safety Requirement Specification

Use of Big Data

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Agenda

1. BASF – At a Glance
2. Process Hazard Assessment – Why and How?
3. Stature® – Our Global IT Tool, Training and Resources
4. SRS/MSD-Tool

BASF – At a Glance

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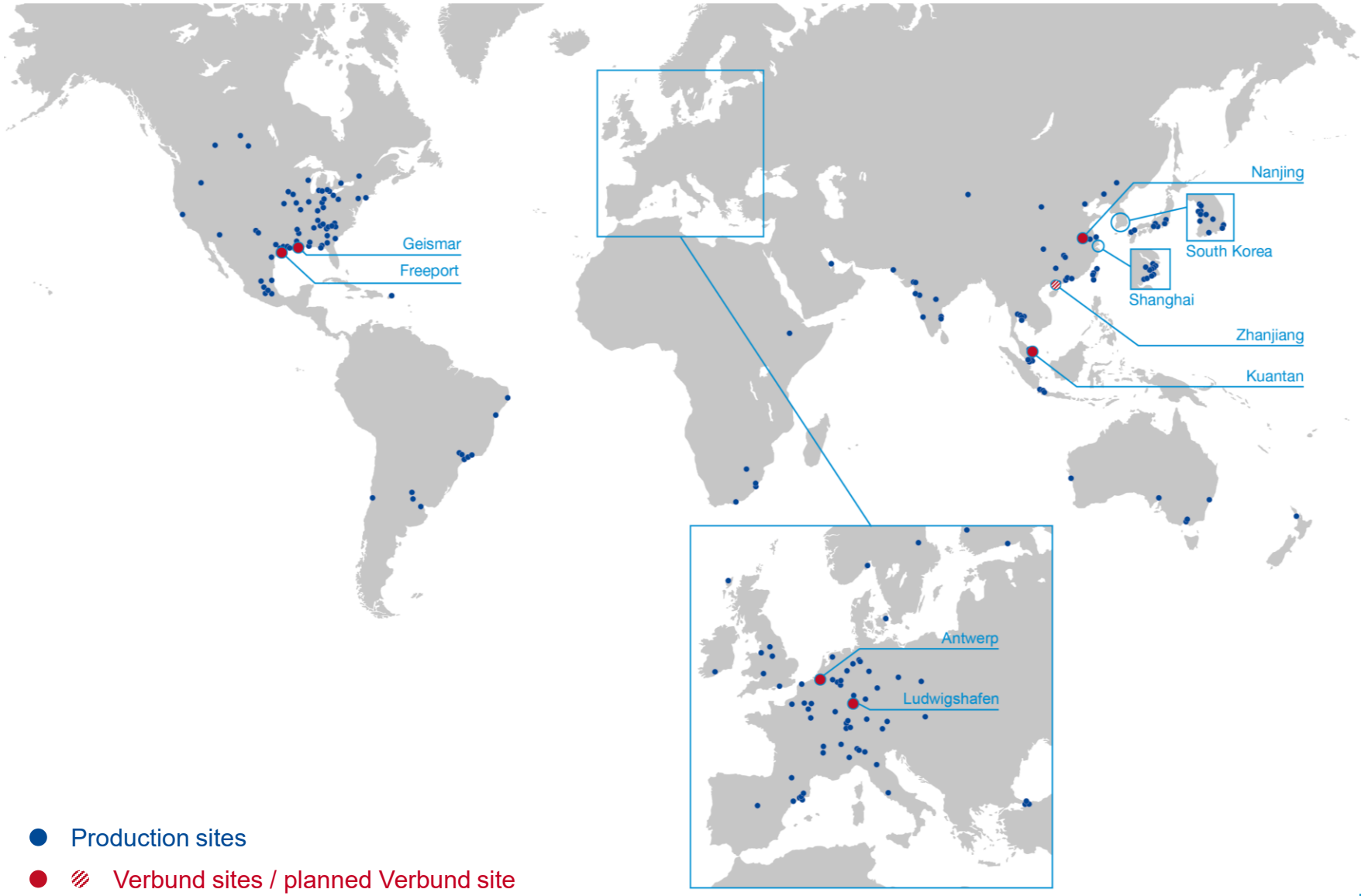
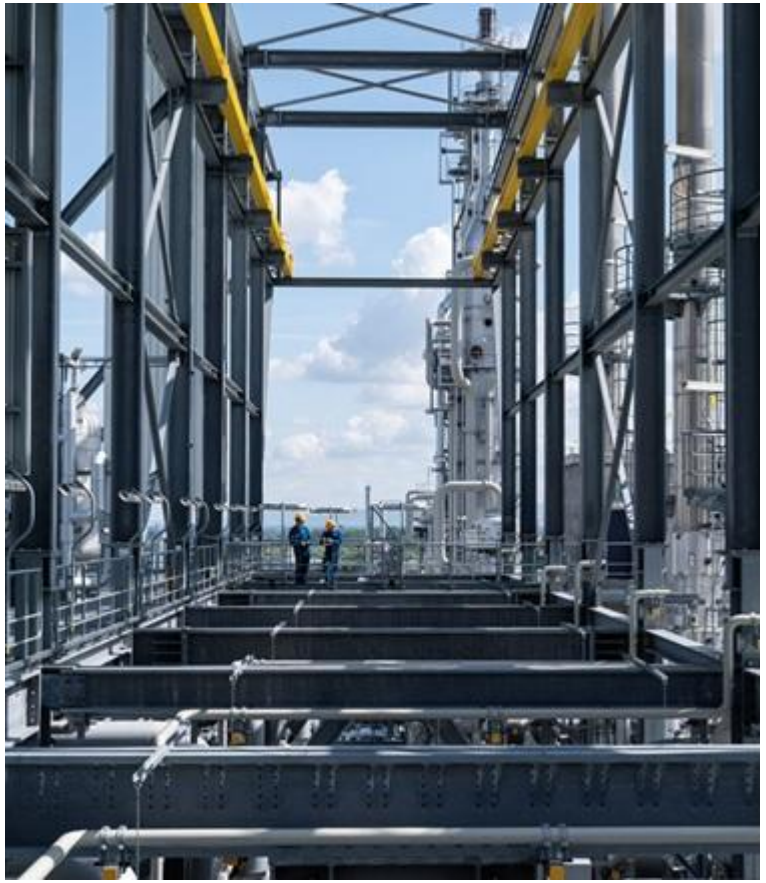
BASF worldwide: Production and Verbund sites



Organization of the BASF Group

- Combined into six **segments**, 12 **divisions**[1] bear strategic and operational responsibility
- Our **central research division** and **innovation competencies in our operational divisions** safeguard our innovative capacity and competitiveness
- The **Corporate Center** units support the Board of Executive Directors in steering the company as a whole
- Five **service units** provide competitive services for the BASF Group



[1]Split of the Catalysts division effective January 1, 2025. New divisions: Environmental Catalyst and Metal Solutions (ECMS) and Battery Materials within Surface Technologies segment.

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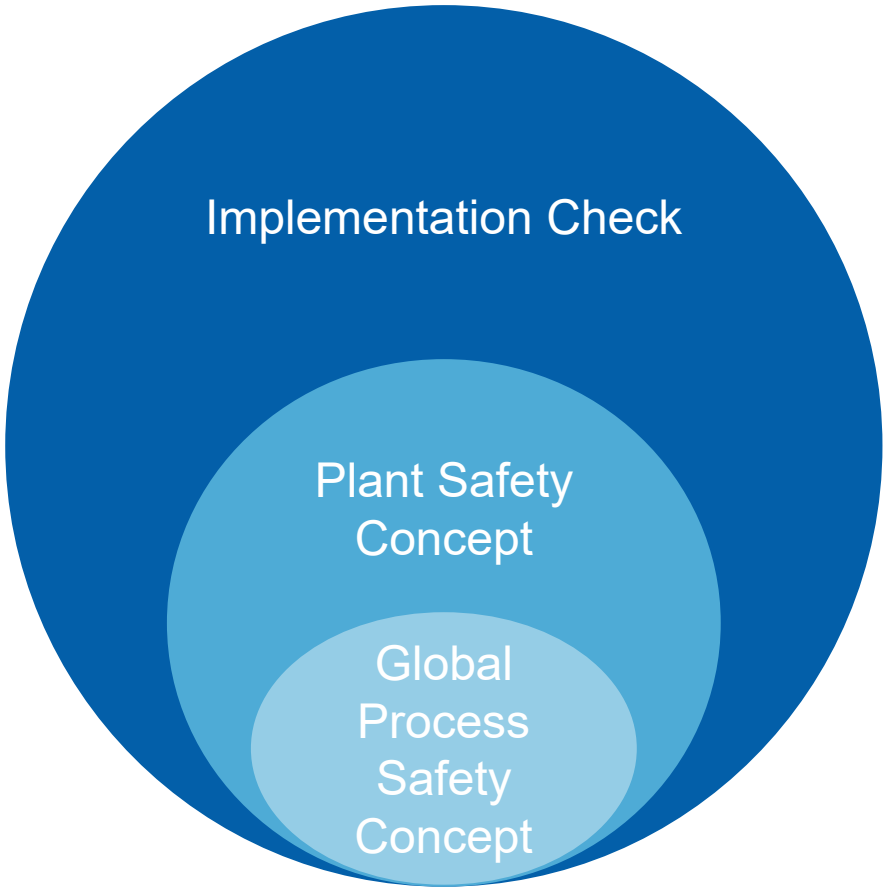
Fundamentals for Safe Operations

Layers within the Framework of Process Safety



Global Process Safety Concept

- For Core Technologies
- Summary of related Hazards, corresponding Risk Evaluation and recommended Countermeasures

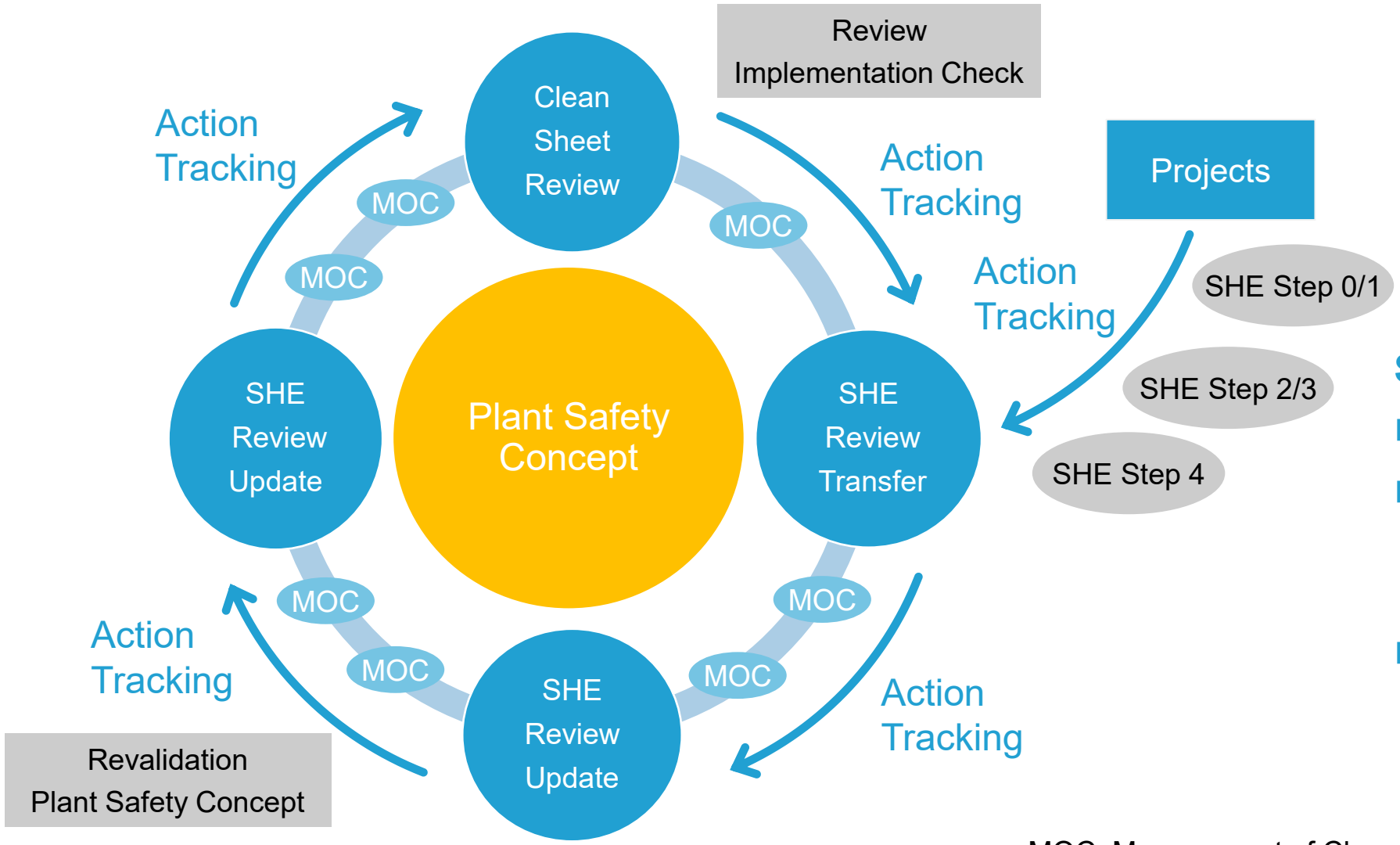
Plant Safety Concept

- For each Plant on a conceptual Level
- SHE Review Process with all Process-Related Hazards, Risks and appropriate Safeguards

Implementation Check (Clean Sheet Review):

- For each Plants on a detailed Level
- Identify based on P&IDs (Piping and Instrumentation Diagrams) appropriate Risk Mitigation Measures and their Effectiveness
- Method depends on Hazard Potential and local regulatory Status

Hazard Review Lifecycle



Stature® for

- Projects (SHE Step 0 - 4)
- Existing Plants, MOC, revalidation und “clean sheets”
- Existing Plants → initial load of documents

MOC: Management of Change

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2. Process Hazard Assessment – Why and How?
3. Stature® – Our Global IT Tool, Training and Resources
4. Results, Experience and Enhancements after 7 Years

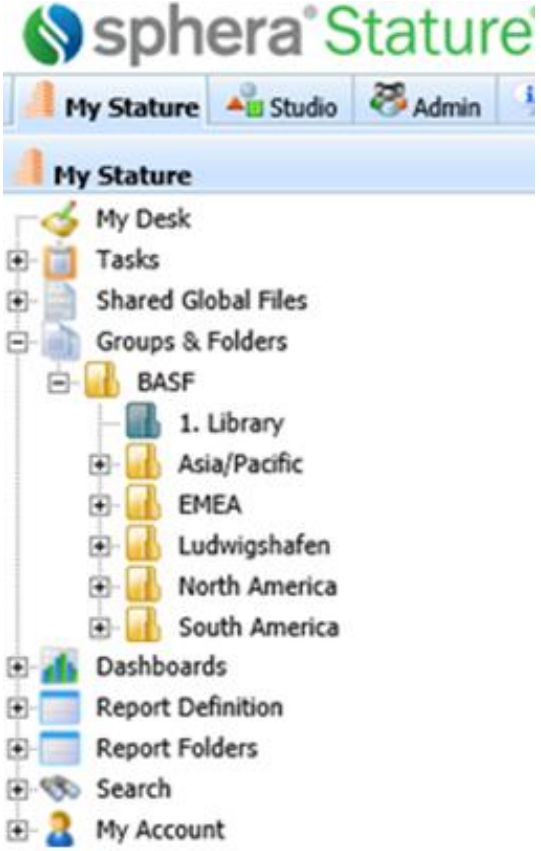
Stature® in BASF

What is it about?

- Stature® is a Global Web-Based Platform for documenting Hazard Assessments for new Projects and existing Plants
- Stature® is a mandatory Tool since 2015
- Stature® facilitates Tracking and Management of Action Items

Who are the User Groups?

- Plant Management / Operations
- Process Safety and Global Auditors
- Engineering
- Global Technology Teams
- More than 10 000 users globally



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Stature® Training & Resources

Online

Classroom or Virtual

In Stature®

sphera® Stature®

E-Learning Modules are accessible via BASF Intranet to all Employees

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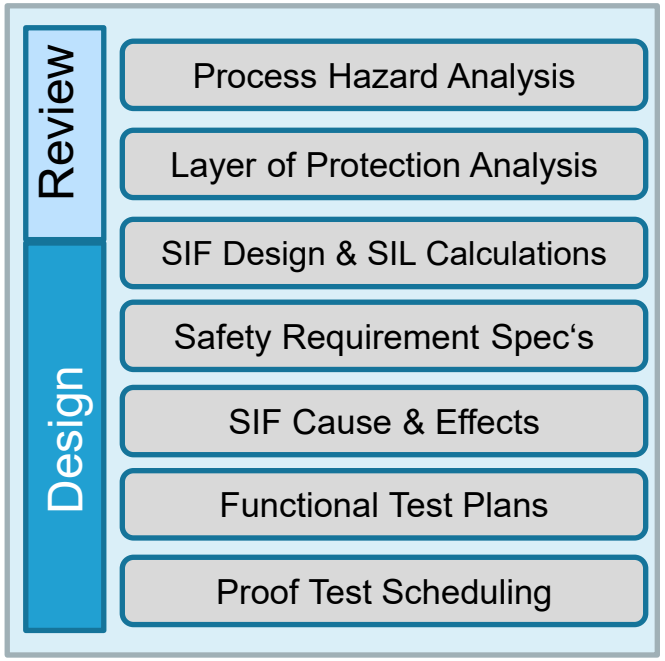
Integrated Process – Digital Transformation IEC 61511 Specification

- Safety Instrumented System (SIS) must be documented in Safety Requirement Specification (SRS, according to IEC 61511)
  - SRS is the Central Anchor Point for the Design, Testing and Operation of a SIS
  - SRS Documentation is based on Countermeasures defined in SHE Review
  - Global Standardized Document (former: Word-Template)



- New: Simplified Data Transfer from SHE Review to SRS/(MSD*) Document
  - Improvement of Quality using a uniform Documentation of Plant Safety
  - Avoidance of possible Errors during manual Data Transfer
  - Achievement of full Data Consistency and Minimization of Workload

- Basis for next steps e. g., check before Start-Up and Management of Change

*MSD: Mechanical safety device
*SRS Safety Requirement Specification

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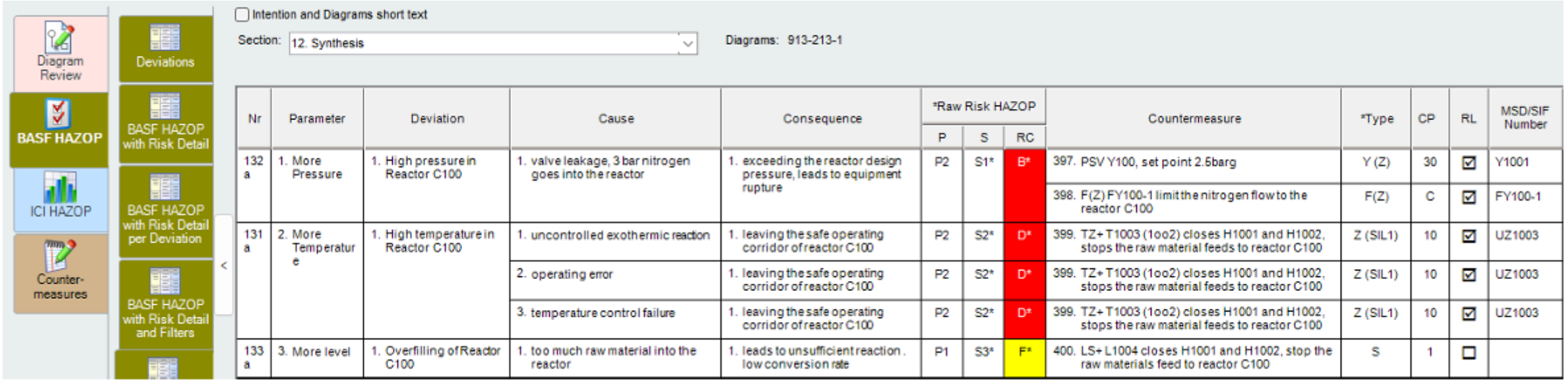
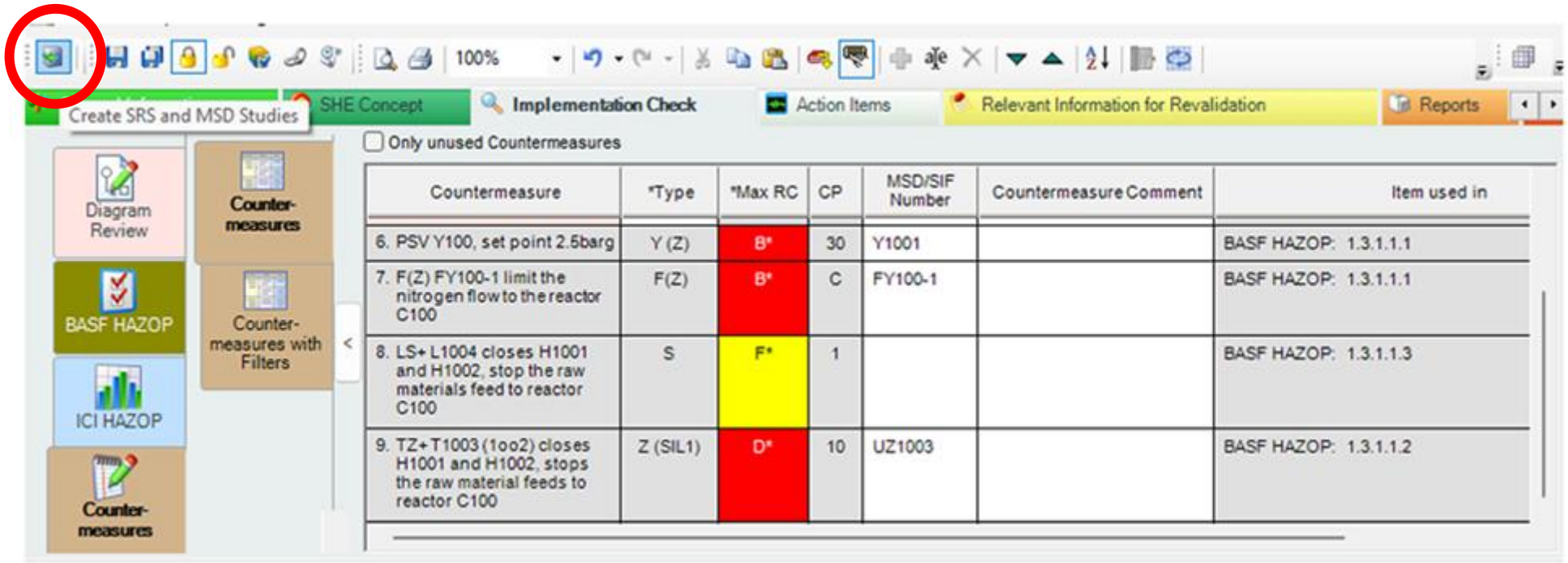
Content of a HAZOP Study – Basic Information for SRS/MSD



Nr	Parameter	Deviation	Cause	Consequence	*Raw Risk HAZOP			Countermeasure	*Type	CP	RL	MSD/SIF Number
					P	S	RC					
132 a	1. More Pressure	1. High pressure in Reactor C100	1. valve leakage, 3 bar nitrogen goes into the reactor	1. exceeding the reactor design pressure, leads to equipment rupture	P2	S1*	B*	397. PSV Y100, set point 2.5barg	Y (Z)	30	☑	Y1001
								398. F(Z) FY100-1 limit the nitrogen flow to the reactor C100	F(Z)	C	☑	FY100-1
131 a	2. More Temperature	1. High temperature in Reactor C100	1. uncontrolled exothermic reaction	1. leaving the safe operating corridor of reactor C100	P2	S2*	D*	399. TZ+ T1003 (1oo2) closes H1001 and H1002, stops the raw material feeds to reactor C100	Z (SIL1)	10	☑	UZ1003
			2. operating error	1. leaving the safe operating corridor of reactor C100	P2	S2*	D*	399. TZ+ T1003 (1oo2) closes H1001 and H1002, stops the raw material feeds to reactor C100	Z (SIL1)	10	☑	UZ1003
			3. temperature control failure	1. leaving the safe operating corridor of reactor C100	P2	S2*	D*	399. TZ+ T1003 (1oo2) closes H1001 and H1002, stops the raw material feeds to reactor C100	Z (SIL1)	10	☑	UZ1003
133 a	3. More level	1. Overfilling of Reactor C100	1. too much raw material into the reactor	1. leads to unsufficient reaction . low conversion rate	P1	S3*	F*	400. LS+ L1004 closes H1001 and H1002, stop the raw materials feed to reactor C100	S	1	☐	

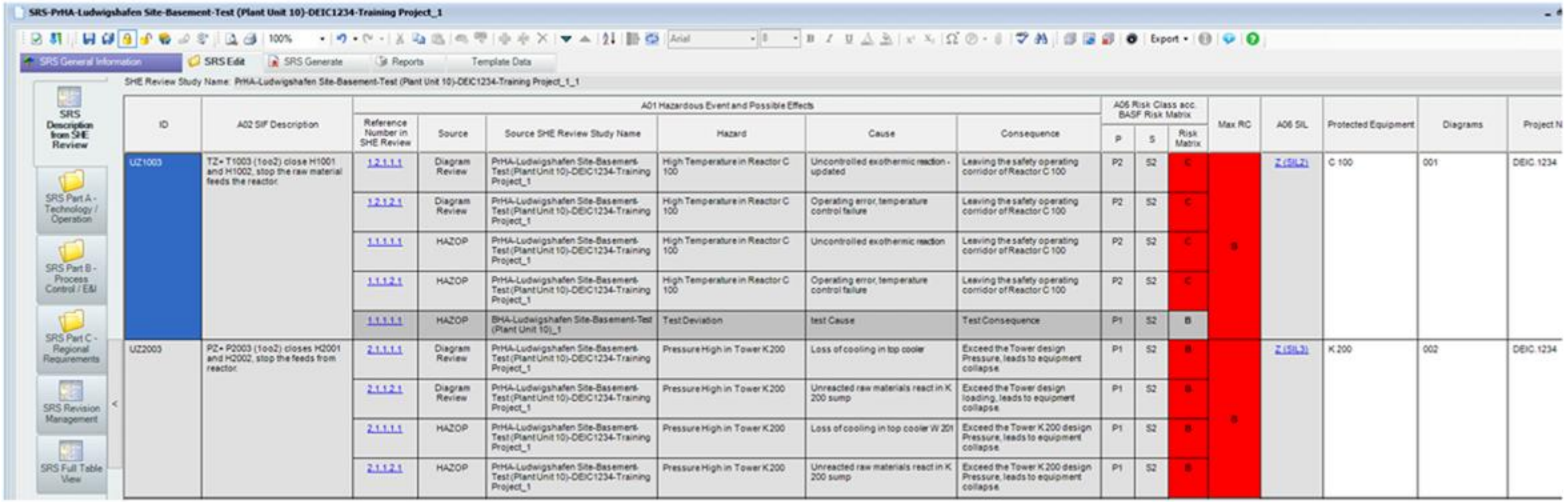
Create a new SRS/MSD “Study” – Grab the data from the SHE Review

It‘s just a single click into the left upper corner to start the SRS/MSD-Tool, to collect all needed information from the Hazard Assessment and to create the SRS/MSD-study.



Countermeasure	*Type	*Max RC	CP	MSD/SIF Number	Countermeasure Comment	Item used in
6. PSV Y100, set point 2.5barg	Y (Z)	B*	30	Y1001		BASF HAZOP: 1.3.1.1.1
7. F(Z) FY100-1 limit the nitrogen flow to the reactor C100	F(Z)	B*	C	FY100-1		BASF HAZOP: 1.3.1.1.1
8. LS+ L1004 closes H1001 and H1002, stop the raw materials feed to reactor C100	S	F*	1			BASF HAZOP: 1.3.1.1.3
9. TZ+T1003 (1oo2) closes H1001 and H1002, stops the raw material feeds to reactor C100	Z (SIL1)	D*	10	UZ1003		BASF HAZOP: 1.3.1.1.2

SRS-”Study” – SRS Description from SHE Review

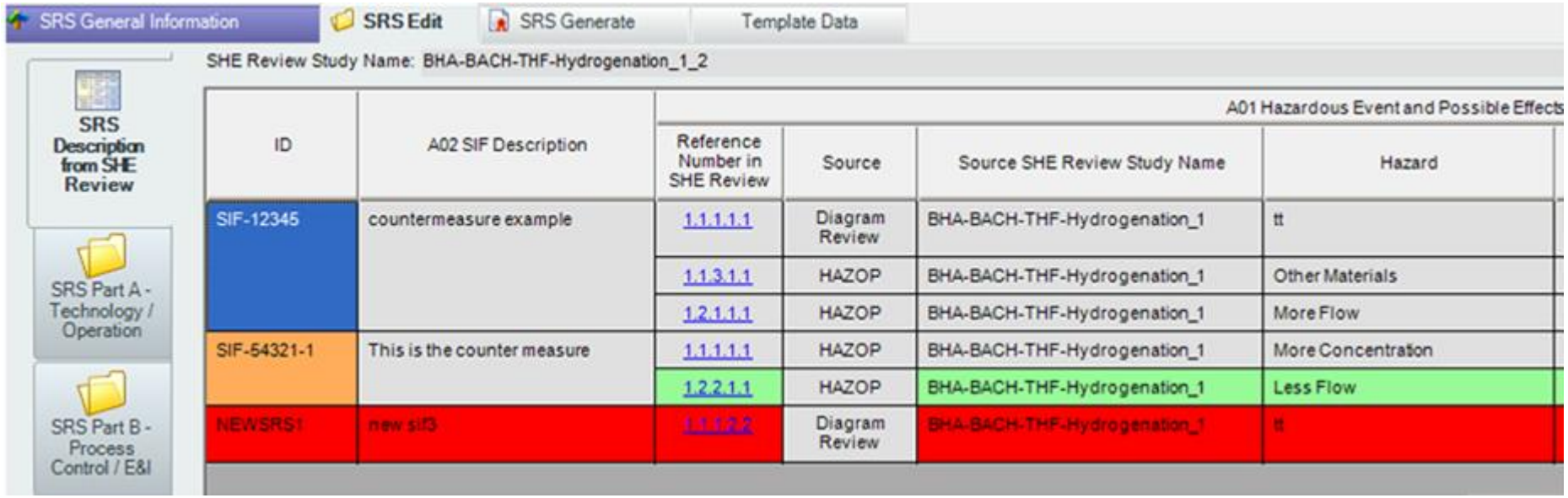


ID	A02 SIF Description	A01 Hazardous Event and Possible Effects						A06 Risk Class acc. BASF Risk Matrix			Max RC	A06 SIL	Protected Equipment	Diagrams	Project N
		Reference Number in SHE Review	Source	Source SHE Review Study Name	Hazard	Cause	Consequence	P	S	Risk Matrix					
UZ1003	TZ- T1003 (1oo2) close H1001 and H1002, stop the raw material feeds the reactor.	1.2.1.1.1	Diagram Review	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	High Temperature in Reactor C 100	Uncontrolled exothermic reaction - updated	Leaving the safety operating corridor of Reactor C 100	P2	S2	C		Z (SIL2)	C 100	001	DEIC.1234
		1.2.1.2.1	Diagram Review	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	High Temperature in Reactor C 100	Operating error, temperature control failure	Leaving the safety operating corridor of Reactor C 100	P2	S2	C					
		1.1.1.1.1	HAZOP	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	High Temperature in Reactor C 100	Uncontrolled exothermic reaction	Leaving the safety operating corridor of Reactor C 100	P2	S2	C					
		1.1.1.2.1	HAZOP	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	High Temperature in Reactor C 100	Operating error, temperature control failure	Leaving the safety operating corridor of Reactor C 100	P2	S2	C					
		1.1.1.1.1	HAZOP	BHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)_1	Test Deviation	test Cause	Test Consequence	P1	S2	B					
UZ2003	PZ- P2003 (1oo2) closes H2001 and H2002, stop the feeds from reactor.	2.1.1.1.1	Diagram Review	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	Pressure High in Tower K 200	Loss of cooling in top cooler	Exceed the Tower design Pressure, leads to equipment collapse.	P1	S2	B		Z (SIL3)	K 200	002	DEIC.1234
		2.1.1.2.1	Diagram Review	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	Pressure High in Tower K 200	Unreacted raw materials react in K 200 sump	Exceed the Tower design loading, leads to equipment collapse.	P1	S2	B					
		2.1.1.1.1	HAZOP	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	Pressure High in Tower K 200	Loss of cooling in top cooler W 201	Exceed the Tower K 200 design Pressure, leads to equipment collapse.	P1	S2	B					
		2.1.1.2.1	HAZOP	PrHA-Ludwigshafen Site-Basement-Test (Plant Unit 10)-DEIC1234-Training Project_1	Pressure High in Tower K 200	Unreacted raw materials react in K 200 sump	Exceed the Tower K 200 design Pressure, leads to equipment collapse.	P1	S2	B					

- Risk data imported automatically from HAZOP upon study creation
- Summary of SRS/MSD ID, countermeasure and related risk scenario
- Manual consistency check of imported data (navigation back to source HAZOP via blue Link)
- User Input of Equipment, Diagrams, etc.

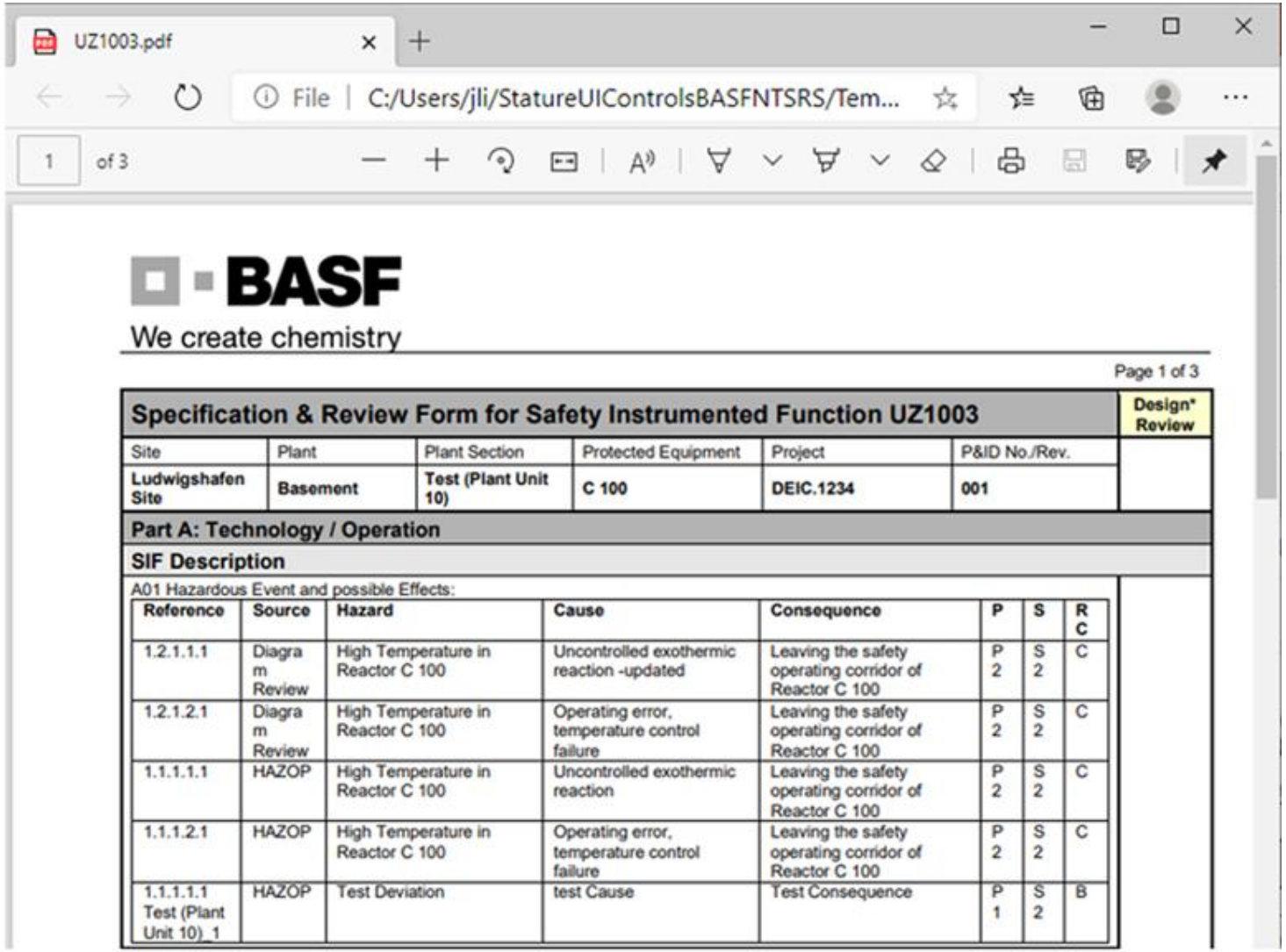
View Highlights

- Highlight changes can be viewed on the first worksheet
  - Green – New added item
  - Orange – Modified item
  - Red – Deleted items



ID	A02 SIF Description	A01 Hazardous Event and Possible Effects			
		Reference Number in SHE Review	Source	Source SHE Review Study Name	Hazard
SIF-12345	countermeasure example	1.1.1.1.1	Diagram Review	BHA-BACH-THF-Hydrogenation_1	tt
		1.1.3.1.1	HAZOP	BHA-BACH-THF-Hydrogenation_1	Other Materials
		1.2.1.1.1	HAZOP	BHA-BACH-THF-Hydrogenation_1	More Flow
SIF-54321-1	This is the counter measure	1.1.1.1.1	HAZOP	BHA-BACH-THF-Hydrogenation_1	More Concentration
		1.2.2.1.1	HAZOP	BHA-BACH-THF-Hydrogenation_1	Less Flow
NEWSRS1	new sif3	1.1.1.2.2	Diagram Review	BHA-BACH-THF-Hydrogenation_1	tt

SRS/MSD Document Generation – Resulting Document



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Page 1 of 3

Specification & Review Form for Safety Instrumented Function UZ1003					Design* Review
Site	Plant	Plant Section	Protected Equipment	Project	P&ID No./Rev.	
Ludwigshafen Site	**Basement**	**Test (Plant Unit 10)**	**C 100**	**DEIC.1234**	**001**	

Part A: Technology / Operation

SIF Description

A01 Hazardous Event and possible Effects:

Reference	Source	Hazard	Cause	Consequence	P	S	RC
1.2.1.1.1	Diagram Review	High Temperature in Reactor C 100	Uncontrolled exothermic reaction -updated	Leaving the safety operating corridor of Reactor C 100	P 2	S 2	C
1.2.1.2.1	Diagram Review	High Temperature in Reactor C 100	Operating error, temperature control failure	Leaving the safety operating corridor of Reactor C 100	P 2	S 2	C
1.1.1.1.1	HAZOP	High Temperature in Reactor C 100	Uncontrolled exothermic reaction	Leaving the safety operating corridor of Reactor C 100	P 2	S 2	C
1.1.1.2.1	HAZOP	High Temperature in Reactor C 100	Operating error, temperature control failure	Leaving the safety operating corridor of Reactor C 100	P 2	S 2	C
1.1.1.1.1 Test (Plant Unit 10)_1	HAZOP	Test Deviation	test Cause	Test Consequence	P 1	S 2	B

Advantages of SRS/MSD-Tool

- No manual work to collect all relevant scenarios from the hazard assessment – no scenario will be forgotten
- Changes in the hazard assessment are highlighted – changes are visible
- Automatically generated specification sheets, manual adaptions possible – less workload and time consumption
- Digital signing of the specification sheets in the tool are optional

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