ISA Delhi Section

Setting the Standard for Automation™

Implementation of Safety Integrity Level (SIL) at Yara Babrala, UP

Presented By: Amit Chauhan (Instrumentation)
Gopal Kushwaha (Ammonia Process)
Arindam Samanta (Electrical)

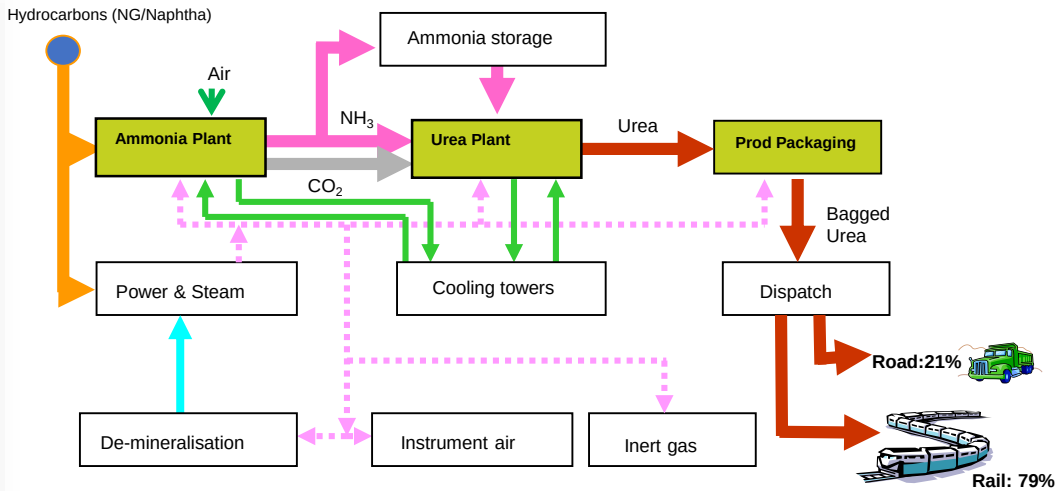
ISA-D: “Fertiliser , Food and Pharma Symposium-2019”

Contents

ISA Delhi Section

Yara Fertilizers India Pvt. Ltd, Babrala overview

ISA Delhi Section



- Located on HBJ pipeline in Western UP
- Plant capacity

Ammonia	2000 MTPD
Urea	3500 MTPD

Incidents that shape up Process Safety & Functional Safety

ISA Delhi Section

Most of the Companies not able to come back into the Business after the Incidents.

Bhopal (India) – 1984

- Methyl Isocyanate (MIC) leaked
- More than 3000 killed immediately
- Thousands died in following weeks
- Millions got affected

Thousands Died

Tragic

After Effects

BP Refinery (Texas City) – 2005

- Vapour Cloud Explosion
- 15 killed
- More than 170 injured
- Loss > US $3 billion

Extensive Loss

Explosion

Blaze

Piper Alpha Disaster (North Sea, UK) – 1988

- Fire and explosion
- 167 people died
- Loss of US $1.7 billion

On Fire

Before

After

Flixborough (UK) – 1974

- Release of highly flammable Cyclohexane
- Fire Explosion
- Plant Demolished
- 28 Fatalities
- 53 Injuries
- 1800 houses & 167 shops damaged

Plant Demolished

Fire

Explosion

Source : Wikipedia

Safety Journey at Yara Babrala over the years

ISA Delhi Section

1994 -2000
- PPEs Culture
- Safety Work Permit

2005 - 2008
- British Safety Council Model for SHE

2008
- Near miss Reporting

2009 - 2011
- Dupont e modules
- Dupont BBS

2013
- Risk Based PSM

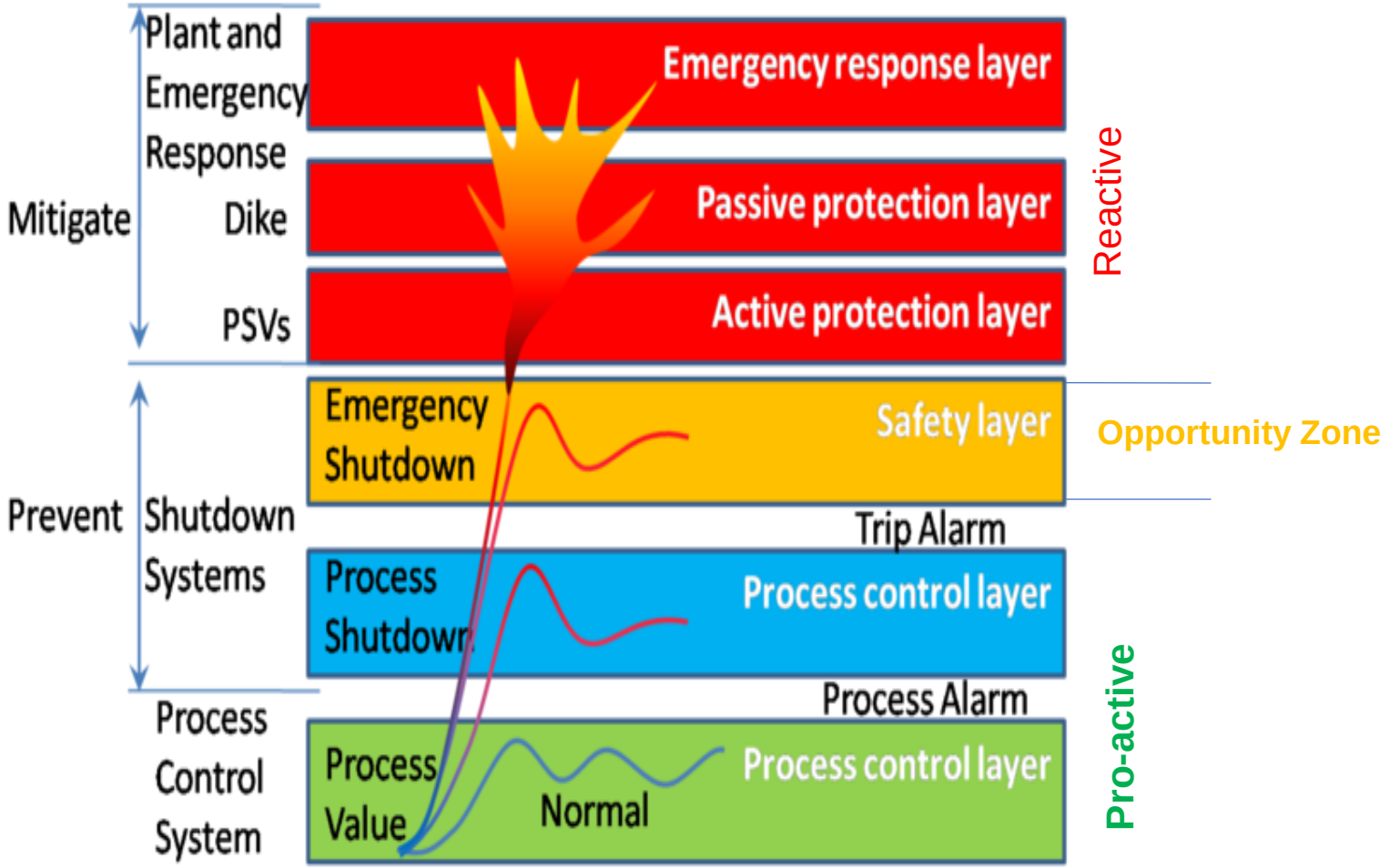
2017
- E Safety Work Permit

2019
Implementation of Safety Integrity Level

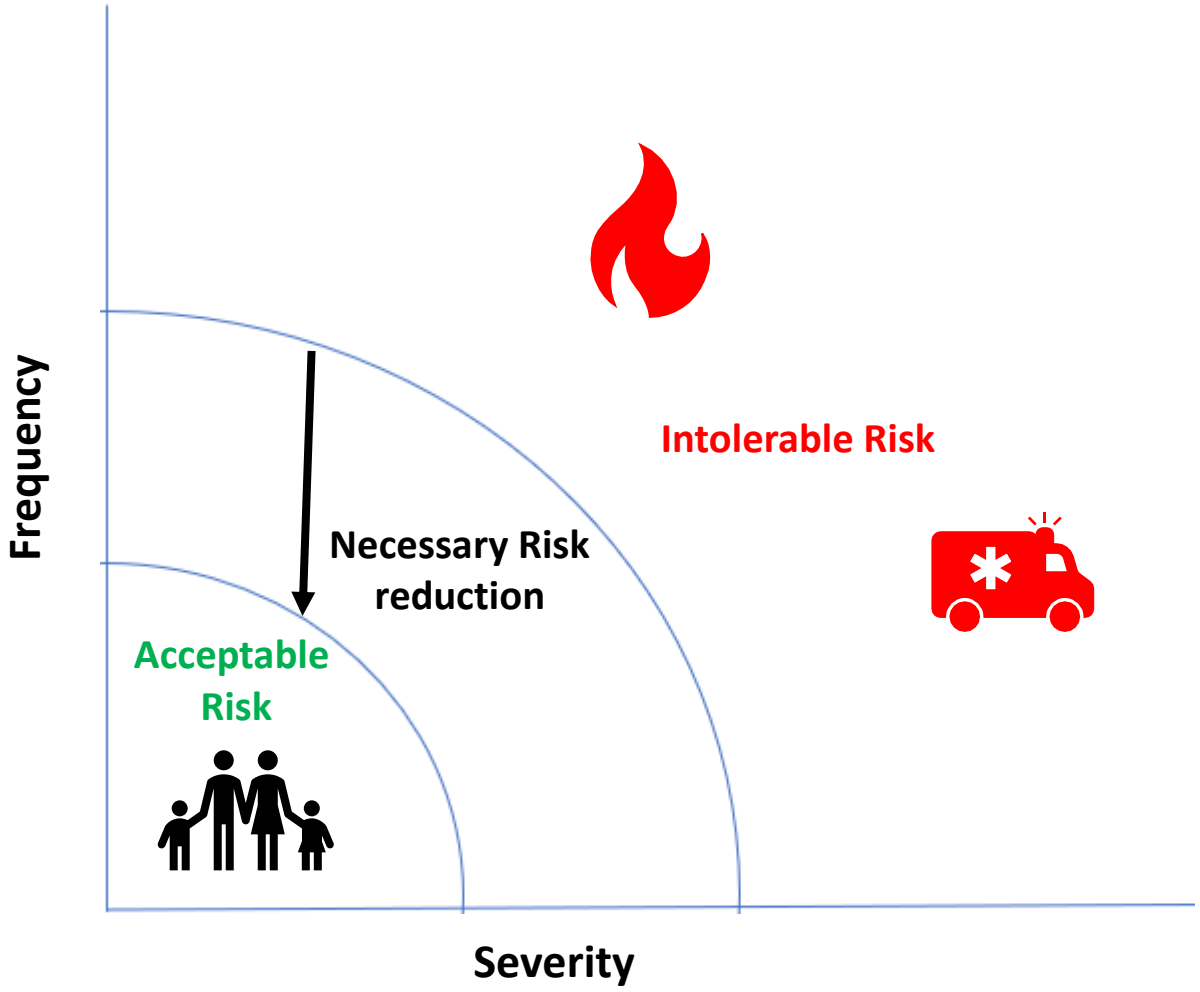
safe BY CHOICE

Layers of Protection

ISA Delhi Section



Risk Reduction Concept



IEC 61511 Safety Integrity Levels (4 discrete levels)

ISA Delhi Section

SIL Safety Integrity levels	RRF Risk Reduction factor	PFD Probability of failure on Low demand (1/RRF)	Safety Availability (1-PFD avg)
SIL 1	>10 to ≤ 100	.01 to .1	90 -99 %
SIL 2	>100 to ≤ 1000	0.001 – 0.01	99 - 99.9%
SIL 3	>1000 to ≤ 10000	.0001 t0 .001	99.9 - 99.99%
SIL 4	>10000 to ≤ 100000	.0001 to .00001	>99.99%

Phases of Safety Life Cycle

ISA Delhi Section

ANALYSIS
(20 Weeks)

IEC - 61511
(Clause 8, 9, 10)

DESIGN & IMPLEMENT
(20 Months)

IEC - 61511
(Clause 11, 12, 13 14, 15)

OPERATION & MAINTENANCE
(20 Years)

IEC - 61511
(Clause 16,17, 18)

PHA, Tolerable Risk, Set Target SIL, Write SRS

Design & Verify SIF, Manufacture, Test, Install, Commission, Validate

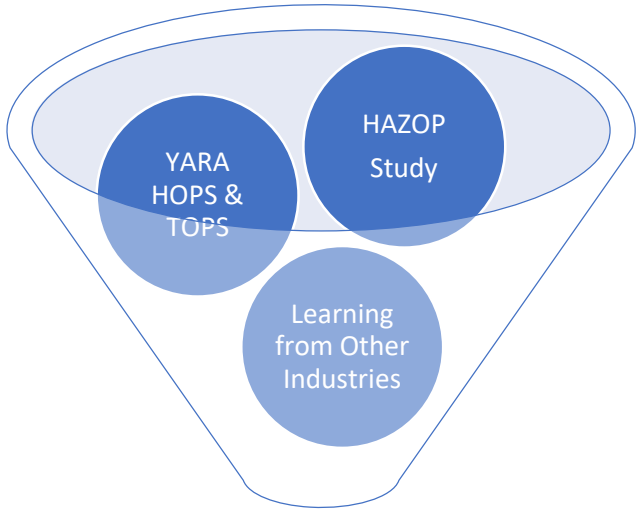
Operate, Maintain, Test, Modify, Decommission

Functional Safety Management (FSM)

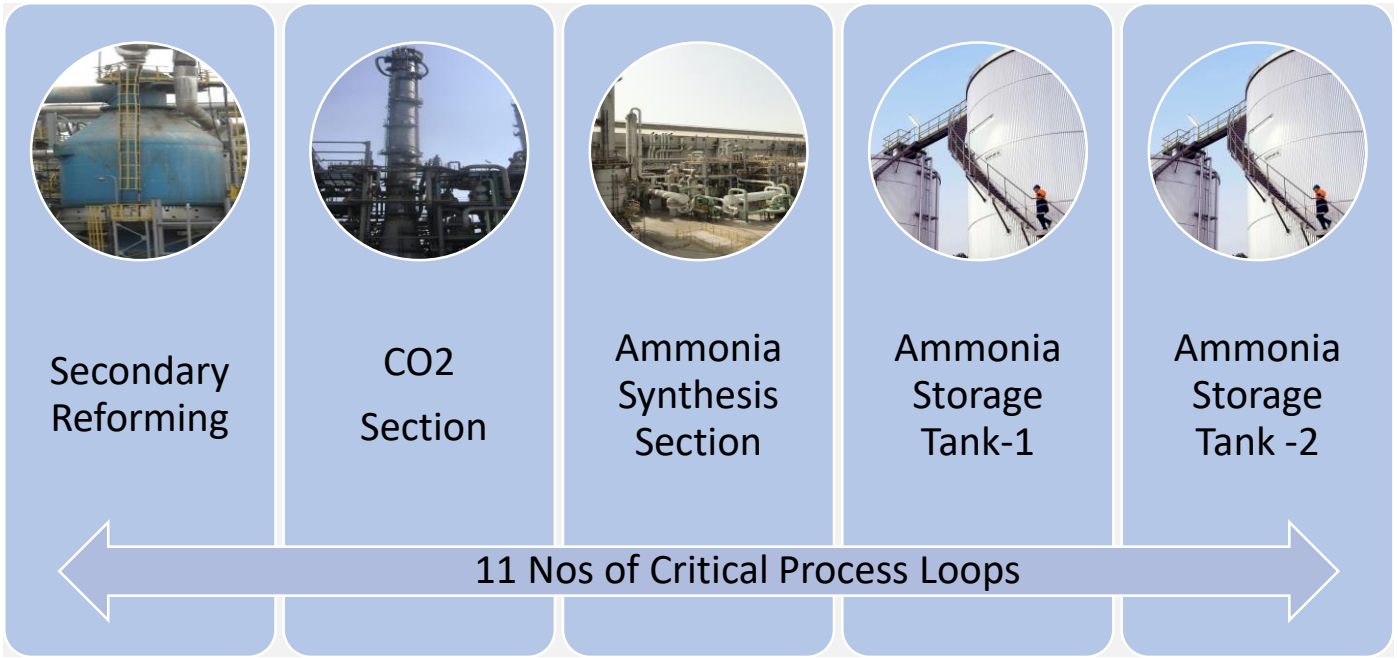
ISA Delhi Section

1. An organization involved at any step of life cycle must have the functional safety Management in place.
2. The FSM should specify all management & technical activities necessary to achieve the required functional safety.
3. It must have the procedures, responsibilities of all persons, department and organizations involved in functional safety.

Process loops taken for SIL assessment and Implementation

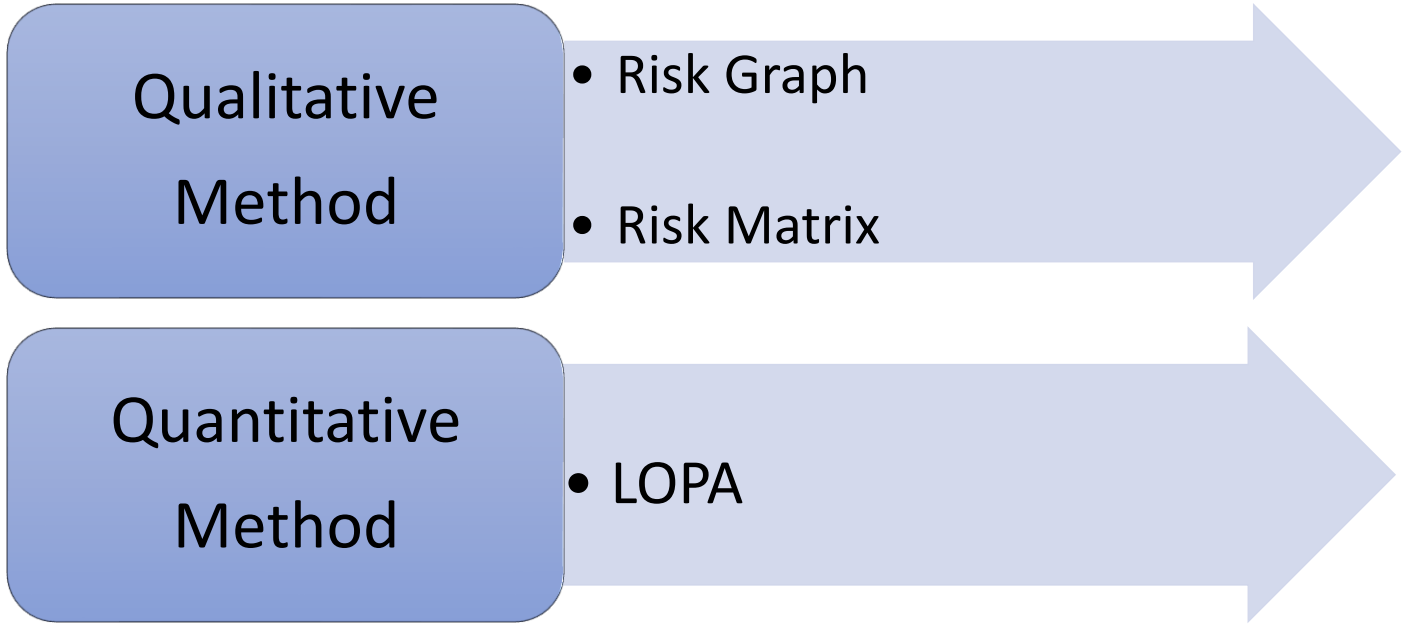


11 Nos of Critical Process Loops



Methods for determination of RRF & SIL

ISA Delhi Section



Inputs for LOPA Study

ISA Delhi Section

PE

YARA FERTILISERS INDIA PVT LTD
FERTILISER (N) BUSINESS
TITLE: HAZOP STUDY REPORT

Date	25.10.18	**Session number:**	18
P&ID No.	4314-1012-0025	**Equipment number:**	
Mod. Description:	5 Year HAZOP (Node-35)	**Members:**	KA/ DKD/GSK
	Mixing of hot and cold NG fuel and supply of fuel mixture to Primary Reformer Furnace		
Design intent:	**Material**	Natural gas (CH4 = 98.39%, C2H6 = 1.4%, C3H8 = 0.1%, N2 = 0.01%, O2 = 0.1%, Sulphur = Maximum 10 ppm, Dry basis), LHV = 8653 K Cal/Nm3, Mole	
	Activity	Receiving and mixing of 11423 Nm3/hour of natural gas, hot from E-204B (NG preheater coil outlet at 4.3 Kg/cm2g and 180°C) and cold from E-219 O Kg/cm2g and 49°C) Supply of fuel gas mixture and then supply to Primary Reformer furnace	
	Source	Hot NG fuel from E-204B coil outlet, cold NG fuel from E-219 tube side outlet	
	Destination	To Primary reformer fuel	

Ref No.	Deviation	Possible Cause(s)	Potential Consequences (s)	Existing Safeguards	Impact (I) Pe	A	E	Pr h
35.1	No flow	High pressure at downstream side	Over pressurization of upstream fuel piping leading to gas leak and subsequent fire -Injury/asset damage/environment/reputation	12"-02-FG201A-B22-I, 12"-02-FG201-B22-V, 4"-02-FG702A-B22-V are designed for 12 Kg/cm2g at 250°C	3	3	2	
				12"-02-FG201A-B22-I, 12"-02-FG201-B22-V, 4"-02-FG702A-B22-V are covered in Safety Critical-1 in CMC inspection schedule.				
				02PC23 tip pressure indication and PVHI alarm at DCS				
				02FT32 indication and PVLO alarm at DCS				

HAZOP Inputs/ Report

Enablers. Modifiers & IPLs with their PFD Values

Organization Tolerable risk Matrix

Team of People from all relevant discipline

IPL	Comments *Assuming an adequate design basis and inspection/maintenance procedures*	PFD from Literature and Industry	PFD Used in This Book (For screening)
Relief valve	Prevents system exceeding specified overpressure. Effectiveness of this device is sensitive to service and experience.	$1 \times 10^{-1} - 1 \times 10^{-5}$	1×10^{-2}
isc	Prevents system exceeding specified overpressure. Effectiveness can be very sensitive to service and experience	$1 \times 10^{-1} - 1 \times 10^{-5}$	1×10^{-2}
	Can be credited as an IPL if not associated with the initiating event being onsidered (see also Chapter 11). (See C 61508 (IEC, 1998) and IEC 61511 EC, 2001) for additional discussion.)	$1 \times 10^{-1} - 1 \times 10^{-2}$ ($>1 \times 10^{-1}$ allowed by IEC)	1×10^{-1}

YARA

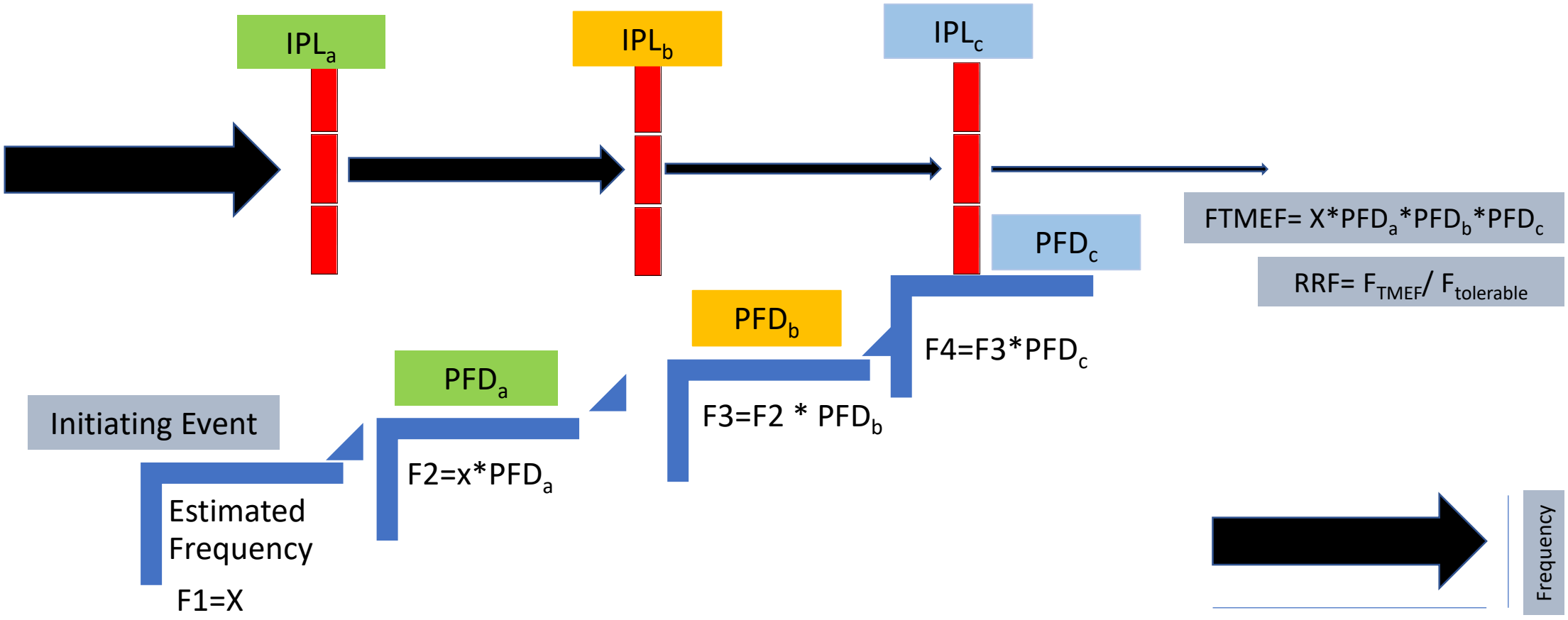
INTERNAL
PROCESS SAFETY
2011-04-04

Table 5 Yara Risk Matrix

RISKS			FREQUENCIES					
	HIGH RISK		VERY FREQ.	FREQUENT	PROBABLE	LOW PROB.		
	MEDIUM RISK		5	4	3	2		
	LOW RISK		> 10 / yr	> 1 / yr	> 10^{-1} / yr	> 10^{-2} / yr	> 10^{-}	
CONSEQUENCES	CATASTROPHIC	5						
	CRITICAL	4						
	DANGEROUS	3						
	SOME DANGER	2						
	MINOR DAMAGE	1						

LOPA Concept more Depth

ISA Delhi Section

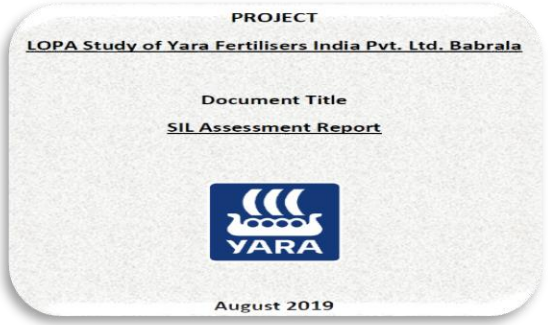


SPEND MORE 'TIME' HERE, TO SPEND 'LESS' MONEY ON SIS.

Outcome of the Analysis Phase

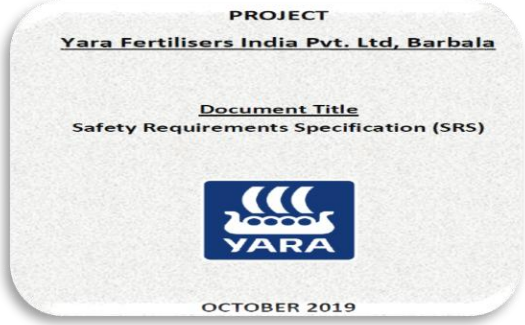
ISA Delhi Section

• SIL Assessment Report



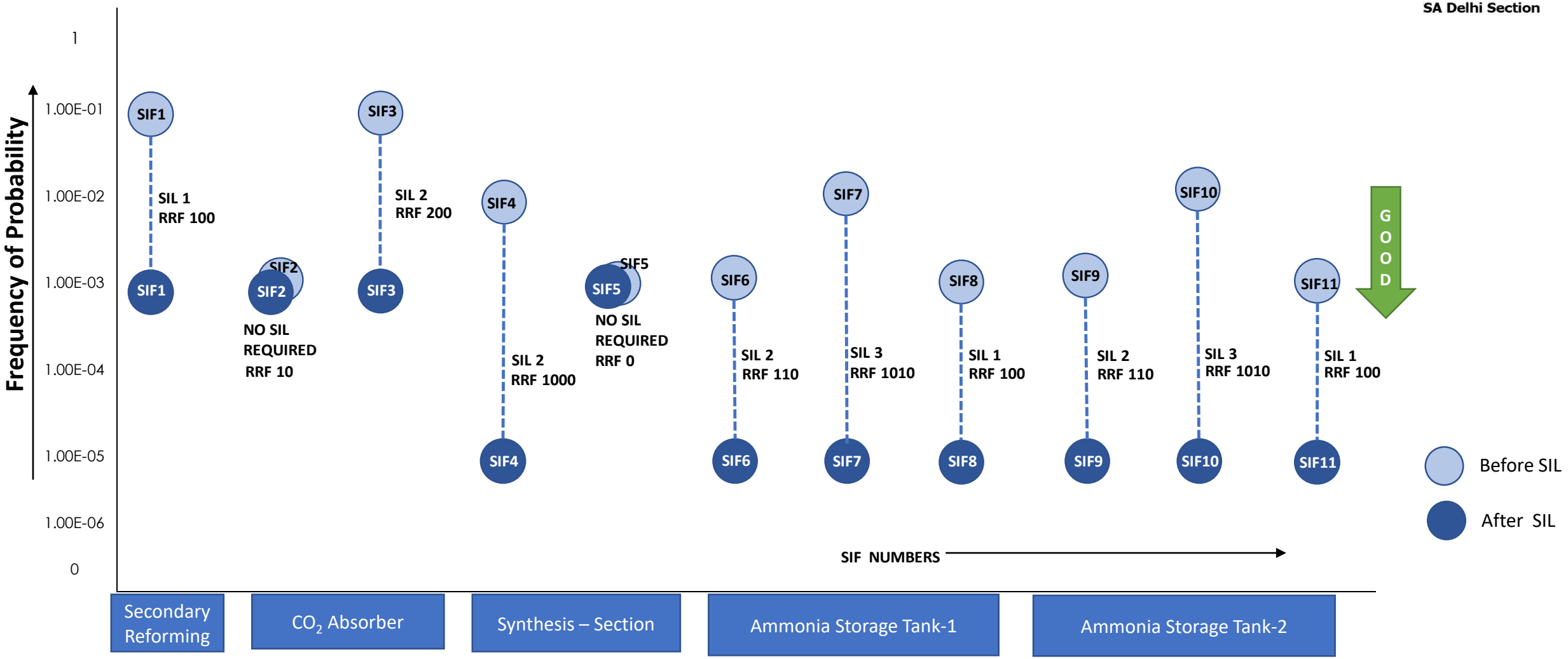
- Hazop Report
- Initiating frequency
- Severity of the consequences
- Tolerable risk Matrix and frequency
- Enablers
- Modifiers
- Risk Reduction Factor
- Target SIL Level

• Safety Requirement Specification (SRS)



- Target SIL Level with RRF
- Mission Time & Start up time
- Trip values & Spurious Trip details
- Mean Time To Repair (MTTR)
- Process Safety Time & SIF Response time requirement
- Manual shutdown & Bypass requirements
- Application software details and requirements
- Proof-test & Partial Stroke Testing requirements

Outcome of the Analysis Phase



Limitations faced during implementation of SIL

ISA Delhi Section

- ✓ To identify the loops (SIFs) i.e. from where to start
- ✓ To determine the Process Safety Time (PST)
- ✓ Installation and commissioning of SIL devices during operations.
- ✓ Proof testing during running of plant.

Functional Safety Assessment

ISA Delhi Section

- ✓ FSA-1 After SRS is ready
- ✓ FSA-2 After design of the SIS is ready
- ✓ FSA-3 After FAT (Mandatory)
- ✓ FSA-4 After Commissioning (Mandatory)
- ✓ FSA-5 During Operation phase

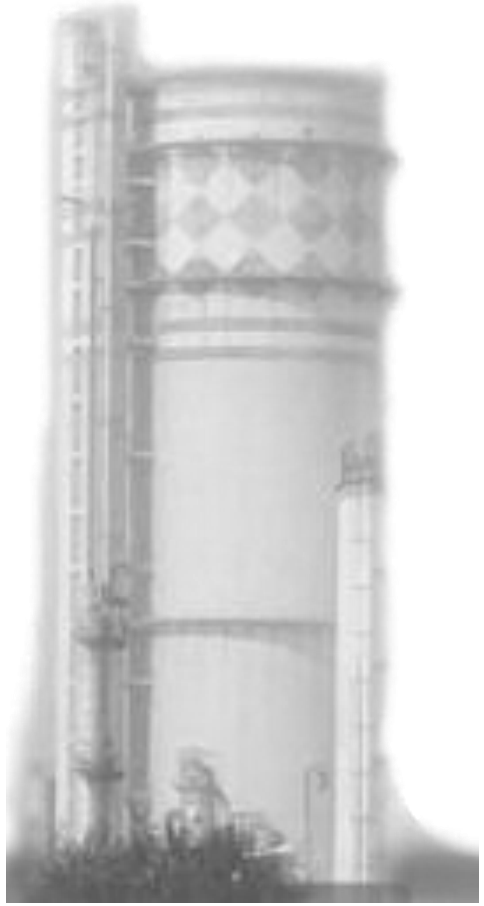
Verification and Validation

ISA Delhi Section

Verification and Validation is important as it demonstrates that

- The function fulfill their requirement
- The safety Standards are followed

ISA Delhi Section



ISA Delhi Section