

# Risk Assessment pitfalls

Kumarkrishna Bhattacharjee (Novartis)

Vijaya Kumar Bendi (Johnson & Johnson)

PSCI PSM sub team

# AGENDA

Recent incidents in Indian Context

Case Study

Risk Assessment

Common gaps and pitfalls of inadequate risk assessments

Good risk assessment

Conclusion



# Speaker Bio

## Kumarkrishna Bhattacharjee

Head- Supplier HSE assurance and risk, India Region  
Novartis India pvt ltd.

[kumarkrishna.bhattacharjee@novartis.com](mailto:kumarkrishna.bhattacharjee@novartis.com)

- Chemical Engineer (B.E), PGCBM-XLRI
- 19+ years of diverse and multidisciplinary experience in field of manufacturing (API), process engineering, process development, technology transfer and Health, Safety and Environment.
- Previous experiences – Associate director, Process safety management – Corporate SH&E Drreddy's, Process engineer, AstraZeneca, Bangalore.
- PSCI Role : Process safety management subcommittee member, India Subcommittee member.



# Speaker Bio

## Vijaya Kumar Bendi

Manager, External Supply EHS&S

Johnson & Johnson Pvt. Ltd.

[vbendi@its.jnj.com](mailto:vbendi@its.jnj.com)

- M.Sc. (Environmental Chemistry) M. Tech. (Environmental Management), Diploma in Ind. Safety
- >14 years of multidisciplinary experience in EHS&S in various industries (Pharmaceutical, Consumer & Medical devices)
- Support EHS&S for J&J External Suppliers in India & South East Asia - EHS&S Onsite Assessments, Technical / Capability Building visits
- Core team member of J&J PSM Team
- PSCI Role: PSM sub team member



# Some Recent Incidents – Indian Context

Date	Location	Incident	Consequences	Reason
07-May-2020	Vizag	Styrene Leak	12 citizens losing their lives and 585 citizens being hospitalized, causing loss of livestock and vegetation.	Risk Assessment/SOP failure
03-June-2020	Dahej, Bharuch	Boiler Explosion	8 dead, 50 injured	Risk Assessment/SOP failure
13-Jan-2020	Tarapur, Boisar	Explosion during testing of new reactor	8 killed & 6 injured	Risk Assessment/No factory license
07-May-2020 01-July-2020	Cuddalore	Boiler Explosion	8 workers injured 6 losing their lives & 17 injured	
30-June-2020	Parawada, Vizag	Gas leak	2 dead & 4 fall sick	Risk Assessment/PSSR
13-Apr-2020	Tarapur, Boisar	Explosion	2 killed & 1 injured	Risk Assessment/PSSR
17-Aug-2020	Tarapur, Boisar	Reactor Explosion	2 killed & 4 critically injured	Risk Assessment/Pressure build up in reactor
12-June-2020	Ankleshwar	Reactor explosion	1 killed & 5 injured	Risk Assessment/Pressure build up in reactor

\* Source: Collected recent accidents from internet

# Case Study - LG Polymers

## Description of the event:

- When: In the early hours of 7th May 2020, an accident of uncontrolled release of Styrene vapour occurred at LG Polymers India Pvt. Ltd. (LG Polymers) at Vizag from one of the Styrene storage tanks (M6).
- Type of industry: LG Polymers manufacturing of Polystyrene (General purpose PS & High impact PS), Expandable Polystyrene (EPS) & engineering plastic compounds -expanded the manufacturing capacities from time to time.
- Impact: The hazardous Styrene vapours spread beyond the factory premises, affecting the populace of five villages / habitations. This led to 12 citizens losing their lives and 585 citizens being hospitalized, besides causing loss of livestock and vegetation.

Source: High Power Committee Report

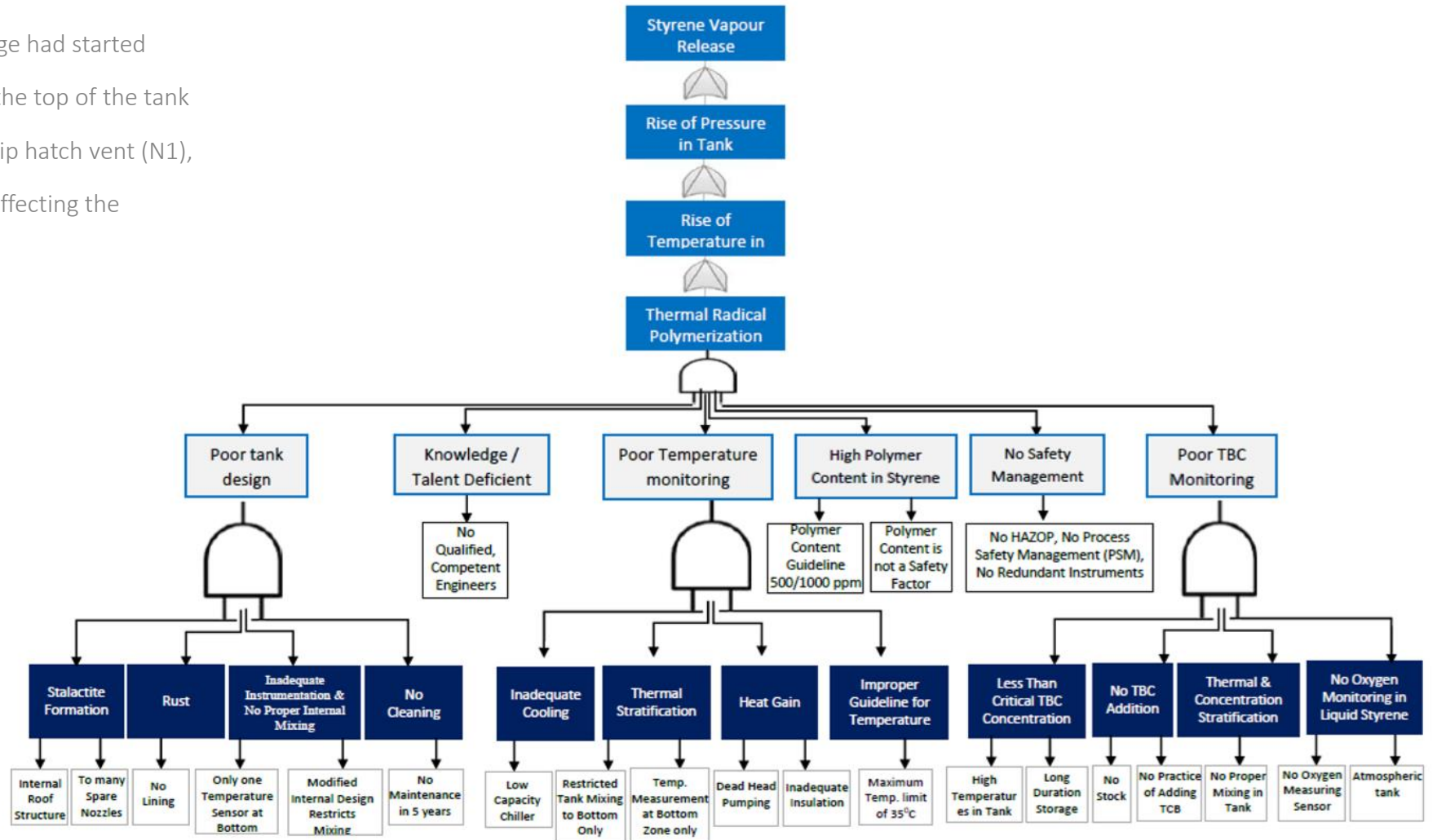
# Case Study - LG Polymers

## Some properties of Styrene:

- Colorless liquid at normal temperature
- Highly Flammable with Explosive range: 1.1 to 7% , Flash point: 31°C , Boiling point: 145°C , Density: 0.906 g/mL at 20 °C; Vapor Density :3.6 (air -1)
- Highly reactive and can polymerize (exothermic reaction) - The rate of polymerisation increases with increase in temperature and results in **runaway reaction at 65°C**
- Polymerisation is controlled in normal circumstances by adding low temperature inhibitor substance like **p-tert-butyl catechol (TBC)**. At higher temperatures, only high temperature inhibitors like Tertiary Dodecyl Mercaptan (TDM) and n-dodecyl mercaptan (NDM) etc. can inhibit the polymerisation of Styrene
- Tim weighed average for 8 hours a day: 50 ppm; Short-term Exposure Limit (STEL) of maximum 15 minutes: 100 ppm; Immediate Danger to Life & Health (IDLH): 700 ppm. (**ACGIH recommends TLV of 20ppm >>10ppm**).
- Causes severe eye, skin and respiratory irritation, CNS depression, nausea, vomiting etc. on short term exposure

# Case Study - LG Polymers

- Styrene storage M6 Tank with 1937 MT storage had started uncontrolled release of Styrene vapors from the top of the tank through the Flame arrestor / Vent (N6) and Dip hatch vent (N1), which spread beyond the factory boundary, affecting the neighboring areas & habitations.



Fault Tree Diagram

Source: High Power Committee Report



# Case Study - LG Polymers

## Reasons for the release of Styrene Vapour - Investigation report revelations/findings

There are number of contributory factors which led to the accident – in this presentation mainly we are highlighting some reasons link to the risk assessment

- No thorough HAZOP/ risk assessment carried out for M6 Tank before it was installed, commissioned, modified and converted from molasses storage tank to Styrene storage tank
- Seriousness in execution of warm shut-down and warm restart : Pre-Startup Safety Review (PSSR) has not conducted prior to startup of a processing/manufacturing plant to ensure that installations meet the original design or operating intent, to catch, re-assess any potential hazard due to changes during the lockdown period, has not been done
- Redundant instruments/Accessories not provided for critical parameters
- Electrostatic discharge hazard assessment not in place - Bonding and grounding of Styrene storage tanks and pipelines, and inspection of these system on a periodical basis are also missing in the plant.
- Thorough trainings on Process safety management not in place/ process safety measures not followed

Source: High Power Committee Report

# Introduction- Risk assessment

- Process industries are vulnerable to the risk of Process safety incidents due to use of Hazardous chemicals and process conditions if not controlled suitably.
- Process safety incidents such as explosion, Fire, toxic release (Impacting community) etc. results into loss of business (shut down of facility), Reputation loss (loss in business) and Regulatory violation (shut down).
- These are caused due to either or many of these gaps such as
  - Inadequate job knowledge or insufficient training
  - Inadequate understanding of process safety information
  - Inadequately designed equipment or modification of equipment with inadequate safety knowledge.
  - Inadequate inspection and maintenance
  - Incomplete or obsolete operating and emergency procedures
  - Inadequate supervision
- It is very important that proper Management process is set to Prevent, Mitigate and Respond to such incidents.
- One of the important step in above management process is Risk Assessment which combines science, skill and Judgement to systematically identify (know your hazardous), evaluate (find scenarios) and develop method (prevent &/or mitigate) to control Hazards.
- Different type of risk assessments are available which are What if analysis, What if with checklist, HAZOP, FMEA, ETA, FTA etc.

# Risk assessment

## Pitfalls of inconsistent/incomplete Risk assessments as observed from audits

### ■ Risk assessment with out process safety information

- No/inadequate information on Hazards of material (in normal and challenged condition), process technology and equipment results in incomplete risk analysis and Risk assessment
- This in turn fails to identify potential risk and hence right control in place

### ■ Risk assessments focusing only on work place safety (e.g. Personal injuries like trip, falls, cuts etc.)

- Wrong impression to management that process risk assessments are identified and addressed.
- Organization is exposed to probability of process safety incidents.

### ■ Inadequate identification of risk

- Due to lack of understanding of Hazardous event and process safety information, which in turn is due to inadequate skills, expertise and insufficient resource allocation, results in incomplete risk assessment.
- E.g. 1. unable to identify risk of decomposition of reaction mass near operating temperature, risk of non-sequential addition of chemicals or reagent can result in fire/explosion. 2. ignition sensitivity and dust cloud explosion risk of formulation mixture etc.

### ■ Inadequate identification of controls commensurate with risk

- Risk identified having high consequences and probability with weak controls implemented such as only training & administrative control like instruction in SOP etc., may result in incidents.
- Right control/s based on risk shall be implemented, for example passive controls, active controls, redundant controls etc, based on risk.

# Risk assessment

## Pitfalls of inconsistent/incomplete Risk assessments as observed from audits

- **Inadequate system to implement identified recommendations or controls**
  - Failure of management to allocate budget and resource to implement recommendations like engineering controls can result in incident when event occurs without preventive and mitigation system in place
- **Inadequate or improper upkeep of controls over life cycle of process**
  - Not identifying list of process safety critical equipment and absence of robust preventive maintenance program can result in failure of control and resulting in incident.
- **Outsourcing risk assessment and considering it as one time activity**
  - Conducting risk assessment as one time activity just to meet requirement of audit clearance and not making as part of management system can result in process safety incident during such time such as implementation of change , introduction of new process and modification of facility etc.
- **Risk assessment without considering risk to/from neighbouring industry**
  - Incidents at neighbouring industry impacts operations of site at close vicinity and vice-versa
  - Risk assessment if do not identify such risk result into shut down and loss of life. For example risk assessment considering facility siting identifying largely populated office near fire zone of risky process of neighbouring site and impact of site on nearby population (temporary/permanent)
- **Not making risk assessment as part of input to Onsite emergency plan**
  - Hazardous event scenario identified during risk assessment shall become part of onsite emergency plan and drill. During real event absence of such drill results into large scale damage

# Good risk Assessment

Good / Adequate Risk assessment	Inputs for adequate Risk assessment
➤ Identifies hazardous processes and materials handled and used in process	➤ Collection and evaluation of process safety data, physical properties, safety data, thermal data etc.
➤ Provides outline for understanding the hazardous events and responses to them.	➤ Definition of safe process conditions and critical limits
➤ Identifies unknown hazardous event.	➤ Systematic search for deviations from normal operating conditions
➤ Assigns severity and probability to hazardous event and identifies risk profile.	➤ Right Interpretation of data
➤ Identifies action to eliminate or reduce risk (ALARP) involved with known and unknown hazardous event.	➤ Clearly defined assessment criteria
➤ Provide input to disaster risk management	➤ Professional experience
	➤ Identify Process improvement measures
	➤ Define technical measures
	➤ Integrate into Plant management
	➤ Management of change
	➤ Test of controls and management system

# Conclusions – LG Polymers

- The uncontrolled Styrene vapour release from the M6 Tank at LG Polymers Visakhapatnam, qualifies as a major accident under MSIHC Rules, 1989.
- If facility would have conducted good risk assessment - would have addressed
  - Poor design of tank
  - Inadequate refrigeration and cooling system
  - Absence of circulation & mixing systems
  - Inadequate measurement parameters
  - Poor safety protocol
  - Minimized impact of its operations on the neighboring community by good preparation (conducts dispersion study)
  - Insufficient knowledge of the chemical properties of Styrene (mainly how it behaves with increasing temp.), especially during storage under idle conditions and total breakdown of the emergency response procedures

Source: High Power Committee Report

# Conclusions – LG Polymers

---

It is difficult to predict catastrophic incidences but using systematic approach of hazard identification, assessment of risk and providing controls can prevent or mitigate such incidents.

Source: High Power Committee Report





# CONTACT



[pscinitiative.org](http://pscinitiative.org)



[info@pscinitiative.org](mailto:info@pscinitiative.org)



Annabel Buchan:  
+44 (0) 7794 557524



[PSCI](#)



[@PSCInitiative](#)

WeChat

[制药供应链组织PSCI](#)

For more information about the PSCI please contact:

#### PSCI Secretariat

Carnstone Partners Ltd  
Durham House  
Durham House Street  
London  
WC2N 6HG

[info@pscinitiative.org](mailto:info@pscinitiative.org)

+44 (0) 7794 557524

#### About the Secretariat

Carnstone Partners Ltd is an independent management consultancy, specialising in corporate responsibility and sustainability, with a long track record in running industry groups.

**carnstone**  
partners ltd