International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

# On-Site Emergency Planning in Pharmaceutical Industries: A Case Study of Indian Pharmaceutical Combined Association

**Saniya Mansoori[1], Anjani Kumar Dwivedi[2]**

[1]Research Scholar, Department of Chemical Engineering, Ujjain Engineering College, Ujjain

[2]Professor, Department of Chemical Engineering, Ujjain Engineering College, Ujjain

**Abstract:** ***Industrial operations, especially in chemical and pharmaceutical sectors, carry significant environmental and safety risks. The handling, storage, and processing of hazardous substances create a high probability of accidents such as fires, explosions, toxic releases, and chemical spills, which, if not managed effectively, may escalate into large-scale industrial disasters. This study focuses on evaluating and optimizing the On-Site Emergency Plan at IPCA Laboratories Ltd., Ratlam, a major pharmaceutical manufacturing unit. The objective of this project was to gain practical experience and knowledge on the implementation and effectiveness of a safety work system in a real-life industrial setting, the research highlights both the strengths and gaps in current practices. The case study of IPCA Laboratories Ltd., Ratlam, provides practical insights into safety protocols, emergency preparedness, and disaster mitigation efforts. The aim is to enhance the effectiveness of industrial risk management through structured plans, modern methodologies, and regulatory compliance.***

**Keywords:** Safety, On-site emergency plan, Indian pharmaceutical combined association, EHS

## 1. Introduction

Emergency planning has become an integral part of industrial safety, especially in chemical and pharmaceutical sectors. This project evaluates the existing OSEP at IPCA Laboratories Ltd., Ratlam, and suggests improvements aligned with best practices and legal frameworks. On-Site Emergency Plans (OSEPs) serve as a foundational framework for mitigating risks, safeguarding human lives, and protecting the environment. Industrial safety and environmental protection are interlinked domains that have become increasingly significant in the age of rapid industrialization. The pharmaceutical and chemical sectors, in particular, deal with hazardous substances that can pose acute risks to human health, property, and the surrounding ecosystem. The consequences of such emergencies may range from minor injuries and equipment loss to large-scale disasters involving human fatalities and environmental degradation. To address this, industries are mandated to establish a comprehensive On-Site Emergency Plan (OSEP) that outlines the procedures, resources, and responsibilities required to handle emergencies efficiently. The importance of an OSEP lies not only in ensuring compliance but also in fostering a safety culture within organizations, where workers, managers, and emergency responders understand their roles during crises. Furthermore, effective OSEPs integrate environmental safeguards, such as containment of leaks, proper hazardous waste management, and prevention of groundwater or air contamination during emergencies. This project report, centered around IPCA Laboratories Ltd., Ratlam, investigates the structure and implementation of the company's emergency preparedness system. It also proposes improvements based on real-time observations and best practices recommended by regulatory bodies such as the Ministry of Environment, Forest and Climate Change**,** Factory Act, 1948**,** And The National Disaster Management Authority The increasing complexity of industrial operations has amplified the risk of accidents and environmental hazards.

### 1.1 Particulars of the organization

M/s Ipca Laboratories Limited, Ratlam having Factory License No. 83/7647/RTM/2M(I) is located on Mhow-Neemuch Road, about 8 Kms Away from District Headquarter place Ratlam. The Ipca site is spanning over an area of 68 acres in the North – East of village Sejawata. The Factory premises on 3 sides are surrounded by th agricultural land there is no significant population/residential housing in the 2 Km. vicinity of the Factory.

Plant operated in mainly in 04 shifts, Total Employees Approx-

1) Permanent Workers 683, Temporary Worker 1887, Permanent Staff 1615
2) Total Employees- 4185

An objective of Emergency Planning is to maximize the resource utilization and combined efforts towards emergency operations. Emergency planning has become an integral part of industrial safety, especially in chemical and pharmaceutical sectors.

## 2. Methodology

The methodology adopted in this study was designed to systematically analyze, evaluate, and optimize the existing On-Site Emergency Plan (OSEP). Subsequently, detailed process mapping of the emergency response system was undertaken, which included evaluating the availability and readiness of emergency facilities (firefighting systems, PPEs, emergency control centers, and medical facilities) and assessing their accessibility during different scenarios. Primary data was collected through site visits, structured

interviews, and interactions with plant personnel, EHS managers, and emergency coordinators**.** Secondary data included company records, safety manuals, incident reports, and past drill evaluations. Special emphasis was placed on the observation of mock drills of varying intensity (low, medium, and high emergency) to assess real-time response effectiveness, communication efficiency, and coordination among departments. The methodology also included a gap analysis where strengths of the current system were benchmarked against best practices, and weaknesses such as limited digital monitoring, inadequate community coordination, or redundant documentation were identified.

The consideration in preparing Emergency Plan will be included the following steps:

a) Identification and assessment of hazards and risks.
b) Identifying, appointment of personnel & Assignment of responsibilities.
c) Identification and equipping Emergency Control Centre.
d) Identifying Assembly, Rescue points, Medical Facilities
e) Formulation of plan and of emergency sources.
f) Training, Rehearsal & Evaluation.
g) Action on Site.

### 2.1 Warning/Alarm/Communication System of Emergency

a) Any Employees spotting such condition/situation having the potential to cause emergency, must inform to his superior (shift In- charge/Plant in Charge). He may try to control the situation, If qualified trained for the same.
b) After judging the gravity of the situation, main controller will declare the emergency and instruct the security to raise the siren.
c) On the instruction of the main controller, security will raise the siren, as follows-

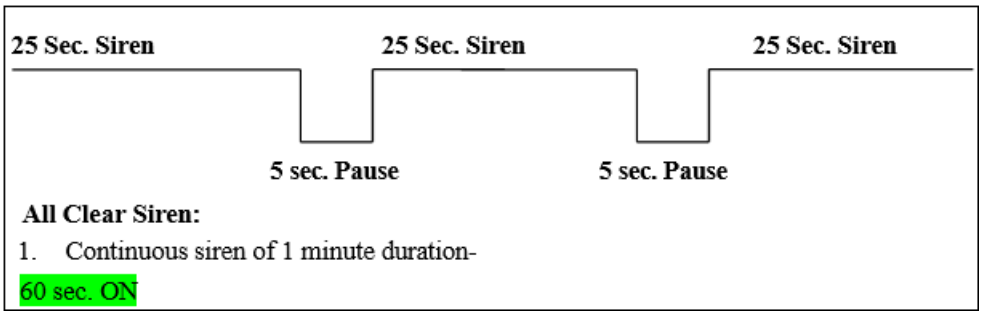


**Figure 1.2:** Siren figure (Time duration)

### 2.2 Mock Drill Plan followed by IPCA

Mock drill plan has been prepared for the identified three types of degree of emergencies and is being practice to ensure effective utilization of resources in order to mitigate the emergency.

**Table 1.1:** Frequency of Mock drill plan

| Type of emergency | Frequency | Coverage | Type of scenario |
|---|---|---|---|
| Low | Monthly | Single Plant | Small fire, spillage of chemical in small Quantity. |
| Medium | Quarterly | Group of plants/ area/department | Fire catching other building, toxic gas release, Major spillage. |
| High | Yearly | Entire company | Multiple fire, explosion, toxic gas release, natural disaster. |

### 2.3 Spillage of Flammable Chemical

a) The affected area should be evacuated and cordoned off immediately use appropriate PPE's while entering in the area.
b) Heat and ignition source in the vicinity should be removed immediately.
c) Keep $CO_2$ or DCP type fire extinguisher ready.
d) Plug the leakage.
e) Transfer the liquid a safe container.
f) If there is any doubt, consult MSDS of particular solvent.
g) Ensure that flammable material do not enter storm water drain

### 2.4 Hydrant System

Adequate number of fire hydrants and monitors will be provided at various locations in and around the buildings and other plant areas. The hydrants will be provided on a network of hydrant mains drawing water from the hydrant pump, which starts automatically due to drop of pressure in the event of operating the hydrant valves.

**Table 1.2:** Number of Hydrant Systems & Hydrant Pump details

| Sr. No. | Hydrant System | Nos. (Approx.) |
|---|---|---|
| 1 | Single Hydrant | 205 |
| 2 | Double Hydrant | 002 |
| 3 | Water/Foam Monitor | 021 |
| 4 | Fire Hose Box | 204 |
| 5 | Fire Hoses | 390 |

| Sr. No. | Pump | Driven By | H.P | RPM | Head | Capacity |
|---|---|---|---|---|---|---|
| 1 | Electrical (main) | Electricity | 150 | 2961 | 90M | 76 LPS |
| 2 | Diesel | Diesel Oil | 120 | 1800 | 70 m | 76 LPS |
| 3 | Jockey | Electricity | 015 | 2900 | 70 M | 03 LPS |

## 3. Results & Discussion

The findings of this study highlight that the On-Site Emergency Plan (OSEP) implemented at IPCA Laboratories Ltd., Ratlam, demonstrates a robust safety framework**,** but at

the same time reveals opportunities for modernization and integration with emerging industrial risk management practices. The strengths identified, such as an extensive network of fire hydrants, over 950 portable extinguishers, strategically placed SCBA kits, and well-trained personnel for firefighting and first aid, indicate that the company has invested significantly in building a resilient safety infrastructure. Regularly scheduled mock drills—monthly for low-level, quarterly for medium-level, and annually for high-level emergencies—further reinforce preparedness by ensuring that employees remain aware of their responsibilities and emergency response protocols. However, the gap analysis reveals certain systemic limitations that could undermine response efficiency during high-risk scenarios. The absence of digital monitoring systems**,** such as GIS-based hazard tracking, AI-enabled gas detectors, or real-time communication dashboards, reflects a dependency on manual reporting and human intervention, which may cause delays in fast-escalating emergencies. While IPCA's safety culture is strong, the evolving industrial landscape demands a transition from reactive to predictive emergency management**.** Introducing AI-driven gas detectors, remote siren triggers, cloud-based SOP updates, can optimize response time and accountability.

### 3.1 Practices in Other Industries

In comparison to other industries, IPCA Laboratories has a well-structured On-Site Emergency Plan but Advanced industries also use digital monitoring systems such as GIS-based sensors, automatic sirens, and IoT leak detectors, while IPCA relies on manual reporting methods. Similarly, refineries and fertilizer plants maintain formal linkages with District Crisis Groups and hospitals, and implement real-time effluent monitoring and spill tracking systems, which are not fully developed at IPCA. Other industries are also adopting modern approaches such as simulation-based training and community awareness programs. Therefore, while IPCA meets national standards and has strong infrastructure, it can improve by adopting digital technologies, strengthening environmental planning, and involving external agencies for greater crisis preparedness. Many companies include mutual aid agreements with nearby industries, so resources like fire tenders, ambulances, and trained manpower can be shared in case of a major incident. Emergency drills are designed to be scenario-based, for example simulating a solvent spill or ammonia leak, and are carried out with participation from local authorities.

Pharma industries also maintain detailed Material Safety Data Sheets (MSDS) at every unit for quick reference during emergencies. A strong focus is given to medical preparedness—many companies run Occupational Health Centres with doctors on duty and tie-ups with multi specialty hospitals which ipca also follows. Some industries also prepare evacuation maps for workers and nearby residents, display emergency signage across plants, and ensure that contractors and visitors are trained in basic safety procedures.

**Table 1.3:** Comparison Table with Other Industries

| S. No | Aspect | IPCA Laboratories Ltd. (Ratlam) | Other Industries (as per studies & case references) | Scope for Improvement at IPCA |
|---|---|---|---|---|
| 1 | Mock Drills | Conducted monthly (low), quarterly (medium), yearly (high) | Other pharma/chemical industries stress frequent multi-agency drills with police, hospitals, community. | Involve district authorities & community in drills |
| 2 | Emergency Facilities | Fire hydrants, extinguishers, ECC, PPE kits are well maintained | Other pharma/chemical industries integrate digital monitoring & automatic alarms. | Adopt GIS-based monitoring & early warning systems |
| 3 | Community Linkage | Limited coordination with local police/hospitals | Post-Bhopal Gas Tragedy (1984), industries maintain formal MoUs & public alert systems. | Build stronger off-site coordination & awareness |
| 4 | Environmental Focus | More focus on worker safety than environmental impact | Case studies show real-time effluent monitoring & containment strategies. | Strengthen environmental response planning |

## 4. Conclusion & Recommendations

This project confirms the importance of OSEPs in industrial safety management. The case study demonstrates that while traditional systems offer basic resilience, optimization through digital technology and regular training can significantly enhance performance. A proactive, well-communicated plan ensures reduced environmental damage and improved personnel safety. The evaluation of the On-Site Emergency Plan at IPCA Laboratories Ltd. underscores the organization's proactive approach toward industrial safety. With extensive infrastructure, trained personnel, and a well-documented strategy, IPCA is largely compliant with national standards such as the Factories Act and MSIHC Rules. However, to further enhance safety, modernization and digitization of emergency systems are recommended. Crisis situations demand not only response but also foresight—and this project provides a roadmap to optimize preparedness, improve environmental protection, and reinforce community resilience. By addressing identified gaps, IPCA can become a model pharmaceutical unit in industrial disaster preparedness.

**1) Integrate Digital Emergency Tools:**
- Use gas-leak detectors with IoT integration.
- Install CCTV-linked alert systems for ECC.

**2) Periodic Collaboration with Local Authorities:**
- Conduct mock drills involving the District Crisis Group, SDMA, Fire Brigade, and local hospitals.

**3) Upgrade Environmental Spill Response:**
- Introduce real-time effluent monitoring systems post-leakage.
- Use GIS mapping for vulnerable zones and drainage. Example: A toxic gas release → GIS shows which nearby areas/villages will be impacted based on wind direction, population density.

- Helps authorities plan evacuation routes, shelters, and resources.

**4) Revamp Training Programs:**

- Include simulation-based training using VR/AR for key response personnel.
- Mandatory quarterly evaluation of first aid/firefighting skills

**5) Digitize Safety Records:**

- Use mobile apps for emergency roles, asset locations, and chemical inventories.
- Provide QR-enabled access to updated SOPs at high-risk zones.

## References

[1] Agarwal, P., Goyal, A., & Vaishnav, R. (2018). Chemical hazards in pharmaceutical industry: An overview. *Asian J. Pharm. Clin. Res*, 11(2).

[2] Ahmad, S., Hafeez, A., Al-Taie, A., Siqqqui, S. A., Talwar, I., Kamboj, A., & Ahmad, M. (2022). Industrial hazards and safety management in pharmaceutical industry. *Authorea Preprints*.

[3] Alexander, D. (2005). Towards the development of a standard in emergency planning. *Disaster Prevention and Management: An International Journal, 14*(2), 158-175.

[4] Alexander, D. E. (2017). *How to write an emergency plan*. Liverpool University Press.

[5] Alexander, David E. (2015). *Disaster and emergency planning for preparedness, response, and recovery*. Oxford University Press.

[6] Alomi, Y. A., Alamri, N. S., Alrasheedi, B. M., Abu Sabah, M. A., Al Otaibi, A. K., & Hakami, M. (2024). Pharmacy Safety and Occupational Health: Crisis and Disaster Management. *International Journal of Pharmacology and Clinical Sciences, 12*(3), 129-137.

[7] Alper, Samuel J., & Karsh, B. T. (2009). A systematic review of safety violations in industry. *Accident Analysis & Prevention, 41*(4), 739-754.

[8] Aruru, M., Truong, H. A., & Clark, S. (2021). Pharmacy Emergency Preparedness and Response (PEPR): a proposed framework for expanding pharmacy professionals' roles and contributions. *Research in Social and Administrative Pharmacy, 17*(1), 1967-1977.

[9] Ashley, S. F., Vaughan, G. J., Nuttall, W. J., & Thomas, P. J. (2017). Considerations in relation to off-site emergency procedures and response for nuclear accidents. *Process Safety and Environmental Protection, 112*, 77-95.

[10] Austin, R. F., DiSera, D. P., & Brooks, T. J. (2015). *GIS for critical infrastructure protection*. CRC Press.

[11] Chen, C., & Reniers, G. (2020). Chemical industry in China: The current status, safety problems, and pathways for future sustainable development. *Safety Science, 128*, 104741.

[12] Cornelissen, P. A., Van Hoof, J. J., & De Jong, M. D. T. (2017). Determinants of safety outcomes and performance: A systematic literature review of research in four high-risk industries. *Journal of Safety Research, 62*, 127-141.

[13] Cox, S., Tomas, J. M., Cheyne, A., & Oliver, A. (1998). Safety culture: the prediction of commitment to safety in the manufacturing industry. *British Journal of Management, 9*, 3-11.

[14] Duke, A. C. (2012). Emergency response for toxic gas release incidents. In *SPE Middle East Health, Safety, Security, and Environment Conference and Exhibition* (pp. SPE-152611). SPE.

[15] El Barkani, M., Benamar, N., Talei, H., & Bagaa, M. (2024). Gas leakage detection using Tiny machine learning. *Electronics, 13*(23), 4768.

[16] Emami, P., & Marzban, A. (2023). The synergy of artificial intelligence (AI) and geographic information systems (GIS) for enhanced disaster management. *Disaster Medicine and Public Health Preparedness, 17*, e507.

[17] Essery, G. L. (1991). On-site emergency planning and the use of predictive techniques. *Journal of Loss Prevention in the Process Industries, 4*(1), 44-48.

[18] Flin, R., & Yule, S. (2004). Leadership for safety: industrial experience. *BMJ Quality & Safety, 13*(Suppl 2), ii45-ii51.

[19] Ge, S., Shan, M., & Zhai, Z. (2025). Emergency Preparedness in China's Urban Rail Transit System: A Systematic Review. *Sustainability, 17*(2), 524.

[20] Goudsmit, F. (2012). Disaster planning for biotechnology companies. *Journal of Commercial Biotechnology, 18*(3).

[21] Graves, S. L. B. M. L. Z., et al. (2009). New challenges to emergency management of pharmaceutical/healthcare supply chain disruptions. *DHS Workshop on Incident Management, Resource Management, and Supply Chain Management.*

[22] He, Z., Shen, K., Lan, M., & Weng, W. (2024). An evacuation path planning method for multi-hazard accidents in chemical industries based on risk perception. *Reliability Engineering & System Safety, 244*, 109912.

[23] Jianwen, Z., Lei, D., & Wenxing, F. (2014). An approach for estimating toxic releases of H2S-containing natural gas. *Journal of Hazardous Materials, 264*, 350-362.

[24] Jiang, Y., Xu, K., Gai, W., & Salhi, S. (2022). Emergency response for tackling major accidental toxic gas releases: What should be done and when? *Safety Science, 154*, 105819.

[25] Jones, F. V., Caudle, D. D., & Pappworth, S. S. R. (1996). International regulatory compliance and EHS planning. In *SPE International Conference and Exhibition on Health, Safety, Environment, and Sustainability* (pp. SPE-35930). SPE.

[26] Junior, J. A. G., Busso, C. M., Gobbo, S. C. O., & Carreão, H. (2018). Making the links among environmental protection, process safety, and industry 4.0. *Process Safety and Environmental Protection, 117*, 372-382.

[27] Latonen, S., Pussila, S., Seeck, H., Airaksinen, M., & Juppo, A. M. (2025). Crisis management in the pharmaceutical industry during the COVID-19 pandemic. *International Journal of Disaster Risk Reduction*, 105566.

[28] Lentz, C. (2006). How one emergency plan works in a complex research facility. *Journal of Chemical Health & Safety, 13*(3), 21-25.
[29] Leso, V., Fontana, L., & Iavicoli, I. (2018). The occupational health and safety dimension of Industry 4.0. *La Medicina del Lavoro, 109*(5), 327.
[30] Maniar, M. S., Kumar, A., & Mentzer, R. A. (2020). Global process safety incidents in the pharmaceutical industry. *Journal of Loss Prevention in the Process Industries, 68*, 104279.
[31] McIntyre, A., Scofield, H., & Trammell, S. (2019). Environmental health and safety (EHS) auditing. In *Handbook of Occupational Safety and Health* (pp. 613-637).
[32] Ministry of Environment, Forest and Climate Change. (2000). *MSIHC Rules in Indian Industries*. https://moef.gov.in
[33] Miranda, E. S., Fitzgerald, J. F., & Osorio-de-Castro, C. G. (2013). A methodological approach for the evaluation of preparedness of pharmaceutical services. *Revista Panamericana de Salud Publica, 34*, 312-320.
[34] Nosraty, N., et al. (2025). Artificial intelligence for disaster risk management in the beauty industry. *International Journal of Advanced Multidisciplinary Research and Studies, 5*(3), 1076-1086.
[35] Ramabrahmam, B. V., Sreenivasulu, B., & Mallikarjunan, M. M. (1996). Model on-site emergency plan. Case study: toxic gas release from an ammonia storage terminal. *Journal of Loss Prevention in the Process Industries, 9*(4), 259-265.
[36] Ramabrahmam, B. V., & Mallikarjunan, M. M. (1995). Model off-site emergency plan. Case study: toxic gas release from a fertilizer unit. *Journal of Loss Prevention in the Process Industries, 8*(6), 343-348.
[37] Ramsay, C. G. (1999). Protecting your business: from emergency planning to crisis management. *Journal of Hazardous Materials, 65*(1-2), 131-149.
[38] Russell, D., & Simpson, J. (2010). Emergency planning and preparedness for the deliberate release of toxic industrial chemicals. *Clinical Toxicology, 48*(3), 171-176.
[39] Saeed, A., Hosny, G., & Atef, S. (2024). Effective development of integrated safety management in pharmaceutical industries. *American Journal of Management, 24*(4), 83.
[40] Sasie, S. D., et al. (2025). Developing a comprehensive framework for evaluating public health emergency management program implementation: A scoping review. *Public Health, 239*, 22-31.
[41] Saxena, K., Balani, S., & Srivastava, P. (2022). The role of pharmaceutical industry in building resilient health system. *Frontiers in Public Health, 10*, 964899.
[42] Thangam, J. A., Jeshurun, S. B., Thangapoo, A., Gnanaraj, S. J. P., & Appadurai, M. (2022). Industrial hazards and safety measures – An empirical study. *Materials Today: Proceedings, 60*, 834-838.
[43] The Factories Act, 1948. https://labour.gov.in/factories-act-1948
[44] Tomar, P., Srivastava, S., & Pandey, S. (2024). Revolutionizing Crisis Management: Innovative Supply Chain Strategies for Resilient Pharmaceutical Companies.
[45] Vidmar, D. M., & Ramos, J. M. (1998). Implementation of an EHS Management System at Multiple Facilities through Utilization of Networked Processes and Tools – A Case Study. In *SPE International Conference and Exhibition on Health, Safety, Environment, and Sustainability* (pp. SPE-46700). SPE.
[46] Vladimirovna, E. E. (2015). Approaches to implementation of an integrated management system in the pharmaceutical industry. *International Journal for Quality Research, 9*(3), 527.
[47] Xiao, X., et al. (2025). A dynamic risk-informed framework for emergency human error prevention in high-risk industries: A Nuclear Power Plant case study. *Reliability Engineering & System Safety, 261*, 111080.
[48] Yeşil, S., & Gökeri, G. (2018). On-site emergency planning and response approach for nuclear power plants. *Turkish Journal of Nuclear Sciences, 30*(2), 32-49.
[49] Zhang, F. Q., Wang, J., & Liu, P. (2022). Data-driven AI emergency planning in process industry. *Journal of Loss Prevention in the Process Industries, 76*, 104740.
[50] Zhang, W., Li, C., & Gai, W. (2024). How does evacuation risk change over time? Influences on evacuation strategies during accidental toxic gas releases. *International Journal of Disaster Risk Reduction, 108*, 1044531
[51] Zohar, D. (1980). Safety climate in industrial organizations: theoretical and applied implications. *Journal of Applied Psychology, 65*(1), 96.