



Publisher: Scientific-Professional Society for Disaster Risk Management

International Journal of Disaster Risk Management

Journal homepage: <https://internationaljournalofdisasterriskmanagement.com>



Short Communication

Business Continuity Planning for the Hazardous Chemical Handling Industry: A New Conceptual Approach

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Received: 10 September 2024; Revised: 17 November 2024; Accepted 8 October; Published: 25 December

ABSTRACT

The conceptual approach of handling an on-site emergency and continuity of the business in difficult circumstances has been presented. The framework defines the various teams, which are involved in handling an emergency like an explosion of one of our chemical manufacturing units, which has caused due to the uncontrolled reaction of the 4-Nitro-N-Methyl phthalimide reaction. The firefighting team along with the state emergency rescue team have been involved in controlling the emergency. The various steps which are taken in handling the emergency have been informed to the management team through the management representative. After ascertaining the situation, the management team permits activating the business continuity plan and shifting the men, materials, and machinery to one of the new units located at Atchutapuram, Visakhapatnam, India, to continue the business. There were some delays during the transition stage. After erecting the process equipment, pre-start-up safety reviews have been conducted and resumed production, thus meeting the production goals leading to sustainable business in difficult circumstances.

KEYWORDS

On-site emergency, Business continuity planning, Emergency Response Team, Management representative, Management team, Sustainable business.

1. Introduction

Hazardous chemical industries are prone to frequent incidents/accidents and injuries (Tahmid et al., 2020), as there are chances that this chemical reaction may go out of control in the occupational environment, which may result in an explosion causing a devastating effect (Gong et al., 2024), so safety is given the highest priority in chemical handling industry (Bhusnure et al., 2018, Wang et al., 2018). It is always better to have a clear-cut ideology to see that in case of any such eventuality, we continue the business without hindrance and we have a dedicated plan to run the business during the difficult times so that we can protect the moral and ethical values of the business and meet the client requirement as per the terms and conditions (Boatright 2020, Carroll 2000), which have been accepted mutually before manufacturing of the product. The business continuity planning (BCP) is prepared in a standardized way (Tucker 2014, Sawalha 2021) so that we can meet the requirements of the production planning. Emergency planning requirement, which includes business impact anal-

ysis, plays a crucial role in assessing the damage of the accidents (Epstein and Khan 2014, Păunescu et al., 2018), which are linked to the production plan. Such a type of analysis will help us to plan the requirements for the production activities and fulfil the demand of the customers (Bakar et al., 2015, Faertes 2015, Baldwin 2019).

The deceleration of an emergency, using high-end technology for risk management (Jovičić et al., 2024) and its combination of the onsite emergency plan (OSEP) with BCP plays a vital role in the form of a new approach. Handling an emergency in a critical industry will be difficult as it requires proper scientific planning and trained people who can handle the disastrous situation. However, the criticality depends up on the type of disaster and handling of the onsite emergency. The different ways of safety training, which are provided during mock drills (Soman & Sundararaj, 2015), help in handling critical situations, where we practise the various scenarios in handling emergencies in the hazardous chemical handling industry. The combination of the roles of the individual team members of the OSEP, not only saves the property of the company but also restricts the spread of the disaster from becoming an off-site emergency (Sorensen et al., 2013). Further proper planning during the onsite emergency helps in saving the lives of the employees and contractors who are working in the hazardous chemical handling industry.

The new approach, pays a way to support the goals of environmental health and safety (EHS) policy for handling the critical circumstances of the organisation (Khair et al., 2018). The combination of the OSEP and BCP, which acts a dual purpose, is we can save the life and the property of the company by implementing the OSEP further the BCP, which helps in continuing the business without any hindrances and fulfilling the needs of the global customers. We have presented a broader view in this paper, where we have handled a disastrous situation in our chemical manufacturing industry. Proper planning has helped us in saving the life, although we lost some people during the incident we have saved the lives of our many employees by activating the OSEP and continuing the business despite the odd circumstances, we have faced in difficult circumstances, as we have shifted our business from unit 4 to Unit 5, where we have started manufacturing the same product. Nolan (2014) reported the criticality of the product has been understood by performing the risk assessment in the form of hazard repeatability (HAZOP), further, we have carried out the pre-start-up safety review (PSSR) for our critical reaction, we have improved our safety aspects in our organisation for the safer production and achieving the targeted goals of the production has been presented.

2. Methodology

The new scientific approach, to handling the emergency during the difficult circumstances in the chemical handling industry has been presented, various steps were taken after the blast of the reactor, which happened while carrying out the 4-Nitro-N-Methyl phthalimide reaction on 13th April 2022 in one of the unit 4, which has led to the activating the onsite emergency plan, we have presented the various ways of activating BCP, which has helped in the continuing of the business during the difficult times. It has resulted in the continuity of the business and satisfying the needs of the global customers, where we have applied the combination of emergencies and business continuity, which is in the form of OSEP and BCP. Various steps have been presented in the form of an overview of handling critical situations by the various ways of forming the different teams for the various activities.

3. Results and discussion

The preparation of the BCP, which includes the activation of the response of handling the eventuality like fire, explosion and disaster due to natural calamity in coordination with the Emergency response team (ERT) (Reilly, 2015), which is part of the on-site emergency plan (OSEP) in the hazardous chemical handling industry. Such type of teams will remain active during the emergency, which saves human lives (Dimitriou et al., 2018, Spellman 2023), machinery and involve in stopping the escalation of the fire in the hazardous chemicals storage area (Madrzykowski 2016, Zhang et

al., 2019), so it is necessary to conduct an informed and uninformed mock drill every three and six months once to tackle the emergency in different scenarios such as explosion, fire, gas leak and natural disaster in the hazardous chemical handling industries (Soman and Sundararaj 2015, LeBoeuf 2020, Petridou et al., 2023). In case of any such eventuality, the site controller will discuss it with the management team after the emergency comes to normality for crisis management (Khairilmizal 2020). The site controller will activate the recovery plan, and check the damage of the men, material and machinery (3M concept). After gathering the post-disaster information, the site controller will make a road map to shift the required materials such as equipment, chemicals and people sent to other units, so that the production plan will not be affected, which leads to the sustainability of the business during the difficult circumstances, which is known as BCP (Corrales-Estrada 2021). During the process, many of the internal departmental teams are involved in the successful shifting of 3M to the new unit to fulfil the demands of production planning leading to the continuity of the business, which is the form of emergency planning responsibility team (EPRT) matrix, which are given in the Table. 1, which helps in the recovery of the business in difficult circumstances, all the financial aspects concerning the shifting of the equipment, manpower and other resources will be coordinated with management representatives in consultation with the finance head, which are approved by the top management.

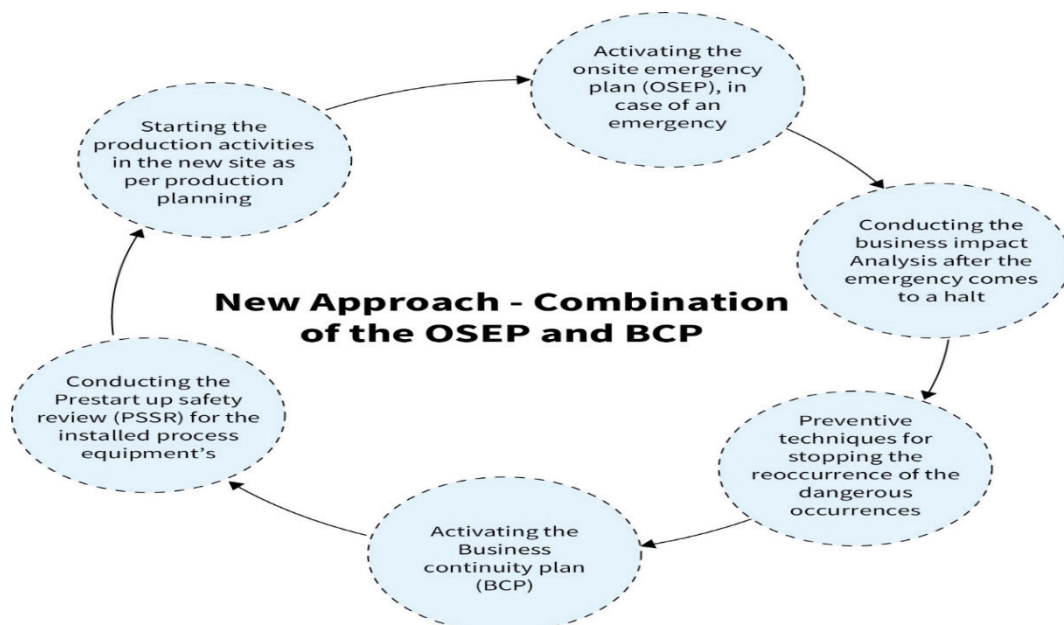


Figure 1. An overview of the new Approach – Combination of the OSEP and BCP

Table 1. Emergency planning responsibility team (EPRT), which is involved in the shifting of the business from one unit to another.

S.No.	Category Teams	Responsible Department(s)
1	Legal	Finance
2	Regulatory	EHS, Site In-charge
3	Environmental, Health & Safety	EHS
4	Economic and Financial	Finance
5	Personnel	Human resource (HR) & Admin
6	Supply Chain	Commercial/ Supply Chain
7	Market	Sales
8	Geo-political unrest in servicing markets	Sales, Commercial/ Supply Chain
9	Government Policy changes	Relevant dept. as per issue
10	Natural disaster events	HR & Admin, Site In-charge

Combining the On-Site emergency planning and the BCP will help us not only save the 3 M but also it helps in activating the sustainability of production without delay (Steen et al. 2024), which is one of the new approaches that has been introduced in Figure. 1, which we initiated during one of the disasters which has happened in the recent past in our chemical manufacturing unit. We have presented an outline of a case study of an uncontrolled reaction, which resulted in a disaster in the chemical manufacturing unit, where we have activated OSEP, which is followed by BCP, which has resulted in the successful continuity of the business in difficult circumstances.

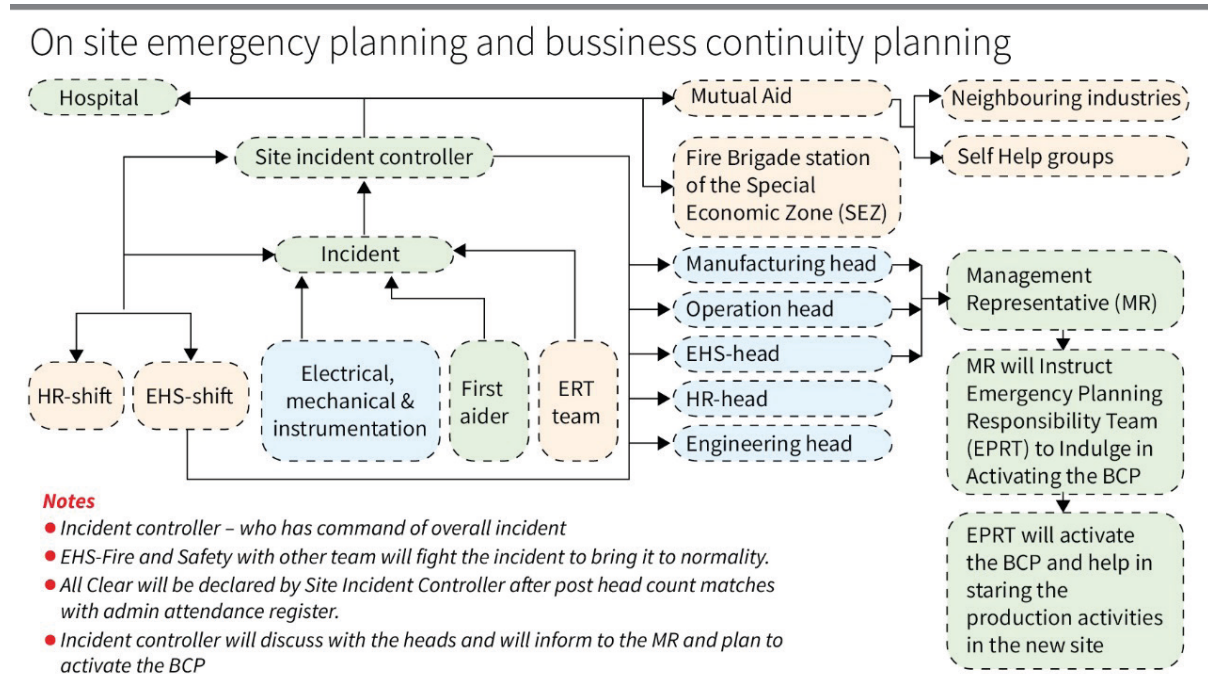


Figure 2. On-site emergency planning and activating the business continuity planning (BCP)

3.1. On-site Emergency, which has a direct relationship with the risk matrix in ascertaining the emergency.

The on-site emergency plan plays a key role in acting up on the emergency and there is a protocol for reporting an onsite emergency (Bernabei 2021, Wang et al. 2024) so that the emergency can be tackled systematically (Figure 2). The risk handling mainly depends up on the risk matrix, which is categorized based on Low, medium and high / very high, which is given in Figure 3, such type of matrix will help us to ascertain the onsite emergency and the category of risk to be handled before the eventuality (Druel & Çelebi 2023) so that the on-site emergency plan team member pre-prepared to any kind of disastrous situation (Figure. 2), which may occur due to fire, explosion, toxic / gas leak and the natural calamities in the hazardous chemical handling industry (Hou 2021). We have classified the handling of risky situations, which are classified based on likelihood and consequences (Figure. 3).

Consequence	Likelihood			
	Low	Medium	High	Very high
Low	Low	Low	Medium	Medium
Medium	Low	Medium	Medium	High
High	Medium	High	High	Very high
Very high	High	High	Very high	Very high

Figure 3. Likelihood and consequence matrix for handling the risky situation using the onsite emergency plan

3.2. *Avoiding the risk – Giving the highest priority by installing the safety critical equipment in the hazardous chemical storage area and the processing equipment of the various blocks, where these hazardous chemicals are used in the process for achieving the desired results as per batch management process (BMR).*

3.3. *Reducing or mitigating the risk – Taking measures to reduce the likelihood or impact of the risk depends on the handling of risky situations, an example is handling the toxic spillage of chemicals. This mainly depends on how well you are prepared to avoid the risk.*

3.4. *Sharing the risk – Sharing the risk depends on the handling of the emergency, which is in the form of mutual aid, where neighbouring industries, self-help groups and state fire emergency and rescue operational services are involved in handling the emergency.*

3.5. *Retain or accept the risk – Taking an action due to a cost/benefit analysis, which comes into action after the emergency comes to an end, which results in an all-clear signal from the incident controller, the incident controller and all the team members will discuss with the management representative (MR). The teams which are involved in the OSEP for tackling the emergency are listed in Figure. 2, where the incident controller will have command of the whole of the situation, he is an officially authorized person on the site to declare the emergency, after tackling the emergency, when the situation becomes normal, he will give all-clear signal, so that it indicates that the emergency has come to a halt. Goyal (2019) has reported that mutual aid plays an important role in disaster governance and community resilience. During the emergency, the mutual aid members in and around the factory premises will be involved in tackling the emergency, by providing additional self-contained breathing apparatus (SCBA), fire-resistant suits and boots. The site incident controller will inform the nearby police station, district collectorate, pollution control board (PCB), electricity board, and factory inspector and send a report of the incident and the suitable measures taken to all the concerned departments. The MR will discuss with the incident controller and with all the heads of the departments (HODs), same will be explained to the management for the various root causes of the incident/accident, various ways, which are involved in tackling the emergency, overall view of the business impact analyses, which includes 3M and various preventive measures, which are taken to stop the reoccurrence of such type of incident/accident. The management, after assessing the whole situation, will work on the cost-benefit analysis for running the business by applying the business sustainability concept and keeping market demand into consideration. They will activate the BCP by instructing the MR. The MR will direct the Business Continuity Coordinator (BCC) in coordination with EPRT and will organize the required 3M for the sustainability of the business. The main functions of the BCC are as follows:*

1. To start the Disaster Recovery/Business Continuation process to recover the business functions through an alternate site.
2. They will inform various steps to the MR, which will lead to the sustainability of the business.
3. Only the MR after obtaining permission from the management will disclose the various developments to the public, by making an official public statement concerning the post-disaster plans for sustaining the business. Monitor the progress of all Business Continuity and Disaster Recovery teams daily.
4. MR will report the steps taken in the BCP status to the management team daily so that they can know the status for resuming the production activities.
5. Communicate directions received from senior management to the emergency teams such as EPRT and BCC for the successful starting of the production activities.
6. Provide ongoing support and guidance to the business continuity teams and personnel.
7. Review staff availability and recruit the staff based on the present requirement and need for sustaining the business based on the production plan
8. It will be ensured that all the records of all business continuity and disaster recovery activity and expenses incurred are being maintained properly and the same will be shared with the management.

3.6. *Handling the difficult circumstances in the organization during the major accidents and its continuation of the business – An overview of the case study, which has resulted in activating the BCP*

On 13th April 2022 in one of unit 4, all the occupants were working in the various production blocks, in one of the D blocks, where were carrying out 4-Nitro-N-Methyl phthalimide reaction in a 10 KL reactor with a standard temperature of 90 to 110-degree centigrade as per batch processing record (BPR), which is an exothermic reaction. The reaction has gone out of control due to the failure of chilling in the reactor jacket, which has resulted in the uncontrolled reaction, and it has resulted in leakage of the Monomethylamine gas leak due to pressure build-up in the reactor, which has resulted in explosion of the reactor vessel, resulting in fatality and the injury of the workers working in the occupational environment. Similarly, Furlong et al. 2024 have reported that gas explosions has been caused in the chemical industry due to the improper lopping of the system in a United States laboratory, Abbasi et al. 2010 have classified the various chemical explosions, which occurred in chemical processing industries and several authors have reported the explosion causes and the prevention techniques (Fukuoka et al. 2022) but very little information is published combining the causes of the accidents and the sustainability and application of the BCP after post disaster management plan. The site controller, on hearing about the accident, informed the emergency team members to raise the siren and the headcount of the operators was counted at the emergency assembling point and saw that it matched with the headcount of the digital display board, which is near to the entrance of the security gate of the company, such type of digital boards helps us to the exact number people available during the emergency. Kuligowski & Wakeman (2017) stressed the importance of the sound mechanism as a tool, which has been used for alerting the occupants working in the factory premises so that the people working in the occupational environment can reach the safe assembly point and the public at large, which includes the neighbouring industry can also be alerted in the occurrence of an emergency. By hearing the siren, the ERT team members reached the accident site, where the incident had taken place.

The ERT team members were involved in the firefighting, first aiders were involved in treating the injured person and they were given primary treatment, further occupants were rushed to the hospital for further treatment. Hamilton et al. 2022 have stressed the importance of treating the injured person during difficult times as the emergency teams are highly active not only giving the primary treatment but also saving the life in time. It is also important that mutual communication between the incident controller, rescue team, first aiders and other team members who are involved in the emergency operation should be in line way to tackle the disastrous situation so that the emergency can be fought time a bound manner (Brown et al. 2021).

During the disaster situation fighting phase, the emergency lasted for more than three hours and in the fourth hour all clear signals were given by the site controller. The site controller has presented the in-depth incident report to the MR and the MR has presented the same report to the management. Further, we have also ascertained that damage of around fifty Croes has been estimated for the process equipment of the D block. After one week of the incident, the management team instructed MR to activate the BCP to continue the business. Păunescu et al. 2018 have reported that the business impact analysis in Romanian enterprises has played a vital role in ascertaining the impact after the post-disastrous situation, the critical role is to capture the market and enhance the sustainability of the business in difficult circumstances.

The BCP team members of EPRT and BCC were involved in shifting the 3m from one unit to another unit, which is located at the Atchutapuram, Vizag, where around 10 reactors, 5 centrifuges and other process equipment were shifted to the new site and started manufacturing after installation and conducting the pre-startup safety review (PSSR) for the newly installed process equipment's. Abu Bakar and Abdul Aziz (2024) have reported that developing the PSSR technique has played a vital role in the safer operation in the hazardous chemical handling industries. The EPRT members, which were involved after the post-disaster in shifting of the business, which includes legal, regulatory, environmental health and safety, finance, personal & human resource and supply chain were 3, 2, 4, 2, 4 and 2 people are involved in shifting of the 3M. The BCC, includes the production team members, quality control, quality assurance, mechanical and maintenance, projects, utility and electrical department. Adapting to the changes in the location and continuity of the production with resilience to change played a vital role in meeting the goals of the production planning (Whyte et al. 2022). Steen & Pollock, 2022 reported that handling uncertainty is a challenging task, the resilience of the team members should be having a good knowledge of the projects and operational activity, it should lead to oper-

ational excellence resulting in achieving the production goals. Many of the other authors stated that the complex problems of restarting the business and continuing the operations, required dedicated vision of team members and the support of the top management (Hollnagel, 2015, Heger et al., 2017, Groenendaal & Helsloot, 2020). The visionary approach to planning with the help of BCP is in the Figure. 4.

Although there were many issues and delays during the transmission stage, the highest priority has been given by the management to see that production continued despite the delay due to the dangerous occurrence of the incident. In this way, the BCP has not only helped us to continue the business, but it has also helped in reaching the targets of the production there were a few delays, which occurred in getting the final product and achieving the targets, and this has been conveyed to the customer. In this way, the BCP has helped in customer retention and satisfying the global demand during difficult circumstances. The Ethical and moral values of the client and customers have been maintained and we have become the largest producing chemicals in the special economic zone at the Atchutapuram, Vizag, India within one and a half years. In this way the BCP not only helps is sustainability of the business but also helps satisfying the demand of the customers.



Figure 4. Visionary approach for tackling the emergency and activating the BCP.

4. Conclusion:

The new conceptual methodology, where the onsite emergency plan and the business continuity plan can be combined so that we can fight an emergency and sustain the business in difficult circumstances. In case of deceleration of the emergency, the emergency response team and other team members are involved in fighting an emergency like fire, explosion, emission and natural calamities. The ERT members are well-trained in handling challenging situations in the hazardous chemical manufacturing industry. Overall, the site controller is responsible for handling the emergency, he reports to the management representative. The management representative conveys the various steps which are taken in fighting an on-site emergency to the management. After the emergency comes to a halt, the MR will discuss with the management team, and plan to activate the business continuity plan to continue the business in difficult times, the emergency planning responsibility team is responsible for shifting the 3M in consultation with the MR and after shifting to new site, the PSSR has been conducted for all the process equipment before starting of the equipment, although we have

found few delays in starting of the production, same has been explained to the clients and we have streamlined the production to achieve the targets, which has resulted in sustainability of business in the difficult times.

5. End notes

1. Handling on-site emergencies requires highly trained people for handling dangerous occurrences.
2. Practicing mock drills will help us in the successful implementation of the OSEP during the occurrence of an emergency in the chemical handling industry.
3. The new approach will have a broader view for the chemical handling industries to sustain the business in difficult times by successful implementation of the BCP
4. Management support and the vision of the company business play a vital role in activating the BCP in difficult circumstances
5. Fighting an emergency with the least impact on 3M, which plays a vital role so that less impact on the invested capital for running the business.
6. Saving the life of the occupants plays a crucial role in handling an emergency.
7. Team coordination is important while activating the OSEP and successful implementation of the BCP for sustaining the business in difficult circumstances.

Funding: There is no funding involved, as this is a practical approach, which has resulted in the implementation of OSEP and BCP.

Acknowledgement: I thank all my team members in the safety department and other members of the organization for handling the emergency and helping to continue the business in difficult circumstances.

Conflict of interest: The author has no conflict of interest.

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