

EMERGENCY RESPONSE AND PLANNING  
MANAGEMENT SYSTEM FOR PROCESS  
INDUSTRIES

NURUL IZZUREEN MUHAMAD ZURAI

BACHELOR OF OCCUPATIONAL SAFETY  
AND HEALTH (Hons)

UNIVERSITI MALAYSIA PAHANG

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ID Number : PA14027

Date : January 2018

EMERGENCY RESPONSE AND PLANNING MANAGEMENT SYSTEM FOR  
PROCESS INDUSTRIES

NURUL IZZUREEN MUHAMAD ZURAIDI

Thesis submitted in fulfillment of the requirements  
for the award of the degree of  
Occupational Safety and Health (Hons)

Faculty of Engineering Technology  
UNIVERSITI MALAYSIA PAHANG

JANUARY 2018

## **ACKNOWLEDGEMENTS**

I am truly grateful and would like to express my sincere thanks and gratitude to my supervisor, Dr.Hanida Binti Abdul Aziz for her constant guidance and support in making this research possible. She had always believed in me and my abilities despite the many flaws I showed throughout the whole research process. She had relentlessly helped me improve not only my thesis, but also myself as a whole with her passion and care. Her encouragement has given me the strength and willpower to keep pushing to complete this research and I am truly thankful and honoured to be given the golden opportunity to be guided by her.

My most sincere and utmost thanks goes to both my beloved parents for showing me so much love and support to mould me into the person I am today. Without their love and sacrifices, I would not be here today. Their constant prayers and belief in me kept me staying strong especially at times when I felt like giving up. They were my pillars of strength and without the constant support from them; I wouldn't have been able to finish this project on time. I would also like to express my gratitude to my fellow course mates and friends whom provided guidance and help throughout the two semesters of this thesis.

I would like to thank everyone whom had contributed either directly or indirectly throughout the process of this research.

## **ABSTRAK**

Penerbitan cecair, reaktif, atau cecair yang mudah terbakar dan gas dalam proses yang melibatkan bahan kimia yang sangat berbahaya telah dilaporkan selama bertahun-tahun, dalam pelbagai industri menggunakan bahan kimia dengan sifat tersebut. Terlepas dari industri yang menggunakan bahan kimia yang sangat berbahaya ini, ada potensi untuk dilepaskan secara tidak sengaja kapan pun mereka tidak dikontrol dengan baik, menciptakan kemungkinan bencana. Pengurusan keselamatan proses (PSM) ditangani dalam piawaian khusus untuk industri am dan pembinaan. Piawaian OSHA menekankan pengurusan bahaya yang berkaitan dengan bahan kimia yang sangat berbahaya dan mewujudkan program pengurusan komprehensif yang mengintegrasikan teknologi, prosedur, dan amalan pengurusan. Kajian ini dijalankan untuk membangunkan sistem pangkalan data ERP yang dapat mengurus dan mengesan maklumat, dokumen, dan penyelesaian cadangan yang berkaitan dengan bahaya proses. Sistem ini disahkan melalui kajian kes. Kesimpulannya, untuk memastikan syarikat mematuhi standard PSM dan peraturan CIMAHA yang berkaitan dengan kesediaan tindak balas kecemasan, lebih lama diperlukan supaya sistem dapat ditingkatkan.



## **ABSTRACT**

Unexpected releases of toxic, reactive, or flammable liquids and gases in processes involving highly hazardous chemicals have been reported for many years, in various industries using chemicals with such properties. Regardless of the industry that uses these highly hazardous chemicals, there is a potential for an accidental release any time they are not properly controlled, creating the possibility of disaster. Process safety management (PSM) is addressed in specific standards for the general and construction industries. OSHA's standard emphasizes the management of hazards associated with highly hazardous chemicals and establishes a comprehensive management program that integrates technologies, procedures, and management practices. This study conducted to develop ERP database system that able to manage and track information, documents, and resolution of recommendations related to the process hazards. The system is validated through case study. In conclusion, in order to ensure the company comply with the PSM standard and CIMAHA regulations related to ERP, longer time is needed so that the system can be upgraded.

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## **LIST OF ABBREVIATIONS**

CIMAH 1996	(Control Of Industrial Major Accident Hazards) Regulations 1996
PSM	Process Safety Management
ERP	Emergency Response Plan
EAP	Emergency Action Plan
ERPMS	Emergency Response Plan Management System
SMS	Safety Management System



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

This chapter is mainly emphasizes on the general idea of this study along with the problem statements, objectives, significance of study, scope of study, and the study limitations.

#### **1.2 BACKGROUND STUDY**

Economic growth of Malaysia had increased from day to day followed by the increasing of process industries developed. Most of the processing industry in our country has been using chemicals that are harmful to the environment. Various type of emergency had occurred at workplace due to human negligence during working. This will cause loss of properties and lives. Major accident is likely to occur in workplace. Major accidents is any occurrences including a major emission, fire or explosion that resulted from uncontrolled development of industrial activity which leads to serious danger to person (Ah Lek, 1989).

Emergency Response Plan (ERP) is one of the most contributing factors to prevent further incident. For example, Bhopal incident occurred 30 years ago in the midnight of December 2, 1984, the tank 610 (one of three tanks) containing methyl isocyanate (MIC), which is an intermediate compound in the production of a highly toxic pesticide called cevine, got contaminated with water. This reaction turned into a violent 'runaway', which is a term, used to describe an accelerated and uncontrollable chemical reaction.

According to Occupational Safety and Health Act 514, section 15(1) stated that employer must to protect the safety, health and welfare of their employees as far as practicable. In order to provide safety and health of workplace, emergency response plan must to be established. Emergency can be define as a sequenced of human error or natural events that gives effect to the society, property, and environment (Fogli, Greppi, & Guida, 2017).

Emergencies can create a variety of hazards for workers in the impacted area. Preparing before an emergency incident plays a vital role in ensuring that employers and workers have the necessary equipment, know where to go, and know how to keep them safe when an emergency occurs. In addition, employer must to develop the emergency action plan before and accidents happen. This will ensure that the employees know how to response if accidents happen. According to (Skryabina, Reedy, Amlôt, Jaye, & Riley, 2016), emergency response plan activities includes the cycle of planning, equipment, training and exercises. The plan must be documented and shared to all employees. By means, all of the employees and stakeholders know their own responsibilities to response when accident or disasters happen.

Despite preventions methods and controls implemented at process industries, the industrial accident rate (defined as the number of injuries and deaths per 100 workers or employees) and the fatality rate (defined as the number of deaths per 100,000 workers or employees) in the Republic of Korea are highest rather than developed countries in Europe and North America (Choi, 2016).

CSB finds ineffective EPR system in certain accidents such as the Missouri DPS Enterprise Chlorine Gas Release accident in 2002. DPS EPR failed in planning on location of emergency equipment and accessibility. Many other accidents have occurred throughout the decade and even though organizations have their own EPR system, there are issues in meeting minimum PSM requirements.

On Saturday 1 June 1974, the Nypro (UK) site at Flixborough was severely damaged by a large explosion. Twenty-eight workers killed and a further 36 suffered injuries. It recognized a 20-inch bypass system ruptured, which a fire on a nearby 8-inch pipe may have caused. There was a massive vapour cloud explosion that caused extensive damage and started numerous fires on the site. Eighteen fatalities occurred in the control room as a result of the windows shattering and the collapse of the roof. No

one escaped from the control room. The fires burned for several days and after ten days those that still raged were hampering the rescue work.

One of the established standards which has been used in developing EPR systems is the Occupational Safety and Health Administration (OSHA) Process Safety Management (PSM) of Highly Hazardous Chemicals, 29 CFR 1910.119. Many countries and organizations have adapted PSM as guidance for handling hazardous chemicals in the manufacturing industry.

The main objective of this standard is to manage highly hazardous chemicals, which are present in the process above a certain threshold quantity and reduce the frequency of incidents happening such as fire, explosion and chemical toxic release. PSM is an OSHA standard, which governs a safe work practice approach to control and contain hazards, prevent and mitigate loss events. Since its implementation in 1992, the number of accidents has significantly reduced, leading to higher productivity, improved perception towards process safety and reduction of human error. However, an employer with 10 or fewer employees may communicate the plan orally to employees.

In Malaysia, we have been used the Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 to guide employers in managing emergency response preparedness in workplace. European Community government passed regulations about major hazard directive in chemical process facilities (SEVESO DIRECTIVE). Britain enforced the directive, known as the Control of Industrial Major Hazard (CIMAH) regulations in 1984. This regulation is essential to protect workers from any accident that will result in loss of lives and properties.

### 1.3 PROBLEM STATEMENT

Hazards are likely to exist in every workplace even though there were so many preventive measures provided. Employers may be concern about the safety rules on the jobs, but the likelihood for workplace injuries are still happening. The injuries not only give impacts to employees in medical treatment or event death. It also can give impacts to the decrease of productivities, increase of insurance rates or compensation claims and decrease the company status.

According to (Mannan, 2012), due to lack of emergency response plan, a sudden failure occurred in anhydrous ammonia storage tank at Potchefstroom in South Africa. Workers in a building 80m from the release survived, but people who left their house from it died.

In addition, a major accident hazard also occurred at Associated Octel, Ellesmere Port, Merseyside. The accident happen when fire following flammable liquid metal spillage where the sodium spilled during road tanker offloading. Based on, (Whitfield, 2002), the accident was happened because of failure to follow emergency response plan procedures

Failure to comply with PSM standard has become a citable deficiency for example in Flixborough fire and explosion where poor operating actions were a major contributing factor in the cause of the incident (Gordon McKay PhD, 1992). Nevertheless, successful compliance audit is also predicted on a well-structured and fully documented PSM program. However, due to the large process data, producing, communicating, controlling and maintaining PSM document sometimes was seemed to be very difficult to handle and requires great effort from the industries.

In order to reduce the accidents, a systematic system has to be developed to comply and manage emergency response plan. The system consists of the framework and model. When the industry have a well develop emergency response plan, the risk of accidents occurs can be reduced. This system will develop based on OSHA PSM Standard 29 CFR 1910.119 (n) standard and Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996.

## **1.4 RESEARCH OBJECTIVE**

The objectives of this research are:

- 1.4.1 To analyse requirement of ERP based on CIMA Regulations 1996 and PSM Standard.
- 1.4.2 To develop framework of ERP based on CIMA regulations 1996 and PSM Standard.
- 1.4.3 To develop ERP database system based on developed framework of CIMA 1996 and PSM Standard.
- 1.4.4 To conduct case studies for system validation

## **1.5 RESEARCH QUESTION**

This study was conducted to answer the following question:

- 1.5.1 What are the requirements of regulations that related to emergency response plan?
- 1.5.2 What is the suitable framework and database management system to be developed?
- 1.5.3 How the database management system can be optimized?

## 1.6 SIGNIFICANT STUDY

The outcome of this research is to propose the framework and database system for emergency response plan of workplace management system. The effective emergency response plan will decreased the level of impact to an organization if an incident occurs. This database system also will guide an organization on how to deal with the emergency incident and compliance with Emergency Response Plan of Process Safety Management of Highly Hazardous Chemicals, 29 CFR 1910.119, Occupational Safety and Health Administration US 1992 and CIMAH Regulations 1996.

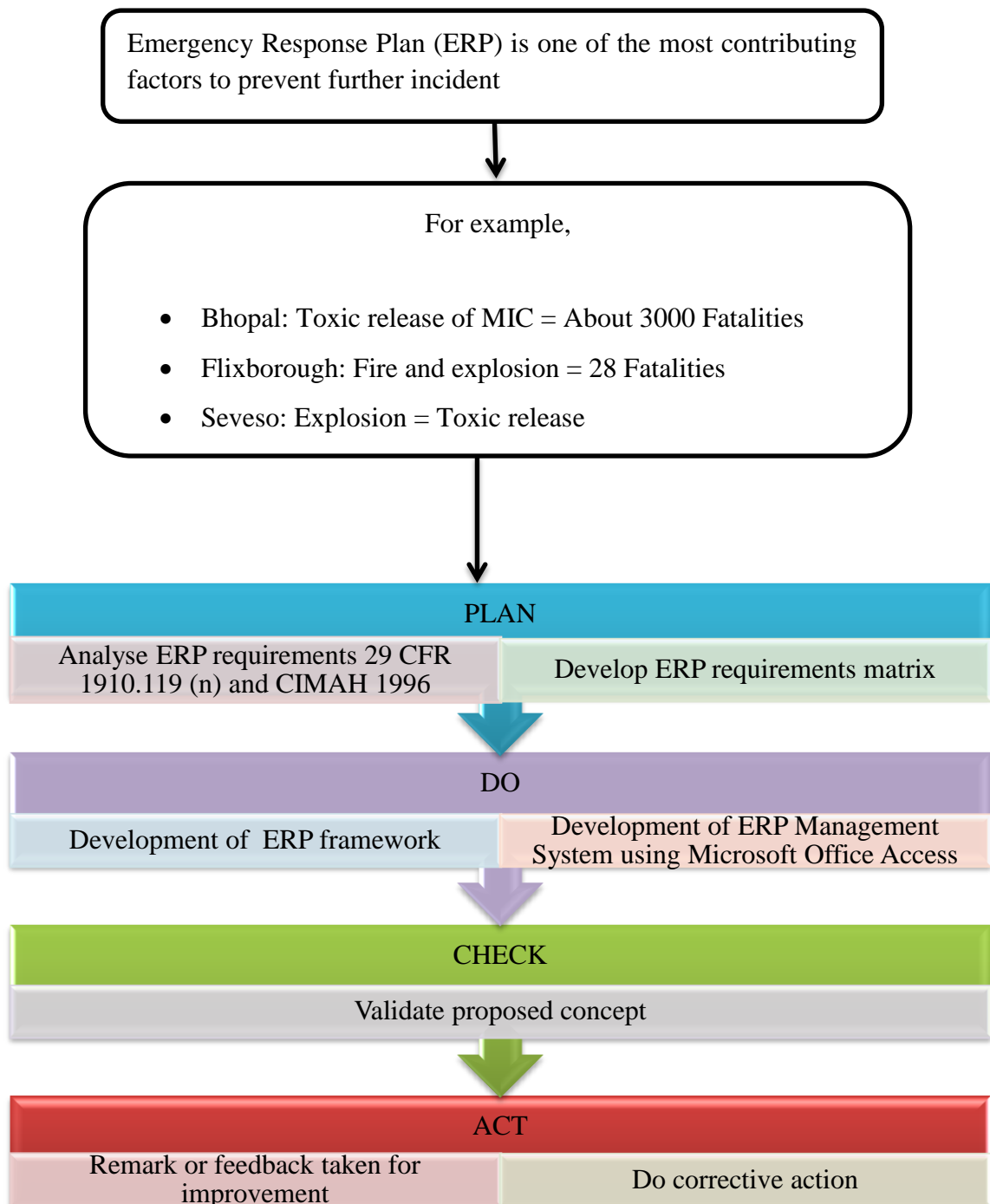
Employees also will know their responsibilities to response with incident. In other hand, multi-agency such as fire department, police department and medical agency also must to be included in the framework model so that they know their roles and responsibilities. The communities from the residential area and other plants nearby also will know how to evacuate and where is the safe area to go if accident happens.

## 1.7 SCOPE OF STUDY

This study will focus on Emergency Response Planning element. Regulations of Process Safety Management of Highly Hazardous Chemicals, 29 CFR 1910.119, Occupational Safety and Health Administration US 1992 and Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 were analysed. The research was conducted at two chemical process industries at Gebeng, Kuantan. The data collected and analysed based on the emergency response plan that had been used by the company. Their HSE department also will be interviewed to know their perception and their knowledge about their company's emergency response plans procedure.

The framework and system developed focused on two regulations, which are Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 and Process Safety Management of Highly Hazardous Chemicals, 29, CFR 1910.119, Occupational Safety and Health Administration US 1992.

## 1.8 CONCEPTUAL FRAMEWORK



## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter gives insight on the ideas of past research that support and strengthened this study. Upon these past research and journal is where the study gets its cues and used these ideas to support the theories, models and ideas. The past researches related to this study will be discussed in order to obtain more knowledge and information related to this study.

#### **2.2 PROCESS SAFETY MANAGEMENT**

Every workplace has come out with the risk. This is due to human negligence that disobeys the rules and guidelines of safe of work procedures. Every persons in the organization from the top management until the workers must to involve in the safety culture to establish a safe workplace. However, emergency responder team must to work proactively in managing the emergency accidents.

Most of process industries have a potential to produce major accidents such as fires, explosions, and the release of toxic chemicals. Thus, this will cause fatalities and damages to the environments. As the process industries become more complex, the accidents will become more danger if the emergency response plans not well function. According to (Diana, Majid, Shariff, & Rusli, 2015), stated that the impact of large scale of accidents such as in Bhopal (1984) had caused many losses of properties and lives that have altered the process industry landscape and changes in regulations and development of standards and management systems.

These regulations establish a comprehensive safety program that integrates technologies, procedures, and management practices (Mohd Shariff, Abdul Aziz, &



Abdul Majid, 2016) PSM comprises of 14 elements that are used to manage facilities, technology, and personnel. The elements of OSHA PSM standard are:

1. Employee Participation (EP)
2. Process Safety Information (PSI)
3. Process Hazard Analysis (PHA)
4. Operating Procedures (OP)
5. Training (TNG)
6. Contractor (CONT)
7. Pre-Startup Safety Review (PSSR)
8. Mechanical Integrity (MI)
9. Hot Work Permit (HWP)
10. Management of Change (MOC),
11. Pre-start up safety review (II)
12. Emergency Planning and Response (EPR)
13. Compliance audit (CA)
14. Trade Secrets (TS)

Currently, the practical implementations of PSM are varied from plant to plant due to lacking of established technique for industries to comply with PSM requirements and maintaining the effective process safety programs.

### **2.2.1 APPLICATION OF PSM**

In order to ensure safety and health of worker at workplace, OSHA has established the Process Safety Management (PSM) (29 CFR 1910.119) that state about the requirements for the management of hazards related with processes using highly hazardous chemicals (Diana et al., 2015). PSM is a proactive and systematic process to mitigate, identify, and evaluate chemical hazards results in failure process. It also emphasized the management of hazards that related to highly hazardous chemicals. Using this approach, the training programs, mechanical integrities, emergency response preparedness, safe work of procedures and other elements that affect the process are considered in the evaluation.

The PSM Standards contains 14 elements, including Emergency Planning & Response (EPR) in CFR 1910.119 (n) (O. Safety, 2000). EPR is a compulsory practice in preparing for any unexpected and emergency events. When preventive measures in the process fail, EPR plays a vital role in mitigating such events and ensuring minimum risk exposures to workers and surrounding community. Consequently, EPR guides in the planning for emergency action plans and response procedures which include responding to small and large chemical release (Lin, Chang, Chang, Chen, & Shu, 2009). PSM provides guidelines on how EPR can be incorporated within the scopes of waste handling or clean-up operations (Osha, 2003). However, incidents are still occurring and the numbers have risen recently in the past few years despite PSM Standards being implemented almost three decades ago.

PSM requires the employer to meet certain requirements for EPR as given in CFR 1910.119 (n) as a guideline, but specific methodologies are not mentioned. This regulation also links with two other related regulations namely CFR 1910.38 Emergency Action Plan and CFR 1910.120 Hazardous Waste Operations and Emergency Response.

Process safety management directed toward preventing process-related incidents, which affect personnel, equipment, or off-site communities (O. Safety, 2000). Each person involved in transporting, storing, or processing materials is responsible for managing the hazards of the operation to avoid incidents, injury to personnel, and damage to equipment and the environment. Process safety management is everyone's job.

According to (P. Safety & Protection, 2008), on 17 May 2007, a toxic release from a boiler explosion in a chemical firm triggered a large amount of xylene (7 ton), isopropanol (8 ton), phosphorus trichloride (44.7 ton), and dimethyl formamide (DMF) (1.37 ton) to be released to the atmosphere with total damages of 2000m<sup>2</sup> level ground.

Bhopal incident occurred 30 years ago in the midnight of December 2, 1984, the tank 610 (one of three tanks) containing methyl isocyanate (MIC), which is an intermediate compound in the production of a highly toxic pesticide called cevine, got contaminated with water. This reaction turned into a violent 'runaway', which is a term, used to describe an accelerated and uncontrollable chemical reaction.

In response to these catastrophic accidents regulatory bodies and safety communities has come out with more straight regulations and safety interventions. One of the excellent outcomes is OSHA PSM Standard 1992.

### 2.3 CIMAHS 1996

Major accidents also occur in Malaysia especially in workplace. Thus, Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 was enacted in response indirectly to the Bhopal incident in India in 1984 and the Sungai Buluh firecracker factory tragedy in Malaysia which has killed 23 workers in 1992.

The world's worst industrial disaster in Bhopal, India, happened because of inadequate maintenance by Union Carbide and poor monitoring by the Indian authorities. This incident happened because of malfunctioning safety measures, inappropriate location of the plant, and lack of information about the identity and toxicity of the gas worsened the effects of the accident on people and livestock.

In addition, the firework industries are a dangerous business. Malaysia also has experienced tragedies through a fire and explosion of Bright Sparklers fireworks factory. One of the factor that caused the explosion is the Sparklers Sdn. Bhd management was not comply with the manufacturing regulations and lack of safety management (Prevention, 2002). Figure 2.1 shows the disaster of fireworks industries.

Year	Date	Location	Accident	Number of	
				Deaths	Injured
2001	31/12	Lima, Peru	Fireworks spark, fire	282	134
1998	24/01	China, Peking	Road accident, explosion, fireworks	40	100
1994	4/1	India, Madhyapradish	Explosion, fire crackers	30	100
1993	25/11	China, Dulin	Explosion, fireworks	26	–
1993	29/8	China, Nanshankon	Explosion, fireworks	27	2
1992	20/6	Libya, Alssawani	Explosion at factory, fireworks	17	143
1992	25/1	India, Tharia	Explosion, fire, fireworks	>25	100
1991	1	India, Lhudiana	Market, fireworks	>40	–
1991	12/7	India, Meenampalti	Explosion, firework factory	38	–
1991	4/5	Kuala Lumpur, Malaysia	Explosion, fireworks	41	61
1989	19/1	China, Henan	Explosion, fireworks	27	22
1988	11/12	Mexico, Mexico city	Explosion, fireworks	62	87
1979	12/4	Pakistan, Rawalpindi	Explosion, fireworks	>30	100
1974	19/7	India, Allahabad	Explosion of rail transport, fireworks	42	–
1973	29/8	Indonesia, Jakarta	Fire, explosion	52	24

Figure 2.1 Disasters due to firework industries (Prevention, 2002)

The first regulation controlling risks promulgated under OSHA 1994, Control of Industrial Major Accident Hazards Regulations (CIMAH) 1996, came as a result of lessons learnt from major accidents worldwide, e.g., release of methyl isocyanate in Bhopal, India in 1984 and locally, e.g., the Bright Sparklers incident, an explosion in a fire crackers factory in Malaysia in 1990. The CIMAH Regulations 1996 requires the employer to notify of major hazard installation, prepare emergency plan and notify major accident that occur in their premises. The Industrial Major Hazard Unit formed within DOSH addresses this issue.

Despite companies having their own EPR system, accidents are still occurring due to lack of meeting the minimum requirements of PSM Standards. All the issues identified from CSB investigation findings pinpoint to the fact there lack a structured technique in managing EPR in the organization. Self-regulatory practices can also contribute to this problem, as the minimum requirements may not be fully addressed. In conclusion, to help organizations meet these minimum requirements, the purpose of this paper is to present a structured and easy technique for organizations to plan and implement EPR as per PSM requirements.

## 2.4 EMERGENCY RESPONSE PLAN

The actions taken in the initial minutes of an emergency are critical. A prompt warning to employees to evacuate, shelter or lockdown can save lives. A call for help to public emergency services that provides full and accurate information will help the dispatcher send the right responders and equipment. An employee trained to administer first aid or perform CPR can be lifesaving (Renschler et al., 2016). Action by employees with knowledge of building and process systems can help control a leak and minimize damage to the facility and the environment.

According to (Zhang, Ni, Huang, & Duarte, 2017), the first step when developing an emergency response plan is to conduct a risk assessment to identify potential emergency scenarios. An understanding of what can happen will enable you to determine resource requirements and to develop plans and procedures to prepare your business. The emergency plan should be consistent with your performance objectives.

At the very least, every facility should develop and implement an emergency plan for protecting employees, visitors, contractors and anyone else in the facility. This part of the emergency plan is called “protective actions for life safety” and includes building evacuation (fire drills), sheltering from severe weather such as tornadoes, “shelter-in-place” from an exterior airborne hazard such as a chemical release and lockdown (Bullock & Coppola, 2008). Lockdown is protective action when faced with an act of violence.

When an emergency occurs, the first priority is always life safety (Alim, Kawabata, & Nakazawa, 2015). The second priority is the stabilization of the incident. Many actions can be taken to stabilize an incident and minimize potential damage. First aid and CPR by trained employees can save lives. Use of fire extinguishers by trained employees can extinguish a small fire. Containment of a small chemical spill and supervision of building utilities and systems can minimize damage to a building and help prevent environmental damage.

Some severe weather events can be forecast hours before they arrive, providing valuable time to protect a facility. A plan should be established and resources should be

on hand, or quickly, available to prepare a facility. The plan should also include a process for damage assessment, salvage, protection of undamaged property and cleanup following an incident (O'Mahony, Doolan, O'Sullivan, & Hession, 2008). These actions to minimize further damage and business disruption are examples of property conservation.

#### **2.4.1 EMERGENCY ACTION PLAN**

One of legal requirements that employer must to obey is emergency planning. Every employer should establish an emergency plan to minimize the impact of dangerous occurrence in workplace. An emergency action plan (EAP) is a written document required by particular OSHA standards [29 CFR 1910.38(a)]. The aim of emergency action plan (EAP) is to organize and facilitate all workers including the employer to react during emergencies in workplace.

Emergency planning is needed to prevent victims from the dangerous occurrence become worse. It can minimize the impact from accident that has potential to expose to victims. A well-established emergency plans will result in less impact to employees injuries and less infrastructural damage to company's facilities. Poorly managed preparation will make the impact of accident become more dangerous. According to (Skryabina et al., 2016), the emergency preparedness activities is includes a cycle of preparedness, adequate training, exercise and management improvement.

Hazard identification is a must while developing emergency action plan (Bullock, 2008). The assessment of hazards sources need to be listed. The hazard assessment need to be included while establishing an emergency plan. According to (P. Safety & Protection, 2008), physical or chemical hazards are the main sources that have potential that contributed to accident. The analysis of past incident is necessary in identifying the main causes of any accident (Girgin & Krausmann, 2016).

Every workplace must to have at least two exit routes (Henshaw, 2001). This will make employees to be evacuated easily during emergency. Exit route is can be define as a continuous and unblocked path of exit travel from any point of workstation to a safe assembly point. However, the number of exit routes is depending on the size

of the building, number of employees and the design of the workplace (Osha, 2003). Exit routes must be located as far away as practical from each other in case one is blocked by fire or smoke.

In addition, the exit route must have adequate fire extinguisher, water sprinkler, map, first aid kit and signage. Proper signage is essential in emergency evacuation plan. According to Emergency Evacuation and Stairwell Signage Guideline California, the signage should be posted clearly the information related to emergency exit routes for example, stairways, exit signage, where to initiate fire alarm, how to use fire extinguisher and the location of assembly point (E-, 2007).

#### **2.4.2 EMERGENCY RESPONSE CYCLE**

According to (Park & Box, 2008), emergency is can be defined as an unexpected and dangerous situation that must be deal with immediately. Responder must provide the emergency plan to prevent the accident that will happen. Basically there are 4 phases in emergency cycle which are mitigation, preparedness, response and recovery.

Mitigation and preparedness is important during pre-emergency. Mitigation is the process of prevention from any hazards or danger that will come out from any industrial activities (Paper, 2010). Hazard identification, risk assessment, and risk control are essential to know the level of risk that the hazard elements can produce.

However in preparedness have its own roles in emergency plan management. At this phase, preparation is a must to counter back and sustain the accident that will occur. As the industrial activities growth increase, more preparation need to be build such as planning, training and exercising of the responders (Henshaw, 2001) . Thus the organization must ensure that they are complies with preventive measures and in a state of readiness to rescue victims in order to minimize loss of life, injury and damage to property.

In addition, response phase should be established during the emergency stage. At this moment, the responder must to take action immediately as they have been trained at the preparedness stage. This includes initiatives taken to ensure that the needs and

provisions of victims are met and suffering is minimized (One & Tm, 2014). Rescuing victims is important but the rescuers lives also need to be considered in this phase.

Lastly, the recovery phase also included in this cycle. Rehabilitation and reconstruction of collapse buildings or destroy areas to provide humanitarian needs for example shelters, foods, families and properties so that the victims can live their life as good as before.

### **2.4.3 TRAINING**

The established action plans must include employees in the planning process. Before implement the action plan, training must to be performed first. This will ensure the employees have knowledge on how to use the emergency plans developed. The quality of good emergency planning is consisting of employee training as well as the employee ownership of and involvement with the plan to provide a better prepare workplaces for emergency situations (Renschler et al., 2016).

According to (Skryabina et al., 2016), exercise can be divided into two which are discussion-based exercise and operation-based exercise. Discussion-based exercises are includes tabletop exercises, workshops or seminar. Seminar is an informal discussion. It is used to orient participants to new or update plans, policies and procedures. Tabletop exercises are also a process of discussion but it is differ from seminar.

Table top exercises usually comprise the discussion on 3d model that design exactly the same as the emergency response plan of the selected location. Discussion-based exercises can function to familiarize participants with the plans, roles and procedures. This will allow the participants to practice their roles and responsibilities in the developed emergency plan by demonstrating the model.

However, operation-based exercises are includes drills, functional exercises and full scale exercises. Operation-based exercise was developed to simulate an emergency situation into realistic conditions. Drills are design to practice specific skills or procedures such as triage, evacuation and communication skill. Functional exercise is involved to examine the coordination, command and controls between multi-agencies coordination .



Full scale exercises are multi-agency, multi-jurisdictional, multi-discipline exercise involving functional and boot on the ground response . Operation-based exercises are more difficult to conduct because it involve the real activities need to be performed as well as the real emergency.

## 2.5 **CURRENT METHOD**

SMSs have many common characteristics in that they are systematic, proactive and explicit (Mitchison & Papadakis, 1999). Generally, safety management systems refer to a set of procedures connected by logical links. SMSs have general elements in common; they may be used in different industries while their elements are similar; and they are the result of continuous improvement following their life cycles. Shows a complete safety management system following Hale's (2005) model, which is also a generic SMS as these elements can be applied in various industries or organizations.

The generic SMS consists of two main elements: the risk control system and the learning system, each of which can be unpacked to reveal several sub-elements. The generic SMS is influenced through feedback by its own system performance and the societal context in which it operates.

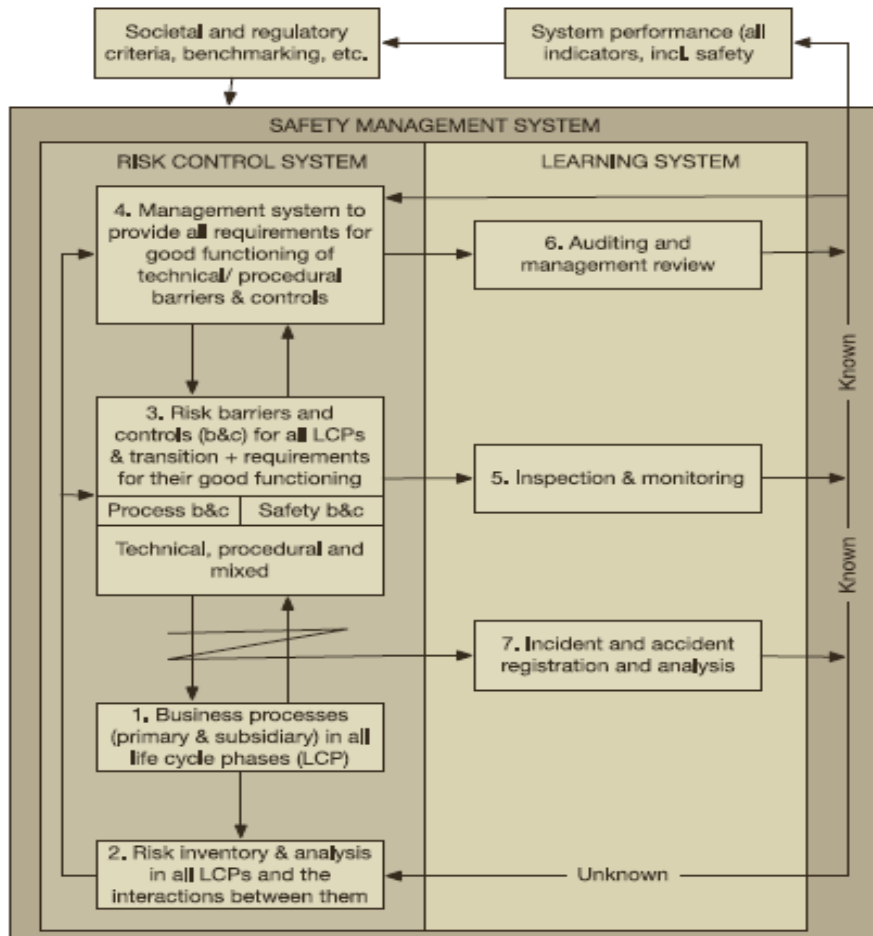


Figure 2.2 Safety Management System Hale's Model

(Yu, Quddus, Peres, Sachdeva, & Mannan, 2017)

Even though a framework had been used in many organizations, the failure in ERP process still happens. When the incidents happen, employees still do not know where the correct ways to evacuate immediately and safely. Many of these systems lacked proper planning, communication between vital parties, and adequate training for employees.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 INTRODUCTION**

This chapter will be discussing about the research procedures that used throughout the study. This chapter consists of research design, study sample, study area, sampling techniques, process and procedures, data collection technique, research instruments, and data analysis. In achieving the objective, there are several methodology is used. A research study cannot be conducted without the attainment of the results that it desires. Methodology refers to the systematic way of the comprehensive methods that applied during this research.

#### **3.2 RESEARCH DESIGN**

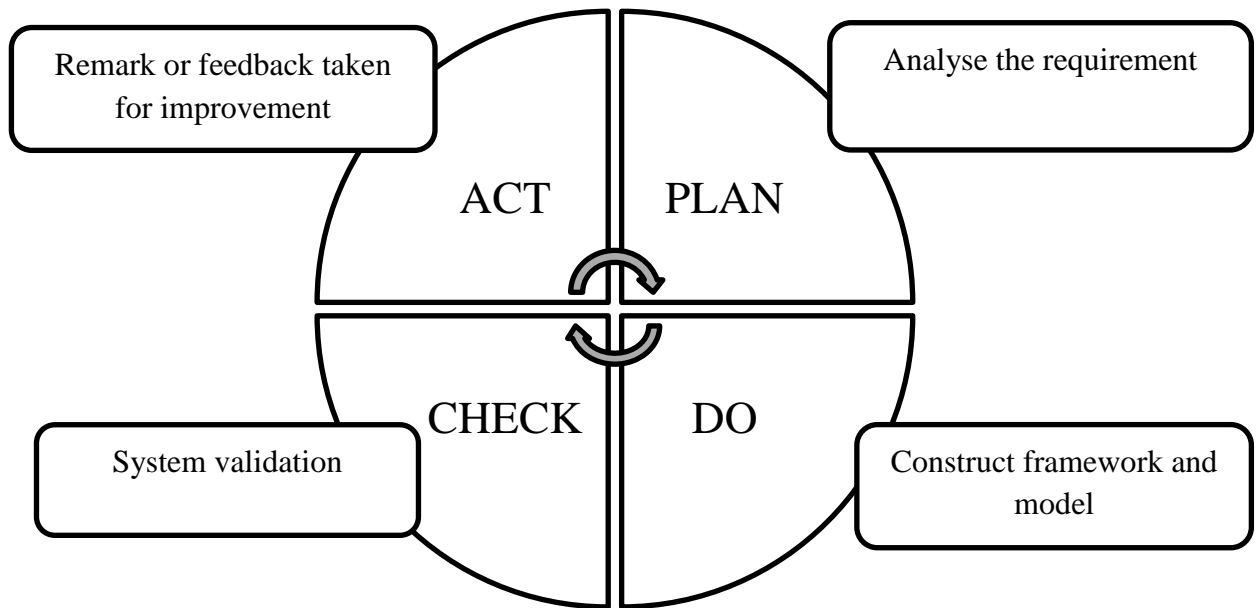
The research design of this study is non-experimental. It is descriptive survey design and cross sectional study. The data is collected to gain several answers for the questions concerning the about the awareness, knowledge, decision process and practices on the community preparedness towards major accident hazard. The study is cross-sectional because the data are collected at one point in time. Furthermore, the data collected are in qualitative form. Besides that, semi-structured interview will be conducted during face-to-face interview in the group of respondent and individual respondent.

#### **3.3 STUDY AREA**

The validation of developed system was conducted at two different process plants located at Gebeng, Kuantan. The plants were chosen due to its daily operations that involve in highly hazardous chemicals.

### 3.4 RESEARCH PROCESS AND PROCEDURES

Figure shows PDCA cycle used in this research. It was consist of four–step model for carrying out change. Just as a circle has no end. The PDCA cycle used because the research conducted must be repeated for continuous improvement.



#### 3.4.1 Plan

##### 3.4.1.1 Understanding Elements of Emergency Response Plan 29 CFR 1910.119 (n) and CIMAHA 1996

Study briefly about the Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996 and ERP element of Process Safety Management of Highly Hazardous Chemicals, 29 CFR 1910.119, Occupational Safety and Health Administration US 1992. It is important to find the most suitable journals that related to this study. The information need to be extracted from the selected journals. Matrix of regulation was developed based on the CIMAHA 1996 Regulations and PSM Standards.

### **3.4.2 Do**

#### **3.4.2.1 Development of the framework for Emergency Response Plan (ERP)**

The framework was developed by gathering all of the information that existed in the ERP of PSM and CIMAH will be arranged systematically in the framework.

#### **3.4.2.2 Developed ERP Management System using Microsoft Office Access**

After the framework has been developed, the ERP Management System was developed by using Microsoft Office Access. The information that has arranged in the framework was extracted to the Microsoft Office Access. Interface that consists of requirement checklist are developed. However, some of the requirements have their sub standards and linkage attached and need to be checked.

### **3.4.3 Check**

#### **3.4.3.1 Validate proposed concept**

User from a process industry at Gebeng then validates the completed database system. Then the user test the database system by clicking complete or incomplete based on their document recorded. By using this database system they can list out or detect the location of the documents, update and review record, and check compliance to the ERP standard.

### **3.4.4 Act**

#### **3.4.4.1 Remark or feedback taken for improvement**

After validation of database, the feedback from user needs to be remarks. The improvement can be done by altering the ease to access the database system for user to track the location of the documents, update changes and progress, and check compliance to the ERP standard.

## **CHAPTER 4**

### **RESULTS AND DISCUSSION**

#### **4.1 INTRODUCTION**

#### **4.2 REQUIREMENTS FOR ERP OF PSM 29 CFR 1910.119 (N) AND CIMAH 1996**

Emergency action plan for the entire plant must be developed and implemented in accordance with the provisions of other OSHA rules (29 CFR 1910.38(a)). In addition, the emergency action plan must include procedures for handling small releases of hazardous chemicals. Employers covered under PSM also may be subject to the OSHA hazardous waste and emergency response regulation (29 CFR 1910.120(a), (p), and (q)).

In addition, Control of Major Accident Hazard Regulations 1996 of Occupational Safety and Health Act 1994 [Act 514] is used in Malaysia which concern on ERP in industry to provide the safety and health of employees in workplace. Table 1 tabulates the standard for ERP in PSM and CIMAH regulations.

Table 1 ERP requirements matrix based on CIMA 1996 and PSM (Ah Lek, 1989) and  
(O. Safety, 2000)

REQUIREMENTS	CIMA 1996	PSM
<p>a) Application</p> <p>An employer must have an emergency action plan whenever an OSHA standard</p>	✓	✓
<p>b) Written and oral emergency action plans</p> <p>An emergency action plan must be in writing, kept in the workplace, and available to employees for review. However, an employer with 10 or fewer employees may communicate the plan orally to employees</p>	✓	✓
<p>c) Minimum elements of an emergency action plan</p> <p>(1) Procedures for reporting a fire or other emergency</p> <p>(2) Procedures for emergency evacuation, including type of evacuation and exit route assignments</p> <p>(3) Procedures to be followed by employees who remain to operate critical plant operations before they evacuate</p> <p>(4) Procedures to account for all employees after evacuation</p> <p>(5) Procedures to be followed by employees performing rescue or medical duties</p> <p>(6) The name or job title of every employee who may be contacted by employees who need more information about the plan or an</p>		✓

explanation of their duties under the plan		
<p>d) Employee alarm system</p> <p>An employer must have and maintain an employee alarm system. The employee alarm system must use a distinctive signal for each purpose and comply with the requirements in § 1910.165</p>		✓
<p>e) Training</p> <p>An employer must designate and train employees to assist in a safe and orderly evacuation of other employees</p>	✓	
<p>f) Review of emergency action plan</p> <p>An employer must review the emergency action plan with each employee covered by the plan:</p> <p>(1) When the plan is developed or the employee is assigned initially to a job</p> <p>(2) When the employee's responsibilities under the plan change</p> <p>3) When the plan is changed</p>	✓	✓
Regulation 12 Application	✓	✓
Regulation 13 Registration of Competent Person	✓	
Regulation 14 Report on industrial activity	✓	



Regulation 15 Modification	✓	
Regulation 16 Updating of report	✓	✓
Regulation 17 Review of report	✓	✓
Regulation 18 On-site emergency plan	✓	✓
Regulation 19 Updating of on-site emergency plan	✓	✓
Regulation 20 Review of on-site emergency plan	✓	✓
Regulation 21 Off-site emergency plan	✓	✓
Regulation 22 Information to the public	✓	✓

#### 4.3 FRAMEWORKS FOR ERP BASED ON PSM AND CIMAHA 1996 REGULATIONS

Figure 4.1 shows the ERP framework developed based on PSM and CIMAHA 1996. First, user must check whether the chemical substances used in their plant is listed under in 29 CFR 1910.119(a) or not. If chemical used in a company is not listed in the standard, then this framework is not applicable to the company. If yes, the company must to update or review response procedure for identification and notification of industrial activity as required in CIMAHA PART II.

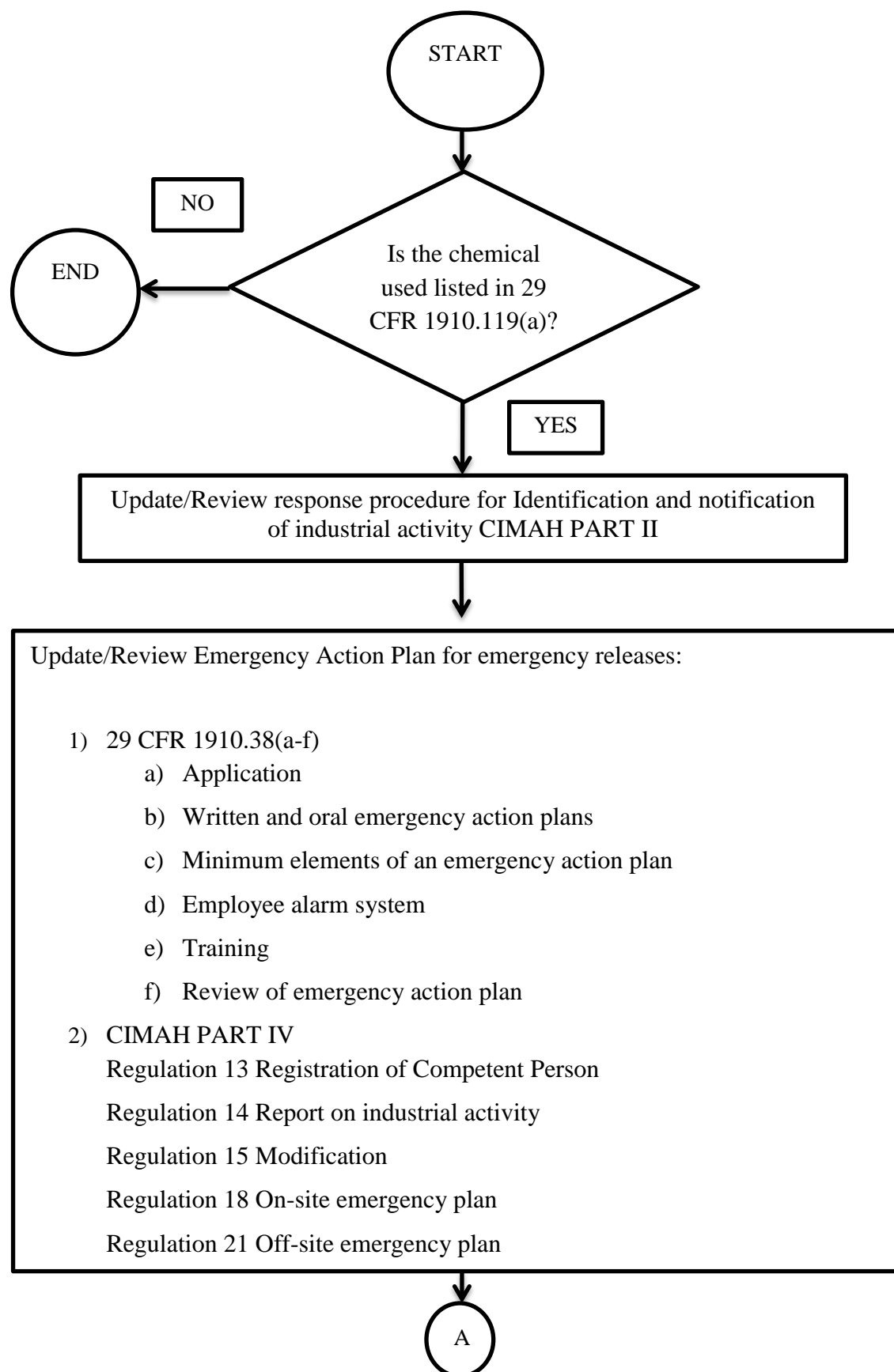
Second, the user needs to update or review emergency action plan (EAP) for emergency release procedure as required by 29 CFR 1910.38(a-f) and CIMAHA PART IV which include procedure of evacuation, employee alarm system, training, on site and off site emergency plan.

Then the user is required to update or review the clean-up operations follow the requirement needed in PSM standard. If the company's operation classified in 29 CFR 1910.120(a) 1(i/ii/iii), then the company must update or review the following requirement under 1910.120(b)-(o). Then, the company must check whether they classified in 1910.120(a)1(iv).

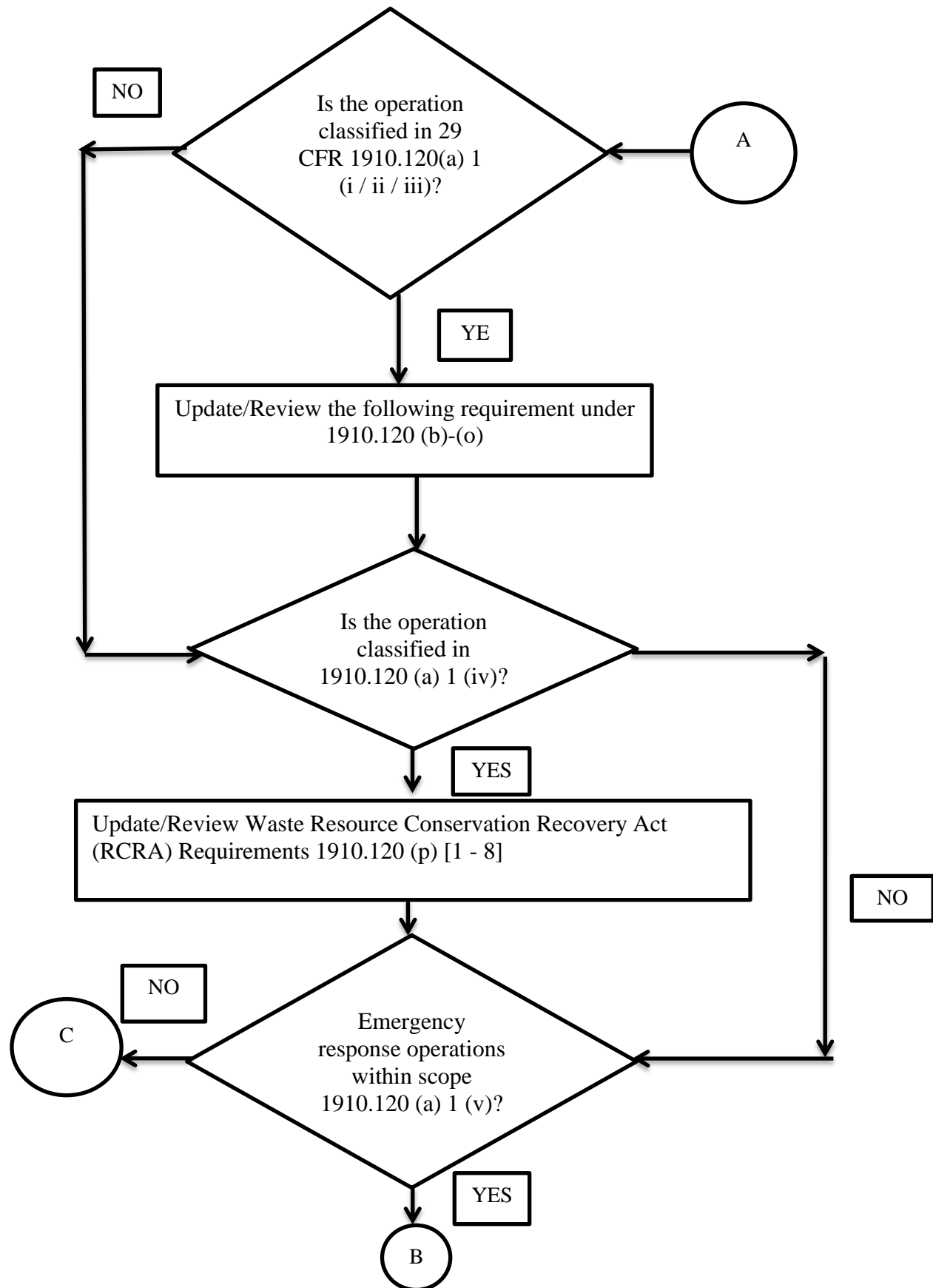
Otherwise, if the company is not classified in 1910.120(a)1(i / ii / iii) the company then have to check whether they classified in 1910.120 (a)1(iv) which is operations involving hazardous waste that are conducted at treatment, storage, disposal (TSD) facilities.

Third, if the company is classified in 1910.120(a)1(iv), the company then need to fulfil the requirements 1910.120 (p) [1 - 8]. Then, the company must check if the emergency response operations within scope 1910.120 (a)1(v). However, if the company is not classified in the requirements they should check whether their emergency response operations within scope 1910.120 (a)1(v) or not.

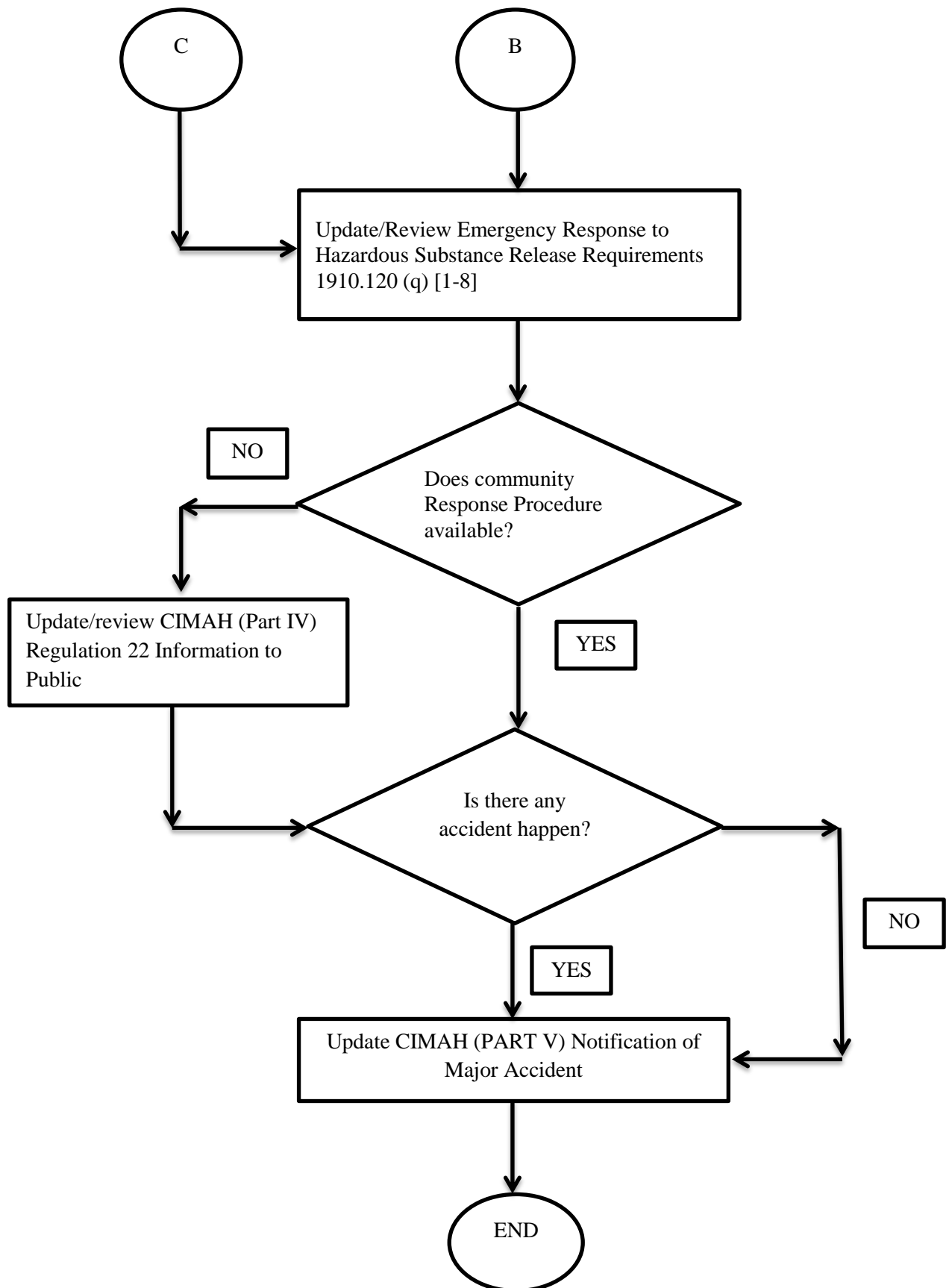
The next step is on emergency response operations 1910.120 (q) [1-8] and procedure are developed or updated to cover scopes requiring the employees to respond to emergencies of any releases from hazardous substance. Furthermore, the user needs to update or review CIMAHA (Part IV) Regulation 22 which is includes community response procedure regarding current hazards existing in the plant. Lastly, the user needs to update CIMAHA (PART V) where a major accident occurs on a site a manufacturer shall notify the nearest occupational safety and health office of the accident by the quickest means available for notification of major accident.



**Figure 4.1 ERP Framework developed based on CFR 1910.119(n) and CIMAII 1996**



**Framework (continued)**



**Framework (continued)**

#### **4.4 DEVELOPMENT OF DATABASE SYSTEM BASED ON FRAMEWORK**

The database developed was created using Microsoft Access as a tool to manage data. This database was developed based on the constructed ERP framework. This framework is constructed by organizing all of the requirements needed to comply with PSM 29 CFR 1910.38 and CIMAHA 1996.

#### **4.5 CASE STUDY**

Case study 1 has been conducted at petrochemical plant located at Gebeng, Kuantan. The company produced Dispersion Polyvinyl Chloride (DPVC), Expanded Polyethylene Beads and Planks (EPE).

Case study 2 has been conducted at chemical plant located at Gebeng, Kuantan. This plant produced and processes the high purity rare earth product.

##### **4.5.1 Case study 1**

###### **4.5.1.1 ERP requirements**

Figure 4.2 shows the main interface of ERP system. The main interface displays the columns that consist of 'ERP Requirement', 'Complete', 'Incomplete', 'Issuance By', 'Last Update', 'Remarks'. This main interface represents an overall requirements based on the framework which an employer needs to comply with PSM 29 CFR 1910.38 and CIMAHA 1994. This page also provides columns 'Last Update' for the responsible person to complete the document and 'Last Update' for the date of record keeping.

In this section, the system helps to identify or check the overall status of compliance. User has to check whether the company has completed the documentation for ERP requirements include identification and notification of industrial activity, emergency action plan, clean-up operation, waste handling procedures, emergency response for hazardous substances release, information to public and notification of major accident. If the company have documentation on the ERP requirements then the user have to tick on the 'Complete' box or vice versa. Then, if the company did not complete the requirement, 'Remarks' column should be verified with additional information.

From case study, Figure 4.2 shows Plant X has not fully completed the requirements for ERP. The plant only completed requirements for identification and notification of industrial activity, information to public and notification of major accident. This database allows users to track documents easily and provide a basis gap analysis to be carried out. The 'Remarks' column was filled because the company does not have complete documentation on emergency action plan, clean-up operation, waste handling procedure and emergency response to hazardous substances release.

ERP REQUIREMENT					
ERP Requirement	Complete	Incomplete	Remarks	Issuance By	Last Update
<a href="#">Identification and Notification</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Emergency Action Plan</a>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Incomplete document of minimum elements of Emergency Action Plan, Review of Emergency Action Plan, Registration of competent person		
<a href="#">Clean up Operation</a>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Incomplete document of illumination and sanitation		
<a href="#">Waste Handling Procedure</a>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
<a href="#">Emergency Response to Hazardous Substances Release</a>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Incomplete document of procedures for handling emergency respons, traning, trainers and post-emergency response operations		
<a href="#">Information to Public</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Notification of Major Accident</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.2 Main interface of ERP**

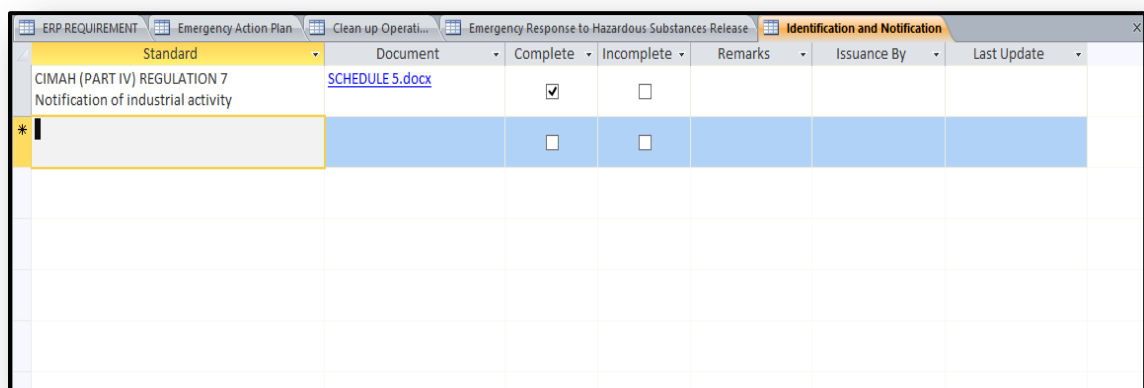
#### 4.5.1.2 Identification and notification

Figure 4.3 shows identification and notification interface of ERP system. In this section, users only need to identify an industrial activity within his control and submit to the Director General the Notification of Industrial Activity Form (hereinafter referred to as the "Notification") specified in Schedule 5 within three months after the commencement of these Regulations in respect of an existing installation or an installation which is under construction or in respect of a new installation after the commencement of these Regulations within a month before the construction thereof.

The column “Last Updated” is created to allow users aware the necessity of updating documents. The period of review and updating the document is solely based on the user's convenience and needs. For this purpose, the model allows users to identify responsible persons and due dates for when the section needs to be updated or completed.

In addition, the ‘Document’ column was attached with the Schedule 5 as it required by CIMAH 1994 in documentation of ERP procedures. So that, the user just needs to click the hyperlink of Schedule 5, Figure 4.4 to fulfil the requirement needed.

From Figure 4.3, it can be seen that Plant X has complete the documentation for identification and notification of industrial activity.



Standard	Document	Complete	Incomplete	Remarks	Issuance By	Last Update
CIMAH (PART IV) REGULATION 7 Notification of industrial activity	<a href="#">SCHEDULE 5.docx</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
*		<input type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.3 Identification and notification requirement**



**SCHEDULE 5**

**OCCUPATIONAL SAFETY AND HEALTH ACT 1994**

**OCCUPATIONAL SAFETY AND HEALTH (CONTROL OF INDUSTRIAL MAJOR ACCIDENT HAZARDS)  
REGULATIONS 1996**

**(Paragraph 7(1)(b))**

***NOTIFICATION OF INDUSTRIAL ACTIVITY FORM***

I, the undersigned hereby give notice of the industrial activity concerned particulars of which are as given below:

A. Particulars of Installation

1. Name of Manufacturer	
2. Address of Installation	
3. Date of commencement of operation	
4. Name and address of local authority or port authority having jurisdiction	

**Figure 4.4 Schedule 5 form**

#### **4.5.1.3 Emergency action plan**

Figure 4.5 shows emergency action plan interface of ERP system. This section displays standards and requirements to be followed by a company in implementing the Emergency Action Plan (EAP) procedure. In this page, the complete and incomplete checklist allows users to monitor their progress. This interface also has sub standards and linkage to be checked by user.

Users also need to complete the document of procedures of alarm systems, training employees for evacuation and reviewing the document which required updating when the plan is developed or the employee is assigned initially to a job, the employee's responsibilities under the plan change and when the plan is changed. However, some of

the requirement have substandard element to be checked for example, the minimum element of EAP and review of EAP developed.

Moreover, user needs to check the report on industrial activity where manufacturer must consult a Competent Person to prepare a written report containing the information as specified in Schedule 6 and send a copy of the report to the Director General at least three months before commencing the activity. Next, the user also must check for modification requirement where manufacturer must consult a Competent Person to prepare a written report containing the information as specified in Schedule 6 and send a copy of the report to the Director General at least three months before making the modifications.

The on-site emergency plan also needs to be checked by user which manufacturer have to prepare and keep an up-to-date and adequate on-site emergency plan detailing how major accidents are to be dealt with on the site. The plan shall include the name of the person who is responsible for safety on the site and the names of those who are authorised to take action pursuant to the plan in the event of an emergency. In addition, manufacturer shall prepare and submit the on-site emergency plan to the Director General when at least three months before the commencement of the industrial activity in the case of an industrial activity which has commenced before the commencement of these Regulations, within three months of the commencement

Lastly, user must check the off-site emergency plan where manufacturer have to inform the local authority or port authority of the area, in the case of an industrial activity which has commenced before the commencement of these regulations, inform the local authority or port authority within three months of the commencement, provide the local authority or port authority with the information relating to the industrial activity and afford to the local authority or port authority upon request all reasonable facilities for the preparation and implementation of an off-site emergency plan.

Based on Figure 4.5, it shows that Plant X did not comply with the general emergency action plan requirements. They did not have enough documentation for minimum elements of emergency where no procedures to be followed by employees who remain to operate critical plant operations before they evacuate. They also don't have enough

procedures for review of emergency action plan where they have no documentation of EAP when the employee's responsibilities under the plan change. Lastly, Plant X does not have a competent person but they have trained person under certain roles and responsibilities.

Standard	Description	Complete	Incomplete	Remarks	Issuances By	Last Update
29 CFR 1910.38 ( a )	Application	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
29 CFR 1910.38 ( b )	Written and oral of Emergency Action Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
29 CFR 1910.38 ( c )	Minimum elements of Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No procedures to be followed by employees who remain to operate critical plant operations before they evacuate		
29 CFR 1910.38 ( d )	Employee alarm system	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
29 CFR 1910.38 ( e )	Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
29 CFR 1910.38 ( f )	Review of Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No documentation of EAP when the employee's responsibilities under the plan change		

**Figure 4.5 Emergency action plan**

ERP REQUIREMENT - Emergency Action Plan - Clean up Operati... - Emergency Response to Hazardous Substances Release							
Standard	Description	Complete	Incomplete	Remarks	Issuances By	Last Update	
⊞ CIMAH (PART IV) REGULATION 13	Registration of competent person	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not Competent Person but we have trained person under certain roles and responsibilities			
⊞ CIMAH (PART IV) REGULATION 14	Report on industrial activity	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
⊞ CIMAH (PART IV) REGULATION 15	Modification	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
⊞ CIMAH (PART IV) REGULATION 18	On-site emergency plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
⊞ CIMAH (PART IV) REGULATION 21	Off-site emergency plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

**Figure 4.5 Emergency action plan (continued)**

Figure 4.6 shows the substandards of minimum elements of emergency action plan. The element includes the procedures for reporting a fire or other emergency, emergency evacuation, and employees who remain to operate critical plant operations before they evacuate including type of evacuation and exit route assignments.

ERP REQUIREMENT - Emergency Action Plan							
Standard	Description	Complete	Incomplete	Remarks	Issuances By	Last Update	
29 CFR 1910.38 ( c )	Minimum elements of Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No procedures to be followed by employees who remain to operate critical plant operations before they evacuate			
Sub standard	Document	Complete	Incomplete	Remarks	Issuance By	Last Update	
Procedures for reporting a fire or other emergency		<input checked="" type="checkbox"/>	<input type="checkbox"/>				
Procedures for emergency evacuation, including type of evacuation and exit route assignments		<input checked="" type="checkbox"/>	<input type="checkbox"/>				
Procedures to be followed by employees who remain to operate critical plant operations before they evacuate		<input type="checkbox"/>	<input checked="" type="checkbox"/>				
Procedures to account for all employees after evacuation		<input checked="" type="checkbox"/>	<input type="checkbox"/>				

**Figure 4.6 Substandard of minimum elements of emergency action plan**

In addition, Figure 4.7 shows that user also needs to check for the linkage attached for example the. A company must to review the EAP when the plan is developed or the employee is assigned initially to a job, when the employee's responsibilities under the plan change and when the plan is changed.

ERP REQUIREMENT		Emergency Action Plan				
Standard	Description	Complete	Incomplete	Remarks	Issuances By	Last Update
29 CFR 1910.38 ( f )	Review of Emergency Action Plan	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No documentation of EAP when the employee's responsibilities under the plan change		
Sub standard	Document	Complete	Incomplete	Remarks	Issuance By	Last Update
When the plan is developed or the employee is assigned initially to a job		<input checked="" type="checkbox"/>	<input type="checkbox"/>			
When the employee's responsibilities under the plan change		<input type="checkbox"/>	<input checked="" type="checkbox"/>			
When the plan is changed		<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.7 Substandard for review of action plan**

#### 4.5.1.4 Clean up operation

Figure 4.8 shows the requirements for clean-up operation. This section needs to be filled up whenever the organization has to comply with any local federal or state regulations in conducting clean-up operations after an emergency occurs.

In references of PSM regulation for clean-up operation procedure, it requires the user or any organization to have documentation of 14 elements which are safety and health program, site characterization and analysis, site control, training, medical surveillance, engineering controls, work practices, PPE, monitoring, informational programs, handling drums and containers, decontamination, emergency response by employees at uncontrolled hazardous waste, illumination, sanitation at temporary workplace, and new technology programs.

From Figure 4.8, it can be seen that Plant X not fully complies with clean-up operation requirements where they did not have documentation about illumination and sanitation at temporary workplace. This is because the company did not complete all requirements for sanitation includes inadequate supply of potable water, outlets for no potable water, toilet facilities, food handling, temporary sleeping quarters, washing facilities, showers and change rooms.

Clean up Operation							
Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update	
1910.120 ( b )	Safety and Health Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( c )	Site Characterization and Analysis	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( d )	Site Control	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( e )	Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( f )	Medical Surveillance	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( g )	Engineering Controls, Work Practices, PPE	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( h )	Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( i )	Informational Programs	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( j )	Handling Drums and Containers	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( k )	Decontamination	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( l )	ER by Employees at Uncontrolled Hazardous Waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120 ( m )	Illumination	<input type="checkbox"/>	<input checked="" type="checkbox"/>	no documentation for illumination			
1910.120 ( n )	Sanitation at Temporary Workplace	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Incomplete all requirements for sanitation			
1910.120 ( o )	New Technology Programs	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

**Figure 4.8 Clean-up operation**

Each of the standards has the substandards for example sanitation at temporary workplace in Figure 4.9. Users will check accordingly through this linkage. This model allows users to monitor documents completion within the 14 elements and remark any non-compliance. Only by fulfilling the elements in the substandard can the user tick “Complete” in the main interface.

ERP REQUIREMENT - Emergency Action Plan - Clean up Operation - Emergency Response to Hazardous Substances Release - Identification and Notification							
Standard	Description	Complete	Incomplete	Remarks	Issuance By		
1910.120 ( n )	Sanitation at Temporary Workplace	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Incomplete all requirements for sanitation			
Sub standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update	
1910.120(n)(1)	Potable water	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(2)	Nonpotable water	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(3)	Toilet facilities	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(4)	Food handling	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(5)	Temporary sleeping quarters	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(6)	Washing facilities	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(n)(7)	Showers and change rooms	<input type="checkbox"/>	<input checked="" type="checkbox"/>				

**Figure 4.9 Substandard for clean-up operation**

#### 4.5.1.5 Waste handling procedure

Figure 4.10 shows the interface of waste handling procedure. This section is applicable to organizations complying with any local regulations of waste handling involved in any operations at treatment, storage or disposal. User needs to check eight elements to be complied with respective sub standards. The element includes safety and health program, hazard communication program, medical surveillance program, decontamination program, new technology program, material handling program, training program and emergency response program.

This model allows users to monitor documents completion within the 8 elements and remark any non-compliance. Only by fulfilling the elements in the substandard can the user tick “Complete” in the main interface. From Figure 4.13 shows that waste handling requirements do not applicable to Plant X.



ERP REQUIREMENT		Waste Handling Procedure					
	Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
⊕	1910.120 (p) 1	Safety And Health Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 2	Hazard Communication Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 3	Medical Surveillance Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 4	Decontamination Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 5	New Technology Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 6	Material Handling Program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 7	Training program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		
⊕	1910.120 (p) 8	Emergency response program	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not applicable		

**Figure 4.10 Waste handling procedures**

#### 4.5.1.6 ER to hazardous substances release

Figure 4.11 shows the interface of emergency response to hazardous substances release. This section applies to organizations that have employees engaged in emergency response regardless of the location. The interface of the model for this section consists of 11 elements to be complied with respective sub standards. User needs to check he 11 elements of emergency response to hazardous substance release which includes written ERP, elements of an ERP, procedures for handling emergency response, skilled support personnel, specialist employees, training, trainers, refresher training, medical surveillance and consultation, chemical protective clothing, and post-emergency response operations.

Moreover, some of the requirements have substandard which must also be complied with. The interface allows users to track their compliance and describe their practices and specific documents, which contain this information, along with identifying persons responsible in any action items.

From Figure 4.11, it can be seen that Plant X did not comply with the emergency response to hazardous substances release requirements that are incomplete of procedures for handling emergency response, training, trainers, and post-emergency response operations.

ERP REQUIREMENT		Emergency Response to Hazardous Substances Release					
	Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
+	1910.120 (q) 1	Written ERP	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 2	Elements of an ERP	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 3	Procedures for handling emergency response	<input type="checkbox"/>	<input checked="" type="checkbox"/>	incomplete procedure for ICS		
+	1910.120 (q) 4	Skilled support personnel	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 5	Specialist employees	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 6	Training	<input type="checkbox"/>	<input checked="" type="checkbox"/>	not have training document for hazardous materials technician		
+	1910.120 (q) 7	Trainers	<input type="checkbox"/>	<input checked="" type="checkbox"/>			
+	1910.120 (q) 8	Refresher training	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 9	Medical surveillance and consultation	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 10	Chemical protective clothing	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
+	1910.120 (q) 11	Post emergency response operations	<input type="checkbox"/>	<input checked="" type="checkbox"/>			

**Figure 4.11 Emergency response to hazardous substances**

In addition, in this page also needs user to check for the linkage attached for example in Figure 4.12 shows the substandard that a company must to have for documentation of training which includes first responder awareness level, first responder operations level, hazardous materials technician, hazardous materials specialist, and on scene incident commander.

ERP REQUIREMENT Emergency Response to Hazardous Substances Release							
Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update	
1910.120 (q) 6	Training	<input type="checkbox"/>	<input checked="" type="checkbox"/>	not have training document for hazardous materials technician			
Substandard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update	
1910.120(q)(6)(i)	First responder awareness level	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120(q)(6)(ii)	First responder operations level	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120(q)(6)(iii)	Hazardous materials technician	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
1910.120(q)(6)(iv)	Hazardous materials specialist	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
1910.120(q)(6)(v)	On scene incident commander	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

**Figure 4.12 Substandard for emergency response for hazardous substances release**

#### 4.5.1.7 Information to public

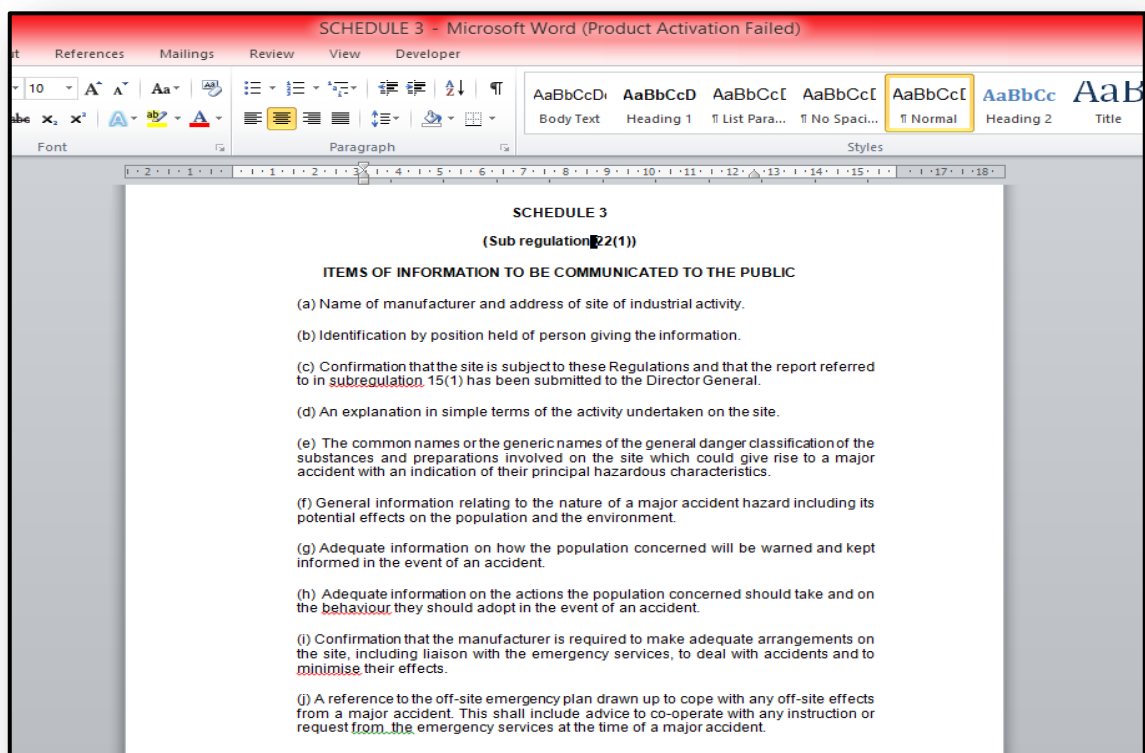
Figure 4.13 shows the information to public interface of ERP system. This section displays the interface of information to public requirements. User should check the requirement which a manufacturer have to ensure that persons outside the site who are likely to be in an area which, in the opinion of the Director General, is likely to be affected by a major accident occurring at the site, are supplied in an appropriate manner with at least the information specified in Schedule 3, without their having to request for it. The Schedule 3 was attached in the 'Document' column to make the user feel easy to access to the schedule, Figure 4.14.

Moreover, manufacturer should endeavour to enter into an agreement with the local authority or port authority in whose area the industrial activity is situated for the local authority or port authority to disseminate the information specified in Schedule 3 to the persons concerned but the manufacturer shall remain responsible for the accuracy, completeness and form of the information supplied. Manufacturer should ensure that the information supplied is updated and re-supplied at appropriate intervals.

From Figure 4.13, it can be seen that Plant X was complete the procedure for information to public requirement.

Emergency Response to Hazardous Substances Release		Information to Public				
Standard	Document	Complete	Incomplete	Issuances By	Last Update Review	Remarks
CIMAH (PART IV) REGULATION 22 Information to Public	<a href="#">SCHEDULE 3.docx</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
* [Redacted]		<input type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.13 Information to public**



**Figure 4.14 Schedule 3 attached**

#### 4.5.1.8 Notification of major accident

Figure 4.15 shows the notification of major accident interface of ERP system. This section displays the requirement about notification of major accident. If a major accident occurs on a site, a manufacturer should notify the nearest occupational safety and health office of the accident by the quickest means available. User needs to check whether the manufacturer provide the following information relating to the accident as soon as it becomes available for example information about circumstances of the accident, the hazardous substances involved, the date available for assessing the effects of the accident on persons and the environment, and the emergency measures taken.

Figure 4.15 shows Plant X has fully completed the documentation for notification of major accident procedure.

Notification of Major Accident						
Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Circumstances of the accident	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Hazardous substances involved	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Data available for assessing the effects of the accident on persons and the environment	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Emergency measures taken	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.15 Notification of major accident**

#### 4.5.2 Case study 2

##### 4.5.2.1 ERP requirements

Figure 4.16 shows the main interface of ERP system. The main interface displays the columns that consist of 'ERP Requirement', 'Complete', 'Incomplete', 'Issuance By',

‘Last Update’, ‘Remarks’. This main interface represents an overall requirements based on the framework which an employer needs to comply with PSM 29 CFR 1910.38 and CIMA 1994. This page also provides columns ‘Last Update’ for the responsible person to complete the document and ‘Last Update’ for the date of record keeping.

In this section, the system helps to identify or check the overall status of compliance. User has to check whether the company has completed the documentation for ERP requirements include identification and notification of industrial activity, emergency action plan, clean-up operation, waste handling procedures, emergency response for hazardous substances release, information to public and notification of major accident. If the company have documentation on the ERP requirements then the user have to tick on the ‘Complete’ box or vice versa. Then, if the company did not complete the requirement, ‘Remarks’ column should be verified with additional information.

From Figure 4.16, it can be seen that Plant Y has complied with all of the ERP requirements except for Emergency Action Plan requirement. It also shows the gap identified where the company did not completed the requirement for employee alarm system.

ERP REQUIREMENT					
ERP Requirement	Complete	Incomplete	Remarks	Issuance By	Last Update
<a href="#">Identification and Notification</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Emergency Action Plan</a>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Not complete the documentation of employee alarm system		
<a href="#">Clean up Operation</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Waste Handling Procedure</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Emergency Response to Hazardous Substances Release</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Information to Public</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
<a href="#">Notification of Major Accident</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

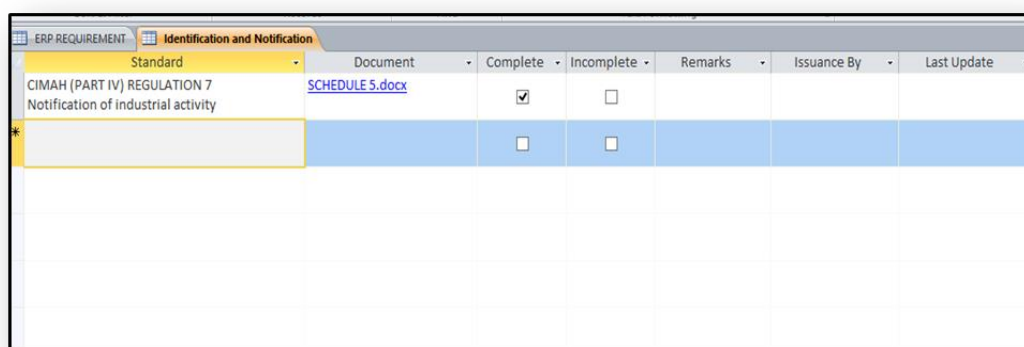
**Figure 4.16 ERP requirements**

#### 4.5.2.2 Identification and notification

Figure 4.17 shows identification and notification interface of ERP system. In this section, users only need to identify an industrial activity within his control and submit to the Director General the Notification of Industrial Activity Form (hereinafter referred to as the "Notification") specified in Schedule 5 within three months after the commencement of these Regulations in respect of an existing installation or an installation which is under construction or in respect of a new installation after the commencement of these Regulations within a month before the construction thereof.

The column "Last Updated" is created to allow users aware the necessity of updating documents. The period of review and updating the document is solely based on the user's convenience and needs. For this purpose, the model allows users to identify responsible persons and due dates for when the section needs to be updated or completed.

In addition, the 'Document' column was attached with the Schedule 5, as it required by CIMAHA 1994 in documentation of ERP procedures. So that, the user just needs to click the hyperlink of Schedule 5 to fulfil the requirement needed. Based on Figure 4.17, it can be seen that Plant Y has completed the requirement needed in identification and notification of industrial activity by fulfil the Schedule 3 attached.



Standard	Document	Complete	Incomplete	Remarks	Issuance By	Last Update
CIMAHA (PART IV) REGULATION 7 Notification of industrial activity	<a href="#">SCHEDULE 5.docx</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
*		<input type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.17 Identification and notification**

#### 4.5.2.3 Emergency action plan

Figure 4.18 shows emergency action plan interface of ERP system. This section displays standards and requirements that need to be followed by a company in

implementing the Emergency Action Plan (EAP) procedure. In this page, the complete and incomplete checklist allows users to monitor their progress. This interface also has sub standards and linkage to be checked by user.

Users also need to complete the document of procedures of alarm systems, training employees for evacuation and reviewing the document which required updating when the plan is developed or the employee is assigned initially to a job, the employee's responsibilities under the plan change and when the plan is changed. However, some of the requirement have substandard element to be checked for example, the minimum element of EAP and review of EAP developed.

Moreover, user needs to check the report on industrial activity where manufacturer must consult a Competent Person to prepare a written report containing the information as specified in Schedule 6 and send a copy of the report to the Director General at least three months before commencing the activity. Next, the user also must check for modification requirement where manufacturer must consult a Competent Person to prepare a written report containing the information as specified in Schedule 6 and send a copy of the report to the Director General at least three months before making the modifications.

The on-site emergency plan also needs to be checked by user which manufacturer have to prepare and keep an up-to-date and adequate on-site emergency plan detailing how major accidents are to be dealt with on the site. The plan shall include the name of the person who is responsible for safety on the site and the names of those who are authorised to take action pursuant to the plan in the event of an emergency. In addition, manufacturer shall prepare and submit the on-site emergency plan to the Director General when at least three months before the commencement of the industrial activity in the case of an industrial activity which has commenced before the commencement of these Regulations, within three months of the commencement

Lastly, user must check the off-site emergency plan where manufacturer have to inform the local authority or port authority of the area, in the case of an industrial activity which has commenced before the commencement of these regulations, inform the local authority or port authority within three months of the commencement, provide the local



authority or port authority with the information relating to the industrial activity and afford to the local authority or port authority upon request all reasonable facilities for the preparation and implementation of an off-site emergency plan. Based on Figure 4.18, it can be seen that Plant Y has complete all the requirements except for employee alarm system.

ERP REQUIREMENT - Identification and Notification - Emergency Action Plan							
Standard	Description	Complete	Incomplete	Remarks	Issuances By	Last Update	
29 CFR 1910.38 ( a )	Application	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
29 CFR 1910.38 ( b )	Written and oral of Emergency Action Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
29 CFR 1910.38 ( c )	Minimum elements of Emergency Action Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
29 CFR 1910.38 ( d )	Employee alarm system	<input type="checkbox"/>	<input checked="" type="checkbox"/>				
29 CFR 1910.38 ( e )	Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
29 CFR 1910.38 ( f )	Review of Emergency Action Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
CIMAH (PART IV) REGULATION 13	Registration of competent person	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
CIMAH (PART IV) REGULATION 14	Report on industrial activity	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
CIMAH (PART IV) REGULATION 15	Modification	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
CIMAH (PART IV) REGULATION 18	On-site emergency plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
CIMAH (PART IV) REGULATION 21	Off-site emergency plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

**Figure 4.18 Emergency action plan**

#### 4.5.2.4 Clean up operation

Figure 4.19 shows the requirements for clean-up operation. This section needs to be filled up whenever the organization has to comply with any local federal or state regulations in conducting clean-up operations after an emergency occurs.

In references of PSM regulation for clean-up operation procedure, it requires the user or any organization to have documentation of 14 elements which are safety and health program, site characterization and analysis, site control, training, medical surveillance, engineering controls, work practices, PPE, monitoring, informational programs, handling drums and containers, decontamination, emergency response by employees at uncontrolled hazardous waste, illumination, sanitation at temporary workplace, and new technology programs.

From Figure 4.19, it can be seen that has completed all of the requirements needed in clean-up operation.

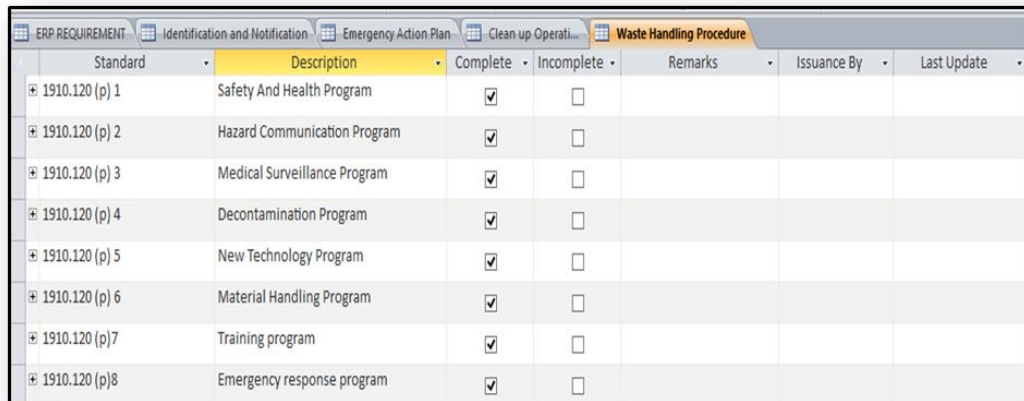
ERP REQUIREMENT							
Standard		Description	Complete	Incomplete	Remarks	Issuance By	Last Update
1910.120 ( b )		Safety and Health Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( c )		Site Characterization and Analysis	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( d )		Site Control	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( e )		Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( f )		Medical Surveillance	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( g )		Engineering Controls, Work Practices, PPE	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( h )		Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( i )		Informational Programs	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( j )		Handling Drums and Containers	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( k )		Decontamination	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( l )		ER by Employees at Uncontrolled Hazardous Waste	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( m )		Illumination	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( n )		Sanitation at Temporary Workplace	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 ( o )		New Technology Programs	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.19 Clean-up operation**

#### 4.5.2.5 Waste handling procedure

Figure 4.20 shows the interface of waste handling procedure. This section is applicable to organizations complying with any local regulations of waste handling involved in any operations at treatment, storage or disposal. User needs to check eight elements to be complied with respective sub standards. The element includes safety and health program, hazard communication program, medical surveillance program, decontamination program, new technology program, material handling program, training program and emergency response program.

This model allows users to monitor documents completion within the 8 elements and remark any non-compliance. From Figure 4.20, it can be seen that, Plant Y has completed all the requirements needed for waste handling procedures.



Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
1910.120 (p) 1	Safety And Health Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 2	Hazard Communication Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 3	Medical Surveillance Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 4	Decontamination Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 5	New Technology Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 6	Material Handling Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 7	Training program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (p) 8	Emergency response program	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

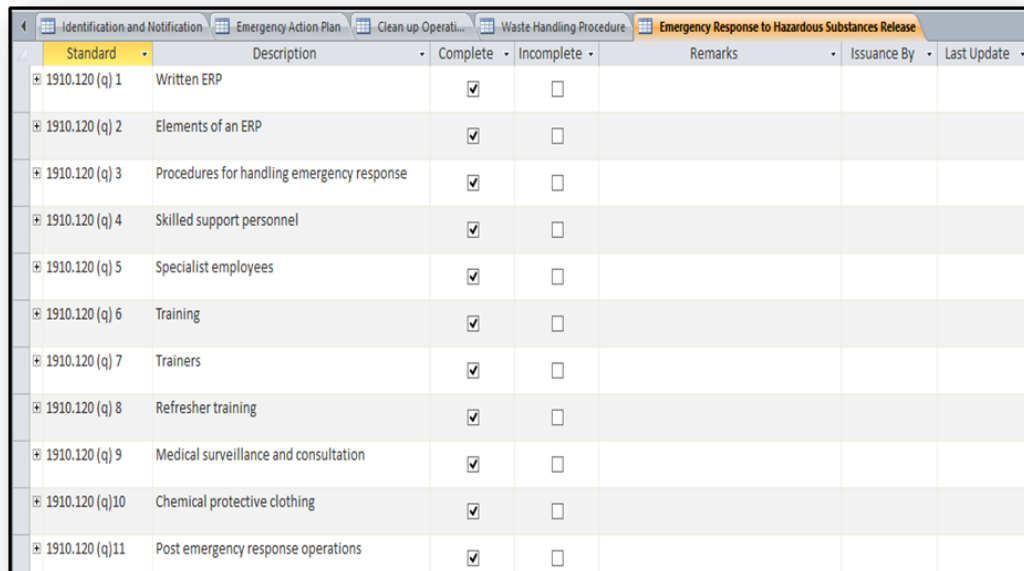
**Figure 4.20 Waste handling operation**

#### 4.5.2.6 Emergency response to hazardous substances release

Figure 4.21 shows the interface of emergency response to hazardous substances release. This section applies to organizations that have employees engaged in emergency response regardless of the location. The interface of the model for this section consists of 11 elements to be complied with respective sub standards. User needs to check he 11 elements of emergency response to hazardous substance release which includes written ERP, elements of an ERP, procedures for handling emergency response, skilled support personnel, specialist employees, training, trainers, refresher training, medical surveillance and consultation, chemical protective clothing, and post-emergency response operations.

Moreover, some of the requirements have substandard which a company must comply with. The interface allows users to track their compliance and describe their practices and specific documents, which contain this information, along with identifying persons responsible in any action items. In addition, in this page also needs user to check for the linkage attached for example the substandard that a company must to have for documentation of training which includes first responder awareness level, first responder operations level, hazardous materials technician, hazardous materials specialist, and on scene incident commander.

From Figure 4.21, it shows that Plant Y has completely fulfilled the requirements for emergency response to hazardous substances release procedures.



Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
1910.120 (q) 1	Written ERP	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 2	Elements of an ERP	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 3	Procedures for handling emergency response	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 4	Skilled support personnel	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 5	Specialist employees	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 6	Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 7	Trainers	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 8	Refresher training	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 9	Medical surveillance and consultation	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 10	Chemical protective clothing	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
1910.120 (q) 11	Post emergency response operations	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.21 Emergency response to hazardous substances**

#### 4.5.2.7 Information to public

Figure 4.22 shows the information to public interface of ERP system. This section displays the interface of information to public requirements. User should check the requirement which a manufacturer have to ensure that persons outside the site who are likely to be in an area which, in the opinion of the Director General, is likely to be affected by a major accident occurring at the site, are supplied in an appropriate manner with at least the information specified in Schedule 3 without their having to request for it. The Schedule 3 was attached in the 'Document' column to make the user feel easy to access to the schedule, Figure 4.23.

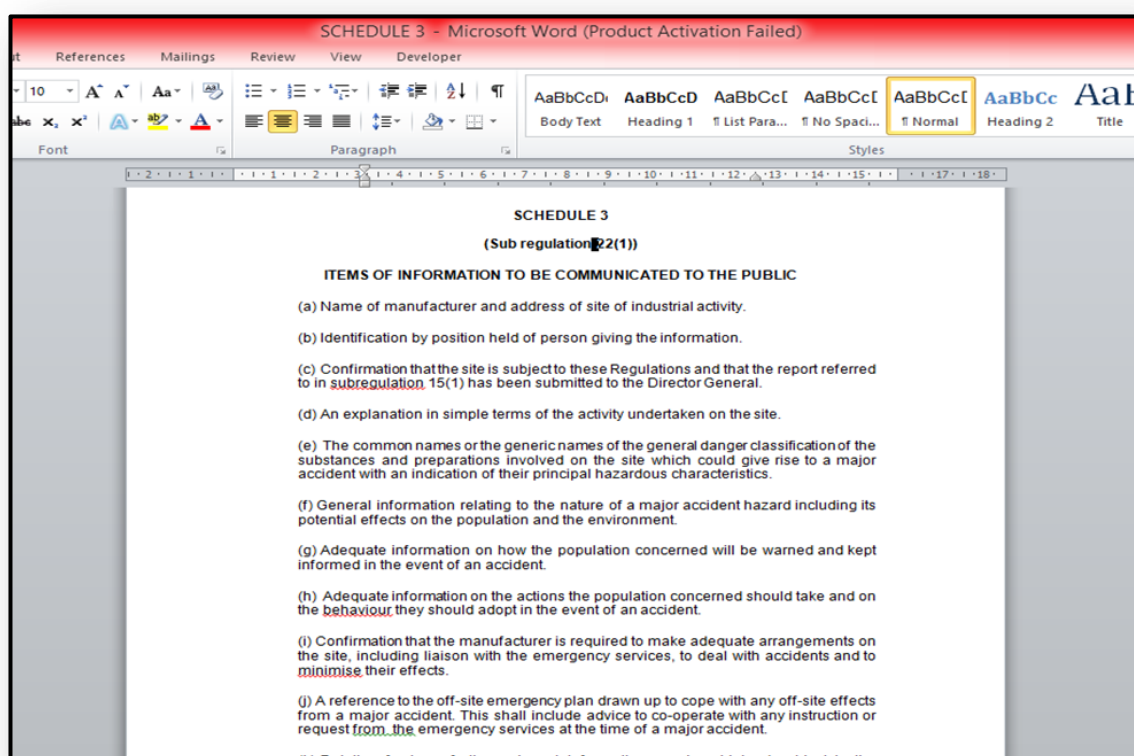
Moreover, manufacturer should endeavour to enter into an agreement with the local authority or port authority in whose area the industrial activity are situated for the local authority or port authority to disseminate the information specified in Schedule 3 to the persons concerned but the manufacturer shall remain responsible for the accuracy,

completeness and form of the information supplied. Manufacturer should ensure that the information supplied is updated and re-supplied at appropriate intervals.

From Figure 4.22, it can be seen that Plant Y was complete the procedure for information to public requirement.

Standard	Document	Complete	Incomplete	Issuances By	Last Update Review	Remarks
CIMAH (PART IV) REGULATION 22 Information to Public	<a href="#">SCHEDULE 3.docx</a>	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
*		<input type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.22 Information to public**

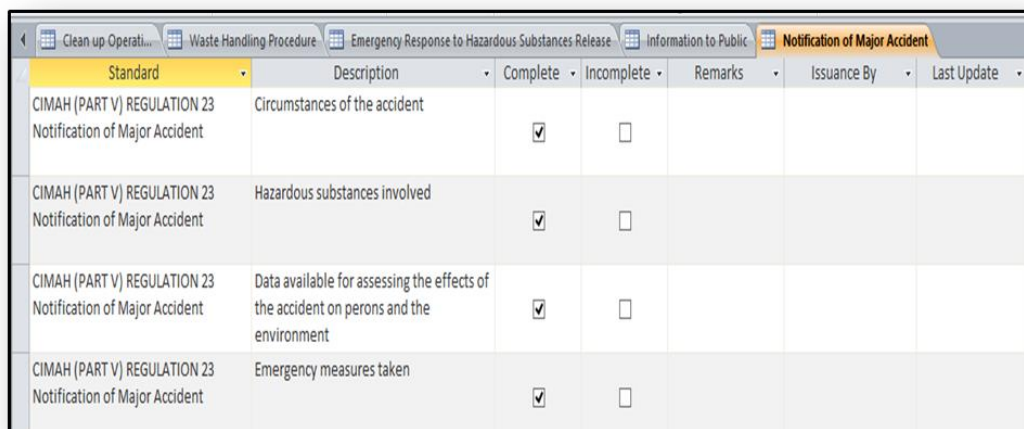


**Figure 4.23 Schedule 3**

#### 4.5.2.8 Notification of major accident

Figure 4.24 shows the notification of major accident interface of ERP system. This section displays the requirement about notification of major accident. If a major accident occurs on a site, a manufacturer should notify the nearest occupational safety and health office of the accident by the quickest means available. User needs to check whether the manufacturer provide the following information relating to the accident as soon as it becomes available for example information about circumstances of the accident, the hazardous substances involved, the date available for assessing the effects of the accident on persons and the environment, and the emergency measures taken.

Figure 4.24 shows Plant Y has fully completed the documentation for notification of major accident procedure.



Standard	Description	Complete	Incomplete	Remarks	Issuance By	Last Update
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Circumstances of the accident	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Hazardous substances involved	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Data available for assessing the effects of the accident on persons and the environment	<input checked="" type="checkbox"/>	<input type="checkbox"/>			
CIMAH (PART V) REGULATION 23 Notification of Major Accident	Emergency measures taken	<input checked="" type="checkbox"/>	<input type="checkbox"/>			

**Figure 4.24 Notification of major accident**

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATIONS OF FUTURE WORKS**

#### **5.1 CONCLUSION**

A systematic approach towards the ERP element for PSM implementation in process industries is presented in this research to comply with the requirements of CFR 1910.119 (n). A framework for ERP requirements has been developed based on PSM Standards and CIMA 1996 Regulations. Furthermore, a model has been developed based on this framework with features, which allows users to track documents easily and provide a basis for gap analysis to be carried out. This assists users to better manage their ERP system and improve accordingly..

The conducted case studies have been done in a process industry at Gebeng, Kuantan and results have shown how the model aids users in managing ERP in compliance with PSM Standards CIMA 1996 Regulations. Users have a bigger overview of what they are complying with and what gaps exist in their system. The findings conclude that this concept and structured technique are feasible and have the potential to be implemented in the industries. This proposed technique can also be used by organizations and customized to develop similar models in order to ensure that emergency response can be well planned and managed in real-life situations.

#### **5.2 RECOMMENDATION**

For future recommendation, in upgrading the system, continuous research of ERP program should be done within a longer time frame so that it provides more impactful result to the system and discover full ability or strength of the system. Once the database system is proven to be manageable by the end users, it can be implemented in

process industries as the best way to manage the ERP of the company in order to assure high level of safety is practiced as intended and lead to no accidents.

Besides, other elements of PSM are encouraged to follow the introduced technique used by ERPMS in order to comply with overall PSM requirements. Finally yet importantly, to integrate the other 13 PSM elements into a centralized database system to obtain complete integration of PSM program and completely prevent any hazards related to the accidents in process industries.



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## APPENDIX A

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