

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	SHAUN DALLING	Student ID number:	
Programme:	HNC Process Operations Engineering		
Module:	Process Safety Systems		
Module code:	PCPO4006	Contribution to Overall Module Assessment (%):	50%
Lecturer:	Yan Mills	Internal Verifier:	L. Rutherford
Assignment Title:	Safe Systems of Work	Word count (or equivalent):	2000
Submission deadline:	05/05/2022	Return date of provisional marks & written feedback:	26/05/2022
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

- Explain the elements required to ensure the safe operation of an industrial process.
- Explain the strategies and procedures required to ensure an industrial process meets legal and regulatory requirements, and how safe systems of work are established.

STUDENT FEEDBACK FORM

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	20	16
2. Knowledge and Understanding Skills		
Excellent knowledge and understanding of the basic underlying concepts.	30	24
3. Cognitive and Intellectual Skills		
Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements	30	24
4. Practical Application Skills		
An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful.	10	8
5. Transferable Skills for Life and Professional Practice		
Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility for further development.	10	8

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)

Late Submission Penalties (tick if appropriate)

Up to 1 week late (40% Max)

Over 1 week late (0%)

80%

Process Safety Management

Assignment 2

Lecturer: Yan Mills

Word Count: 1943

SHAUN DALLING
HNC Process Operations
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Introduction

This report will focus on the necessity and implementation of process safety management with focus on the prevention of major hazards. This will factor in process safety systems and human factors when looking at accidents and the prevention of accidents. The report will also look at the different safe working practices such as the permit to work system used on Pembroke refinery and how it helps control the activities that take place on the refinery. This could include hot work such as welding or inspection using radiation.

Task 1 - Layers of Protection Failure and Human Factors

Process safety failure in the refining industry can lead to catastrophic consequences so numerous control measures are in place to avoid this. These controls can be seen as Lines of Defence or Layers of Protection. The HSE describes these lines or layers as “*serve to either prevent an initiating event (such as loss of cooling or overcharging of a material to a reactor, for example) from developing into an incident (typically a release of a dangerous substance), or to mitigate the consequences of an incident once it occurs.*” (Amey VECTRA Limited, 2017). This can also be seen in the diagram from the HSE below showing the layers around the process:

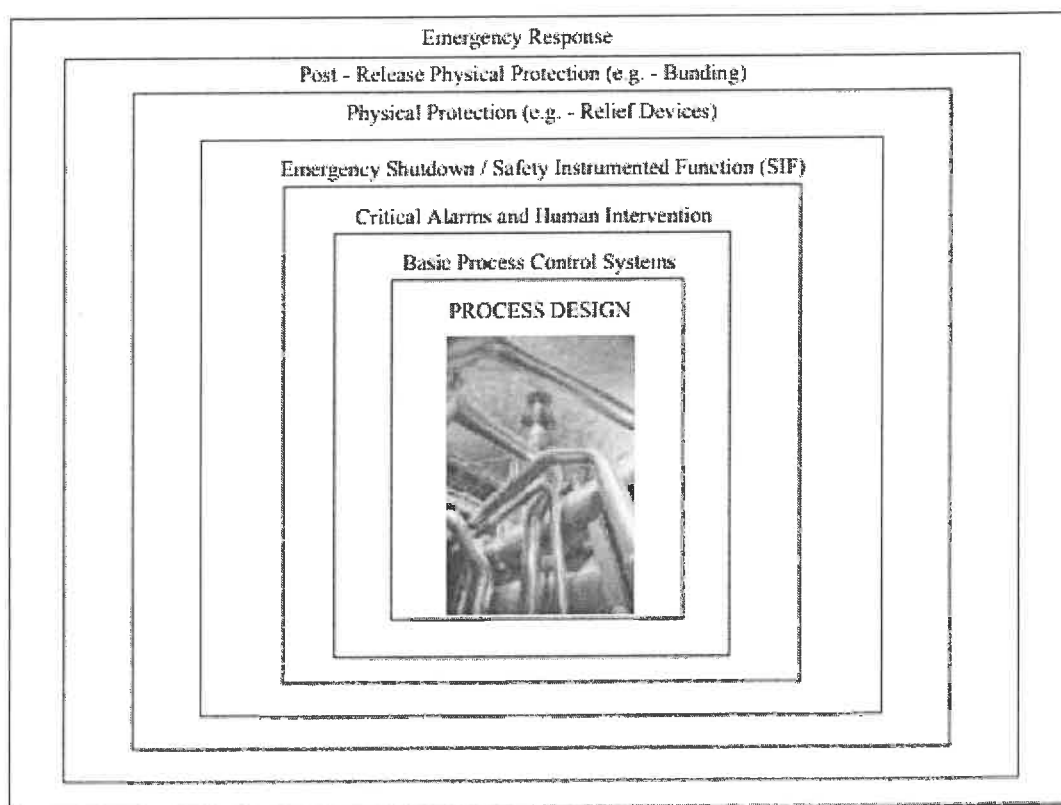


Figure 1 - Layers of Protection (Amey VECTRA Limited, 2017)

The layers of protection can fail however which can lead to process safety failure. For the layers of protection to fail there has to be multiple failures with each level failing. These multiple failures are also known as the swiss cheese model which can be seen below:

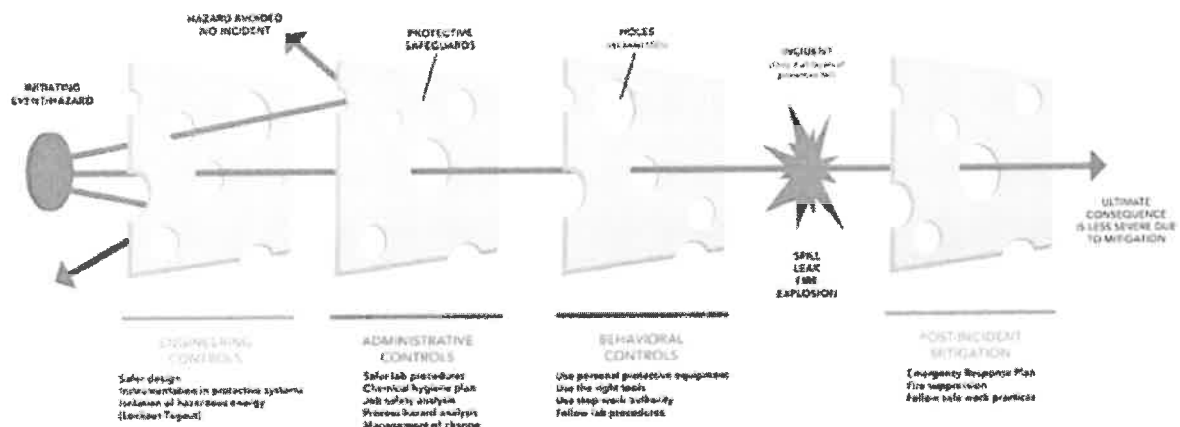


Figure 2 - Swiss Cheese Model (MichiganTech, 2018)

When looking at the swiss cheese model it is evident that not all initiating events will lead to process failure. This is because of the layers mitigating the hazard. As the image shows it is also possible to reduce the severity of the process failure once it has happened. If no response happens to an incident however then the incident could cause large amounts of damage or injuries/fatalities. Human factors are a common cause of failure within the swiss cheese model. One example of this would be not using the correct procedure or emitting steps from a procedure. As procedures used are risk assessed to create the safest method of carrying out a task if any step is emitted the risk is increased. This increase in risk could lead to process conditions that would not normally cause any issues to lose control as the control measures in place are no longer adequate.

Case Study

An example of when layers of protection and human factors have led to an accident can be seen in the accident at the MGPI processing facility in Atchison, Kansas. In the MGPI processing facility a sulphuric acid delivery had arrived, and the operator had unlocked the filling compound and claimed he pointed the correct fill line to the driver. The operator then left and left the driver to carry out the task. The driver connected his hose to what he thought was the correct line as it was unlocked. However, the line he connected to was the sodium hypochlorite which was eighteen inches away from the sulphuric acid fill line. When combined with sulphuric acid a chlorine gas is formed which is toxic. When looking at this with the layers of protection there is multiple failures that led to the accident. The initial process design

fault was that the two connection lines were close together and had the same connection allowing the same hose to connect. The next layer that had failed was the critical process alarms and human intervention. The tank in question had no pressure alarms that would have alarmed the operators to increase gas pressure on the liquid. There were also no flow metres to alert the operators that a flow was detected within the incorrect line. The next failure in the emergency shutdown/safety instrumented function was the location of emergency shutdowns. There should have been a control valve in the line that could have been shutdown from within the control room as the only shutdown was on the side of the truck or to block the inlet to the tank in. As this was quickly overcome with chlorine gas it required emergency services in respirators to block the trailer in. Within the system there were no levels of physical protection such as a relief valve to a tank. As the gas was formed it was allowed to escape from the tank out into the atmosphere. Due to the nature of chlorine gas, there was no post release physical protection that could have reduced the severity of the accident. The failure in the emergency response from the operators was due to the requirement to lock respirators away when changing shift. As the lockers were locked and the gas was entering the control room through the ventilation system, they didn't have time to don the equipment and instead had to escape to a safe area whilst the emergency services arrived with the equipment. The main human factors that caused this accident was that the operator in question did not oversee the driver's connection or to remain with the tanker as it was filling. If either of these tasks were carried out by the operator, then the accident would not have happened or would have quickly been shutdown avoiding the severity of the accident. This case study shows that each layer is capable of failing potentially leading to catastrophic incidents. (CSB, 2018)

Task 2 - Safe Working Practices

In the oil refining industry, it is important that safe working practices are adhered to by all employees. This is due to the highly dangerous equipment and processes that are used throughout. A safe working practice are described as *"usually written methods showing how to perform a task with minimum risk to personnel, equipment, materials, environment and processes. These are guidelines like do's and don'ts but*

may not always be suitable when a new hazard been identified. Employees should know, understand and follow the SWPs those are applicable to own work."

(Safeopedia, 2017). For Valero Pembroke refinery the initial training received in safe working practices is the use of the seven life saving rules. These are:

- Work with a valid work permit when required
- Verify energy isolation before beginning work
- Obtain authorization before entering a confined space
- Obtain authorization before overriding or bypassing a safety system
- Use specified life protection equipment
- Protect yourself against a fall when working at heights
- Smoke in designated areas only

The first life saving rule of working with a valid work permit is the way maintenance personnel are able to check what is required for a certain task. The permit will identify hazards and equipment required as well as any. By attaching a cover sheet that requires each workers signature after reading through the permit operations can be certain that all workers understand the risks associated. The other life saving rules feed in to the permit to work system. To allow a permit to be issued it is first up to operations to prepare the equipment by isolating the equipment from all energy sources whether this is electrical or process. Dependent on the task being carried out the equipment may need to be depressured and purged of hydrocarbon vapors. Once this has been completed and the relevant documentation signed for confirmation the permit can be issued. As a new requirement with Valero Pembroke refinery zero-energy tags are associated with jobs that must be signed by the operator on shift to prove that energy isolation is still maintained before being worked on. Gas testing may also be required dependent on the task being carried out. This will involve the operator testing the equipment and the surrounding area to make sure there is no adverse conditions that could interfere with the job being carried out such as hydrocarbon vapors in the area around where welding is to take place.

Obtaining authorization for overriding or bypassing safety systems are essential in maintenance tasks such as instrumentation calibration. The safe working practice for overriding equipment involves the instrument technician filling in a override form and

getting the shift team leaders signature to say it is acceptable to override. Once the signature is given a copy should be given to the control operator to keep at the panel to alert any control operators that are on that the equipment is bypassed. The instrument technician should also give a copy of the procedure to the control operator so they are aware of the work being carried out. This procedure of prerequisites is the safest way to allow the maintenance of safety equipment as without the prerequisite's equipment could be bypassed and dangerous process conditions could form.

Using specified life protection equipment is a safe working practice on the refinery which will be specified to maintenance when permits are issued. During the permit issuing the operator will relay any requirements that are set out. An example when this would be the case is if blinding was taking place on a piece of equipment but the isolation valves are passing so hydrocarbons may be present. As a safe working practice if any hydrocarbon vapors are likely to be present, the potential for H₂S or other dangerous gases then breathing apparatus must be worn. It is also part of the rules around using breathing apparatus that a standby person is used upwind of the task being carried out with a working radio. This is so if anything was to happen to the person in breathing apparatus, they can call for help before donning there breathing apparatus to ensure their own safety. It is also part of the training that is given that checks of the breathing apparatus are carried out to confirm that there is enough air to last the task and that there are no leaks around the mask that could allow any vapors in. When getting breathing apparatus for a job it is important that the fire technician responsible with issuing the breathing apparatus checks the personnel requiring BA's card. The card is issued when the training has been complete, and the test passed. This is renewed every year to make sure that all personnel are sufficiently trained in its use.

A safe working standard across the refinery is the use of PPE dependent on the area being worked in. There are three main areas on the refinery that require different levels of PPE. The first is the green zone where suitable long sleeve clothing should be worn and suitable footwear. This typically is used in the admin offices and canteen areas etc. The next zone is the amber zone which requires the use of

overalls, or a two-piece fire-retardant set of clothes. Safety boots, hard hat and safety glasses must also be worn. However, there is an exception when travelling to the point of work and home every day. This is typically off plot areas. The last zone is the red zone which requires all the previous PPE as well as hearing protection, H₂S monitor and any specialist PPE (such as alky suits). This is typically within the units on site.

Conclusion

This report has highlighted the importance of the implementation of process safety management and the use of safe working practices. The aim of using these in an industry such as refining is to reduce the chance and severity of accidents. This is done by using set out safe working practices to reduce human factors of accidents so if there was a failure in the process layers of protection the safety of employees and equipment is maintained.

References

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