

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	LEWIS MURRAY	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)

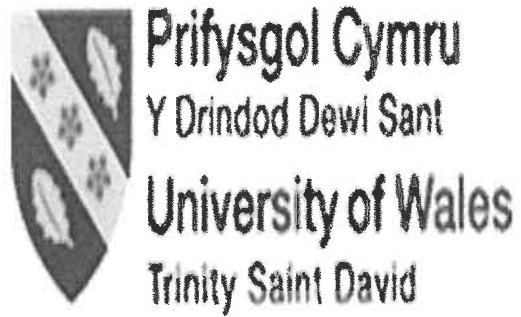
- Explain the elements required to ensure the safe operation of an industrial process.
- Explain the strategies and procedures required to ensure an industrial process meets legal and regulatory requirements, and how safe systems of work are established.

STUDENT FEEDBACK FORM

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing.	20	1
2. Knowledge and Understanding Skills		
Competent knowledge of the basic underlying concepts and principles	30	20
3. Cognitive and Intellectual Skills		
Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.	30	21
4. Practical Application Skills		
A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application.	10	6
5. Transferable Skills for Life and Professional Practice		
Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness	10	6

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)		62%
Up to 1 week late (40% Max)		
Over 1 week late (0%)		



Process Safety Systems

Safe Systems of Work

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Task 1

When a process safety failure occurs, it commonly occurs due to multiple failures over a sustained period of time rather than just one failing during a particular task. In order to understand this further, within an industrial process environment, we use the swiss cheese method as shown in figure 1.

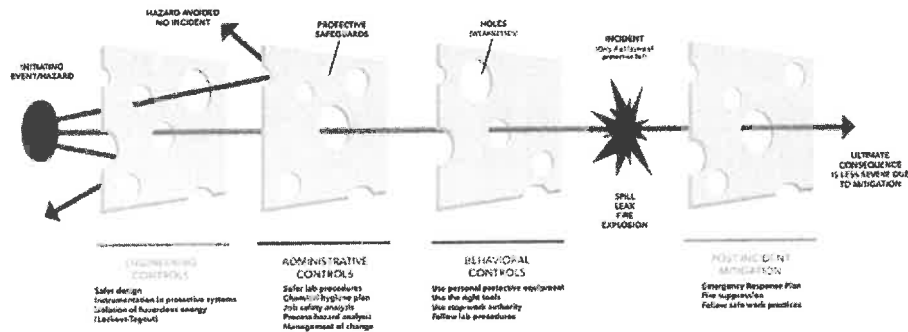


Figure 1 - Swiss cheese process safety (Grohowski, 2018)

The swiss cheese method offers the workforce an insight into how different safety protocols, called barriers, help to prevent a major incident occurring or reducing the severity. Swiss cheese can be known as the barriers put in place to prevent an incident from occurring and a major accident is like a beam of light which is able to shine through the main holes found within swiss cheese. When all these holes align, this is when a process incident occurs such as an explosion, a leak or worse case a catastrophic accident (Dearden, 2019). In order to help ensure a process incident does not occur, instead of just providing one barrier in order to reduce the likelihood of an incident occurring, it is common practice in the petrochemical industry to introduce multiple barriers so that if one does fail, there are still other safety measures in place.

Barriers used within the petrochemical industry in order to make up the swiss cheese safety method can include both process safety measures and human factors (Steshetz, 2021). Human factors can include many different barriers including the personal protective equipment (PPE) worn in order to perform particular tasks as well as routine tasks carried out by operators in order to reduce the likelihood of a worst case scenario occurring. A common task performed at an oil refinery is blowing down the fuel gas to flare. This task involves removing any

liquid from the fuel gas before it reaches a fired heater or boiler and liquid within a fire box will cause an explosion.

In order to further reduce the likelihood of a process incident occurring, within the petrochemical industry we also use process safety measures as well as human factors. These safety features can make use of process instruments which are able to continuously monitor the flow, pressure, level or temperature within a certain section of process. Whilst these process variables are being monitored, they are relayed back to a control room where a panel operator is able to observe these variables and make adjustments to the process accordingly. In order to ensure no dangerous situations are missed, panels are built with many different safety features included. A main safety feature to ensure the panel operator is aware of any dangerous situations occurring is the use of an alarm if the variable being measured goes either low or high, this alarm alerts the operator to the particular piece of equipment so that adjustments can be made. Another safety process safety measures put in place within the petrochemical industry is the use of a feature called 'auto assist'. The auto assist feature will alert the panel operator to a dangerous situation which could possibly arise, however take the piece of equipment out of the operator's control and self adjust valve positions in order to place the process back into a safe state. This safety feature is commonly used with fired heaters where it is too dangerous to ask plant operators to approach a fired heater when there is a risk of an explosion occurring. The last process safety feature is the ability for the process to self trip equipment in order to prevent a dangerous situation from occurring. On the steam plant at Pembroke refinery, the boilers will trip if any of the following situations occur in order to ensure a safe state:

- Low water level within the steam drum.
- Low air flow from the forced draft fan into the firebox.
- All flame scanner failures.
- Low fuel gas pressure.
- Emergency shutdown button engaged.

The last slice of cheese within the swiss cheese safety method is how a workforce will respond if an incident does occur at their site. Although a process incident occurring is the worst case scenario, all eventualities have got to be planned for including the safety response.

At Pembroke refinery, this includes what all personnel will do in the case of a site emergency. Commonly all personnel except for operations and designated safety officers will 'muster', this involves gather at a safe location within the refinery in order for a personnel count to take place so that everyone is accounted for. This also ensures that the operations department and safety personnel are able to carry out their part of the incident response in order to ensure further incidents do not occur due to a knock on effect, making the site safe.

Task 2

Safe working practices

Safe working practices must be abided to at Valero's Pembroke refinery as they help to ensure the safety of all personnel at the refinery by preventing possible major process incidents occurring.

Safe working practices begin with all work personnel carrying out their own LPSA (loss prevention self assessment) before undertaking any task. An LPSA is a written risk assessment performed by all work personnel at the site where the task will be taking place prior to the task taking place. These are performed as within a working environment such as Pembroke refinery conditions are always changing, therefore new hazards may have arisen since the risk assessment has taken place or since the permit has been issued by operations. An LPSA ensures a worker considers whether there PPE is adequate for the task taking place, if personnel in the environment need to be aware of their actions, whether there is adequate access and egress points as well as are there any learning points which should be considered in the future to prevent a possible hazardous environment occurring.

Another safe working practice used during every task at Pembroke refinery is the use of pre-set, authorised procedures. Procedures are created and authorised by not only the personnel undertaking the task but also by engineers, health and safety personnel as well as management to ensure that all personnel at the refinery agree on the way in which commonly performed tasks will be carried out to ensure the safety of all personnel. All procedures at Pembroke refinery are easily accessible for all personnel within PRMS on the refineries intranet. When working through a procedure, personnel are required to sign and date when each stage has been completed and, on some procedures, enter data which can then be referenced in the future. At Pembroke refinery, personnel are also welcomed to suggest any

improvement in which procedures could be improved in the future in order to further increase the safety of all personnel at the refinery.

Another safe working practice which needs to be abided by daily at Pembroke refinery to ensure the safety of all personnel is the LOTO (lock out tag out) system. This safe working practice ensures that all equipment isolated for maintenance has been de-pressurised and hydrocarbon freed. A LOTO pack is built by the operations maintenance co-ordinator and states the location and position of which all valves need to be in for the maintenance to take place, either open or closed. These isolations are then hand written onto LOTO cards by the plant operator and hung once the isolation has been made.

An example of de-pressuring a piece of equipment for removal by maintenance would be a PSV, the inlet valve would be closed followed by the outlet valve. Once these valves have been closed, the plant operator would then open the vents either side of the PSV in order to de-pressure the PSV for safe removal. Individual LOTO tags would then be hung on all the valves ensuring that no other personnel is able to operate these valves until maintenance have completed their work on the PSV.

Before commencing work, operations will show maintenance all isolations which have been made to further verify that all personnel are happy with the conditions in which the job will take place. If a piece of equipment requires electrical isolation, for example a motor, all personnel associated with the job, operations, electrical and maintenance, will then place a tag on the motor starter. This ensures that the piece of equipment can not be returned to process conditions until all personnel are happy that they have completed their work and therefore removed their lock.

The main purpose of safe working practices at Pembroke refinery are to minimise health and safety hazards in order to reduce the likelihood of a major safety hazard occurring.

Permit to work systems

The permit to work system ensures that all work ongoing on the refinery is within a controlled and safe manner, without a valid work permit then no work can take place. A work permit at Pembroke refinery is usually issued by the operations department after certain checks have been carried out and acts as permission in writing that a certain task can be carried out within the specified area. Some work permits require the operations department to

carry out a gas test to ensure that no explosive or toxic vapours are in or around the area in which the work will be getting carried out.

When a work permit is issued at Pembroke refinery, a risk assessment of the work taking place is included with any further safety measures such as personal protective equipment or working time stated, a brief description of the work taking place and where on the refinery as well as the number of workers undertaking the task. Each worker undertaking the task is required to sign onto the back page of the permit to state that they have read and understood the information contained within the permit and that they accept all working conditions whilst undertaking the work. Contained within the back page of a permit is also a map of Pembroke refining showing where all eleven of the emergency muster locations are located around the refinery as well as what to do in the case of an emergency.

A work permit is an essential component in ensuring the safety all work personnel at Pembroke refinery as it helps to identify all work based hazards associated with the job taking place as well as stating what safety measures are put in place in order to reduce the hazards stated.

In order for a lead operator to issue a work permit to maintenance, all isolations must have been signed off electronically inside 'RAP', the software used at Pembroke refinery to control all work taking place, this means all the LOTO (lock out tag out) isolations have been made with tags hung on the valves by the operations department as required declaring the piece of equipment safe to work on. Before each permit can be issued to maintenance, the operations department also have to undertake a gas test of the area in which the work will be taking place to ensure no hazardous or flammable gasses exist within the working area.

Every permit at Pembroke refinery must be collected in person by the maintenance personnel from the lead operator, this is another important safety measure put in place at the refinery ensuring that the operations department know exactly who will be working on the task and also enables a conversation to take place between maintenance and operations regarding any outstanding safety issues.

References

Dearden (2019) Available at: <https://www.thechemicalengineer.com/features/process-safety-models-cheese-chains-or-cords/#:~:text=THE%20Swiss%20cheese%20model%20is,hazard%20consequence%20will%20be%20realised.> (Accessed: 2nd May 2022).

Grohowski (2018) Available at: <https://www.mtu.edu/unscripted/2018/02/swiss-cheese-and-safety.html> (Accessed: 2nd May 2022).

Steshetz (2021) Available at: http://websites.umich.edu/~safeche/swiss_cheese.html (Accessed: 2nd May 2022).