

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	JACK HARRIS	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:	Process Safety Management	Word count (or equivalent):	2000
Submission deadline:	17/02/2022	Return date of provisional marks & written feedback:	10/03/2022
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.		

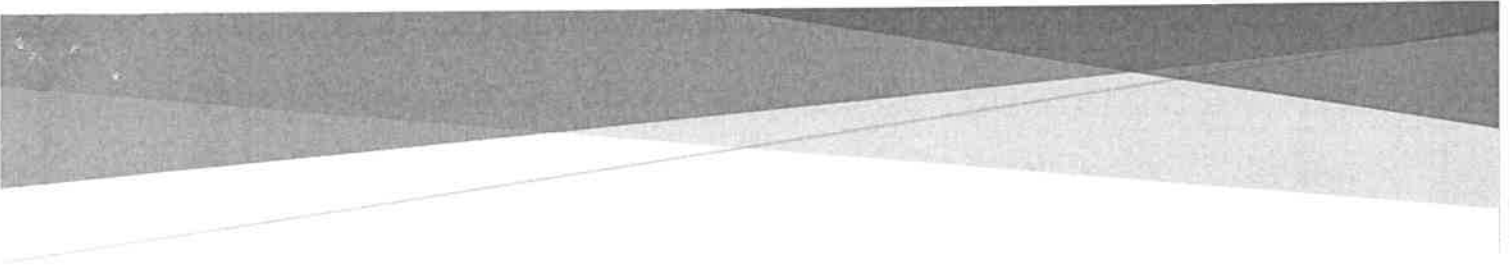
Module Learning Outcomes (from module syllabus)

- 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.	15	10
2. Knowledge and Understanding Skills		
Competent knowledge of the basic underlying concepts and principles	35	23
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	20
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	7
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)		66%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		



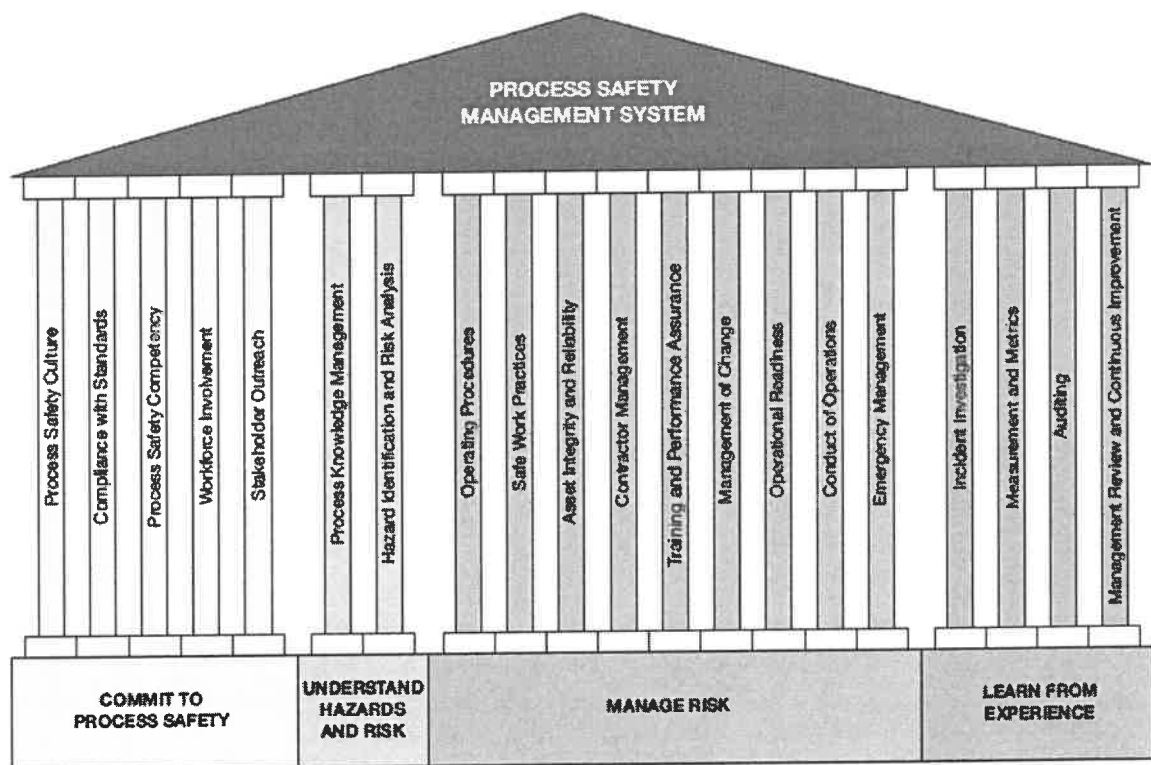
PROCESS SAFETY SYSTEMS

Process Safety Management

Jack Harries
155847

Task 1

Process safety generally refers to the prevention of unintentional releases of chemicals, energy, or other potentially dangerous materials (including steam) during processes that can have a negative effect on the people or environment. As an example, it could involve the prevention of leaks, spills, equipment malfunction, over-pressures, over-temperatures, corrosion, metal fatigue and other similar conditions. As you can see below, this is an image of how process safety management is broken down into different areas.



The process safety Management system is split into 4 main sections;

- Committing to the Process Safety
- Understanding of Hazards and Risks
- Management of the Risk
- Learning from Experience

As stated above, the first stage of the process safety management system is the "committing to process safety". This stage is split into the following headings;

- Process safety culture
- Compliance with Standards
- Process safety competency
- Workforce Involvement
- Stakeholder outreach.

Safety departments in any form of workplace will initially need to build up a safety system or program from the start. This will involve the company doing their research into what would be classed as acceptable behaviour, and what would not be. As an example, if an individual would be ignoring a regular alarm, this is unacceptable. The company would have to make sure that these safety systems will fall into place with all safety standards, codes, regulations, and laws. These standards regularly get updated; therefore, a regular audit will need to be carried out in order to comply. Then arguably the most important part of the first stage of PSM is ensuring the workforce have a clear knowledge of all the information that is in place. This can be sent out via email, bulletins, announcements, whatever is the best way to reach the complete workforce. Having the workforce involved in safety is vital. It allows all personnel to speak up about any concerns that they may have in the workplace, which makes it easier to continuously improve safety at the workplace. It always helps to have members of the workplace having roles and responsibilities within the safety department to help the safety of operations. The last stage of the commitment stage is the reaching out to stakeholders. Seeking out certain individuals and organisations that believe that they could be affected by the operation of the workplace and building a relationship with these people will help create more accurate information about process hazards and risks.

(The Safety Master, 2021)

The second stage of the process safety management system is the understanding of the risks and hazards that could be found at a workplace. For this stage, all forms of written documentations regarding all aspects of the process must be maintained. This includes designs, fabrication, installation of equipment, various chemicals through the process, and any process procedures have been compiled. By using all these documents, it will improve overall process knowledge in order to make decisions on safety systems. Once a good level of knowledge has been obtained, all hazards must be identified and a risk analysis must be carried out. This will be a documented analysis of all the different hazards and risks at any area of the workplace throughout their life cycle. This involved all modes of operation considering any impacts that could happen to employees, the public, and the environment.

The managing the risk stage of PSM is arguably the most important. These are the precautions put in place to aid the safety of the workforce and the environment. The management of risk is split up into 9 different subsections that are shown below;

- Operating Procedures
 - These procedures require proper development and verification before use. They must include safe operating limits and consequences of any deviations any personnel may take from these limits.
- Safe Working Practices
 - Practices governing maintenance and non-routine work should be documented including under what conditions the work can be conducted.
- Asset Integrity and Reliability

- The inspection department must carry out regular checks around the workplace in order to ensure any equipment is safe to work on.
- Contractor Management
 - Implementation of various practices to ensure that contracted workers that visit the workplace will perform their jobs safely, and that they will not pose a risk to any other people in the immediate area.
- Training Performance and Assurance
 - Regular training of all employees is critical to ensure that all personnel are competent to complete any task they are required to do.
- Management of Change (MOC)
 - Changes to processes over the life of the workplace can create hazards that may be unexpected. MOC is the review of all of these changes and then the implementation to ensure that no events happen and no new hazards are introduced.
- Operational Readiness
 - The ensuring of safe start-up and shutdown of any processes throughout the facilities.
- Conduct of Operations
 - This involves the execution of operational management tasks in a structured process to ensure all personnel can perform any required tasks successfully and safely.
- Emergency Management
 - Nobody wants to be involved in an emergency, however it is important to plan for any possible incidents that may happen. This involved allocating resources, practicing and improving plans, and effectively informing employees and stakeholders in the event of any incidents.

The fourth and final stage of the PSM system is "Learning from experience". Unfortunately, in industry incidents to occur, whether they are minor or major. The first thing a workplace should do after an incident is to investigate exactly what happened. A formal process should be carried out for the incident detailing all steps that were taken. Once all the steps have been identified from the incident, the safety team will be able to make alterations to any documentation and procedures to ensure that it wouldn't happen again. Auditing should also be carried out after an incident. This element includes a system of scheduling, staffing, performance, and documenting all of the aspects that made the incident happen. A management review should be the final step to carry out in PSM. This is the basic evaluation of whether management systems are performing as intended, and whether they are producing the desired results as efficiently as possible.

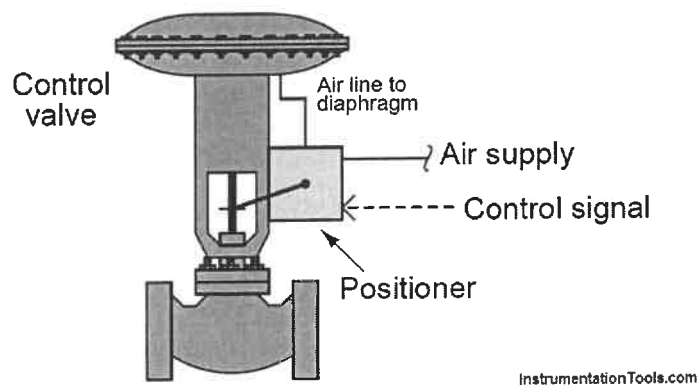
(Scribd, 2018)

Task 2

Process control measures are a critical part of the running of a Refinery. Not only for the safety and smooth running of the process, but for the general safety of all personnel working on the site, and in the surrounding area. The first and most commonly used form of control measure used on Pembroke Refinery is a control valve.

Control Valve

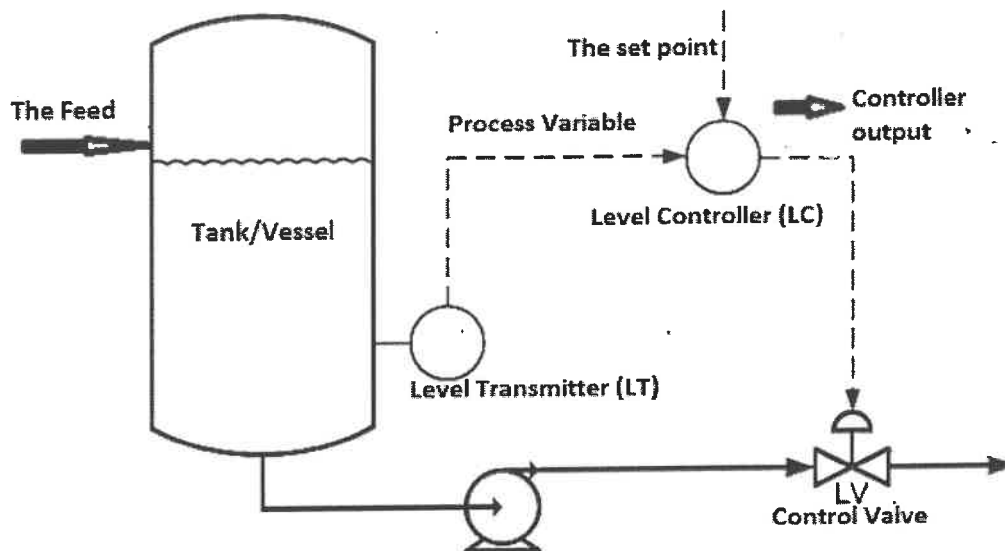
A control valve is a valve used to control fluid flow by varying the size of the flow passage as directed by a signal from a controller. This enables the direct control of flow rate and the consequential control of process quantities such as pressure, temperature, and liquid level.



The actuator on the valve gets controlled by a control station where it can be adjusted through a system to allow the flow to meet process demands. On Pembroke refinery, the usual location of a control valve will be in a line between a pump/turbine and a vessel. This controls the flow going into the vessel, and therefore controlling levels.

Process Control Loop

Control loop systems monitor and regulate the devices, instrumentation, and machines used in industrial or manufacturing processes. The system operates hardware components and software control functions necessary to measure and adjust the variables that affect each process. As mentioned above control valves are used to monitor flows through the process, however sometimes this isn't enough. Using a Tank level as an example, in usual processes, a tank level should be kept within certain limits using different instrumentation and equipment. The tank will have alarms at certain levels. If the tank hits a low-level alarm, there will be something in the process that will happen in order to increase the level back to normal operating level. On Pembroke Refinery, the use of "Auto Cut In" standby pumps are used. When the level hits the low alarm, these standby pumps will automatically start, increasing the flow into the tank, also increasing the level until it's at a stable level.

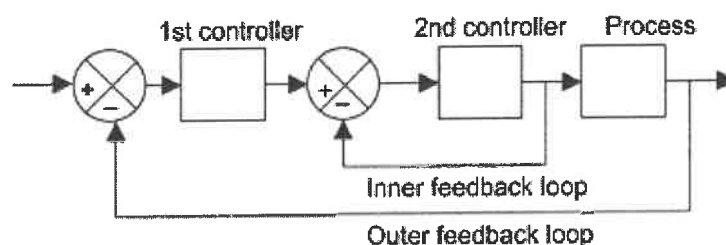


The image above is very similar to the explanation above. This image shows how a pump and control valve are both used to maintain a tank level. If the tank level is too high the pump will start and control valve open in order to lower the level. Then the opposite for low level, the pump will stop running and control valve will start to close, decreasing the flow.

(Montavalo, n.d.)

Cascade Control

A form of control used on Pembroke Refinery is Cascade control. Cascade control is used when there is more than one measurement, but only one control variable is available. Cascade control involves the use of two controllers with the output of the first controller providing the set point for the second controller, the feedback loop for one controller nestling inside the other. This form of control can give better response to certain disturbances.



The image above illustrates how cascade control might be used in controlling the level of a liquid in a tank. With the single loop control system, the level sensor provides the feedback which gives the error signal to the controller and hence initiates the controlling action on the rate at which fluid enters the tank. if we have a disturbance which causes a change in the input flow rate, there can be considerable

delay before the level changes enough to initiate a correction. With the cascade system, the level sensor provides the feedback to the outer loop controller which then gives an output which provides the set point input to the second controller, this being used to control the rate of flow of the liquid. The flow level loop responds quickly to flow disturbances and so considerably reduces the level fluctuations that would have occurred with the single loop control system.

(Dimian, Bildea and Kiss, 2014)

Task 3

In this task, I am going to use my place of work, Pembroke Refinery Steam Plant unit as my example of how process safety measures are used for process safety. The steam plant provides steam, gas, water and air for the rest of the refinery to run as efficiently and smoothly as possible. The most critical part of the unit is the boiler system. There are 9 boilers, and each of them are designed to create superheated steam to inject into the headers, and pushed around the rest of the refinery. Due to the importance of the boiler, there are various safety controls that are used on them.

The first input into any of the boilers is the boiler feed water which is treated earlier on in the process prior to it entering the boiler. A boiler cannot start up, or continue to run without the correct level of BFW in the steam drum. If the level is too high, there will be a carryover of moisture in the steam entering the header. This will cause a high amount of aggressive steam hammer and has a high chance of damaging piping. If the level in the steam drum gets too low, the temperature of the boiler will rise significantly, causing damage to the tubes and general refractory of the boiler. To ensure process safety, a control valve is in place before the BFW enters the boiler. The control valve will have a controller that can alter the position, and this will be done from the control room. The control station will be able to control the level of BFW in the steam drum by adjusting the flow entering the boiler.

One of the key pieces of equipment used on Pembroke refinery in general is a Pressure Safety Valve (PSV). PSVs are in place to prevent any vessel from overpressuring by either releasing to atmosphere, or to blowdown. There are two PSVs that are in place on the steam drum of the boiler to prevent any overpressuring. This could happen if there is a valve closed further downstream.

Another process safety measure that they have in place at Pembroke refinery is the use of operating procedures. Operating procedures are designed to be used during any task. As an example, in this case, if a Boiler was required to be shut down, personnel will be required to log in to the refinery's "PRMS" system, and search for the relevant procedure that will allow personnel to safely carry out the operation of shutting down the boiler. These procedures will have a step by step checklist, starting with pre-requisites checks to ensure it is safe to carry out the task, carrying onto the procedure. Using procedures ensures the safety of all personnel in the area and the environment.

Bibliography

- The Safety Master, 2021. *Process Safety Management: What is it and why do we need it?* - TSM TheSafetyMaster Private Limited. [online] TSM TheSafetyMaster Private Limited - TSM TheSafetyMaster Private Limited. Available at: <<https://www.thesafetymaster.com/process-safety-management-what-is-it-and-why-do-we-need-it/#:~:text=Fundamentally%2C%20process%20safety%20management%20is%20about%20an%20activity-based,all%20personnel%20in%20the%20implementation%20of%20this%20system.>> [Accessed 09 February 2022].
- Scribd, 2018. *The Four Pillars of Risk Based Process Safety | PDF | Safety | Risk Management*. [online] Scribd. Available at: <<https://www.scribd.com/document/347493237/The-Four-Pillars-of-Risk-Based-Process-Safety>> [Accessed 12 February 2022].
- Montalvo, n.d. *The Basics of Control Loop Systems and Components* - Montalvo. [online] Montalvo Corporation. Available at: <<https://www.montalvo.com/article-library/control-loop-systems-explained/>> [Accessed 12 February 2022].
- Dimian, A., Bildea, C. and Kiss, A., 2014. *Integrated Design and Simulation of Chemical Processes*. Burlington: Elsevier Science.

