

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	PARRY PHILLIPS	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)

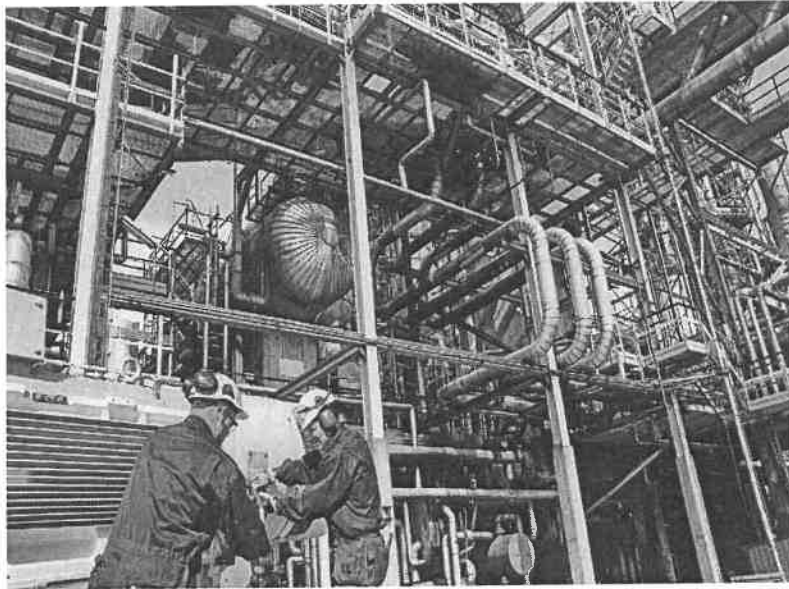
- Explain the elements required to ensure the safe operation of an industrial process.
- Explain the strategies and procedures required to ensure an industrial process meets legal and regulatory requirements, and how safe systems of work are established.

STUDENT FEEDBACK FORM

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	15	12
2. Knowledge and Understanding Skills		
Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.	35	26
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	23
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 with an appetite for further development.	10	7

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)		76%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

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Title: Process Safety Management

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Task 1

A process safety management system is a disciplined framework that helps businesses manage the integrity of operating systems and processes that handle hazardous substances. The system provides structure on how to maintain safety with a variety of approaches to keep the hazardous substances in the pipeline to protect the employees, the business and the environment. Process safety management (PSM) differs from occupational safety management, PSM aims are to prevent large scale disasters. The four pillars are general approach that many companies follow to drastically reduce the likelihood of a large-scale disaster occurring.

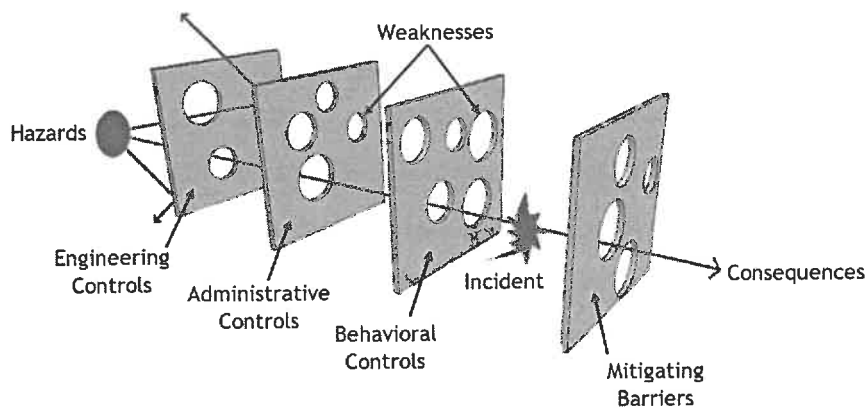
The first part of the pillars is committing to process safety, this is the culture that is installed from the top of the company right down to the bottom. It's the combination of group values and behaviours that determine the way process safety is managed. Through constant training, educating, and communicating the company can inspire the workforce to understand how to work on site, what is expected of the worker and how to act when no one is watching.

Another aspect of committing to process safety, is the compliance of standards that are enforced upon companies who handle dangerous and hazardous substances. The relevant standards will be put forward to the company and the company by law will have to adhere to these standards as a bare minimum to allow to operate safely. For example, at Dragon LNG which identifies as an upper tier Control of Major Accident Hazards (COMAH) site. Dragon LNG will have to abide by the COMAH regulations. Regular inspections and ongoing advice are provided by the competent authority. Learnings from relevant incidents are incorporated into the inspection to improve process safety.

The second pillar of process safety management is to understand the hazards and risks that the site imposes on the health and safety of the employees and the environment. An experienced knowledgeable team is needed to ensure that if any hazardous event occurs the process safety

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systems catch it before it escalates and if it does bypass the safety systems, a plan is in place to react to the worst-case scenario.



If the process safety management fail to organise effective safety systems with defects at each stage, there is a high risk that a large-scale disaster could occur.

Figure 1. http://websites.umich.edu/~safeche/swiss_cheese.html

These measures will be put in place and will be continuously approved upon to minimise the weaknesses in the system.

The third pillar is to manage the risks that are present on the process. Risk management is the technique of identifying potential hazards. The goal is to identify, then analyse and evaluate the risks they create. A risk matrix is used to compare the severity of a hazardous event occurring versus the likelihood. A cost analyse will also be introduced to see if elimination of the hazard is reasonably practicable which is the best method of risk management. If the hazard cannot be removed due to it being economically unreasonable or it not being possible, substitution is the next step. Substitution involves replacing that causes a hazard with a lesser risk or an even complete elimination. Elimination and substitution are generally only viable during the development stage of the process as it easier to modify the design of the plant. Engineering controls are the next step towards risk management. Engineering control's purpose is to remove the hazard at the source before it affects the working personal. For example, a double block and bleed isolation removes the source of the hazard for the maintenance team. PPE and administrative controls are the least effective way of risk management, as it relies on human instinct to wear the correct PPE and act accordingly when performing work. The likelihood is PPE will only reduce the harm done to the employees in the event of a loss of containment at Dragon LNG.

The final pillar of process safety management is learning from experience on site. First feature of learning from experience is carrying out incident reports. The report should include as much evidence as possible. The evidence will then need to be investigated. This could be an operator

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proofreading a procedure to see where the fault is in the procedure that led to a loss of containment. The procedure will then be revoked and changed before it can be used by employees again.

Another aspect is management review and continuous improvement. The management team will need to collect all the data to be able understand what they are doing correct and where needs improving. Therefore, it is important that no matter how small the incident, it still needs to be reported so that Dragon can analyse where it's going wrong and why. This leads to the company being able to act on the hazards and improve the safety on the process.

Task 2

Process control measures are methods used to control and maintain a process within the designated area. Dragon engineers will look at all information supplied and will calculate variables such as temperatures, flows, pressures, and levels that the infrastructure and equipment can safely run and maintain at. However, if these variables are exceeded due a failure or mistake on site, process control measures can safely deescalate the problem.

A process safety measure enforced at Dragon is instruments that are calibrated within these parameters. Specific instruments will be fitted into the pipework to measure the variables such as temperature, flows, levels, and pressures. These instruments will relay back to the control panel so that the control panel operator can manage these variables. If a human error or piece of equipment fails and the levels cannot be maintained within the parameters a high or low alarm will occur. This will highlight the figure out of range to the panel operator. If the figure continues to get further away from the parameters, it will reach a high-high alarm or low-low alarm which will make sure Emergency Shutdown Valves fail in the correct position and isolate the problem. The equipment tied in with instruments will also be automatically stopped.

Another safety measure at Dragon LNG is safe vent paths for pressurised lines. Each line has either a Pressure Relief Valve (PRV) or a Temperature Relief Valve (TRV). At Dragon LNG PRV's and TRV's operate in the same way. The difference being what pipe they are attached to. TRV's are lined up with liquid service lines and PRV's are attached to gaseous lines. The purpose of the relief valves is to reduce the high inlet pressure and reduce it to a lower outlet pressure. This at Dragon LNG is relieved to the Boil off Gas (BOG) header which is lined up with the flare and the storage tanks. The relief valves work by the downstream pressure puts back pressure on the seat and diaphragm of the valve, which in turn overcomes the spring pressure opening the seat of the valve relieving the pressure until the back pressure is less then the spring pressure. The spring pressure is set accordingly to each line to protect the pipework and the equipment.

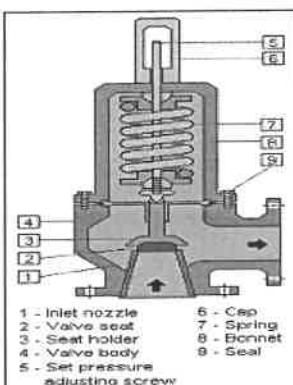


Diagram to assist text about Relief Valves.

Most of the valves at Dragon LNG such as control valves and emergency shutdown valves are pneumatically actuated using instrument air. To contribute to process safety control at Dragon LNG instrument air receivers are connected to each emergency shutdown valve. In the event of loss of

instrument air compressors, each instrument air receiver has enough capacity to supply 100% of

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the consumption rate of 200 Nm³/h for 10 minutes in the process area and 5 minutes for the Jetty area. These receivers allow the panel operators to operate the ESD valves to safely react to a site shutdown.

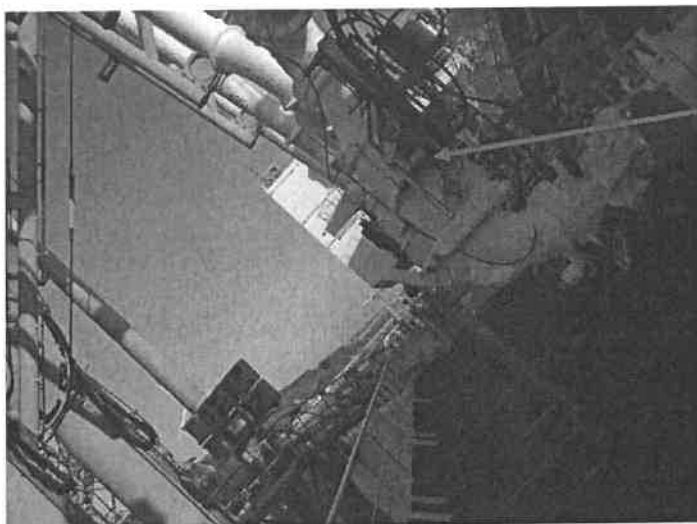
Task 3

At Dragon LNG ship unloading is scrutinised by the Health and Safety department as it has a lot of variables that could result in an incident occurring some of which are out of Dragon LNG's control. Hence why so many safety measurements have been brought in to prevent incidents occurring or if an incident does occur it is minimised reducing the repercussions on the employee's health and safety, the businesses economics, and the damaging effects on the environment.

Prior to the ships arrival at least two days before the ship arrives, the shift operators are required to perform a pre arrival checklist. This is to ensure the availability and correct functions of equipment necessary for the ships approach, berthing, unloading and cargo analysis. This procedure enforced by the company is required to be followed and signed by the shift operator to ensure that the pre arrival checks are completed correctly which in turn reduce the likelihood of an incident occurring during the ships unloading as the equipment has been fully tested.

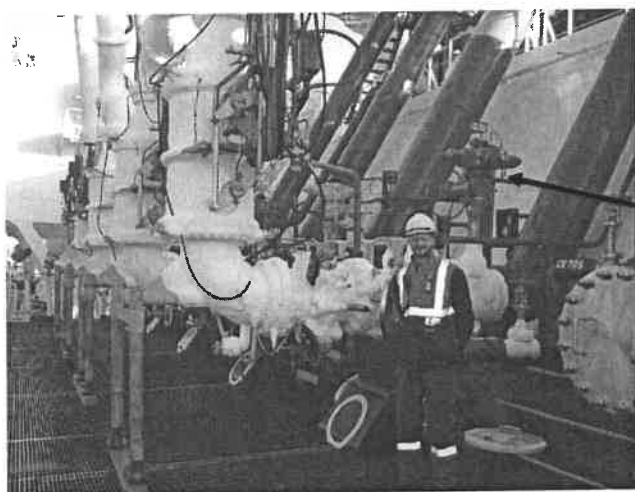
After the ship has been berthed it will undergo continuous monitoring such as the tension on each rope, winds speeds and swell of the ocean. This continuous monitoring is passed from ship to shore and vice versa by fibre optic cables and a backup electric cable if the fibre cable fails. The jetty operators will now begin following the shipping unloading procedure. The first step is to connect the unloading arms, the first set of safety controls are the interlocks that prevent some arm functions such as simultaneous movement of more than one arm, overextension of the arms using alarms triggered by proximity switches. The Vapour Return arm is connected first to provide vapour path from ship as soon as possible after the first connection is made.

Once the arms have been connected by the hydraulic clamps which couple the ships manifold to the unloading arms the mechanical team will inspect the connection of the ships manifold and the unloading arms. The Powered Emergency Release Coupling (PERC) valves will now be armed by an axis pin and opened. If the axis pin breaks or an ESD 2 is signalled the PERC valves will close and a separation of the PERC to break the connection between the ship and the unloading arms.



PERC separation point. Either side of the PERC are valves that will go closed if an emergency release of the arms and the ship occurs.

The unloading arms will now undergo a pressure test. The three liquid arms will be pressured up to 5 barg nitrogen while the vapour return arm will be pressured up to 1 barg nitrogen. The isolations will be the Emergency Shutdown Valves (ESDV) on the shore side and the ESDV's on the ship side.



Ships Manifold Emergency Shutdown Valves

The jetty operators will be looking for any drops in pressure as highlights a potential leak. A bubble test will also be performed by the mechanical department where a liquid is sprayed along the connected flanges and inspection for any bubbles which highlights a leak. After the pressure test and bubble test has been completed. The stored pressure between the two isolations will be vented to atmosphere. The Jetty operators will perform a gas test on each unloading arm. The gas test the operators perform will be to measure the oxygen levels in each of the arms. The oxygen level in the stored pressure that will be getting vented will need to be below 2% of the gaseous mixture. The reason behind this is so that when Liquid Natural Gas (LNG) and Natural Gas (NG) are introduced into the unloading arms it doesn't have the potential to become a flammable mixture.

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An emergency Shutdown (ESD) will be tested to ensure that in the event of an ESD being initiated that all the correct valves fail in their correct position. Firstly, the Ship will initiate an ESD, the jetty operator will check to see if all the correct valves fail in the correct position. Once the resets have been complete and valves have returned to the line-up position the shore will initiate an ESD to see if the signal operates both shore and ship. Once the ESD has been tested Ship to Shore and vice versa the cooldown procedure can now begin.

The cooldown procedure will be performed by the ships LNG spray pumps up to the shore side ESDV's. It is crucial that when the spray pumps are started that the cooldown rates do not exceed 3°C per minute otherwise this may cause thermal shock of the unloading arms - this may cause brittle fracture and loss of containment.

Once the cooldown is complete a cold ESD test is performed ship to shore side. If the valves fail in their correct position the ESD can be reset, and the unloading process can begin.

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