

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Morgan Osborne	Student ID number:	114688
Programme:	HNC Process Operations Engineering		
Module:	Environmental Protection and Sustainable Manufacturing Systems		
Module code:	PCPO4003	Contribution to Overall Module Assessment (%):	100%
Lecturer:	Richard Wray	Internal Verifier:	Lance Rutherford
Assignment Title:	Research Report	Word count (or equivalent):	2000
Submission deadline:	15/05/19	Return date of provisional marks & written feedback:	29/05/19
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)

LO1, LO2.

TASK DESCRIPTION

Investigative report

There are many examples of industrial manufacturing plant, equipment and process that pose a potential risk to the environment and/or where operations may meet or fall short of the requirements for sustainable manufacturing.

For this assignment you are required to analyse a chosen industrial process at your place of work with respect to environmental protection and sustainable manufacturing systems.

Research Guidance

- Fully research the industrial plant, equipment and manufacturing process design and operation
- Evaluate specific aspects associated with meeting environmental protection, legal requirements and best practice
- Evaluate specific aspects associated with ensuring sustainable manufacture can be achieved through efficient equipment, plant and process operation
- Develop conclusions and recommendations on how the process could be improved with respect to environmental protection and manufacturing sustainability

Note: When choosing a work based plant, equipment or process please ensure you have your employers permission to use relevant information in your assignment. Do not include names of personnel or commercially sensitive information.

Research evaluation

You will produce the written report in a clearly structured and professional manner. The report should evaluate the findings of your research and present logical arguments and conclusions. It is expected that you will organize your report following a pattern to that suggested below:

- A brief abstract
- An introductory section outlining the background, the scope and intended readership
- A clear statement of the aim and objectives of the report
- Central sections, explaining any findings, arguments and outcomes
- A suitably structured conclusion that draws together the findings of your research and any recommendations you are making

When writing your report make sure that you:

- Use acceptable academic language and tone
- Check spelling and grammar
- Show that you can evaluate evidence from reference sources and use this material to make a logical and consistent argument
- Make sure that you analyse and evaluate arguments and evidence in a way that meets your stated outcomes and objectives

Report structure

The report document must be constructed in a formal and professional manner using an appropriate word-processed program. The completed report should contain the following sections:

- A cover page or document title page
- A table of contents page
- Sections or paragraph headings related to each aspect of the report
- Headers on each page with the title of your report
- Paragraphs should be spaced using '1.5 line spacing'
- Footers on each page with the author's name on the right hand side and 'Page ... of ...' on the left
- A references page and bibliography as appropriate
- Appendices where appropriate for larger quantities of data
- Diagrams, charts or tables, suitably incorporated and labelled
- The text format should be Times New Roman or Ariel with a font size of 12
- A word count of 2000 words ($\pm 10\%$)

Environmental Protection and Sustainable Manufacturing Systems



Name: Morgan Osborne

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Brief Abstract

I chose to research the process of gasoline blending and storage at the Valero Pembroke Refinery as this process has undergone design and operational changes in recent years. This was necessary to meet both environmental protection legislation and economic challenges to continue the sustainability of these systems.

Introduction

Gasoline blending is a refinery operation that blends different component streams, from the refining units, into different specifications of gasoline. These component streams include Platformate, Light and Heavy Catalytic Naphtha, Alkylate, Butane, Isomerate and Reformate. The correct ratio of each component is directed into a finished tank where it may need further mixing before final testing.

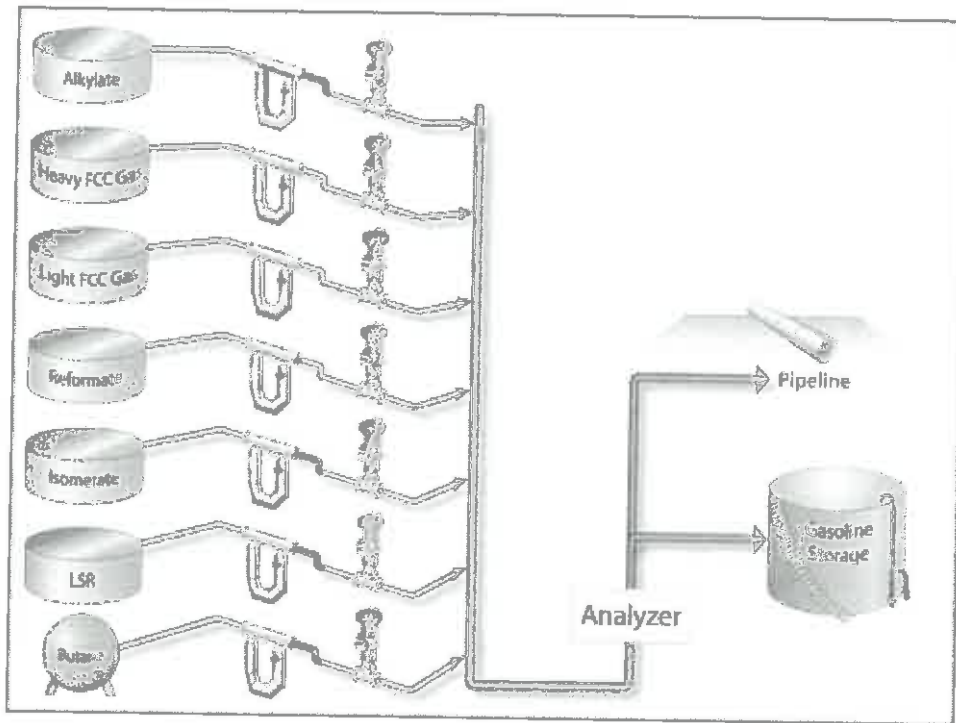
Typical UK unleaded gasoline grades include a standard 95 RON (octane number) and super unleaded which is around 98 RON. Gasoline exported to other countries will have slightly different specifications. Another specification, the Reid Vapor Pressure (RVP), depends on where the gasoline will be used as locations with colder average temperatures need higher RVP than warmer climates. To blend gasoline above the required specification will result in octane giveaway and therefor reduce profits.

Environmental considerations

The Integrated Pollution Prevention and Control (IPPC) regulation requires all industrial installations with a high pollution potential to have a permit. It regulates how the site is operated regarding emissions to air, land and water, with its main objective to minimise, prevent and eliminate pollution. This permit is issued only if the environmental conditions are met, therefore the installation operators are responsible for preventing and reducing any pollution they may cause.

Gasoline Blending

For many years blending gasoline at Pembroke Refinery was completed by pumping set volumes of gasoline component streams, controlled from a Distributed Control System (DCS) in the control room, into a header and on to a final gasoline tank. The laboratory analysis of this tank would determine if a 'touch up' was required to meet the desired quality specification. These 'touch ups' usually resulted in increased costs through octane giveaway as an additional buffer would be added to avoid a second touch up, in addition to the extra cost of manpower and equipment utilisation. Finally, the on-test gasoline tank was now ready for export. Gasoline is mainly exported over the jetty to ships, with smaller quantities pumped to other depots by pipeline or to the road tanker loading rack.



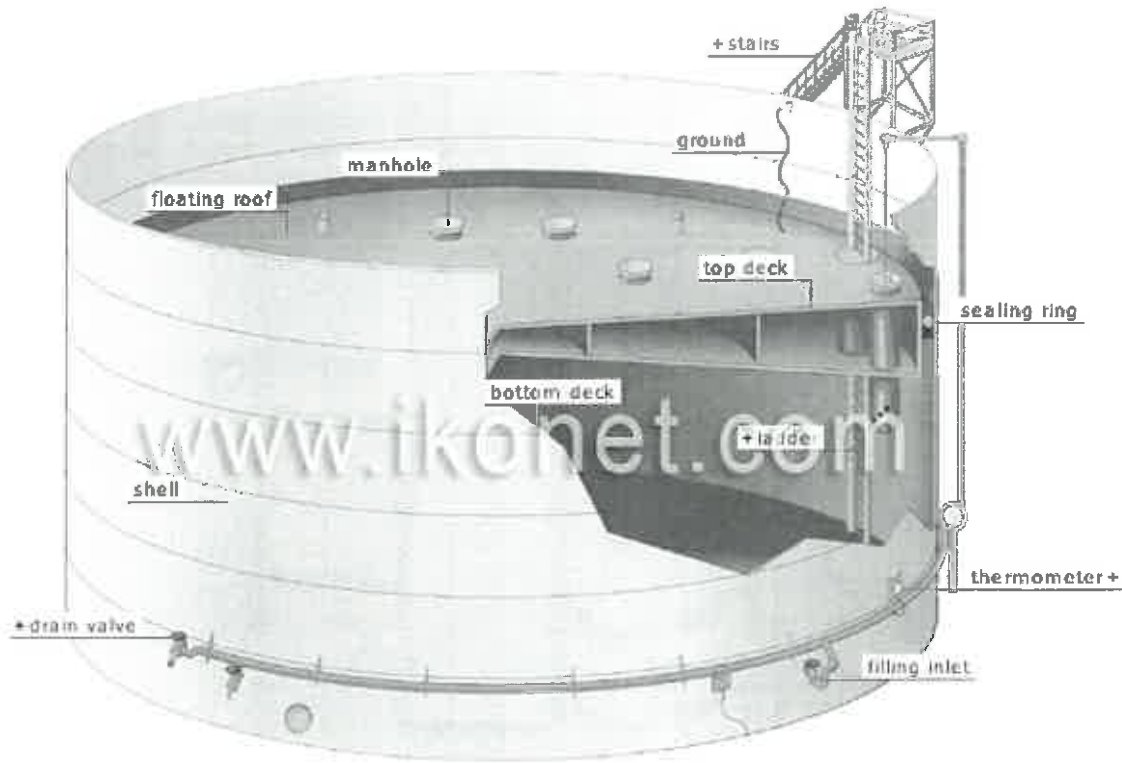
Typical Gasoline Blend Process.

I may be should be identifier i.e. Figure 1 and referenced in the text.

Tanks are costly as they require maintenance and must also meet safety and environmental regulations. Many final gasoline tanks are needed for this operation. At set times the tanks have to be taken out of service for statutory inspection and overhaul. These outages can run into many months and are expensive both in the cost of repairs and lost capacity to the refinery.

Tankage

Gasoline and its components are by their nature volatile and prone to evaporation, which is a pollution (air) concern as well as a safety and economic issue. To overcome these concerns the gasoline component tanks (except butane) and the gasoline storage tanks are of a floating roof construction (butane is stored in pressurised sphere tanks). This limits any build-up of vapour as there is no space between the liquid and the roof, although a small amount of vapour may still escape from the outer roof seal.



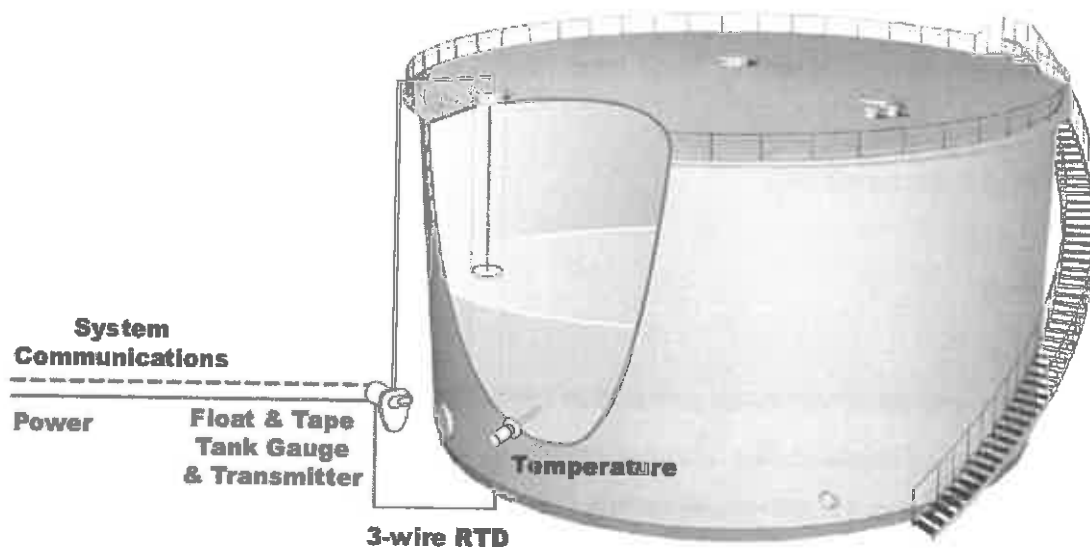
Floating Roof Tank

To minimise any pollution to the land should these tanks leak these tanks are located in tank bunds. For large tanks the bund walls can be of earth construction, with more recent constructions lined with concrete. This secondary containment area should be able to hold 110% of the maximum capacity of the largest tank. This allows capacity for fire-fighting water or foam during for any emergency response. ✓



Tanks in bunded areas at Valero Pembrookshire Oil Terminal (VPOT)

For many years the gauging system for the gasoline tanks relied on float and tape tank gauge and transmitter system for level control monitoring, as well as product temperature information from a temperature transmitter. This provided a local readout at the tank side location with the gauge and temperature information also transmitted to a panel position in the main control room. This was linked to the distributed control system (DCS) where a required level set point could be set when filling or emptying a tank. This system will also monitor fill/emptying rates, trends and temperature information, as well as alerting the panel operator with secondary 40 minute and 20 minute warnings to set point levels and all alarm levels.



Varec Float and Tape Tank Gauge and Transmitter

Alarm level conditions could be programmed to prevent exceeding the high and low operating levels of the tank. In addition to this an independent mechanical high level alarm (100MM above high working level) was also fitted should the automated system fail. This was also independently wired directly to a stand-alone alarm panel in the control room. ✓



Floating Roof Tank High Level Alarm

Improvements and Sustainability

Gasoline Blending

To meet new safety and environmental protection legislation, improve equipment efficiency and maintain manufacturing sustainability, improvements to the gasoline blending, storing and delivery process has been carried out over recent years.

A control system update had already been scheduled to replace the existing, and obsolete, distributed control system (DCS). The opportunity was also taken at this time to upgrade the existing gasoline blending system to one that would allow the blended gasoline to be delivered directly to a ship at the jetty, rather than solely to tankage. *An interesting project.*

This new system is made up of a highly standardized mix of both software and hardware components. It has several layers with the DCS at the bottom, just above the equipment on the plant. Next, to handle the ratio control functions is an advanced regulatory software package. Above this there is a Blend Optimisation Supervisory System (BOSS) software package, which calculates an accurate recipe for the blend at any given moment after processing data from analysers and flowmeters.

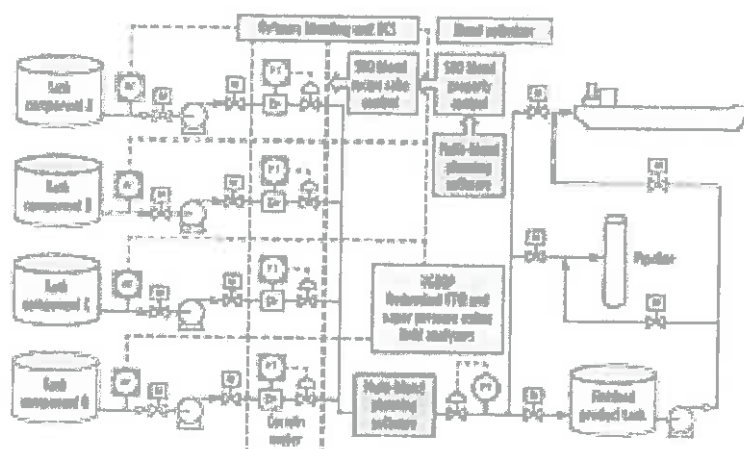
'Boss Functions:

- Simultaneously control of the blend qualities specified by the grade.
- Calculation of initial blend ratios.
- Tank heel correction.

- Quality integration in the target tank using on-line analyzer measurements (Product certification).
- On-line analyzer validation and control.
- Check component availability.
- Alarming.
- Operator guidance in case of infeasible operating conditions.
- Reports: set-up, snapshot and historical (End of Blend).
- Offline package to prepare blends and carry out 'what if' analysis' ✓

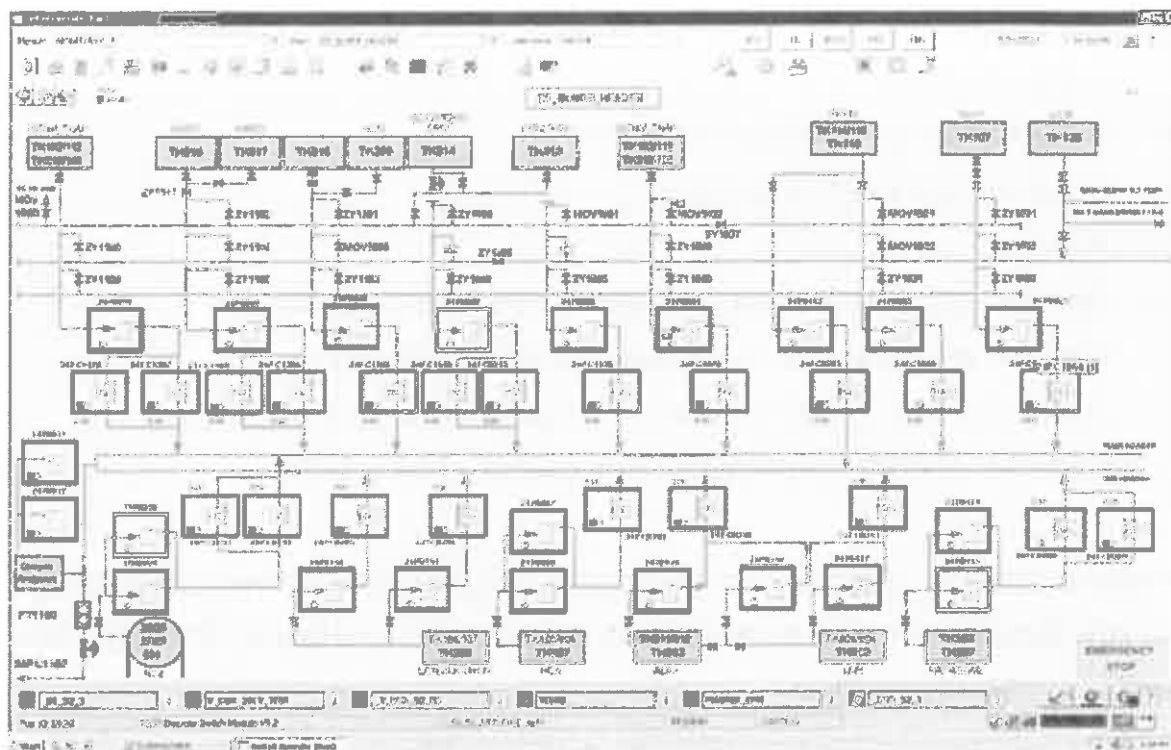
Ref: Valero Pembroke – BOSS operations training course – Power Point

This optimised recipe, SBO (Single Blend Optimised), from the BOSS is used to calculate the appropriate flow setpoints for the individual blend component control loops. The diagram below shows how this system fits together.



A schematic drawing of the new blend optimization system. ✓

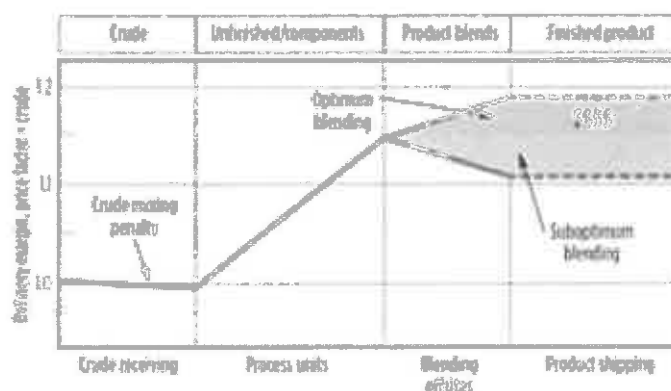
The new system provides for simultaneously blending up to 21 different component streams in a header, with mid-blend pump and tank changes. The component's target ratios are programmed and controlled through individual proportional integral derivative (PID) controllers and flowmeters. ✓



The Blend Header screen on the DCS control panel.

Modern redundant sample compositors are used in conjunction with online analysers to give feedback for optimization and certification of each blend. This 'on test' gasoline can go into tankage or directly onto a ship. This would mean a reduced number of tanks would be needed for gasoline storage, reducing potential air pollution from tank rim seal leaks and pollution to surrounding land from other tank failures such as floor leaks, as well as saving on costly tank maintenance. Also, the upgrade would improve the blending process reducing the risk of blend giveaway.

Any blend giveaway is lost revenue and cancels out the benefits from optimizing upstream unit process areas, as shown in the diagram below.



Gasoline Blend Optimization

So this improved system will potentially save the refinery large quantities of money each year, adding to the sustainability of the refinery.

Tankage

Product tanks in the refinery tank farm require secure bunds to provide the secondary containment in the event of a spill. Many bunds, including those built years ago at Pembroke Refinery, had no impermeable layer within them which would prevent seepage of any spill of oil into the ground. Over recent years there has been a programme of installing an impermeable liner within the tank bund during periods that the tank is out of service undergoing statutory inspection and repairs.



Impermeable layer being installed in a tank bund.

This provides a much improved environmental protection to the area within the tank bund preventing further oil seepage in the ground in the event of a spill.

On the morning of 11th December 2005 there was an explosion followed by major fire at the Hertfordshire Oil Storage Terminal in Buncefield. Overall twenty large storage tanks were involved resulting in the total destruction of the terminal and nearby facilities. The fire lasted until the afternoon of 13th December. This fire was the biggest of its kind in peace time Europe.



Buncefield, Aerial picture of fire and smoke plume

The release of fuel and fire-fighting foam caused pollution of the soil and groundwater which exceeded the threshold for reporting the environmental impact to the European Union. While the National Environmental Technology Centre (uk) report 'estimated that 8,000 tonnes of PM10 particles may have been released during the fire; this is equivalent to approximately 6% of the total annual emissions of this pollutant in the UK (based on 2003 figures from the UK National Atmospheric Emissions Inventory)' AEA/ENV/R/2168 Issue 1 May 2006.

The Buncefield incident was also one of the most intensely studied tank overfill events of all time, with the HSE incident report influencing the current edition of API 2350 'Overfill Protection for Storage Tanks in Petroleum Facilities'.



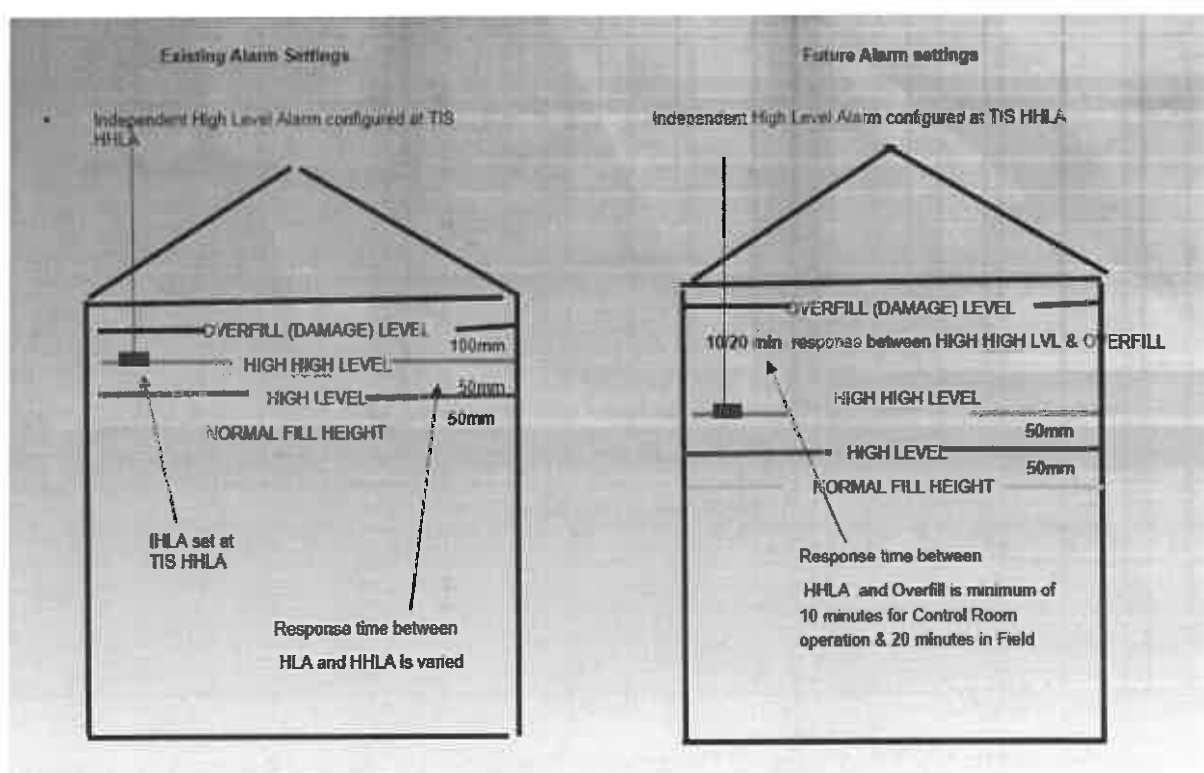
Aerial views of the Buncefield depot before and after the incident

In order to comply with this latest standard Pembroke Refinery had to make changes to its own standard for setting tank levels and providing tank overfill protection. These changes were started in 2012 and completed in 2014. The main aspects of these changes included:

- All Tank Levels of Concern Set-point's to be changed in line with new standard level

- Field changes to be carried out to Tank Independent High Level Alarm levels
- Control room TIS(Tank Inventory System)/DCS Alarms to be updated
- Manuals to be updated
- Tank Schedule to be updated
- Based on Capex Funding Auto-reel type level gauges will be changed out to a Radar type gauge.

These changes have effectively reduced the maximum working levels of the tanks to allow for an appropriate response time between High High level and overfill level at maximum flowrates, as shown in the diagram below.



Valero Pembroke Refinery Tank Overfill Protection Power Point slide showing the old and new working tank levels

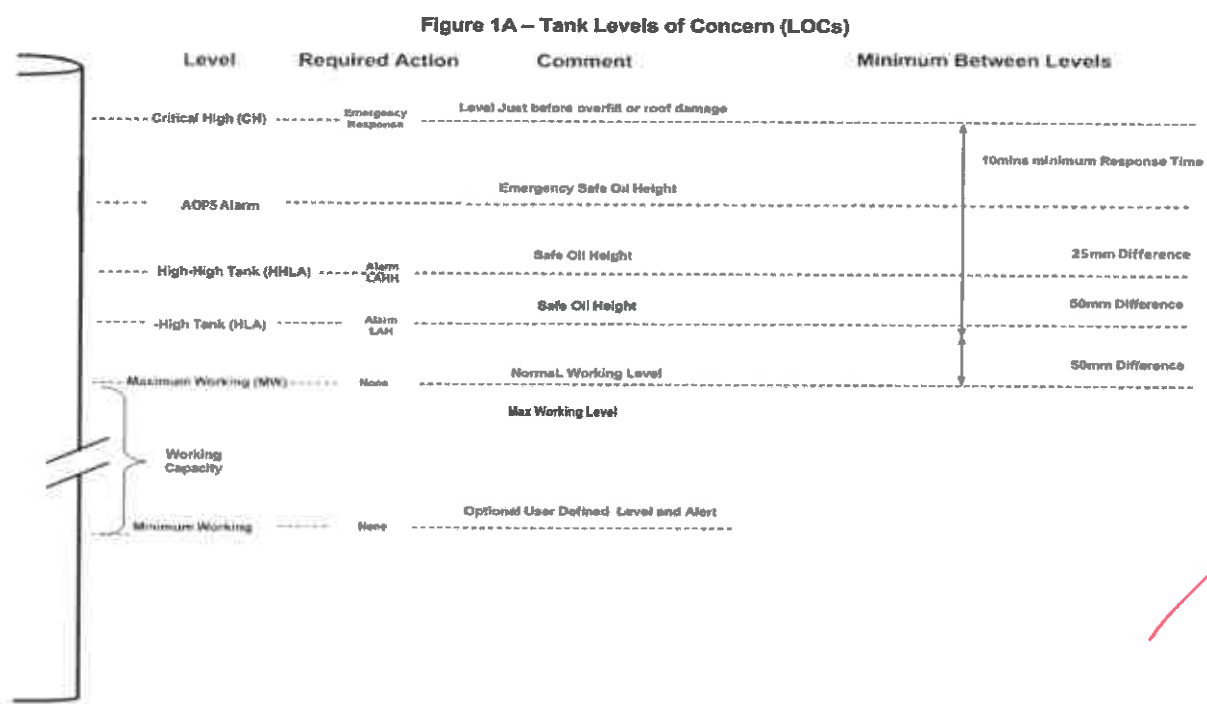
In particular for Gasoline Tankage:

- Automatic Overfill Protection System (AOPS) valves to be fitted to final gasoline tanks to independently activate in the field on reaching given set point
- AOPS valve alarm settings will be set at 25mm above the TIS/DCS High High Alarm Setting.
- There will be a 10 minute response time at maximum filling rate (2400m³/hr) between AOPS alarm setting being activated, and Overfill Level being reached. This allows sufficient

time for the Control Operator to acknowledge the alarm status, to confirm the relevant AOPS valves have closed, and to take appropriate action to safely shut down associated equipment

- When AOPS alarm setting is activated both rundown and suction valves will close on the relevant tank
- AOPS valves will close in 90 seconds to prevent line hammer occurring

These changes have also reduced the tank maximum working level, as well as having an additional 'AOPS' alarm level, independently activating shut off valves to prevent overfill, as shown in the diagram below.

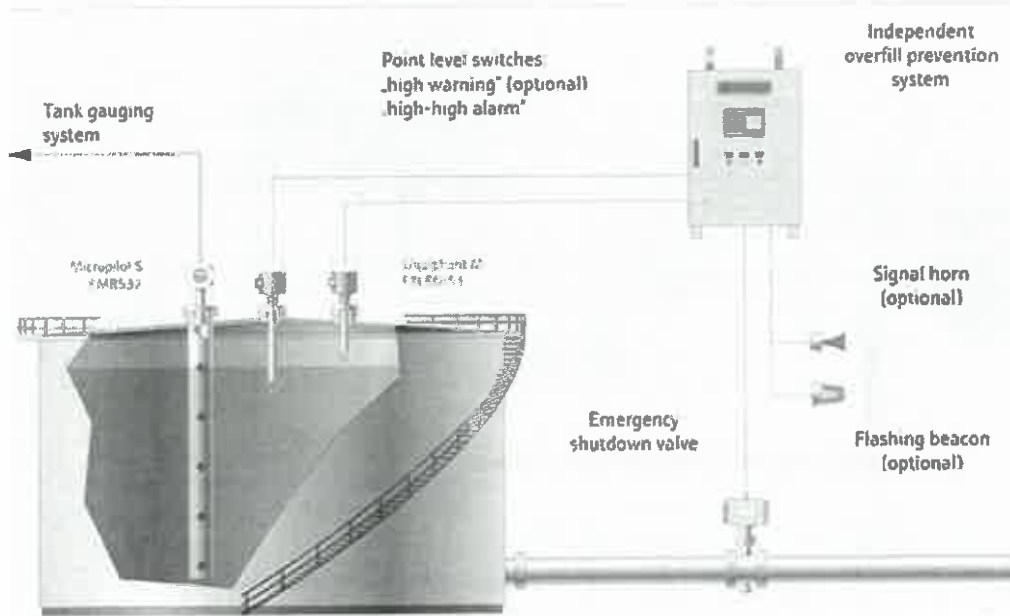


Valero Pembroke Refinery Tank Overfill Protection Power Point slide showing new working tank levels, including AOPS level, for Gasoline Tankage.

Automatic Overfill Protection System (AOPS)

AOPS is intended to be totally separate from the automated tank gauging system and operational tank suction and rundown valves. The advantage to AOPS is that it is capable of executing a shutoff without human intervention. As soon as the AOPS level is reached the emergency shut off valves to the tank will close, preventing the tank overfilling and causing safety or environmental incidents.

Overfill prevention system



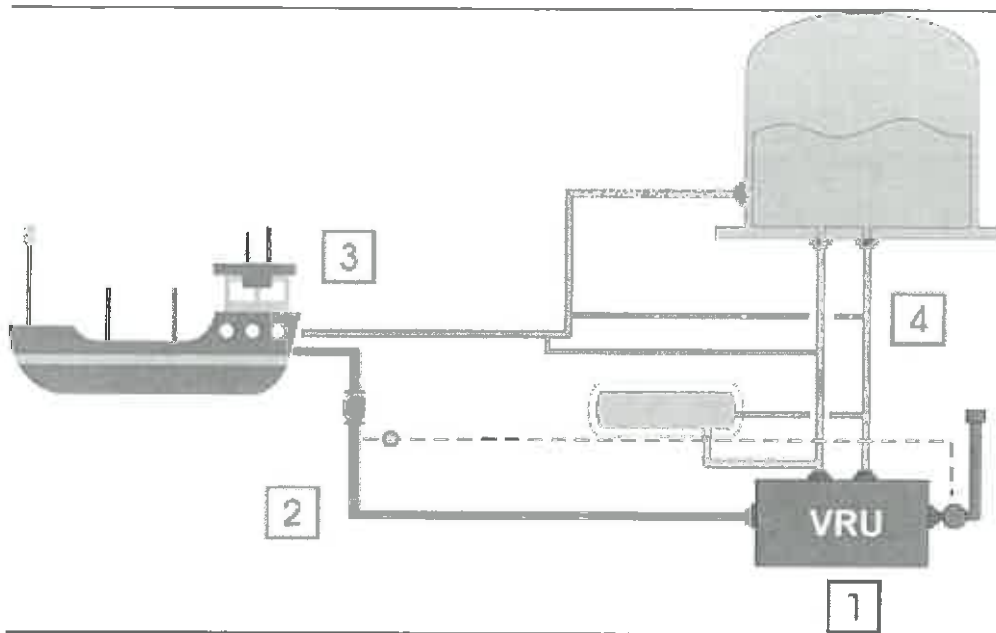
Typical set up showing AOPS system is independent from the tank gauging system.

Conclusion

The improvements to the gasoline blender has given both efficiency savings and reduced environmental impact by reducing tankage requirements for gasoline. Improvements to gasoline tank bund construction will improve product recovery and environmental impact should there be a tank failure and spill into the bund. Although reduction in tank working levels has slightly reduced available capacity, legislation has been complied with and risk of environment incidents reduced. The addition of AOPS has also added another layer of protection against costs of potential safety and environmental disasters such as Buncefield. These improvements have added to the safety and sustainability of gasoline production at the refinery.

Future recommendations.

Pembroke refinery does not have a vapour recovery system for gasoline loading at the jetty. Presently a ship loading gasoline will vent vapour, created in the ship's tanks, to atmosphere. Modern facilities are now built with vapour recovery systems to recover these vapours from the ships. The recovered vapours have a value while also reducing air pollution.



Basic diagram showing ship loading with a vapour recovery system.

A very good effort!

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<https://www.pembrokeshire.ac.uk/my-college/>

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

NOTE: The guidance offered below is linked to the five generic assessment criteria overleaf.

1. Engagement with Literature Skills

Your work must be informed and supported by scholarly material that is *relevant* to and *focused* on the task(s) set. You should provide evidence that you have accessed an appropriate *range* of sources, which may be academic, governmental and industrial; these sources may include academic journal articles, textbooks, current news articles, organisational documents, and websites. You should consider the *credibility* of your sources; academic journals are normally highly credible sources while websites require careful consideration/selection and should be used sparingly. Any sources you use should be current and up-to-date, mostly published within the last five years or so, though seminal/important works in the field may be older. You must provide *evidence* of your research/own reading throughout your work, using a suitable referencing system, including in-text citations in the main body of your work and a reference list at the end of your work.

Guidance specific to this assessment: You must provide evidence of individual research with respect to the area of study and provide relevant referencing.

2. Knowledge and Understanding Skills

At level 4, you should be able to demonstrate knowledge of the underlying concepts and principles associated with your area(s) of study. *Knowledge* relates to the facts, information and skills you have acquired through your learning. You demonstrate your *understanding* by interpreting the meaning of the facts and information (knowledge). This means that you need to select and include in your work the concepts, techniques, models, theories, etc. appropriate to the task(s) set. You should be able to explain the theories, concepts, etc. to show your understanding. Your mark/grade will also depend upon the *extent* to which you demonstrate your knowledge and understanding.

Guidance specific to this assessment: Your report should show you gained knowledge of the subject area.

3. Cognitive and Intellectual Skills

You should be able to present, evaluate and interpret qualitative and quantitative data, in order to develop lines of argument and make sound judgements in accordance with basic theories and concepts of your subject(s) of study. You should be able to evaluate the appropriateness of different approaches to solving problems related to your area(s) of study and/or work. Your work must contain evidence of logical, analytical thinking. For example, to examine and break information down into parts, make inferences, compile, compare and contrast information. This means not just describing what! But also justifying: Why? How? When? Who? Where? At what cost? You should provide justification for your arguments and judgements using evidence that you have reflected upon the ideas of others within the subject area and that you are able to make sound judgements and arguments using data and concepts. Where relevant, alternative solutions and recommendations may be proposed.

Guidance specific to this assessment: The report should show analysis of the research.

4. Practical Skills

At level 4, you should be able to apply the basic underlying concepts and principles to evaluate and interpret these within the context of your area of study. You should be able to demonstrate how the subject-related concepts and ideas relate to real world situations and/or a particular context. How do they work in practice? You will deploy models, methods, techniques, and/or theories, in that context, to assess current situations, perhaps to formulate plans or solutions to solve problems, or to create artefacts. This is likely to involve, for

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Name: Morgan Osborne

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Excellent: Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	25	20
2. Knowledge and Understanding Skills		
Excellent: Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.	25	20
3. Cognitive and Intellectual Skills		
Very good: 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	18
4. Practical Application Skills		
Very good: A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	10	6
5. Transferable Skills for Life and Professional Practice		
Excellent: 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. Please see additional comments in assignment text.	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)		71%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

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Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
	25	20
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	25	20
3. Cognitive and Intellectual Skills		
	30	18
4. Practical Application Skills		
	10	6
5. Transferable Skills for Life and Professional Practice		
	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)

Up to 1 week late (40% Max)

Over 1 week late (0%)

71 %

instance, the use of real world artefacts, examples and cases, the application of a model within an organisation and/or benchmarking one theory or organisation against others based on stated criteria.

Guidance specific to this assessment: The report indicates a level of research with respect to the application and deployment of the equipment, materials or processes that form the basis of the area of study.

5. Transferable Skills for Life and Professional Practice

Your work must provide evidence of the qualities and transferable skills necessary for employment requiring the exercise of some personal responsibility. This includes demonstrating: that you can communicate the results of your study/work accurately and reliably, and with structured and coherent arguments; that you can initiate and complete tasks and procedures, whether individually and/or collaboratively; fluency of expression; clarity and effectiveness in presentation and organisation. Work should be coherent and well-structured in presentation and organisation.

Guidance specific to this assessment: Your work should be well organised and presented in a professional manner.

GENERIC ASSESSMENT CRITERIA

Level 4

In accordance with the Framework for Higher Education Qualifications, at the end of Level 4 students will be expected to have demonstrated knowledge of the basic underlying concepts and principles of a subject, and an ability to evaluate and interpret these within the context of that area of study. They should be able to present, evaluate and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements in accordance with basic theories and concepts of their subject(s) of study. They will have learned how to evaluate different approaches to solving problems, and will be able to communicate the results of their study/work accurately and reliably, and with structured and coherent arguments. They will be able to undertake further training and develop new skills within a structured and managed environment and will have the qualities and transferable skills necessary for employment requiring the exercise of some personal responsibility.

Level 4	Category	FAIL 0-29%	MARGINAL FAIL 30-39%	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
	Engagement with literature (including reading, referencing, academic conventions and academic honesty)	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.	Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts rather than other sources. Referencing may show minor inaccuracies or inconsistencies.	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing, with no/very few inaccuracies or inconsistencies.	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	Exceptional engagement with an extensive range of relevant and credible literature. High-level referencing skills consistently applied.

Level 4	Category	FAIL	MARGINAL FAIL	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
		0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
	Knowledge and understanding (Knowledge of the basic underlying concepts and principles of a subject.)	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies.	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing.	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding.	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles
	Cognitive and intellectual skills (Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)	Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements.	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.	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.	Exceptional evaluation of the underlying concepts and principles based on evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements.

Level 4	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
Practical skills (Different approaches to solving problems in particular contexts.)	Limited or no use of taught, basic methods, tools and/or techniques. Little or no appreciation of the context of the application. Very weak evidence of different approaches to problem-solving in particular contexts.	Rudimentary application of taught, basic methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak evidence of different approaches to problem-solving in particular contexts.	An adequate awareness and mostly appropriate application of basic methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Can identify problems in particular contexts and propose basic alternative approaches or solutions though there may be errors.	A good and appropriate application of basic methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Good evidence of different approaches to problem-solving in particular contexts and proposes mostly appropriate solutions.	A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	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. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	Exceptional levels of application and deployment skills in particular practical contexts. Outstanding of identification of problems in particular contexts and formulation of wholly appropriate, thoughtful solutions / different approaches.

Level 4	Category	FAIL 0-29%	MARGINAL FAIL 30-39%	SATISFACTORY (3 rd / Pass) 40-49%	GOOD (2.2 / Pass) 50-59%	VERY GOOD (2.1 / Merit) 60-69%	EXCELLENT (1 st / Distinction) 70-84%	EXCEPTIONAL (1 st / Distinction) 85-100%
	Transferable skills for life and professional practice (Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.	Mostly coherent, organised work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.	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 excellent skills for employment requiring the exercise of some personal responsibility, with an appetite for further development.	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.	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team, with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development.

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