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LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Joseph Underwood	Student ID number:	151025
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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.		

Disclosure:	I declare that this assignment is all my own work and that I have acknowledged all materials used from the published or unpublished works of other people. All references have been duly cited.		
Student's Signature:	<i>Hardcopy assignments will not be accepted without a signature here</i> 	Date:	13/01/2021

Module Learning Outcomes (from module syllabus)
LO1 LO2

Learner Name: Joseph Underwood.

Course: HNC Process Operations Engineering Year 2.

Module Code: PCPO40047.

Module: Process Engineering Practice.

Responsibility, operational and maintenance activities.

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Task 1 (LO1).

When working on various processes such as what is found on Pembroke refinery, it is important to have a key understanding of the equipment that is being used from an operational view and a fundamental view.

Across all the plant, there is a wide range of equipment being used from turbine and motor driven equipment, compressors, vessels for separation and stripping and so on. All such equipment can be found on the unit that I am trained to manage and operate, known as the Steam plant which is used for utility operations and steam generation.

Found on the steam plant are various steam generating boilers and the associated equipment found to operate such boilers including pumps, compressors, control valves and various instrumentation. All are required to have at least a basic understanding of the fundamentals to operate and a key operational understanding to be used effectively.

Basic arrangement of Steam Generation.

Boiler feed water.

Boiler feed water, BFW, is taken from a vessel known as the Deaerator to the boiler feed water pumps. The BFW is then pressured up to roughly 700PSI and distributed across the boilers and to other users of BFW. The water leaves from the distribution pipework into the control valves used to control the water flow into the boilers, as seen in appendix figure one.

Steam drum.

The water enters the steam drum, as seen in appendix one, to allow the boiler to continuously keep a level of water. Here in the steam drum is where the water that has boiled off to exit the steam drum and enter what's known as the super heater pipework.

Boiler tubes.

The boiler tubes are where most of the heat transfer takes place between the boiler's burners and the water. The burners are located horizontally to the tubes with the flames passing between the tube. They are used to cause a thermosiphon effect where the colder water enters the steam drum and passes through the down-commer tubes, where they are then heated up and pass through the mud drum and then flow through the riser tubes as seen in the appendix on figure 2.

Mud drum.

The mud drum serves three main functions, a large supply of water to ensure boiler tube dry out doesn't occur, a connection between the boiler down-commers and riser tubes and a place to allow sediment to collect to prevent plugging of tubing.

Super heater.

The super heater is consisting of pipework where the hot generated steam passes through. The super heater tubes pass by the hottest point of the boiler, which is directly facing the boiler's burners. The use of the super heat is to dry further heat the steam in order to dry out the steam and remove moisture which can cause steam hammer and damage to pipework and associated equipment such as steam turbines.

Instrumentation.

Found on all the boilers are various instrumentation from level control, flow readings, temperature readings and analysers. The use of this instrumentation is to ensure that all boilers are controlling correctly and are operating within safe operational limit.

Fundamentals of pumps.

Pumps are used in the arrangement of steam generation to supply each boiler with the needed BFW to boil and generate steam. These such pumps used are multistage pumps which can reach pressures above 700PSI needed to overcome

the internal pressure of the boiler which operates at 450PSI. For a simplified explanation of how pumps operate, there are a few components need.

- Pump bowl.
- Impellor.
- Drive.
- Suction and discharge.

The pump bowl is simply a casing that forms the main box of the pump and is designed to hold the fluid while the impellor causing a change in pressure.

[1]The impellor of a pump the mechanism of the pump that does the work to create changes in pressure. Impellors are designed to have a fan, called vanes, like shape in order to draw in fluids and discharge them outwards, for cases such as centrifugal pumps. The impellor creates a pressure difference at the eye of the impellor, which is lower than the surrounding fluid, drawing in other fluids from the pipework. As the impellor rotates, the vanes will accelerate the fluid outwards into the pump bowl's volute. The volute is the outward curve of the inside of the pump bowl which flows the water from the impellor to the discharge of the pump, the volute is designed specifically to cause the fluid to accelerate outwards from the impellor and along to the discharge pipework.

Suction and discharge pipework are simply the pipework which connects the pump from the previously part of the process, where the liquid is coming from, to the next stage of where the fluid is needed. See appendix ^{which one} for figures three and four of arrangements of traditional centrifugal and multistage pumps.

Multistage pumps are used as stated before to allow the BFW to reach the required pressure to overcome the internal boiler pressure. The difference between a traditional centrifugal and a multistage pump is the number of impellors inside the pump case. The ones used for BFW house five impellors, which after each impellor the pressure increases while keeping the flow rate mostly unchanged.

[2]All pumps will be given a specific output which it is rate to work to known as a pump curve, found in appendix. A pump curve displays the relationship between a pumps pressure and flowrate that it can achieve. As can be seen from figure five, a pumps flow and pressure have direct correlation meaning as one variable change as so will the other. An example of this being controlling the discharge pressure on a pump by adjusting the valve on the discharge. As the discharge valve is closed, the flow will decrease from the pump but the pressure will increase and the changes will follow the figures that are given with a specific pumps curve. This means that a pump will only be able to operate along that curve and is unable to deviate from the curve, for example the pump would be unable to maintain a higher pressure will still achieve the same flow rate. See figure 6 in appendix for a working example of a pump curve.

Maintenance needs.

As with all equipment that requires continuous use, said equipment also requires planned maintenance to allow it to operate continuously and safely. Most equipment will have and stick to its own scheduled maintenance for when it comes to routine checks and calibrations and some will fail early and require equipment maintenance to be brought forward.

Commonly equipment maintenance will include driver PMs (Planned maintenance) for pumps which will either require servicing a motor or turbine depending on what is needed or online. This will usually include disassembling the driver, for example of a turbine, and carrying out quality assurance checks that the equipment is not failing or likely to fail. Such checks will include clearance and tolerances on seals and mating faces, governor speed checks and general wear of bearings and impellor. The bearing lubrication will also be sampled and analysed to determine whether the bearing is failing as the oil would show initial signs of bearing failure. Mean time between PMs average 2-3 years depending on previous failures with the equipment.

Other equipment showing maintenance needs would be instrument and control systems. Controls valves require stroke checking and calibrations when the

boilers come offline due to the need, only being brought forward when the control valve fails to operate correctly. Instrumentation average 6-12 months between calibration, determined by the service the instrument is in, with shut down equipment having more frequent calibrations as they control the safety systems of the equipment. Such maintenance can be carried by authorising specific control overrides from higher authority to ensure the instrumentation can be tested without triggering shut down systems or relaying back into the control loop, all while being carried out at a safe time and manner.

Conclusion?

Task 2 (LO2).

As a trained operator, my current role is to continue to show interest in my work and forward understand of further process found on site to train to manage those process further. As can be seen in the appendix, I have included my up to date CV.

To gain competency of my job role, I have completed various initial basic training modules known as the “Valero Basic Operator Training” which takes individuals with no previous process knowledge or understanding of key principles of operating various equipment, and trains them to gain the relevant knowledge and understanding of such process and equipment.

Further to carrying out basic training, I have also carried out my unit specific training module which is needed to prove competency of operating a given system on the plant. The full booklet of training can be found in the appendix. Going through this training involves gaining a knowledge of the plant and how to control it, how to operate and shutdown the involved equipment and how to prepare the equipment to handed to maintenance for maintenance activities. Further to this the training involves gaining a strong understanding on how to react during potential emergencies such as major process upsets or potential leaks or other release of harmful or dangerous chemicals.

Upon completing the relevant training to become a plant operator, further training is required to understand and use the RAP system, risk assessed permits,

which is the key permit system used for all work activities for maintenance personnel. The system is required to understand implications involved of carrying out gas testing for work locations and what safety measures are required to be put in place to ensure that all equipment to be worked on are safe. At current moment on plant, a four level of authorisation when it comes to permits with level one being the lowest in severity and four being the highest. At the moment, my permit authorisation is at level two meaning I can authorise permits that are non-invasive and do not include hot working equipment such as cutting and welding equipment. Further to my development as a process operator, my permit authorisation will be increased once consolidating a second position or control operator position to allow me to authorise higher levels of permits.

Currently my development plan is stagnant at the moment but will soon be involved with training a second process operator position, likely to begin training the Crude Distillation Unit before the end of 2021. With training the crude unit, I will also begin training level three RAP authorisation. My current plan afterwards would to consolidate the CDU outside position before moving onto training either the CDU control operator position or Steam Plant control operator position.

While monitoring safety aspects of during shift work, I have been commemorated for identifying specific safety concerns and highlighting them to the relevant personnel. The safety system in use on plant is known as "LPS" or "Loss prevention system". While carrying out various recorded observations for safety documentation, I have identified some possible improvements to our system that should be included to help aid in the safety of steam plant process operators. During an observation, I identified that there was no written risk assessment used to identified carrying out a routine task of removing sediment from boiler mud drums called "intermittent blowdown". I raised the problem using the LPS and suggested a solution, to generate a risk assessment using the procedures found on site. After generating such an assessment, it was forwarded on to my shift team leader and complex manager of the refining complex and has now been approved to be added to LPSA (Loss prevention self-assessment) booklets that are required to be carried by all operators.

Additional jobs carried out by process operators is ensure that equipment is isolated safely and correct for an specific maintenance task that is required for it. To ensure this LOTO packs are created, lock out tag out. The work pack will be compile by the operations and maintenance coordinator and will then require to be verified by an additional person before carrying out isolations, this reduces human error by ensuring multiple personnel have reviewed the scope and agree it is ~~the~~ correct course of action to take. In the appendix, a pack can be found for the isolation of a 450PSI boiler which I carried out the isolations for. As can be seen, I included additional isolations to the pack which were not initially added by the coordinator. To limit human error, I asked my lead operator to counter sign the included isolations to show that multiple people had witness the isolations and was safe to carry out work.

Word Count: - 2078 words.

References.

[1]Valero Energy Training Material. Basic Operator Training, Fundamentals of pumps. Volume 3: Process fundamentals version 07. Available on Valero internal intranet.

[2]Standards.doe.gov. 2021. *Thermodynamics, Heat Transfer, And Fluid Flow, Volume 3 Of 3 — DOE Technical Standards Program*. [online] Available at: <<https://www.standards.doe.gov/standards-documents/1000/1012-bhdbk-1992-v3>> [Accessed 1 December 2020].

Any more you could include?

Appendix.

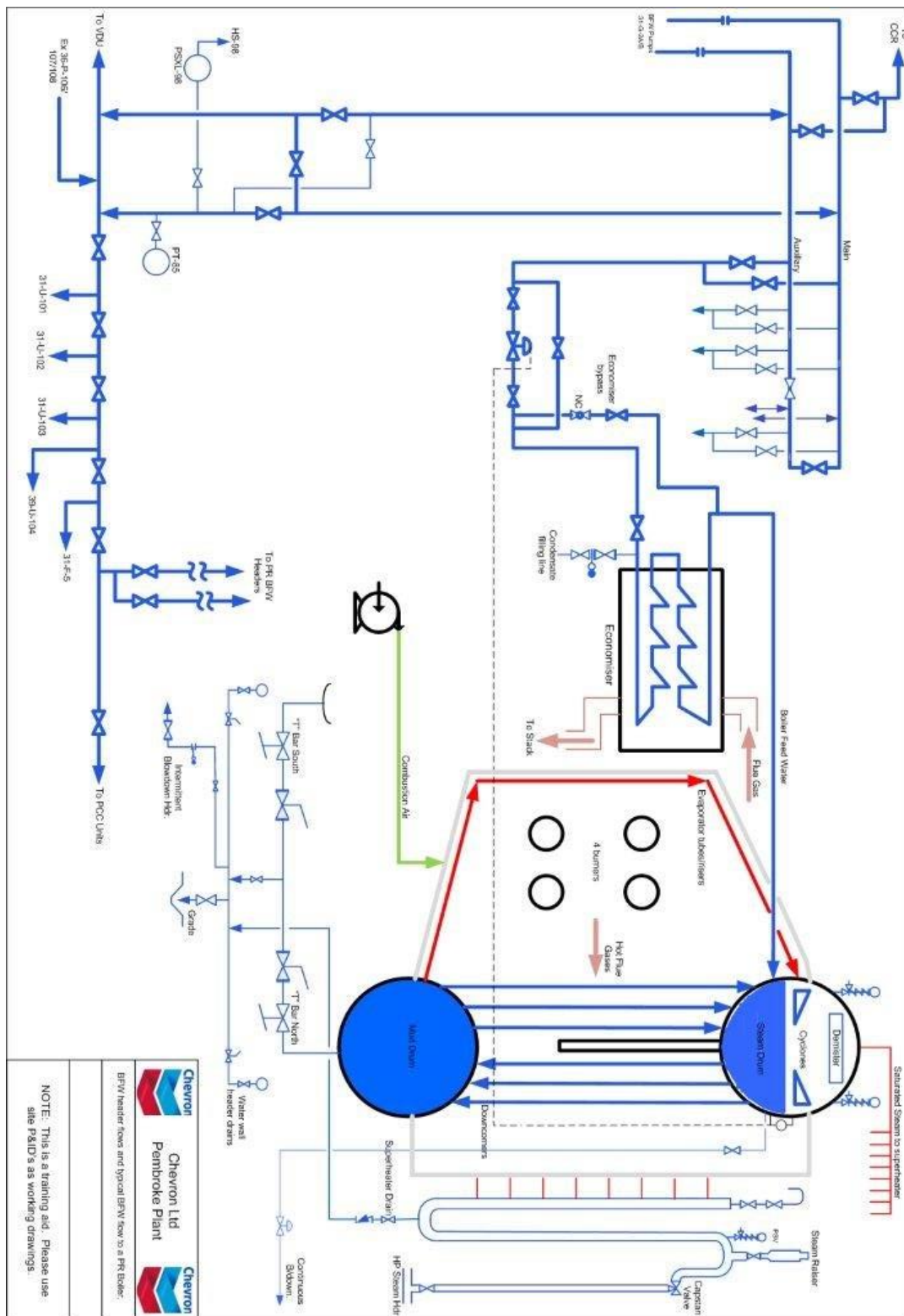


Figure 1, Basic arrangement of boiler.

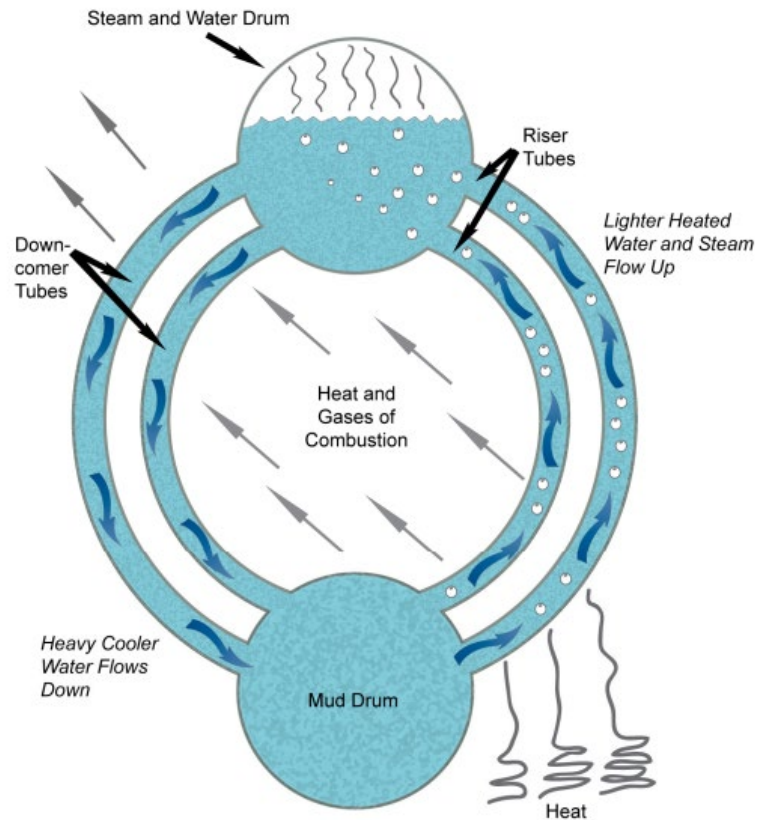


Figure 2, Simplified boiler diagram.

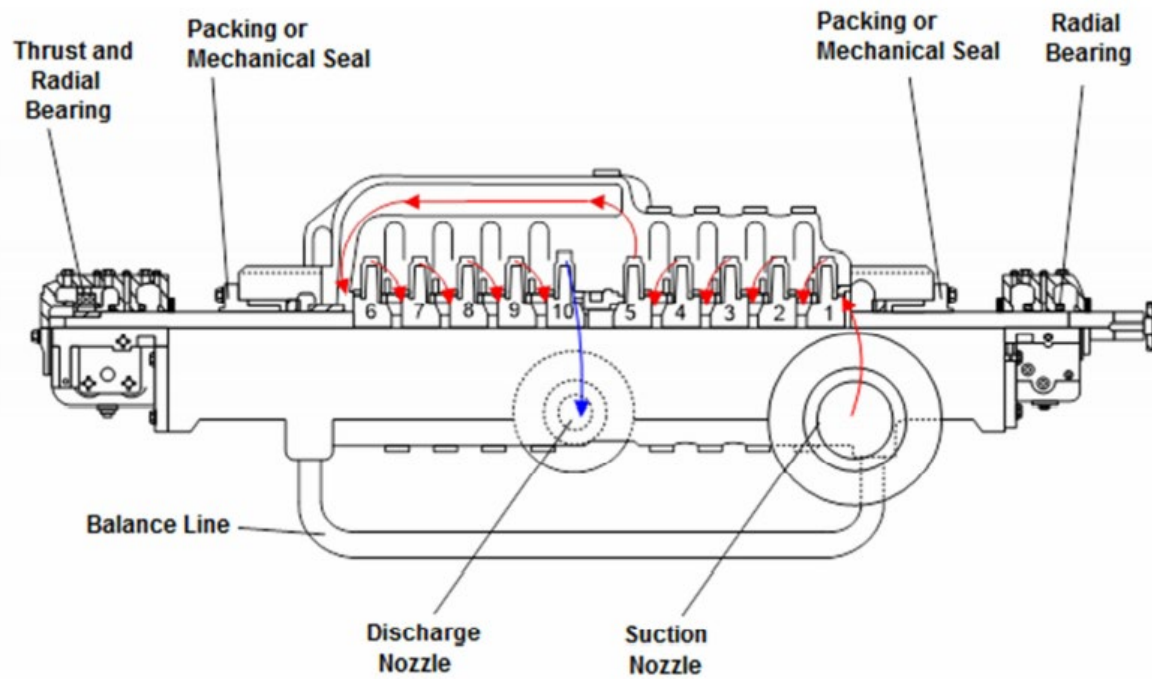


Figure 3, Example of multistage pump.

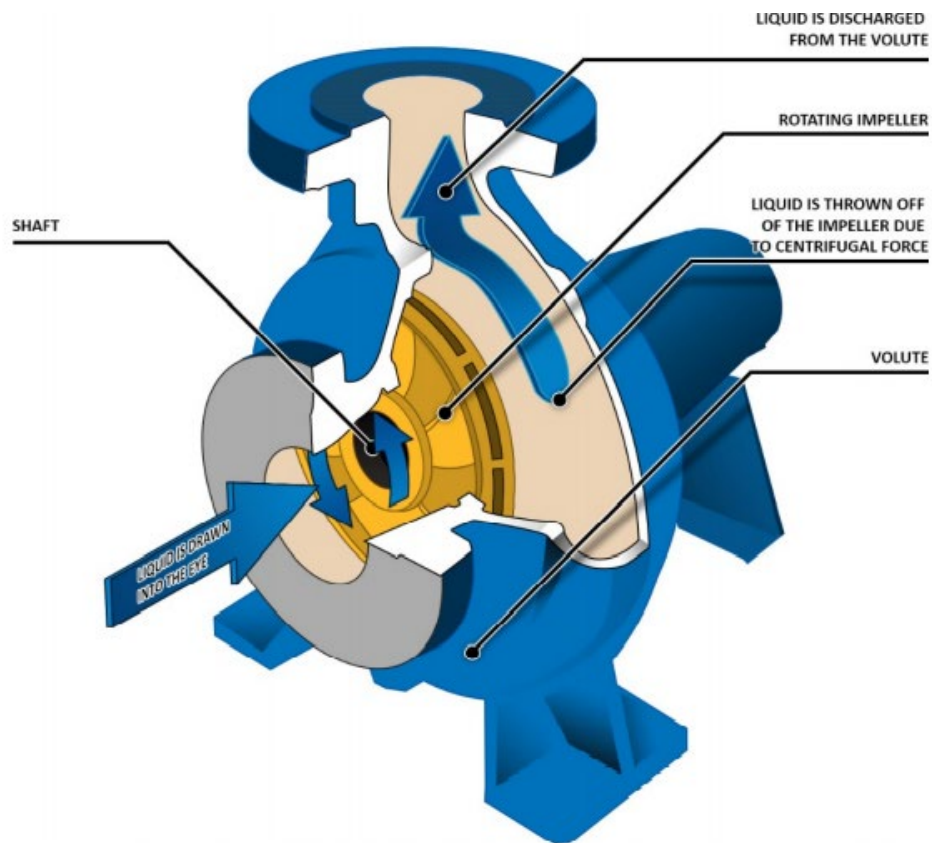


Figure 4, Centrifugal pump diagram.

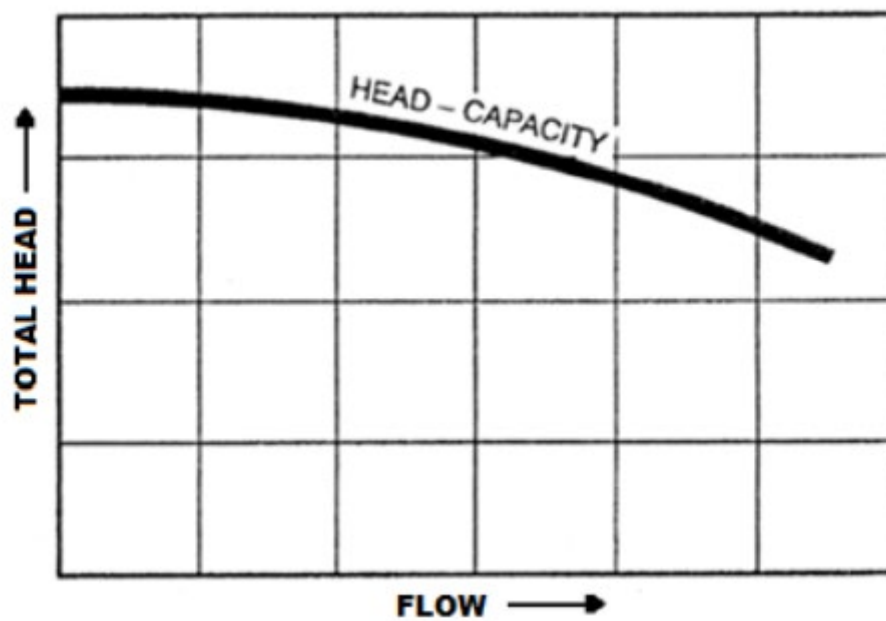


Figure 5, Example of typical pump curve.

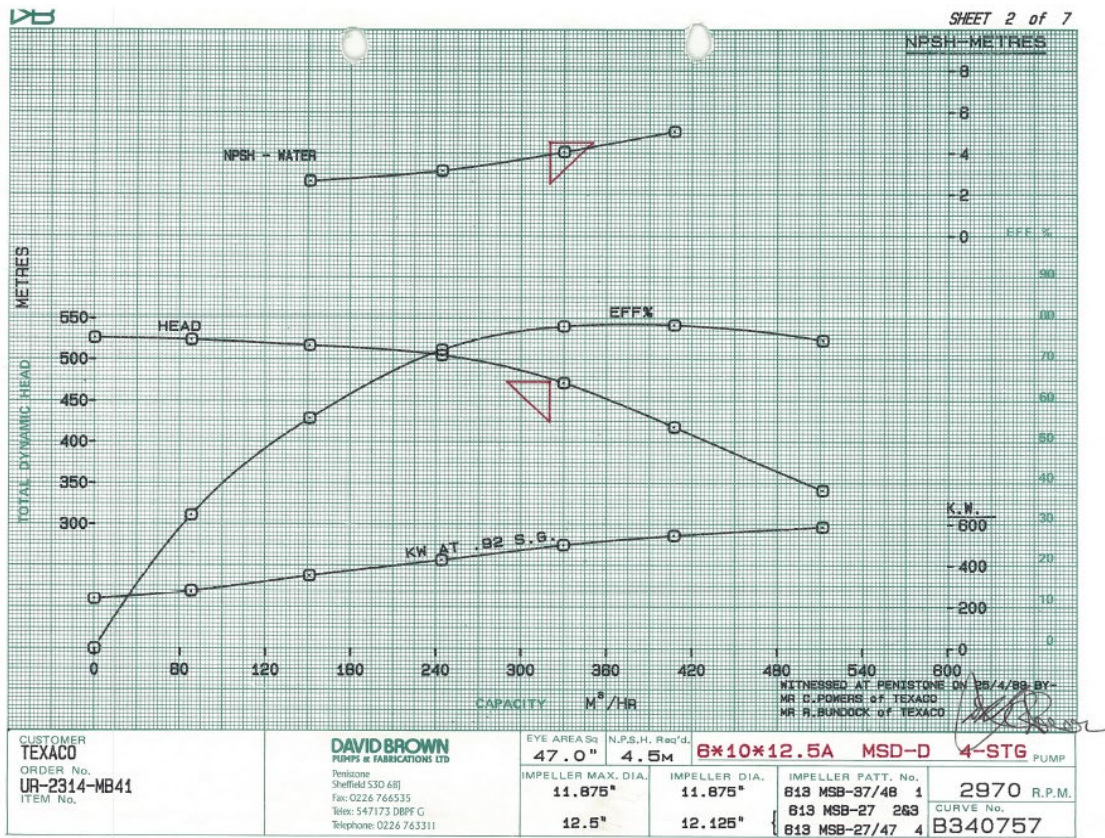


Figure 6, Pump curve of multistage pump currently in service for BFW.

Reply Reply All Forward IM



Sun 10/01/2021 11:14

Underwood, Joseph (Contractor)

FW: Boiler blowdown HIT tool

To ☐ josephunderwood1998@gmail.com

Retention Policy Zone1 Sent Items (6 months)

Expires 09/07/2021

From: Baker, Huw

Sent: 02 January 2021 13:45

To: Underwood, Joseph (Contractor) <Joseph.Underwood@contractor.valero.com>

Subject: RE: Boiler blowdown HIT tool

Thanks Joe. Great work – I'll take a look through and once it's approved I'll put it onto the HIT Tool List.

Huw.

From: Underwood, Joseph (Contractor)

Sent: 02 January 2021 13:17

To: Baker, Huw

Subject: Boiler blowdown HIT tool

Figure 7, Email from STL.

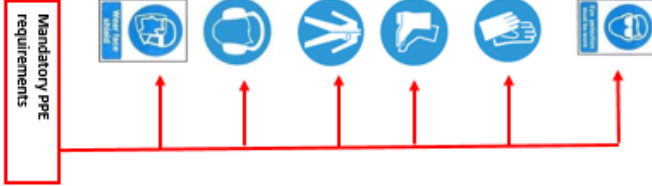
Intermittent Boiler Blowdowns

Pre-requisites check

1. Ensure boiler is in service at working level and suitable for blowdown activities to take place.
2. Ensure there are no standing isolations to prevent from carrying out blowdown activities.
3. Ensure intermittent blowdown receivers are in service/ able to blowdown to grade.
4. There is suitable access and egress from the work area.
5. An escape route is identified is an incident were to happen.
6. You are aware of others that are working in the area.

Summary of actions

1. Communicate with Steam Plant control operator the intention to start boiler blowdown activities
2. Check valve line up and ensure it is lined up to intermittent blowdown header or to grade if receiver is out of service.
3. Prepare the blowdown pipework by opening inner block valve and then outer block valve.
4. Inform the operator that blowdown activities are about to happen on the boiler.
5. Prime pipework by gently pressing dead-mans handle valve for two seconds then releasing for five seconds. This allows pipework to warm gently and prevent steam hammer.
6. Carry out blowdown procedure by pressing dead-mans handle valve for five seconds and releasing for five seconds. This will remove sediment from the mud drum and water will header of the boiler in without draining the boiler too quickly.
7. Repeat the task of blowing down the boiler two more times.
8. Isolate the boiler by blocking in the outer upstream valve, followed by the inner upstream valve.
9. Depressure the blowdown pipework by pressing the dead-mans handle valve for 2 more seconds.



Potential Hazards

- Poorly prepared line can cause steam hammer, damaging the line and potentially breaking containment of the pipework, resulting in damage to personnel or equipment.
- Not communicating carry out blowdown activities could lead to injuries/burns due to open bleeder drain/vents, steam leaks or contact to hot piping and equipment.
- Not communicating intent to carry out blowdown activities can result in boiler process upset, potentially causing boiler to shutdown.
- Continually blowing down water wall header valves can lead to boiler tube dry-out with the possibility of damaging boiler tubes.
- Personnel working in close proximity to blowdown line drains may receive injuries/burns due to steam and hot condensate draining from open drains.
- Pressing dead-mans handle valve too quickly or too long could result in line hammer, boiler level drop, pipework heating up too quickly causing thermal damage to pipework which can lead to injury.
- Partially opened main blowdown valve can lead to gate valve erosion/damage, causing valves to be inoperable by not seating correctly and not creating a seal when closed.
- Potentially leaking pipework can cause boiler water to leak during blowdown activities which can lead to injuries. Water at this temperature will instantly evaporate at ambient pressure, causing a rapid expansion of hot steam which can lead to injuries.
- Use of intermittent blowdown pipework requires the use of dead-man handle valve with high risk of pinch points. Ensure that correct hand position and PPE to avoid injury.



Assess the risk **Analyse** how to reduce the risk **Act** to ensure loss-free operation

Figure 8, Risk assessment generated in response to safety observation.

MAINTENANCE WORKSCOPE

Equipment	31-U-103		
MWO No	RAP No		
Workscope	Clear plugged pressure tapping		
Area	Utilities	Unit	Steam Plant
Location	31-U-103		



Figure 9, Page one of LOTO pack, front page of pack.

Operations Release to Maintenance Handover Form

MWO / PJN No: _____
 Equipment No: 31-U-103
 Work Description: Clear plugged pressure tapping

Item	Description of item to be checked	Acceptable			Comments
		Yes	No	N/A	
1	All debris associated with the equipment being prepared (such as old bolts, gaskets, blinds, etc) has been removed to skips / bins.	☒	☐	☐	
2	All trip / slip hazards (such as unused hoses, oil spills etc.) have been removed.	☒	☐	☐	
3	The equipment is free of dirt / oil / debris.	☒	☐	☐	

This is to certify that the area has been cleaned, all tools, materials and debris removed. I have inspected the area and it is in an acceptable and safe condition to handover to Maintenance.

For:	Operator
Name:	Joseph Underwood
Signed:	<i>Joseph Underwood</i>
Date:	12/1/21

Figure 10, Page two of LOTO pack, operations release to maintenance form.

This was printed on 12/03/2021. Once printed it is an UNCONTROLLED document. Do not use this hard copy without checking the LOTO status against that in the electronic filing system. If this is out of date then destroy this copy

PERMIT NUMBER:		PP-PEM-JBA-0033		Compiled By: SP Mayne	
MWO:				Verified By: J Underwood	
PROCEDURE No (if req'd):				Accepted by Maintenance	
UNIT	EQUIPMENT	MAINTENANCE ACTIVITY		By Whom	Date
Steam Plant	31-U-103	Clear plugged pressure tapping			
ISOLATION POINT	POSITION	DATE ISOLATED	BY WHOM	DATE REMOVED	BY WHOM
			PRINT SIGN		PRINT SIGN
1	ISFW Header Valve	Closed	12/1/21 J Underwood		
2	B/V Downstream of 31-FV-978	Closed	12/1/21 J Underwood		
3	31-FV-978 6" Bypass	Closed	12/1/21 J Underwood		
4	31-FV-978 2" Warm Up Line	Closed	12/1/21 J Underwood		
5	450# Main Stop	Closed	12/1/21 J Underwood		
6	IBD Header Valve	Closed	12/1/21 J Underwood		
7	CBD Valve @ Steam Drum	Closed	12/1/21 J Underwood		
8	Steam Raiser	Open	12/1/21 J Underwood		
9	Steam Drum Vent	Open	12/1/21 J Underwood		
10	Saturated Steam Vent	Open	12/1/21 J Underwood		
15	Superheater Vent	Open	12/1/21 J Underwood		
16	Superheater Drain	Open	12/1/21 J Underwood		
17	Mud Drum Drain X3	Open	12/1/21 J Underwood		
18	WWH Drain X3	Open	12/1/21 J Underwood		
19	Fuel gas at XV	closed	12/1/21 J Underwood		gan
20	Fuel gas HDR	closed	12/1/21 J Underwood		gan
21	Pilot gas HDR	closed	12/1/21 J Underwood		gan

Figure 11, Page three of LOTO pack, List of isolations.

CV.

Joseph Kyle Underwood

Address: 34 Westaway Park

Rosemarket

Milford Haven

Pembrokeshire

SA73 1JL

Mobile number: 07471740758

E-Mail address: josephunderwood1998@gmail.com

Education

School: Milford Haven School Pembrokeshire College

Steynton Road Haverfordwest

Milford Haven Pembrokeshire

Pembrokeshire SA61 1SZ

SA73 1AE

Qualifications.

Level 3 Apprenticeship in Engineering Manufacture and Maintenance.

Level 3 NVQ Ext. Diploma Instrumentation and Control- Distinction.

Level 3 BTEC Ext. Diploma Operations and Maintenance - Double Grade Distinction

Level 3 Welsh baccalaureate - Pass

Level 2 City and Guilds in Engineering - Distinction

Mathematics- C A Level

Design Technology- E A Level

Business Studies – B GCSE

Engineering – B (Merit) GCSE

English Literature – C GCSE

Science – C GCSE

English Language – C GCSE

ICT – C (Pass) GCSE

Employment History.

September 2017 to Current.

Process Operator Apprentice, Pembroke Refinery.

Began training as an apprentice in 2017 in Pembrokeshire college learning various subjects such as mathematics, metal machining, health and safety, electrical fitting, electronics, etc. During this time in college, a group of us apprentices partook in a project to design and manufacture an smart card automated traffic barrier designed for use on the refinery.

Following was a year spent with the instrumentation department to learn from and assist instrument technicians in the maintenance of instrumentation equipment and the associated control circuits which control processes on the refinery.

Completed Valero's Basic Operator Training programme by learning from the operations departments and gained extensive knowledge of the various plant and equipment used.

Currently trained as a Utilities outside operator, responsible for carrying out daily routines and ensuring equipment is running safely and without fail.

Currently attending Pembrokeshire College, working towards a HNC in Operations Engineering, completed first year with Merits and Distinctions.

January 2017 to July 2017

Home bargains customer assistant.

As a customer assistant, I was responsible for stacking the shelves in the store front for expended stock. I manned checkout tills, and assisted customers with their requests.

Work Based Qualifications.

LPS training.

Self contained breathing apparatus training .

Trained in the use of risk assess permitry.

Interests.

Have always enjoyed music, currently learning to play piano, previously played saxophone and violin.

I enjoy reading comic books.

References

- Miss K. Dootson

My Previous head of year at Milford Haven School

Address: Milford Haven School

Steynton Road

Milford Haven

Pembrokeshire

SA73 1AE

- Amanda Mayne

Previous employer

Clean Image Laundry Service

Robert Street

Milford Haven

Pembrokeshire

SA73 2HS

01646 690139

Any development plans etc.