

HNC Process Operations Engineering Year 2

2020 - 2021

PROCESS ENGINEERING PRACTICE ASS. 1

SAMUEL LEWIS

UNIVERSITY TRINITY ST. DAVIDS | PEMBROKESHIRE COLLEGE

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Task 1

Introduction

In industries like oil refineries, process is moved through units to enable the product to be formed from raw materials. This is accomplished by means of a pressure gradient and that if a material in a certain area is at a higher pressure than another area, the material in the higher-pressure area will move down the gradient to the lower pressure area. This is achieved by implementing pumps into the system. A pump works by increasing the pressure of a liquid by using centrifugal force to increase pressure and continue through the process. A pump works alongside a driver, such as a steam turbine. Drivers supply rotational energy via a shaft connected by a coupling and the driver's rotational energy is then transferred. For this example, a steam driven turbine will be used.

Typical Multistage Steam Turbine

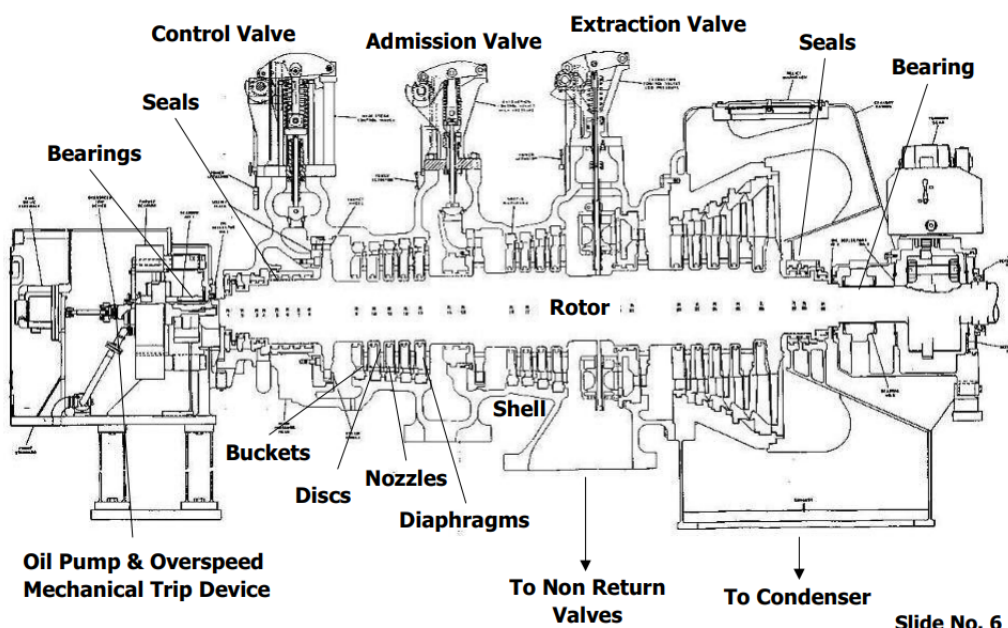


Figure 1 - Diagram of Multistage Steam Turbine

Working Theory

A steam turbine uses 450# steam to drive a rotor within the turbine's casing, which is attached to the drive shaft of the machine, allowing the rotation to be transferred to the pump. The rotor has a specific design to maximise energy transferred from the steam, to the buckets of the rotor, to transfer the energy to the driveshaft. The used steam is then converted to 40# and exhausted from the turbine. An integral part in the maintenance of the turbine is the trip and throttle valve (T&T valve). This valve controls the speed of the rotor's rotation by restricting the steam into the casing, while also acting as a safety shut off for the steam if the speed exceeds the pre-set value for the machine. The T&T valve works alongside the governor of the turbine, which governs the speed of the rotor. The drive shaft is also attached to the governor's shaft via a Tushion coupling, so the governor shaft rotates at the same velocity of the driveshaft. The governor then has flyweights attached to it. While the shaft spins, it creates centrifugal force which then forces the flyweight's outwards. More velocity means more centrifugal force which in turn forces the flyweight's outwards. These flyweights are then connected to the T&T valve via a linkage. As the flyweights are thrust outwards, this moves the linkage and starts to close the throttle valve, restricting steam. As the velocity of the shaft decreases and the flyweights move inwards towards the shaft it then pulls the linkage and opens the throttle valve. This is how the machine controls the velocity to allow the turbine to rotate at a set speed, which can be altered by tightening or loosening the governor spring, which alters the position of the throttle linkage.

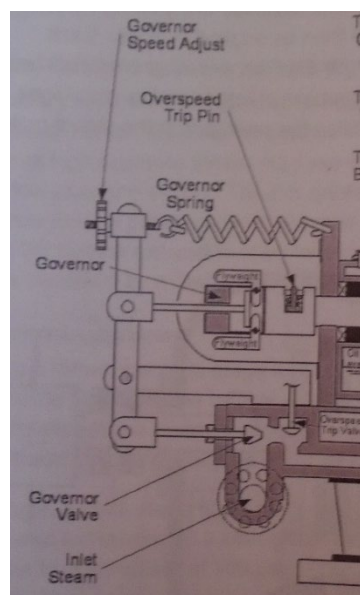


Figure 2 - Diagram of Steam Turbine Governor & Throttle Valve

There is a small chance of the turbine over speeding, this can lead to catastrophic damage, therefore the trip valve is vital. Upon the main turbine drive shaft is a ball bearing pulled toward the centre of the shaft by a spring. This spring can then be tightened or loosened to adjust the speed at which the turbine will trip. As the centrifugal force of the spinning shaft increases, it will overcome the tension of the spring and the ball bearing will protrude outwards from the shaft and strike a trip arm. Once the trip arm is struck, the trip lever falls away. The trip lever has a knife edge located on it, where the trip linkage of the trip valve sits in the open position. Once the lever falls away the trip linkage is removed from the knife edge and a spring then pulls the trip valve shut, preventing steam entering the system and terminating energy to the system.

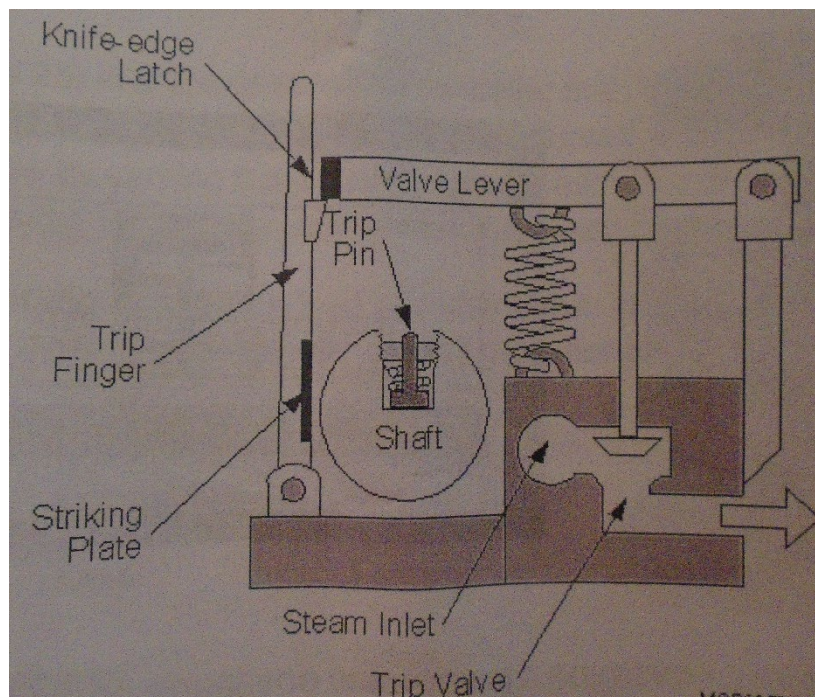


Figure 3 - Diagram of Steam Turbine Trip Mechanism

Perhaps include evidence on you operating the turbine. You have described the operation of the turbine. You need to demonstrate your operational activities with the turbine.

Maintenance

There are many different levels of maintenance activities for a steam driven turbine, ranging from level one, to preventative, to reactive. Level one maintenance being the simplest, but paramount to achieve a high level of performance from the machine. This method may include lubricating associated valves, topping up oils, draining sediment pots of water and debris and flushing the lubrication system if required. This may indicate further maintenance is required, for example, there may be a high level of water being produced in the sediment pots, this may indicate that the carbon seals have failed due to becoming brittle from heat and will require replacement, to prevent condensate from the steam entering into the oil chamber.

Preventative maintenance is carried out upon a turbine every 12 months. This will include an oil flush, a check of white metal bearing clearances to the shaft and a running check to ensure the running and trip speeds are correct.



Figure 4 - White Metal Bearing Clearances Being Checked as Part of A Turbine PM

This PM may also indicate any deeper problems with the machine that may require it to undergo reactive maintenance. For example, the bearings or moving parts are found to be in poor condition, such as the rotors buckets becoming eroded. This would lead to the machine requiring an overhaul to replace damaged components.



Figure 5 - White Metal Bearing In Poor Condition With Grooves Cut Into The Metal

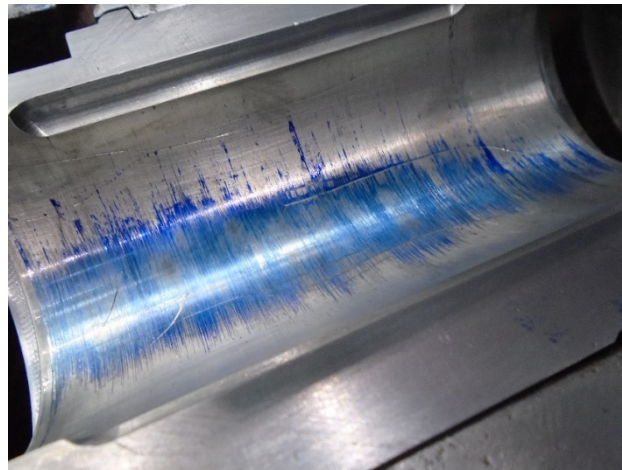


Figure 6 - Replaced White Metal Bearings Being Blued to Fit The Shaft

Finally, there is reactive maintenance, which is implemented when a failure has occurred, and the maintenance team will react to rectify the failure. An example of this occurring may be during a running check, the trip valve may have worn away from the high-pressure steam and may be passing, this failure of the trip system may pose an immediate threat to safety and equipment. This would then require the valve to be removed from service and another one fitted in its place to allow the trip system to fully cut off energy supply to the machine in a trip situation. Reactive maintenance usually follows lower levels of maintenance, as the problems are often identified during preventative maintenance tasks. For instance, bearing failures could be identified when carrying out vibration and temperature checks on turbines and operational failures could be identified during PM's which include controlled running of the equipment to identify faults.

Conclusion

Task 2

Current Job Description

Plant operators are employees widely employed through industrial processes, ranging from water treatment to gas and oil plants. As a plant operator, the employee is expected to maintain, supervise and run an area of the industrial plant or process, alongside the aid of a control operator and a lead operator. The plant operator will have a range of tasks required to be undertaken, including and not limited to:

- Gas testing for maintenance
- Sampling processes
- Checking and maintaining equipment
- Work alongside maintenance department to isolate and commission equipment
- Make required moves on valves and other pieces of equipment to bring them on or offline

Person Specification

To be able to undertake this job, the specification of the candidate should include:

- Be physically fit, able and willing to traverse ladders and work at height
- Have a basic knowledge of plant equipment, i.e. Pumps, compressors and turbines
- Attentive and detail orientated to be able to spot and rectify abnormalities within the plant
- Safety consciousness, as all tasks carried out may pose a hazard to themselves and others, so must be carried out correctly and safely to prevent this
- Dexterous to be able to work with and use an array of different tools for different purposes
- Actively be able to problem solve on the spot, any upsets in the process will require immediate response to rectify and being able to identify what is required to rectify the fault under pressure is a priceless asset.

Curriculum Vitae

Below is the personal C.V. used to gain a place on the apprenticeship programme at Pembroke refinery:

D.O.B. 22/10/1996 **Place of Birth** - Haverfordwest, Pembrokeshire, Wales

Current Address- Knapp Farm, Redberth, Tenby, Pembrokeshire SA70 8RN

Home Number - 01646 651498 **Mobile Number** - 07570 805 401

E-mail - sammylew415@gmail.com

Personal Statement

I am a determined and hardworking individual who always strives to achieve and complete tasks and objectives safely, to a high standard and on time. I created a report on fuel and power sources in the UK due to my personal interest in engineering and the production of petrochemicals during secondary education. I studied the refining process in detail and learned the basic operation of the process.

Since securing a place on Pembroke Refineries apprenticeship programme, as an operations apprentice, I have gained first-hand experience of working on an active refinery, where I worked alongside the Rotating maintenance and Operations departments. I have completed my NVQ Level 3 in the mechanical rotating equipment department and since then have gone on to learn and pass out successfully as a crude unit outside operator.

Skills

- Safety-conscious
- Familiar with machinery and equipment
- Works well independently or in a group
- Basic computer skills, including knowledge to use Microsoft programmes such as Word and Excel
- Eager to learn new skills and information
- Good with people and can converse successfully with colleagues and customers in a professional friendly manner
- Familiar with the safe and appropriate use and control of hand and power tools

Employment History

September 2017 to Current

RSD & Valero Pembroke Refinery

Three Year Apprenticeship Programme (Operations)

Completed a project specific to the workplace, a pneumatic automated safety barrier was fabricated and programmed from scratch to meet safety standards in industry.

Completed a second project, fabricating a complete battery powered wheelchair which met other certain parameters. This project was to represent the company and college in the World Skills UK competition, which we as a team qualified for the national finals in Birmingham's NEC in November 2018.

12-month placement in mechanical rotating equipment department, working on and maintaining refinery rotating equipment.

Gained valuable mechanical knowledge on the operation of plant equipment and processes.

Currently working to complete an HNC in Process Operations at Pembrokeshire College.

Passed out as a crude plant operator, wherein the short time I have been qualified have already taken part in a unit start-up.

Volunteering & Work Experience

I have previously contributed to the community through volunteer work which has been beneficial to me as it has allowed me to give time to help and assist the people in my area, while also teaching me valuable new skills. My first experience in volunteer work was helping my family and Killgetty FC organise a charity football tournament that has taken place from the year 2002 to the present, which donates funds to local charities as well as the nationwide charity CRY, which aims to diagnose and treat rare cardiac problems that usually occur in young males. My roles in aiding this event consist of helping to mark out the pitches as well as make the goalposts to be used. I have also taken part in events organised through Valero's volunteering programme, such as beach cleans arranged at Freshwater West and throughout the county. This was particularly rewarding, as living in a rural area such as Pembrokeshire, it is important that we strive to maintain a healthy environment for future generations to enjoy.

Education

2019, Pembrokeshire College, Haverfordwest, Pembrokeshire, Wales

- *Operations & Maintenance Engineering (QCF) (Achieved Distinction* Distinction*)*
- *Engineering Manufacture (Engineering Maintenance) Level 3 Apprenticeship*

College
Certificate?

2018, Pembrokeshire College, Haverfordwest, Pembrokeshire, Wales

- *WJEC Level 2 Essential Communication Skills*
- *WJEC Level 2 Essential Application of Number*
- *WJEC Level 2 Essential Digital Literacy*
- *Pearson BTEC Level 3 Subsidiary Diploma In Engineering (QCF) (Achieved Distinction Grade)*



Interests

I have participated for numerous sporting societies from a young age, including football, rugby and athletics:

- Carew FC 2006 - Present
- Pembroke RFC - 2007 - 2013

Through sport participation I have achieved many individual and team honours at different levels and kept myself in good physical shape. It has also taught me the importance of teamwork, and the necessity of hard work which is vital in achieving goals individually and as a group. It has also given me confidence allowing me to work well with and be comfortable around other people.

I have lived on an active working family farm my whole life and have assisted in maintaining and running the farm since a young age. The skills I have attained from these activities range from more menial everyday tasks, to more technical ones, such as, caring for and maintaining farm equipment.

Reference

Julian Dessent

Former English Teacher & Head of Sixth Form @ Ysgol Greenhill School

Company Address: Heywood Ln, Tenby SA70 8BN

Company Telephone Number: [01834 840100](tel:01834840100) (Main Reception Desk Ysgol Greenhill School)

E-Mail: sjdess@ysgolgreenhillschool.co.uk

Development Action Plan

Below is my personal development action plan, which was discussed with my Shift Team Leader, to pinpoint the next steps in my career to be able to develop and improve. The list is in chronological order and has been signed and dated by myself and my STL.

- Continue gaining first-hand experience and required skills of operations and all the involved tasks. Allowing me to better understand the process and how to carry out certain tasks safely and correctly.
- Start & complete IOSH, Managing Safely course. This will be provided via the training and development department in work to, hone and perfect personal knowledge of following and enforcing health and safety rules and guidelines.
- Secure full time Valero employment, via the next available recruitment process.
- Begin training second area and look to be ready for assessment after 3 months of training.
- Complete Operations HNC.

STL Signature

.....

DATE 10/14/12

Developee

Sam Lewis

DATE 10/14/12

Figure 7 - Scan of Signed Action Plan

Technical Competence

Below is a scanned image of my competency pack. This indicates I have passed the required tests to carry out my responsibilities of a crude plant outside operator, which has also been signed by my STL, mentor, Ops superintendent and head of refining. This form shows I am technically competent to carry out the job of an operator and also have the skills to carry out certain tasks required and the knowledge of the plant and how it operates.

Plant Operator Crude Unit

PEMBROKE PLANT

Specification of Competence Document
Refining Business Unit

**Crude Unit
PLANT OPERATOR**

Originator: Operations T&D	Revision : Nov 18	
Approved: K Stone	Approval Date: 16/11/18	

	Printed Name	Signature
Trainee :	Sam Lewis	
Assigned Shift		
Mentor (nominated by STL)	Phil Jones	
Date Started:		
Date Completed:	14 MAY 2020	

The mentor & assessor must be nominated and deemed competent by the STL in the specific business area.

The assessor signature denotes the trainee has demonstrated competence in each aspect required, and has been checked to a satisfactory standard required by the performance/knowledge criteria.

Assessed by:	PHIL JONES	
Assessed by:	JEREMY MORRIS	
Written Test Score	82 %	
Walkabout Test Score	74 %	
Competence Acceptance Approval		
Lead operator	Phil Jones	
Operations superintendent / Delegate	Phil Lewthwaite	OS signature
Period of "loose cover" required	N/A sets	
Period of consolidation required	6 months (1st role) 3 months (2nd / subsequent role)	STL signature
Approved by (S.T.L.): PCR request complete / N/A	KEVIN MILICH	
Approved by (C.M. Refining):	ANDY SMITH	

Technical trainer:
Date: 27-5-20

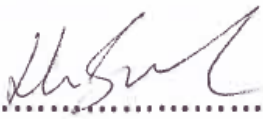
Figure 8 - Scan of Completed CDU Operator Competency Pack

Recognition of Results

Below, is a signed statement from my STL that states I was part of an operations team to start up numerous process units. The team and my STL recognise the contributions I made to assist in achieving the results of getting the units up and running again.

I hereby acknowledge that Sam has taken part in assisting in the start-up of multiple process units (FCCU & CDU). Both times he was involved in a team of operations who successfully started the units and returned them to normal operating.

STL Signature:

.....

Date:

.....10/12/20.....

Wood

Figure 9 - Scan of STL Results Acknowledgement

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Conclusion-

Table of Figures

<u>Figure No.</u>	<u>Source</u>
1	International Association of Engineering Insurers, John Latcovich (Chairman) (2005) Maintenance & Overhaul of Steam Turbines. Available From: https://www.imia.com/wp-content/uploads/imiamembers/activities/past_conferences/maintenance_of_steam_turbines.pdf [Accessed 12/12/2020]
2	Valero Basic Operator Training Manuals (2015) – Volume 3.A – Fundamentals of Drivers
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4	NVQ Lvl 3, Sam Lewis (2018) Write Up No.7, Turbine PM
5	NVQ Lvl 3, Sam Lewis (2018) Write Up No.9, Turbine Removal
6	NVQ Lvl 3, Sam Lewis (2018) Write Up No.10, Turbine Overhaul
7	Action Plan (2020)
8	Sam Lewis CDU Competency Pack (2020) Valero, Pembroke Refinery, Training Dept.
9	Recognition of Results (2020)

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