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PRESSURE VESSEL DESGIN AND SELECTION

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

ABSTRACT

The objective of this project is to highlight the importance of design and selection for pressure vessel. Pressure vessels are used in a wide number of industries, such as the power generation industry, chemical industry and petrochemical industry. Pressure vessel is a container which carry, store or receive fluids with a pressure difference between outside and inside. Pressure vessels often have a combination of high pressure and high temperature or in some cases flammable fluids and highly radioactive materials. Because of such hazards, it is crucial that the design be such that no leakage can occur. A good design of pressure vessels needs to be done before manufacturing or purchasing so that the selected pressure vessels can deliver the task for any project. The scope of study is including literature review of the mechanical design of pressure vessel based on the ASME Boiler and Pressure Vessel Code, Section VIII Division 1. This project concluded that the objective of this project highlight the experience and methods which implementing during construction and designing of pressure vessel, the project which includes all the design parameters, selection, material selection and implementation.

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1. INTRODUCTION

Pressure vessels are used in a wide number of industries, which are first the power generation industry for fossil and nuclear power. Secondly, they are used in the petrochemical industry for storing and processing crude petroleum oil in tank farms as well as storing gasoline in service stations. Besides that, they are used in the chemical industry, specifically in the chemical reactors. In other word, pressurized equipment is essential for industrial plant for storage and manufacturing purposes (Wiencke, 2010).

Pressure vessels came out in various shapes and sizes. The designation and geometry of pressure vessels vary according to standards in the industries. Therefore, this project uses the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII Division 1 as the standard.

Figure 1. Typical pressure vessel

2. Objectives

The objective of this project is to develop and understand the complete producer during design selection and manufacturing of pressure vessel, Using the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Division 1 for the design standard of pressure vessels.

Unfired Pressure Vessels

Literature review

3. Types of Pressure Vessel

3.1 According to their functions

A) Storage vessels
B) Reactors
C) Boilers
D) Mixers, and
E) Heat exchangers.

3.2 According to structural materials

Steel
Cast iron
Copper, and
Plastic pressure vessels.

3.3 According to methods of fabrication

a) Welded
b) Cast
c) Brazed, and
d) Flanged pressure vessels.

3.4 According to size and geometric form

The size and geometric form of pressure vessels diverge greatly from the large cylindrical vessels used for high-pressure gas storage to the small size used as hydraulic units for aircraft.
Some of the vessels are buried in the ground or deep in the ocean, but most are positioned on ground or supported in platforms. There are four types of pressure vessels. But mainly two types of pressure vessels usually available in industry:

I. Cylindrical
II. Spherical
III. Conical, and
IV. Combined

But mainly two types of pressure vessels usually available in industry:

3.5 .Cylindrical Pressure Vessel

This type of a vessel designed with a fixed radius and thickness subjected to an internal gage pressure.
This vessel has an axial symmetry.
The cylindrical vessels are generally preferred, since they present simpler manufacturing problems and make better use of the available space. Boiler drums, heat exchangers, chemical reactors, and so on, are generally cylindrical

3.6 Spherical Pressure Vessel

This type of pressure vessels are known as thin walled vessels. This forms the most typical application of plane stress.

Plane of stress is a class of common engineering problems involving stress in a thin plate. Spherical vessels have the advantage of requiring thinner walls for a given pressure and diameter than the equivalent cylinder.
Therefore they are used for large gas or liquid containers, gas-cooled nuclear reactors, containment buildings for nuclear plant, and so on.

3.7 According to scheme of loading
Vessel working under internal pressure and,
Vessel working under external pressure.
3.8 According to wall temperature
Heated and,
Unheated pressure vessels.
3.9 According to corrosion action
High corrosion effect and,
Moderate corrosion effect pressure vessels.
3.10 According to the orientation in space
Vertical,
Horizontal and,
Sloped pressure vessels.
3.11 According to the methods of assembly
Detachable and,
No detachable pressure vessels.
3.12 According to the wall thickness:
Thin walled($d_\circ/di<1.5$) and
Thick walled ($d_\circ/di\geq1.5$) pressure vessels.
Where; $d_\circ$ and di are the outer and inner diameter of the shell respectively. [1]
3.13 According to the dimension
The pressure vessels according to their dimensions may be classified as thin shell or thick shell the ratio of equal thickness (t) of the shell to its diameters (D) deciding factor.

Thin shell: - if the ratio of $\frac{t}{D}$ is less than $\frac{1}{10}$ is called a thin shells

,**Thick shell**:- if the ratio of $\frac{t}{D}$ is equal or greater than $\frac{1}{10}$ is called thick shell used in high pressure cylinders, gun, barrels and other equipments where as thin shell are used in boiler, tanks and pipes.
3.14 According to the end construction
This can be classified in to two groups:-
Open end construction pressure vessels
Closed end construction pressure vessels
3.15 According to the materials
The pressure vessels are according the material classified as:-

Brittle material pressures vessels
Ductile material pressure vessels

3.16 According to the direction of force acting on the wall of vessels

a) Subjected to internal pressure (pi)

b) Subjected to external pressure (p)

3.16 component of pressure vessel

There are four components of pressure vessels this are:-
head
shell
nozzle and
support

SHELL

The shell is the primary component that contains the pressure. Pressure vessel shells are welded together to form a structure that has a common rotational axis. Most pressure vessel shells are cylindrical, spherical, or conical in shape. Horizontal drums have cylindrical shells and are fabricated in a wide range of diameters and lengths.

NOZZLE

A nozzle is a cylindrical component that penetrates the shell or heads of a pressure vessel. The nozzle ends are usually flanged to allow for the necessary connections and to permit easy disassembly for maintenance or access. Nozzles are used for the following applications:-
Attach piping for flow into or out of the vessel.
Attach instrument connections, (e.g., level gauges, thermo wells, or pressure gauges).
Provide access to the vessel interior at many ways.
Provide for direct attachment of other equipment items, (e.g., a heat exchanger or mixer)

SUPPORT

The type of support that is used depends primarily on the size and orientation of the pressure vessel. In all cases, the pressure vessel support must be adequate for the applied weight, wind, and earthquake loads. Calculated base loads are used to design of anchorage and foundation for the pressure vessels.

4.Standards and Codes for Pressure Vessels

Pressure vessels usually have a combination of high pressures together with high temperatures, and sometimes it involves flammable fluids or highly radioactive materials. It is crucial that the design of the pressure vessels results in no leakage can occur because of the hazards. Moreover, the pressure vessels have to be designed carefully to cope with the operating temperature and pressure (Chattopadhyay, 2004).
As the pressure vessels are made in various shapes and sizes, there are certain standards and codes that the engineer or designer need to follow in the design of the vessels. (Chattopadhyay, 2004) mentioned pressure equipment, such as the American Petroleum Institute (API) storage tanks are designed to forbid internal pressure to no more than that generated by the static head of the fluid contained in the tank. Below are the design and construction codes for pressures vessels:

Figure 2 Design and Construction Codes for Pressure Vessels

Country	Code	Issuing authority
U.S	ASME Boiler & Pressure Vessel Code	ASME
U.K	BS 1515 Fusion Welded Pressure Vessels BS 5500 Unfired Fusin Welded Pressure Vessels	British Standard Institute
Germany	AD Merblatter	Arbeitsgemeinschaft Druckbehalter
Italy	ANCC	Associanize Nationale Per IIControllo Peula Combustione
Netherlands	Regeis Voor Toestellen	Dienst voor het Stoomvezen
Sweden	Tryckkarls kommissionen	Swedish Pressure Vessel Commision
Australia	AS 1200:SAA Boiler Code AS 1210 Unfired Pressure Vessels	Standards Association of Australia

Belgium	IBN Construction Code for Pressure Vessels	Belgian Standards Institute
Japan	MITI Code	Ministry of International Trade and Industry
Country	Code	Issuing authority
France	SNCT Construction Code for Unfired Pressure Vessels	Syndicat National de la Chaudronnerie et de la Tuyauterie Industrille

5. ASME Boiler and Pressure Vessel Code

The organization of the ASME Boiler and Pressure Vessel Code is as follows:

Section I: Power Boilers
Section II: Material Specification:
Ferrous Material Specifications – Part A
Non-ferrous Material Specifications – Part B
Specifications for Welding Rods, Electrodes, and Filter Metals – Part C
Properties – Part D
Section III Subsection NCA: General Requirements for Division 1 and Division2
Section III, Division 1:
a.Subsection NA: General Requirementsb.Subsection NB: Class 1 Components c.Subsection NC: Class 2 Components d.Subsection ND: Class 3 Components e.Subsection NE: Class MC Components
f. Subsection NF: Component Supports g.Subsection NG: Core Support Structures
h.Appendices: Code Case N-47 Class 1: Components in ElevatedTemperature Service
Section III, Division 2: Codes for Concrete Reactor Vessel andContainment
Section IV: Rules for Construction of Heating Boilers
Section V: Nondestructive Examinations
Section VI: Recommended Rules for the Care and Operation of Heating Boilers
Section VII: Recommended Guidelines for Care of Power Boilers
Section VIII
Division 1: Pressure Vessels – Rules for Construction
Division 2: Pressure Vessels – Alternative Rules

Section IX: Welding and Brazing Qualifications
Section X: Fiberglass-Reinforced Plastic Pressure Vessels
Section XI: Rules for In-Service Inspection of Nuclear Power

Figure 3 ASME Section VIII Division 1 – "Unfired" Pressure Vessel Rules

Pressure limits	Usually up to 3000 psig
Organization	General, Construction Type & Material U, UG, UW, UF, UB, UCS, UNF, UCI, UCL, UCD, UHT, ULT
Design Factor	Design Factor of 3.5
Design Rules	Membrane - Maximum StressGenerally Elastic analysis Very Detailed design rules with Quality (joint efficiency)Factors. Little stress analysis required; pure membrane without consideration of discontinuities controlling stress concentration to a safety factor of 3.5 or higher
Material and Impact testing	Few restrictions on materials

("A Brief Discussion on ASME Section VIII Division 1 and 2 and The New Division 3,"2000)

6. Design Procedure for Pressure Vessels

Pressure vessels are designed to meet requirements specified by a team, which includes process engineers, thermodynamic experts and mechanical engineers. The functional requirements cover the geometrical parameters, which are size and shape of the vessel; method of vessel support; and location and size of attachments and nozzles.The operational requirements are imposed on the vessel as part of the overall plants which include the operating pressure, fluid conditions, external loads and transient conditions. Then, the materials are selected with acceptable temperature rangesand design stresses.
Recommendation

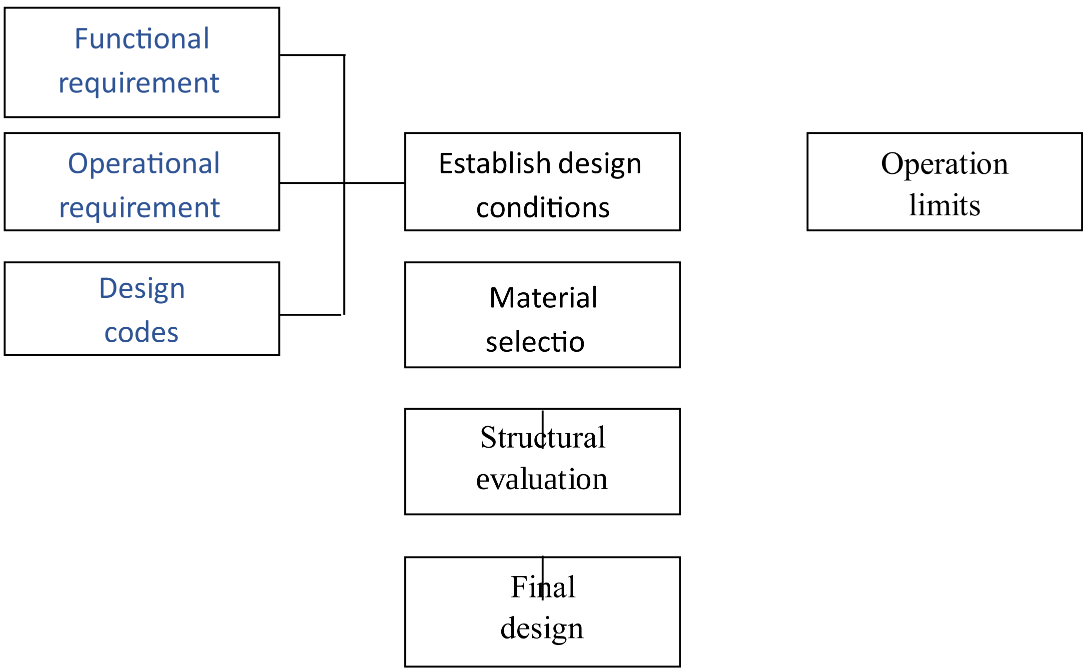

Figure 4 Design Procedure for Pressure Vessels

7. Application of pressure vessels

A pressure tank connected to a water well and domestic hot water system Pressure vessels are used in a variety of applications. These include the industry and the private sector. They appear in these sectors respectively as industrial compressed air receivers and domestic hot water storage tanks, other examples of pressure vessels are: diving cylinder, recompression chamber, distillation towers, autoclaves and many other vessels in mining or oil refineries and petrochemical plants, nuclear reactor vessel, habitat of a space ship, habitat of a submarine, pneumatic reservoir, hydraulic reservoir under pressure, rail vehicle airbrake reservoir, road vehicle airbrake reservoir and storage vessels for liquefied gases such as ammonia, chlorine, propane, butane and LPG.

In different applications, the pressure in a pressure vessel is achieved either from a direct source or an indirect one by the application of heat. Pressure vessels have an array of applications, ranging from compressed gas storage tanks, such as oxygen and nitrogen, to autoclaves used in laboratories to hydro-pneumatic tanks and refrigerant vessels. Whether it is oil refineries, petrochemical plants, mining, submarines, or nuclear reactors, all use pressure vessels at one place or another. Airplanes are a unique example of pressure vessels; the entire structure of a plane is a pressure vessel, which does two functions -- enduring the cabin pressure and maneuvering load of the aircraft

8 METHODOLOGY

8.1 Overview

In this chapter, the information in selection of pressure vessel is described and the application of selected pressure vessel is been discussed. To design of pressure vessel the selection of Code are important as a reference guide to achieve the secure pressure vessel. The selections of ASME Code Section VIII div 1 are described. The standard of material selection used are explains in this chapter. Beside of that, the design and analysis software to obtain the result are introduced. Instead of that, design process methodology is also described.

8.2 General Design Considerations Pressure Vessels

8.2.1 Materials

General material requirement based on ASME code standard and also the availblity of material selection and equivalent material grade There are some points that must be considered which is related to the general material requirements that will be discussed below.

The main factors of material selection that must be considered are

A Strength

Strength is a material's ability to endure an imposed force or stress applied. Strength is an important factor in the material selection for any particular application.

Strength determines the thick of a component that must be to withstand the forced loads.

B Corrosion Resistance

Corrosion defines as the weakening of material by chemical reaction. Material's resistance to corrosion is the most important factor that influences its selection for a specific application. Specify a corrosion allowance is the common method that used to define corrosion in pressure vessels components.

C Fracture Toughness

Fracture toughness defines as the capability of a material to withstand conditions that could cause a brittle fracture. The fracture toughness of a material can be determined by using Charpy V-notch test to define the magnitude of the impact energy and force that is required to fracture a specimen.

D Fabric ability

Fabric ability defines as the ease of construction and to any special fabrication practices that are required to use the material.

Commonly, pressure vessels use welded construction. The materials used must be weldable so that components can be assembled onto the completed pressure vessel.

The pressure vessel design codes and standards include lists of acceptable materials; in accordance with the appropriate material standards.

8.2.2 Design and Operating Temperature

In ASME Code Section VIII Div 1, maximum and minimum design temperatures can be established in Paragraph UG-20. The maximum design temperature can be define as the maximum temperature used in vessel design and it shall not be lesser than the mean metal temperature estimated under normal operating conditions for the part that want to be considered. The operating temperature is the gas or fluid temperature that occurs under the normal operating conditions. Before designing a vessel, the operating temperature must be set based on the maximum and minimum metal temperatures that the pressure vessel may encounter any situation. According to current column the design temperature is 450C

8.2.3 Design and Operating Pressure

Design pressure of the vessel can be established in Paragraph UG-21. In this paragraph, the requirement of the vessel to be designed for any severe pressure and temperature that is coincidentally expected in normal operation has been provided. When establish the maximum operating pressure, all conditions such as start-up, shutdown, and any identified upset conditions can be considered. Set pressure of the pressure relief device in an operating system must be above the operating pressure by a sufficient amount so that the device does not actuate accidentally. A vessel must be designed to withstand the maximum pressure to which it is likely to be subjected in operation condition. Before designing a vessel, the operating pressure must be set based on the maximum internal or external pressure that the pressure vessel may encounter.

The design pressure is normally taken as the pressure at which the relief device is set for vessel that under internal pressure. To avoid spurious operation during minor process upsets, normally the operation pressure is 5 to 10 per cent above the normal working pressure. The hydrostatic pressure in the base of the column should be added to the operating pressure if deciding the

9. Pressure vessel design procedure (fuel oil vacuum distillation unit)

Scope of this project from manufacturing, material selection and implementation and site installation

Basic design parameters for distillation pressure vessel

DESIGN OF VERTICAL PRESSURE VESSEL SPECIFICATION		
Parameters	**Value**	**Unit**
Design code	**ASME second DV. ED 2017**	
Design pressure	**3.5**	Bar.g
Design temperature	DT=220ºC-360ºC-420ºC OT=136ºC-254ºC -390ºC	ºC
Operation pressure	0.040 (30) TOP 0.107 (80) BOTTOM	Bar (g)/(mm/Hg)
Total inside volume	234.17	m3
Bottom discharge Nominal diameter	1200	Mm
Insulation type/THICKNESS	80mm-130mm-150mm	
Pre heat test	yes	

Pwht test, post weld heat	yes
Heat treatment head	yes
Material grade for shell	SA-516M Gr.70N+CLAD.SS-317L
Working fluid	Light fuel oil and heavy fuel oil
Vessel orientation	Vertical
Support element	Yes/ Carbon steel structure

Figure 5: Vessel design parameters details

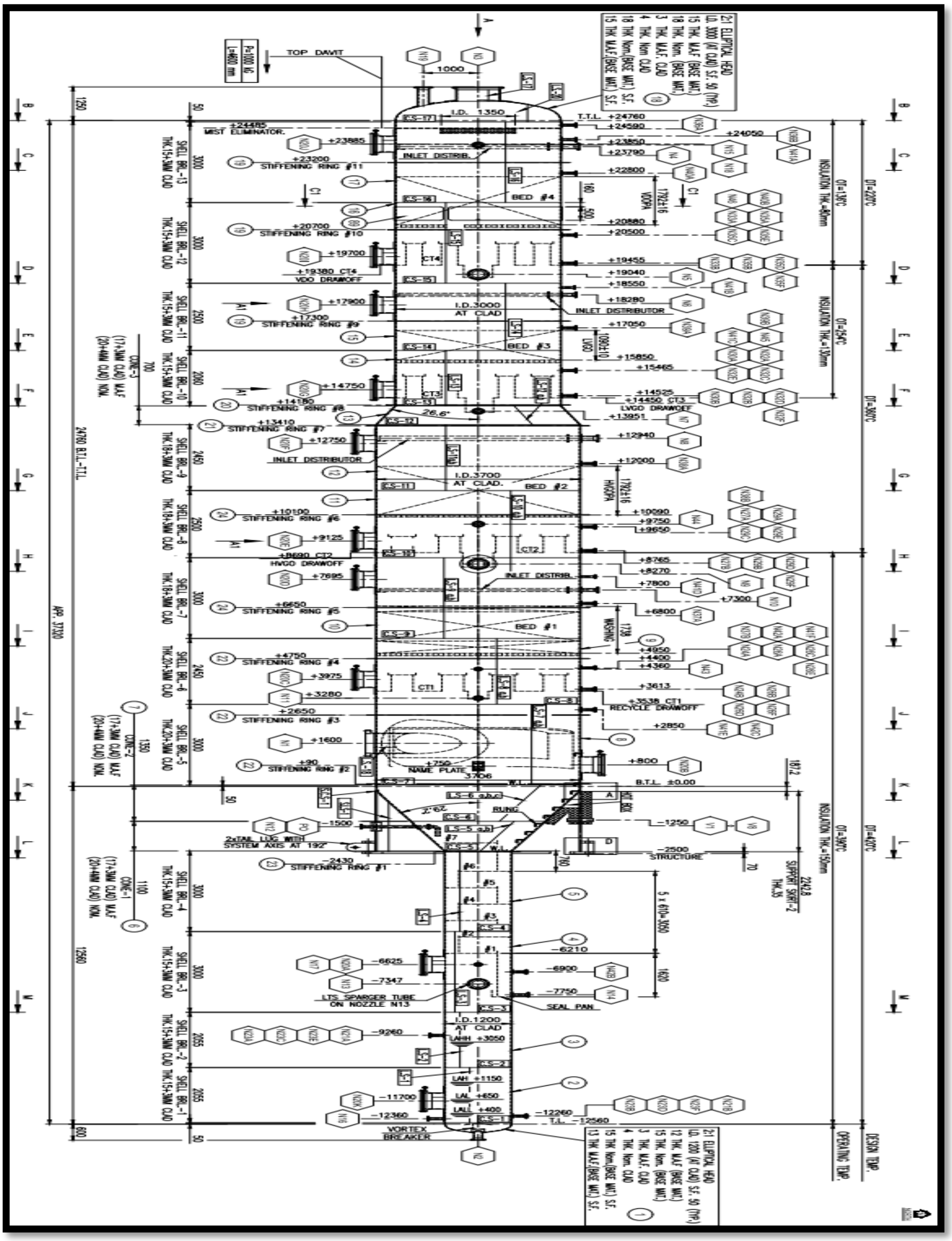

Figure6: vertical pressure vessel Distillation unit

9.1 Material

Unless otherwise specified on the individual Material Requisition and/or Vessel engineering drawing(s), materials of construction shall be, as minimum, in accordance with the requirements of applicable Codes, ASME or ASTM equivalent specifications listed below, any other applicable specification and the present document. Dual certificate materials ASTM/ASME are not mandatory. For this project material of killed carbon steel used with verity grade

General Requirements for Material of Construction

Materials shall be selected with due regard to minimum/maximum design temperature. Only new materials free of defect other than those permitted by relevant Specifications shall be used.

Reinforcing pads welded to the pressure parts shall be made of the same plate material specification used for the vessel parts to which the pads are attached,

All external / internal attachments welded to the pressure parts shall be made of material equivalent to the one of the vessel parts to which they are attached,

Fittings for pressure parts shall be seamless.

Carbon, killed carbon, low temperature carbon and low alloy steels used in welded construction shall have a carbon content less than 0.23%.

Carbon Steel materials (C.S.) and Killed Carbon Steel material (K.C.S.)

Carbon steel and killed carbon steel with minimum tensile strength of 485 MPa (70 ksi)or greater shall have a Carbon Equivalent (C.E.) less than 0.45%. The C.E. shall be evaluated on the basis of the following formula:

C.E.= C% + Mn%/6 + (Cr%+Mo%+V%)/5 + (Ni%+Cu%)/15

Carbon steel and killed carbon steel used to construct vessel to be submitted to PWHTfor process or Code requirements, shall have Vanadium and Niobium content limited asfollow:

V% + Nb% < 0.10%

Where Carbon Steel (CS) and/or killed carbon steel (KCS) is specified, the followingmaterials shall be used:

Structural steel shapes for vessel support (for temperatures not higher than 343°C)	SA-36

Where Low Temperature Carbon Steel (LTCS) is specified, the following materials shallbe used:

COMPONENT	ASME STANDARD
Pressure containing plates: shells, heads, reinforcing pads, nozzle and manways necks	SA-516 gr. 60 (note 1) and impacttested at Minimum Design Metal Temperature (MDMT)
Forgings	SA-350 LF2 class 1SA-765 Grade II
Pipe used in nozzle necks or extensions permanently attached to the vessel	SA-333 Grade 6
Internal and external plates welded to pressure parts	SA-516 gr. 60 (note 1) and impacttested at Minimum Design Metal Temperature (MDMT)
Internal and external plates not directly welded to the pressure parts (note 2)	SA-285 Gr CSA-283 Gr CSA-36 SA-516 any grade

Where Low Alloy steel is specified, the following materials shall be used:

COMPONENT	ASME STANDARD
Pressure containing plates: shells, heads, reinforcing pads, nozzle and manways necks	SA-204 grade as specifiedSA-387 grade as specified
Forgings	SA-182 grade as specifiedSA-336 grade as specified
Pipe used in nozzle necks or extensions permanently attached to the vessel	SA-335 grade as specified
Internal and external plates welded to pressure parts	SA-204 grade as specified SA-387 grade as specified

9.2 CORROSION ALLOWANCE

Minimum corrosion allowance, Definition of corrosion allowances

For all parts of vessel where sizes or thicknesses are indicated on Vessel engineering drawing(s), the corrosion allowance is included in the thickness specified. If other sizesor thicknesses need to be determined, the corrosion allowance shall be included as follows:

On the inside of shells, heads, nozzles, manholes and covers: the full corrosion allowance.
On internal parts welded to the inside of the vessel: the full corrosion allowance added to each face in contact with the vessel content.

On bolted removable parts: one half corrosion allowance added to each face in contact with the vessel contents, except as specified in paragraph V.B.1.e below.

On fillet and seal welds on internal attachments: the full corrosion allowance addedto the thickness necessary for strength or tightness measurement across the throat(but not to exceed 10 mm throat thickness).Internal gratings, where used, are to be specified as follows: For 3 mm corrosion, a standard size carbon steel grating of twice the loadcapacity as the one required for actual load and spacing is to be provided. For 6 mm corrosion, a standard size grating of four (4) times the loading capacity as the one required for actual load is to be provided. For corrosion above 6 mm special consideration should be given. If found more economical, Vendor may use as substitute alloy material for allgratings where corrosion in the vessel exceeds 3 mm provided prior written consent is obtained from Foster Wheeler. Unless otherwise specified on individual Material Requisition / Vessel engineeringdrawing(s), minimum corrosion allowance shall be as follows:

Materials of Construction	Minimum Corrosion Allowance
Unlined Carbon and low alloy steels	3 mm
Internal SS lining vessel (clad/weld overlay)	NONE
High alloy steels and all non-ferrous materials	NONE
Support skirt	1.5 mm (total)
Foundation bolts	3 mm (on root diam.)

9.3 Fabrication

Fabrication shall be per applicable Code and the additional requirements contained inthis document.

Plate layout

Plate layout shall be arranged so that all longitudinal weld seams shall miss all nozzlesand manholes and/or their reinforcing pads. The same requirement shall be applied to circumferential weld seams where possible. Circumferential weld seams shall also be 50 mm clear of all internal support rings and all the external stiffener and/or insulation support rings. Any deviation from above shall be submitted to Foster Wheeler for agreement/comment.
all the welds are accessible for fabrication and in-service NDT such as radiographic examination or UT.If technical feasible shell courses shall be obtained from one plate (with only one longitudinal weld for each course).Shell course shall be as long as practical to minimise the number of circumferential seams. No shell course should be less than 1000 mm long. All welds for pressure or non-pressure attachments shall be at least 50 mm clear of the shell seam or shell coursewelds.

9.4 Vessel inspection steps

All standard process implemented during manufacturing of the vessel the test and inspection carried out with different team to achieve maximum result during construction and welding process NON-DESTRUCTIVE EXAMINATION NDT

POST WELD HEAT TREATMENT

Post Weld Heat Treatment (PWHT) carried as required by Foster Wheeler Eng. Standard ED0776A-88A1 and. Standard 19057-ME-000-SP-006, by the Code and by the individual Material Requisition. Toughness property of the construction materials. Vessel shall be preferably subjected to PWHT in one piece fully fabricated.. , prior to heat treatment. When vessel is specified to be PWHT for service or process conditions, it is understood that no welding or burning is permitted after PWHT. In case that PWHT is required for other reasons,. Vessel which has been submitted to post weld heat treatment shall have a large warning notice painted on shell.

Radiography (RT)
All radiographic examination procedures and acceptance criteria shall be as minimum in accordance with the Codes and the applicable standards.
Magnetic particle examination (MT)
Magnetic particle examination procedure and acceptance criteria shall be as minimumin accordance with the Codes and the applicable standards.
Liquid penetrant examination (PT)
Liquid penetrant examination and acceptance criteria shall be as minimum in accordance with the Codes and the applicable standards. PT shall be used on non-magnetic materials. For magnetic

materials MT is preferred. This test not been used during assembly and welding
Ultrasonic examination (UT)
Ultrasonic examination and acceptance criteria shall be as minimum in accordance withthe Codes and the applicable standards. Only when RT test not applicable

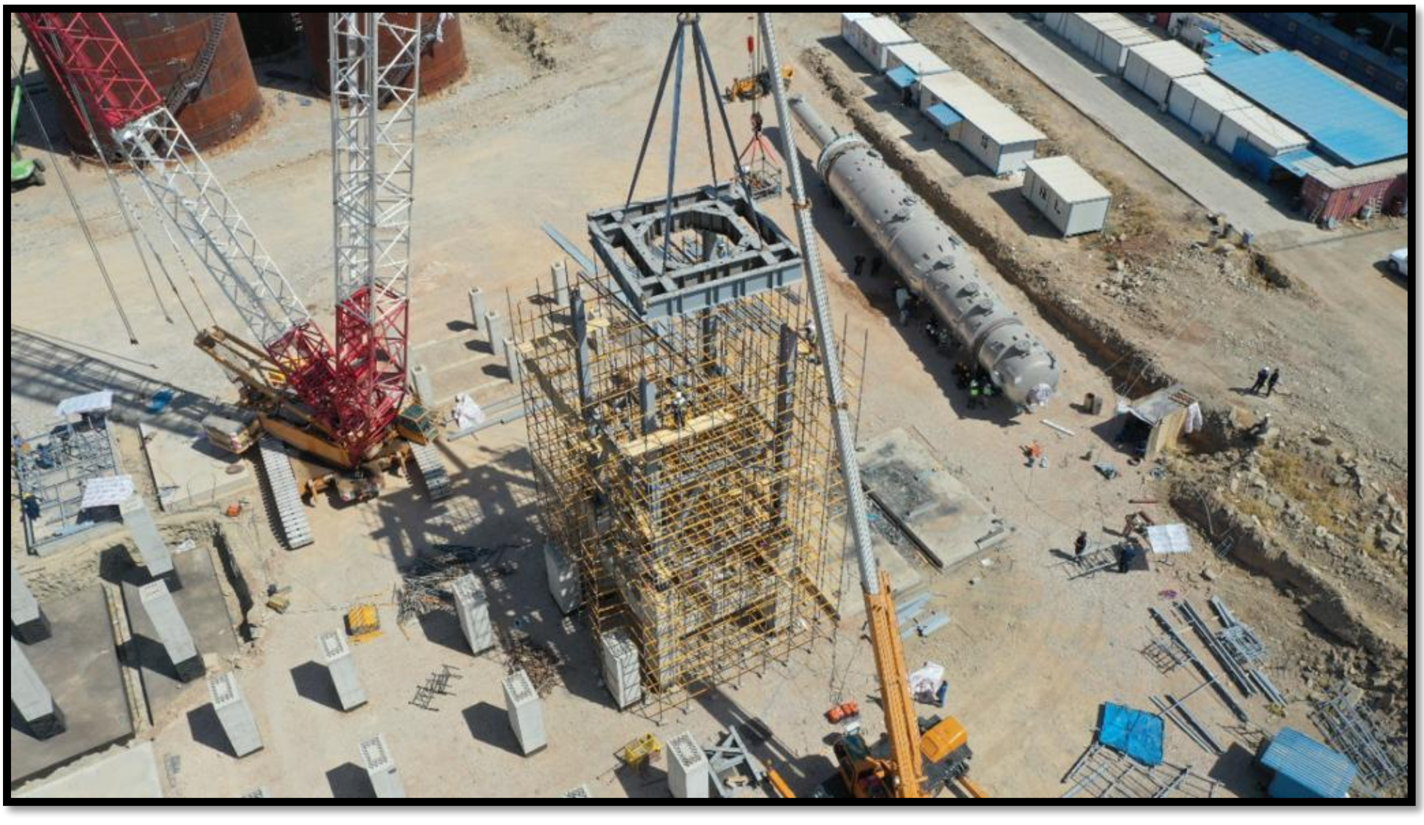

Figure 7,8 and 9: Pressure vessel during erection at site capacity 1400 MT per day

CLIENT	VACCUM DISTILLATION UNIT, SLEMANI		EPC CONTRACTOR
FRONTIER COMPANY	Document Title	INSPECTION TEST PLAN FOR VACUUM TOWER	SPEC

Legend
H - Mandatory Hold Point
W - Witness
M - Monitor
R - Review (Documentation)

Project No : 19057
Client : Frontier Company Arbat, Slemani
Mfg Sr No. : PV-SPECJA-2019-280
Tag No : S100-C-001
Equipment : VACUUM TOWER

1.) Fabricator : SPEC OIL&GAS FZCO
2.) Client TPI
3.) Authorized Inspector

Drawing No:- 19057-100-18-C001
Drawing Rev:- 0
ITP :-PV-ASME-ITP-2019-280
Rev. 0

Construction Code:- ASME Section VIII DIV.1 Edition-2017.

ITEM	ACTIVITY	CHARACTERISTICS TO BE CHECKED	QC MANUAL REF	REFERENCE DOCUMENT	ACCEPTANCE STANDARD	RECORD FORMAT	1		2		3		Remarks
							STATUS	SIGN	STATUS	SIGN	STATUS	SIGN	
1.0	DOCUMENTATION												
1.1	Design Calculations	Review of Design Calculations	Sec. 6	Datasheet, ASME Sec VIII Div.1 Ed. 2017	Datasheet, ASME Sec VIII Div.1, Application Specification and Drawing	Approved Design Calculations	H				R		
1.2	Drawings	Review of Drawings	Sec 6	Specifications, Drawings	Datasheet, ASME Sec VIII Div.1 , Application Specification and Drawing	Approved Drawings	H				R		
1.3	Welding procedudre qualification(WPS) / Procedure Qualification Record (PQR) and Weld	Review and Verification of SPEC's Qualified PQR	Sec 10	18016-ME-000-SP-006, Approved Drawings, ASME Sec VIII Div.1 UCS-67 and	18016-ME-000-SP-006, Approved Drawings and ASME SEC-IX, ASME	WPS and	H				R		R-Review for

Figure 10: Inspection data sheet for pressure vessel

9.5 TESTING

Shop fabricated vertical vessel shall be shop hydrostatically tested in accordance with the provisions of the Code and/or as specified on applicable job specification and Vessel engineering drawing(s). No provision for field hydrostatic testing for shop fabricated vessel need to be made,

this test carried out in duabi work shop during manufacturing . drawing(s). The vessel shall be completely drained immediately after testing and anyremaining pockets of water shall be thoroughly dried.
Field fabricated vessel shall be hydrostatically tested unless otherwise allowed by the Codes and local laws. Field hydrotest shall be carried out for the whole pressure parts in compliance with applicable Codes and specifications. Vessel may be hydrotested in vertical position installed on the foundation when supports, foundations or subsoil permit. Pneumatic test as alternative to hydrostatic test shall be avoided (unlessotherwise indicated in individual Material Requisition / Vessel engineering drawing(s).

10. conclusion

Pressure vessel is one of the most common devices which used in industries. But there are several defects created on this device. Such as corrosion, loss of thickness, mechanical & metallurgical failure, cracking, mechanical deformation etc. and these defects are influenced negatively on the function of this device. However, these defects can be solved by different mechanisms. Such as by proper material selection, by proper manufacturing process: like welding process etc. However as much as possible we would like to design our project (vertical layout pressure vessel) by eradicating these problems to a minimum position. The pressure vessels that not follow any standard codes can be very dangerous. In fact many fatal accidents have occurred in the history of their operation and development. Improper design and construction, irregular testing and inspection cause safety hazards to pressure vessels.
When a substance is stored under pressure, the potential for rupture and leakage is greater. The risk of damage from a pressure vessel increases when vessel contents are toxic, flammable or gaseous substances. When a substance is stored under pressure, the potential for rupture and leakage is greater. Improper design and construction, irregular testing and inspection causes safety hazards to pressure vessels. Finally vessel design and maintenance must be considered carefully as even a small imperfection increases the risk of pressure vessel failure, posing a serious safety hazard. Engineers must determine the pressure level, temperature, material components, size and shape. Engineers also consider the corrosion resistance and abrasion potential of the vessel before deciding these factors. As pressure vessels have a temperature range that can exceed 550°C and the contents of those vessels are constantly under high pressure, operator safety is of large importance.
There are standard regulations and formulas to which the pressure vessel manufacturers' designs follow in order to avoid potential hazards associated with pressure containment. The American Society of Mechanical Engineers (ASME) provides a Boiler and Pressure Vessel Code on which engineers base pressure vessel design. Although the ASME Code remains the most common standard, engineers also follow other codes, such as that of the American Petroleum Institute (API).
Rigorous analyses for complex pressure vessels are created when standard design rules do not apply. In
such instances, engineers conduct intensive mathematical and scientific analyses to ensure design and construction methods meet the stringent requirements of pressure vessels: material, size, shape, temperature and pressure level of the pressure vessel, as well as personal preferences.
The materials used to create pressure vessels must be high strength and durable, and

able to maintain their shape and properties even under pressure.
Testing and inspection of the pressure vessel ensures design technique success, proper vessel operation and certification approval.
A regular inspection remains necessary to ensure that the vessel continues to meet industrial standards and safety requirements.

11. References

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