Industrial / Practical Training Report on

PIPING DESIGN & DETAILED ENGINEERING

At

SMARTBRIDGE EDUCATIONAL SERVICES PVT. LTD., HYDERABAD

Submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA, KAKINADA

In Partial Fulfillment of the Requirements for the

Award of the Degree of

BACHELOR OF TECHNOLOGY

In

MECHANICAL ENGINEERING

By

AREPALLI BHOGESH

(18485A0317)

Under the Guidance of

Sri A.RAJESH

Associate Professor

DEPARTMENT OF MECHANICAL ENGINEERING

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

SESHADRI RAO KNOWLEDGE VILLAGE

GUDLAVALLERU- 521356

2020-2021

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CERTIFICATE

This is to certify that an internship report entitled “**Piping Design & Detail Engineering**” carried out at " SMARTBRIDGE EDUCATIONAL SERVICES PVT.LTD.,HYDERABAD”,is a bonified record of work by **AREPALLI BHOGESH (18485A0317)** under my guidance and supervision and submitted to Jawaharlal Nehru Technological University Kakinada, Kakinada, in partial fulfillment of the Degree of Bachelor of Technology in Mechanical Engineering during the academic year 2020-2021

Sri A.Rajesh
Project Guide

Dr. A. JawaharBabu
Head of the Department

SMARTBRIDGE
Let's Bridge the Gap

Date: 29/05/2020

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr./Ms. Arepalli Bhogesh** pursuing B.Tech in Mechanical Engineering from Gudlavalleru Engineering college, Gudlavalleru has successfully completed his/her Summer Internship from **29/04/2020** to **29/05/2020.**

During this period he/she had learned the concepts of **Piping Design & Detailed Engineering** and successfully completed a project **"River Water Treatment Process Piping Detail Engineering".**

Refer the enclosed **Certificate of Merit** for his/her performance during the tenure of Internship.

We wish him/her all the best for his/her future endeavours.

For **SmartBridge Educational Services Pvt. Ltd.**,

SmartBridge Educational Services Pvt. Ltd. Hyderabad

Jayaprakash.ch,
Program Manager
RSIP-2020

SMARTBRIDGE
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Certificate of Merit

This is to certify that **Mr./Ms. Arepalli Bhogesh** has completed his/her internship program from **29/04/2020** to **29/05/2020** with **Piping Design & Detailed Engineering** as the specialization and secured a SKILL INDEX **9** of 10

Career Readiness Factor (CRF)

Evaluation Metrics: (on a scale of 1 to 4)

1 - Rarely/poorly displays characteristic

2 - Occasionally displays characteristic

3 - Frequently displays characteristic

4 - Always displays characteristic

NA – Not Applicable

Motivation/Enthusiasm	3
Leadership Qualities	3
Flexibility towards work	3
Professionalism/Work Ethics	3
Self-Confidence	3
Ability to work independently	3
Oral/written communication	4
Problem solving skills	4
Over All Score	26

Date: 29/05/2020

Jayaprakash. ch

Program Manager (RSIP-2020)

ACKNOWLEDGEMENT

I convey my heartfelt thanks to **Mr. B. Pardha Saradhi, Mrs. C. Sravanthi, trainer at Smartbridge Educational Services Pvt.Ltd.,Hyderabad** for their inspiring assistance till the end of my internship programme.

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I convey my sincere and indebted thanks to our beloved Professor & Head of the Department **Dr. A. Jawahar Babu** - for his encouragement in the completion of Internship programme.

I also extend my gratitude to our Professor & Principal **Dr. G.V.S.N.R.V.Prasad** and **Dr. B. Karuna Kumar**- Professor & Director, for their support in the completion of Internship programme.

I impart my heartfelt gratitude to the Training & Placement Cell for helping us in all aspects related to our Internship programme.

I thank, my parents and friends and all others who rendered their help directly and indirectly to complete my Internship.

AREPALLI BHOGESH

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CONTENTS

ABSTRACT

Water treatment is the process that improves quality of water to make it more acceptable for a specific end use. It removes contaminants and undesirable components or reduces the concentration so that water becomes fits for the use. This report depicts and determines the study of various aspects of a Water Intake and Treatment Filter Feed Sump and Pumps as well as Instrument Air Receiver piping instrumentation diagram. It is an inductive study and relied upon legends that explain the equipment and general symbols of piping and its abbreviation. Data analysis has been done through plot plan, piping fluid velocities, piping schedules. Auto-cad drafting and pipe pro data helped to analyze various kinds of fitting and bends.

1.TYPES OF PROCESS INDUSTRIES

An industry/plant which processes the raw products into the semi-finished or finished end product by defining the stage by stage process, utilities required for operation, and also control and operation procedure based on the customer requirement is called processing industry.

For the design of any process industry various disciplines like Chemical, Civil& structural, Mechanical, Piping, Electrical, Control & Instrumentation need to be involved for the start of the process to achieve the required output.

Major process industries are

1) Oil & gas (Offshore & Onshore)
2) Power (Thermal/ Hydroelectric/ Solar/Nuclear)
3) Petrochemical
4) Pharmaceutical
5) Fertilizer
6) Chemical

2 . MAJOR PLAYERS IN THE PROJECT

To build and operate the plant we require different parties/ contractors for performing different activities in each phase of the project.

The important players in the industry are OWNER/CLIENT/END-USER: The one who owns the responsibility to maintain, operate and produce energy.

Example: IOCL, NTPC, RELIANCE, HPCL.

- EPC contractor: The company which helps the Owner in giving Engineering, Procurement and Construction services to build the process plant and sets to operation of the plant. Once the plant is run/operated, then the complete operation of the plant will be handed over to Owner.

Example: L&T, TATA PROJECTS, JGC.

Engineering Consultant: The company who does the complete design and detail engineering i.e. defines the technical requirements

Example: Honeywell, Hitachi.

3. PHASES IN ENGINEERING

A) Front End Engineering Design (FEED):

It is to define the technical and project specific requirements for a system to provide a clear scope and design basis for entrance into execution phases. The secondary goal of FEED is to develop a good project cost estimate that can be used further for budget authorization.

The following documents shall be prepared in Basic/ FEED engineering :

- Project/ Job specification
- Plant site-data
- Preliminary Plot Plan
- Preliminary Piping & Instrument diagrams
- Technical specifications

B) Pre-bid Engineering:

It is the phase where visions and plans become reality. This phase of engineering is done for evaluating the total project cost by estimating the material required and also manpower required for executing the project within the timeline defined by the Customer. The quantities and cost of the project will be submitted in the form of bid document and will participate in the bidding process to be preferred consultant to execute the project (L1 bidder). Inputs for carrying out pre-bid engineering activity will be FEED engineering documents.

The following documents shall be prepared in Pre-bid Engineering includes:

- Review of P&IDs and scope of work
- Technical clarifications/queries for any missing information or ambiguities
- Material take-off (MTO) / Bill of material (BOM)
- Material requisitions to float enquiry to Vendors for cost of particular item/ equipment
- Basis of Proposal (This document specifies any assumptions, deviations, exclusions with reference to scope of work)
- Man-hour estimation (This gives the detail engineering duration of the project, time required for each document we prepare in detail engineering, software requirement and also team members in the project)

TOTAL PROJECT COST = MATERIAL COST + ENGINEERING COST + MAN -POWER COST

C)Detailed Engineering:

It is the phase to develop all the design drawings and documents. This engineering information is used for purchase/procurement of the material, defining fabrication and installation of the system. All engineering disciplines required for the project are included in this phase.

Piping detail engineering activities:

- Pipe design – Line sizing details
- Pipe material selection
- Pipe stress analysis
- Pipe routing and clash resolution (2D or 3D Modelling)
- Pipe support details
- Piping Isometrics.

Mechanical detail engineering activities:

- Vessel and Reactor Design.
- Exchanger Thermal Design.
- Equipment Selection and Specification.
- Rotating Equipment Selection.

4. ROLE OF MECHANICAL ENGINEERING IN PROCESS INDUSTRY:

Mechanical engineer plays an important role in Mechanical Equipment design and Piping design.

However, the complete engineering is divided into detail engineering and design engineering.

- Engineer (Detail engineering) – One who involves in preparation of technical specifications, Datasheets, Design calculations, MTO and review of vendor technical information as procurement support activity.
- Designer (Design engineering) – The one who prepares pipe routing drawings, Location layouts, Plot plan etc. (i.e. who does the modelling part either 2D or 3D)
- Draftsmen- The one who updates the drawings based on the inputs/writeup provided by the Engineer/Designer. Drafting activities based on the red mark-ups/ comments from Client/ Engineer/Designer. Works on either AutoCAD or any designing 3D Modelling tool.
- Project Engineer/Manager – The one who involved in complete scope of work for a project and different interfacing requirement with another disciplines/ Client/ Vendor. He also prepares the plan for the execution of the project. Project plan includes, master deliverables list & complete project activities with submission timelines.
- Site Engineer – The one who takes care of the repairs and maintenance activities of the equipment/ pipe at site, fixing the issues that arises and also ensures that regular checks are done to avoid any failure or malfunctioning of the equipment.

5. LIST OF DOCUMENTS PREPARED FOR MECHANICAL/PIPING :

DETAIL ENGINEERING PHASE:

- ➢ MECHANICAL DETAIL ENGINEERING DOCUMENTS:
    - Mechanical Equipment Design Criteria

- Equipment List
- Specifications
- Datasheets
- Equipment General Arrangement Drawing
- Equipment Pressure Vessels Calculations
- Equipment Spare Part Details
- Material Take-Off
- HVAC Design
- Mechanical Package Design and Interface Engineering

➢ PIPING DETAIL ENGINEERING DOCUMENTS:

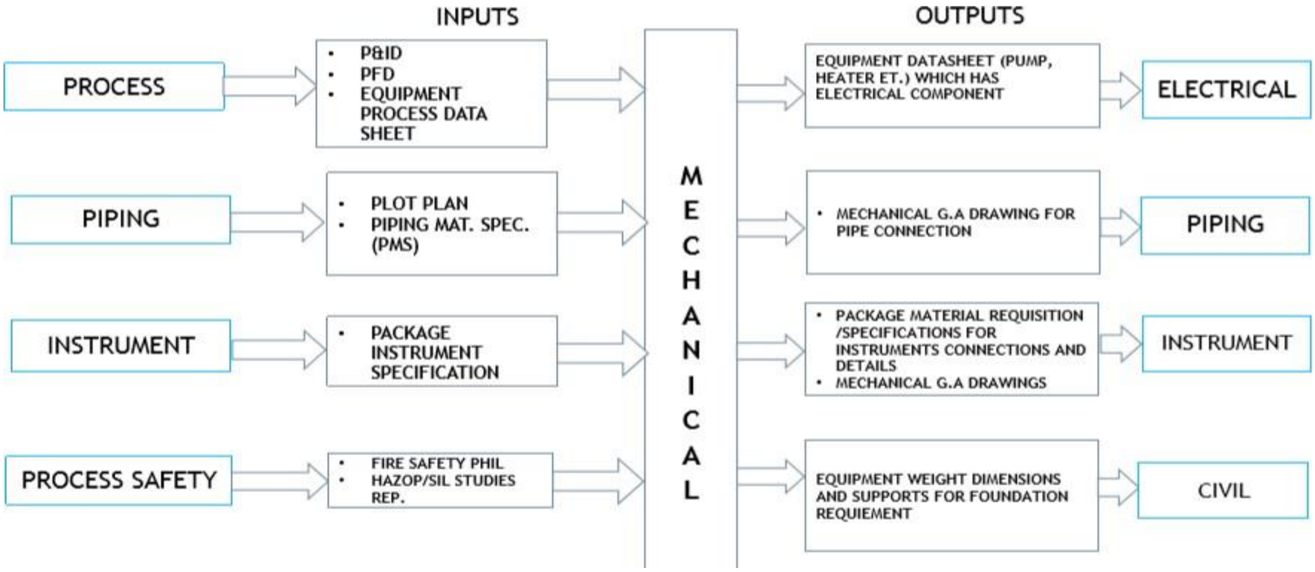
- Overall Site Plot Plan
- Process Area Plot Plans
- Piping & Instrumentation Diagrams
- Line List and Valve List
- Piping Material Specifications
- Special Piping (SP) Item Schedule and Data Sheets
- Standard Piping Details
- Fabrication and Installation of Pipe-Work Specification
- Piping General Arrangement Drawings
- Isometric Drawings for 2" And Above Pipe-Work Above and Below Ground
- Material Take-Offs
- Key Plans Of Piping General Arrangements.
- Stress Analysis Specification and Stress Report
- Pipe Routing Drawing above Ground and Below Ground

6. MECHANICAL ENGINEERING INPUTS AND INTERFACE REQUIREMENTS:

<u>INPUTS REQUIRED ARE:</u>

- Project specification
- Plant process description
- Process flow diagram (PFD)
- Fluid list with its process parameters and properties
- Heat and mass balance drawing
- Water balance drawing
- Tie-in point details

MECHNICAL INTERFACE WITH OTHER DISCIPLINES:



7. PIPING AND INSTRUMENTATION DIAGRAM:

A piping and instrumentation diagram (P&ID) is a detailed diagram in the process industry which shows the piping and process equipment together with the instrumentation and control devices.

Superordinate to the P&ID is the process flow diagram (PFD) which indicates the more general flow of plant processes and the relationship between major equipment of a plant facility.

P&ID shows the interconnection of process equipment and the instrumentation used to control the process. In the process industry, a standard set of symbols is used to prepare drawings of processes. The instrument symbols used in these drawings are generally based on International Society of Automation (ISA) Standard S5.1

They usually contain the following information:

- Mechanical equipment: Pressure vessels, columns, tanks, pumps, compressors, heat exchangers, furnaces, wellheads, fans, cooling towers, turbo-expanders, pig traps, Bursting discs, restriction orifices, strainers and filters, steam traps, moisture traps, sight-glasses, silencers, flares and vents, flame arrestors, vortex breakers, educator’s.
- Process piping details:
  - Pipe classes and piping line numbers
  - Flow directions
  - Interconnections references
  - Permanent start-up, flush and bypass lines
  - Pipelines and flow lines
  - Blinds and spectacle blinds
  - Insulation and heat tracing

- Miscellaneous - vents, drains, flanges, special fittings, sampling lines, reducers and swages

8. DIFFERENT LAYOUTS AND THEIR USE:

Overall Plot Plan:

An Overall Plot Plan, sometimes this plan called a Site Plan or a Site Master Plan is the primary document for the designing of plant and is always show in plan view i.e. Top view. We will have an indication of True north and plant north to help us approaching to the particular location of the plant. By seeing the plot plan, we can understand the site boundaries, space for any future expansion, location of the equipment's, facilities, buildings, approach roads, Pipe racks, furnaces, elevations, floor plan, coordinates etc.

Equipment layout:

It is the detailing of conceptual layout. It is the basic document of mechanical engineering design or in other words this document is the basis for development of construction drawing by all disciplines. It is sometimes also referred as plot plan for large outdoor plant.

It consists of following information: -

A. Floor space needed for the equipment and other facilities are shown.

B. Access, removal space, cleaning area, storage space and handling facilities are outlined.

The essential data or documents required for preparation of equipment layout is as: -

A. P&ID and PFD

B. Process Design Data

C. Equipment Sizes and Buildings

Piping Layout:

Piping layout shows the is over all dimensions of the plants/system/unit from where the plantsstarts and ends which shows the all piping, equipment nozzles, structure, piping supports, instruments tags, sp items etc. Piping layout is very important for installation of piping in the site.

Piping layout drawings shall show the piping on plan view and give all the information required for the preparation of isometric drawings and for erection of the piping. Cross- section anddetails shall be drafted on these drawings to facilities the drafting of the isometric's drawings.

9. PIPE LINE SIZING CALCULATION:

In any chemical process industry, various types of fluids are being used in different forms like liquid, gaseous, slurry, etc. Raw material, intermediate product or finished product produced through various unit operations require connectivity of all the units with pipelines and fittings due to the following reasons:

- Ease of operation
- Safe handling of materials
- Avoiding loss of material
- Hygienic conditions of the plant

Line sizing to done The purpose of line sizing (for common, water-like liquids, gases, and applications) is :

- To obtain the suitable diameter of the pipe to attain the required flow velocity, discharge and also to withstand the pressure of the fluid flowing in it.
- To fill in appropriate data on P&ID's, datasheets, and line lists
- To determine pump head requirements
- To meet design process parameters such as flow, velocity & pressure

The factors effecting the line size are:

- Economics
- Velocity
- Pressure drop effects
- Space
- Equipment nozzle connections

Though various formulae and thumb rules are available in literature and can be used directly for sizing of pipelines, criticality with respect to experience in the fluid handling of related chemical process industry cannot be avoided. Over or under sizing of pipelines may even become a bottleneck for plant operations. For slurry applications, a larger size pipeline not only increases the plant cost but also creates operational problems. Likewise, the smaller pipe size may consume more energy for fluid movement. One should bear in mind that the larger pipeline size than necessary increases plant cost due to pipelines along with the connected valves, fittings, supporting structures, etc.

Many factors should be kept in mind before sizing any pipeline. The basic principle of pipeline size is based on the available pressure drop between its two ends. Normally to maintain certain fluid velocity (may be from the available thumb rules), e.g. considering 1.5 meter / second for clear water at pump discharge for the maximum possible fluid flow rate through that pipeline, cross-sectional area (or diameter) of pipeline is calculated. Based on this, the nearest commercially available pipeline size (of inside diameter closely matching with the calculated value) is selected for application. With these preliminary calculations of pipeline sizing and pipe routing, pressure drop between start and end point, incorporating all fittings, is calculated. Decision of the selection of higher or lower pipeline size is made according to the available pressure drop versus calculated pressure drop.

The points should be kept in mind while sizing:

- Characteristics of sample fluid
- Less fluid losses
- Safety during sample withdrawal
- Ease of operation
- Location of sample point, etc.

10. PIPE THICKNESS CALCULATION:

The primary requirement of the pipe wall-thickness selection is to sustain stresses for pressure containment.Factors that affect the pipe wall thickness requirement are:

- Maximum working pressures
- Maximum working temperatures
- Chemical properties of the fluid
- The fluid velocity
- The pipe material and grade
- The safety factor or code design application

Based on the NPS and schedule of a pipe, the pipe outside diameter (OD) and wall thickness can be obtained from reference tables such as those below, which are based on ASME standards B36, 10M and B36, 19M.

If there are no codes or standards that specifically apply to the oil and gas production facilities, the design engineer may select one of the industry codes or standards as the basis of design. The design and operation of gathering, transmission, and distribution pipeline systems are usually governed by codes, standards, and regulations. The engineer must verify whether the particular country in which the project is located has regulations, codes, and standards that apply to the facility.

The basic formula for determining the pipe wall thickness is

$$t = \frac{P \times D}{2(SE + PY)} + A$$

where,

P = allowable internal pressure in the pipe, psi (MPa—metric)

D = outside diameter of the pipe, in. [mm—metric]

S = allowable stress for the pipe, psi [N/mm2—metric]

E = longitudinal weld-joint factor [1.0 seamless, 0.95 electric fusion weld, double butt, straight, or spiral seam APL 5L, 0.85 electric resistance weld (ERW), 0.60 furnace butt weld]

Y= Coefficient of Wall Thickness

11. PIPE PRESSURE DROP CALCULATIONS:

Pressure drop is defined as the difference in total pressure between two points of a fluid carrying network.

A pressure drop occurs when frictional forces, caused by the resistance to flow, act on a fluid as it flows through the tube. If there is a high pressure drop in a pipe, then the pipe is too small for the flow. It was cheap to install but it will cost more to pump water through that pipe over time. If there is a low pressure drop then the pipe is bigger than needed for the flow.

The amount of head loss is influenced by the following factors:

a. The length of pipe:The longer the pipeline, the greater the head loss. This loss is directly proportional to the length; i.e., the head loss for 200 meters of pipe would be twice that for 100 meters under the same conditions.

b. The diameter of the pipe:The smaller the diameter of the pipeline, the greater the friction will be for the same flow of water. The differences are not proportional.

c. The velocity of water in the pipe:The higher the flow rate of water in a given pipe, the greater the head loss due to friction. Friction increases as the square of the velocity.

d. The pipe material:The smoother the inner surface of the pipe, the lower the head loss. Thus, since PVC pipe is smoother than steel or cast iron, it has a lower head loss for identical conditions.

e. The number of fittings or bends in the pipeline:A straight pipeline would have a lower head loss than one of the same length with fittings or bends.

f. Viscosity of fluid:One of the accepted methods to calculate friction losses resulting from fluid motion in pipes is by using the Darcy– Weisbach equation. For a circular pipe:

Darcy– Weisbach equation:

$$h_f = \frac{f\ L\ V^2}{2\ g\ d}$$

Where,

hf = head loss (m)

f = friction factor

L = length of pipe work (m)

d = inner diameter of pipe work (m)

v = velocity of fluid (m/s)

g = acceleration due to gravity (m/s2)

Hazen-Williams Equation:

The Hazen–Williams equation is an empirical relationship which relates the flow of water in a pipe with the physical properties of the pipe and the pressure drop caused by friction. It is used in the design of water pipe systems such as fire sprinkler systems, water supply networks, and irrigation systems.

The equation can be given by

$$h_f = \frac{10.65\ Q^{1.852}\ L}{C^{1.852}\ D^{4.87}}$$

hf = head loss due to friction

Q = flow rate

C = Hazen-Williams Coefficient

d = inside diameter of pipe

L = length of pipe

12. LINE LIST:

A line list (or line schedule) is a database created to communicate between the process and mechanical engineering teams when designing piping in a plant or process unit.

Role of different engineers in preparing line list:

Process Engineers - Specifies the process requirements such as the design and operating pressures & temperatures, flowing medium, piping code, Line ID, reference P&ID numbers etc.

Mechanical Engineers - Specifies line numbers, connections, isometric numbers, and other items that are related to the overall construction of the piping.

At a minimum, the information on a line schedule is as follows:

- Line Identifier (Line Designation, Line Number) - a unique number that identifies the line in the plant or process unit. The author of this article cannot stress enough the use of the word unique.
- Start and ending point of the line - includes equipment connections or connections to other lines.
- Service or commodity - materials that are flowing through the piping
- Fluid Phase - Liquid, vapor, two phase, etc.
- Piping Specification and/ or piping code
- Design and operating pressure and temperature of the service
- P&ID reference numbers
- Piping Isometric reference number
- Corrosion Allowance
- Insulation type and thickness
- Heat Tracing Type l

13. PIPE FITTINGS AND COMPONENTS:

PIPE FITTINGS:

Fittings are used in pipe and plumbing systems to connect straight pipe or tubing sections, to adapt to different sizes or shapes, to branch or re-direct the piping system and if necessary, to provide a jointing method if two dissimilar piping materials are used in the one system. Fittings for pipe and tubing are most often made from the same base material as the pipe or tubing being connected, e.g., stainless steel, steel, copper or plastic. However, any material that is allowed by code may be used, but must be compatible with the other materials in the system, the fluids being transported, and the temperatures and pressures inside and outside of the system. For example, brass-bodied fittings are common in otherwise copper piping and plumbing systems.

The common types of fittings are

- Elbow.
- Tee
- Cross
- Reducer
- Cap

Elbow: A pipe fitting installed between two lengths of pipe or tube allowing a change of direction, usually 90° or 45°. The ends may be machined for butt welding, threaded (usually female), or socketed, etc. When the two ends differ in size, it is called a reducing or reducer elbow.

Tee: A tee is used to either combine or split a fluid flow. Most common are equal tees which have the same body and branch diameter but there is also a wide range of reducing tees where either the branch or the body is a different diameter relative to each other. These are further categorized into

•Equal/Straight tee.

•Unequal tee.

Cross: A cross has one inlet and three outlets, or vice versa and like tees come in equal and reducing forms. A cross is more expensive than two tees but has the advantage of reduced space and requires less labor to install.

Reducer: Reducers are used to join two different pipe sizes together. They can be either concentric or eccentric which refers to the relative position of the center lines of the outlet and inlet. Special attention must be given when using reducers in a horizontal orientation as the slope will prevent free draining of a system if not installed.

They are further divided into

•Concentric reducer.

•Eccentric reducer.

<u>Cap or Plug</u>:A type of pipe fitting which is liquid or gas tight, and is used to cover the end of a pipe. A cap has a similar function to a plug. For screwed systems the cap would have female threads where a plug would have male threads.

These are categorized as

- Stainless steel end caps.
- Carbon steel end caps.
- Flared and non-flared plugs.
- Tapered plugs.

PIPING COMPONENTS:

A piping system is an assembly of various components put together with a propre method of joints, functionally to transport fluid from its source to destination. The different components put together are defined as piping components. Piping components are of many types and include:

- Pipes.
- Tubes.
- Valves.
- Fittings.
- Flanges.
- Gaskets.
- Bolting.
- Hoses.
- Expansion joints.
- Sight Flow glasses.
- Filters.
- Strainers.

<u>Tubes</u>:Tubing is the normal flow conduit used to transport produced fluids to the surface or fluids to the formation .Tubes is classified into three major types

- Structural tube.
- Mechanical tube.
- Pressure tube.

<u>Valves</u>:A valve is a mechanical device that blocks a pipe either partially or completely to change the amount of fluid that passes through it.Valves can be categorised based on the operating mechanism.

<u>Fittings</u>:Fitting od adapter is used in pipe systems to connect straight sections of pipe, adapt to different sizes or shapes and for other purposes such as regulating fluid flow.

<u>Flanges</u>:There are many different flange standards to be found worldwide. To allow easy functionality and inter-changeability, these are designed to have standardized dimensions.

These are classified into the following types

- Weld Neck.
- Slip-on.
- Socket weld.
- Threaded.
- Lap Flange.
- Blind Flange.

Gaskets:A gasket is a mechanical seal which fills the space between two or mating surfaces, generally to prevent leakage from or into the joined objects while under compression.

- Gaskets used in piping commonly called as flange gaskets.

Hoses:A hose is a flexible hollow tube designed to carry fluids from one location to another. The shape is usually cylindrical.

Types of hoses are

- Delivery hose.
- Suction hose.
- Hose reel hose.

Expansion Joints: It is installed in piping systems to not only absorb vibrations and shock but also to relieve anchor stress, reduce noise, and compensate for misalignment.

- Universal Expansion Joint.
- Pressure Balanced Expansion Joint.
- Gimbal Expansion Joint.

14. PIPE SUPPORT DETAILS:

A pipe support or a pipe hanger is a designed element that transfer the load from a pipe to the supporting structures. The load includes the weight of the pipe proper, the content that the pipe carries, all the pipe fittings attached to pipe and the pipe covering such as insulation.

The main functions of pipe supports are

- Anchor.
- Absorb Shock.
- Guide.
- Support a specified load.

In case of tension loads, a hanger is used whereas in case of compressive loads, a support is used.

Pipe supports are used based on load that is acting on the system. It might be

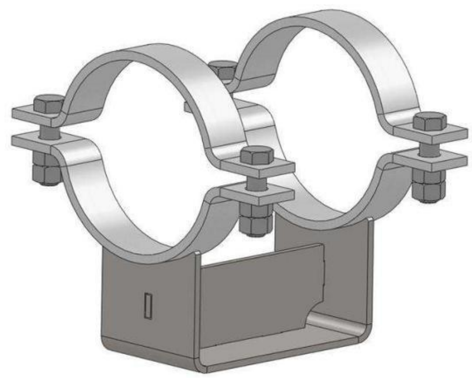
- Primary Load: These are typically steady or sustained types of loads such as internal fluid pressure, external pressure, gravitational forces acting on the pipe such as weight of pipe and fluid, forces due to relief or blow down, pressure waves generated due to water/steam hammer effects.it can be
- Sustained Loads.
- Occasional Loads.

Secondary Load: These are caused by displacement of some kind.

For instance, pipe connected to a storage tank may be under load if the tank nozzle to which it is connected moves down due to tank settlement. Similarly, pipe connected to a vessel is pulled upwards because the vessel nozzle moves up due to vessel expansion. Also, a pipe may vibrate due to vibrations in the rotating equipment to which it is connected.

Displacement Loads:

- Load due to Thermal Expansion of pipe.
- Load due to Thermal movement of Equipment.

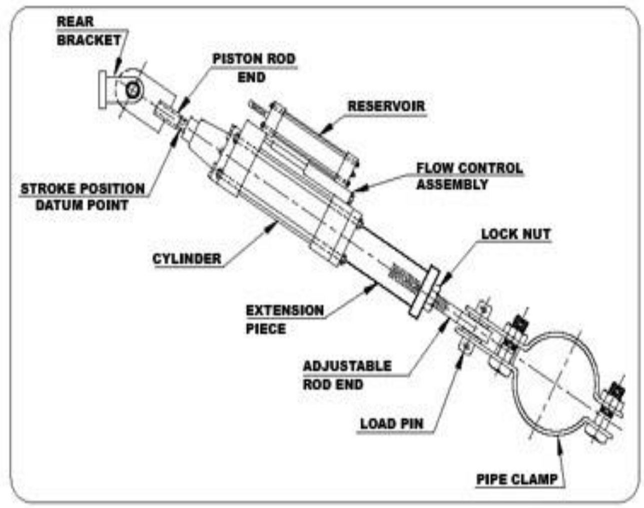


Pipe supports are

- Rigid Support.
- Spring Support.
- Snubber Support.
  - Rigid support: Rigid supports are used to restrict pipe in certain direction without any flexibility. Main function of a rigid support can be Anchor, Rest, Guide or both Rest & Guide .These are further classified as
  - Pipe shoe: Rigid support can be provided either from bottom or top. In case of bottom supports generally a stanchion or Pipe Clamp Base is used. It can be simply kept on steel structure for only rest type supports. To simultaneously restrict in another direction separate plate or Lift up Lug can be used. A pipe anchor is a rigid support that restricts movement in all three orthogonal directions and all three rotational directions, i.e. restricting al the 6 degrees of freedom.
  - Rod Hanger: It is designed to withstand tensile load only (no compression load should be exerted on it, in such case buckling may take place). It is rigid vertical type support provide from top only. It consists of clamp, eye nut, tie rod, beam attachment. Selection of rod hanger depends on pipe size, load, temperature, insulation, assembly length etc.
  - Rigid Strut: It is a dynamic component that is designed to withstand both tensile and compression load. Strut can be provided in vertical as well as horizontal direction. V-type Strut can be used to restrict two degrees of freedom. It consists of stiff clamp, rigid strut, welding clevis. Selection depends on pipe size, load, temperature, insulation, assembly length.
- Spring Support:Spring supports or Flexible supports use helical coil compression springs to accommodate loads and associated pipe movements due to thermal expansions. They are

broadly classified into variables effort support & constant effort support. The critical component in both the type of supports are helical coil Compression springs. Spring hanger & supports usually use Helical coil compression springs.

These are further classified as



- Variable Spring Hanger or Variable Effort Support: Variable effort supports also known as variable hangers or variables are used to support pipe lines subjected to moderate (approximately up to 50mm) vertical thermal movements. VES units (Variable effort supports) are used to support the weight of pipe work or equipment along with weight of fluids (gases are considered weightless) while allowing certain quantum of movement with respect to the structure supporting it. Spring supports may also be used to support lines subject to relative movements occurring typically due to subsidence or earthquakes.
- Constant Spring Hanger or Constant Effort Support: When confronted with large vertical movements typically 150 mm or 250 mm, there is no choice but to select a constant effort support (CES). When the Load variation percentage exceeds 25% or the specified max LV% in a variable hanger, it is choice less but to go for a CES.
- Snubber or Shock Absorber: A shock absorber absorbs energy of sudden impulses or dissipate energy from the pipeline.pipe it is a common practice to use CES. In a constant effort support the load remains constant when the pipe moves from its cold position to the hot position.
- Hydraulic Snubber: Similar to an automobile shock arrestor the hydraulic snubber is built around a cylinder containing hydraulic fluid with a piston that displaces the fluid from one end of the cylinder to the other. Displacement of fluid results from the movement of the pipe causing the piston to displace within the cylinder resulting in high pressure in one end of the cylinder and a relatively low pressure in the other.
- Mechanical Snubber: Whilst having the same application as the hydraulic snubber, retardation of the pipe is due to centrifugal braking within the snubber. A split flywheel is made to rotate at high velocity causing steel balls to be forced radially outwards. The flywheel is forced apart by the steel balls causing braking plates to come together thus retarding the axial displacement of the snubber. Rotation of the flywheel is generated by the linear displacement of the main rod acting on a ball-screw or similar device. It is also very expensive.

15. PROJECT:

1. WATER INTAKE AND TREATMENT FILTER FEED SUMP&PUMPS

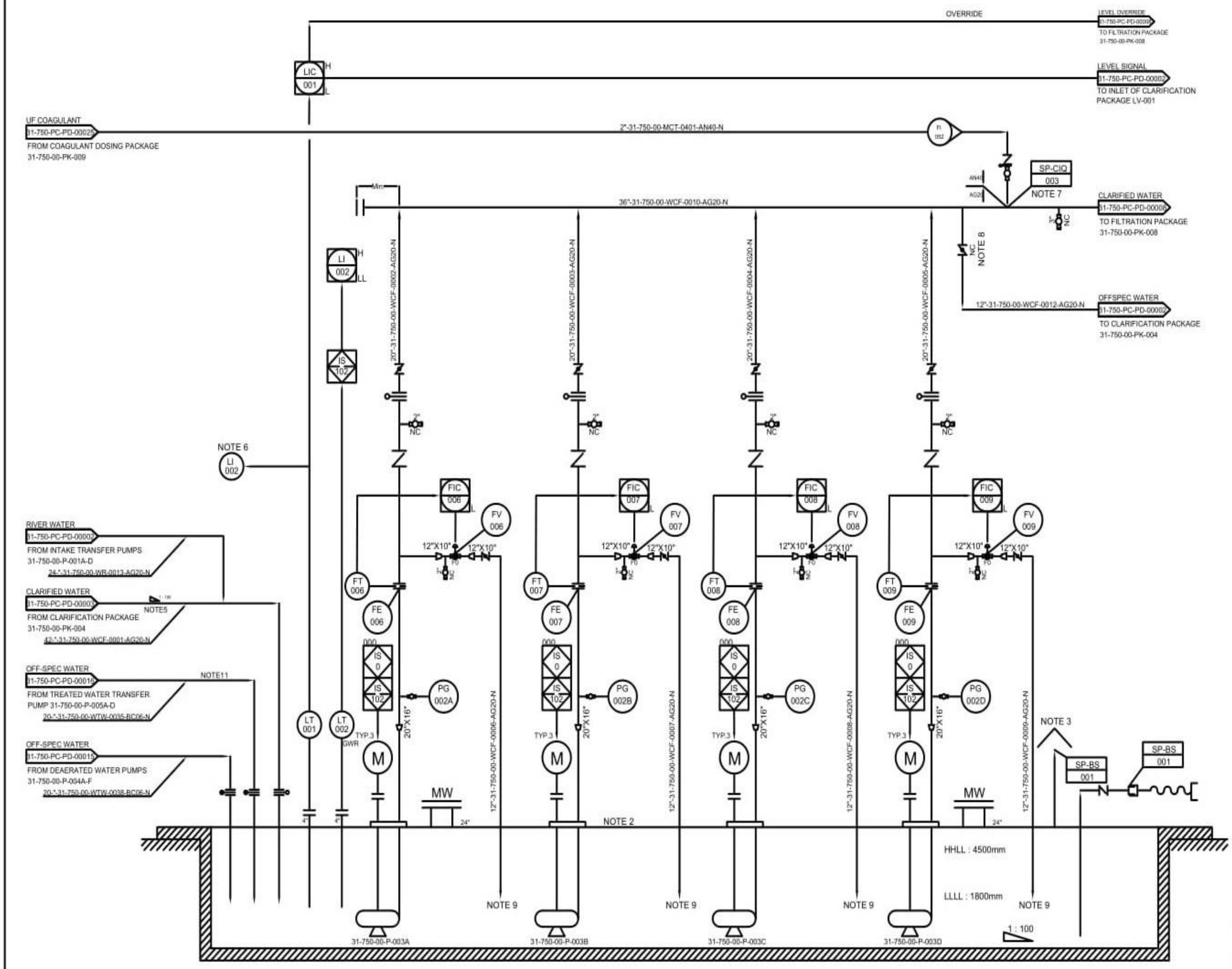
Water intake and treatment filter feed sump&pumps is a System intended to treat the River Water with the UF Coagulant Dosing Package While the water from the feed sump is being pumped to a Common-Header. The Inlet to the system is River water, Clarified water, OFF-Spec water. It is directed to the feed sump through the pipe lines. From the feed sump the Pumps A, B, C & D. The intake water is being pumped through motor operated Vertical pump. For each of the pipe line there is a separate By-pass line sent to the feed sump. A pipe line from the UF Coagulant Dosing Package through flow indicator is being connected to the Common-Header to get the Treating Operation to be done. Then the Clarified Water is sent to the Filtration Package. There is a pipe line derived from the Common-Header of OFF-Spec water sent to the Clarification Package. From the filter feed sump there is a vent provided with the Weather Hood. There is a separate pipe line for the emptying the sump called the Pump-Out connection (Removal by Vacuum truck). There are valves for flow control and instruments for flow indication. There are reducers for Concentric Reduction of the Pipe line. During ESD condition level-0, Pump shall be tripped. There are two Ways provided for the Filter Feed sump.

31-750-00-BA-002
FILTER FEED SUMP

CAPACITY	: 480 m3
SIZE	: 14500(L)X14500(W)X4800 (H)mm
OPERATING TEMP./PR.	: 34deg.C/ATM
DESIGN TEMP./PR.	: AMB/ATM

31-750-00-P-003A-D
FILTER FEED PUMP

DESIGN FLOW	: 1919 m3/h
DIFFERENTIAL HEAD	: 58m
POWER(ABSORBED).	: 400 KW
DESIGN TEMP./PR.	: 87 deg C/6 bar
WORKING/STANDBY	: 3 + 1



31-750-00-BA-002

NOTES

1. FOR GENERAL NOTES AND SYMBOLS, TYPICAL INSTRUMENT AND OTHER CONNECTION DETAILS REFER P&ID NOS. 8015-0150-WP01-31-000-PC-0001 TO 0005.ALL INSTRUMENTS SHALL BE PREFIXED WITH FACILITY CODE (31)-UNIT CODE(750)TRAIN NO (00). E.G. 31-750-00-FV-001.
2. FILTER FEED SUMP SHALL BE COVERED.
3. VENT TO BE PROVIDED WITH WEATHER HOOD.
4. PUMP OUT CONNECTION (REMOVAL BY VACUUM TRUCK).
5. GRAVITY FLOW.
6. LI-002 SHALL BE READABLE AT THE LOCATION OF TRUCK CONNECTION.
7. THE QUILL TO BE PROCURED WITH FLANGE AND INSULATING GASKET.REFER TO DETAIL CHEMICAL INJECTION QUILL ON P&ID NO. 8015-0150-WP01-31-000-PC-PD-00006.
8. CLARIFIED WATER FROM FILTER FEED SUMP SHALL BE SENT TO CLARIFICATION PACKAGE INLET IN CASE OF OFFSPEC (HIGH TSS).
9. PUMP RECIRCULATION LINES TO BE LOCATED BELOW LLLL.
10. DELETED.
11. INTAKE TRANSFER PUMPS SHALL BE STOPPED DURING OFF-SPEC WATER REPROCESSING.

INTERLOCK DESCRIPTION

000-IS-0 DURING ESD LEVEL-0, PUMP SHALL BE TRIPPED, REFER CAUSE & EFFECT CHART FOR VARIOUS ESD LEVEL-0 SCENARIOS.

IS-102 LOW LOW LEVEL (LA-002) IN FILTER FEED SUMP TO STOP FILTER FEED PUMPS (31-750-00-P003A/B/C/D), UF COAGULANT DOSING PUMPS AND ANTIFOAM DOSING PUMPS.

PIPING AND DESIGN ENGINEEING INTERNSHIP

RISP - REMOTE INTERNSHIP SMART BRIDGE PROGRAM

GUDLAVALLERU ENGINEERING COLLEGE

DRAWING TITLE	PIPING AND INSTRUMENT DIAGRAM WATER INTAKE AND TREATMENT FILTER FEED SUMP & PUMPS		
DRAWING NO.	8015-0150-WP01-31-750-PC-PD-00007		
SCALE	NTS	DRAWN	M VENKATA NAGA SAI
REV	00	CHECKED	SRAVANTHI CHELLU
		APPROVED	PARDHA SARADHI

- **PIPE LINE SIZING CALCULATION**:

  To calculate the diameters and thickness of the pipe in the P&ID

  Continuity Equation : **Q=AV**

- **For discharge of 1919 m3/hr Of Filter Feed Pump and Discharge pipe line to common header (20"-31-750-00-WCF-0002-AG20-N)**

  Velocity of the air = 3.05 m/s (process waters from crane data book)

  From continuity Equation

  $$1919/3600 = \pi/4 * d2*3.05$$

  d= 0.04717 m= 471.72 mm(Internal diameter of pipe)

  As per ASME 36.1

  DN500 Sch-40 Pipe is considered as it satisfies the internal diameter from the calculation

  The Schedule (thickness) of the pipe is = 15.09 mm

  Inner Diameter (471.72mm)can be round figured as per ASME31.10 = 477.82 mm

  Outer diameter of the pipe = 477.82 + (2*15.09) = 508 mm

  So the inner diameter of the pipe is 477.82mm(18.8"), Outer diameter is 508mm(20'') , with a pipe Schedule of 40.

  Same values are considered for Pump lines A,B,C&D.

- **For discharge of 800 m3/hr Of Pump Recirculation to Feed Sump line From Pumps A,B,C&D (12"-31-750-00-WCF-0006-AG20-N)**

  Velocity of the air = 3.05 m/s(PROCESS WATERS FROM CRANE DATA BOOK)

  From continuity Equation

  $$800/3600 = \pi/4 * d2*3.05$$

  d= 0.3045 m= 304.57mm(Internal diameter of pipe)

  As per ASME 36.1

  DN300 Sch-STD Pipe is considered , it satisfies the internal diameter from the calculation

  The Schedule(thickness) of the pipe is = 9.53 mm

  Inner Diameter(304.57mm)can be round figured as per ASME31.10 = 304.74 mm

  Outer diameter of the pipe = 304.74 + (2*9.53) = 323.8mm

  So the inner diameter of the pipe is 304.74mm(12"), Outer diameter is 323.8mm(12.7'') with a pipe Schedule of STD is 9.53mm.

  Same values are considered for Pump Recirculation lines A,B,C&D.

- **For discharge of 7676 m3/hr Through Common Headerof junctions of A,BC&D Pump lines To Filtration Package s A,B,C&D (36"-31-750-00-WCF-0010-AG20-N)**

  Velocity of the air = 3.05 m/s(PROCESS WATERS FROM CRANE DATA BOOK)

  From continuity Equation

  $$7676/3600 = \pi/4 * d2*3.05$$

  d= 0.9434 m= 943.45mm (Internal diameter of pipe)

  As per ASME 36.1

DN950 Sch-STD Pipe is considered , it satisfies the internal diameter from the calculation
The Schedule (thickness) of the pipe is = 9.53 mm
Inner Diameter(943.45mm)can be round figured as per Asme31.10 = 945.94 mm
Outer diameter of the pipe = 945.94 + (2*9.53) = 965mm
So the inner diameter of the pipe is 945.94mm(37.2"), Outer diameter is 965mm(14.3'') with a pipe Schedule of STD is 9.53mm.

- **For discharge of 89 m3/hr Sump To Pump Out Connection to the Vacuum Truck Pipe line (4"-31-750-00-WCF-0011-AG20-N)**
  Velocity of the air = 3.05 m/s(PROCESS WATERS FROM CRANE DATA BOOK)
  From continuity Equation

  $$89/3600 = \pi/4 * d2*3.05$$

  $$d= 0.1015 \text{ m}= 101.58\text{mm(Internal diameter of pipe)}$$

  As per ASME 36.1
  DN100 Sch-40 Pipe is considered , it satisfies the internal diameter from the calculation
  The Schedule(thickness) of the pipe is = 6.02 mm
  Inner Diameter(101.58mm)can be round figured as per Asme31.10 = 102.26 mm
  Outer diameter of the pipe = 102.26+ (2*6.02) = 114.3mm
  So the inner diameter of the pipe is 102.26mm(4"), Outer diameter is 114.3mm(4.5'') with a pipe Schedule of 40 is 6.02mm.

- **For discharge of 15.5 m3/hr UF COAGULANT From Dosing Package to Filtration Package (2"-31-750-00-MCT-0401-AN40-N)**
  Velocity of the air = 2.13 m/s(CHEMICALS,REAGENTS,POLYMERS TYPE FROM TBV DATA BOOK)
  From continuity Equation

  $$15.5/3600 = \pi/4 * d2*2.13$$

  $$d= 0.0507 \text{ m}= 50.73\text{mm(Internal diameter of pipe)}$$

  As per ASME 36.1
  DN50 Sch-40 Pipe is considered , it satisfies the internal diameter from the calculation
  The Schedule(thickness) of the pipe is = 3.91 mm
  Inner Diameter(50.73mm)can be round figured as per Asme31.10 = 52.48 mm
  Outer diameter of the pipe = 52.48+ (2*3.91) = 60.3mm
  So the inner diameter of the pipe is 52.48mm(2"), Outer diameter is 60.3mm(2.3'') with a pipe Schedule of 40 is 3.91mm.

- **For discharge of 4795 m3/hr RIVER WATER From INTAKE TRANSFER PUMPS to FILTER FEED SUMP (24"-31-750-00-WR-0013-AG20-N)**
  Velocity of the air = 4.57 m/s(FEED WATER TYPE FROM CRANE DATA BOOK)
  From continuity Equation

  $$4795/3600 = \pi/4 * d2*4.57$$

d= 0.609 m= 609.17mm(Internal diameter of pipe)

As per ASME 36.1
DN650X25.4 Pipe is considered , it satisfies the internal diameter from the calculation
The Schedule(thickness) of the pipe is = 25.4 mm
Inner Diameter(609.17)can be round figured as per Asme31.10 = 609.2 mm
Outer diameter of the pipe = 609.2+ (2*25.4) = 660mm
So the inner diameter of the pipe is 609.2mm(24”), Outer diameter is 660mm (25.9’’) with a pipe 25.4mm Thick.

- **For discharge of 9814 m3/hr Of CLARIFIED WATER Through CLARIFICATION PACKAGE ToFILTER FEED SUMP(42"-31-750-00-WCF-0001-AG20-N)**
  Velocity of the air = 3.05 m/s(PROCESS WATERS FROM CRANE DATA BOOK)
  From continuity Equation

$$9814/3600 = \pi/4 * d2*3.05$$

d= 1.0667 m= 1066.78 mm(Internal diameter of pipe)

As per ASME 36.1

DN1100X25.4 Pipe is considered as it satisfies the internal diameter from the calculation

The Schedule(thickness) of the pipe is = 25.4 mm
Inner Diameter(1066.78)can be round figured as per Asme31.10 = 1067.2 mm
Outer diameter of the pipe = 1067.2 + (2*25.4) = 1118mm
So the inner diameter of the pipe is 1067.2mm(42”), Outer diameter is 1118mm(44’’) with a pipe of 25.4Thick.

➢ PRESSURE DROP CALCULATION:

Head loss in valves and fittings

Darcy –Weisbach equation: (head loss due to friction)

$$H_L = 0.3048\, k\,(V^2/2g)$$

For Process water line Having Ball valve, Butterfly valve, Globe valve, From

Cranes handbook velocity can be considered as v = 3.05m/s , k=0.4

$$H_L = 0.3048*0.4*\frac{3.05^2}{2 * 9.81}$$

$$H_L = 0.0578 \text{ m}$$

Head loss across each valve is 0.0578 m

For a UF Coagulant Pipe line having Ball valve in its Operation velocity can be Considered as v = 2.13m/s , From TBV data book.

From cranes handbook for Ball Valve k=0.4

$$H_L = 0.3048*0.4*\frac{2.13^2}{2 * 9.81}$$

$$H_L = 0.0281 \text{ m}$$

Head loss across Ball valve in UF Coagulant Pipe line is 0.0281 m

<u>Head loss in Pipe:</u>

Hazen Williams Equation: $$h_f = \frac{10.65\ Q^{1.852}\ L}{c^{1.852}\ D^{4.87}}$$

- **For discharge of 1919 m^3/hr Of Filter Feed Pump and Discharge pipe line to common header (20"-31-750-00-WCF-0002-AG20-N)**

  Q= 1919 m^3/hr , L=200m , I.D= 508mm = 0.508m
  Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{1919}{3600})^{1.852} * 200}{120^{1.852}\ 0.508^{4.87}}$$

$$h_f = 2.5408 \text{ m}$$

The head loss caused by friction in 200m length pipe of DN500 Sch-4 is 2.5408m.

- **For discharge of 800 m^3/hr Of Pump Recirculation to Feed Sump line From Pumps A,B,C&D (12"-31-750-00-WCF-0006-AG20-N)**

  Q= 800 m^3/hr , L=200m , I.D= 304.74mm = 0.3047m
  Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{800}{3600})^{1.852} * 200}{120^{1.852}\ 0.3047^{4.87}}$$

$$h_f = 6.058 \text{ m}$$

The head loss caused by friction in 200m length pipe of DN300 Sch-STD is 6.058m.

- **For discharge of 7676 m^3/hr Through Common Headerof junctions of A,BC&D Pump lines To Filtration Package s A,B,C&D (36"-31-750-00-WCF-0010-AG20-N)**

  Q= 7676 m^3/hr , L=200m , I.D= 945.94mm = 0.945m
  Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{7676}{3600})^{1.852} * 200}{120^{1.852}\ 0.945^{4.87}}$$

$$h_f = 1.611 \text{ m}$$

The head loss caused by friction in 200m length pipe of DN950 Sch-STD is 1.611m.

- **For discharge of 89 m^3/hr Sump To Pump Out Connection to the Vacuum Truck Pipe line (4"-31-750-00-WCF-0011-AG20-N)**

Q= 89 m^3/hr , L=200m , I.D= 102.26mm = 0.102m
Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{89.0}{3600})^{1.852} * 200}{120^{1.852}\ 0.102^{4.87}}$$

h_f= 21.41 m

The head loss caused by friction in 200m length pipe of DN100 Sch-40 is 21.41m.

- **For discharge of 15.5 m^3/hr UF COAGULANT From Dosing Package to Filtration Package (2"-31-750-00-MCT-0401-AN40-N)**

Q= 15.5 m^3/hr , L=200m , I.D= 52.48mm = 0.05248m
Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{15.5}{3600})^{1.852} * 200}{120^{1.852}\ 0.05248^{4.87}}$$

h_f= 21.39 m

The head loss caused by friction in 200m length pipe of DN50 Sch-40 is 21.39m.

- **For discharge of 4795 m^3/hr RIVER WATER From INTAKE TRANSFER PUMPS to FILTER FEED SUMP (24"-31-750-00-WR-0013-AG20-N)**

Q= 4795 m^3/hr , L=200m , I.D= 609.2mm = 0.6092m
Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{4795}{3600})^{1.852} * 200}{120^{1.852}\ 0.6092^{4.87}}$$

h_f= 5.71 m

The head loss caused by friction in 200m length pipe of DN650X25.4 is 5.71m.

- **For discharge of 9814 m^3/hr Of CLARIFIED WATER Through CLARIFICATION PACKAGE ToFILTER FEED SUMP(42"-31-750-00-WCF-0001-AG20-N)**

Q= 9814 m^3/hr , L=200m , I.D= 1067.2mm = 1.067m

Hazen Williams constant C=120

$$h_f = \frac{10.67 \left(\frac{9814}{3600}\right)^{1.852} * 200}{120^{1.852}\ 1.067^{4.87}}$$

h_f= 1.406 m

The head loss caused by friction in 200m length pipe of DN1100X25.4 is 1.406m.

- **VALVE LIST:**

VALVE AND EQUIPMENT LIST FILTER FEED SUMP & PUMP P&ID				M VENKATA NAGA SAI
S.NO	VALVE	SIZE	QUANTITY	DESIGNATION
1	Ball Valve	2"	1	-
2	Ball Valve	20"	4	-
3	GLOBE VALVE	10"	4	-
4	BUTTERFLY VALVE	12"	4	-
5	BUTTERFLY VALVE	20"	4	-
6	BUTTERFLY VALVE	36"	1	-
7	LOCAL DRAIN 2" NC	10"	4	-
8	LOCAL DRAIN 2" NC	20"	4	-
9	LOCAL DRAIN 3" NC	36"	1	-
10	REDUCER	20"X16"	4	-
11	REDUCER	12"X10"	4	-
12	EXPANDER	12"X10"	4	-
13	LEVEL INSTRUMENT	-	2	LT001 ,LT002
14	PRESSURE INSTRUMENT	-	4	PG002A,B,C,D
15	ORIFICE FLOW METER	-	4	FE006,7,8,9&FT006,7,8,9
16	FLOW INDICATOR & CONTROL	-	4	FIC006,7,8,9
17	ROTA METER	-	1	FI 052
18	FULL VACCUN	-	4	FV006,7,8,9
19	BIRD SCREENS	-	1	SP-BS 001
20	CHEMICAL INJECTION QUILL	-	1	SP-CIQ 003

S.NO.	LINE SIZE (mm)	LINE NUMBER	SERVICE	PIPE CLASS	INSULATION	MATERIAL
1	508	20"-31-750-00-WCF-0002-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
2	508	20"-31-750-00-WCF-0003-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
3	508	20"-31-750-00-WCF-0004-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
4	508	20"-31-750-00-WCF-0005-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
5	304.8	12"-31-750-00-WCF-0006-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
6	304.8	12"-31-750-00-WCF-0007-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
7	304.8	12"-31-750-00-WCF-0008-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
8	304.8	12"-31-750-00-WCF-0009-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
9	914.4	36"-31-750-00-WCF-0010-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
10	101.6	4"-31-750-00-WCF-0011-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
11	304.8	12"-31-750-00-WCF-0012-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
12	50.8	2"-31-750-00-MCT-0401-AN40-N	UF COAGULANT	AN40	N	ASTM B861 Gr. 2
13	609.6	24"-31-750-00-WR-0013-AG20-N	RIVER WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
14	1066.8	42"-31-750-00-WCF-0001-AG20-N	CLARIFIED WATER	AG20	N	Glass-fiber Reinforced Vinylester (GRV)
15	508	20"-31-750-00-WTW-0035-BC06-N	TREATED WATER	BC06	N	A106 Gr. B
16	508	20"-31-750-00-WTW-0038-BC06-N	DEAERATED WATER	BC06	N	A672 Gr. C65 CL. 12

- **LINE LIST:**

FROM	TO	P&ID NO.	OPERATING		DESIGN CONDITIONS	
			PRESS(barg)	TEMP(^oC)	PRESS(barg)	TEMP(^oC)
FILTER FEED PUMP A	COMMON HEADER	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
FILTER FEED PUMP B	COMMON HEADER	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
FILTER FEED PUMP C	COMMON HEADER	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
FILTER FEED PUMP D	COMMON HEADER	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
PUMP A RECIRCULATION	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
PUMP B RECIRCULATION	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
PUMP C RECIRCULATION	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
PUMP D RECIRCULATION	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
COMMON HEADER	FILTRATION PACKAGE	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	-
FILTER FEED SUMP	PUMP OUT CONNECTION(VACUUM TRUCK)	8015-0150-WP01-31-750-PC-PD-00007	ATM	34	1	87
COMMON HEADER	CLARIFICATION PACKAGE	8015-0150-WP01-31-750-PC-PD-00007	5.8	34	7.5	87
COAGULANT DOSING PACKAGE	FILTRATION PACKAGE	8015-0150-WP01-31-750-PC-PD-00025/00007	5	56	8	87
INTAKE TRANSFER PUMPS	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00002 / 00007	4.8	34	6	87
CLARIFICATION PACKAGE	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00003 / 00007	ATM	34	1	87
TREATED WATER TRANSFER PUMP	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00016 / 00007	23	34	30	87
DEAERATED WATER PUMPS	FILTER FEED SUMP	8015-0150-WP01-31-750-PC-PD-00015 / 00007	0.1	34	5.3	87

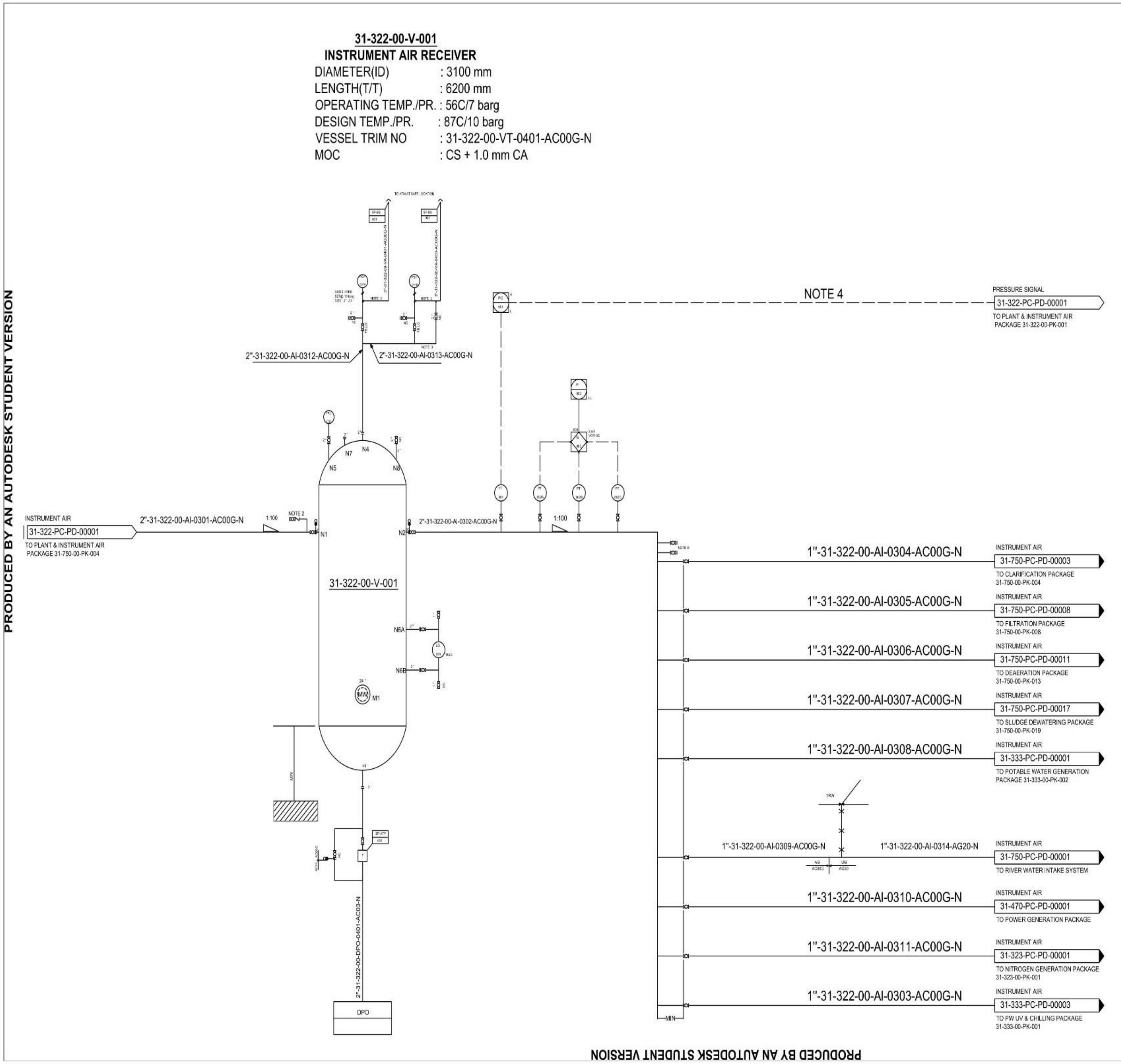
2. INSTRUMENT AIR RECEIVER

The instrument Air from the Plant & Instrument Air Package enters in and gets dumped into the vertical vessel. From the vertical vessel a line is sent to the Open Drain System (DPO). A line is sent to the Atmosphere at the safe location by regulation of the Pressure using Pressure Safety Valve (PSV).

A pressure Signal is sent to the Plant & Instrumentation package using the Pressure Indication Controller (PIC). A line from the Vertical Vessel is sent to the Common Header which has Pressure Transmitters in between connected parallelly.

<u>The following lines originate from the common header:</u>

1. Line to Clarification package that transfers Instrument Air
2. Line to Filtration package that transfers Instrument Air
3. Line to Deaeration package that transfers Instrument Air
4. Line to Sludge Watering package that transfers Instrument Air
5. Line to Potable Water Generation package that transfers Instrument Air
6. Line to River Water Intake System that transfers Instrument Air
7. Line to Power Generation Package that transfers Instrument Air
8. Line to Nitrogen Generation Package that transfers Instrument Air
9. Line to PW UV & Chilling Package that transfers Instrument Air



NOTES

1. FOR GENERAL NOTES AND SYMBOLS, TYPICAL INSTRUMENT AND OTHER CONNECTION DETAILS REFER P&ID NOS.
   8015-0150-WP01-31-000-PC-PD-00001 TO 00005.
   ALL INSTRUMENTS SHALL BE PREFIXED WITH UNIT CODE(322) TRAIN NO.(00),Eg.31-322-PT-001
2. SPARE CONNECTION FOR TEMPORARY INSTRUMENT AIR SUPPLY.
3. WEEP HOLES TO BE PROVIDE AT LOW POINT.
4. COMPRESSOR SHALL START ON LOW PRESSURE AND STOP ON HIGH PRESSURE OF INSTRUMENT AIR HEADER.
5. ALL BRANCH CONNECTIONS SHALL BE TAKEN FROM TOP OF THE HEADER.
6. NUMBER OF INSTRUMENT AIR TAKE OFF VALVES TO BE DETAILED OUT DURING EPC.
7. INSTRUMENT AIR HEADER SHALL FORM A CLOSED LOOP ACROSS THE PLANT.

INTERLOCK DESCRIPTION

000-IS-005 CONFIRMED LOW PRESSURE IN INSTRUMENT AIR HEADER TO INITIATE ESD-0

PIPING AND DESIGN ENGINEEING INTERNSHIP

RISP - REMOTE INTERNSHIP SMART BRIDGE PROGRAM

GUDLAVALLERU ENGINEERING COLLEGE

DRAWING TITLE
PIPING AND INSTRUMENT DIAGRAM
INSTRUMENT AIR RECEIVER

DRAWING NO.	8015-0150-WP01-31-322-PC-PC-00002		
SCALE	NTS	DRAWN	M VENKATA NAGA SAI
REV	00	CHECKED	SRAVANTHI CHELLU
		APPROVED	PARDHA SARADHI

➢ PIPE LINE SIZING CALCULATION:

To calculate the diameters and thickness of the pipe in the given P&ID:

Continuity Equation : Q=AV

Velocity of the air = 76.2 m/s

- **For discharge of 140 m^3/hr**

From continuity Equation, $\frac{140}{3600} = \frac{\pi}{4} * d^2 * 76.2$

d= 0.0254m=25.4mm≈1’’

As per ASME 36.1, the thickness of the 25mm pipe is 3.38 mm

So the outer diameter of the pipe = 25 + (2*3.38)= 30.38 mm

So the inner diameter of the pipe is 25.4mm(1”), Outer diameter is 30.38 mm (1.12’’) , with pipe thickness of 3.38 mm

- **For discharge of 555 m^3/hr**

From continuity Equation , $\frac{555}{3600} = \frac{\pi}{4} * d^2 * 76.2$

d= 0.05075=50.75mm≈2’’

As per ASME 36.1, the thickness of 50.75mm pipe is 3.91 mm

So the outer diameter of the pipe = 25 + (2*3.91) =58.57mm

So the inner diameter of the pipe is 50.8mm(2’’), Outer diameter is 58.57 mm(2.3’’) , with pipe thickness of 3.91 mm.

- **For discharge of 1250 m^3/hr:**

From continuity Equation , $\frac{1250}{3600} = \frac{\pi}{4} * d^2 * 76.2$

d= 0.07616=76.16mm≈3’’

As per ASME 36.1, the thickness of 76.16 mm pipe is 5.3 mm

So the outer diameter of the pipe = 76.16 + (2*5.3) =86.76 mm

So the inner diameter of the pipe is 76.16(3’’), Outer diameter is 86.76 mm(3.41’’) , with pipe thickness of 5.3 mm .

➢ PRESSURE DROP CALCULATION:

Head loss in valves and fittings:

- **Darcy –Weishbash equation**: (head loss due to friction)

$$H_L = 0.3048\ k\ (V^2/2g)$$

Considerations: v=76.2 m/s , g=9.81 m/s^2

It is independent of the pipe Diameter

From cranes handbook ,For Ball Valve,Check valve and Pressure Safety Valve k=0.4

$$H_L = 0.3048*0.4*\frac{76.2^2}{2 * 9.81}$$

$$H_L = 36.08 \text{ m}$$

Head loss across each valve is 36.08 m

Head loss in Pipe:

- **Hazen Williams Equation:** $h_f = \frac{10.65\ Q^{1.852}\ L}{C^{1.852}\ D^{4.87}}$

  - considerations from Instrument Air Receiver P&ID:
    Q= 140 m^3/hr , L=200m , D=25.4 , DN=0.0254m
    Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{140}{3600})^{1.852} * 200}{120^{1.852}\ 0.0254^{4.87}}$$

h_f= 43188.43 m

The head loss caused by friction in 200m length pipe of 25.4 DN is 43188.43 m

  - considerations from sea water intake P&ID:
    Q= 555 m^3/hr , L=200m , D=50.8 , DN =0.0508m
    Hazen Williams constant C=120

$$h_f = \frac{10.67\ (\frac{555}{3600})^{1.852} * 200}{120^{1.852}\ 0{,}0508^{4.87}}$$

h_f= 18930.09 m

The head loss caused by friction in 200m length pipe of 500 DN is 18930.09 m

  - considerations from sea water intake P&ID:
    Q= 1250 m^3/hr , L=200m , D=76.2 DN = 0.0762m
    Hazen Williams constant C=120

$$h_f = \frac{10.67\left(\frac{1250}{3600}\right)^{1.852} * 200}{120^{1.852}\ 0.0762^{4.87}}$$

h_f= 11820.48 m

The head loss caused by friction in 200m length pipe of 1400 DN is 11820.48 m

- **LINE LIST:**

S.NO.	LINE SIZE (mm)	LINE NUMBER	SERVICE	PIPE CLASS	INSULATION	MATERIAL
1	50.8	2"-31-322-00-AI-0301-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
2	50.8	2"-31-322-00-AI-0302-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
3	25.4	1"-31-322-00-AI-0303-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
4	25.4	1"-31-322-00-AI-0304-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
5	25.4	1"-31-322-00-AI-0305-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
6	25.4	1"-31-322-00-AI-0306-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
7	25.4	1"-31-322-00-AI-0307-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
8	50.8	2"-31-322-00-AI-0308-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
9	25.4	1"-31-322-00-AI-0309-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
10	25.4	1"-31-322-00-AI-0310-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
11	25.4	1"-31-322-00-AI-0311-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
12	50.8	2"-31-322-00-AI-0312-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
13	50.8	2"-31-322-00-AI-0313-AC00G-N	Instrument Air	AC00G	NO	A106 Gr. B + Galv
14	25.4	1"-31-322-00-AI-0314-AG20-N	Instrument Air	AG20	NO	Glass-fiber Reinforced Vinylester(GRV)
15	76.2	3"-31-322-00-VA-0401-AC00G-N	Vent Air	AC00G	NO	A106 Gr. B + Galv
16	76.2	3"-31-322-00-VA-0403-AC00G-N	Vent Air	AC00G	NO	A106 Gr. B + Galv
17	50.8	2"-31-322-00-DPO-0401-AC03-N	Open Drain	AC03	NO	A106 Gr. B, A672 Gr. C65 Cl. 12

FROM	TO	P&ID NO.	OPERATING		DESIGN CONDITIONS	
			PRESS(barg)	TEMP (ºC)	PRESS(barg)	TEMP(ºC)
Plant &Instrumentation Air Package 31-322-00-PK-001	Vertical Vessel 31-322-00-V-001	8015-0150-WP01-31-322-PC-PD-00001/ 8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Vertical Vessel 31-322-00-V-001	Common Header	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Common Header	PW UV & Chilling Package 31-333-00-PK-001	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-322-PC-PD-00003	7	60	10	87
Common Header	Clarification Package 31-750-00-PK-004	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-750-PC-PD-00003	7	60	10	87
Common Header	Filtration Package 31-750-00-PK-008	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-750-PC-PD-00008	7	60	10	87
Common Header	Deaeration package 31-750-00-PK-013	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-750-PC-PD-00011	7	60	10	87
Common Header	Sludge Dewatering Package 31-750-00-PK-019	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-750-PC-PD-00017	7	60	10	87
Common Header	Potable Water Generation Package 31-333-00-PK-002	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-333-PC-PD-00001	7	60	10	87
Common Header	AG Pipe	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Common Header	Power Generation Package	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-470-PC-PD-00001	7	60	10	87
Common Header	Nitrogen Generation Package 31-323-00-PK-001	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-323-PC-PD-00001	7	60	10	87
Vertical Vessel 31-322-00-V-001	Pressure Safety Valve 001A	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Vertical Vessel 31-322-00-V-002	Pressure Safety Valve 001B	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
UG Pipe	River Water Intake System	8015-0150-WP01-31-322-PC-PD-00002/ 8015-0150-WP01-31-750-PC-PD-00001	7	60	10	87
Pressure Safety Valve 001A	ATM at Safe location	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Pressure Safety Valve 001B	ATM at Safe location	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87
Vertical Vessel 31-322-00-V-001	Open Drain	8015-0150-WP01-31-322-PC-PD-00002	7	60	10	87

VALVE LIST:

	VALVE AND EQUIPMENT LIST INSTRUMENT AIR RECEIVER P&ID		M V NAGA SAI
S.NO	VALVE	QUANTITY	DESIGNATION
1	Ball Valve	31	
2	Check Valve	1	
3	Pressure Safety Valve	2	PSV 001A PSV 001B
4	Level Gauge	1	LG 001
5	pressure Gauge	1	PG 003
6	Piping Speciality System	3	SP-BS 001 SP-BS 002 SP-ATP 001
7	Pressure Transmitter	4	PT 001 PT 002A PT 002B PT 002C
8	Pressure Indication Controller	1	PIC 001

16. CONCLUSION:

Water Intake and Treatment Filter Feed Sump and Pumps as well as Instrument Air Receiver piping instrumentation diagram projects detail engineering is carried out by following industrial legends that explain the equipment and general symbols of piping and its abbreviation. Data analysis has been done through plot plan, piping fluid velocities, piping schedules. Auto-cad drafting and pipe pro data software's were useful to analyze various kinds of fittings and bends in pipe location and installation aspects.

Program Outcomes (POs):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Engineering Graduates will be able to:

PSO-1: design and analyze various thermal systems used in power generation and human comfort.

PSO-2: design, analyze and develop products by adopting best manufacturing practices.

PSO-3: use various mechanical engineering software tools for design and analysis of various engineering components.

Gudlavalleru Engineering College

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, GUDLAVALLERU
Department of Mechanical Engineering

Class: IV B. Tech - I Sem **A.Y: 2020-2021**

Name of the Subject: Industrial /Practical Training **Batch: 2017-2021 (R17)**

Each CO is mapped with the POs and PSOs in three levels, '3' indicates high, '2' indicates moderate and '1' indicates low level

INDUSTRIAL / PRACTICAL TRAINING																
COURSE OUTCOMES	**PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**		**PSO1**	**PSO2**	**PSO3**
CO1: Identify, formulate and model problems, and propose solutions with industrial training undergone.																
CO2: Develop solutions keeping social, cultural, ethical and environmental factors.																
CO3: Compose oral and written presentations effectively																
CO4: Apply principles of management and team work in individual and multidisciplinary setup.																
CO5: Make use of trends in technology to solve real life problems.																
INDUSTRIAL /PRACTICAL TRAINING																

Name of the Faculty: **Signature of the Faculty:**