OIL & NATURAL GAS CORPORATION LTD.

REPORT ON THE SURFACE PROCESS AND MEASURING INSTRUMENTS

AT ADB AND KONABAN GCS

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B.TECH, 3RD YEAR, ROLL N0: 14UEI036

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Sincerely thanking all of the above once again ,I hope to continue to take the guide from the aforementioned in near future .It has been great experience for me.

Thanking You

Ashish Kumar Kanoujia

Electronics & Instrumentation Engineering

3rd Year, NIT Agartala

OIL AND NATURAL GAS CORPORATION

TRIPURA ASSET, AGARTALA

CERTIFICATE

This is to certify that **MR. ASHISH KUMAR KANOUJIA**, B.Tech(3rd year), of **NIT AGARTALA** has successfully completed the vocational training from **15th May,2017 to 14th June ,2017** under my close supervision. During the period he submitted a report on "**The Surface Process and Measuring Instruments at ADB and Konaban GCS**" which was found to be satisfactory.

While working in O.N.G.C, Tripura Assets, he was found to be sincere & hard working, he also bears a good character.

We wish his every success in his life.

Mr. R.S. MONDAL — **Dy. Manager (HR)-TRG**

Mr. G. MANJUNATHA — **CE(Instrumentation)**

CONTENTS

INTRODUCTION

ONGC (OIL AND NATURAL GAS CORPORATION OF INDIA)

ONGC is an Indian multinational oil and gas company headquartered in Dehradun, India. It is a Public Sector Undertaking (PSU) of the Government of India, under the administrative control of the Ministry of Petroleum and Natural Gas. It is India's largest oil and gas exploration and production company. It produces around 69% of India's crude oil (equivalent to around 30% of the country's total demand) and around 62% of its natural gas.

HISTORY OF ONGC

During the period of pre-independence of India, the Assam Oil Company in the north-eastern and Attock Oil Company in north-western part of the undivided India were the only oil producing companies, with minimal exploration input.

Until 1955, private oil companies mainly carried out exploration of hydrocarbon resources of India. The Assam oil Company was producing oil at Digboi (discovered in 1889) and Oil India Ltd. (a 50% joint venture between Government of India and Burma Oil Company).

In 1955, Government of India decided to develop the oil and natural gas resources in the various regions of the country as part of the Public Sector development. With this objective, an Oil and Natural Gas Directorate was set up towards the end of 1955, as a subordinate office under the then Ministry of Natural Resources and Scientific Research. The department was constituted with a nucleus of geoscientists from the Geological Survey of India.

In 14th August 1956, the directorate was raised to commission with enhanced power. In October 1959 the commission was converted into a stationary body by an act of Indian Parliament which enhanced the power of the commission.

MAIN FUNCTIONS OF ONGC :

1. To plan, promote, organize and implement programs for development of petroleum resources.

2. Production & Sale of products & petroleum products produced by it.

3. To perform other function as the central govt. may hand over time to time.

ONGC VIDESH

ONGC Videsh Ltd. (OVL) is an Indian oil company whose primary business is prospecting for oil and gas acreages overseas. As part of its exploration, development and production efforts, the company owns stakes in 36 oil and gas assets in 17 countries. It contributes 14.5% and 8% of India's oil and natural gas production, respectively. Its oil and gas operations produced 8.36Mt of oil and oil equivalent gas in 2013-2014. ONGC holds 100% stake in ONGC Videsh Limited.

Presence of ONGC Videsh Limited(OVL)in Latin America:

- Brazil
- Colombia
- Cuba
- Venezuela

Presence of ONGC Videsh Limited (OVL) in CIS & Far-East:

- Vietnam
- Myanmar
- Russia
- Kazakhstan

Presence of ONGC Videsh Limited (OVL) in Africa:

- Libya
- Nigeria
- Sudan & South Sudan
- Mozambique

Presence of ONGC Videsh Limited (OVL) in MiddleEast:

- Iraq
- Syria

ONGC TRIPURA ASSETS

TRIPURA is one of the main work centres of ONGC in North-eastern region. It is based at Agartala with man power from all over India.

Agartala asset mainly produces gas consisting of Methane (CH4) almost 98.99%.

Agartala asset:

- 3 Drilling Rigs.
- 2 ONGC Rigs .
- 1 Private Rig.

Average gas production is 2.3 mm3/day for the Agartala assets.

In Agartala ONGC sells it to

 GAIL

 NEEPCO

 TNGCL

Seeing the gas production and natural resources the ONGC has started a joint venture project **OTPC.**

ONGC TRIPURA POWER COMPANY (OTPC) :

OTPC is a joint venture which was formed in September 2008 between ONGC,Infrastructure Leasing and Financial Services Limited and the Government of Tripura.It is developing a **726.6MW** CCGT thermal power generation project at Palatana in Tripura which will supply electricity to the power deficit areas of the north eastern states of the country.OTPC have Machines Supplied by GE USA. A 400 kV D/C Transmission system connecting Palatana (generation project site) in Tripura to Bongaigaon in Assam over a distance of around 650 km for the evacuation of power from the generation project.

SURFACE PROCESS AT ONGC

The work process at ONGC occurs in 3 steps:

- **Exploration**: Locating the probable oil or gas resources
- **Drilling**: Extraction of the oil and gas
- **Processing**: Seperating the products extracted and preparing for delivery to consumers.

So, naturally the ONGC composed of following teams:

- **Survey Teams**
- **Drilling Teams (Rigs)**
- **Surface Teams**

Survey Teams: This team comes into picture first after ONGC takes oany part of land for exploration of natural resources. Main aim is to find the place where any resources may present at some depth. So,the job of the team is to tell about places where we are likely to get petroleum products, at some approximate depth.This team basically consists of geologists, scientists physicist and chemists.

Drilling Teams: The team comes into action secondly when survey team has submitted their report, these drills and find the actual condition of petroleum products present inside the rocks. Then, it finds the actual quantity of gas & petroleum found in a reservoir.

Surface Teams: The job of this team is to collect and produce the gas /petroleum product and to sell them to their desired customer in a safe and secure way.

SURFACE PROCESS AT ADB GCS:

ADB GCS (Gas collecting Station) is one of the most important projects under ONGC, Tripura Asset. It is located about 12Km away from the project office, Badharghat, Agartala, Tripura West. In ADB GCS total 22 nos. Of wells are connected. The existing capacity of ADB GCs is 2.2 MMSCMD of gas. The main consumer of ADB GCS are TSECL (Tripura State Electricity Corporation Ltd.), GAIL, TNGCL, OTPC.

SURFACE FACILITIES AT ADB GCS:

- ✓ Well head
- ✓ Well header
- ✓ Flow line network
- ✓ Storage tank
- ✓ Metering station
- ✓ Fire fighting system
- ✓ Instrumentation system
- ✓ Electrical system
- ✓ Flare system

Fig:- Well head at ADB GCS

PROCESS FLOW DESCRIPTION AND EQUIPMENTS:

- ✓ **MANIFOLD:**

The gas from different flow lines of the wells flows to the GCS. The gas first enters into the manifold. After temperature and pressure measurement in each flow line the gas flows through individual bean housing for pressure reduction. Then the gas is measured in each flow line while pressure is measured at one place only after shut down valve in each header. The gas is collected into two headers (named production header & test header) as per the line up.

- ✓ **HP HEADER**:

The HP or high pressure header collects gas along with condensate & water from the fluid wells. The gas and liquid flows into 3phase HP separator (V-101) via bath heater (E-101A) to avoid hydrate formation. The gas is to be maintained at 60 kg/cm^{2}.

- ✓ **MP HEADER:**

The medium pressure header receives gas which also contains condensate & water from medium pressure wells. This fluid directly goes to 3-phase MP Separator (V-102).

- ✓ **TEST HEADER:**

This is meant for testing of individual wells. The operating pressure can be 60 kg/cm2 lower up to 28 kg/cm2 depending upon the pressure of the wells to be tested. The gas from this header flows into 3-phase Test Separator (V-107) via bath heater (E-101B).

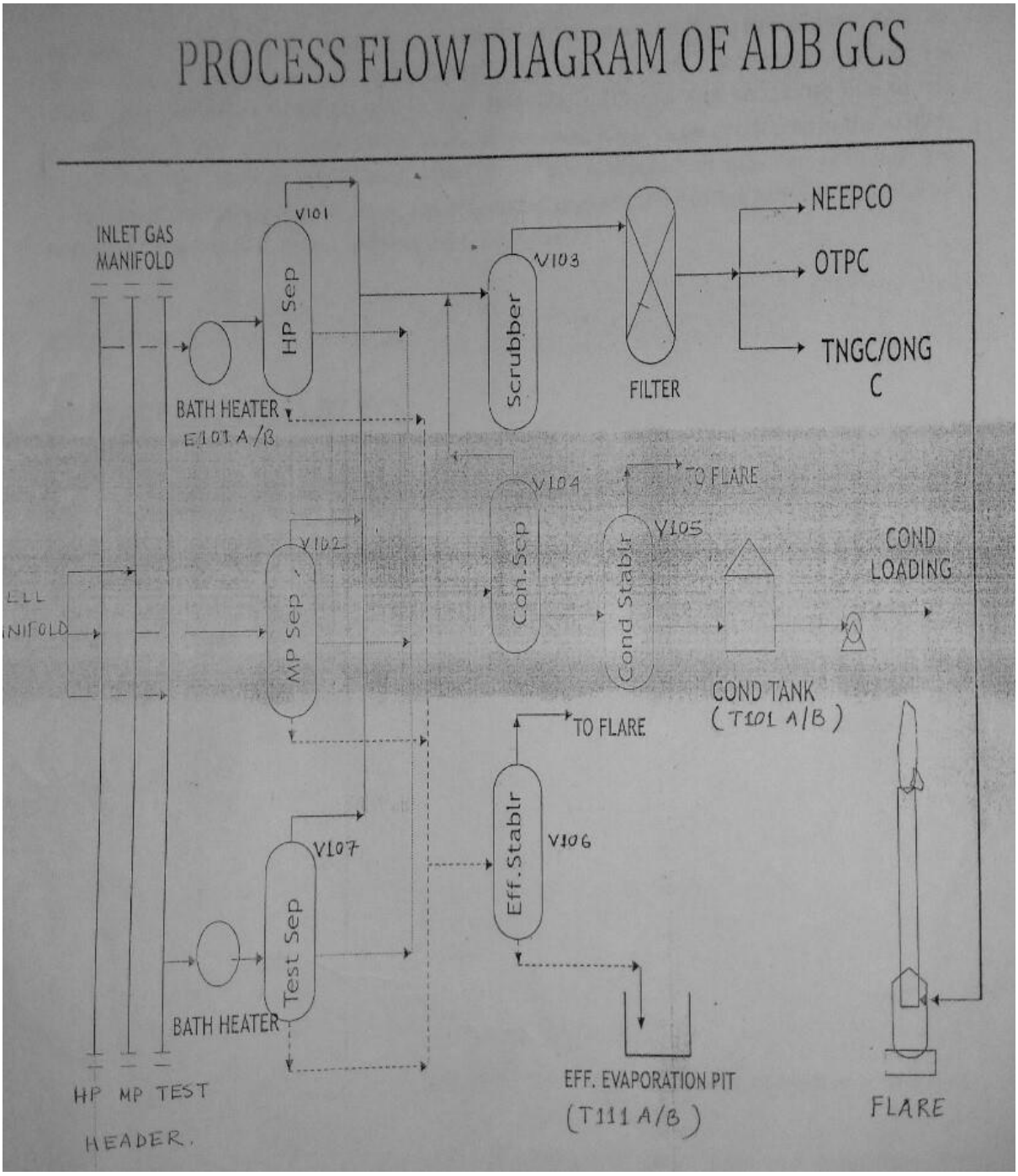


Fig: Process flow diagram at ADB GCS.

- ✓ **<u>BATH HEATER</u>**:

A process bath heater is a simple and safe method for indirectly heating various process mediums. A bath solution is heated by a fire tube style burner submerged at the bottof of the heater vessel. The bath solution then heats a submerged process coil, in which the flowing process medium is then heated. Water-glycol mixtures are very common solutions for most low temperature heating applications, and can typically be used up to 250F. Salt melts can be used to meet the higher operating temperature in some specialized applications. An indirect bath heater (E-101A) is used to heat he HP header fluid stream up to 35oC at 60kg/cm2. Then the fluid is fed in HP separator. There should not be any hydrate formation in subsequent reduction of pressure if indirect bath heater is used to heat the gas stream. A separate bath heater (E-101B) is used to heat tset fluid before feeding into the test separator (V-107) to avoid hydrate formation in subsequent reduction of the pressure. The test bath heater may be used as stand by heater for HP heater if required.

- ✓ **SEPARATORS:**

Separators are employed to cause a primary phase separation of the liquid hydrocarbon from those that are Gas and to discharge the separated gas and liquid from the vessel and ensure that no re-entrainment of one into the other takes place. Three kinds of separators are used at the field :

HP SEPARATOR:

The fluid from HP header flows into HP separator (V-101) via bath heater (E-101A), which is to be maintained at 60kg/cm2. The fluid is to be heated up before sending into HP separator. The gas from the HP separator will flow to Gas Scrubber (V-103) at 24kg/cm2.

MP SEPARATOR:

After receiving fluid from wells MP header directly feeds it to MP separator (V-102). Gas released from MP separator is sent to Gas Scrubber for further processing.

TEST SEPARATOR:

The gas and liquids from test header flow via bath heater (E-101B) into test separator (V-107). This separator can be used as standby of V-101 or V-102 in case of shut down of these separators. The gas from test separator will flow into Gas Scrubber for further processing.

- ✓ **Gas Scrubber:**

The gas from HP & MP separator will flow to the gas scrubber at 24 kg/cm^2 for further processing. The gas from the gas scrubber flows to filters to supply liquid free gas to consume after measurement. The gas from gas scrubber flows to filters (F101A/B) to supply liquid free gas to the consumers.

- ✓ **CONDENSATE TANKS:**

The condensate and water from HP separator are received in condensate Separator (V-104). . The condensate from condensate separator flows to condensate stabilizer (V-105) for further stabilization. Finally, the condensate from V-105 is sent to storage tanks (T101A/B).

Fig: Condensate tanks at ADB GCS.

- ✓ **Effluent Water Stabilizer:**

The water from separators is received in this (V-106) at 1.5 kg/cm^2 for stabilization. The Effluent water from effluent water stabilizer is sent to Effluent Water Evaporation Pit (T-111A/B) after stabilization for onward disposal.

- ✓ **FLARE** :

The flare gas will flow to horizontal Knock Out Drum (KOD) (V-108) where liquid droplets are arrested and after that it will flow to flare stack and will be burnt out at safe disposal point to take care of pollution measures.

Fig: The Flare at ADB GCS.

- ✓ **INSTRUMENT GAS RECEIVER:**

Sufficient amount of gas is taken in the instrument gas receiver (V-109) through gas dryer (D-101A/B) from the outlet of the Gas filter (F-101A/B) for instrumentation purpose. Heatless regenerative dryer is used to remove the moisture in the gas so that dry gas is used for instrumentation.

SURFACE PROCESS AT KONABAN GCS:

The surface process at Konaban GCS and Agartala Dome are mostly same except that there are 64 numbers of wells at Konaban and that the production quantity is a bit lower than ADB.

The equipments present in Konaban GCS are:

- ✓ Separators: Production seperators, Test separator.
- ✓ Water Flash Drum
- ✓ Condensate stabilizers
- ✓ Effluent gas stabilizers
- ✓ Gas Srubbers
- ✓ Gas Filters
- ✓ Flare system

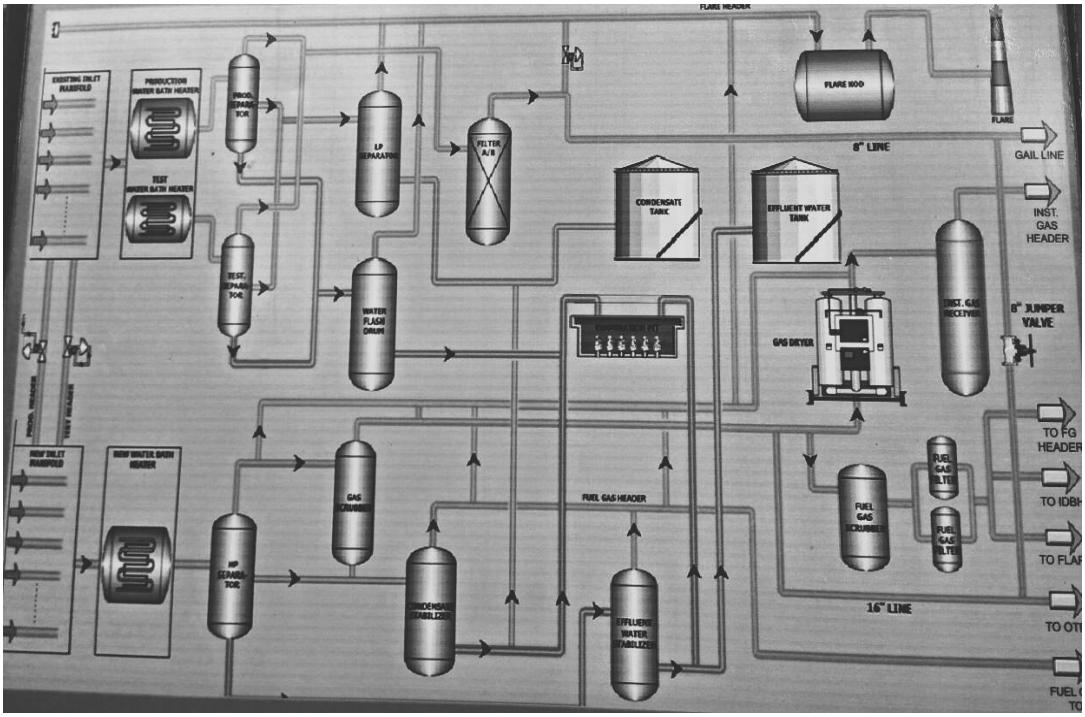


Fig: Process Flow Diagram of Konaban GCS.

MEASURING INSTRUMENTS:

- ✓ Pressure Measurement
- ✓ Flow Measurement
- ✓ Level Measurement
- ✓ Temperature Measurement

PRESSURE MEASUREMENT:

1. PRESSURE GAUGE:

Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure pressure are called pressure gauges or vacuum gauges. These are mainly C-type Bourdon tube. They are used for high pressure measurement.

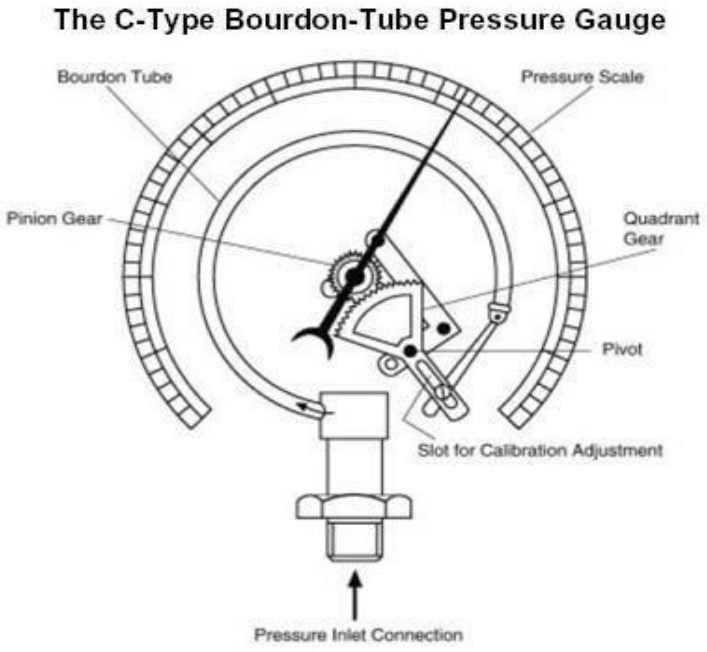


Fig: C-type bourden tube pressure gauge.

2. Piezoresistive transducers:

Resistance bridge – 4 active arms

Strain-gauge – Calibration required at temperature

Example: Endevco 8510B

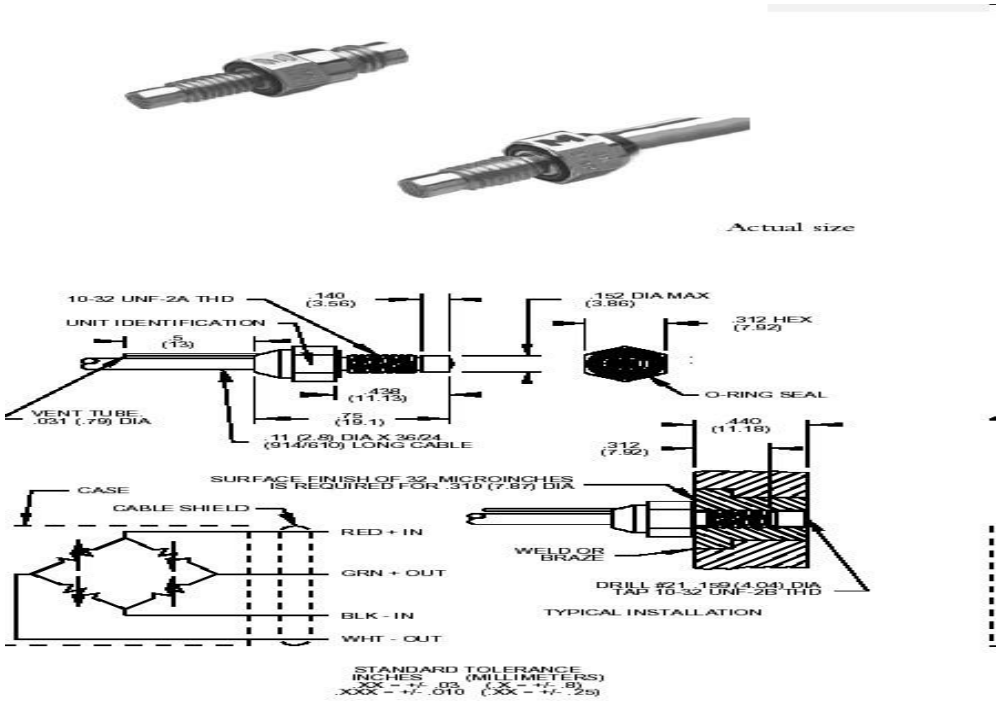


Fig: Piezo-resistive transducers.

FLOW MEASUREMENT:

1. ORIFICE PLATE: .

An orifice plate is a device used for measuring flow rate, for reducing pressure or for restricting flow (in the latter two cases it is often called a restriction plate). Either a volumetric or mass flow rate may be determined, depending on the calculation associated with the orifice plate. It uses the same principle as a Venturi nozzle, namely Bernoulli's principle which states that there is a relationship between the pressure of the fluid and the velocity of the fluid. When the velocity increases, the pressure decreases and vice versa.

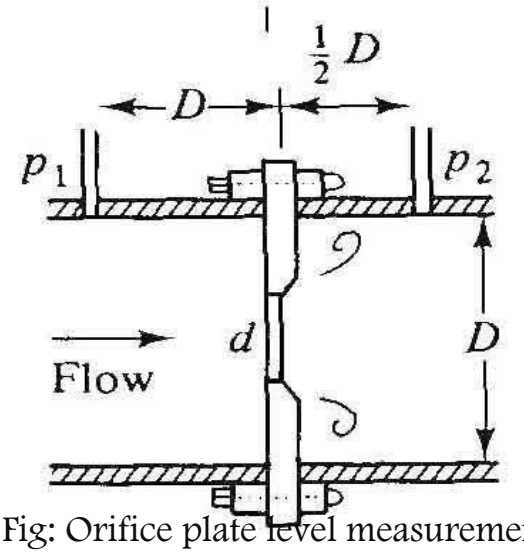


Fig: Orifice plate level measurement

2.Flow measurement using differential pressure type

As we know that velocity of fluid is directly proportional to the square root of differential pressure across the orifice plate. After measuring the velocity of the fluid we can measure the flow rate easily.

3. CORIOLIS FLOW METER:

A mass flow meter, also known as an inertial flow meter is a device that measures mass flow rate of a fluid travelling through a tube. The mass flow rate is the mass of the fluid travelling past a fixed point per unit time.

The mass flow meter does not measure the volume per unit time (e.g., cubic meters per second) passing through the device; it measures the mass per unit time (e.g., kilograms per second) flowing through the device.

Volumetric flow rate is the mass flow rate divided by the fluid density. If the density is constant, then the relationship is simple. If the fluid has varying density, then the relationship is not simple. The density of the fluid may change with temperature, pressure, or composition, for example. The fluid may also be a combination of phases such as a fluid with entrained bubbles.

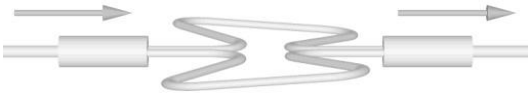


Fig: Coriolis Mass Flow Meter

There are two basic configurations of coriolis flow meter: the curved tube flow meter and the straight tube flow meter. When there is mass flow, there is some twisting of the tubes. The arm through which fluid flows away from the axis of rotation must exert a force on the fluid to increase its angular momentum, so it is lagging behind the overall vibration. The arm through which fluid is pushed back towards the axis of rotation must exert a force on the fluid to decrease the fluid's angular momentum again; hence that arm leads the overall vibration.

The inlet arm and the outlet arm vibrate with the same frequency as the overall vibration, but when there is mass flow the two vibrations are out of sync: the inlet arm is behind, the outlet arm is ahead. The two vibrations

listed below with the positive electrode (assuming) first, followed by the negative electrode.

LEVEL MEASUREMENT:

LEVEL DETECTION USING DIFFERENTIAL PRESSURE:

Differential pressure level measurement technique makes use of a differential pressure detector which is installed at the bottom of the tank whose level is to be detected. The liquid inside the tank creates pressure which is comparatively higher than the reference atmospheric pressure. This pressure comparison is performed via the Differential pressure detector.

In case of open tanks i.e. tanks which are open to the atmosphere, only high pressure ends of the DP transmitter is needed to be connected whereas the low pressure end of the DP transmitter is expelled into the atmosphere. Hence, the differential pressure happens to be the hydrostatic head or weight of the fluid contained

in the tank. The highest level detected by the differential pressure transmitter usually depends upon the maximum height of fluid above the transmitter, whereas the lowest level detected is based upon the position where the transmitter is attached to the tank or vessel. Now, in cases where tanks or vessels are not open to the atmosphere i.e. in pressurized tanks, both the high and low pressure ends of the differential pressure detector are required to be connected. These tanks are entirely covered in order to avoid release of vapours or steam outside. Due to this, the liquid inside the tank gets pressurized.

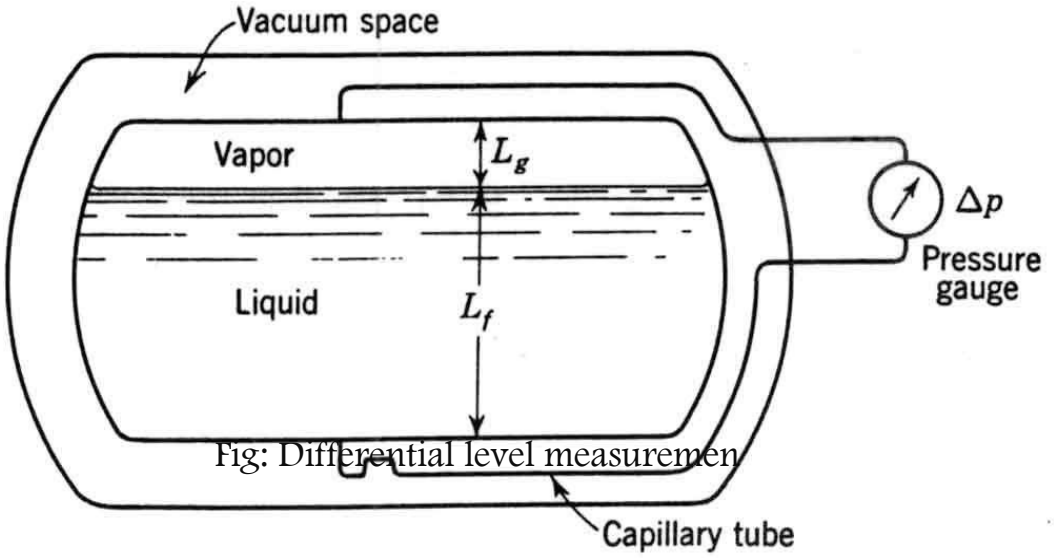


Fig: Differential level measuremen

Capacitive Level Gauges:

Most are custom, some are available As a prototype commercial units,Particularly for high dielectric constant fluids (e.g. LN2) Measurement Methods:

- AC Bridge
- High frequency oscillator
- Time constant method
- Phase-lock loop technique

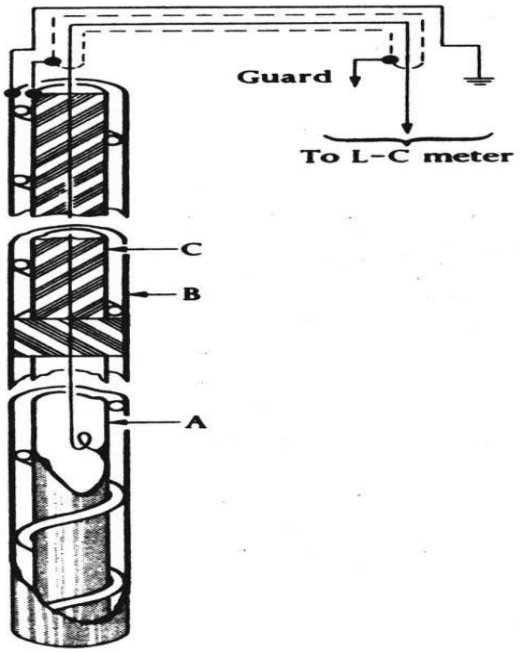


Fig: Capacitive level measurement

Ultrasonic level measurement:

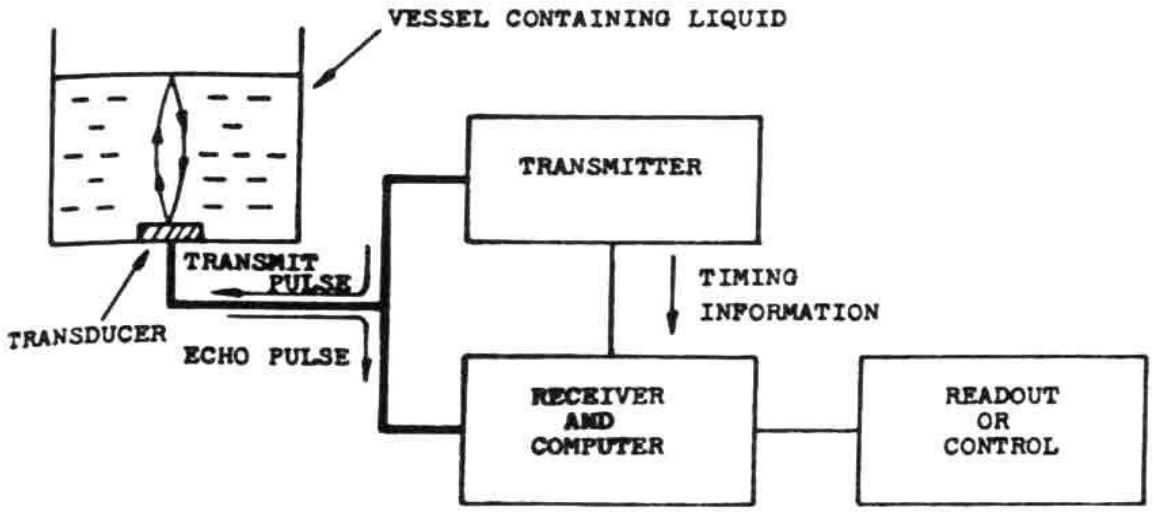


Fig: Ultra sonic level measurement

GENERAL LOOPS USED IN MEASUREMENT PROCESS:

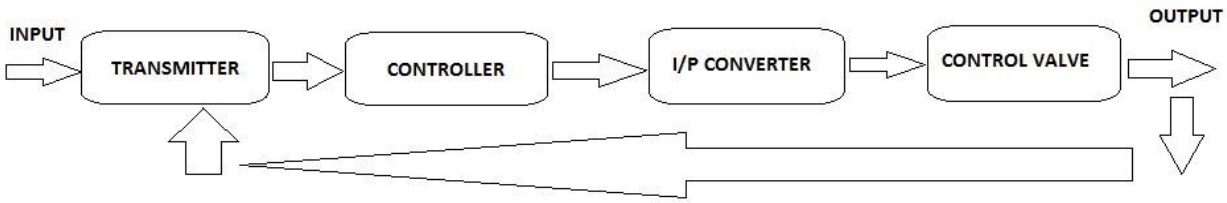


Fig: A closed loop control system

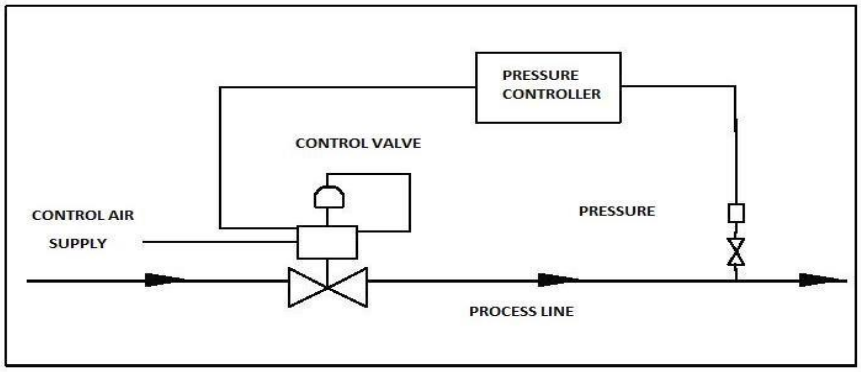


Fig: A pressure control loop

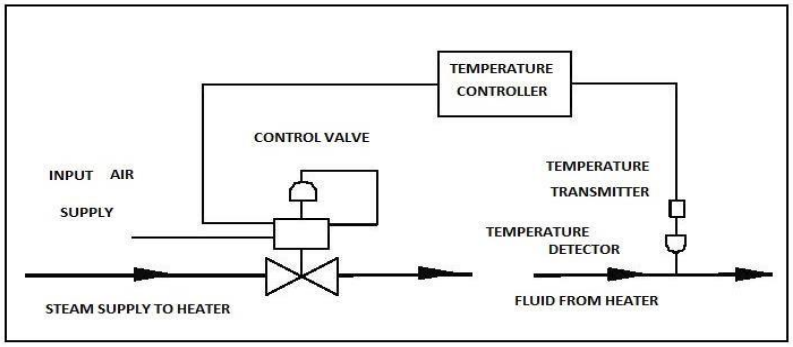


Fig: A temperature control loop

CONTROL VALVES:

Control valves are valves used to control conditions such as flow, pressure, temperature, and liquid level by fully or partially opening or closing in response to signals received from controllers that compare a "setpoint" to a "process variable" whose value is provided by sensors that monitor changes in such conditions. Control Valve is also termed as the Final Control Element.

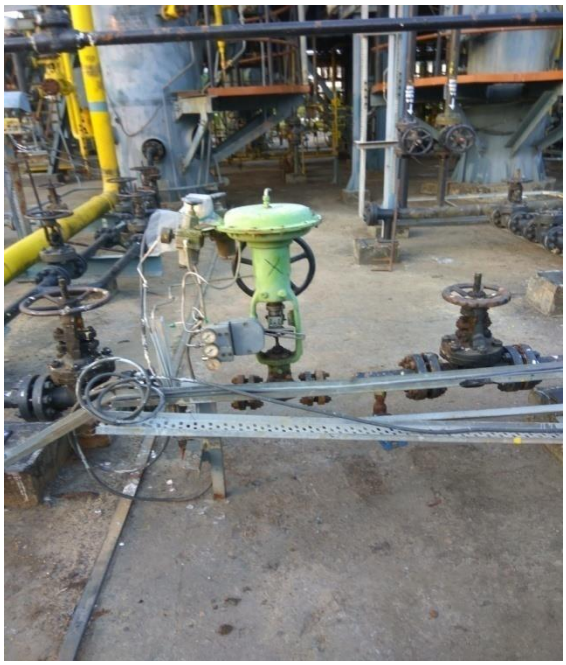


Fig: A control valve at ADB GCS

The opening or closing of control valves is usually done automatically by electrical, hydraulic or pneumatic actuators. Positioners are used to control the opening or closing of the actuator based on electric, or pneumatic signals. These control signals, traditionally based on 3-15psi (0.2-1.0bar), more common now are 4-20mA signals for industry, 0-10V for HVAC systems, and the introduction of "Smart" systems, HART, Fieldbus Foundation, and Profibus being the more common protocols. Some of the control valve available is Reverse Double-Ported Globe-Style Valve Body, Three-Way Valve with Balanced Valve Plug, Flanged Angle-Style Control Valve Body, and Valve Body with Cage-Style Trim, Balanced Valve Plug, and Soft Seat.

A control valve consists of three main parts in which each part exist in several types and designs:

- Valve's actuator
- Valve's positioner

Fig: Schematic diagram of a control valve.

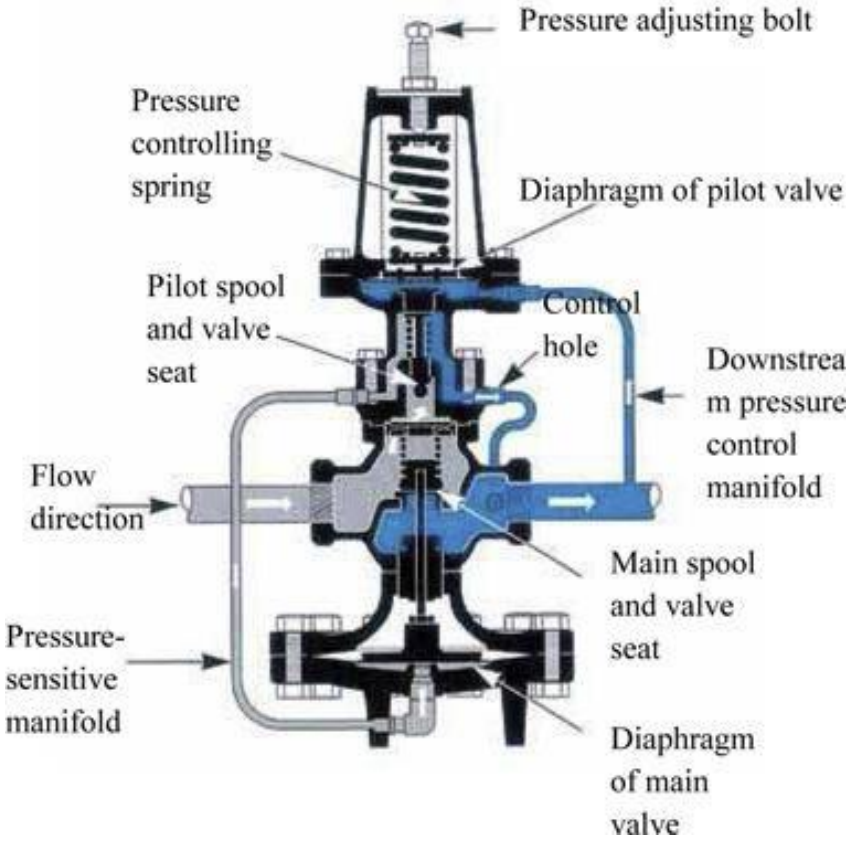
TYPES OF VALVE:

For fluids, metal seated ball valves are used as shut-down valves (SDV's). Use of metal seated ball valves leads to overall lower costs

when taking into account lost production and inventory, and valve repair costs resulting from the use of soft seated ball valves which have a lower initial cost.

Straight-through flow valves, such as rotary-shaft ball valves, are typically high-recovery valves. High recovery valves are valves that lose little energy due to little flow turbulence. Flow paths are straight through. Rotary control valves, butterfly valve and ball valves are good examples.

For air intake shut down, two distinct types are commonly utilized, i.e. butterfly valves and swing gate or guillotine valves. Because diesel engines ignite fuel using compression instead of an electronic ignition, shutting off the fuel source to a diesel engine will not necessarily stop the engine from running. When an external hydrocarbon, such as methane gas, is present in the atmosphere, it can be sucked into a diesel engine causing over speed or over revving, potentially leading to a catastrophic failure and explosion. When actuated, ESD valves stop the flow of air and prevent these failures.



SOLENOID VALVE:

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a twoport valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design. Besides the plunger-type actuator which is used most frequently, pivoted armature actuators and rocker actuators are also used.

Parts of Solenoid Valve

1) Valve body
2) Inlet port
3) Outlet port
4) Coil / Solenoid
5) Coil winding
6) Lead wires
7) Plunger or piston
8) Spring
9) Orifice

Solenoid valve is used to control the flow of automation basic element, belongs to the actuator, not limited to hydraulic, pneumatic. Solenoid valve used to control the direction of hydraulic flow, the factory machinery is general by hydraulic steel control, so will use the solenoid valve.

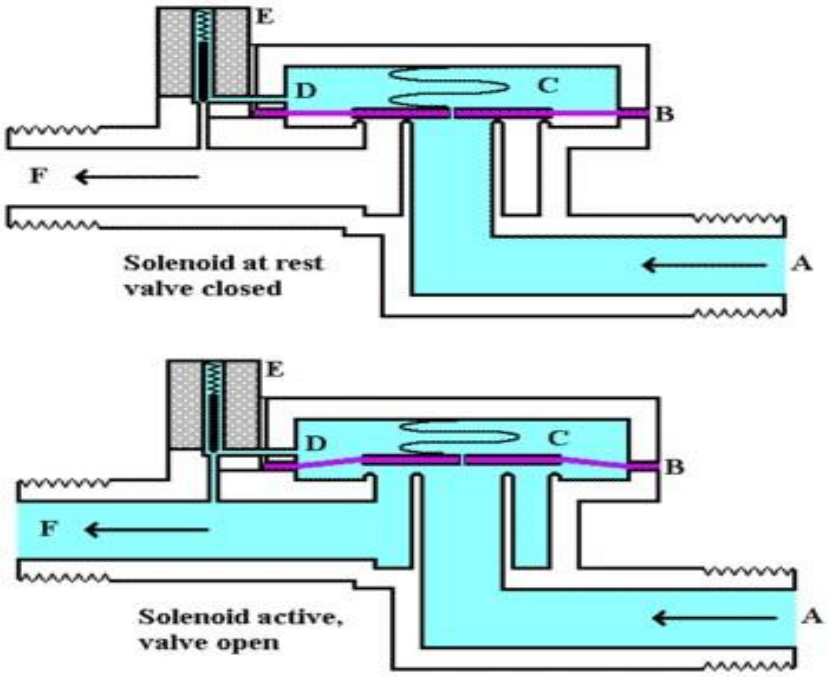


Fig: Schematic diagram of a solenoid valve in action.

The working principle of solenoid valve, solenoid valve has closed cavity, in different position opened a through hole, each hole all leads to different tubing, cavity intermediate is valve, both sides are two pieces of electromagnet, which face the magnet coil electricity will be attracted to the body which side, by controlling the movement of the body to live or file a different discharge of oil leakage of the hole, and the oil hole is always open, hydraulic fluid will enter the different oil drain, and then through the oil pressure to push oil just the pistons, piston and piston rod driven, piston driven mechanical devices moving pole. So through the control electromagnet current controls the mechanical movement. ZF Hydraulic & Pneumatic parts Co., Ltd supply kinds of solenoid valve, such as Yuken type DSG directional solenoid valve, Rexroth type directional solenoid valve and etc.

SAFETY VALVES:

A safety valve is a valve which has the function of increasing the safety of a thermal-hydraulics plant. An example of safety valve could be a pressure safety valve (PSV), i.e. a pressure relief valve (PRV) which automatically releases a substance from a boiler, pressure vessel, or other system, when the pressure or temperature exceeds preset limits. Also pilot-operated relief valves could have the function of safety valves. Safety valves were first used on steam boilers during the Industrial Revolution. Early boilers operating without them were prone to accidental explosion. Vacuum safety valves (or combined pressure/vacuum safety valves) are used to prevent a tank from collapsing while it is being emptied, or when cold rinse water is used after hot CIP (clean-in-place) or SIP (sterilization-in-place) procedures. When sizing a vacuum safety valve, the calculation method is not defined in any norm, particularly in the hot CIP / cold water scenario, but some manufacturers have developed sizing simulations.

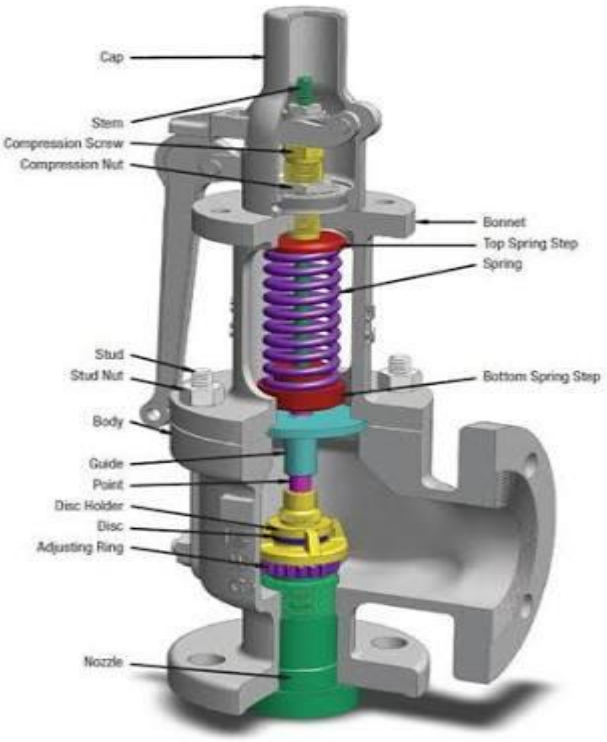


Fig: Schematic of a safety valve

SHUTDOWN VALVES:

A shut down valve (also referred to as SDV or Emergency shutdown valve, ESV, ESD, or ESDV) is an actuated valve designed to stop the flow of a hazardous fluid or external hydrocarbons (gases) upon the detection of a dangerous event. This provides protection against possible harm to people, equipment or the environment. Shutdown valves form part of a Safety instrumented system. The process of providing automated safety protection upon the detection of a hazardous event is called Functional Safety.

Fig: A shutdown valve

Shutdown valves are primarily associated with the petroleum industry although other industries may also require this type of protection system. ESD valves are required by law on any equipment placed on an offshore drilling rig to prevent catastrophic events like the BP Horizon explosion in the Gulf of Mexico in 2010.

PROGRAMMABLE LOGIC CONTROLLER :

A programmable logic controller, PLC, or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many machines, in many industries. PLCs are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in batterybacked-up or non-volatile memory. A PLC is an example of a "hard" realtime system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

Fig: PLC systems

PROGRAMMING :

Early PLCs, up to the mid-1990s, were programmed using proprietary programming panels or special-purpose programming terminals, which often had dedicated function keys representing the

various logical elements of PLC programs. Some proprietary programming terminals displayed the elements of PLC programs as graphic symbols, but plain ASCII character representations of contacts, coils, and wires were common. Programs were stored on cassette tape cartridges. Facilities for printing and documentation were minimal due to lack of memory capacity. The very oldest PLCs used non-volatile magnetic core memory.

More recently, PLCs are programmed using application software on personal computers, which now represent the logic in graphic form instead of character symbols. The computer is connected to the PLC through Ethernet, RS-232, RS-485, or RS-422 cabling. The programming software allows entry and editing of the ladder-style logic. Generally the software provides functions for debugging and troubleshooting the PLC software, for example, by highlighting portions of the logic to show current status during operation or via simulation. The software will upload and download the PLC program, for backup and restoration purposes. In some models of programmable controller, the program is transferred from a personal computer to the PLC through a programming board which writes the program into a removable chip such as an EPROM.

PROGRAMMABLE LOGIC RELAY :

In more recent years, small products called PLRs (programmable logic relays), and also by similar names, have become more common and accepted. These are much like PLCs, and are used in light industry where only a few points of I/O (i.e. a few signals coming in from the real world and a few going out) are needed, and low cost is desired. These small devices are typically made in a common physical size and shape by several manufacturers, and branded by the makers of larger PLCs to fill out their low end product range. Popular names include PICO Controller, NANO PLC, and other names implying very small controllers. Most of these have 8 to 12 discrete inputs, 4 to 8 discrete outputs, and up to 2 analog inputs. Size is usually about 4" wide, 3" high, and 3" deep. Most such devices include a tiny postage-stamp-sized LCD screen for viewing

simplified ladder logic (only a very small portion of the program being visible at a given time) and status of I/O points, and typically these screens are accompanied by a 4way rocker push-button plus four more separate push-buttons, similar to the key buttons on a VCR remote control, and used to navigate and edit the logic. Most have a small plug for connecting via RS-232 or RS-485 to a personal computer so that programmers can use simple Windows applications for programming instead of being forced to use the tiny LCD and push-button set for this purpose. Unlike regular PLCs that are usually modular and greatly expandable, the PLRs are usually not modular or expandable, but their price can be two orders of magnitude less than a PLC, and they still offer robust design and deterministic execution of the logics.

THANK YOU