Appendix C - Field Instrument Technologies

Device / Recommended Manufacturers	Description	Advantages	Disadvantages	Application
1. Flow Measurement				
Electromagnetic Flow Meters Yokogawa Emerson Endress & Hausser	Measure the velocity of an electrically conductive liquid as it cuts the magnetic field produced across the metering tube	No moving components, chemical compatibility with virtually all liquids, indifference to viscosity, pressure, temperature and density, linear analog output, suitable for bi-directional flow, extensive range of sizes, and ease and rapidity of re-ranging on site.	Fluid must be electrically conductive (not suitable for gas flow measurements), Initial capital cost is high and approach pipe workflow profile conditions are fairly critical.	Raw and Treated water High turndown and/or accuracy applications.
Variable Area Flow Meters ABB King Key Instruments	Measure the flow of gases and clear liquids. The equilibrium position of the float is proportional to flow rate with direct reading	Very low cost, direct reading, no power supply required, suitable for both gases and liquids, including high viscosity products, minimal pipe work installation.	Limited size therefore very low flow rate and pressure capability, high-pressure loss and limited accuracy. The output signal is not available as standard.	Chemical Injection equipment
Flow Switches Magnatrol Kayden	Flow switches are commonly used to determine if the flow rate is above or below a certain value. This value (the set point) can be fixed or adjustable.	Low cost for paddle designs (some electronic units are higher cost), large variety of flow switch types (capacitance, hot wire, paddle, thermal, ultrasonic, valve body and variable area).	Paddle type flow switches are sensitive to pipeline turbulence, pipe vibration and installation configuration, and incapable of distinguishing low flow velocities from no-flow conditions. Thermal type flow switches cannot respond instantaneously to flow changes.	No flow detection for pump protection purposes.
2. Pressure Measurement				
Absolute Pressure Instruments Yokogawa Emerson Endress & Hausser	These meters use a bellows-type, bourdon-type, piezo crystal or diaphragm-type pressure sensors for the principle of operation.	Diaphragm-type pressure sensors are the most sensitive pressure detector in the family of elastic element sensors. Piezo crystal devices do not drift unlike LVDT type devices.	Bellows elements include being subject to work hardening and sensitive to ambient temperature variations. The disadvantages of bourdon elements include being not ideally suited for low-pressure, vacuum or compound measurements.	Various process line systems pressure Aeration Pressure Instrument Air System Pressure
Pressure Switches Dwyer United Electric ITT Neo-Dyne	Pressure switches are used commonly to energize and de-energize electrical circuits as a function of the relationship between the process pressure and a predetermined set point.	Cheap and relatively easy to install		Pump / system over pressure protection

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Pressure Accessories	Chemical Seals or diaphragm protectors can be provided with most pressure sensors. These components prevent corrosive slurries or viscous polymers from entering and plugging the detector element. Pneumatic to Current (P/I) or (I/P) Converters – used to convert pneumatic signals to an electrical format for use with electronic transmitters/controllers.			Pressure measurement or switching for applications where the process fluid is not compatible with the device internals.
3. Level Measurement				
Level Probes (Conductivity) Magnatrol Emerson Endress & Hausser	Switches are available in a variety of configurations; they can be used for on-off control of individual equipment or for staged control of several pieces of equipment. Wide variety of additional control requirements can be met by increasing the number of probes and relays.	Low cost, simple design, no moving parts in contact with the process liquid.	Limited in application to conductive and non-coating processes.	Point level detection for water or chemical storage systems
Electronic Differential Pressure Level Transmitters Yokogawa Emerson Endress & Hausser	Differential pressure can be detected by sensing two pressures separately and taking the difference to obtain liquid level. The most widely used method of level measurement in the vessels. For vessels operated at atmospheric pressure, the high side of the instrument is connected to the bottom of the vessel and the low side is vented to atmosphere. For pressurized vessels, the high side is connected to the vapour space in the vessel.	Generally reliable and low maintenance when used with chemical seals.	Depending upon tank size – costly to route LP leg. Require adequate working space for maintenance purposes, sometimes difficult to access. Additional equipment e.g. manifold isolation	Filter level and headloss detection
Float Level Switches Flygt Magnetrol	Follow the liquid level in the tank or vessel. They all fall into two types: Direct connected for atmospheric tanks Sealed units for pressurized tanks	When used as secondary level monitoring device – extremely cost effective solution.	When used as primary detection device in dirty service applications float level switches require regular maintenance.	Redundant device for High Level detection in tanks or vessels

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Ultrasonic Level Siemens Milltronics Endress & Hauser Emerson Magnetrol	Principle of operation of this unit is based on measurement of the time required for an ultrasonic pulse to travel to the process liquid and back. The transducer/receiver are packaged as a single unit and mounted above the liquid level.	Absence of moving parts and the capability for continuous measurement without contacting the process liquid. Unaffected by variations in composition, density, thermal or electrical conductivity, capacitance or other variables.	Not suitable for liquids with surface bubble generation.	Raw or treated water wells with sufficient head space for the transducer and its inherent blanking zone
4. Temperature Measurement				
RTDs Emerson Endress & Hauser	Operate on the principle of an increase in resistance with an increase in temperature. They are usually used where the temperature to be measured is less than 120°C.	Most stable & accurate of all temperature measuring devices, less susceptible to electrical noise, require no reference and are easy to interchange.	Relatively more expensive compared with T/Cs, have a slower response and require a current source, limited temperature range.	Ultra sonic flow measurement. pH measurement
Temperature Transmitters Yokogawa Emerson Endress & Hausser	Operate in conjunction with the above temperature sensors. The transmitter will process the electrical signal from the sensor and condition to an industrial standard 4-20mA signal. See above for advantages and disadvantages.	Necessary when transmitting data electronically to plant computer systems.		
Temperature Switches Endress & Hauser Moore Industries ITT Neo-Dyne	Temperature sensors generally utilize a Resistive Temperature Detector (RTD) for temperature measurement. Temperature is sensed by measuring the change in resistance of the RTD. As temperature increases, resistance of the RTD also increases. The signal is evaluated by a micro-processor inside the temperature control monitor and will energize and de-energize electrical circuits depending on the set point value.		See 4.1 for disadvantages.	Various types of pump and/or motor protection
5. Analytical Instrumentation				
Ambient Gas Detection MSA Detectronics	Combustible Gas – Infrared detection or catalytic reaction measurement technique Toxic (H2S) Gases - Infrared detection or electrochemical cell	Bi-annual calibration verification required No moving parts	Sensors must be kept dry Storage and use of calibration gases (hazardous material)	Personnel protection in Hazardous locations