ASGMT

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STRATEGY | PROJECT DEVELOPMENT | CAPITAL

SEPTEMBER 2022
DESIGN OF COMPLETE METERING, PREHEATING, FCV, BI-DI, REGULATING, ODORIZATION and SCADA FACILITIES

Presented by

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Agenda

1. History and Supply Chain of Natural Gas Pipelines, Underground Storage LNG facilities and H2 in US

2. Measurement Concepts, Codes and Standards, Project Cycle and IA Process

3. Design of Complete M&R systems: Pipeline Tap, Metering, FCV, Pre-heat, Regulating, Odorization, SCADA

US HISTORICAL OVERVIEW:

NATURAL GAS, UNDERGROUND STORAGE AND LNG DEVELOPMENT

US IN GAS AT 50,000 FT IN 2022

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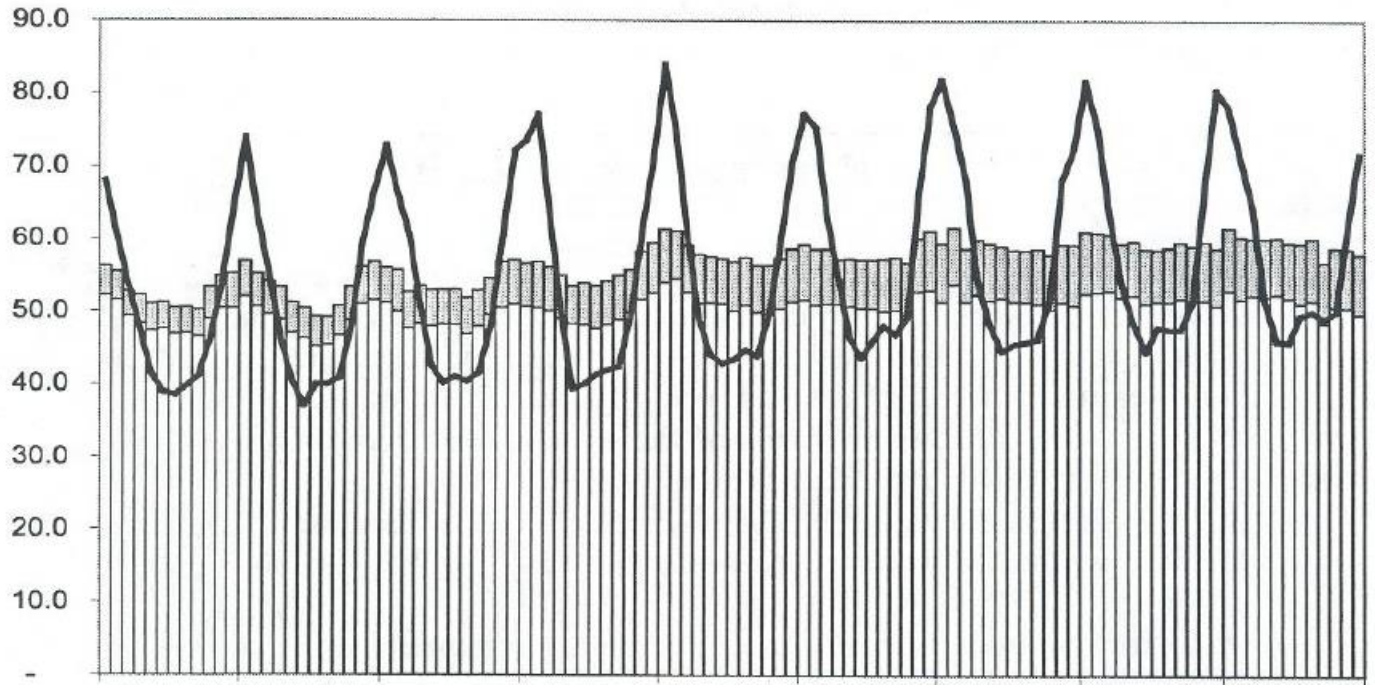
30 TCF/Y CONSUMPTION
160 BCFD PEAK DAY
82 BCFD OF PRODUCTION
$8.38/DT



WILL NATURAL GAS BE HERE IN THE FUTURE ???
YES

New Energy believes that NG use will conservatively grow to 2050 at 1.1% per year from a 33% share of the energy market to 40% share. H2 and renewables will grow the fastest.

TABLE 3: Current United States annual energy use by energy type quadrillion BTU/yr.

ITEM	NAT G	OIL	REN	COAL	BIOM	NUC	TOTAL
USA	32.74	38.25	7.59	10.28	3.10	8.29	100.25
% USA	33%	38%	8%	10%	3%	8%	100%

TABLE 4: Projected 2050 United States energy use by energy type quadrillion BTU/yr.

ITEM	NAT G	OIL	REN	COAL	BIOM	NUC	TOTAL
USA	44.74	39.31	12.02	5.69	3.66	3.93	109.35
Growth/y	1.1%	0.1%	2.3%	-2.2%	0.4%	-2.4%	0.3%

Manufactured Gas & Nat Gas by Decade

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- Mid-1800 : 500 BTU/CF Manufactured Coal Gas was being utilized in major US cities by the Civil War
  - Numerous Municipal gas lighting and
  - Then heavy industrial applications 1950: Natural Gas Transmission arrived in NE
  - Complete Appliance Conversion was Required
  - 1000 BTU/CF Fuel
- 1960: Propane Air was quickly identified as a peak shaving Fuel
- 1960-70: LNG and NY/PA midstream gas storage were developed in parallel
- 1999: LNG Import peaked at 800 BCF/Y
- 21st Century Fracking Technology Shale plays make importing LNG unattractive
- 2010: Abundant supply of NG lowers prices creates LNG commodity market
- 2022: ESG, Decarbonization, RNG, RSG, Hydrogen Blends. Is it Real?

US PIPELINES, UNDERGROUND GAS STORAGE AND LNG FACILITIES FUTURE H2

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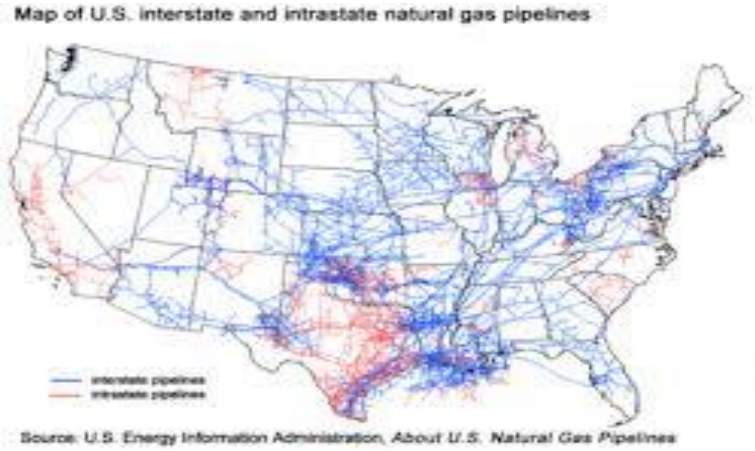
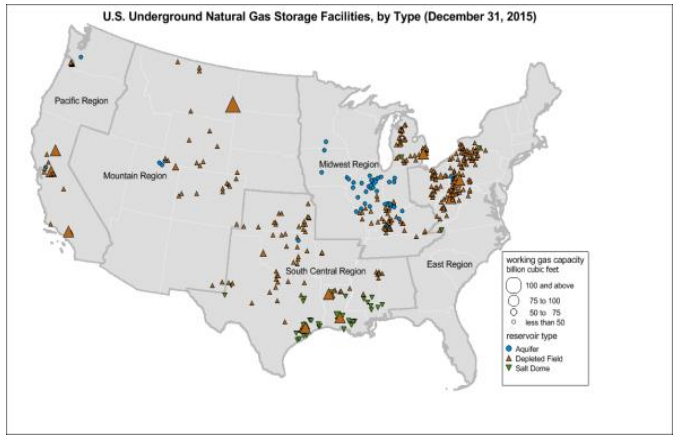
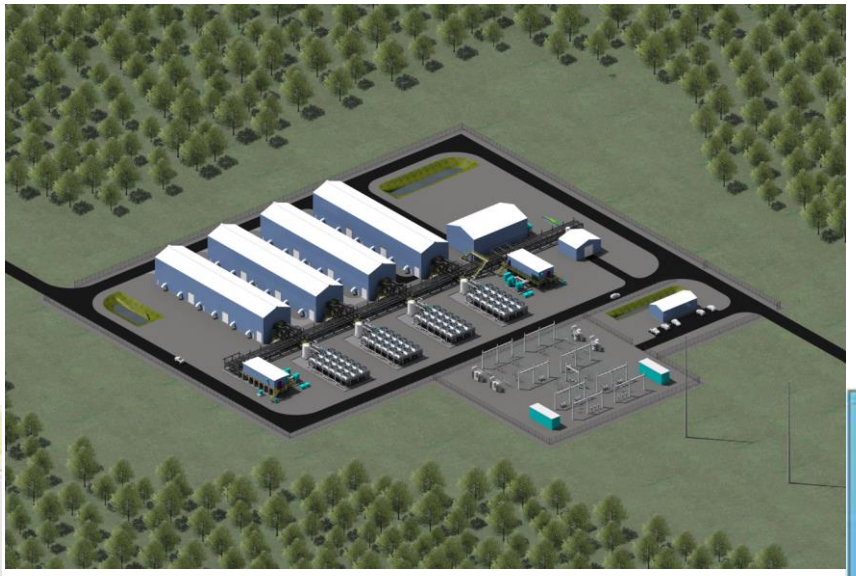
Interstate Pipelines in Red 250,000 Miles Intrastate in Blue 2.25 MM Miles



400 Natural Gas Storage Fields in US with 30 TCF Storage



FUTURE GREEN H2 PRODUCTION



100 LNG plants in US 100 BCF

30 TCF/Year of Production

DESIRED FEATURES OF M&R FACILITIES

Safe, Reliable, & Cost Effectiveness

- Meets or Exceeds Codes and Standards.
- Solid business case for ROI.
- Performs to required design conditions.
- Ergonomic
- Appropriate Levels of Redundancy

PROJECT DEVELOPMENT PROCESS DEFINED

- Establish business case and credit
- Perform Preliminary Engineering
- Negotiate IA & Responsibility Matrix
- Procure Equipment and Services
- Complete Engineering Design
- Prefabricate Components/Buildings
- Adjudicate Permits and Approvals
- Conduct Field Construction,
- NDT Testing
- Commission, Train, Documentation
- Commercial Ops

FEED ENGINEERING IS THE TECHNICAL FOUNDATIUON FOR A SUCCESSFUL PROJECT

- Codes/Standards/Authority Having Jurisdiction: Interstate or Intrastate
- Design Basis: Hydraulics, Mechanical, I&C, Electrical, Civil, Structural, SCADA, CP, AC Mit.
- Sizing and Calculations
- Responsibility Matrix
- Site Selection
- Material, Instrumentation, Buildings and Equipment Selection and Specifications
- Approval Process Defined
- Cost and Schedule
- Drawings Needed in Early Phase 1:
  - -P&ID's
  - -Site Layouts
  - -Hazardous Area Plan
  - -Electrical One-Line
  - -I/O List
  - - SCADA/Communications Drawing

Determine First the Authority having Jurisdiction.
Are the facilities interstate, intrastate or a mixture of both between the Pipeline and the End User?

Some Examples Below of Typical Codes and Standards

- US DOT 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards,
- States have theIR own natural gas distribution and transmission safety codes.
- IBC International Building Code
- NFPA 70, NEC, National Electrical Code
- ASTM A53, Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- API 5L, American Petroleum Institute - Specification for Line Pipe
- API 6D, American Petroleum Institute - Specification for Pipeline Valves
- API-6FA:, American Petroleum Institute - Specification for Fire Rated Pipeline Valves
- API 1104, American Petroleum Institute - Welding of Pipelines and Related Facilities
- AGA-XF-0277, American Gas Association - Recommended Practices Classification Gas Utility Areas Electrical Installations
- ASME-B31.8 Gas Transmission and Distribution Piping Systems
- Gas Measurement - Part 8, American Gas Association - Electronic Flow Computers and Transducers
- AGA-9, Measurement of Gas by Multipath Ultrasonic Meters : Meter type Dependent

It Defines which Entity Provides:

- Payment of Capital Cost
- Payment of O&M
- Ownership of Facilities
- Engineering
- Construction
- Operation and Maintenance

For the

- Hot tap Site
- Site Utilities
- Site Work
- Access Roads
- Permits and Easements
- Metering and FCV
- Pre-heating and Regulation
- Electronic Gas measurement.

CUSTODY TRANSFER CONCEPTS

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When we transfer custody of Natural Gas, we are concerned with establishing a common standard to define volume of flowing gas and the energy content for each SCF of the flowing gas.

Ideal Gas Law (Compressible fluid) : PV = nRT: Pressure, volume, amount of gas, gas constant and temperature. Originally empirically derived. (Super-compressibility and gas composition are factors as natural gas is not an ideal gas)

Standard Cubic Foot (SCF) : In order to transfer custody of gas, we convert the gas to an agreed standard pressure and temperature such as 60 degrees Fahrenheit and 14.73 pounds atmospheric temperature for billing. **(Should be defined in IA. RTU load consistent)**

BTU (British Thermal Unit): Amount of heat required to raise the temperature of one pound of water by one Fahrenheit Degree.

HHV or LHV: Higher or Lower heting values take into consideration The amount of usable energy that is available during combustion because of the evaporation of water vapor during combustion. Important to list the assumption in pricing.

Therm: 100,000 BTU's

Dekatherm (from Greek number ten, DEKA): Ten Therms or 1,000,000 BTU's

WHAT IS THE IDEAL P&ID FOR UNI- DIRECTRIONAL AND BI DIRECTION M&R?

SAFE, CODE COMPLIANT, RELIABLE, AND COST EFFECTIVE CONCEPT OF SINGLE INCIDENT PROTECTION

PRIMARY COMPONENTS OF M&R SYSTEMS

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PIPELINE TAP SITE

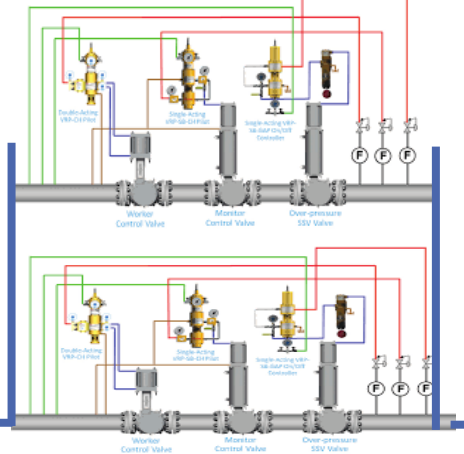
FIL/SEP

METERING & FCV

SHELL AND TUBE HTEX

REMOTE GLYCOL WATER HEAT AND PUMP.

WORKING MONITOR, WORKING REG, FCV, AND SUPER MONITORS, THERMAL RELIEF



EGM: RTU/GAS QUALITY

ODORIZATION

BI-DIRECTIONAL GULF STYLE FIL/SEP, METERING, FCV/OPP

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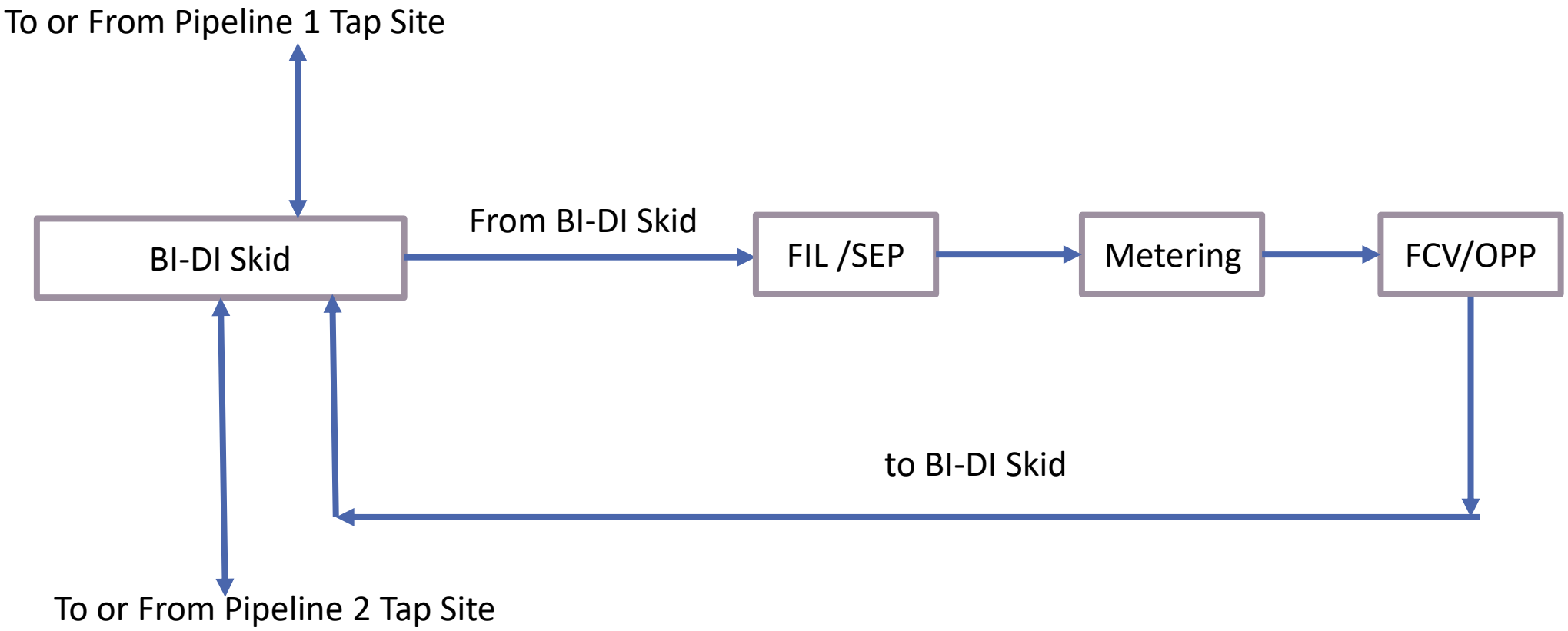

BI-DIRECTIONAL SKID SCHEMATIC

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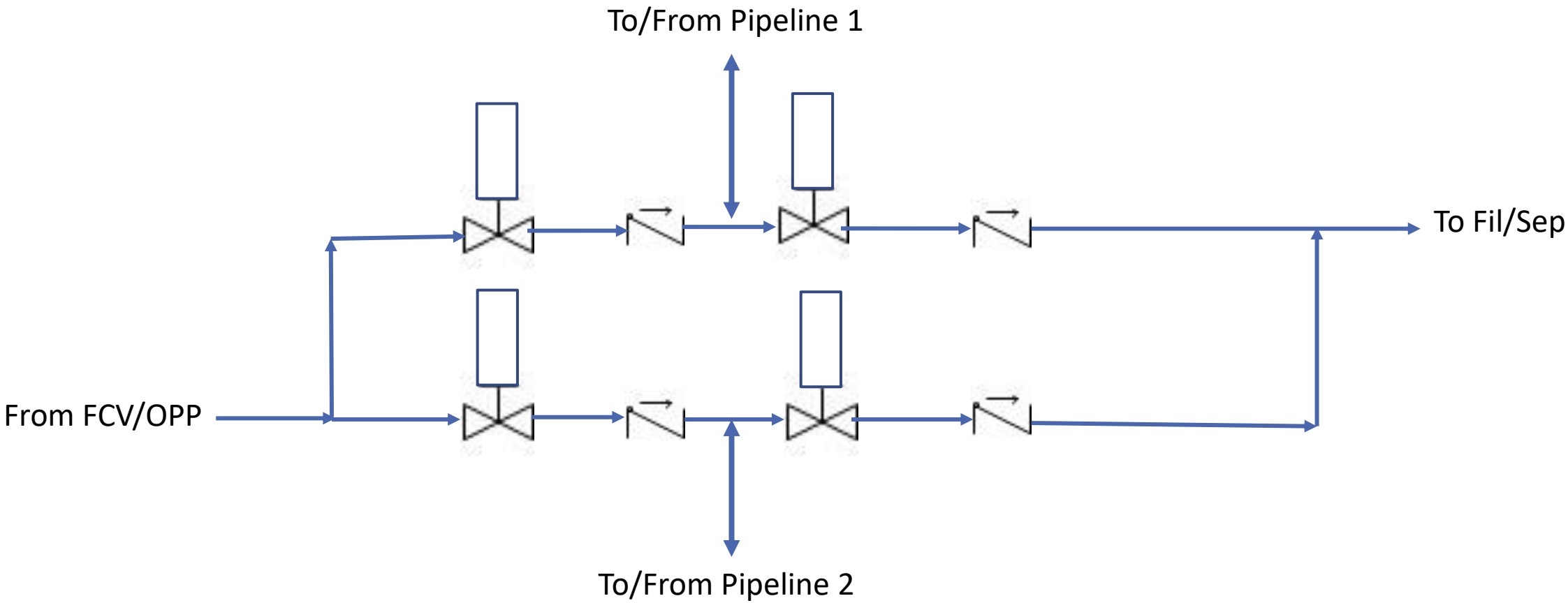

THE IDEAL M&R P&ID

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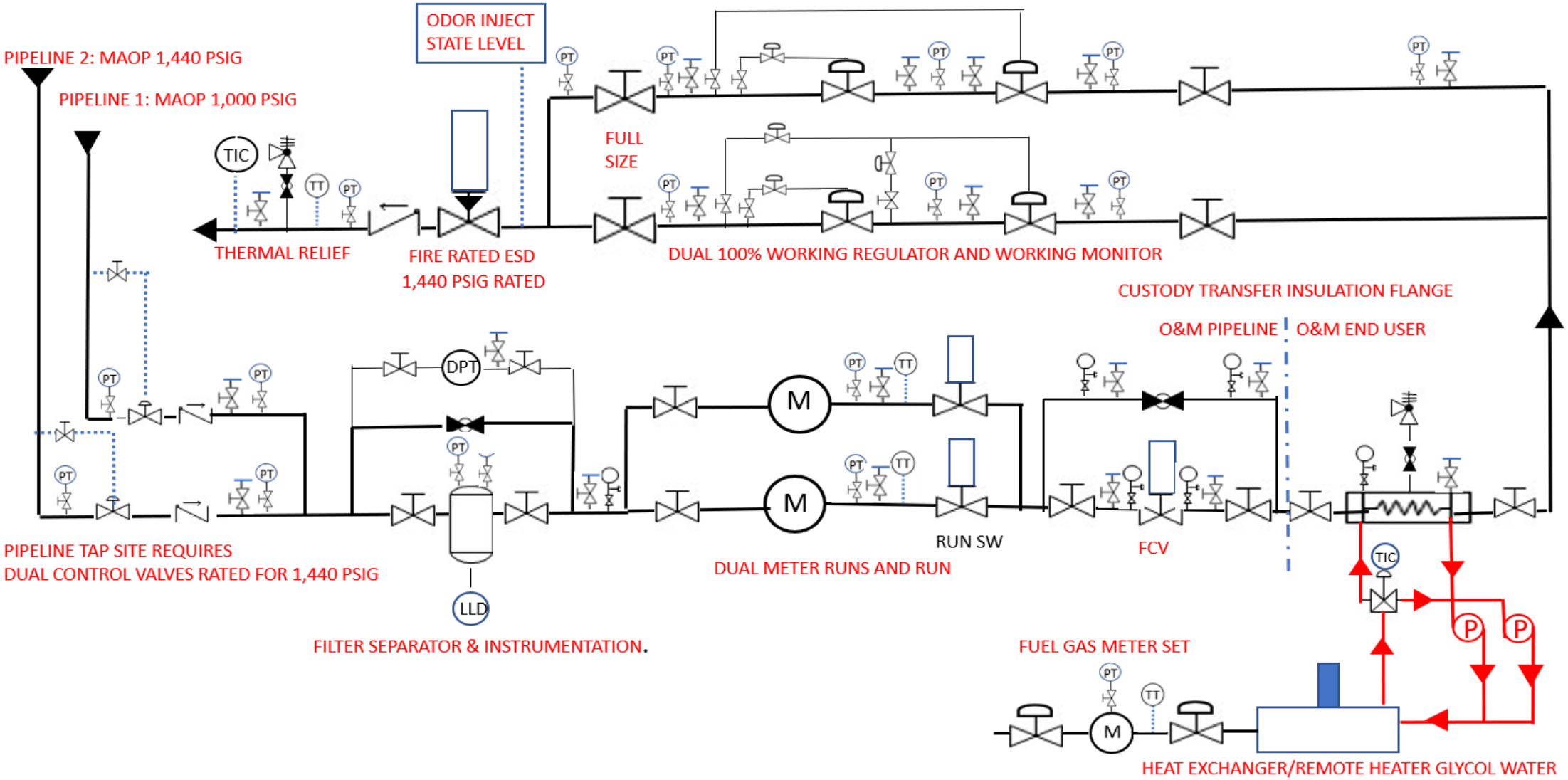

ELECTRICAL HAZARDOUS AREA CLASSIFICATIONS

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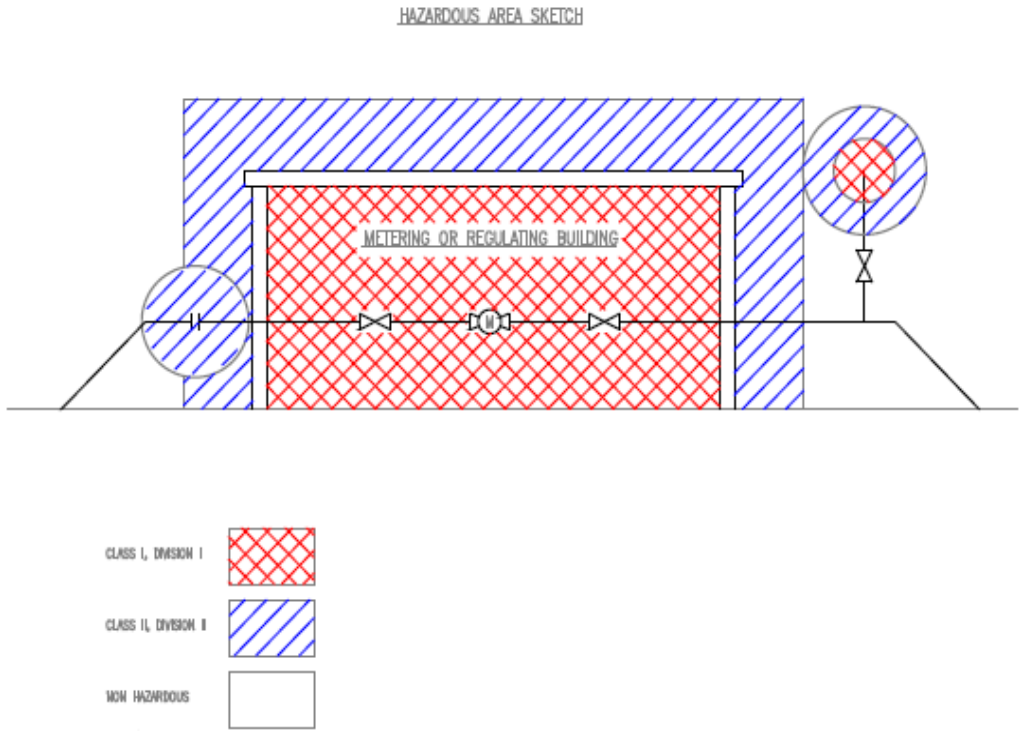
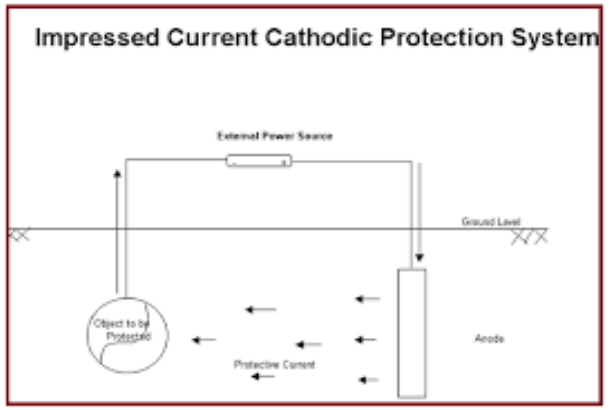
Class I, Division I, Group D:
When natural gas vapor and air flammable mixture is routinely expected.

Class I, Division II, Group D:
When a flammable mixture of natural gas vapor is expected during upset condition.

Non-Hazardous General Purpose:
When a Flammable Mixture is not Expected.





Corrosion occurs when the iron in unprotected carbon steel pipe has a free electron space available for oxygen for Ferrous Oxide. An Impressed current CP system puts DC current and electrons on the pipe and iron and inhibits corrosion formation.

AC Surge Protection

AC Current can be induced on gas facilities. Capacitive devices and grounding create short circuit to ground for AC while preventing the DC CP from leaving the pipe.

CLOSING THOUGHTS

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The gas industry began in the 19th Century with manufactured coal gas plants in every major US City.

In the 20th Century it morphed into the natural gas supply chain: pipes, UG storage, LNG, LDC's

Oil use created 200,000 gasoline stations, and trade deficit imports of Oil.

In the 21st century the US became the largest producer of NG and oil in the world.

In the 21st Century, expect an integrated energy infrastructure with decarbonization and renewable energy supply.

Renewables are intermittent and require Grid Scale Energy Storage.

Green H2 storage and electric generation is Predicted.

Natural Gas, H2, RNG, Energy Storage, Renewable Electric Generation, Cleaner Base Load.

SCADA

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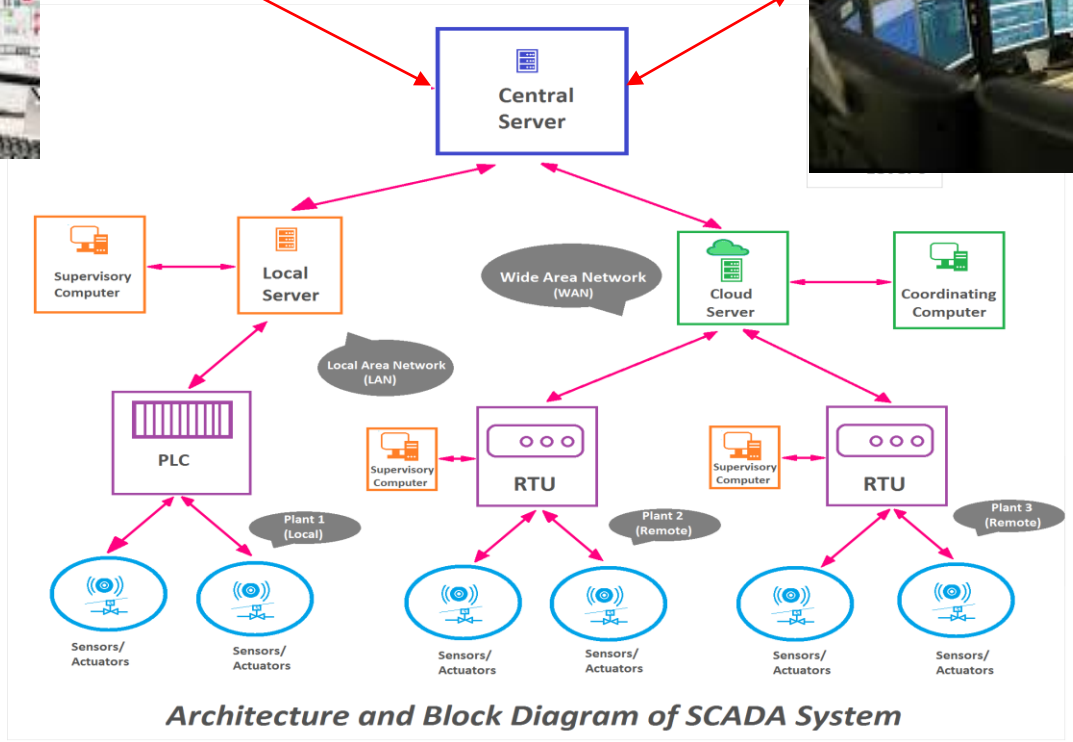
CONTROL CENTER 1 COMPUTERS AND HMI

CONTROL CENTER 2 COMPUTERS AND HMI



Architecture and Block Diagram of SCADA System

- **DEVELOP CONTROL PHILOSOPHY**
- **DEVELOP P&ID**
- **DEVELOP I/O LIST**
- **DEVELOP SYSTEM ARCHITECTURE**
  - **Select Equipment**
  - **Determine HMI**
  - **Select Communication Link**

Hardware/software
Distributed Versus Local
SCADA
Communications
Field Devices
Local HMI
Remote HMI

CONCLUSION

This natural gas industry is a great business that we've chosen.

The implementation of a successful project depends upon a capable team performing preliminary engineering, design, procurement, installation, training, and documentation. Deregulation has added new pipeline interconnects, shortened the schedules, created the need for new types of facilities and created market based projects.

The successful players in this century will accomplish their objectives in concert with customers and suppliers by sharing facilities, sharing information, finding win-win situations and ……..

UNDERSTANDING OUR ROLES IN THE MARKETPLACE