FLARE FLOW MEASUREMENT & COMBUSTION CONTROL SOLUTIONS OPTIMIZE OPERATION COST & ENABLE ENVIRONMENTAL REGULATIONS COMPLIANCE

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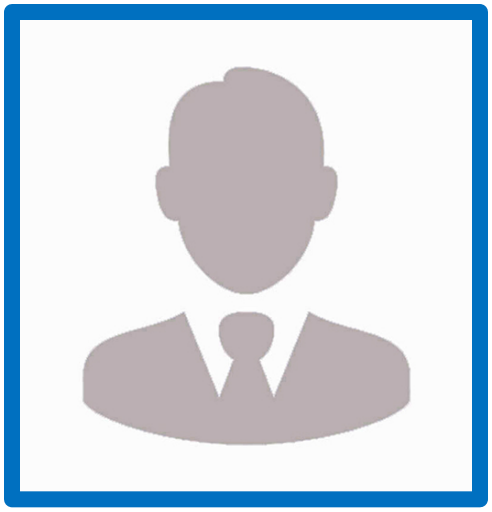
OFFICIAL SPONSOR



RAMY DIAA

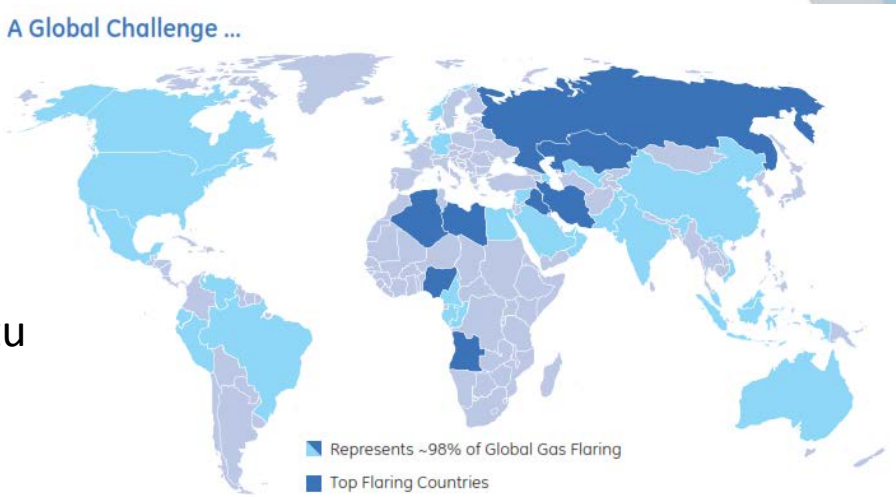
Flow Products Manager MENAT & SSA

KUWAIT FLOW MEASUREMENT TECHNOLOGY CONFERENCE 2017

Flaring systems are designed to protect personnel and equipment during emergencies or processing disruptions.

More than 150 billion cubic meters per year of flared gas is roughly equivalent to …

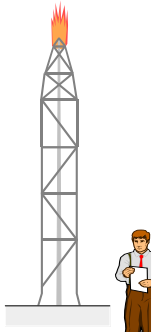
- Gas use in all US residences for a year
- 5% of global natural gas production
- 23% of US natural gas use
- 30% of EU natural gas use
- US$10 Billion lost revenue at $2.00 per MMBtu
- 2.4 Million barrels of oil equivalent per day



Flaring gases is

. a multi-billion dollar waste
. a local environmental tragedy
. a global environmental issue
. an energy problem that can be solved

Why Measure Flare Gas Flow?



STEAM CONTROL

- Steam Injection
  - Complete burning
  - Smokeless operation
- Steam Consumption
  - Expensive
  - Flow rate controlled
  - Molecular weight
    - proportion steam

ACCOUNTABILITY

- Flare Base Load
  - Typically unknown
- Mass Balance
  - Complete balance
  - Drive flaring reduction

Global - Key Environmental Regulations – Emission Control & Reduction

Kyoto protocol (Global)

an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets

EU emissions trading system (EU ETS)

a cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhouse gas emissions cost-effectively. It is the world's first major carbon market and remains the biggest one

EPA - NSPS, 40 CFR Part 60 & (RSR) 63.670

pollution control standards issued by the United States Environmental Protection Agency (EPA). refer to air pollution emission control & reduction

MENAT Environmental Regulations – Emission Control & Reduction

Majority of MENAT countries have generic national Regulations address the needs for limiting Industrial emissions monitoring & control which is not stringent & detailed yet **…. But start to be more stringent recently**

Major O&G Producers & National O&G companies have their own initiatives and regulations to minimize & control flaring which is main driver for flare recovery projects and process optimization

What Environmental Regulations Focus On

Define the total quantities of flare Emission gases through all the flaring conditions including the base load & min flaring and even purging … **for that a flow measuring device should be used**

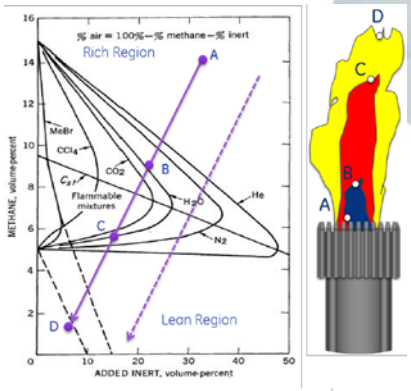
Define the percentages of COx , NOx , HC various gases , H2S on the total quantities of Emission gases …. **For that Gas Analyzers should be used like GC , Continuous Emission Monitoring Systems (CEMS) , predictive emissions monitoring systems (PEMS)**

What Environmental Regulations Focus On

How efficient Combustion of HC gases to turn it to CO2

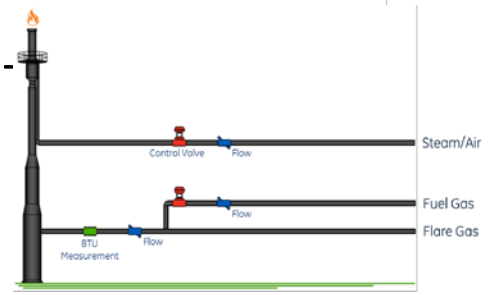
HC gases is 4 times more harmful than CO2

Defining the Net heat value of flared gases , flow rates of flared gases , steam , Fuel gas Control is key factors on flare gases combustion control and Flare gas Destruction &removal efficiency (DRC) in addition to smock less flare



Flare Measuring & Control System and Equipment validation

Some of Regulation Require to validate the flare meters Bi-annually



Flare Management Solution

Flare gas Volume & Mass Flow & total Quantity measurement complete ultrasonic flow metering for all types of flare & vent lines sizes 2” – 120”

Flare combustion control system .. plug-and-play solution to meet Local & Global Environmental compliance. pre-programmed with all required algorithms necessary to address the most difficult aspects of proper flare control. GE’s patent SmartSteam control algorithm utilizes surrogate modeling to draw correlations between flare flow conditions and the required steam input to operate with no visible emissions.

Predictive Emissions Monitoring System (PEMS) complete system designed for Continuous Emission Monitoring for various stationary Emission sources meet Local & Global Environmental compliance to monitor, self-certify, and justify emissions of NOX, CO, CO2, SO, and unburned hydrocarbons to

Flare Management Solution – Values

- Enable full compliance to environmental regulation via reporting flare Greenhouse gases percentage & quantities and dynamic control for flare gas combustion efficiency

- Enable Significant saving on steam utility cost

- Increase efficiency of the complete flare system

- Improve the accuracy of plant mass balance calculation

- Enhance plant safety by give early indication for process upset and valves leak detection on vent / flare network utilizing accurate flare flow measurement at low flaring and flare gases Molecular weight measurement

Flare Gas Measurement Challenges

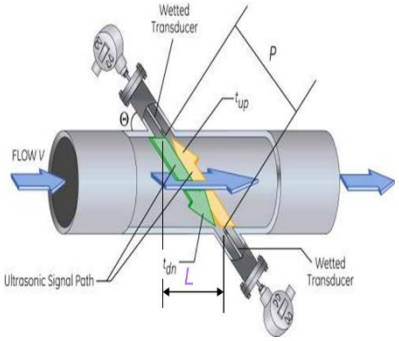
- **Variable Flow Rates**
  - Low flow = normal flare
  - Moderate flow = inadvertent flare
  - High flow = emergency flare
- **Variable Composition**
- **Range of hydrocarbons**
  - H_2 to C6 + (typical)
- **Corrosive Environment** …. H_2S, HF etc.
- **Liquid dropout**
- **Low Pressure**
- **Atmospheric (slightly negative to slightly positive)**
- **Wide Temperature Range** From –190C to 250C overall

Conventional technologies all have problems with one or more of these characteristics of flare gas operation, resulting in inaccuracy, poor reliability and high cost of ownership.

Why Ultrasonic Flare Gas Flowmeter

GE ULTRASONIC METER for Flare

- Proven for over 35 years with thousands of installations
- Wide Turndown ration 1:4000
- Wide Flow rage / velocity (0.03 to 120 m/s)
- Accurate measurement for low flare / purging
- Multivariable meter (Volume , Mass , STD
- Volume , MW , Density)
- Materials Compatibility (Ti, Monel, Hastelloy)
- No pressure drop
- No maintenance
- Wide process temperature range (-220c to 250c)
- On-site verification & advance diagnostic



$$T_{UP\to DOWN} = \frac{P}{C + V * \sin\theta}$$

$$T_{DOWN\to UP} = \frac{P}{C - V * \sin\theta}$$

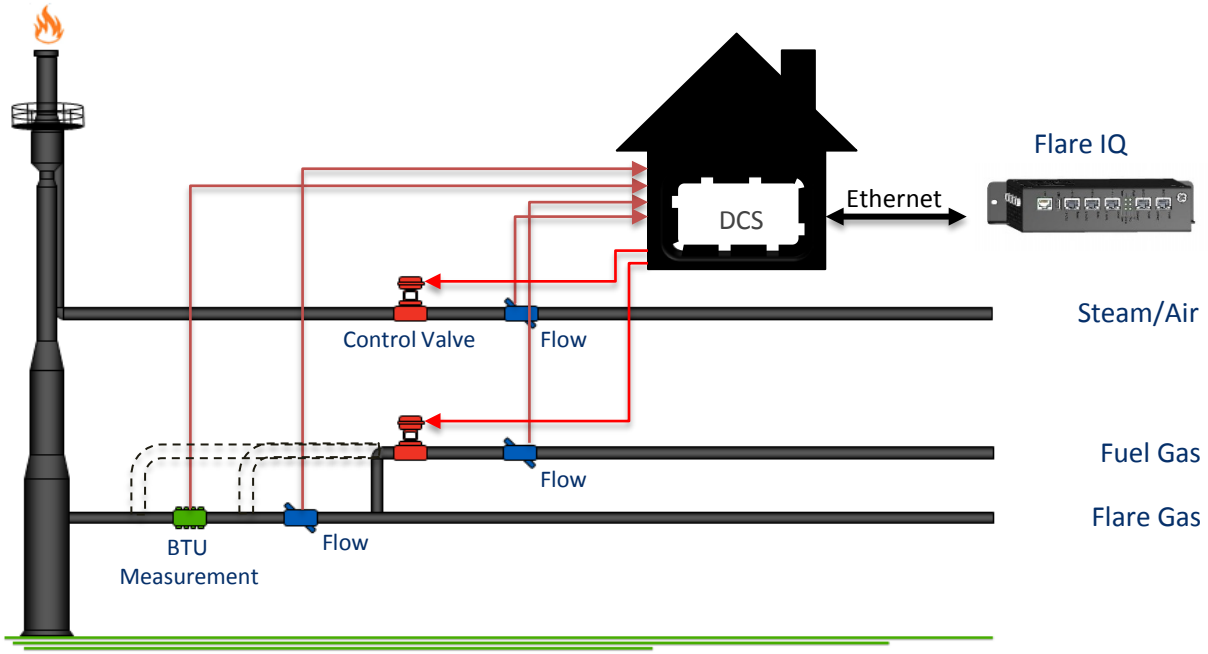
$$V = \frac{P}{2\sin\theta} * \frac{T_{DOWN\to UP} - T_{UP\to DOWN}}{T_{DOWN\to UP} * T_{UP\to DOWN}}$$

$$Q = V * A$$

Principle is independent of:

- Velocity of sound (C)
- Viscosity
- Density
- Temperature
- Pressure

GE - Flare IQ (Flare Control System)



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Flare.IQ - A Multi-Patented Solution

US Patent 6,216,091: Ultrasonic Measuring System with Molecular Weight Determination

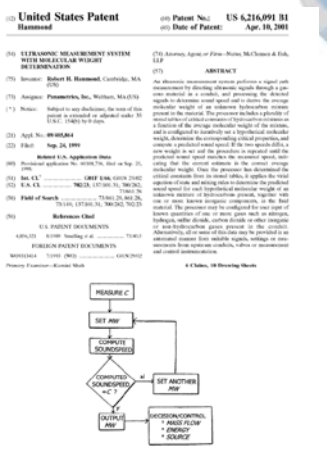
Molecular Weight determination of a gas mixture using SOS, pressure and temperature

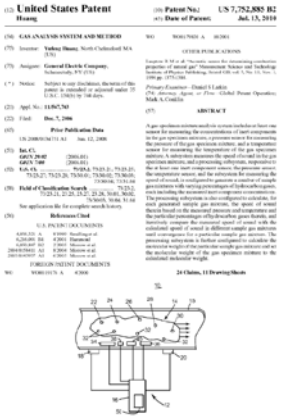
US Patent 7,752,885: Gas Analysis System and Method

Allows for multi-inert compensation using SOS, pressure and temperature to derive a gas samples hydro-carbon molecular and by inference total NHV of the gas

US Patent Pending: Flare Management System and an Associated Method thereof

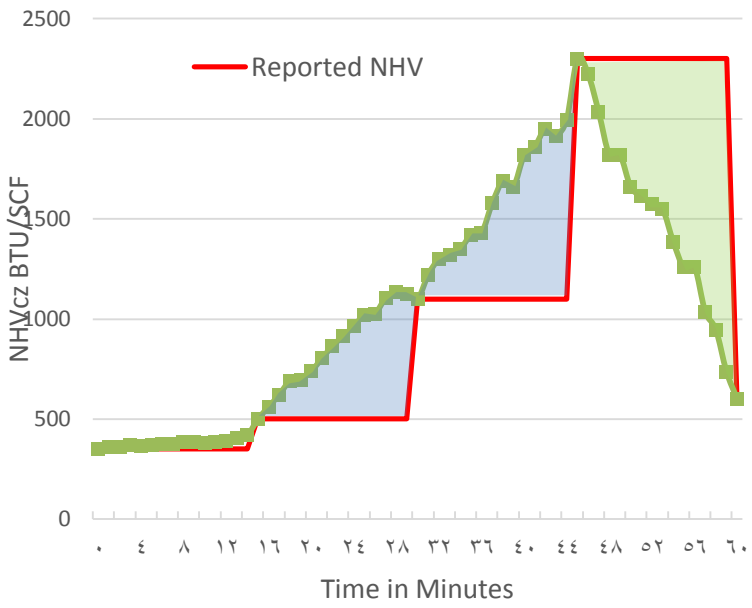
Defines the use of multi-Inert compensated MW as a means for course steam and fuel gas control between GC or calorimeter readings





Flare IQ

Benefits of Course Steam and Fuel Gas control



Flare.IQ improves operational efficiency while maintaining compliance

Improved efficiency of system by **reducing instances of over-steaming or use of excess fuel**

Flare.IQ provides operators with as many as 2.5MM more datapoints than a GC per year

Reduction of plant utility cost through **steam usage optimization**

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complete system designed for Continuous Emission Monitoring for various stationary Emission sources meet Local & Global Environmental compliance to monitor, self-certify, and justify emissions of NOX, CO, CO2, SO, and unburned hydrocarbons to

The installed costs of PEMS modeling software solution can be just one third those of a similar-accuracy CEMS

- Lower Cost of Regulatory Compliance
- Eliminate the need for costly analyzers as GC, CEMS
- Local and Remote Access to PEMS
- Enhanced Condition Monitoring performance & availability
- 24/7/365 Emissions Prediction
- Improved Operational Planning
- Tailored Notifications

GE Flare Reduction Solutions

Unique solutions for different types of flare problems in different regions…….. **That's Another Story**

Thanks for Attention