Risk Assessment on Gas Reduction Station of Power plant (Oil and Gas Refinery)

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Abstract— Oil and Gas demand is increasing day by day. This industry is considered as a high hazard industry owing to their operation and handling large amount of flammable material. Even though petroleum refineries and oil/ gas processing installations are generally located in remote areas, experience shows that residential/industrial units come up in close proximity with the passage of time. Hence these installations which store large quantity of flammable materials, pose threat to surroundings as well, in addition to their own safety. Such conditions therefore, necessitates the introduction of Risk Assessment Study and Implementation of this paper would reduce the fire and explosion risk of this plant.

Key words: Risk Assessment, Fire Prevention System, Hazardous Material, Environmental Protection

I. INTRODUCTION

The report has the intent to provide a Comprehensive Risk Analyses and other associated hazards with regard to Gas Reduction Station (GRS) of Power Plant of Oil and Gas refinery. This Risk Analyses will provide a Risk Score/category in accordance with NFPA 704 & Risk Matrix calculation.

This Risk Analysis focuses on what hazards Power Plant Oil and Gas refinery must prepare for (based on history and science), what is its response and what is the current makeup of the plant based on inspection and data

II. SCOPE

This paper covers the hazards and preventive measures to be implemented in Oil and Gas refinery power plant Gas Reduction Station (GRS) to evaluate emergency mitigation facilities for reduction of fire risk & minimize the health risk. This has scope for all Gas Reduction Station risk assessment to prevent accidents and to lead with continue good productivity.

III. OBJECTIVE

The Report provides a Risk Score calculated for the identified critical area GRS of Power Plant. This Risk Score will indicate the level of risk associated with the specific area.

Based on the numerical value of the Risk Score, We have provided recommendations based on NFPA standard to minimize associated risks, which will enhance the plant/occupants protection level and contribute to business continuity.

IV. METHODOLOGY

Specific factors were considered when developing this Risk Analysis for Gas Reduction Area of Power Plant

– Plant Process

– Equipment’s Involved
– Emergency Control measures for cut off Natural gas supply
– Hazard Identification/ Risk Category
– Existing Fire Protection System capabilities to mitigate emergency effectively
– Identification of critical areas, Residual hazards, Potential factors which may lead to an incident and Fire Protection availability were defined based on periodical visits and inspections, operational records, manual and the material/information provided by Power Plant Management.

A. Plant Process

1) Plant Gas Distribution Network

The fuel gas is supplied by customer, under high pressure to the plant site just outside of the plant boundary. This pipeline enters the plant boundary near its northwest corner. In this installation, the incoming fuel gas is filtered, metered and then passed through a pressure regulating station to supply to the plant at a regulated pressure, meeting the fuel quality requirements of the gas turbines and duct burners of HRSGs. The gas treatment and pressure reducing station compound is kept separated from the rest of the plant by fencing around it.

A blanked connection is provided immediately after the pipe enters the power plant boundary for supply to future phase 2 power plant.

A supply is taken after the gas is filtered and metered to supply to the Aluminum plant through pipeline.

2) Gas Reduction Station:

GRS is identified as a critical area based on the associated hazards, Gas and ignition group, temperature class & Operational Priority.

3) GRS System Operation

Natural Gas is use as a Fuel gas. Fuel gas is received from the customer to the plant terminal point through a pipeline at a pressure of 43 Bar(g) and the maximum possible pressure is indicated as 74.5 Bar(g). It is conveyed from this point by a pipeline to the inlet of the Plant Fuel Gas Treatment Skid. The power-operated valve, in the ESD skid, is to be opened to admit the fuel gas supply to the fuel gas system in the plant.

In the common plant treatment skid, the fuel gas passes through a two-stage filter separator to remove any traces of liquid and solid impurities. It is then passed through a metering skid where measurement is made for the complete gas consumption of the plant. A chromatograph is provided downstream of metering station for continuous analysis of fuel gas in regard to its composition. A flow computer is provided to compute the flow data and also keep record of the gas characteristics from the chromatograph. The gas is then passed through pressure regulating station, where the working pressure regulating
valve maintains the downstream pressure corresponding to
gas turbine requirement.

B. GRS Equipment's Involved

GRS equipment's process and control measures ESD Valve Skid (Emergency Shutdown Valve Skid) gas is supplied through the ESD valve skid, which includes an actuated ball valve, leakage class VI, installed for emergency purpose. The ball valve is operated by a pneumatic, spring return, double solenoid controlled actuator. In order to have the ESD valve operation independent of instrument air availability, the actuator will use the natural gas itself to compress the spring and open the valve. The instrument gas will be taken down-stream of the filtering unit. The ESD valve will be interconnected with a push button installed in the power plant control room. Operation of this push button operation will remove the power to both the solenoids installed in the actuator panel in order to ensure closing of the station in case of emergency. The actuator control panel is equipped with two filter regulators and a pressure relief valve (in order to control and reduce the line gas pressure), two solenoid valves and a flow control valve. The two solenoid valves are installed in order to prevent the closing of ESD valve in case of failure / lack of power of only one of them. The ESD valve will close only if power is not available to both the solenoids. On the upstream and downstream of ESD valve and bypass line, there is a manual double isolation valve each.

Emergency shutdown Valves arrangement is comply with NFPA 850 chapter 7.2.2

1) Common Filter Separator Skid
The filter separator skid consists of 2x100% filter separators each provided with manual isolation valves at inlet and outlet.

2) Fuel Gas Metering Skid
Fuel gas meter of ultrasonic type is provided to serve as a custody meter keeping track of total gas consumption of the power plant and the aluminum plant. A bypass to the meter installation is also provided. Double isolation with vent is provided at inlet, outlet and bypass of the metering station.

3) Gas Pressure Regulating Station
Each station includes a working valve, a monitor valve and a slam shut off valve. The purpose of the pressure reducing station is to reduce the natural gas (NG) supply pressure from the nominal supply line pressure of 43Bar(g) to a nominal pressure of 32.5 Bar(g). On the upstream and downstream of each station, there is a manual double isolation valve.

The working valve normally maintains the downstream pressure to a set value. If this valve sticks open or malfunctions and downstream pressure increases, then the monitor valve will take over. If the pressure rises even after this, a slam shut valve provided at inlet to each pressure reducing station, will shut off. When the gas pressure falls to a pre-set value, the standby station comes in operation. To protect against overpressure due to minor leakage across seat, a small size relief valve is provided downstream of the pressure reducing station.

The pressure reducing station is located outdoors within a fenced and (lockable) gated area.

4) Design Pressure and Temperature
The pressure/temperature design of the fuel gas piping is in accordance with ASME Code (American Society of Mechanical Engineering) for Pressure Piping, B31.1. They are protected from being subjected to pressures greater than their design pressures by pressure limiting devices as per ASME Code for Gas Transmission and Distribution Systems, B31.8. and NFPA 850 Chapter 7.2.1

C. Emergency Control measures for cut off Natural gas supply

General safety considerations for the design of the plant fuel gas system are in accordance with the recommendations of NFPA 850. Isolation valves have been provided in safe areas at the inlets to the consumers for stopping of gas supplies to them in case of fire. Push button has been provided in the power plant control room for remote closing of the ESD valve at the fuel gas inlet to the site for shutting down all fuel gas supplies to the plant if required, in the event of a major fire.

Gas detection system has been provided in the area of gas conditioning to detect gas leakage in the area. The detectors are located such that they cover the entire area within the fence. On detection of gas leakage optical acoustic alarms will be activated in the area. The alarm can also be initiated by push button provided in the area, when needed.

D. Hazards Identification/Risk Assessment

The risks associated with the hazards that are addressed, either are provided on the Fire & Gas Area Chart or have historical precedence, or are remote possibilities that would pose the risk of damage, destruction, injuries, deaths, production loss, etc.; if they did occur.

- Fire and Explosion
- Toxic & Flammable gas leakage
- Flange Leakage or Pipe ruptured
- Electrical System malfunction

Risk Analysis has been categorized by two methods

- Risk Analysis Matrix (Consequence and Probability chart )
- NFPA 704 Diamond (Fire & Gas area chart)

1) Consequence and Probability Matrix calculation:

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Consequence</th>
<th>Probability</th>
<th>Risk Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire &amp; Explosion</td>
<td>Major</td>
<td>Unlikely</td>
<td>Extreme</td>
</tr>
<tr>
<td>Toxic and Flammable gas leakage</td>
<td>Major</td>
<td>Unlikely</td>
<td>Extreme</td>
</tr>
<tr>
<td>Flange Leakage or Pipe ruptured</td>
<td>Major</td>
<td>Very Unlikely</td>
<td>High</td>
</tr>
<tr>
<td>Electrical system malfunction</td>
<td>Low</td>
<td>Unlikely</td>
<td>Low</td>
</tr>
</tbody>
</table>

Risk matrix indicates that Extreme risk associate with Gas Reduction station of Power plan

2) Matrix Description:
### Establish The Consequence/Severity & Assign A Rating Of 1 To 5

<table>
<thead>
<tr>
<th>Level</th>
<th>Consequence</th>
<th>Injury/Illness</th>
<th>Property Damage/Loss</th>
<th>Environment Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low</td>
<td>Very low level or short term injury.</td>
<td>Temporary disability or Damage &lt;$ 5000</td>
<td>Limited damage to minimal area of low significance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(minor injury, first-aid injury, or report only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Minor</td>
<td>Reversible disability or impairment (i.e. disabling injury &amp; short term list time injury)</td>
<td>Permanent disability or damage $ 5,000 - $ 25,000</td>
<td>Minor effects on biological or physical environment</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>Moderate irreversible disability or impairment (&lt;30%)</td>
<td>1 Fatality or damage ($25,000 - $75,000)</td>
<td>Moderate short term effects but not affecting eco-system</td>
</tr>
<tr>
<td>4</td>
<td>Major</td>
<td>Single Fatality and/or severe irreversible disability (&gt; 30%)</td>
<td>2 Fatalities or damage ($75,000 - $100,000)</td>
<td>Serious medium term environment effects</td>
</tr>
<tr>
<td>5</td>
<td>Critical</td>
<td>Multiple fatality and/or significant irreversible effects to &gt; 50 people</td>
<td>More than 2 fatalities or damage (&gt; 100,000)</td>
<td>Very serious long term environmental impairment of eco-system</td>
</tr>
</tbody>
</table>

### Table 1: Matrix Description

Using The Matrix Below Determine The Risk Category

<table>
<thead>
<tr>
<th>Probability/Likelihood</th>
<th>1 Low</th>
<th>2 Minor</th>
<th>3 Moderate</th>
<th>4 Major</th>
<th>5 Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>HIGH</td>
<td>HIGH</td>
<td>EXTREME</td>
<td>EXTREME</td>
<td>EXTREME</td>
</tr>
<tr>
<td>B</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>EXTREME</td>
<td>EXTREME</td>
<td>EXTREME</td>
</tr>
<tr>
<td>C</td>
<td>LOW</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>EXTREME</td>
<td>EXTREME</td>
</tr>
<tr>
<td>D</td>
<td>LOW</td>
<td>LOW</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>EXTREME</td>
</tr>
<tr>
<td>E</td>
<td>LOW</td>
<td>LOW</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>TOLERABLE</td>
<td>ALARP</td>
<td>ALARP</td>
<td>INTOLERABLE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Using the Matrix Below Determine The Risk Category

Establish The Consequence/Severity And Rate A – E

| Probability/Likelihood | | | | | |
|------------------------| | | | | |
| A                      | Very Likely | Often Happens | Typically experience at least once in 6 months by an individual |
| B                      | Likely | Could Easily Happen | Typically experience once every 5 years by an individual |
| C                      | Unlikely | Hasn’t Happened yet but could but could | Typically experience once during the working lifetime of an individual |
| D                      | Very Unlikely | Conceivable but only in extreme cases | Less than 1% chance of being experienced by an individual |
| E                      | Rare | Almost never happens | during their working lifetime |

### Table 3: Probability/Likelihood

3) NFPA 704 Diamond (Fire & Gas Area Chart)

Risk Assessment Parameters indicates a Risk Score calculated through NFPA Diamond:

− a) Total Hazards and Total Mitigations.
− National Fire Protection Association 704 (NFPA 704) – Standard System for the Identification of the Hazards of Materials for Emergency Response, it defines the Fire Diamond used by Emergency Personnel a tool to quickly and easily identify the risks posed by hazardous materials. This is necessary to help determine what equipment should be used or which procedure is to be followed, or precautions considered during an Emergency Response.
− It has four divisions typically colour-coded, where:
  − BLUE indicating level of Health Hazard;
  − RED indicating Flammability;
  − YELLOW chemical Reactivity, and
  − WHITE containing special codes for Unique Hazards.
Each of Health, Flammability and Reactivity is rated on a scale from 0 to 4 where hazards are rated from none (0) to severe risk (4).

b) Gas Reduction Station (GRS) NFPA Diamond Rating

The NFPA Diamond rating was singularly defined for the entire area, in consideration to the process parameter and common Hazardous Material (Natural Gas) used throughout the GRS areas for the power generation.

If more than one chemical is present at a facility, the NFPA diamond indicates overall hazard at that location, not the hazard posed by a particular chemical. It shows the highest of each of the four hazards present.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Health Hazard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Materials that, under emergency conditions, can cause significant irritation</td>
<td>Materials that cause slight to moderate irritation to the respiratory tract, eyes and skin.</td>
</tr>
</tbody>
</table>

d) Flammability

Natural Gas is a flammable gas and Methane is lighter than air. heavy leakage may result in to the catastrophic event

<table>
<thead>
<tr>
<th>Rating</th>
<th>Flammability Hazard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Material that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature that are readily dispersed in air and burn readily</td>
<td>Fire &amp; Explosion. Toxic gases are produced with or without fires. As stated in “Hazardous Substance Fact Sheet and NFPA 704, Chapter 6 Table 6.2 2007.”</td>
</tr>
</tbody>
</table>

e) Reactivity

Natural Gas is not compatible with oxidizing agents and strong based. As stated in “Hazardous Substance Fact Sheet and NFPA 704, Chapter 7 Table 7.2 2007.”

<table>
<thead>
<tr>
<th>Rating</th>
<th>Reactivity Hazard</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Material those in themselves are normally stable even under fire exposure condition and which are not reactive with water.</td>
<td>Group II shall be subdivided in to IIC, IIB &amp; IIA according to the nature of gas &amp; vapor for protection technique.</td>
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However it is advised to avoid contact with strong oxidizing agent. It may increase risk of fire (peroxides, perchlorates, chlorine, and liquid oxygen). (ANSI-Z400.1-2004)

5) Total Hazards Calculation

a) Hazardous Area Classification: Zone 2

As per NFPA 70, National Electrical Code which refers National Electrical Code Article 500, locations shall be classified depending on the properties of the flammable vapours, liquids, or gases, combustible dusts or fibers that may be present and the likelihood that a flammable or combustible concentration or quantity is present. Gas Reduction Station is classified under the Abnormal Condition Hazard. This specific area is nominated as Area Classification Zone 2. The ventilation is natural.

b) Gas/Ignition group: IIA

For purpose of testing, approval and area classification various air mixtures (not oxygen enriched) shall be grouped as required in a, b and c.

c) Health Hazard

At high concentrations, natural gas can displace oxygen and cause asphyxiation. The ACGIH TLV-TWA for C1 to C4 Aliphatic Hydrocarbon Gases is believed to be protective against potential health effects that include CNS (central nervous system) depression and cardiac sensitization. The TLV-TWA is based upon the abilities of these gases (methane, ethane, propane, etc.) to produce weak depressant effects on the CNS at high concentration levels approaching the lower explosive limit. Combustion of Natural gas product is Carbon Dioxide and Carbon monoxide.

As per ACGIH (American Conference of Industrial Hygienist), American National Standard Institute for Hazardous Industrial Chemical (ANSI-Z400.1-2004) in conjunction with NFPA 704, Chapter 5 Table 5.2 2007.7 Health Hazard at Gas Reduction Station (GRS) was classified as follow:

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V. POTENTIAL FACTORS

The potential factors which can lead or escalate to incidents and/or accidents affecting Health, Safety, Environment, Production and/or Business Continuity are listed as follow:

- Failure or Ruptured of Pipes and Flanges
  Any leak from pipes can increase the risk of fire and Explosion.
- Equipment or Process Failure
  Pumps, valves can leak or fail, causing Natural gas leakage
- Unsafe Operations
  Noncompliance of work permit system/ standard operating procedure may lead to an emergency situation.
- Ignition Sources
  Normally there are no ignition sources as part of the normal process — however this can change when hot work or maintenance is performed in the area/adjacent area.
- Domino Effects
  GRS is the main source of Fuel gas supply to the Power plant. Fire may escalate to the adjacent area if Natural gas supply emergency cut off system failure.
- Early warning & Alert system absence
  Non-availability of early warning and emergency communication system may delay in evacuation procedure.
- Non-Connectivity (with ECR) of Fire and Gas Detection System
  GRS gas detection system is not connected with Emergency control room this may delay in emergency response.

VI. EVENT TREE FOR RELEASE OF NATURAL GAS

A. Natural Gas Release Event Tree Analysis:

Release of Natural gas can be created following four scenarios.

If Natural Gas release and get immediate ignition source may resulted into the fire Ball if it is major leaked.

If Natural Gas release and get immediate ignition source may resulted into the Jet Flame if it is minor leaked (release from small opening).

If Natural Gas release and do not get ignition source immediately but at later it accumulated and get delayed ignition from remote source may resulted in to the either pool fire or vapor cloud fire. Vapor cloud fire may be converted in to the jet flame.

If Natural gas release and do not get any ignition source and immediately captured by vent or header can be flaring out safely.

B. Scenario:

Natural gas (NG) leakage from 4” flange at Gas Reduction station Power plant.

1) Process Parameter
   Name of Equipment: Control Valve for NG supplies Pipeline.
   Line Size: 4”
   Pressure: 24-25 Kg/Cm²

2) Environment Data:
   For the purpose of this analysis the ambient conditions have considered as below:
   1. Temperature - 40 °C
   2. Relative Humidity - 50 %
   3. Wind Speed - 2 m/s
   4. Wind Direction - North to South

3) Consequences Analysis:

<table>
<thead>
<tr>
<th></th>
<th>Estimating Fire Flame Height</th>
<th>Max Burn Rate</th>
<th>Safe Distance From The Incident Site</th>
<th>Safe Distance For Fire Fighting With Special Ppe’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>13 M</td>
<td>2.510 Kg/Min</td>
<td>59 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38 m</td>
</tr>
</tbody>
</table>

Note: Above details are calculated using US EPA Guideline – (Environmental Protection Agency)
May very depending upon weather conditions & properties of material.

Fig. 1: Event Tree

THREAT ZONE: Threat Modelled: Thermal radiation from Jet fire

Red : 26 meters --- (10.0 kW/[sq m]) = potentially lethal within 60 sec
Orange: 38 meters --- (5.0 kW/[sq m]) = 2nd degree burns within 60 sec
Yellow: 59 meters --- (2.0 kW/[sq m]) = pain within 60 sec

Note: Above details are calculated using US EPA Guideline – (Environmental Protection Agency)
May very depending upon weather conditions & properties of material.
VII. RESULT AND DISCUSSION
This Risk Analysis Process was found to be very helpful for both the Emergency Management Team and the Department. Various gaps, issues and misunderstandings have been addressed and resolved and mutual understanding was achieved regarding Fire Safety (detection and protection systems) as well as requirements such as Training requirements, Evacuation Procedures, Response Procedures, Valve Supervision

NFPA 704 indicates that High Risk associate with the Gas Reduction Station of Power plant Recommendations are given to comply with NFPA codes and standards and risk association with GRS Power Plant of Oil and Gas refinery.
1) Emergency Communication & Alert System
An emergency communication system should be provided throughout the station to expedite assistance in the event of fire.

Plant-wide audible fire alarm or voice communication systems or both shall be provided for purposes of personnel evacuation and alerting of plant emergency organization. The plant public address system, if provided, should be available on a priority basis. (NFPA 850 Chapter 6 (6.7.3))

Operational experience has demonstrated that operators and other plant personnel have been key factors in the detection of fires and unsafe conditions. It is important that all personnel be properly trained to observe and react appropriately to any potential fire situation.

2) Fire Protection System
Water monitor should be installed at strategic location to provide safe distance from radiant heat during firefighting and prevent escalation of Emergency.

Adequate Fire Extinguishers should be deployed to comply with NFPA 10 Chapter 4

Fire Hydrant & Hose station shall meet the requirement of NFPA 14 (Chapter 2 & 3) (Adequately Equipped, Clear identifications and marking, Install on Foundation etc.).

Wind shock should be installed at strategic location to identify Gas release direction since Natural gas is a colorless and odorless. Considering of wind direction play vital role for tactical Firefighting approach and establish the effective evacuation order.

3) Early Detection & Notification System
Manual fire alarm devices (Manual pull station) should be provided for remote yard hazards as identified by the fire risk evaluation. (NFPA 850 Chapter 6 (6.7.3))

4) Valve Supervision
Locking Control measures should be applied on manually operated valve (NFPA 850 Chapter 6 (6.3)) & Fuel Gas system Manual

Specialist Assistance and Coordination before, during and after incidents was and is in the process of being addressed.

Even during Mutual Aid Exercises or real incidents, it will remain the responsibility of the Emergency Management to brief all involved parties about the hazards/risks involved before and during emergencies.

- The Table below shows Gas Reduction Station-Power Plant rating as per Fire & Gas Area Chart.

<table>
<thead>
<tr>
<th>Area</th>
<th>Risk Score</th>
<th>Status</th>
<th>Recommendations</th>
<th>Risk Score</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Reduction Station</td>
<td>144</td>
<td>High</td>
<td>- Manual Pull Station</td>
<td>65</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Water Monitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Wheeled Unit Fire extinguishers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Emergency Communication &amp; Alert System</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Gas Detection system connectivity with Emergency control room</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NFPA 704 indicates that High Risk associate with the Gas Reduction Station of Power plant Recommendations are given to comply with NFPA codes and standards and risk association with GRS Power Plant of Oil and Gas refinery.

VIII. CONCLUSION
During Risk Analysis, Gas Reduction Station- Power Plant is identified as a high potential Fire Risk area as per method NFPA 704 & Fire & Gas area chart and identified Extreme Risk area as per Risk matrix (consequence & probability) method. Fire Escalation chances are too high due to gases Fire. Addition to that methane is lighter than air, it may travel rapidly and cover surrounding vicinity in short time. Existing Fire protection system is not adequate to control fire or Gas Leakage within short period of time. GRS area is not covered with emergency communication (mass communication) & alert system. Absence of Emergency communication and Alert system will delay evacuation procedure and restrict to convey necessary information (Stop Hot work, Nature of emergency, Evacuation order, Caution etc.) to remote area occupants.

Starvation is the best method to control Gases fire therefore immediate action from the occupier & reliability of Natural Gas supply valve operation play vital role for cut off Natural gas supply to mitigate emergency effectively.

Fire and Gas Area Charts used to analyze the Risk Score of the hazardous areas, was seen as a relevant tool to determine the level of risk involved in the areas, it provides a clear picture on how safe or risky the designated plant is, However, displaying the NFPA 704 diamond in the designated area could be optional; taking into account that has an Emergency Response Team that should be familiar with the Hazards involved in all areas and the associated procedures required to deal with it.

REFERENCES
[1] Nevertheless, other NFPA Codes and Standards (NFPA Fire Protection Engineering Hand book, NFPA 850, 70, 14, 10, ASME, ACGIH, ANSI Code, US EPA) have been used as reference to determine the severity of the identified risks/hazards & for the recommendations.
[3] ASME- American Society of Mechanical Engineers
[4] ACGIH- American Conference of Governmental Industrial Hygienist