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## Hazard Identification and Risk Assessment (HIRA) in Compressed Natural Gas (CNG) stations

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### ABSTRACT

*It is possible by the categorization of the estimated levels of Individual Risk (IR) which the proposed site would impose upon them. An analysis of the consequences and likelihood of credible accident scenarios coupled with acceptable risk criteria is then undertaken. According to the results in many cases, not only required distances have not been provided but also CNG stations are commonly located in vicinity of populated areas to facilitate refuelling operations. Natural gas is in priority because of the relative abundance, ease of use, less environmental pollution, and the price is cheaper than gasoline. This study was done to identify and determine the operational deviations in one of the CNG gas compressors and proposed hazard control measures. Identification of possible causes of deviations in compressor performance and risk assessment was done in several meeting with cast HAZOP experienced experts. Seven operational deviations identified in the performance of the compressor used in CNG station includes no & less flow, more & less pressure, presence of compounds other than gas in compressor, reverse flow and more temperature. 41.34% of the risks were in acceptable range, and 58.66% was in conditionally acceptable. Prepare work instructions, worker education, fix and maintenance and regularly equipment calibration can be useful in prevention of accidents in CNG stations.*

**Keywords:** Individual Risk, CNG Stations, HAZOP

### 1. INTRODUCTION

Compressed Natural Gas (CNG) has been distinguished as one of the substitute fills to fluid petroleum energizes, which has included natural advantages. This fuel is being utilized globally with the demonstrated accomplishment as a car fuel. CNG is a blend of hydrocarbon gasses and vapours comprising of mainly methane in vaporous structure which are packed to a weight of 200 to 250 bars for use as a vehicular fuel. Safety at these installations is most important factor in view of the operating conditions such as pressure, storage of other flammable materials etc. The provisions in this standard shall provide a reasonable level of safety and protection from loss of life and property from fire and explosion.

- To identify the hazards and selection of various risk management techniques.
- Consequence and effects calculations for different risks.
- Risk Estimation for different and presentation of estimated results.
- To compare the Risk assessment data.

### 2. GAS PROCESS FLOW

Figure 1 and 2 shows the natural gas is compressed to higher pressure, it is called Compressed Natural Gas. The CNG is dispensed through the CNG stations to CNG customers. Natural gas is compressed to a pressure of 200-250 Kg/cm<sup>2</sup> (g) (due to its low density) to enhance the vehicle onboard storage capacity. Thus, the compressed form of natural gas is used as a fuel for transportation purposes.

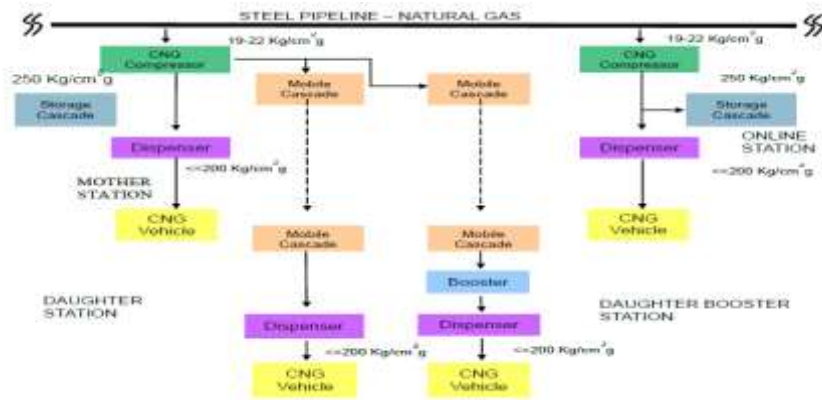


Fig. 1: Process of Compressed Natural

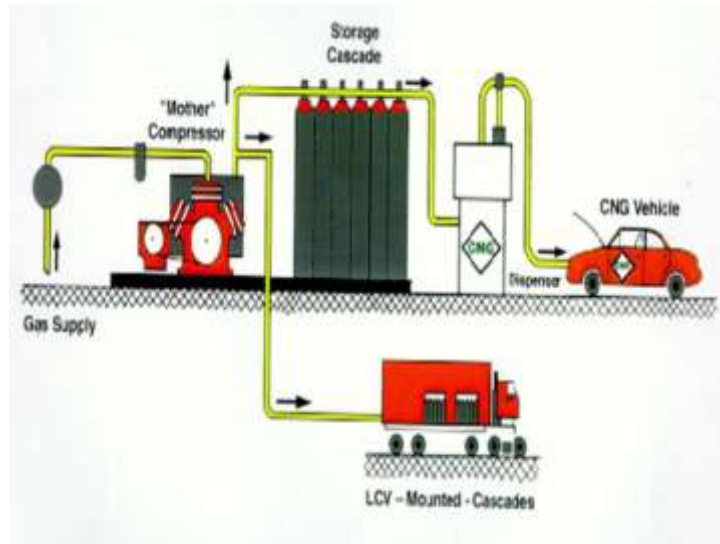


Fig. 2: Gas CNG Station

### 3. ELEMENTS OF COMPRESSED NATURAL GAS PUMPING STATION

A CNG pumping station has a number of components to be dealt with in order to have a steady flow of CNG through the cascades up to the point of discharge into the vehicle.

- Gas Compressor
- Cascade
- Dispenser
- Air compressor
- Generator
- SS tubing (Stainless Steel)
- Metering skids
- Light Commercial Vehicle (LCV)

It is very much evident to look upon each element of the CNG station in order to infer the different type of risks associated with each element as well as to quantify the risk in order to have a safe fuel filling premises.

Table 1: Inter-distances between gas storage unit and buildings and boundaries:

Total storage capacity of gas storage (Litres)	Min. distance between buildings and CNG pump (Meters)
Up to 4500	2.5
4500 to 10000	4.0
10000 to 100000	10.0

#### 3.1 Metering system at CNG online / mother station

The following metering system is installed in all the CNG station as per the standards.

- M1 = Metering skid for station (mass flow meter)
- M2 = Flow meter IC engine (PD meter)
- M3 = Meter to compressor inlet (mass optional)
- M4 = Mass flow meter at outlet of compressor
- M5 = Meter installed in CNG dispensers (mass flow meter)
- M6 = Mass flow meter in feed line to LCV

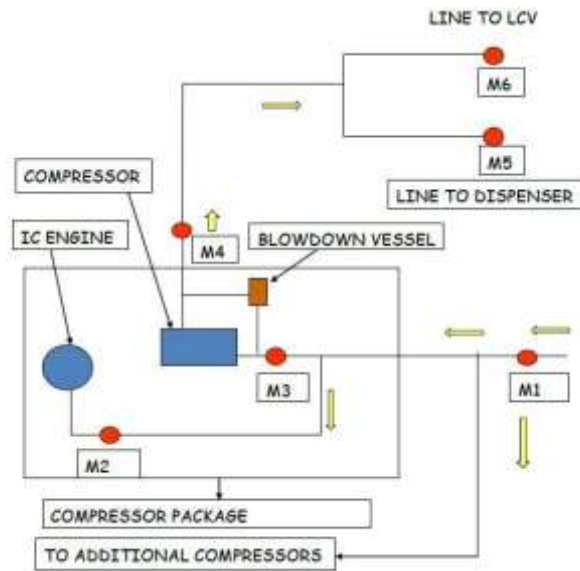


Fig. 3: Metering System at CNG Online / Mother Station

#### 4. RISK ASSESSMENT IN CNG PUMPING STATIONS

An oil and gas office can possibly bring about mischief, for example,

- Sickness, damage or death of specialists and individuals in the encompassing group
- Damage to property and speculations
- Degradation of the physical and natural environment
- Interruption to creation and disturbance of business

A state or condition having the capacity to bring about a deviation from uniform or proposed conduct which, may bring about harm to property, individuals or environment, is known as danger. Along these lines a scrubber trap is a risk since it can possibly bring about a flame; procedures such as gas pressure is a risky movement since it can possibly bring about flames and blasts. "Hazard" does not express a perspective on the greatness of the results or how likely it is that the mischief will really happen. A "noteworthy risk" is connected with Loss of Containment and can possibly bring about huge harm or various fatalities.

##### 4.1 Quantitative risk assessment

The study depends on the premises of a conventional Quantitative Risk Assessment. The key parts of a QRA are clarified underneath, with Figure A.

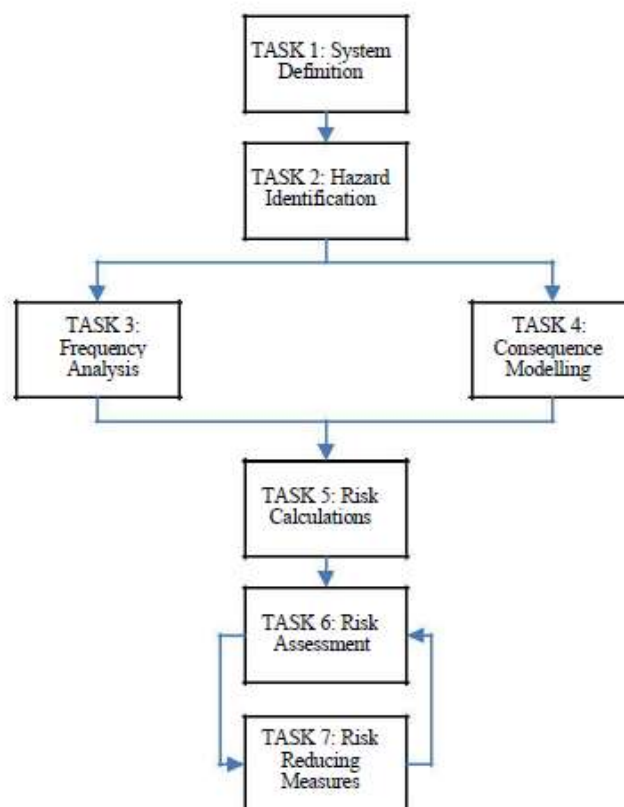


Fig. 4: QRA Methodology

Different types of danger presentation might be utilized, normally assembled as takes after:

- Individual hazard - the danger experienced by a distinct individual.
- Group hazard - the danger experienced by a gathering of individuals presented to the risk.

The procedure has been absolutely specialized, and is known as hazard investigation. The following stage is to present criteria, which are measuring sticks to demonstrate whether the dangers are worthy, or to make some other judgment about their essentialness. Hazard appraisal is the procedure of contrasting the level of danger against an arrangement of criteria and in addition the recognizable proof of real hazard givers. The motivation behind danger appraisal is to create alleviation measures for unsuitable generators of danger, and also to lessen the general level of danger to As Low as Reasonably Practical (Figure B).

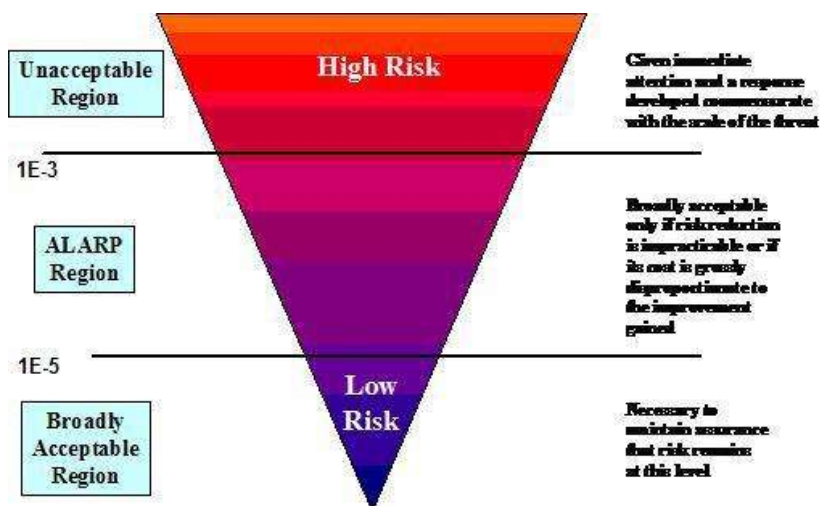


Fig. 5: Risk Assessment pyramid

Firefighting facilities need to be carefully planned. However, at least the following Portable fire extinguishers shall be positioned:

Table 2: Fire Fighting Parameters

Location	Type of Fire Extinguishers
Dispensing Unit	1*10 Kg DCP type
Compressor	1*10 Kg DCP type
CNG Storage	1*10 Kg DCP type
Cascade refueling	1*10 Kg DCP type
Electrical installations	1*4.5 Kg CO <sub>2</sub> type

## 5. CONCLUSIONS

There are many hazards in the compressed natural gas stations. It deals with the natural gas which is lighter than air. If any leakage in the pipelines or in any other equipment's like Compressor and Storage cascade, initial precautionary measures are taken to eliminate the hazards. Risk assessment or Hazard identification should be done in the CNG stations. Job safety analysis and HAZOP study is also done in the initial stage to set the CNG stations.

Proper maintenance of equipment is crucial for safe operations. Demand and capacity management along with proper pricing and cost control are crucial for profitable operations. Capital intensive project 5-6 times the cost of a petrol station. Cost to set up the CNG stations is high, but it is *Environmental Friendly*.

So by seeing all the conditions and parameters in natural gas, usage of Compressed Natural Gas (CNG) should be encouraged. High operating cost, cost of compression, transportation to daughter stations and maintenance cost of the CNG station is high.

- Deteriorating ambient air quality - common concern of citizens
- CNG is also proven & commercially available clean fuels as on date
- With low price of CNG, most of the motorists willing to switch to CNG
- CNG is bound for a phenomenal growth with setting up more and more CNG outlets in various cities

Therefore it is very much evident to use CNG as a substitute for gasoline fuel provided with acknowledge of all the hazards it may / may not pose on human health & environment.

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