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FEASIBILITY STUDY ON COMPRESSED NATURAL GAS STATIONS AND RISK IDENTIFICATION FOR STORAGE OF COMPRESSED NATURAL GAS (CNG)

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Abstract: This study considers the application of compressed natural gas stations and identification of risks associated with the storage of CNG and determining nearby land use limitations. In such cases the most important consideration is to be assured that the proposed site would not be incompatible with existing land uses in the vicinity. 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. This enables the IR aspects of the proposed site to be considered at an early stage to allow prompt responses or in the later stages to observe limitations. 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. This is chiefly because of inadequate risk assessment studies and ambiguities to define acceptable risk criteria. Natural gas is in priority because of the relative abundance, ease of use, less environmental pollution, and the price is cheaper than gasoline. Gas-powered cars and creates CNG fuelling stations at a rapid rate on the rise. This study was done to identify and determine the operational deviations in one of the CNG gas compressors and proposed hazard control measures. HAZOP study is done in order to risk analysis. Data gathered through visiting the work place, direct observation of the process, identify detailed components of gas compressor, interviews with staff and specialists, review procedures, operational instructions, and records of events and browse other technical information. 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: compressed natural gas, risk assessment, 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 mainlymethane in vaporous structure which are packed to a weight of 200 to 250 bars for use as a vehicular fuel. Furthermore, establishment of change pack in an automotive framework, two noteworthy establishments should be raised i.e. Compressors station for either on-line operation or to serve asmother station. Refuelling station either with on-line office or with moveablecourse.

Safety at these installations is most important factor in view of theoperating 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.

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Natural Gas is another important fossil fuel. Natural gas burns easily and produces a lot of heat. Natural gas consists of mainly of Methane (CH_4) with small quantities of Ethane and Propane. In fact, natural gas consists of up to 95%Methane, the remaining being ethane and propane. Natural gas occurs deep underthe crust of the earth either alone or along with the oil above the petroleum deposits. Thus some wells dug into the earth produce only natural gas, whereas others produce natural gas as well as petroleum oil.

Natural Gas is a new age fuel. With standout carbon and four hydrogen atoms for each particle, Natural Gas has the least carbon to hydrogen proportion, thus it blazes totally, making it the cleanest of fossil energizes. Regular Gas fulfils the greater part of the prerequisites for fuel in a cutting edge modern culture, being effective, non-dirtying and moderately efficient. The intermittent vulnerabilities and unpredictability in both the cost and supply of oil have likewise helped Natural Gas develop as a noteworthy fuel in the vitality wicker container crosswise over nations.

2. LITERATURE SURVEY

This study considers the utilization of quantitative Risk Assessment (QRA) on the siting of packed characteristic gas (CNG) stations and deciding adjacent area use impediments. In such cases the most critical thought is to be guaranteed that the proposed site would not be contradictory with existing area utilizes as a part of the region. It is conceivable by the classification of the assessed levels of individual Risk (IR) which the proposed site would force upon them. An investigation of the outcomes and probability of valid mischance situations combined with adequate danger criteria is then embraced. This empowers the IR parts of the proposed site to be considered at an early stage to permit brief reactions or in the later stages to watch confinements. As per the outcomes much of the time, required separations have not been given as well as CNG stations are generally situated in region of populated ranges to encourage refuelling operations. This is essentially in view of lacking danger evaluation studies and ambiguities to characterize satisfactory danger criteria.

At CNG filling station, packed common gas must be put away frameworkwith a specific end goal to make the use of the station more proficient. There aretwo frameworks for putting away regular gas in particular cushion and course stockpiling frameworks. In cradle stockpiling, CNG is put away at single high weight supplies. The course stockpiling framework is typically isolated into three stores, by and large termed low, medium and high- weight repositories. In current study, taking into account first and second laws of thermodynamics, discussion of mass and genuine gas suppositions, a hypothetical investigation has been created to study impacts of reservation sort on execution of CNG filling stationsand filling process. Considering the same last regular gas vehicle barrel (NGV) on-board in-chamber pressure for both stockpiling frameworks, the outcomes demonstrate that every capacity sort has points of interest over the other. The best design ought to be chosen by adjusting these favourable circumstances.

As ecological issues undermine the across the board utilization of fossil fills, Compressed Natural Gas (CNG) vehicles are investigated as another optionto the traditional gas fuelled vehicles. CNG vehicles must be furnished with sheltered and solid stockpiling tanks, for example, composite pressure vessels, since the disappointment of the CNG stockpiling tank can prompt travellerfatalities and wounds. The most likely explanations of disappointment of the CNG vehicles are flame and vessel break. In this exploration, the reason for vessel disappointment is examined through formal assessment and building test strategies. In particular, the disappointment component will be distinguished by fractography, and the material properties of a reference part will be researched through the instrumented space method. Also, the composite weight vessel configuration will be accepted utilizing the limited component technique.

3. COMPRESSED NATURAL GAS

Mother Cng Station

- Connected with the natural gas supply pipeline and have facilitiesfor dispensing CNG to vehicles.
- Have facilities to fill mobile cascades.
- Have facilities to fill all types of vehicles
- Consists of the following equipment:
- Compressor (min. 1000 cm/hr capacity)
- Dispenser
- Car
- Bus
- Storage cascade
- Facility for filling a mobile cascade

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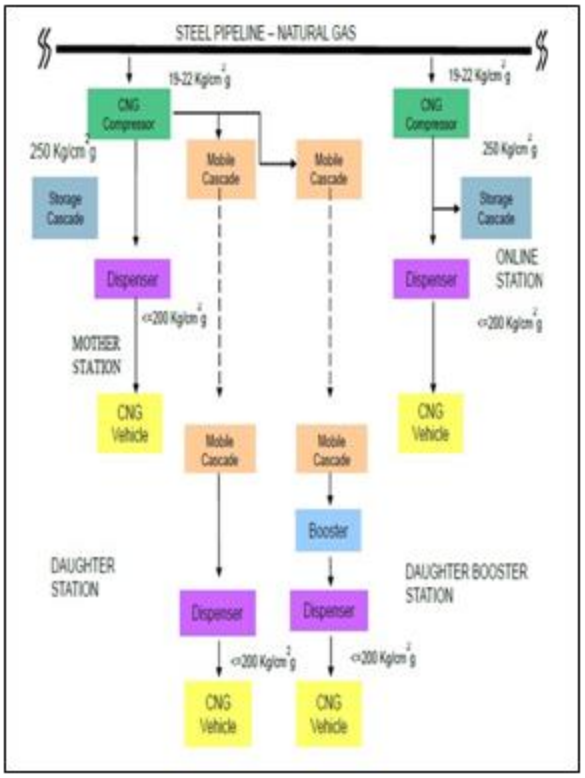

Figure.3.1 Process of Compressed Natural Gas

4.Elements of CNG Pumping Station

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

The following are the different elements that can be seen normally in a CNG pumping station:

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

4.1 Metering System at CNG Online / Mother Station

The following metering system is installed in all the CNG station as perthe 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 flowmeter at outlet of compressor

M5 = Meter installed in CNG dispensers (mass flow meter) M6=Mass flow meter in feed line to LCV

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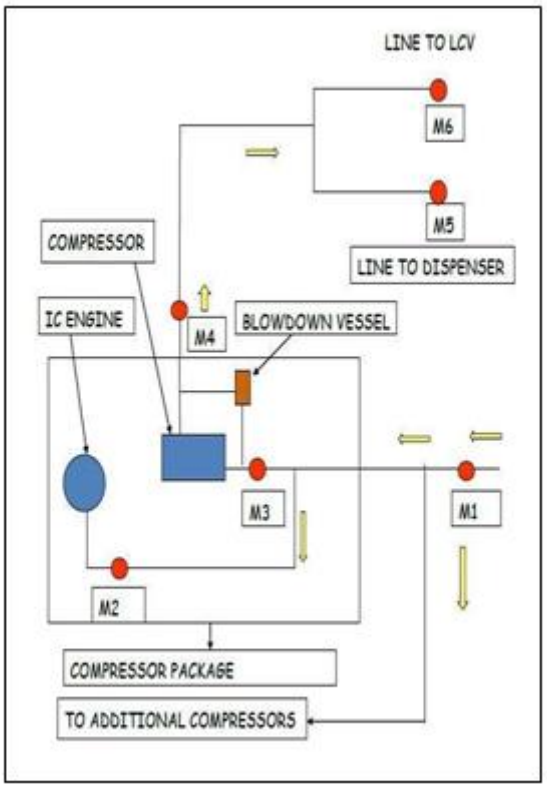

Figure 4.1 Metering System at CNG Online / Mother Station

4.2 Operation & Maintenance Of CNG PumpingStation

Goals of Operation & Maintenance Plan

- ✓ Provide continuous CNG as per Specifications and at 200 barpressure
- ✓ Manage Operation and Maintenance Activities
- ✓ Cost Control
- ✓ Customer satisfaction

Factors to Establish Operation & Maintenance

- ✓ Safety concern for the station users, owner personnel and thegeneral public
- ✓ Customer service through enhanced reliability
- ✓ Environmental& Regulatory agency compliance
- ✓ Control the Cost of Operating the station
- ✓ Protect the long term investment in capital equipment.

CNG Specification

Variation in CNG composition can adversely affect the Engineperformance Fuel supplier has to ensure that the CNG meets the quality specifications

Following are the important parameters:-

- ✓ Methane content,
- ✓ Total inert content,
- ✓ Total Sulphur content,
- ✓ O2content,
- ✓ Oil content,
- ✓ particulate matter

BIS is also working on a plan to bring out a code on CNGspecification

Oil Content in CNG

- ✓ Source of Oil
- ✓ Oil in the gas supplied by the Gas supplier
- ✓ Compressor Oil (Lubricated compressors) from the Compressor installed at CNG station
- ✓ Ensure to install Filters at the station inlet, upstream of Meter, to remove impurities and Oil

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✓ Filters should be installed and maintained at both compressor outlet and at Dispenser inlet to remove Oil carry over from the Compressor
✓ Maintain Oil level in CNG at 10 ppm maximum
✓ Carry out volume balance of Compressor Oil, preferably on daily basis. This will give a fare indication of Oil carryover with CNG
✓ Get CNG samples tested at regular intervals

5.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 theencompassing group
✓ Damage to property and speculations
✓ Degradation of the physical and natural environment
✓ Interruption to creation and disturbance of business

Quantitative Risk Assessment

Quantitative Risk Assessment (QRA) is a method for making anefficient investigation of the dangers from risky exercises, and shaping a levelheaded assessment of their essentialness, keeping in mind the end goal to give contribution to a basic leadership process.

QRA is now and then called 'probabilistic danger appraisal' or 'probabilistic security examination'; terms initially utilized as a part of the atomic business. The term 'quantitative danger investigation's is generally utilized, yet entirely this alludes to the absolutely numerical examination of dangers with no assessment of their centrality. The study depends on the premises of a conventional Quantitative Risk Assessment. The key parts of a QRA are clarified underneath, with Figure 5.1.

The Hazard distinguishing proof comprises of a subjective survey of conceivable mischances that may happen, taking into account past mishap experience or judgment where essential. There are a few formal systems for this, which are valuable in their own entitlement to give a subjective valuation for thereach and greatness of dangers and show suitable relief measures. This subjective assessment is depicted in this aide as "Hazard assessment". In a QRA, risk recognizable proof uses comparative procedures, yet has a more exact reason – characterizing the limits of a study as far as materials to be demonstrated, discharge conditions to be displayed, sway criteria to be utilized, and distinguishing and selecting a rundown of disappointment cases that will completely catch the peril capability of the offices to be contemplated.

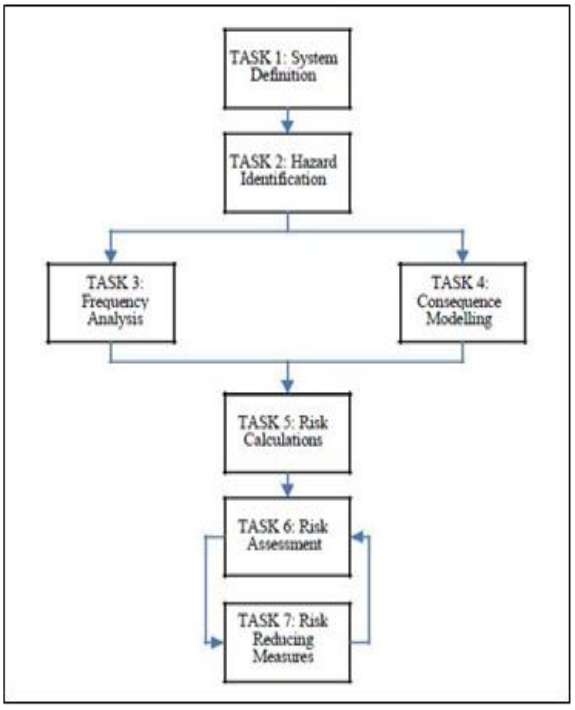

Figure 5.1 QRA Methodology

Disappointment cases are typically determined by separating the procedure framework into a bigger number of sub-frameworks, where disappointment of any segment in the sub-framework would bring about comparative results. In

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pipeline case, this can be performed by breaking the line into segments relying upon accessibility of separation valves along the line. Once the potential hazardhave been distinguished, the recurrence investigation assesses how likely it is for the mishaps to happen, in light of the sort and number of gear segments incorporated into the characterized disappointment cases.

5.1 Safety Measures in CNG Pumping Stations

General Safety Rules & Guidelines

✓ Smoking is strictly prohibited in the areas where flammable materials are handled

✓ Employees should not leave their jobs until the persons to relieve them are properly advised of all operating conditions

✓ Personal protective equipment must be worn by employees while handling hazardous substances

✓ Only authorized personnel should operate or stop theequipment and can change the status of valves etc. Other personnel are strictly prohibited from operating any of the equipment except during emergency that too under the instructionauthorized personnel

✓ All employees including contractor employees shall wear safety belt while working at heights of more than **1.2m** and where adequate protection or working platform or proper railing asa safeguard against falling is not available

✓ In addition to the requirement of wearing a safety belt while working at height, the employees shall also wear safety belt with life line anchored when they go inside any tank/vessel or sewers orenclosed spaces

✓ Before starting any repair or maintenance work on the equipment/system, make sure that you have obtained the necessarysafety work permit

✓ Use of flash type camera or any other non-flame proof instruments, mobile phones or machines are not permitted in hazardous area

✓ Carrying of any arms and ammunitions inside the operating area isstrictly prohibited

✓ When any dangerous/unsafe condition is observed, it should be immediately reported to your supervisor and/or safety department

✓ All stairways, platforms and walkways must be kept clean at all times

✓ Do not attempt to operate or set in motion any machine or equipment to which you are not assigned

✓ Horseplay is strictly forbidden. Apply your thoughts to safety andthrough workmanship

✓ Do not use defective equipment of any kind

✓ Keep the firefighting equipment free from all obstructions as theseare required to be used in emergencies

✓ Any injury, no matter how minor it is must be reported to your supervisor and safety department.

✓ In case of oil/chemical spill on your body, wash thoroughly with water & change your clothes and report immediately to hospital for further treatment/advice

✓ If any gas leak occurs, inform your supervisor area in charge and the fire & safety dept., stop all hot jobs, and keep spark producingequipment away from the leakage area

✓ All traffic sign and regulations must be observed at all times

✓ When ascending or descending monkey ladder, it is important thatworker faces the ladder and obtains a firm grip with both hands

✓ Portable ladders when placed must either be fixed at the top or aman must be stationed to hold the foot of the ladder

✓ Ladders must be carefully lowered and not be dropped on to thefloor or any other object/structure

✓ Never place the ladder on slippery floor

✓ Rest the top of the ladder on a solid base and secure it by tying

✓ Ensure that the ladder is placed at a safe angle

✓ Always face the ladder and hold with both the hands whileclimbing and descending

✓ Follow the three point contact rule strictly

✓ Do not climb the ladder with muddy/slippery shoes

✓ Place ladders on a firm base and secure at top of askperson to hold the ladder

✓ Ladders should rise at least 1 meter above landing place

✓ Beware of overhead lines while using ladders

✓ When climbing on ladders or structures, carry tools or material inshoulder bag/ waist bag so as to provide free use of your hands

✓ Do not leave tools or materials in such a manner or at such placeswhere they may accidentally fall on persons below

✓ Do not wear polyester (Terene/ Terylene) or nylon or any other synthetic fiber clothing while on duty. There are chances of generation of static charge in these clothing which may become a source of ignition

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General Safety Rules for CNG PumpingStations

✓ Switch off the mobile phones while entering the CNG station
✓ Validity of the CNG cylinder should be ensured before refuelling
✓ Keep watching the customers and passengers not to use theirmobile phones inside CNG station area
✓ Request passengers & visitors to stay away from the dispenser,high pressure & unauthorized entry area
✓ Ensure no vehicle is started when there is any leakage in theCNG station
✓ Ensure that there are no unauthorized persons inside the restrictedentry area
✓ Always use PPE while moving around the compressor & highpressure area
✓ Keep yourself away from the hot surface while inspectingcompressor & generator
✓ Do not open the doors of running compressor & generator
✓ In case of any leakage of gas inside the CNG station immediatelystop refilling & stop the compressor. Do not allow the driver to start vehicles & move vehicles away from the leakage area by manual push method to safe area
✓ Identify & know the location of the emergency shutdown buttons for compressor & dispensers in the CNG station. Alsolearn how to operate these ESD
✓ Ensure that there is no leakage of gas from cascade or from any fittings. Leak test should be done with foam solution or with a portable gas detector.
✓ Ensure that cascade cylinders are hydraulically tested every three years
✓ Always follow work permit system while doing any maintenancework in CNG station
✓ Keep away from the live part of the electrical installation
✓ Ensure placement of Fire Extinguishers at safe distance and easilyaccessible place for use in case of emergency
✓ Know how to operate fire extinguishers in case of any fire in theCNG station
✓ In case of emergency follow the emergency action plan
✓ Do not refill the CNG while passengers are inside the vehicle
✓ Use of match box, open flame & smoking is prohibited inside the CNG station
✓ Identify & know the location of the isolation valves in the CNG station which will require to be closed during any emergency in CNG station\
✓ Be aware of the location & operation of the cylinder valve, mastershut off valve and burst disc of the CNG vehicle cylinder. The valves are required to be closed during any gas leakage in the CNGvehicle
✓ Always follow the safe operating procedure & maintenance procedure for any O&M activities in the CNG station

Safety Instructions for Filling CNG Vehicle

✓ Ensure that the CNG vehicle is entering the station slowly and reaching the dispenser safely
✓ Stop the CNG vehicle at designated place only
✓ Stop the engine and remove the ignition key
✓ Remove all the passengers from the vehicle and send them to assembly point
✓ Check the hydro test due date of the CNG cylinder and ensure the validity of the test date. Also ensure that there is no physical damage on the CNG kit and refilling receptacle
✓ If any defect is found then instruct the customer to rectify the defect at the earliest
✓ Enter the defect in the log book maintained in the CNG station
✓ Ensure that the defects are rectified before filling the CNG in the vehicle
✓ Ensure that there are any open wires, any abnormal smell, high temperature & any other defect not existing in the vehicle before filling of CNG
✓ Ensure that there is no flammable materials are present in the vehicle
✓ Ensure that the station area is no smoking area
✓ Ensure that mobile phones are not used in the CNG station area
✓ Ensure that there is minimum three meter distance maintained between the vehicles during refilling
✓ Ensure that the earthing is connected during filling.
✓ Cover the battery with a rubber mat prior to start of refilling
✓ Check the vent pipe
✓ Remove the dust plug
✓ Ensure that the nozzle is properly fitted in the filling point and then open the valve. Hold it securely while refilling
✓ Ensure that the cylinder pressure will not go beyond 200.2 / kg cm
✓ Remove the nozzle carefully after filling the CNG in the vehicle
✓ Put the dust plug
✓ Remove the rubber mat from the battery
✓ Ensure that there is no leakage of natural gas prior to start of thevehicle

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- ✓ Start the engine and move the vehicle out of the station slowly
- ✓ If anybody is not following the safety instruction do not allow himfill CNG.

Safety Instructions for CNG Customers

- ✓ Fit & Repair the CNG kit from accredited workshop only
- ✓ Get the CNG kit checked every year from a recognized workshopand hydro test the cylinder every three years. Get the compliance plate from the work shop & fit it near the filing point. Always carrythe certificates along with the vehicle
- ✓ Stop the engine and remove the key from the vehicle & give it tothe filler boy.
- ✓ All the passengers including the driver must get down from the vehicleprior to filling of CNG
- ✓ Keep the wiring of the vehicle in a good condition and do not useopen wires.
- ✓ Battery terminal must be covered prior to filling of CNG. Do not keep the terminals loose and cover it with insulation tape
- ✓ Do not start the vehicle during any leakage of gas and take the vehicle to a safe location by pushing the vehicle. Then close the cylinder valve to stop the gas leakage
- ✓ It is prohibited to use open flames like match box etc. in the CNGstation area
- ✓ It is prohibited to smoke in the CNG station area
- ✓ It is prohibited to use mobile phones in the CNG station area,please keep the mobile phones off in the CNG station area
- ✓ Do not spread rumors during any emergency and follow theinstructions of the CNG station staff
- ✓ Keep patience during emergency & keep yourself away from theemergency area, always follow the safety & security rules

Do's & Don't's for Customers at CNG FillingStations

Do's

- ✓ Always ensure that installing / servicing the CNG kit is donethrough authorized workshop
- ✓ Hydro testing of CNG cylinder must be done every three years
- ✓ Get the vehicle thoroughly checked by an authorized workshopevery year
- ✓ Always keep the certificate of CNG kit and cylinder
- ✓ Keep a portable fire extinguisher and first aid box in the vehicle
- ✓ Follow the safety rules while filling and driving the vehicle
- ✓ Be alert for any emergency

Don'ts

- ✓ Do not install LPG, Propane or any other cylinder in place of aCNG cylinder
- ✓ Do not start the vehicle while the filling is under progress
- ✓ Do not use mobile phones near CNG filling area
- ✓ Do not use any naked flame near CNG filling area

Safety Instructions for Filling LCV

- ✓ Ensure that the LCV is entering the station slowly and reachingthe LCV filling point safely
- ✓ Park the LCV at its designated place only
- ✓ Turn off the engine and remove the ignition key.
- ✓ Apply the hand brake so that the vehicle will not move duringfilling of CNG
- ✓ Put wheel chock on wheels.
- ✓ Connect the earthing point to the cascade & vehicle
- ✓ Ensure that there are any open wires, any abnormal smell & anyother defect not existing in the vehicle before filling of CNG
- ✓ Ensure that there are no flammable materials & unauthorizedperson are present in the vehicle
- ✓ Enter the incoming time of LCV & pressure in the cascade in thelog book.
- ✓ Ensure that the station area is no smoking area
- ✓ Ensure that mobile phones are not used in the CNG station area
- ✓ Put the ignition key in the filling hose pipe so that it cannot beused during refilling of CNG
- ✓ Ensure that the three way valve is closed before fitting of thehose to the cascade
- ✓ Connect the hose pipe with the LP bank and ensure that it hasbeen connected properly
- ✓ Open the two way valve of LP bank of cascade
- ✓ Then open the three way valve of the LCV filling point
- ✓ Always present near the filling area & monitor the pressure level in the cascade while the filling is under

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progress

- ✓ Close the three way valve carefully after filling
- ✓ Close the two way valve of the LP bank carefully
- ✓ Carefully remove the hose from the receptacle and keep it onthe stand.
- ✓ Remove the ignition switch from the hose
- ✓ Remove the wheel chock from the wheel
- ✓ Ensure that there no leakage of natural gas before starting of theLCV
- ✓ Carefully start the vehicle and remove from the LCV filling point
- ✓ Enter the outgoing time of LCV & pressure in the cascade in thelog book
- ✓ Instruct the driver to follow the traffic rules and also to follow thedesignated route, ensure that the LCV has arrived the destination safely
- ✓ Carry out the surprise checks and ensure that the driver isfollowing the traffic rules.

Safety Instructions For Unloading of LCV

- ✓ Ensure that the LCV is entering the station slowly and reaching theLCV unloading point safely.
- ✓ Park the LCV at its designated place only
- ✓ Turn off the engine and remove the ignition key
- ✓ Apply the hand brake so that the vehicle will not move duringunloading of CNG
- ✓ Put wheel chock on wheels
- ✓ Connect the earthing point to the cascade & vehicle
- ✓ Ensure that there are any open wires, any abnormal smell & any other defect not existing in the vehicle before unloading of CNG
- ✓ Ensure that there is no flammable materials & unauthorized personare present in the vehicle
- ✓ Enter the incoming time of LCV & pressure in the cascade in thelog book
- ✓ Ensure that the station area is no smoking area
- ✓ Ensure that mobile phones are not used in the CNG station area
- ✓ Put the ignition key in the filling hose pipe so that it cannot be usedduring unloading of CNG
- ✓ Ensure that all the valves are in close condition before connectionthe hose
- ✓ Connect the hose pipe with the LP bank and ensure that it has beenconnected properly, Open the valves slowly & carefully
- ✓ Always present near the unloading area & monitor the pressurelevel in the cascade while the unloading is under progress
- ✓ After unloading close the valves carefully & slowly, also vent thegas in the hose carefully
- ✓ Carefully remove the hose from the receptacle and keep it onthe stand, Remove the ignition switch from the hose
- ✓ Remove the wheel chock from the wheel
- ✓ Ensure that there no leakage of natural gas before starting of theLCV
- ✓ Carefully start the vehicle and remove from the LCV filling point
- ✓ Enter the outgoing time of LCV & pressure in the cascade in the log book
- ✓ Instruct the driver to follow the traffic rules and also to follow thedesignated route, Ensure that the LCV has arrived the destination safely
- ✓ Carry out the surprise checks and ensure that the driver is following the traffic rules

Safety Instructions for LCV Drivers / OperatorsDo's

- ✓ Check the oil, water, air, brake & horn etc. before start of thevehicle
- ✓ Ensure all the documents of the vehicle like driving license; RC,TREM card etc. are available with the vehicle
- ✓ Always follow the traffic rules
- ✓ Ensure that the fire extinguisher is in a well maintained condition
- ✓ Ensure that the wheel stopper and earthing wire are used prior tofilling & unloading of CNG
- ✓ Always keep the vehicle in good working condition
- ✓ Always follow the safety & security rules

Don'ts

- ✓ Do not run the vehicle more than 40 km/Hr.
- ✓ Do not use any open wire & electrical appliances in the vehicle
- ✓ Do not remain in the vehicle during the filling and unloading
- ✓ Do not use any open flames like match box etc., and also do notsmoke inside the vehicle
- ✓ Do not allow to sit any unauthorized person in the vehicle

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Emergency Action Plans

Emergency Situation

- ✓ Accident of the vehicle
- ✓ Fire in the electrical wires of the vehicle
- ✓ Over turning of the vehicle
- ✓ Gas leakage from the cylinders
- ✓ Fire in the cascade & vehicle

Guidelines during any emergency situation

- ✓ In case of any leakage of gas & fire remove the vehicle in a safelocation
- ✓ Do not allow the public to gather around the vehicle
- ✓ Inform the GAIL gas officers, police & local fire brigade regardingthe emergency situation

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 crucialfor 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 ondate
- ✓ With low price of CNG, most of the motorists willing to switch toCNG
- ✓ CNG is bound for a phenomenal growth with setting up more andmore 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.

REFERENCES

[1] Naser Badri "Quantitative Risk Assessment to Site CNG RefuellingStations", 2010
[2] Eui Soo Kim "Risk analysis of CNG composite pressure vessel viacomputer-aided method and fractography", 2013
[3] Muhammad Imran Khan "Technical overview of compressed naturalgas (CNG) as a transportation fuel", 2015
[4] Mehdi Parlini "Consequence modeling of explosion at Azad-ShahrCNG refuelling station", 2014
[5] Javad Khadem "Mathematical modeling of fast filling process atCNG refueling stations considering connecting pipes", 2015
[6] Mahmood Farzaneh-Gord "Studying effects of storage types onperformance of CNG filling stations", 2011
[7] Naser Badri "Quantitative Risk Assessment to Site CNG RefuellingStations", 2010
[8] Eui Soo Kim "Risk analysis of CNG composite pressure vessel viacomputer-aided method and fractography", 2013
[9] Muhammad Imran Khan "Technical overview of compressed naturalgas (CNG) as a transportation fuel", 2015
[10] Mehdi Parlini "Consequence modeling of explosion at Azad-ShahrCNG refuelling station", 2014
[11] Javad Khadem "Mathematical modeling of fast filling process atCNG refueling stations considering connecting pipes", 2015
[12] Mahmood Farzaneh-Gord "Studying effects of storage types onperformance of CNG filling stations", 2011