



**DEPARTMENT OF PETROLEUM
RESOURCES**

**GUIDELINES FOR THE DESIGN,
CONSTRUCTION AND OPERATION
OF COMPRESSED NATURAL GAS
(CNG)
REFUELLING STATION**

JUNE 2010

PART ONE

PROCEDURE AND CONDITIONS FOR GRANTING APPROVAL FOR THE APPLICATION DESIGN, CONSTRUCTION, INSTALLATION, OPERATION, MAINTENANCE, AND ABANDONMENT OF A COMPRESSED NATURAL GAS (CNG) REFUELLING STATION

1.0 CATEGORIES OF LICENCES

1. CNG Compression Station Licence
2. CNG Industrial Licence
3. CNG Refuelling Licence

1.2 APPLICATION PROCEDURE:

1.2.1 Approval To Construct (ATC) for CNG Refueling Station

Application for approval to construct a refueling station for retailing compressed natural gas shall be submitted to the Department of Petroleum Resources (DPR) giving details of the proposals and any information that may be relevant to the project.

In addition, the following documents should be submitted along with the application form.

1. Application fees as may be prescribed and payable in bank draft to FGN-DPR fees Account.
2. Three (3) copies of a plan showing the building existing or proposed on the site and the relation of the site to the roadways and adjoining property.
3. Three (3) copies of layout drawing showing the location of equipment in relation to the CNG storage tank and petrol station if any.
4. Three (3) copies of storage tank details.
5. Three (3) copies of the piping and instrumentation diagram of the CNG refueling station.
6. Current Tax clearance certificate for preceding three years.
7. A certificate signed by the chief Federal/State Fire Officer or an officer authorized in that behalf that the arrangements proposed for the prevention of fire at the site are satisfactory.
8. A certificate by the Area/Town Planning Authority for the construction of a CNG Refueling station on the proposed site.

9. A certificate signed by the Divisional Police Officer or Superior Police Officer In-Charge of the Police Motor Traffic that he is satisfied that the site and in/out of the proposed refueling station does not constitute an unnecessary traffic hazard.
10. Evidence that the company applying is duly registered as a limited liability company by the appropriate Federal Ministry to deal in petroleum products.
11. Two copies of Environmental Impact Assessment (EIA) report of the proposed site should be submitted to the DPR and the report shall be prepared by a professional consultant accredited by DPR. DPR staff shall participate in all the EIA processes in accordance with the DPR EGASPIN, 2002 or latest issue.

1.3 APPROVAL TO CONSTRUCT/INSTALL

After the above listed documents have been submitted, inspection of the site will then be arranged. "APPROVAL TO CONSTRUCT/INSTALL" will be granted by the Department of Petroleum Resources if the proposed site fulfils the conditions stipulated in the relevant sections of this guideline.

Construction and operation of any gas facility without the required approval and licence attract appropriate penalty as contained in the Petroleum Regulations.

1.3.1 APPROVAL TO CONSTRUCT (ATC) issued by the Department shall expire one (1) year after the date indicated on the approved letter if construction has not commenced within that year.

1.3.2 Types of Approvals

ATC for CNG Compression Station

ATC for CNG Industrial storage

ATC/ ATI (Approval to Install) for CNG refuelling station

1.4 LICENCE PROCEDURE

1. After the completion of the construction/installation work, application for a storage and sale licence shall be made to the Department of Petroleum Resources (DPR). Such licence is granted after the station has been inspected and certified as being satisfactory by officials of the DPR.

The following facilities must be provided at the refueling station before it could be considered for licensing:

- (a) Air compressor and air gauge in good working conditions
- (b) Provision of water (pipe-borne/well-treated bore-hole)
- (c) Well stocked first aid box
- (d) Refuse containers/waste basket(s)
- (e) Fire extinguisher
- (f) Electrical Generator

2. **CNG FACILITIES ATTENDANTS:**

All CNG facilities attendants must be very well trained and possess valid certificate of competence obtained from an organisation recognised by the Department of Petroleum Resources (DPR).

3. **ENQUIRIES**

Further inquiries may be directed to the Director, Department of Petroleum Resources, 7, Kofo Abayomi Street, Victoria Island, P.M.B. 12650 LAGOS, or any of the Operations Controller nearest to the State (s) where the refuelling outlet is situated.

PART TWO

GUIDELINES FOR THE DESIGN, CONSTRUCTION, INSTALLATION, OPERATION, MAINTENANCE, AND ABANDONMENT OF COMPRESSED NATURAL GAS (CNG) REFUELING STATION

1. INTRODUCTION

Compressed Natural Gas (CNG) must be stored under pressure in vessels designed to withstand safely the vapour pressure at the maximum temperature. Construction of such vessel must be to an acceptable design codes such as: -

- a. The American Society of Mechanical Engineers (ASME) Boiler and pressure vessel code for unified pressure vessels. Code Reference ASME.
- b. The American Petroleum Institute standard 2510 (2)
- c. The British standard BS 1500 Part 1 Fusion welded pressure vessels for use in the chemical petroleum and Allied industries or BS 1505
- d. ASME Code: Boiler and pressure vessel code, Section VIII: Unfired pressure vessels .
- e. ASME B31.8 : 1995 – Gas transmission and distribution piping systems.
- f. Nigerian Standards Organization of Nigeria (SON) approved standard on pressure vessels.
- g. Any other internationally acceptable codes and standards.

2. GENERAL DESIGN CONSIDERATION FOR CNG FACILITIES

Tanks for the storage of Compressed Natural Gas (CNG) shall be designed for a working pressure corresponding to the vapour pressure at the highest temperature that the content of the tanks are likely to reach. The design and fabrication of the tank and accessories including pressure relief devices, fitting, piping pressures, gauges flexible hose shall be for the full range of pressures, temperatures and loading to which they may be subjected to and shall be compatible with natural gas and its service conditions.

- a. The gas storage system may be provided by an arrangement of linked multiple gas cylinders or by bulk storage tanks. Multiple cylinder units stored in a vertical position shall be limited to a width of 1.1meters, a length of 5.5

meters and a height of 1.6 meters above ground level. Each such storage unit shall be separated from other units by a distance of 2 meters. For cylinders in a horizontal position, each storage unit shall be limited to a height of 1.6 meters, a length of 5.5 meters and a width equal to the length of one cylinder up to 2 meters. Whichever arrangement is used, they shall be linked by piping to form a single gas storage unit.

- b. Compressed Natural Gas storage facilities may be protected from effects of the weather by a roof or canopy. Such a roof if provided shall allow the dispersion of free or escape gas.
- c. Aboveground storage shall be protected from damage or unauthorised interference by means of a mesh steel fence fitted to surround the storage area at 1 meter from the cylinder banks.
- d. The CNG dispensing point shall not be closer than 2.50 meters to the nearest cylinder in the CNG cylinder storage bank and vehicles shall not be permitted closer than 2.0 meters this being controlled preferably by the provision of a kerning surround. The dispensing unit shall not be closer than 5 meters from any source of ignition.
- e. The storage/dispensing facilities shall be well ventilated to avoid accumulation of gas vapours in the premises.
- f. The design layout shall consider the prevailing wind direction with respect to adjoining properties and facilities.

3. TANK LOCATION AND SAFE DISTANCES

- a. Where CNG storage facilities are sited adjacent to an existing petrol station, the two shall be separated by a distance of 6 meters minimum
- b. Each individual cylinder used for the storage or dispensing natural gas shall be located with respect to the nearest building or compressor equipment or other sources of ignition in accordance with table 1.

TABLE 1
ISOLATION DISTANCES FROM BUILDING AND BOUNDARIES
TO GAS STORAGE UNIT

Total capacity of Gas storage (Cubic Meters)	Minimum distance (metres)	Minimum on-site distance between Gas storage units and a 4hr. FRR concrete or Masonry wall (metres)
Up to 1,100	2.5	1.0
1,100 to 2,450	4.0	1.0
2,450 to 24,500	10.0	1.6

- c. A fire clearance zone of a minimum 3 metres shall be maintained around the perimeter fence of any CNG storage facility.

4. CYLINDER STORAGE UNIT

4.1. SAFETY RELIEF DEVICES FOR CYLINDER STORAGE UNITS

- a. Each cylinder or bulk tank used for the storage of CNG shall be equipped with an approved pressure relieving device and an approved isolating valve which shall be readily accessible when installed in the gas unit. The isolating valve shall not be capable of closing off the pressure -relieving device.
- b. Piping and gas storage systems shall be protected against over-pressure by safety relief devices. Relief devices installed to protect the storage systems shall be such that it limits the pressure to 120 per cent above the maximum allowable working pressure of the system or the pressure which produces a hoop stress of 75% of the specified minimum yield strength, whichever is lower.
- c. A shut-off valve shall not be installed between the pressure relief valve and the gas unit or bulk tank except that a shut-off valve may be used on multiple valve installations where the arrangements of the valve will provide full required flow through the safety relief devices at all times. The opening or connection between the gas storage unit and safety relief

device or devices shall have at least the combined areas of all connected safety relief device inlets.

- d. All safety valves shall be fitted with vent pipes discharging vertically upwards at a minimum height of 2 meters above the tank top. The vent pipes shall be fitted with loose fitting raincaps.
- e. Every CNG storage unit including each manifold group of cylinders or bulk storage tank shall be provided with suitable pressure gauges which shall communicate directly with the tank or storage unit system and shall have an opening not to exceed 1.4 mm diameters at the connection. The pressure gauge shall have a dial graduated to read approximately double the operating pressure, but in no case less than 1.2 times the pressure at which the pressure relief valves is set to function. Pressure gauges shall be checked and calibrated every three years.
- f. Methane gas leak detection device shall be provided at the CNG facilities for warning when an airborne methane gas concentration exceeds 20% of the lower explosion limit, warning shall be plainly audible and visible to those within the zone of potential exposure to fire or explosion of vessel, system or delivery operation.
- g. Multiple cylinder units or groups stored in the vertical position shall be limited to a width of no more than 4 cylinders. Units or groups stored in the horizontal position shall be limited to a height of 6 at a width of 4 cylinders. When stacked horizontally, the units or groups shall be separated by not less than 1.5 meters.

5. VALVES

A minimum of four shut-off valves shall be fitted between the gas storage unit and the vehicle refueling filling nozzle except where a master shut-off valve is used and these valves shall be outside by the security fence that surrounds the Gas storage unit.

a. GAS STORAGE ISOLATION VALVE

Each gas storage unit shall have a quick action isolation valve installed in the steel supply pipe immediately adjacent to its gas storage unit to enable individual shut-off and isolation of each such unit.

b. MASTER SHUT-OFF VALVE

A master shut-off valve shall be installed in the steel outlet pipe, but immediately adjacent to the gas storage unit.

The function of this valve is to isolate all downstream equipment from the gas storage unit.

c. **EMERGENCY AND ISOLATION SHUT-OFF VALVE**

A quick action emergency shut-off valve shall be installed on the steel outlet pipe and shall be in readily accessible position. This valve should be shut-off when the re-fuelling point is unused.

d. **VEHICLE REFUELING SHUT-OFF VALVE**

A vehicle refueling shut-off valve shall be installed for each flexible vehicle re-fueling hose. This vehicle re-fueling shut-off valve will control the re-fueling of vehicles with CNG and shall have facilities for venting to allow for the bleeding of residual high-pressure gas in the refueling tank after vehicle refueling

6. PRESSURE GAUGES

Every CNG storage unit including each manifold group of cylinders, bulk storage tank shall be provided with a suitable pressure gauge. The pressure gauge shall communicate directly with the tank or storage unit system and shall have an opening not to exceed 1.4mm diameter at the connection. The pressure gauges shall have a dial graduated to read appropriately double the operating pressure, but in no case less than 1.2 times the pressure at which the pressure relief valve is set to function.

7. RIGID PIPING

All rigid pipe, tubing, fittings and other piping components between the gas storage unit and the emergency and isolating shut-off valve shall be designed for the full range of pressures, temperatures and loading to which they may be subjected with a factor of safety of at-least 8 based on the minimum specified tensile strength at 20 °C. Any material used, including gaskets and packing, shall be compatible with Natural Gas and its service conditions.

All piping and tubing shall be run as directly as practicable with adequate provisions for expansion, contraction, jarring, vibration and setting. Exterior piping may be either buried or installed above ground and shall be well supported and protected against mechanical and corrosive damage.

All piping and tubing shall be tested after assembly to a pressure equal to that of the safety device setting and proved to be free of leaks. It is recommended that this test could initially be carried out with kerosene or an inert gas.

8. FLEXIBLE HOSE

- a. Flexible hose shall only be used downstream of the emergency and isolation shut-off valve
- b. Connections for flexible hose shall be designed with a burst pressure of at least four times the most severe pressure and temperature conditions expected.
- c. All hoses shall be examined usually at interval of not less than one year. Hoses shall be tested for leaks with soapsuds or equivalent at least annually and only leakage shall be reason for rejection.

9. OPERATION

- a. At public refueling stations, vehicle refueling shall be from an overhead hose assembly. When not in use the refueling hose shall be supported by wide clips to ensure against abrasion of leaks and to facilitate the easy withdrawal for use without contact with the ground.
- b. The maximum allowable pressure for vehicle CNG cylinders is 16.5 MPS at 15C or its equivalent at another temperature. There shall be a pressure-controlling device fitted to achieve this.
- c. The refueling procedure and instructions shall be posted in a conspicuous place adjacent to the dispensing hose.
- d. All loading and unloading trucks shall be grounded for static electricity and conductivity at the loading or unloading site in accordance with the latest edition of international standard BS 7430: Code of practice for Earthing.
- e. Loading and unloading operations shall only be carried out during the hours of daylight unless adequate permanent lighting .
- f. Welding shall not be permitted within the vicinity of loading or unloading site while loading or unloading operations are in progress.
- g. DPR shall ensure that all facilities and equipment being converted or procured to be used for CNG handling are fit-for-purpose. The original equipment specification and data sheet shall be made available to DPR for verification purposes.

10. SAFETY PROVISIONS

- a. CNG used for vehicles shall be dried and purified to a level that will not adversely affect the safe operation of CNG equipment.
- b. Building up of hydrate accretions at low temperature shall be avoided.
- c. **"NO SMOKING"** and **"NO OPEN FLAME"** signs shall be conspicuously displayed in the premises and shall indicate that no smoking or open flame is permitted within the refueling operation. This sign shall be easily read from a distance of 30m.
- d. In cases where compressors are subject to automatic starting a notice in letter approximately 75 mm high shall be at height level and at the point of the compressor to read

CAUTION NOTICE: THIS MACHINE MAY AUTOMATICALLY START AT ANY TIME

- e. No natural gas shall be delivered into any vessel or system covered by these safety provisions unless odorized. The gas shall have a distinctive odor of sufficient intensity so that the presence of the gas may be detected down the concentration in air of not over 20% of the lower explosion limit (LEL). Odorants in the concentrations used shall be:
 - I. Harmless to humans
 - II. Non-toxic
 - III. Non-corrosive to steel, iron, brass or copper
 - IV. Non-soluble in water to an extent greater than 2.5 parts per weight of odorant to 100 parts by weight of water
 - V. Be compatible with natural gas at the pressures and temperatures to be encountered in storage, transfer, and service
- f. All accidents, incidents and contaminations must be reported to the nearest DPR office within 24 hours of its occurrence.
- g. No naked fire or lights shall be permitted in any CNG refuelling station.
- h. An adequate number of fire extinguishers of an approved type shall be kept available for use in case of fire.
- i. No natural gas shall be vented to the atmosphere, unless the vent is led to a safe point of discharge.
- j. Unattended refueling stations shall have a gas detector operated cut-off switch fitted to the electrical system of the compressor to automatically switch off in the event of a major gas leak.

11. ELECTRICAL INSTALLATION

- a. All electrical apparatus for power purposes shall be in accordance with Nigerian National Electric Code and/or BS 229 or US National Electric Safety Code.
- b. All electric motors, switches, motor controllers, circuit breakers, wiring and any other electrical facility inside a building housing a CNG pump or other similar equipment, or within 25 feet (7.62 metres) of an outdoor CNG storage tank, loading or unloading point, pump or other similar equipment, shall conform to the regulations set forth in the latest edition of international standard EN 50014/IEC 60079 series: Electrical apparatus for potentially explosive atmosphere as well as the National Electric code.
- c. Telephones and bells shall be in conformity with BS 1259 or the corresponding U.S. Code (explosion-proof).

12. CNG METERING

- a. All CNG dispensers installed in public refuelling stations must be of the type approved by the DPR or an appropriate authority.
- b. Private CNG refuelling stations that are not selling CNG to the public may not have meters.
- c. A CNG dispenser must meter the gas and therefore pressure difference and other estimated methods are not acceptable. The dispenser must meet minimum standard of performance, accuracy, electrical safety and pressure rating of components.
- d. Assessment of dispensers for accuracy shall be carried out by the DPR officials. To this end, a digital weighing device (s) graduated in Kilograms and commercial standardized cylinders which are in use at the station shall be kept for this purpose.

13. COMPRESSOR

- a. Compressors shall be designed for continuous full head duty, mechanically, electrically or hydraulically powered and shall be intended for CNG cylinder refueling applications. Such compressors shall usually, but not necessarily, be multistage reciprocating compressors with cooled lubricated cylinders of either trunk type or cross-head design. Design details, full specifications of compressors shall be submitted to the DPR and approval obtained prior to installation.
- b. Design and operation of the compressor controls shall be such that the compressor shall shut down safely in the event of loss of electrical power or loss of hydraulic oil pressure.

- c. Compressor shall be provided with clear and permanent markings readily accessible and easy to read where the compressor is in the installed position.
- d. Each compressor shall be supplied with installations and operating instructions as well as maintenance schedule.

14. GAS CONNECTIONS

The following equipment must be provided on the inlet gas line to a CNG compressor downstream of the mains metering assembly: -

- a. A non-return valve to prevent back flows in the event of compressor malfunction.
- b. A low-pressure cut-off valve with manual reset to shut off the supply in the event of low retribution system pressure.
- c. A storage chamber that dampens flow pulsation at themeter.
- d. A flexible connection to prevent mechanical vibration being transmitted back on to the metering equipment.

15. MAINTENANCE

The maintenance of equipment, pipeline shall be conducted in accordance with manufacturer's maintenance schedule and the provisions of the Mineral Oils (Safety) Regulations 1997.

16. TESTING, COMMISSIONING AND ABANDONMENT

- a. Testing and commissioning procedure for the compressor must be carried out in accordance with the procedures laid down by the manufacturers of the unit including compliance with the manufacturer's specification for the recommended lubricant.
- b. Any abandonment of CNG facilities shall be reported to the DPR for approval. No existing facilities shall be abandoned without due approval of the Director, DPR.

17. IMPORTANT INFORMATION

Construction, installation and operation of any gas facility without the required approval and licence shall attract appropriate penalties as contained in the Petroleum Regulations.