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USE OF PORTABLE GENERATORS IN DWELLING HOUSES; DANGERS AND PRECAUTIONS, AN APPRAISAL.

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ABSTRACT.

Generators help to power the gargets in buildings and in return causes vibration, noise pollution and air pollution. The health hazards generated by some of these emissions in air are numerous and therefore, cannot be ignored. This paper presents a research conducted on generators vibration impact on buildings, harmful exhaust emissions, effects on humans and preventive strategies. The different types and nature of the harmful exhaust emissions and their sources in buildings were discussed. The effects of these harmful exhaust emissions on humans such as health disorders (Cancer, respiratory tract infection, carbon monoxide poisoning, fatigue, headache, bleeding and depression, lowered immune system) were also highlighted and analyzed. The implementing safe practices, proper use and maintenance of generators, and piping the exhaust emission away from buildings and providing a separate building for generators were recommended as preventive strategies.

Keywords:, Portable Generators, Dwelling Houses, Danger, Precaution..

INTRODUCTION. The dangers associated with the use of generators in dwelling houses cannot be overemphasized. Power generators produce carbon monoxide and can be a source of carbon monoxide [CO] poisoning. During a power outage, generators are useful for providing electricity but can be dangerous if not used with caution. According to (Omidvarborna et al., 2014), generators in general, are not perfect and they produce emissions through their exhaust pipes or other system. These emissions are produced as a result of the combustion of fuels, natural gas, gasoline, and petrol. The major products of the complete combustion of petroleum-based fuels in generators and other internal combustion engine are carbon dioxide, water and nitrogen from air comprising highest percentage. A very small portion of the nitrogen is converted to nitrogen oxides and some nitrated hydrocarbons. Carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NOx), particulate matter and

sulfur dioxide are other emissions from the exhaust of generators. These are all harmful to humans. Some excess oxygen may be emitted which may be dependent on the operating conditions of the generator's engine. [Ezetoha et al, 2020]. Obviously, the emission of generator exhaust contributes greatly to air pollution and are part of the major causes of health disorders and deaths in dwelling homes and also a major cause of building failures across the country due to vibration.

The harmful by-products emitted from generators are usually distributed though out the living areas with the aid of air circulation. Hence, the need to reduce to minimum the health hazards associated with generator exhaust emissions in buildings.

RELATED LITERATURE ON USE OF PORTABLE GENERATORS.

It is worth of note that these emissions can be reduced via maintenance, proper usage of generators (Dahlgren, 2014) and safe practices since the concentration of a chemical species in generator engine exhaust is a function of several factors, including engine type, engine operating conditions, fuel and lubricating oil composition and emission control system (Johnson, 1988).

The Eco chatter was of the opinion that the crisis of environmental pollution from generators has profound effects on ecosystems. Greenhouse gas emissions contribute to climate change, disrupting the delicate balance of ecosystems. Pollutants like nitrogen oxide and sulphur dioxide lead to acid rain, harming ecosystems and endangering plant and animal life. Particulate matter emitted from generators settles on plants and trees, hindering their ability to produce oxygen through photosynthesis. Moreover, noise and vibration from generators disrupt wildlife, causing behavioural changes and population decline.

CLASSIFICATION OF GENERATORS.

The power company in their publication; generator types and their classification, classified generators into two broad types:

A.C Generators
D.C Generators

A.C Generators: Also known as alternators or Synchronous generators, these type of generators are the main sources of power supply in this day and age as Alternating electrical power is the preferred and the

predominant source of power throughout the world. These are of two types one is an induction generator and another one is a synchronous generator or the alternator.

The induction generator requires no separate DC excitation, regulator controls, frequency control or governor. It works by generating an electromotive force by driving a conductor(winding coil or armature) through a magnetic field.

Synchronous generators are large size generators mainly used in power plants. These may be rotating field type or rotating armature type. In rotating armature type, the armature is at rotor and field is at the stator. Rotor armature current is taken through slip rings and brushes. They suffer from high energy losses and are mainly used for low-power requirements. The rotating field(magnetic) type is widely used because of high power generation capability and absence of slip rings and brushes.

A.C generator can generate both 2-phase or 3-phase current or poly-phase(6 or more). 2-phase and 3-phase currents in the simplest sense means that the polarity of the current changes twice and thrice every cycle of operation respectively.

DC Generators: D.C generators are typically found in off-grid applications. These generators give a seamless power supply directly into electric storage devices and DC power grids without novel equipment. The stored power is carried to loads through dc-ac converters. The DC generators could be controlled back to an unmoving speed as batteries tend to be stimulating to recover considerably more fuel. According to Annaratone, D. (2008) generators can be classified based on the employed fuel, generators may be classified into fuel oil, natural gas, coal (or lignite), and low-grade fuel generators.

Types of portable generators.

Portable generators are of different types depending on fuel sources. According to Ecoflow [2023] depending on your needs, some generator types are better suited for your situation than others.

Gasoline Generators

Gasoline generators burn gasoline to provide electrical power. The engine injects air and fuel into a chamber, and a spark plug creates combustion, which forces the piston to move up and down and turn the crankshaft. The motion of the crankshaft spins the rotor and creates an electromagnetic field, producing an electrical current.

Propane Generators

Propane generators work similarly to gas generators but use propane as their primary fuel source. Propane has several advantages over gasoline or diesel. For one, it emits less carbon monoxide and greenhouse gases, making it a cleaner fuel source.

Diesel Generators

Diesel generators provide power more efficiently than gasoline generators. You get more power for the amount of fuel you burn, making it a good source of backup or off-grid power. Some homeowners prefer diesel generators because of their longevity and reliability.

Inverter Generators

Inverter generators work differently than most generators. Instead of running at a constant speed, an inverter generator throttles its engine speed to match the electrical demands. It conserves energy by not running at full throttle the entire time.

Solar Generators

Solar generators convert the sun's energy into electricity. Unlike gas and diesel, solar-powered generators don't release any carbon monoxide or pollutants that harm the environment. That also means you can use them indoors without any issues.

What size generator will I need?

The right portable generator for you is one that meets your needs for power output, battery capacity, durability, safety, and noise. Portable solar generators usually come tops in the scale as they provide clean, renewable energy without making a loud noise, like gas, diesel, and propane options. Ecoflow [2023]

The American red cross [2024] have developed a module for determining the size of generator needed by occupants as stated below:

- Add up the power requirements of the appliances and devices you will want to use. (Check the back and sides for a label with this info.)
- Add up the wattage of all the light bulbs you will want to use.

- ❖ Find the total amps you need by dividing watts by volts.
- ❖ Choose a generator that produces more amps than you need – because some machines draw up to 3 times as much power when starting up, and others lose efficiency over time. The best option is a permanently-installed stationary generator.

MATERIALS AND METHODS.

The study relied on data from secondary sources, which were largely obtained from the extensive review of the existing literature within the scope of the study and other subjects correlated to use of portable generators within the environment. These include; books, articles, journals, web information, and official statistics of the government. Primary sources mostly interviews were also carried out to buttress the information from secondary sources.

DISCUSSIONS

This section offers an overview of approaches for addressing the challenges of using portable generators in homes. Some dangers associated with the use portable generators were identified based on the findings of the studied literature. They cover different aspects which is not limited to carbon monoxide emission, electrocution and fire hazard. these hazards constitute a great deal of negative influences on the building, occupants and the environment.

Dangers Associated with Generators on human beings.

According to Pinellas County Health Department, the primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, fire, noise and vibration

Shock and Electrocution: The electricity created by generators has the same hazards as normal utility-supplied electricity. It also has some additional hazards because generator users often bypass the safety devices (such as circuit breakers) that are built into electrical systems.

Carbon Monoxide Poisoning: Carbon monoxide (CO) is a colorless, odorless, toxic gas. Many people have died from CO poisoning because their generator was not adequately ventilated.

The effects of harmful exhaust emissions on human health are numerous and are stated and analyzed below;

Health Effect of CO

Carbon Monoxide is a product of incomplete combustion (oxidation) of fossil fuels or hydrocarbons. The binding of carbon monoxide (CO) with haemoglobin to form carboxy-haemoglobin (HBCO) reduces the capacity of blood to carry oxygen, and the binding with other haem proteins is directly related to changes in the functions of affected organs, such as the brain, cardiovascular system, exercising skeletal muscle and the developing foetus. Carbon monoxide poisoning is the most common type of fatal air poisoning in many countries. Studies have shown that Poisoning is more serious with higher concentration, longer exposure and more intense physical activity (Omaye, 2002).

Fire Hazards:

Generators become hot while running and remain hot for long periods after they are stopped. Generator fuels (gasoline, kerosene, etc.) can ignite when spilled on hot engine parts.

Noise and Vibration Hazards:

Generator engines vibrate and create noise. Excessive noise and vibration could cause hearing loss and fatigue that may affect job performance.

Health Effect of Nitrogen monoxide.

Mono-nitrogen oxides NO and NO2 (NOx) react with ammonia, moisture, and other compounds that form nitric acid vapor and related particles. When these particles in excess get into the lung tissue, they can cause damage to it, leading to premature death in extreme cases. According to Turner et al. (2017), the inhalation of NO species increases the risk of lung cancer and colorectal cancer. Also, they may cause respiratory diseases such as emphysema and bronchitis and heart disease (EPA, 2013).

Health Effect of Particulate matter (PM10 and PM2.5)

Inhalation of airborne particulate matter can cause asthma and cardiovascular issues. Due to the size of the particles, they can infiltrate the deepest part of the lungs (Babadjouni et al., 2017) and cause lung cancer (Hamra et al., 2015). Inhalation of airborne particulate matter can also cause premature death (Bourdrel et al., 2017).

Health Effect of Hydrocarbons

Long-term exposure to benzene (C6H6) can lead to damage of bone marrow; can cause excessive bleeding and upset the immune system,

increasing the chances of infection. C6H6 in the blood causes leukemia and also other blood cancers and pre-cancers of the blood (Automobile Association Developments Limited, 2012). On the other hand, several Polycyclic Aromatic Hydrocarbons (PAHs) are carcinogenic (IARC, 1983; IARC, 1987)

Health Effect of Sulfur dioxide

Inhalation of sulfur dioxide causes constriction of air passages, creating problems for people with asthma and for young children whose small lungs need to work harder than adults' lungs (Dahlgren, 2014). Health Effect of Ozone Though ozone is beneficial in the upper atmosphere, it reacts with lung tissue in the body. It can inflame and cause harmful changes in breathing passages, decrease the lungs' working ability and cause coughing and chest pains (EPA, 2016). Even healthy people are found to be affected by ozone.

Dangers associated with Generators on the Environment

Portable generators can constitute danger to the environment in so many ways, including:

- **Noise pollution:** Portable generators can be very noisy and can disturb wildlife and nearby residents. This can lead to decreased quality of life and even hearing loss in humans and animals.
- **Air pollution:** Portable generators emit carbon monoxide, nitrogen oxides, and particulate matter into the air, which can contribute to the formation of smog and other air pollutants. These pollutants can have serious health consequences, especially for those with respiratory problems.
- **Water pollution:** Portable generators can leak oil and other fluids, which can contaminate nearby water sources and harm aquatic life.

Having been informed of the potential impacts and potential steps to reduce them, we can minimize the negative effects of using a portable generator on the environment.

SAFETY RULES IN USE OF GENERATORS..

The use of generators in home is becoming unavoidable especially with the poor public power supply in Nigeria. One have to observe precautionary measures to mitigate the impact of the use of generators. Trauma Care international foundation proposed a couple of safety tips that should be

adhered to by portable generator users. They opined that Portable generators are useful in the situations of temporary shortage of power and outdoor occasions..
Below are a few tips to reduce the negative effects of generator usage.

Precautions against Carbon Monoxide Poisoning;

- Manufacturer's instruction should be followed. Do not assume you know it by doing trial and error.
- Carbon monoxide alarms should be installed in your home.
- Check the carbon monoxide alarms regularly and replace batteries if needed.
- Never use a generator indoors or in enclosed spaces such as garages, crawl spaces, and basements. NOTE: Open windows and doors may NOT prevent CO from building up when a generator is located in an enclosed space.
- Make sure a generator has 3 to 4 feet of clear space on all sides and above it to ensure adequate ventilation.
- Do not use a generator outdoors if its placement near doors, windows, and vents could allow CO to enter and build up in occupied spaces.
- If you or others show symptoms of CO poisoning—dizziness, headaches, nausea, tiredness—get to fresh air immediately and seek medical attention. Do not re-enter the area until it is determined to be safe by trained and properly equipped personnel.
- Make sure the exhaust is facing away from your home and any nearby buildings.
- Use of electronic detectors/monitors for monitoring exhaust emissions in buildings. The personal dosimeter is an example of such device for the detection of carbon monoxide (CO).
- Opening doors and windows or using fans will not prevent CO buildup in the home. Although CO can't be seen or smelled, it can rapidly lead to full incapacitation and death. Even if you cannot smell exhaust fumes, you may still be exposed to CO. If you start to feel sick, dizzy, or weak while using a generator, get to fresh air RIGHT AWAY - DO NOT DELAY.
- If the carbon monoxide alarm sounds, move quickly to a fresh air location outdoors or by an open window or door.

Precautions against fire hazards;

- ❖ The generator should be kept dry
- ❖ Do not touch the generator with wet hands.
- ❖ Make sure that the extension cord used should be free of cuts and twists.
- ❖ If you are unqualified, do not try to connect the house wiring to the generator. Seek the help a qualified electrician.
- ❖ If there is need to refuel your generator, turn it off and allow it to cool. A fire could result if petrol gets on hot engine parts.
- ❖ Fuel should be stored away from materials that could easily burn.
- ❖ Gasoline and other generator fuels should be stored and transported in approved containers that are properly designed and marked for their contents, and vented.
- ❖ Keep fuel containers away from flame producing and heat generating devices (such as the generator itself, water heaters, cigarettes, lighters, and matches). Do not smoke around fuel containers. Escaping vapours or vapours from spilled materials can travel long distances to ignition sources.
- ❖ Never try to power the house wiring by plugging the generator into a wall outlet. Known as "backfeeding," this practice puts utility workers, your neighbors and your household at risk of electrocution.
- ❖ Always connect the generator to appliances with heavy-duty extension cords.
- ❖ Test the batteries frequently and replace when needed.

Precautions against Noise and Vibration hazards;

- • Keep portable generators as far away as possible from work areas and gathering spaces.
- • Wear hearing protection if this is not possible.

Precautions to mitigate the effects on the environment;
These strategies involves both reduction of the emission rate and prevention of spread of emissions in buildings.

Reduction of Emission Rate;
The exhaust emissions depend on the engine combustion design and operating conditions, the fuel grade and lubricant and the state of

maintenance (Elias et al., 2009). Reduction of emission rate therefore, involves the following:

- Use of more fuel-efficient or lower emission generator where possible. This may cause higher engine injection pressures to reduce particulates and fitting exhaust gas recirculation systems to reduce gaseous oxide emissions; Proper maintenance of generator. Generator pollutes the least amount when they are brand new. Over time, the emission control systems of the generator degrade and pollution increases. Keeping your generator well-maintained with regular tune-ups will prolong the efficiency of your engine and its emission control systems. Generator owner's manual has a suggested maintenance schedule that can help generators operate efficiently. Maintenance also involves using high grade fuel (cleaner fuels such as low sulphur diesel fuels) and lubricant in running generators.
- Using generators in good operating conditions.
- Using generators without exceeding the load capacity as specified by the manufacturer.
- Use the type of fuel recommended in the instructions or on the label on the generator.
- Regularly check and change the oil and air filter to reduce emissions.

REDUCING IMPACTS ON BUILDINGS.

Vibration that is transferred to a structure or other components may be radiated as unwanted sound and can become a secondary issue. Vibrations from generators may generate lateral loads on buildings and may cause failures in building.

Secondly, the by- products not only harm the occupants, it also causes damage to finishes of the building especially the walls and floors. Elastomeric and spring isolators are very effective at limiting the transfer of vibratory energy to foundation structures and other components.

CONCLUSION

This work has shown that generators produce emissions and other by-products that spread in buildings as a result of human errors. The harmful exhaust emissions are potential causes of health problems such as fatigue, headache, respiratory tract infection, carbon monoxide poisoning, bleeding and depression, lowered immune system and cancer among many others. The study also highlighted that the volume of emission and the associated dangers to human can be prevented by reducing the rate of emission and

preventing such harmful emissions from gaining access into dwelling homes. Various preventive strategies may be applied which is not limited to implementation of safe practices, proper use and maintenance of generators, and piping of exhaust emission away from buildings. It is therefore advised that the preventive
strategies discussed in the paper be adopted by anybody using potable generator in dwelling houses in order to prevent health hazards linked to its exhaust emissions and possible psychological impacts and excessive cost of maintenance on occupants as a result of use of portable generators in the buildings.

RECOMMENDATIONS.

In order to reduce the impact of use generators, the ministry of health and National Orientation agency should amidst other responsibilities create awareness of the dangers of using generators without applying precautions. Environmentally conscious technologies and designs of generators should only be allowed in the country. That way, emissions would reduce drastically.
Greater efforts should be put in to provide stable and affordable public power supply to reduce use of generators.\
Finally, there is an urgent need for change towards cleaner and more sustainable forms of power generation. Renewable energy sources such as solar and wind, along with cleaner burning fuels like natural gas, are emerging as viable alternatives.

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