

Risks Comparison between Nuclear Generated Electricity and Other Electricity Generation Sources in Nigeria

*¹Abdulhameed Salawu and ²Celestine O. Oche

¹Department of Physics, Federal University Lokoja, Kogi State, Nigeria

²Department of Physics, University of Abuja, Gwagwalada, Abuja, Nigeria
salawuhameed@yahoo.com | ochegabasphysics@gmail.com

Abstract— Nigeria with over 0.181 Billion people currently suffers from acute power shortage which has seriously affected the country's economy for several years with no viable solution thus far. Salvaging this situation brings up the need for a search for more efficient means of generating '24/7' electricity in Nigeria. Several attempts by Government to introduce nuclear generated electricity were faced with a lot of criticism from the Nigerian populace. This paper focuses on the perceptions of Nigerians vis-a-vis electricity production using nuclear energy. It raised valid questions and sampled opinions of Nigerians. The survey carried out in this work shows that a lot of Nigerians do not understand that we have accepted more risky physical facilities or riskier option of electrical energy generation as compared to nuclear energy. Hence it made comparison between the casualty rates from other energy generation sources, accident from various means of transportation and from nuclear power plant. The analysis of data used in this work (as provided in table 6.0), shows that it would take road traffic accidents just about four days to claim as much lives as nuclear reactors in 50 years and that in about three years, aviation industry in Nigeria claim more lives than accidents from nuclear reactors in 50 years. We also observed that electricity production from nuclear energy has the lowest record of accidents and fatalities rate as compared to other major energy generation sources.

Keywords— Accident, risks, nuclear, energy, fatality, Road, Air and Death

1. INTRODUCTION

The acceptance of risk associated with the use of nuclear energy for electrical production has been a major source of concern all over the world. Some of the generally accepted physical facilities in Nigeria have some level of risk associated with them with some posing more threats to lives than the other. The main aim of this paper is to investigate the risk perception of electrical production from nuclear energy as compare to those of production from other energy sources or other physical infrastructure in Nigeria. In a hydro power plant station for example, high presence of rain fall can make this method of electrical production a potential threat to inhabitants of the areas around dams. People living around the downstream areas of dams such as Shiroro, Jebba and Kainji dams in Nigeria are always prone to flood with a devastating effect of Landlessness, Joblessness, homelessness, increase morbidity/mortality and food insecurity among others (Micheal, 2004). The consequences of a catastrophic dam failure are enormous because hundreds of thousands of people, who thrive in agricultural business, are inhabitants of the settlements around the dams (Chiroma et al, 2016).

While nuclear energy is completely eco-friendly, huge gas flaring from the oil and gas industry has placed Nigeria (a world leader in Liquefied Natural Gas Production (LNG)) among the world's largest contributor to carbon emission which leads to global warming (Akin, 2008). In addition, oil exploration has caused serious environmental pollution in the land, water and air across States in the Niger Delta region of Nigeria (Yehuwda et al, 2013). Simple transportation of oil and gas via tankers alone has led to several losses of life and properties on the Nigerian roads as compare to cumulative number of deaths from 50 years global records of nuclear power accident.

Several negative effects associated with the use of coal for electrical production are hardly discussed in Nigeria as compare to Nuclear Energy risk. Combustion of coal, account for hundreds of thousands of deaths per year in countries like China, Europe and many other parts of the world (Coal Atlas, 2015). About two third of unused thermal energy generated from coal get into the environment to increase the already high global temperature. There are no other sources of energy that contribute as much to greenhouse gas emission like coal (Coal Atlas, 2015). In over five decades since the use of nuclear energy for electrical production, there are no records that a reactor operating in a normal condition has negative effects on life and properties as compare to coal that has cause several respiratory and other health diseases (Coal, 2015).

Presently, there are more electrical generating sets (popularly called I pass my neighbor in Nigeria) than one can actually count. This means of electrical production has contributed to the global emission of greenhouse gases. In addition to noise pollution, inhaling carbon monoxide fumes from these generators has wiped off several families in Nigeria while sleeping. Apart from deaths caused by insurgency, road traffic accidents are currently by far the main cause of violent deaths in Nigeria (Vitus, 2014). In the aviation industry, one mistake means catastrophe for all passengers and crewmembers onboard and this particular very risky means of transportation has caused a lot of deaths in Nigeria over the last 60 years (Osi, 2012). One pure way of predicting the future is by assessing the past and many of the developed countries today have taken huge and calculated risks in the past. Our goal in this work is to educate Nigerians about the level of risk associated with the use of nuclear energy for electrical production as compare to those of other commonly accepted risk in Nigeria.

*Corresponding Author

2. METHODOLOGY

The primary source of data was the questionnaire which was devised using two media. The first was the creation of Google forms that provides the avenue to have questionnaires drawn online, with inbuilt statistical program to give the required statistics upon request. This was made available to respondent via the link https://docs.google.com/forms/d/1OE8qZ_FauCARRpHtj37Zj7lmkL9TQt3sw38EaHvRo/edit?usp=sharing.

This link was spread in social media platforms and the groups can access the form for their inputs by simply clicking the link. The merit of the online form is that it avails one, the opportunity to get a very good spread in data derived across the country. Hard copies were also distributed to officials of some government agencies (such as FIRS, WAEC, NECO etc.), schools and private institutions after holding a brief session of exposition to the whole idea of nuclear electricity generation.

Secondary data were derived from the National Bureau of statistics (NBS) which includes transportation data from Road transports (reported accidents/casualty profile), Aviation sector (Passenger stats, crashes/casualty figures), other notable published papers around the world for global statistics on various energy sources and transport media that poses some level of risk or the other. The values derived from the primary source which is via questionnaires and oral interviews were analyzed via Microsoft Excel's statistical function. Results were presented in bar charts and frequency distribution tables. A graph was plotted to show the distinction between the casualty level of nuclear accidents, transport media and other commonly accepted risks, first in Nigeria and then globally. About 20% of our sample populations were public servant, 4% were physicists, 32% were undergraduate student, 19% were secondary school teachers and 3% were engineers while the remaining 22% cuts across various facets of the society having one level of education or the other. About 78% of the sampled Nigerians live with less than four (4) hours of uninterrupted electricity daily. About 16% had between 5 and 10 hours of electricity while 7% had more than 10 hours of electricity as indicated in Table 1.

Table 1. Responses to Question on Number of Hours of Uninterrupted Electricity Per day

Hours of electricity supply per day	Number of response	Percentage
0 – 4	141	77.9
5 – 10	28	15.5
more than 10	12	6.6

About 78% of our sample population used small electrical generators to augment the epileptic supply of electricity by the Nigerian government as shown in Table 2 and therefore contributes to carbon emission to the environment. In addition to the fatal effects of inhaling fumes from the overnight usage of these electrical generating sets, it also serves as a major source of noise pollution in many communities in Nigeria. About 51% of those who choose this method of electrical generation declared it as risky, 37% declared it not risky while 11%

declared no knowledge as to the level of risk associated with its usage as presented in Table 3.

Table 2. Various Electrical Energy Generation Sources Used by Respondents in Nigeria

Energy sources	Number of response	Percentage
Solar/inverter	21	11.5
I pass my neighbor (generator)	142	77.6
Gas/oil	16	8.7
coal	4	2.2

Table 3. Responses to the question on the risk associated with energy sources

Energy sources	Risky	Not risky	I don't know
Solar/inverter	6	11	4
I pass my neighbor (generator)	72	52	15
Gas/oil	6	3	7
coal	0	2	2

3. RESULTS AND DISCUSSION

The result of the survey carried out in this work shows clearly the perspectives of Nigerians vis-à-vis the introduction of nuclear generated electricity into national grid. About 68% of our sample population as shown in Table 4 supported the introduction of nuclear energy to provide a lasting solution to the country energy crises as observed in Fig. 1. 59% of these populations have good knowledge of the level of risk associated with the use of nuclear energy for electrical production as presented in Table 5. About 76% of this group of our respondent supported the introduction of nuclear power plant in Nigeria immediately while 14% supports it but not immediately (see Fig. 2a). The percentage of our respondents that supports the installation of nuclear power plant in their neighbourhood is about 13% higher than those that rejected it (see Fig. 2b). These two figures have clearly shown that majority of Nigerians are prepared to accept the risk associated with nuclear generated electricity.

Table 4. Responses to the question on the introduction of nuclear energy in Nigeria

Response	Frequency	Percentage
Yes	135	67.8
No	47	23.6
Indifferent	17	8.5

Some of the concerns of those who opposed the introduction of nuclear technology in Nigeria include the level of technical knowhow, ability to manage nuclear power accidents, mitigation against the effect of radiation exposure, poor attitudes of most Nigerians to work and possibility of attacks by terrorists. Most of these concerns are currently been addressed across the world because manufacturers have investigated many of

the possible causes of reactor accident and are coming up with several strategies that can be used to minimize their chances of occurrence upfront. Therefore, Nigeria can learn from the mistakes of other countries to perfect the development of their nuclear technology. Note that countries usually design a new nuclear reactor system either by studying the successful records of other countries, by updating its own previous experience, or by the availability of nuclear materials (Salawu and Suleiman, 2016).

Table 5. Responses to the question on the knowledge of the level of risk associated with the use of nuclear energy for electrical production.

Response	Frequency	Percentage
Good	118	59
poor	57	28.5
Indifferent	25	12.5

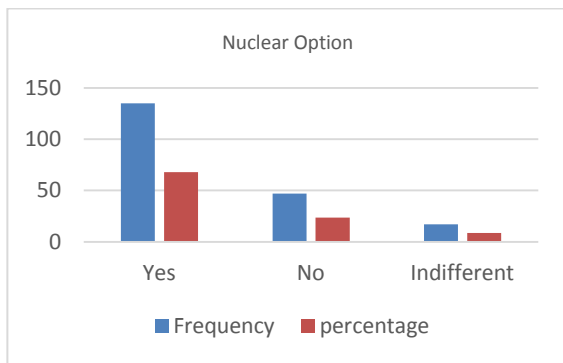


Fig. 1: Frequencies and percentages of respondent supporting the introduction of nuclear energy in Nigeria

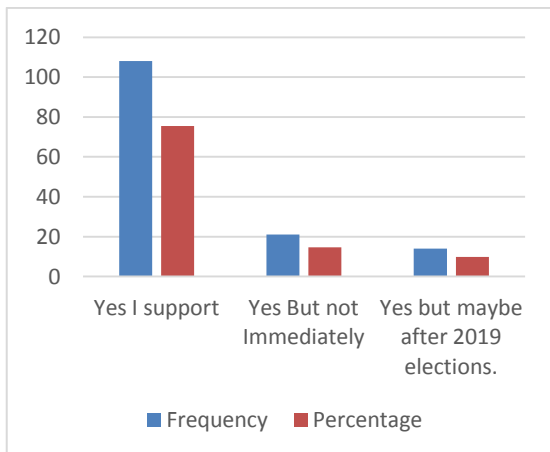


Fig. 2(a): Responses to questions on the support for introduction of nuclear power plant immediately in Nigeria

Fig. 3 shows the level of carbon emission by various electrical energy generation sources. It shows that coal leads the global emission of carbon followed by oil, gas, while nuclear reactors contributed none. Among the worst offenders of these types of emissions are sulfur dioxide, which contributes to the formation of acid rain; nitrogen oxides, which combine with Volatile Organic Compounds (VOCs) to form smog and toxic compounds of mercury (Naganathan, 2014). About 78% of our respondents use one form of electrical generating sets or the other. Exposure to high concentration of carbon

emissions from these sets has resulted to several deaths in Nigeria (Ismail et al, 2012). Death from road traffic accidents in Nigeria was ranked among the highest in the world. In the year 2016 alone, about 5053 Nigerian got killed in road traffic accidents (NBS, 2016). This statistics, plus the one shown in Table 6, has clearly shown that the level of threats to life by simply driving on the Nigeria roads is greater than that of nuclear and aviation sectors put together (see Fig. 5).

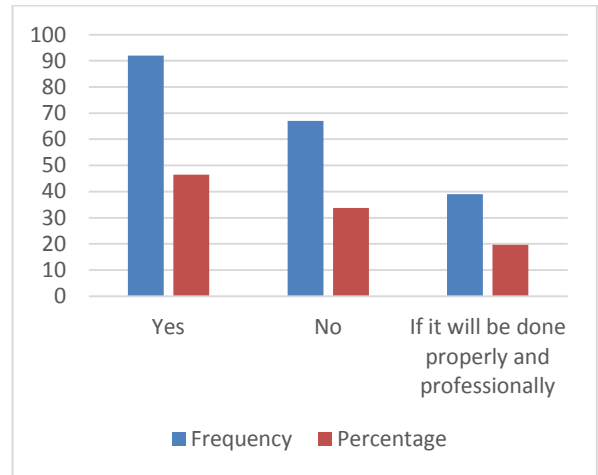


Fig. 2(b): Responses to questions on the support for installation of nuclear power plant in the neighborhood.

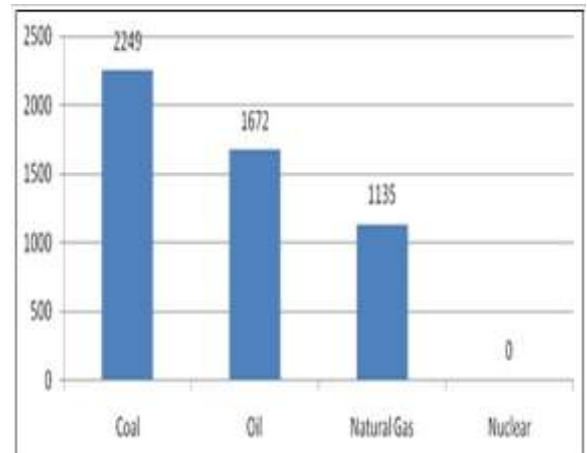


Fig. 3: Average Carbon Emission Levels (Global) (Pounds of Carbon Dioxide Emission MWh) (source: Naganathan, 2014)

The growth of the aviation industry in Nigeria has led to a concomitant rise in aviation disasters. A total of 38 air crashes occurred in Nigeria between the year 1960 – 2011 and this gives an average of almost one air crash per year. During this period, a total of 1514 persons were killed in the air crashes (as shown in Table 6), giving an average of about 39 deaths per year. Therefore, air transportation is by far safer, as compare to road transport in Nigeria with an average of over 6500 deaths per year as evident in Table 6. But the probability of dying in a crash is higher in air than road transportation (Osi, 2012). Despite the high level of casualties associated with air transportation as compare to nuclear (see Fig. 4), people stream into airports in tens of thousands daily against all odds of flying and potential death trap it poses. In terms of fatalities and effects on health and environment, and even taking into account rare destructive accidents such as Chernobyl and Fukushima, nuclear power has overall been safer and more

environmentally friendly than most other means of generating electricity (Edward and Michael, 2012). The total numbers of deaths recorded from these nuclear accidents were negligible as compare to casualty from other forms of energy extraction, such as using small electrical generating sets in Nigeria, coal mines and oil extractions etc.

Table 6. Comparing number of deaths from nuclear reactor accidents across the world with those of road/air transport in Nigeria

Period	Road transport (Nigeria)	Air transport (Nigeria)	Nuclear reactors (Globally)
1960-1969	18,748	198	3
1970-1979	57,136	192	2
1980-1989	92,610	88	56
1990-1999	77,037	378	2
2000-2009	64,119	476	4
2010-11	34227	182	3
Total	343,877	1,514	70

(Death Statistics from FRSC, NBS and Aviation Safety Networks (ASN))

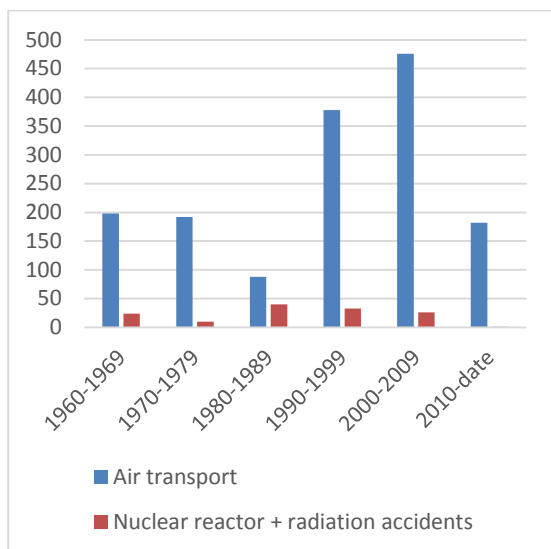


Fig. 4: Deaths statistics from Air transport versus Radiation plus Nuclear reactor Accident.

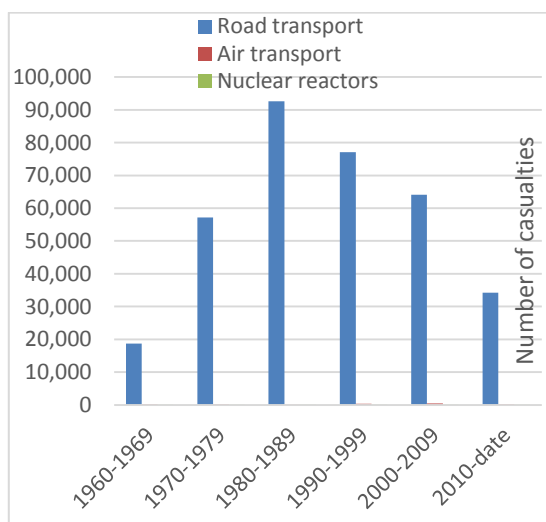


Fig. 5: Deaths statistics from transport sectors in Nigeria and nuclear accidents (in the world) from 1960 to 2011 (see Table 6).

4. CONCLUSION

The majority of our respondents from the survey carried out in this work have accepted the risk associated with nuclear generated electricity. They are strongly in support of the Nigeria government to introduce nuclear generated electricity to provide lasting solutions to the countries energy crises. This survey also shows that majority of the respondents are prepared to accept the installation of nuclear power plant in their neighborhood. Some of the concerns of those who opposed the introduction of nuclear power plant in Nigeria include the level of technical knowhow, ability to manage nuclear power accidents, mitigation against the effect of radiation exposure, poor attitudes of most Nigerians to work and possibility of attacks by militant or terrorists group in Nigeria. Most of these concerns are currently been addressed across the world because manufacturers have investigated many of the possible causes of reactor accident and are coming up with several strategies that can be used to minimize their chances of occurrence upfront.

Quite a large number of Nigerian do not have complete knowledge of the level of risk associated with the use of other commonly accepted facilities in Nigeria such as using small electrical generators, driving on the Nigerian roads and flying on an airplane etc. The total number of deaths recorded from the use of any of these facilities in Nigeria within a year is higher than the casualty figures from the 50 years records of using nuclear energy for electrical production in the world.

REFERENCES

Akin I. (2008). Investment in Electricity Generation and Transmission in Nigeria, Issues and Options. International Association for Energy Economics. Retrieved from <https://www.semanticscholar.org/paper/Investment-in-Electricity-Generation-and-Transmiss-Iwayemi/>

Coal Atlas (2015). Facts and Figures on a Fossil fuel. Retrieved from www.Nigeriaenergy.org/9-coal/30-coal-atlas-nigeria-facts-and-figures-on-a-fossil-fuel.

Chiroma, A., Amu, O., Otongolo, C., Balderman, F. (2016). Kainji and Jebba Hydro Power Plant rehabilitation Project. Retrieved from www.afdb.org/fileadmin/uploads/afdb/documents/environmental-and-social-Assessments/-ESIA_Summary.pdf

Edward D. B. and Michael M. M (2012). Lessons Learned from The Evolution of Nuclear Power Safety after Accidents and Near-Accidents. Retrieved from www.amacad.org/pdfs/lessonslearned.pdf

Ismail A., Jacob S., Funso A., Ademola R. (2012). Environmental Impact of Portable Power Generator on Indoor Air Quality. International Conference on Environment, Energy and Biotechnology (IPCBE-2012) vol.33.

Michael M. C. (2004). Social Impacts and Social Risks in Hydropower Program. Social Aspects of Hydropower Development, United Nations Symposium on Hydropower and Sustainable Development Beijing, China 27-29 October, 2004

Naganathan V. (2014). Analysis on Nuclear Power in India. Do India Really Needs Nuclear Energy for its Energy Shortage. IPASJ International Journal of Management (IJM)-Vol. 2, Issue 6, (pp1-15).

NBS (2015). Reported road accidents and stolen vehicles statistics 2013 – 2015, National Bureau of Statistics. Retrieved from www.nigerianstat.gov.ng

NBS (2016). Road Transport Dat., National Bureau of Statistics. Retrieved from www.nigerianstat.gov.ng

- NEA (2010). Comparing Nuclear Accident Risks with Those from Other Energy Sources. Nuclear Energy Agency. ISBN: 978-92-64-99122-4.
- Osi S. A. (2012). The terror of transport and the transportation of terror. University Of Port Harcourt Inaugural lecture series, no. 94; 27th September, 2012.
- OECD (2010). Comparing Nuclear Accident Risks with Those from Other Energy Sources. Organization for Economic Co-Operation and Development. ISBN 978-92-64-99122-4
- Salawu A. and Suleiman, S.A. (2016): An overview of computational potential in Nigeria for designing a nuclear reactor system for research or power application. Proceeding of the 6th annual and international conference of renewable and alternative energy society of Nigeria. University of Nigeria Innsuka, 20-23rd April, 2016.
- Vitus N. U. (2014). Trends and patterns of fatal road accidents in Nigeria (2006-2014). IFRA-Nigeria working papers series, no.35. Retrieved from <http://www.nigeriawatch.org/media/html/WP6VitusV6Final.pdf>
- Yehuwdah E., Chad-Umoren, Bamidele F. Ebiwonjumi (2013). Nigeria's Nuclear Power Generation Project. Current State and Future Prospects. Journal of Energy Technologies and Policy. ISSN 2224-3232, Vol.3, No.7.