The ES Management and Business
Vol. 1, No. 1, September, pp. 01~06

Involvement Of The Manufacturing Industry In Supporting The Supply Chain of NPP Development Program in Indonesia

[*]Lela Elvira[1], Dharu Dewi[2], Rinfutihat[3], Dewi Astuti[4]

Bina Sarana Informatika University, Indonesia

Article Info

Article history:

Received September, 2022
Revised September, 2022
Accepted September, 2022

Keywords:

Manufacturing Industry
NPP construction
Research Agency
National Innovation
IAEA

ABSTRACT

The development of the industrial sector and the increasing number of people in Indonesia causes the use of energy to increase. Fossil energy which has been the main support for electricity generation in Indonesia has experienced limitations and is running low. The current strategic issue is the government's commitment to reduce greenhouse gas (GHG) emissions, namely reducing carbon emissions by 29% by 2030 with its own capabilities and 41% with international assistance. By 2060 it is expected to achieve the Net Zero Emission (NZE) target. Currently, most of the power generation still relies on fossil energy, which produces G. Nuclear energy is one of the clean energy options in the supply of electrical energy to meet the demand and need for electrical energy in Indonesia. The electrical energy produced by nuclear power plants is a very clean energy because it does not release carbon into the environment. However, nuclear energy among the general public is considered a dangerous energy based on the experience of the three largest nuclear accidents namely Chernobyl, Tree Mile Island and Fukushima. Nuclear energy is environmentally friendly energy and efficient in the use of resources. Government Regulation No. 79 of 2014 states that nuclear energy is included in new and renewable energy (EBT).

Corresponding Author:

Name: Lela Elvira, SE, MM.
Institution Address: Bina Sarana Informatika University
e-mail:lela.llv@bsi.ac.id

1. INTRODUCTION

The nuclear power plant development program in Indonesia is one of the big projects and requires the use of high technology in the construction process. It is called a capital-intensive technology because nuclear power plant technology is very complex because its construction involves not only domestic contractors and vendors but also brings in and cooperates with foreign contractors and vendors to assist in the design of the nuclear power plant construction and components needed as well as the construction of the nuclear power plant itself in accordance with the requirements. Government Regulation No. 2 of 2014 contains permits for nuclear installations and the use of nuclear materials [1].

The international nuclear energy organization known as the International Atomic Energy Agency (IAEA) is pioneering the peaceful use of nuclear and promoting nuclear knowledge as an environmentally friendly energy to the rest of the world. The IAEA acts as a supervisor for the use of nuclear energy and the prevention of nuclear radioactive substances. Until 2019, there were 499 Nuclear Power Plants (PLTN) that had been operated in 38 countries and contributed around 10.4% to the fulfillment of electricity supply worldwide. The guidelines published by the IAEA state that there are 19 infrastructures that must be prepared. One of the 19 infrastructures is industry involvement in nuclear power plant development projects. The nuclear power plant development program in Indonesia requires support from national industries that act as contractors, suppliers, vendors and stakeholders to meet the needs of nuclear power plant components. One of the national industrial sectors that has an important role in it is an industry engaged in manufacturing. The manufacturing industry is one industry that has an important role as a supplier, especially non-nuclear components in the construction of nuclear construction facilities. Basically, the national industry already has the ability to produce several components for conventional power plants, but nuclear power plants have stricter codes and standards for safety and security in all aspects. The manufacturing industry is one industry that has an important role as a supplier, especially non-nuclear components in the construction of nuclear construction facilities. Basically, the national industry already has the ability to produce several components for conventional power plants, but nuclear power plants have stricter codes and standards for safety and security in all aspects.

Fulfillment of components for the development of nuclear power plants in Indonesia requires a sustainable supply chain of components from upstream (materials/raw materials) to downstream (nuclear power plant construction in Indonesia) by potential local suppliers and overseas vendors. The involvement of the national industry in the nuclear power plant development program has a positive impact in increasing the value of the Domestic Component Level (TKDN) as stated in the Regulation of the Minister of Industry of the Republic of Indonesia Number 54/IM-IND/PER/3/2012 which stipulates "Use of domestic products for electricity infrastructure development" , although in the regulation of the Minister of Industry, the TKDN for nuclear power plants has not been regulated. and provide experience and knowledge for the national industrial sector regarding the benefits and advantages of nuclear power plant development in Indonesia [2].

Policy and evaluation of research, technology and innovation on the national manufacturing industry is carried out to find out more about aspects that can support the development and encourage the national manufacturing industry as a local supplier of nuclear power plants, especially non-nuclear components to support the supply chain of nuclear power plant development programs

in Indonesia that will immediately implemented in the area of West Kalimantan and take the right decision steps by formulating the results of research that has been done in the literature. Through the Independent Learning Program at the Independent Campus at the National Research and Innovation Agency in one of the work units "Directorate of Research, Technology and Innovation Policy Evaluation".

2. LITERATURE REVIEW

Getting to Know Nuclear Power Plants

A nuclear power plant (PLTN) is a plant that utilizes a nuclear reactor to produce electricity. In a nuclear reactor, nuclear fission reactions occur or known as nuclear fission reactions that can produce heat and then convert it into mechanical energy that produces electrical energy. The resulting heat energy is then converted into mechanical energy to produce electrical energy. The working principle of a nuclear power plant is very similar to the workings of a fossil fuel steam power plant (PLTU) [3]. If the PLTU uses a boiler to produce its heat energy, the PLTN replaces it by using a fission nuclear reactor. The use of nuclear power plants in Indonesia can meet the government's target of meeting alternative energy reserves that will be built in the near future. Nuclear energy is known as environmentally friendly energy and uses fewer resources to generate electricity. Until 2019, there were 499 nuclear power plants operated by 38 countries around the world and had contributed about 10.4% of the world's electrical energy supply. The United States is the country that uses the most nuclear power plants, followed by France, China, Japan and Russia.

Types of Nuclear Power Plants and Components of Nuclear Power Plants

a. NPP type light water reactor (LWR)
b. Heavy water reactor type nuclear power plant (PWHR)
c. Graphite-moderated gas-cooled nuclear power plant
d. graphite-moderate molten salt nuclear power plant
e. NPP with liquid metal cooling
f. NPP with light water cooling (HO2) moderated graphite (LWGR)

3. METHODS

Uranium Supply Chain Cycle

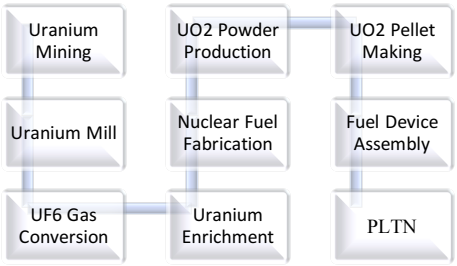


Figure 1. Uranium Supply Chain Cycle

a. Uranium mining: Uranium is a radioactive metal that is commonly formed in the earth's crust. The mining method used is the in-situ-leach method, which uses groundwater with high oxygen content which is sprayed into the pores of the uranium ore to dissolve it and bring it to the surface.

b. uranium milling: The process of grinding uranium into yellow cake (powder concentrate). Uranium ore is crushed and ground to a fine slurry, then sulfuric acid is added to clean the uranium from the rest of the rock. Uranium is deposited in the form of concentrated uranium oxide. After going through the process of drying and heating the uranium oxide concentrate is packaged in a 200 liter drum.

c. Gas UF6 Conversion: Uranium oxide needs additional processing in order to be used as a nuclear fuel. at the conversion facility the uranium oxide is upgraded to uranium dioxide so that it can be used.

d. Uranium Enrichment: The uranium dioxide enrichment facility is converted into gaseous uranium hexafluoride at a relatively low temperature because the enrichment facility requires uranium in gaseous form.

e. Nuclear fuel fabrication: is the final stage of the front end of the nuclear fuel cycle. There are 3 stages in it to make a nuclear fuel device, namely:

- Uranium hexafluoride/ UF6 is

converted to UO2 . powder
- Production processing of high-density and accurate ceramic UO2 powder pellets
- Loading fuel pellets by stacking the pellets into fuel rods and assembling the fuel rods into a ready-to-use nuclear fuel device.

f. **UO2 powder production:** Uranium hexafluoride/ UF6 needs to be converted to uranium dioxide UO2 before being made into pellets. UO2 uranium conversion can be done using two methods, namely:
- The dry method UF6 is heated with steam and processed to become a powder and then reacted with hydrogen gas to remove the fluoride content and will oxidize to UO2. Produces less waste.
- The wet method dissolves UF6 into water to form particulate UO2F2/UO2 which is more flexible. Next clean the fluoride from particulates with hydrogen gas so as to form UO2. Produce more waste.

g. **Manufacturing of UO2 pellets for nuclear fuel:**
- The first process is homogenization, namely the particle size of the powder is equalized to reduce pellet pores.
- Then the UO2 powder is molded into cylindrical pellets with a pressure of several hundred Mpa in a furnace at 1750 degrees Celsius to reduce the volume of pellets.
- The diameter of the pellet is less than 1 cm and the length is less than 1 cm with a weight of 1 gram which will produce energy equivalent to 1 ton of coal.

h. **Fuel device assembly:** UO2 pellets are arranged in a fuel rod, then assembled into a fuel device.

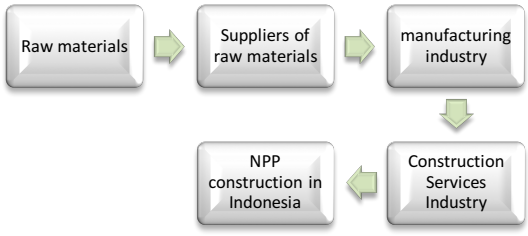
i. **Nuclear power plant:** Facilities for burning fuel to produce electricity.

j. **Nuclear waste management:** Nuclear waste management is the process of handling nuclear waste from the time it is removed from a nuclear reactor or nuclear facility until it is permanently stored. Nuclear waste management facilities are collecting, processing and storing radioactive waste so that the release of radioactive materials into the environment can be minimized. There are 4 facilities in nuclear waste treatment:
- **Used biofuel temporary storage facility** (wet storage, dry storage, dry storage in the form of iron/concrete room).
- **Used biofuel processing and recycling facilities** (one of the used biofuel conversion methods is the PUREX method. The converted uranium is enriched or mixed with High Enriched Uranium (HEU) and then fabricated into ready-to-use biofuels).
- **Conditioning facilities for used biofuels and other waste** (process of processing and cooling by converting radioactive waste materials into a suitable and safe form for the subsequent management of used biofuels (transportation, storage, and final disposal). Burning, packing, cementation, and vitrification can be carried out).
- **Facilities for permanent storage of used biofuels and other waste** (known as sustainable storage of used biofuels is the permanent storage of high levels of used biofuels in the soil at a certain depth for a long period of time.

4. RESULTS AND DISCUSSION

Upstream to Downstream Supply Chain in Nuclear Power Plant Development Program

National industrial supply chain from upstream to downstream for nuclear power plant construction is generally described as follows[4]:



a. Raw materials or materials needed are adjusted and ensured that they meet the application of established codes and standards.

b. Suppliers of raw materials are selected based on experience and the fulfillment of code and standard requirements for the specified materials.
c. The national manufacturing industry is a place where materials that have been obtained are processed into components that are needed.
d. The Construction Services Industry is the main contractor whose role is to select the components of the nuclear power plant in accordance with the codes and standards set for the nuclear power plant construction project.
e. The construction of a nuclear power plant is a site location that has gone through a series of studies and observations to be selected as a location for the construction of a nuclear power plant.

5. CONCLUSION

Nuclear power plants are environmentally friendly energy and use less fuel and have safety and security guidelines in every aspect. The IAEA as an international organization pioneered the use of nuclear energy to sustain greater energy for the future. Every type of nuclear plant, large or small, has provided benefits to help sustain energy needs around the world. The nuclear power plant development program in Indonesia has a positive impact on energy fulfillment in Indonesia and provides opportunities for the industrial sector to participate in the nuclear power plant development program. The participation of the national industry in the nuclear power plant development program has opened up job opportunities for the general public who have expertise.

The supply chain activities of the nuclear power plant development program require support from the national industrial sector which acts as a supplier of nuclear power plants. The national manufacturing industry acts as a local supplier with the aim of developing knowledge and experience and increasing the value of TKDN. The national manufacturing industry needs to cooperate with foreign industries to gain further knowledge about nuclear power plants. National industry cannot participate without the support of several aspects as reinforcement in material production activities. The support of company owners in developing knowledge and experience makes it easy for the government to involve national industries, especially in the manufacturing sector, to participate in supporting the supply chain of nuclear power plant development programs.

Policies and evaluations of all activities provide wider knowledge of the factors that support the development of nuclear power plants in Indonesia. Government policy towards the national manufacturing industry through the National Medium Term Development Plan (RPJMN) for 2020-2024 and the Master Plan for National Industrial Development (RIPIN) for 2015-2035 by procuring facilities, machinery and equipment as well as collaborating with the Ministry of Education regarding additional nuclear engineering study programs and related study programs at various universities and school levels [5].

REFERENCES

[1] Presiden Negara Republik Indonesia, "Peraturan Pemerintah Republik Indonesia Nomor 2 Tahun 2014 Tentang Perizinan Instalasi Nuklir dan Pemanfaatan Bahan Nuklir," *Negara Republik Indones.*, pp. 1–142, 2014, [Online]. Available: https://peraturan.bpk.go.id/Home/Details/5439/pp-no-2-tahun-2014

[2] Presiden Negara Republik Indonesia, "Undang-Undang Republik Indonesia Nomor 11 Tahun 2019 tentang Sistem Nasional Ilmu Pengetahuan dan Teknologi," *Negara Republik Indones.*, pp. 1–83, 2019, [Online]. Available: https://peraturan.bpk.go.id/Home/Details/117023/uu-no-11-tahun-2019

[3] Indonesian Government, "Indonesian Government Law No 79 In 2014 About National Energy Policy," p. 8, 2014.

[4] D. Dewi, "'Rantai Pasok Industri Konstruksi Sipil untuk Mendukung Pembangunan PLTN di

Indonesia,'" *J. Pengemb. Energi Nukl.*, vol. 15, no. 2, 2013.
[5] R. Indonesia, P. Presiden, and R. Indonesia, "Rencana pembangunan jangka menengah nasional 2020-2024," 2020.

BIOGRAPHIES OF AUTHORS

	Name : Lela Elvira, SE.MM. ID : 202209116 Position: Lecturer Home Base : Bina Sarana Informatics University Management
	Name : Dra Dharu Dewi, M.Si ID Number : 196509231991032002 Position : Associate Research Expert Satker : Implementing Policy and Program Evaluation Function Nuclear, Directorate of Research Policy Evaluation, Technology and Innovation, National Research and Innovation Agency
	Name : Rinfutihat NIM : 64191443 Campus : Bina Sarana Informatics University Study program : Management Faculty : Economics and Business Semester : 6 (six) Information and : Research Participants / Research Program MBKM Research Agency National Innovation 2021/2022 Period

	Name : Dewi Astuti, Ssi, MM. ID : 201909258 Position: Lecturer Home Base : Bina Sarana Informatics University Management