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Electricity On The Moon Through Reactors

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Abstract

There are many different ways to create electricity. One of the most common methods nowadays that people conclude to use is nuclear reactors. There are many different types of reactors but they all use similar methods to produce electricity. The most widely used method for reactors is fission, nuclear reactors. Reactors that use fission are common nowadays within the United States and across other countries, countries that are not able to afford nuclear reactors or have not moved to that method are in the works of doing so as it's powerful, long lasting, reliable, and very low maintenance compared to the other ways of producing electricity. As it's very common to have a nuclear reactor/power plant to produce electricity for the country, how efficient is it really and will reactors be the method to help produce electricity on the moon if it's the common method on earth when producing electricity? In this research project, the reader will develop an understanding of how reactors work, the different types of reactors, how powerful and efficient they are, why it's a good method to implement on the moon, and what changes would have to take place in order for a reactor to be on the moon.

Introduction

Nuclear power plants and reactors are commonly used in the United States and across the world as it's the most efficient way to produce electricity as it's long lasting, powerful, efficient, and reliable. Nuclear reactors are very popular and commonly used on earth but do they have the capabilities to produce the same benefits on the moon like it can on earth? Although there are many possible ways to produce electricity on the moon, not all of them will be efficient in the long run. However, there are other technologies in space that use one of the most commonly used methods on earth. That method being fission. This is one of many examples of why reactors, nuclear reactors specifically, are an amazing option when trying to produce electricity on the moon as the method has been implemented before in space through other technologies and has been very successful but the main problems when creating such a reactor on the moon are the power, efficiency, reliability, and its weight during transportation.

Background

Nuclear reactors are commonly used across the United States and in other countries as they are the most powerful and efficient way to produce energy while being very reliable as they require low maintenance as they can last for almost 40 years and don't need to be refueled until 18-24 months. It's currently the best way to produce energy on earth and technologies in space use the same process, fission, which is more of the reason why using nuclear reactors should be the way to produce electricity on the moon. There are already companies implementing and creating ideas of technology that create energy on the moon through fission which goes to show how amazing fission is, making it the most common solution for energy. Although the technologies are in the works, it will be several years until it's actually implemented and put on the moon as the

technologies need to be tested on earth to see if it can withstand being on the moon for many years while producing tons of energy. The nuclear reactors will have to be efficient enough to last for years, have low maintenance so it can operate by itself for many years without needing to fly there and back often, lightweight to make it transportable from the earth to the moon and around the moon, and powerful as it needs to produce enough energy for what other technologies that's going to be using that energy to function.

- Nuclear reactors are already being work on by space companies
- Reactor needs to be lightweight for transportation
- Reactor needs to be efficient for years and have low maintenance as traveling from the moon and the earth back to back will be very costly
- Reactor needs to be powerful for years so it can produce enough energy for the technologies that was use its energy to operate for long periods of time

Nuclear and Fusion Reactors

There are many different types of reactors, the most common one being nuclear reactors (fission) as each reactor operates differently depending on what is needed and the environment. The commonly used nuclear reactors are fast neutron reactor (FNR), light water graphite-moderated reactor (LWGR), advanced gas-cooled reactor (AGR), pressurized heavy water reactor (PHWR), boiling water reactor (BWR), and pressurized water reactor (PWR). Although they are all different, they all use similar materials and all use fission. Table 1 shows the different types of nuclear reactors that are most commonly used across countries with the total number of nuclear reactors in those countries, along with the total GWe (gigawatts equivalent) and what fuel is being used by those nuclear reactors as well as the coolant and moderator. The number of total nuclear reactors from Table 1 are an example of how popular nuclear reactors are and more of the reason to use this method to implement electricity on the moon.

Table 1. Commonly used nuclear reactors in each country (last updated March 2023) [1]

Reactor type	Main countries	Number	GWe	Fuel	Coolant	Moderator
Pressurized water reactor (PWR)	USA, France, Japan, Russia, China, South Korea	308	294.5	enriched UO_2	water	water
Boiling water reactor (BWR)	USA, Japan, Sweden	60	60.9	enriched UO_2	water	water
Pressurized heavy water reactor (PHWR)	Canada, India	47	24.3	natural UO_2	heavy water	heavy water
Light water graphite reactor (LWGR)	Russia	11	7.4	enriched UO_2	water	graphite
Advanced gas-cooled reactor (AGR)	UK	8	4.7	natural U (metal), enriched UO_2	CO_2	graphite
Fast neutron reactor (FNR)	Russia	2	1.4	PuO_2 and UO_2	liquid sodium	none
High temperature gas-cooled reactor (HTGR)	China	1	0.2	enriched UO_2	helium	graphite

As there's many different types of nuclear reactors, there's also different types of reactors. A big one being fusion reactors. Fusion reactors are more powerful, reliable, efficient, and eco-friendly

than nuclear reactors. There have a lot more benefits compared to nuclear reactors but are still behind in development as the power they generate are as much as the sun, making it hard to control compared to fission but is a huge contender to produce electricity on the moon if a way is found to stabilize the power of fusion, is transportable, and lightweight. The main difference between nuclear and fusion reactors is that nuclear uses fission, splitting of the atoms, and fusion uses fusion, fusion of the atoms. Nuclear reactors are being used today and have been used for many years as it's long lasting, reliable, efficient, and powerful whereas fusion reactors are still in development but, in theory, fusion reactors could possibly replace nuclear reactors as it does everything a nuclear reactor could do but better. In the far future, building a fusion reactor would be better than a fission reactor because of the more benefits it has as it has no waste, is more reliable, little to no maintenance and more powerful. "It is estimated there is enough Helium-3 on the moon to power the U.S. and the rest of the world for thousands of years. One future space trip to the moon can bring back enough processed Helium-3 (60 tons) to meet all U.S. energy needs for an entire year (25 tons) and much of the world's needs." [2]. The fuel for fusion reactors should be helium-3 as it's cheap, clean, and safe. Helium-3 uses fusion in order to create energy and doesn't produce waste compared to nuclear reactors, but the main problem for fusion reactors, as of right now, is that it's still being develop and if people want a way to produce electricity on the moon as soon as possible, in the near future, fission will be the best option as it's used all over on earth and is being/have been used in other technologies in space in the past and currently.

There are 6 commonly used nuclear reactors but all of them have similar materials and parts when being created and being functioned. The moderator and coolant are primarily the part that is different from all of the 6 reactors. The common parts of a nuclear reactor are the fuel, moderator, control rod/blades, coolant, and containment. The fuel has to be fissile in order to create fission energy which leads to uranium-235 and plutonium-239 as the commonly used fuel source. Uranium-235 is used more commonly in nuclear reactors as it can be used more than once compared to plutonium-239, which is commonly used for one-time technologies such as nuclear weapons. The moderator and coolant are similar in terms of materials as they both commonly use water as the most common material but have different functions. The coolant is a substance that is circulated through a nuclear reactor to remove or transfer heat and the moderator is used to slow down the process of the atoms splitting through fission similar to control rods but the difference is that the material is to slow it down while the control rods are used to have the leftover neutrons stick on the rod for later uses. The last two common parts in a nuclear are the containment and the control rods/blades. The control rods/blades are to absorb neutrons so when that fission occurs, it captures some of the fast, moving, splitting atoms onto the rod/blade to slow down the energy being produced, making it more controllable. The containment is typically a reinforced steel, concrete or lead structure that encloses a nuclear reactor to contain the escape of radioactive steam or gas if anything were to go wrong.

When making a nuclear reactor, it's already going to be powerful and efficient, as shown from Table 1, so the main problems when trying to create a reactor on the moon is will it withstand the harsh natures of the moon, will it provide energy for many years, will it be reliable, and, the biggest problem, will it be lightweight enough for it to be transported from earth to the moon and mobile enough to move around on the moon with little to no problem.

- Nuclear reactors are a commonly used energy source on earth
- Many different types of nuclear reactors

- Fusion reactors have more benefits than nuclear reactors but currently being worked on as the power produce is dangerous and there hasn't been a definite way to stabilize it
- Fusion reactors do everything that nuclear reactors can but better
- Fusion reactors are the best solution when wanting to producing electricity on the moon as it's very powerful and reliable
- Fusion reactors are still being developed so developing a technology that could be an energy source on the moon will be a lot longer than using fission
- Fission is the best solution when wanting to produce electricity on the moon in the near future
- Being lightweight is main problem with both reactors as it needs to be transportable

Power/Efficiency and Maintenance

Nuclear reactors are already efficient, powerful, and low maintenance as it's been used for years and are commonly used, especially in the United States, as their lifespan can last for about 20-40 years and refueling doesn't happen until 18-24 months after use making it super-efficient and reliable. If a nuclear reactor were to be put on the moon, the reactor would already be reliable for at least 20 years if it can withstand the harsh natures on the moon and would be powerful and reliable during those years. The refueling would be a bit of a problem as traveling from earth to the moon every 18-24 months would be very inefficient as it's very costly to go to the moon so a technology would have to be found to help refuel the reactor on the moon. Luckily, there is already fission fuels on the moon such as uranium, the commonly used fuel, and thorium. "There are two potential fission fuels available on the lunar surface, uranium and thorium. Both can be used as fertile material to breed directly fissionable material rather than require uranium enrichment. This technique has been shown in experimental power production reactors, although not at large scale. Although this technology is not fully commercialized, it is far closer to large-scale energy production than even the most optimistic expectations for fusion and as such the total energy density of each fission fuel will be used assuming perfect breeding and burning." [2] "The lunar surface has been shown to be covered with fissionable material and may have even more buried beneath the surface." [2] Nuclear reactors will already be powerful and there is already fuel on the moon that could be used. Table 2 shows all the many nuclear fuels, fissile materials, that nuclear reactors could use if there was one. It compares all of the fuels by its lunar resources, energy density, and cycle. Although there's already a lot of benefits to nuclear reactors on the moon, two more problems occur which are it being lightweight and the maintenance of the refueling. The best solution to the refueling would be creating a new technology that could help pick up fuel from the moon and refuel the reactor from there as it doesn't require people from earth to waste money and time to go from the earth to the moon to just refuel a reactor. Fusion reactors, however, wouldn't run into this problem because fusion reactors don't need to be refueled as they can use the same fuel over and over.

Table 2. Comparison of nuclear fuels, fissile materials, on the moon [3]

Fuel	Cycle	Energy Density (MJ/kg)	Lunar resources (tons)	Lunar resources (million TWh)
Th	Th-U233	7.94E+07 [9, 17]	6.89E+08	15200
U	U-Pu239	8.06E+07 [9, 17]	1.76E+08	3960
T	Li-T + External D	3.39E+08 [8]	9.59E+07	9030
T	Li-T + Lunar D	3.39E+08 [8]	4.12E+06	393
D	Catalyzed DD	3.47E+08 [10]	1.67E+06	161
D	DD	8.8E+07 [8]	1.67E+06	41
^{3}He	^{3}He + Lunar D	3.53E+08 [3, 8]	1.66E+06	163
^{3}He	^{3}He + ^{3}He	2.07E+08 [3, 8]	9.98E+05	57.5

Table 2 also shows helium-3, which is a good sign, not just for nuclear reactors, but for the option of fusion reactors on the moon as well as helium-3 is the best fuel for fusion. "The vast potential of Helium-3 lies in the fact that it is a reasonably cheap, clean, and safe energy source, with no nuclear waste or potential for a nuclear meltdown." [2] “It may help fill in the gap left by oil and natural gas. It has the potential to provide the world with greater economic prosperity along with a cleaner environment” [2] It has a lot of benefits compared to other fuels and doesn’t need to be refueled, or at least as common as fission, but fusion reactors are still being worked on as it produces so much energy that there hasn’t been a definite way to control it. If a way is found to stabilize the energy, then it would be the go-to solution for producing electricity on the moon as it’s more powerful, efficient, and more reliable than nuclear reactors. Nuclear reactors can also produce lots more energy than normal if FNR (fast neutron reactors) is implemented. FNRs don’t use moderators and utilize the fast neutrons, generating power from the fuel. They can get more than 60 times as much energy from the original uranium compared with normal reactors but are not as common as it’ll take about another decade to have a solid and reliable nuclear reactor that can utilize this method. [1] “The moon's quantities are enough to power the entire world for thousands of years to come. The additional advantages of Helium-3 include its pollution-free output and its safety in use. Helium-3 has the potential to provide the entire world a sufficient amount of long-term energy security that does not exist with current energy sources. It also provides the developing world a relatively cheap and stable source of energy supplies.” [2] Helium-3 is cheap and will be the best fuel for a fusion reactor as it’s safe, clean, and cheap and fusion reactors have little to no maintenance as it reuses the fuel unlike fission reactors making it super reliable. Fusion reactors will be the best solution but for the far future. After a way is found to control the energy then would have to make a compact and lighter and that would take a while as fusion reactors that are being worked on today are already so big. It will be years from now but will be the best in the far future but nuclear reactors will be the best solution if people want electricity on the moon in the near future, as there’s already technology that’s been used and being used in space that uses fission proving that it’s an effective method.

- Changing of fuel for nuclear reactors are within 18-24 months
- Fuel is very accessible and there’s tons of it on the moon

- Helium-3 could be a potential replacement/candidate for nuclear fuel
- Helium-3 have a lot more benefits compared to other fuels as its cleaner, safer, and cheap
- Helium-3 uses fusion and fusion reactors are still being worked on as there's no definite way to control the amount of power released compared to fission reactors
- Fusion reactors can do everything that nuclear can but better
- Fusion reactors will be better in the long run but nuclear reactors are better if wanted electricity on the moon in the near future
- FNR is the most efficient nuclear reactor but there's no reliable and stable FNR at the moment

Lightweight

There are many factors that play into the weight of a nuclear reactor, the main points being the parts it's being made of. The main parts in a nuclear reactor are the coolant, containment, moderator, control rods, and fuel. The fuel needs to be fissile or fusionable in order for the nuclear reactor to function properly, the fuel typically being uranium-235 if using fission and helium-3 if using fusion, but other parts in a nuclear reactor could be modified to make it more lightweight while not losing its efficiency. The other parts being the coolant, containment, moderator, and control rods.

The control rods are rods, plates, or tubes that absorb neutrons so when that fission occurs, it slows down the fast, moving, splitting atoms to help control the energy. Fission happens very quickly to the point where it creates way too much than what is needed and the control rods are there to help stabilize it and prevent it from going out of control that could cause any accidents. The most common material for control rods is boron, enriched boron. As it's very efficient and is already lightweight compared to other materials. The material that is used for control rods needs to capture neutrons and boron already captures neutrons making it the best control rod as it's very efficient while being the lightest weight out of all other neutron absorbing materials.

The coolant is a substance that is circulated through a nuclear reactor to remove or transfer heat and the moderator is used to slow down the process of the atoms splitting through fission similar to control rods but the difference is that the material is to slow it down while the control rods are used to have some of the neutrons stick on the rod to prevent an overflow of neutrons to control the energy and use the neutrons attached for later uses while the moderator is there to slow down the fast moving neutrons with the coolant transferring it at the same time. The coolant and moderator have some similar materials and typically use water as both their coolant and moderator. Water is used because of its efficiency, reliability, and accessibility and is used in almost all of the different kinds of nuclear reactors because it is the best in slowing down neutrons and transferring heat. Although water is the best overall option for both the moderator and coolant, it's not the lightest option available. There are many different kinds of other materials, like the other nuclear reactor parts, that can be a moderator and a coolant. The main purpose is to transfer heat and slow down neutrons during the fission process. One of the lightest options for coolants and moderators is helium though it may not be as efficient as water, it's still a good option in general and can make the nuclear reactor as light as possible. Coolants would use helium and moderators would use light helium. FNR nuclear reactors don't use moderators therefore it provides significantly more energy than common reactors and not having that moderator could be a way to make a nuclear reactor lighter but, just like fusion reactors, FNR reactors are not fully optimal and still being worked on

as of today. Figure 1 shows a nuclear reactor that uses helium as its coolant. The systems are surrounded by inert gas which discharge into closed He-filled vessels preventing the possibility of a pump failure leading to air backfilling of the space surrounding the hydrogen. [6] Table 3 shows the combination of helium coolant and SiC-composite has the highest performance potential i.e. highest cooling outlet temperature for fusion reactors and can be used for nuclear reactors as well.

Table 3. Helium coolant and SiC-composite with cooling outlet temperature for fusion power plant [7]

	FERRITIC STEEL	V–ALLOY	SiC/SiC COMPOSITE
Material T_{max}, °C	550	700	≥1000
Coolant/T_{out}, °C	He/520 (Rankine Cycle)	Li/600 (Rankine Cycle)	He/650–750 Rankine cycle
Coolant/T_{out}, °C	LiPb/425 (Rankine Cycle)	He/550 (Rankine Cycle)	He/≥850 (Brayton cycle)
Industrial maturity	High	Low	Very low

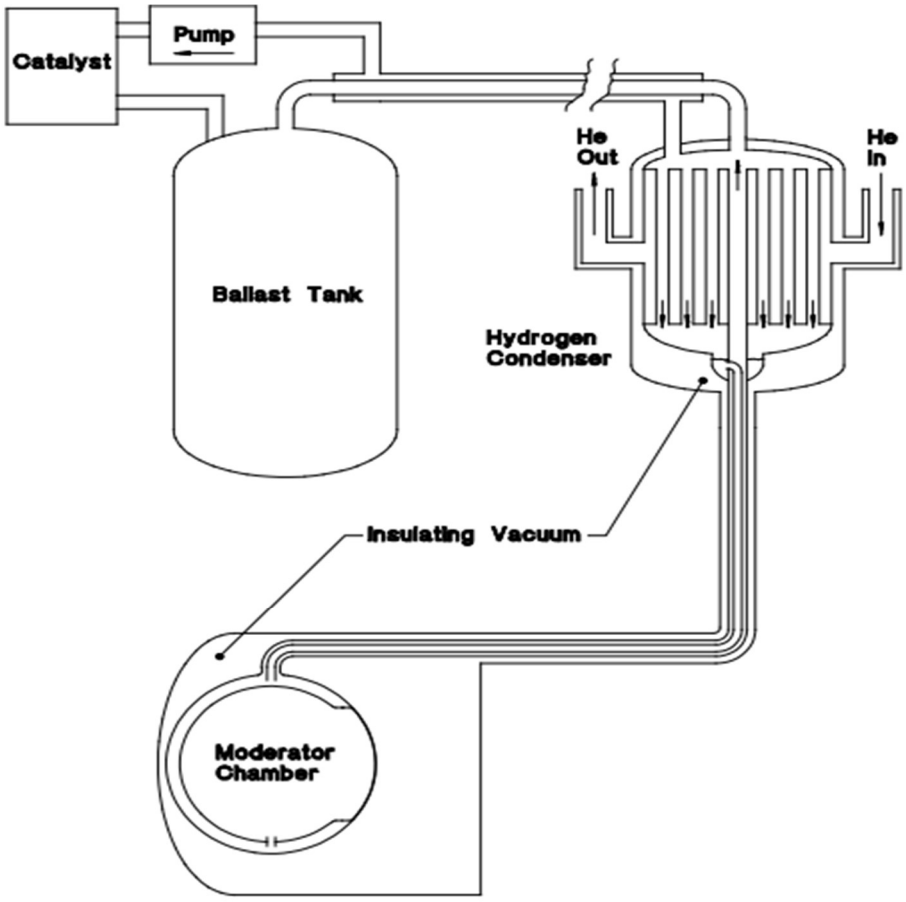

Figure 1. A reactor that uses helium as a coolant [6]

The containment for nuclear reactors is commonly made out of steel as it is cheap while being efficient. The containment is to contain the escape of radioactive steam or gas. There are many metals that can serve this purpose but the lightest metal is magnesium. Magnesium is extremely light as it is 75% lighter than steel, 50% lighter than titanium, and 33% lighter than aluminum. Magnesium is significantly lighter than steel and can serve the same purpose of containing the escape of reactive steam or gas. “Steel production requires high temperatures, which can lead to significant emissions of carbon dioxide into the atmosphere, while magnesium’s production process tends to release fewer emissions overall as no heat is required during its production process. This makes magnesium an attractive option for companies looking for ways to reduce their environmental footprint.” [4] There are other benefits from using besides being extremely light as it releases less emissions of carbon dioxide in the environment compared to steel making it eco-friendlier. The only downside of magnesium is the cost. Magnesium tends to be more on the costly side, especially compared to steel but it's the one of best options when trying to make a reactor as lightweight as possible.

Another possible containment that can make a reactor lightweight is not through a metal but through a gas, helium. Figure 2 shows that the containment can be something else rather than a metal. Figure 2 has helium as a containment instead of the most commonly used steel. Helium is a gas making it significantly lighter than metals like magnesium and steel and therefore is a huge potential into making a nuclear reactor that is lightweight. Figure 2 could potentially provide a similar layout for FNRs, the most powerful and efficient nuclear reactor, in order to create a powerful lightweight nuclear reactor. Figure 2 shows that it is possible to create a nuclear reactor that could use helium as a containment which is lighter than any steel as it’s a gas and having no moderator makes it lose the extra weight. FNRs and fusion reactors are still in development but regular nuclear reactors can still use helium as a containment in order to make a lightweight nuclear reactor in the near future.

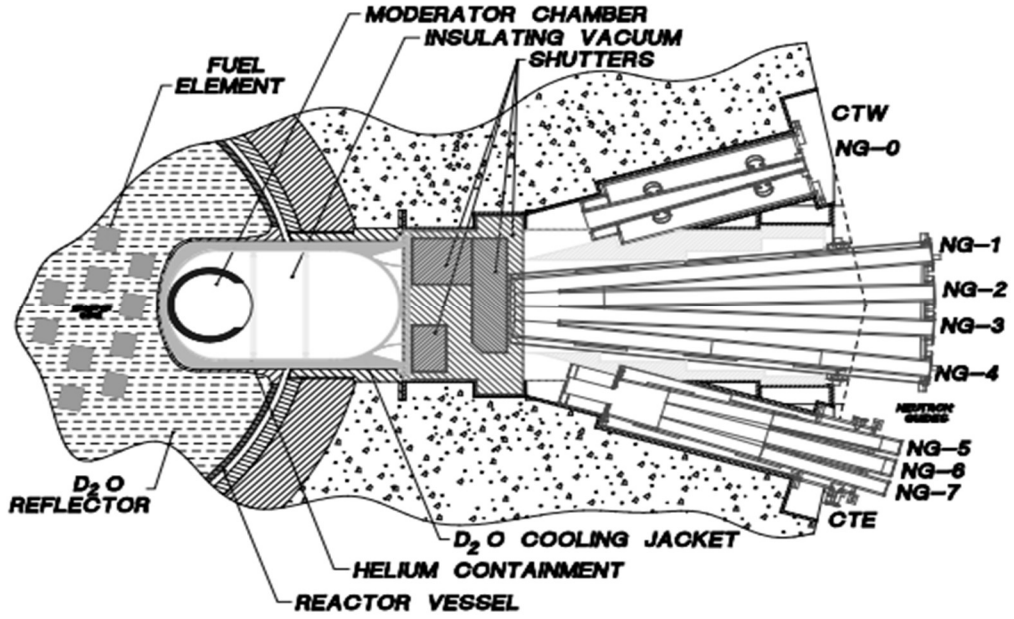

Figure 2. A layout of a nuclear reactor that uses helium as a containment [6]

- Only specific fuels can be used to operate a nuclear reactor
- Boron is the most commonly used material used for control rods and is the most efficient option out of all neutron absorb materials
- Coolants and moderator have similar materials
- Helium can be used as a coolant and moderator as it serves the purposes and is lighter than water
- Water is still the most efficient but helium is also efficient and lightweight
- Helium is one of the lightest elements
- Light helium as the moderator and helium as the coolant is one of the lightest options
- Magnesium can be used as a containment as it can do what steel does
- Magnesium is super lightweight yet expensive
- Helium could be a containment and is lighter than any metal containment
- FNRs don't have a moderator making it the most powerful option and could use helium as a containment to make it lighter as it has no weight of a moderator and the lightness of a gas

System Proposed

The system that is proposed will be a nuclear reactor as fission has been used in space before, making it more credible, and has been used for many years and even in the current day. Although fusion reactors can do what nuclear can but better, it's still a huge risk to try a new method that hasn't been tried in space before. The system proposed will have all the common parts in a nuclear reactor but with different materials. The fuel uses uranium-235, or any fissile material on the moon if compatible, helium being the coolant, light helium being moderator (if needed), and the containment being magnesium or helium. The type of nuclear reactor should be an FNR as it doesn't need to use a moderator and is more powerful than normal reactors. Although FNR nuclear reactors are still being worked on, it will still take years to create a reactor on the moon due the materials and testing needed. Nuclear reactors will be the safer solution and lighter option compared to fusion reactors as fusion hasn't been used in space which is a risk that needs to be tested carefully on earth and the materials for fusion materials haven't been solidified like nuclear reactors as it hasn't been fully completed and used. Nuclear reactors have other options to each part of itself and have been tested or suggested unlike fusion because fusion reactors still need to find a way to control the powerful energy along with parts that are compatible with each other and changing parts of something of a technology that is not fully complete and tested will lead to disasters.

Both nuclear and fusion reactors are the best solution to produce electricity on the moon as it has the best benefits out of all the other options. The benefits are that they are both powerful, efficient, reliable, and low maintenance compared to the other ways of producing energy. Fusion reactors have more benefits as they are more long lasting, powerful, efficient, safer, and eco-friendly compared to fission reactors. Fusion reactors can do what nuclear reactors can but with more efficiency. "Fusion releases several times the energy generated by fission, making it a far more powerful process." [5] "Fusion, unlike fission, does not create harmful radioactive by-products that need to be stored for thousands of years." [5] The fuel, helium-3, that will be used and should be used in fusion reactors are safer, cleaner, cheaper, and produces tons amount of energy while not being radioactive which is one of the many benefits of fusion reactors and the fuel sources

being very accessible, especially uranium-235 (fission) as it's on the moon as well as long with other fissile material and helium-3.

Helium as a coolants and moderator is a good way to make a nuclear reactor to be lighter as it's lighter than the most common moderator and coolants, water. Helium would have to be used as the coolants and the moderator would have to use light helium. The benefits of having helium and light helium, besides being lightweight, are that they cause little or no corrosion to the primary system, cheap, accessible, and a good stabilizer as it has an extremely low boiling point.

Containments are typically made out of steel as it's a cheap yet effective metal but it's not the lightest material as that goes to magnesium. The benefits from using magnesium from steel is that it releases less emissions of carbon dioxide in the environment and is significantly lighter compared to steel, 75% when being compared. This makes magnesium a good choice for going for a reactor that is trying to be lightweight while being eco-friendlier. Magnesium would also go very well with helium-3 as both of them are eco-friendly. Another containment that is a contender is helium and the benefit of having helium as a containment is that it's a gas which is lighter than any metal which can help produce a lightweight nuclear reactor as well.

- System proposed is a nuclear reactor that uses FNR
- Helium-3 uses the process of nuclear fusion
- Uranium-235 uses the process of nuclear fission
- Nuclear fusion has a lot more benefits compared to fission but both have a lot of benefits when compared to other ways of producing electricity
- Nuclear fusion reactors are still being worked on today as there is not definite way to control the amount of energy created but is cheap, clean, long-lasting and safe
- Fission is commonly used today and have been used in space before
- Helium and light helium is one of the lightest coolants and moderators
- Helium is cheap, accessible, and causes no erosion
- Magnesium is 75% lighter than steel while being more eco friendly
- Helium is a very lightweight material

Conclusion

A regular nuclear reactor is already lightweight, efficient, powerful, and low maintenance but since we are trying to find a way to make one to produce electricity on the moon, there will have to be some modifications to a regular reactor, especially making it lightweight. Having it lightweight and transportable will help move it from the earth up to the moon easier and it also makes it easier to move around on the moon. The commonly used materials used in a nuclear reactor already makes it powerful, efficient, and low maintenance but not the lightest. There are many other options for each part of a nuclear reactor to use; the ones that could make the lightest reactor will be having magnesium as its containment, helium as its coolant, light helium as its moderator, and boron as its control rods. These specific materials are ways to make a nuclear reactor lighter compared to a regular one. FNR nuclear reactors specifically don't use a moderator therefore it produces more energy than a regular reactor with potentially less weight due to it not having the weight of a moderator. The most powerful, efficient, and reliable way to produce electricity on the moon though will be using a fusion reactor but, as of today, fusion reactors, like FNR nuclear reactors, are still being worked on as they both produce a significant amount of more energy which makes it harder to control. There hasn't been a definite way to control the power of a fusion reactor

but when there is, that would be the best solution for electricity on the moon. It can do everything a nuclear reactor can but better. Fusion reactors reuse its fuel making it super reliable and has a good fuel source, helium-3, that is eco-friendly than fissile materials and also lots found on the moon. It would be a long time until a fusion reactor is placed on the moon as fusion reactors today are gigantic and still being worked on so making a lightweight and transportable fusion reactor would take some time. There hasn't been any technology that uses fusion in space yet, unlike fission, making it a risk that could go tremendously well or bad. Fusion reactors will be the best solution in the far future but nuclear reactors are the more reliable option, as of today, as there's technologies that use fission already proving that it's a good option when it comes to producing electricity on the moon and is the best solution if wanting to create a reactor in the near future.

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Biography
Joseph Bui was in Saint Louis, MO but moved to Saint Joseph, MO when he was six years old. He went to elementary, middle, and high school in Saint Joseph and graduated from Central High School in May 2019. He is currently a student at Missouri Western State University studying for a B.S. degree in manufacturing engineering technology. His career goal is to graduate from Missouri Western and create products for customers while hoping to have the chance to create and manufacture products of his own, which could be improvements to an already-existing product.

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