COS10025

Technology in an Indigenous Context Project

Innovation Concept Report

Word Count: 5028

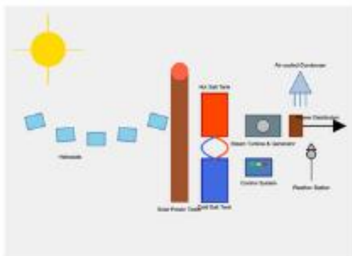

Figure 2.3 Design Idea 4

Figure 2.1 Design Idea 1

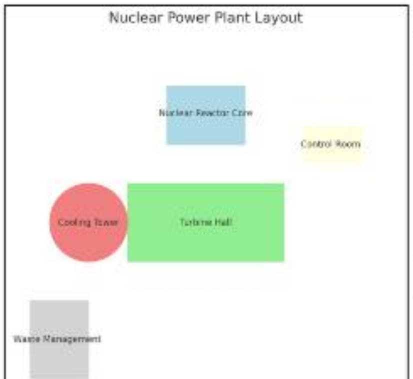

Figure 2.5 Design Idea 5

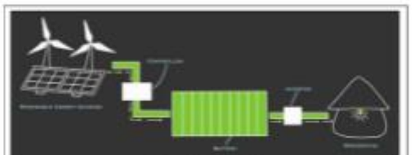

Figure 2.3 Design Idea 3

Figure 2.2 Design Idea 2

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Table of Content

Part A

1.1 Project Overview

For this project, our research focused on an Australian Indigenous group called the **Yuendumu** Community. **Yuendumu** is a town located in the Central Desert Region of the Northern Territory of Australia. According to the Australian Bureau of Statistic in 2021, **Yuendumu** had a population of 740 people, with 50.1% being male and 49.9% being female. The **Yuendumu** community faces severe challenges, including electricity outages, insufficient water sources and internet connection issues. In this project, we will address the issue of electricity outages and propose multiple design ideas that could help the community to resolve this issue.

During our previous research, we found that the community was living with insecure electricity access, which disrupted their daily routines. For example, one of the most significant issues is improper food storage in refrigerators, particularly for frozen foods. Improper storage can lead to the risk of diseases such as food poisoning, which poses a health risk to the community.

1.2 Introduction of the problem

Energy insecurity in the Yuendumu community has seriously disrupted daily life in this remote Aboriginal settlement. The unreliable electricity supply makes it hard for healthcare facilities to function and for families to keep food fresh. This instability affects not only health but also community connections, as events and cultural activities become harder to organize. Businesses struggle to stay open, and families face higher costs from spoiled food and broken appliances. Basic services like water, phone connections, and heating or cooling become unreliable, leading to constant uncertainty. Vulnerable residents, especially the elderly and those with health issues, feel the impact the most. This ongoing energy problem significantly hinders the community’s growth, limiting opportunities for education and economic development, and lowering overall quality of life. It is more than just an inconvenience; it stands in the way of the community’s independence and success.

Part B

Description of the design idea

- Design idea - A detailed explanation of the design idea
- Must include any drawings of your design idea using simple digital tools (images of paper-drawn pictures not allowed)

Design Specifications

- List of hardware and software requirements (Explain in detail each hardware/software required)
- How does your design idea work/function? (explain in detail)

Benefits of design idea

- What are the benefits of the design (at least 3 benefits)?
- How will it impact the community (at least 3 impacts)?
- How the design is culturally appropriate for the community/environment?
- How does the design idea benefit the community in accordance with the guidelines such as access & equity, health & safety, appropriateness, affordability, environmental health, and sustainable livelihoods (few based on the design idea)

Constraints of design idea

- What are some of the potential challenges identified when using the design for present and future needs (at least 2 constraints)?

2.1 Solar Power and Battery System - *by Yadanar Theint* (850 words)

Description

In Yuendumu, the community struggles to get reliable electricity from the government. Because of this, many people must use expensive fuels to power their homes, which makes it hard for families financially and harms the environment. Using these costly fossil fuels not only affects their budgets but also causes pollution and contributes to climate change (Karp, 2021). Switching to solar energy could be a great solution for the people of Yuendumu. By using solar power, they can lower their energy bills, making electricity cheaper and easier to get (Palmetto, n.d.) . Solar energy is a reliable and sustainable option that helps them avoid the ups and downs of fuel prices.

Moreover, moving to solar energy will significantly reduce the community's carbon emissions, leading to a cleaner environment (Government of India, n.d.). With cleaner energy sources, Yuendumu can lessen its impact on the planet and create a healthier place for future generations. This focus on renewable energy helps them join the global effort to fight climate change, showing that they care about the Earth. By adopting solar power, the people of Yuendumu can improve their lives and take important steps toward protecting the environment. This change not only promises a brighter future but also allows them to save money, care for their surroundings, and encourage other communities to embrace renewable energy as well.

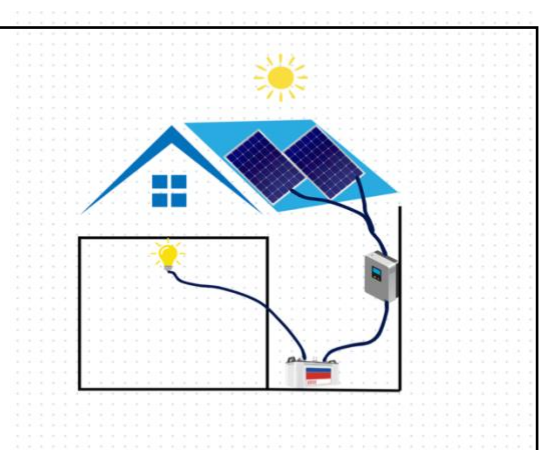

Figure 2.1 Design Idea 1

Design Specifications

Solar renewable energy technology captures sunlight to produce electricity through a few easy steps.

Sunlight Absorption - The process begins with solar panels, which are made up of many small solar cells. These panels are typically installed in sunny locations, such as rooftops or open fields, to maximize sunlight exposure. When sunlight strikes the solar cells, it excites the electrons in the material, often silicon, leading to the generation of electric current (Solar Design Studio, n.d.). This step is crucial, as it forms the foundation for the entire system.

Direct Current Generation - As the solar cells absorb sunlight, they convert this energy into Direct Current (DC) electricity. DC electricity flows in one direction and is the initial type of energy produced by solar panels. This step is essential because it prepares the electricity for the next stage of the process.

Connection with Inverter - The generated DC electricity is sent through cables to an inverter, which is usually located inside the home. The inverter is a critical component of the solar energy system, as it converts the DC electricity into a form that can be used in everyday household applications. Without the inverter, the energy generated would not be usable for most devices and appliances (Palmetto, n.d.).

Conversion to AC (Alternative current) - The main function of the inverter is to change the DC electricity from the solar panels into Alternating Current (AC) electricity. AC is the type of electricity that powers most household appliances, making it compatible with standard electrical systems in homes. This conversion is vital for the practical use of solar energy.

Storage in Battery - Many solar energy systems are equipped with batteries to store excess electricity. This feature allows homeowners to save energy generated on sunny days for use during the night or on cloudy days, improving reliability and energy independence.

Using electricity - Once the electricity is converted to AC and stored in the battery, it can be used throughout the home. Appliances can draw power from the battery or directly from the inverter, making the entire system efficient. Overall, this solar technology not only helps reduce electricity bills but also promotes a cleaner environment by utilizing renewable energy sources, contributing to a sustainable future.

Benefits of the Design

Switching to solar energy offers many great benefits for the Yuendumu community. First, it will provide a more reliable power supply, fixing the ongoing problems with inconsistent electricity. This steady energy will ensure that important services like healthcare and education are always available, which will help the community thrive.

Using cheaper fuel will also lower energy costs significantly (Government of India, n.d.). This means families can manage their budgets better and avoid unexpected expenses, allowing them to spend their money more wisely. Plus, having a consistent supply of electricity improves everyday life by reducing food spoilage, which is a big issue during frequent power cuts.

Additionally, reliable power will reduce the negative effects of outages on health and education. Students will have a better place to learn, leading to improved educational results. Overall, moving to solar energy will create a healthier community, giving residents more control over their energy needs and helping them focus on improving their lives without worrying about unreliable power. This change will help Yuendumu have a brighter and more sustainable future.

Constraints of design idea

Furthermore, embracing solar energy increases **the community's self-sufficiency**, decreasing its vulnerability to changes in fuel prices and outside energy sources (Solar Design Studio, n.d.). It also **promotes environmental sustainability** by reducing carbon emissions and encouraging the use of renewable resources, fostering a more environmentally conscious mindset. Finally, **a stable energy supply** strengthens community resilience, allowing the **Yuendumu** community to effectively respond to emergencies and ensuring that critical infrastructure remains operational during crises.

2.2 Biomass Energy with Food and General Waste - *by Yadanar Theint* (955 words)

Description

The Yuendumu community is facing serious problems with their electricity supply, which affects daily life and important services. To address this issue, we suggest using biomass energy from food and general waste to generate electricity (Solar Reviews, n.d.). This new solution would provide reliable power while also benefiting the environment by turning waste into something useful.

Biomass energy involves converting organic waste such as food scraps, garden waste, and other natural materials into fuel (Clean Energy Business Council, n.d.). This process reduces the amount of waste that goes to landfills, leading to less pollution and fewer greenhouse gases. By using materials, they already have, the community can take control of their own energy production and be less affected by changing fuel prices.

Creating a biomass energy system in Yuendumu would ensure they have consistent, affordable electricity. Having reliable power is crucial for running healthcare facilities and schools, improving the quality of life for everyone. Additionally, when families have dependable electricity, they can spend less on expensive and harmful energy sources, helping them save money.

By adopting biomass energy, the people of Yuendumu can make their community eco-friendlier while contributing to the global fight against climate change. This change not only promises cleaner and more reliable energy but also allows residents to manage their environmental impact and work together towards shared goals.

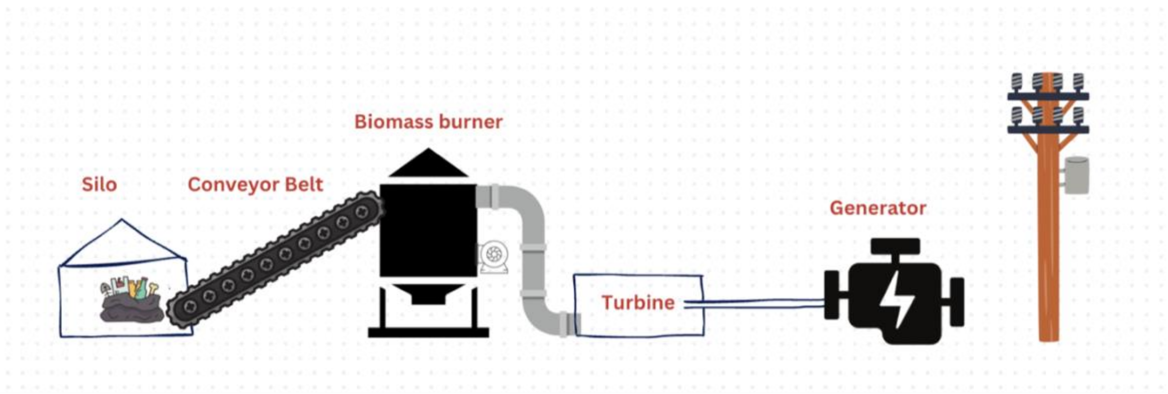

Figure 2.2 Design Idea 2

Design Specifications

Silo - The biomass power plant works as a system of connected parts that turn waste into electricity. At the center of this system is the storage silo, a strong structure made to safely hold different types of organic waste. This silo not only keeps the waste but also helps maintain its quality by controlling the environment inside. It has advanced sensors that check the waste levels and moisture, while automated sorting systems make sure only the right materials move on to the next step.

Conveyor Belt - Next, a conveyor belt system takes over. This durable belt moves the waste from the silo to the biomass burner. It has features like adjustable speeds and metal detectors to ensure safe and careful transport. The conveyor also includes weight sensors and emergency safety measures to control the flow of waste accurately and safely (Kittner et al., 2015).

Biomass Burner - The biomass burner is where the actual power generation happens. Inside its special combustion chamber, the waste is burned in a controlled way, producing high-pressure steam, heat, and ash. The burner has systems to control emissions and collect ash, which helps meet environmental standards while producing energy efficiently (Marsh, 2007).. The steam created here is what drives the next stages of power generation (Kittner et al., 2015).

Turbine - The high-pressure steam moves into the turbine system, where it is converted into mechanical energy. The turbine's blades spin thanks to the steam, creating rotational energy. This part of the system is carefully controlled for temperature and safety, with cooling systems in place to prevent overheating (Kittner et al., 2015).

Generator - Finally, a generator connected to the turbine changes this mechanical energy into usable electricity. It has voltage regulators and monitoring systems to ensure a stable power output. The generator also includes cooling systems and safety features to prevent overload, ensuring reliable electricity for the community (Kittner et al., 2015).

Together, these parts create a complete waste-to-energy solution, turning community waste into valuable electricity while reducing environmental impact. The whole process is monitored by a central control system to ensure efficiency and safety, providing sustainable energy for everyone.

Benefits of the Design

Biomass energy conversion offers many benefits for protecting the environment and supporting community growth. This renewable energy source takes food and general waste and turns it into useful power, which significantly reduces the amount of waste sent to landfills. This process helps prevent pollution and lowers greenhouse gas emissions that usually occur when organic materials break down in landfills, leading to better air quality and improved community health (Clean Energy Business Council, n.d.).

Switching to biomass energy also helps reduce reliance on fossil fuels, making a positive impact on climate change by cutting down harmful emissions. Another advantage of biomass is the creation of nutrient-rich compost, which helps local farming by improving soil health and boosting crop yields (Clean Energy Business Council, n.d.).

To successfully implement biomass energy, a Design 2 Approach focusing on Analysis, Eradication, and Prevention is needed. First, it's essential to analyze the community's electricity usage to ensure the biomass system can meet their energy needs. This careful evaluation allows for a solution that is appropriately sized.

By converting household waste into biomass energy, communities can decrease their carbon footprint and reduce reliance on fuel for generators. Additionally, preventing waste buildup helps address health concerns related to pollution, leading to a cleaner environment for everyone.

Transitioning to biomass energy in Yuendumu promises reliable power and fewer outages. This shift will also create new job opportunities in waste management and energy production while encouraging community involvement in sustainable practices. Overall, it fosters a stronger and more environmentally aware community working toward a sustainable future.

Constraints of design idea

Starting a biomass energy system in Yuendumu comes with several challenges. First, the upfront costs for building infrastructure, like silos and burners, can be high, making it hard to find funding. Effective waste collection and management are also important, requiring the community to actively participate and sort materials properly. There's a need for technical skills to operate and maintain the system, which might involve training local workers. Additionally, following regulations and getting the necessary permits can be tricky and take a lot of (Kittner et al., 2015).

It's important to gain community support, as some people might be hesitant about new technologies. Also, the availability of biomass can change with the seasons, which affects the supply needed for consistent energy production. Finally, competing with current energy sources and creating a sustainable business model are crucial for success. Overcoming these challenges is key to successfully implementing biomass energy in Yuendumu.

2.3 Renewable Energy-based Battery Energy Storage System - *by Angel Lim Sze Ying (941 words)*

Description

The design of the Renewable Energy-based Battery Energy Storage system functions to store and supply energy via a battery storage system. Our target community, **Yuendumu**, located in the desert region of the North Territory of Australia, has been dealing with energy insecurity that severely impacts their daily routines. Therefore, the proposed design of a battery energy storage system aims to support the community with reliable and sufficient access to electrical energy. The Renewable Energy-based Battery Energy Storage System incorporates multiple approaches, including reduce, prevent and analyze energy issues

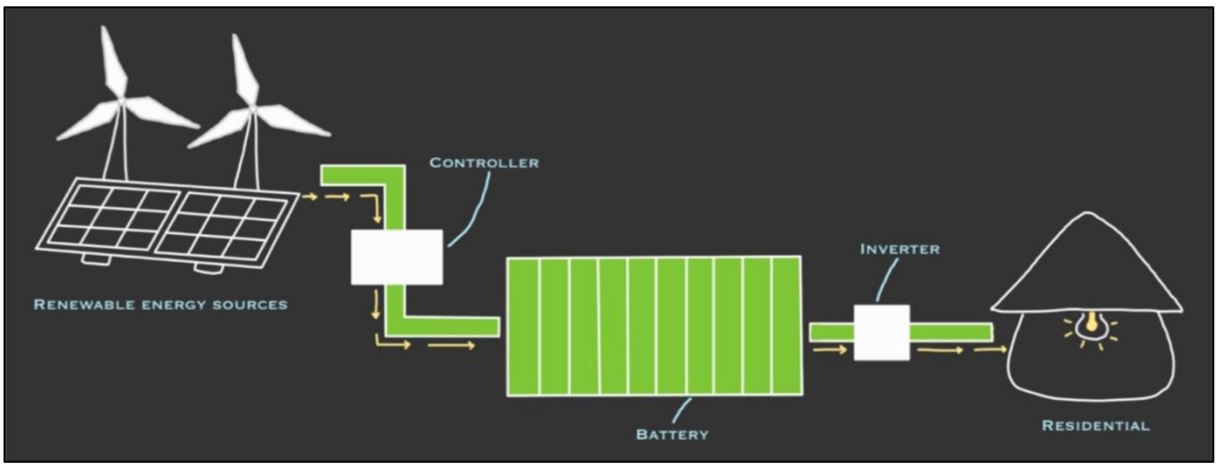

Figure 2.3 Design Idea 3

Design Specifications

The design involves multiple units, each carrying essential functions. The battery energy storage system integrates renewable energy technologies, such as solar panels and wind turbines, to **reduce** reliance on non-renewable energy, offering a more sustainable and eco-friendly solution. Solar panels and wind turbines must be installed for this system to collect energy sources from sunlight and wind. Next, a charge controller is needed to transport the collected energy to the battery storage system by regulating the flow between renewable sources and the batteries. The controller ensures the battery is charged efficiently without overcharging, protecting the battery from damage. Moreover, the main component in this system is the Battery Storage System, which uses lithium-ion batteries for energy storage. This is because lithium-ion batteries can handle large-scale energy storage and offer high energy density, allowing more energy to be stored in a smaller unit. Additionally, lithium-ion batteries are easily scalable and can be charged and discharged quickly compared to the other battery types.

The system is also associated with a Battery Management System (BMS) to ensure safe operation of the batteries while optimizing their performance and lifespan. The BMS helps **prevent** issues such as overcharging, overheating, and deep discharging by monitoring and controlling the charge and discharge cycles, energy flows, battery voltages, and temperatures of each battery cell package. Furthermore, the system introduces the Power Conversion System, which consists of multiple inverters and converters. Inverters are used to convert the direct current (DC) to alternating current (AC) for appliance use, while converters convert AC back to DC for battery charging when needed. To reduce potential accidents, a Cooling and Ventilation System is required to prevent overheating. The system requires the installation of fans and heat sinks, which dissipate heat from electrical components such as batteries and cables to prevent overheating.

As the Renewable Energy-based Battery Storage System is designed to serve the area where the Yuendumu community resides, proper system management is required to maintain peak performance while ensuring overall operational efficiency and safety. This can be achieved through the Energy Management System (EMS), which primarily monitors and controls the flow of energy generation, storage, and distribution, to ensure optimized energy usage. The EMS software **analyzes** energy consumption and battery status, determining when energy should be drawn from storage and when excess energy should be directed to appliances. Additionally, the use of smart meters in EMS provides real-time data to monitor energy usage and battery storage levels. Finally, proper cabling and wiring connections are crucial to ensure the system functions smoothly and efficiently. For instances, cables and wires are needed to connect the solar panels and wind turbines to the battery storage system, as well as to the other system units including BMS, EMS, cooling and ventilation System, and devices such as inverters, converters and the controllers. Also, proper wire connections to residential areas are essential to ensure reliable access to electricity for the community.

Benefits of the Design

One of the benefits from this design idea is that the system runs using renewable energy sources, making it an environmentally friendly approach. It does not generate pollutants and is a sustainable solution since energy sources such as sunlight and wind are easily accessible, particularly in desert regions. Apart from that, the system can be shared within the community, which reduces the installation costs while providing all residents with equal access to electricity for daily use. The community does not need to acquire specific skills to operate the system, but only needs to ensure that the cable connections in their homes are properly set up in order to access the electricity. Last but not least, the battery storage system is centralized, meaning that all energy controls, such as when to charge or discharge energy for appliances, are managed by the system, allowing the energy to be distributed efficiently. It also stores any excess energy safely as a backup during sudden electricity outages or maintenance interference.

This system idea would also provide positive impacts to the Yuendumu community by providing secure electricity access. This allows the community to continue with their daily tasks such as washing laundry and cooking rice without interruptions. Apart from that, secure electricity access matters especially when it comes to storing frozen food in the refrigerator. This reduces the risk of food becoming deteriorated, while reducing the potential health risks such as food poisoning after consuming the deteriorating food. Moreover, sufficient power supplies are essential for lighting, which is most needed by the community particularly during the nights to carry on with their activities.

Constraints of design idea

Nevertheless, there are a few considerations associated with the system. One of them is the battery lifespan, whereby the frequent use of batteries including the number of charge and discharge cycles can lead to battery degradation and may eventually affect the system performance and efficiency (Montel Team, 2024). Also, due to the large-scale of battery implementations, safety may be one of the concerns. Hence, regular monitoring of components' conditions and implementing robust measures are needed to ensure all components within the system do not overheat or overcharge.

2.4 Solar Concentrated Thermal Power System with Thermal Storage – *by Shin Thant Thi Ri (993 words)*

Description

The Yuendumu community faces significant challenges in accessing reliable and sustainable electricity, primarily due to its remote desert location and dependence on diesel generators. This situation creates multiple interconnected problems: high operational costs, environmental concerns, and unreliable power supply affecting essential services. The community's location experiences approximately 3,200 hours of sunshine annually, presenting an opportunity to harness solar energy effectively. The challenge encompasses not only technical aspects of power generation but also cultural considerations and community sustainability.

Additionally, the community's reliance on diesel generators has led to frequent maintenance issues and fuel supply disruptions during extreme weather conditions. The diesel dependency not only strains the community's financial resources but also poses environmental risks through potential fuel spills and continuous emissions. These challenges particularly impact vulnerable community members, including the elderly and young children, who require reliable power for medical equipment and temperature control in the harsh desert climate.

This project proposes a comprehensive solution through a Solar Concentrated Thermal Power (CTP) system with thermal storage, specifically designed to address these challenges while respecting Indigenous values and environmental stewardship. The scope extends beyond mere power generation to include community development, cultural integration, and long-term sustainability.

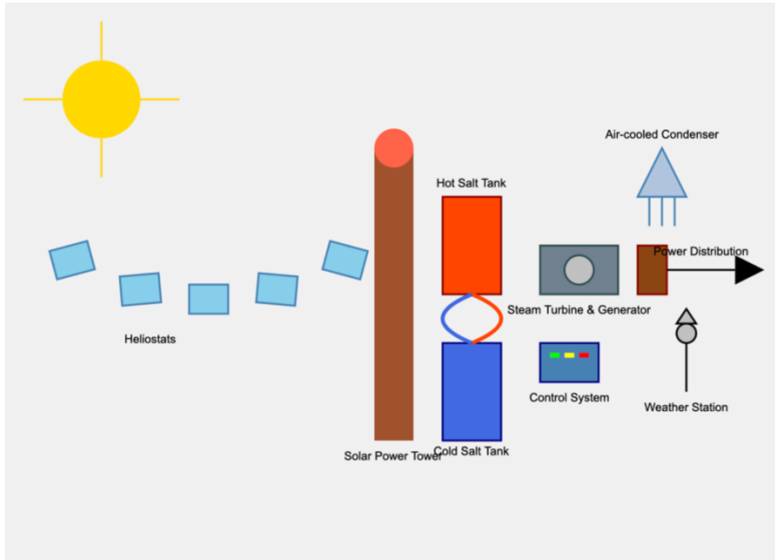

Figure 2.3 Design Idea 4

The proposed solution integrates three complementary approaches to address the identified challenges:

Primary Approach: Solar Thermal Power Generation

The core system utilizes heliostats and a central tower receiver to concentrate solar energy, heating molten salt for power generation. This approach provides the main power generation capability, converting abundant solar resources into reliable electricity. The system employs advanced tracking technology to maximize solar collection efficiency, while thermal storage enables 24-hour operation.

Secondary Approach: Thermal Energy Storage Integration

The thermal storage system utilizes molten salt technology to store excess heat energy, enabling power generation during non-sunlight hours. This innovative approach addresses the intermittency challenge inherent in solar power systems, ensuring consistent electricity supply. The binary salt mixture provides optimal thermal properties for energy storage and transfer, maintaining system efficiency throughout the daily cycle.

Tertiary Approach: Smart Control and Distribution

The intelligent control system optimizes power generation, storage, and distribution through advanced monitoring and management technologies. This approach ensures efficient resource utilization while maintaining system stability and reliability. The integration of weather monitoring and predictive algorithms enables proactive system management and maintenance scheduling.

Design Specifications

The technical implementation combines multiple sophisticated technologies and devices, carefully selected to address specific challenges:

The solar collection system comprises computer-controlled heliostats, each equipped with precision tracking mechanisms and reflective surfaces exceeding 92% efficiency. The central receiver tower, standing 50-80 meters tall, incorporates specialized high-temperature absorbing materials capable of operating at temperatures up to 600°C. This primary technology enables efficient solar energy capture and conversion.

The thermal storage system utilizes a binary molten salt mixture (60% $NaNO_3$, 40% KNO_3) contained within two primary storage tanks. The hot salt tank maintains temperatures at 565°C, while the cold tank operates at 290°C, providing sufficient thermal gradient for efficient power generation. This technology enables crucial energy storage capability, addressing intermittency challenges.

The safety and monitoring infrastructure incorporates redundant systems to ensure continuous operation. Multiple sensor arrays throughout the facility monitor temperatures, pressures, and flow rates, feeding data to the central control system. Emergency shutdown protocols are implemented through a series of automated valves and switches, while backup power systems ensure critical monitoring capabilities remain active even during system maintenance. The facility also includes a sophisticated fire detection and suppression system, specifically designed for the unique challenges of high-temperature solar thermal operations.

The power generation unit integrates a steam turbine-generator system with 95% conversion efficiency, coupled with an air-cooled condensation system specifically designed for desert environments. Advanced power conditioning equipment ensures stable electricity supply to the community grid. The control system implements SCADA technology with real-time monitoring and automated response capabilities, ensuring optimal system performance and safety.

Benefits of the Design

The implementation delivers substantial benefits across three essential guidelines: environmental health, sustainable livelihoods, and community access and equity.

Regarding environmental health, the system eliminates approximately 10,000 tons of CO_2 emissions annually by replacing diesel generators. The air-cooled design minimizes water consumption, crucial in the arid environment, while the solar-based operation eliminates local air pollutants, improving community health outcomes.

In terms of sustainable livelihoods, the project creates permanent technical positions for community members, including system operators, maintenance technicians, and management roles. The reduced energy costs enable local business development, while the reliable power supply supports educational and training initiatives.

The cultural integration aspects of the project demonstrate particular significance. The system's design incorporates traditional knowledge of local weather patterns and seasonal changes, while its operation schedule respects important community events and gatherings. This cultural sensitivity extends to the training programs, which are designed to accommodate traditional learning styles and knowledge-sharing practices within the community. Moreover, the project's success acts as a blueprint for other isolated Indigenous communities dealing with comparable energy issues, which might lead to a wider adoption of sustainable energy solutions throughout Australia's remote areas.

The system ensures equitable access to electricity across the community, supporting essential services including healthcare facilities, schools, and community centers. The centralized management system enables fair distribution of power resources, while the storage capability ensures consistent supply during peak demand periods.

Constraints of design idea

The design faces two primary categories of constraints, each requiring specific mitigation strategies:

Technical and Operational Constraints

The system's complexity necessitates specialized maintenance expertise and comprehensive training programs. The remote location complicates spare parts logistics and technical support access. Environmental factors, including dust accumulation and extreme temperature variations, impact system efficiency and maintenance requirements. These constraints are addressed through robust training programs, preventive maintenance schedules, and strategic parts inventory management.

Long-term Sustainability Constraints

Future challenges include technology obsolescence risk, climate change impacts on system performance, and evolving community needs. Component lifespan and replacement costs require careful financial planning, while changing efficiency standards may necessitate system updates. These constraints are managed through adaptive planning, regular system assessments, and community engagement in long-term development strategies.

2.5 Nuclear Power Plant - *by Joshua Sanjay King (796 words)*

Description

The nuclear power plant will be tailored to the needs of the community that are in need of electricity. A small modular reactor (SMR) will be built as they are compact and safer than traditional large reactors, capable of high output while minimizing environmental impact. The plant would generate heat through nuclear reactions, convert heat into electricity by steam turbines and safely manage waste through a controlled secure waste management system.

The SMR system can operate for extended periods (up to 10 years) without the need for refueling, making it an ideal solution for locations where access to resources is limited. This power generation method produces consistent energy output regardless of weather conditions, unlike renewable options like solar or wind, which are dependent on environmental factors.

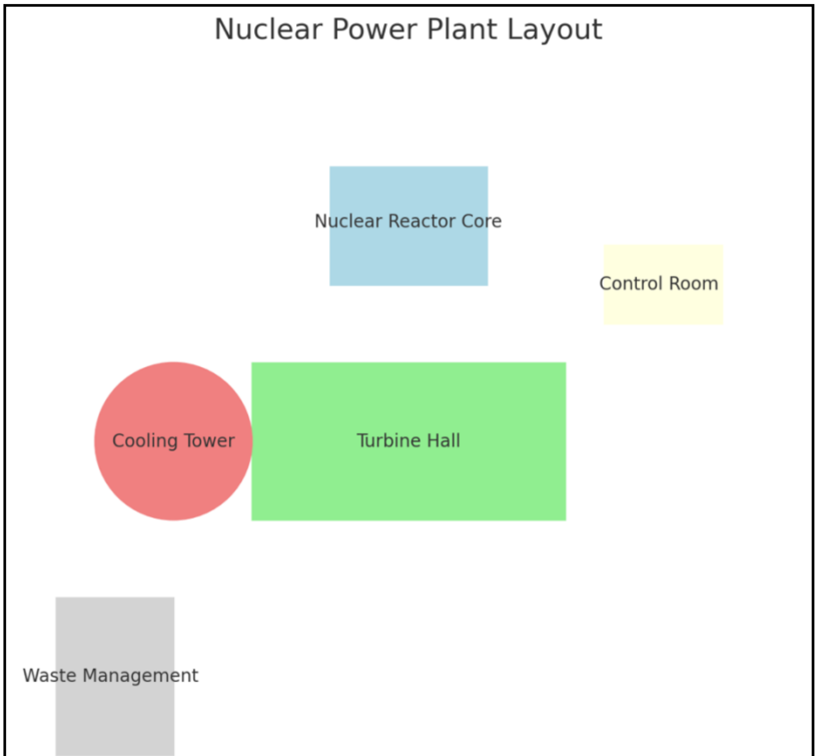

Figure 2.5 Design Idea 5

Design specifications

The SMR design includes both hardware and software elements, which are critical for reliable operations:

Hardware requirements

Nuclear reactor core: for generating heat via nuclear fission. It uses low-enriched uranium to generate heat, which is much safer and easier to handle than high-enriched variants used in large reactors.

Turbines: to convert steam produced by the heated water into mechanical energy, which is then used to generate electricity.

Cooling systems: a passive cooling system that works without external power. This ensures that the reactor remains cool and operates safely under any conditions, even in events of malfunction.

Control systems: provide real time monitoring of reactor performance including temperature, pressure and radiation levels. It ensures automatic shutdown in case of emergencies.

Waste Management system: for handling radioactive waste safely. The facility would be designed according to international standards to minimize environmental impact and prevent radiation leaks.

Software requirements

AI-driven monitoring system: for maintaining and safety checks using AI so that proper analysis and solutions can be provided.

Control software: managing reactor output and ensuring compliance with regulations (Peters et al., 2021).

The SMR will operate by fissioning uranium to produce heat, which will generate steam to drive turbines that create electricity. The plant would be always monitored using AI systems for safety. Redundant safety features like automated shutdown systems will ensure the plants remain safe in the event of failure.

Benefits of the Design

Reliable Power Supply: provides continuous energy source to the community. This reliability is particularly valued at remote locations where disruptions in power can have severe impacts on daily life and essential services. (World Nuclear Association, 2023).

Reduced Environmental Impact: Nuclear energy is a low carbon energy source. It does not produce greenhouse gas emissions during operation, making it an environmentally friendly alternative to diesel generators that are currently being used. By replacing diesel, the community's carbon footprint will be significantly reduced (Peters et al., 2021).

Economic Growth: Having reliable energy will encourage international business and local businesses to develop and invest in the community because working conditions and business operations will be able to run smoothly with a good energy source.

Impacts on the community

Economic opportunities: having stable electricity will encourage new jobs and businesses to be developed in the area. This will lead to a higher employment rate in the area and improving the living standards for the community.

Energy security: Having stable electricity will help support the development and maintenance of critical infrastructure such as transportation systems, communication networks and public services which will ensure that the community will be able to progress.

Environmental health: reduced emissions from power generation will improve air quality and treating waste management correctly will preserve the environment. By reducing reliance on diesel generators, the SMR will help protect the local environment from air and noise pollution, contributing to a healthier and more sustainable community (Peters et al., 2021).

Cultural Appropriateness

The nuclear plant will be developed in collaboration with the community to ensure cultural considerations are taken into account. Workshops and information sessions will educate residents about the benefits and safety of nuclear energy. The decision-making processes will include local leaders to be able to adjust and cater to the needs of the land and heritage of the community.

Guiding Principles

- Ensure all community members benefit equally from the energy supply.
- Prioritize safety in all aspects of plant design and operation
- Focus on environmental safety

Constraints of the design

High initial cost to build a nuclear plant: the upfront cost of installing SMR is high and will be a challenge for Yuendumu. However, with government grants, internation aid and private sector investments can help offset these costs. (Australian Renewable Energy Agency, 2021).

Community's opinion: Fears or misinformation around nuclear power creation could affect the community's decision to go through with the design. Educating the community on the safety features of SMRs, such as passive cooling systems and automatic shutdown mechanisms will provide confidence in building a nuclear power plant. (IAEA, 2020).

Conclusion

We propose several design ideas for the **Yuendumu** community in the Northern Territory: solar renewable energy, biomass energy using food and general waste, a renewable energy-based battery storage system, a solar concentrated thermal power system with thermal storage, and a nuclear power plant. Currently, the community faces unstable and insecure electricity, which impacts various sectors, including health, education, and food resources. Implementing any of these solutions will provide the community with stable and secure access to clean, renewable energy, while also protecting the environment. Adopting one of these ideas will significantly improve the community's quality of life, reducing costs associated with fuel for electric generators and minimizing food spoilage caused by power outages.

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