Mars Reactor Project

The Mars Reactor senior design team is designing a nuclear reactor for the proposed human colony on Mars in the near future. This reactor will supply the colony with the necessary electrical energy required to sustain life on the red planet. Mars is a hostile environment: it is a cold, dusty planet without an oxygen rich atmosphere and no source of water. In order for humans to survive on such a desolate planet, the requirements for life will need to be brought from Earth or created on Mars. Creating these necessities such as water and oxygen and raising the ambient temperature of the housing units requires an enormous amount of energy. A nuclear reactor is the best option for the sustainability of the colony to fulfill the around the clock electrical needs of the colonists. Due to the lack of resources and manufacturing capability on Mars, fabrication will need to be done here on Earth and then sent by rocket to the red planet. This will require the reactor to be smaller and lighter than what we currently have on Earth.

The design of a nuclear reactor of this scale requires an innovative approach to meeting the energy and size demands. Carbon and carbon fiber reinforced materials will be considered for use as the structural components of the reactor. Most reactors on Earth currently utilize dense materials such as lead and concrete which are too heavy to deliver up to space. Utilizing unconventional materials for use on the reactor would encourage new research into space-faring materials. Since Mars has a carbon dioxide (CO$_2$) dominant atmosphere, special considerations must be accounted for when designing the reactor. It would be ideal to utilize the abundant source of CO$_2$ as the coolant and working fluid. The reactor would operate under a single loop system and deploy an emergency coolant system in the case of an accident. Another innovative aspect of this design is the ability to use depleted uranium (nuclear waste) from Earth as the fuel for this reactor. This will help to reduce the accumulating waste on Earth while supplying electricity to the colony. Designing a reactor for Mars will encourage new technological advances that would have applications in other areas of research. For example, material selection will play a big factor to withstanding the temperature extremes found on Mars. This may encourage new research towards developing materials that could later be used for other applications. For instance, newly developed materials used for space reactor applications can be tested for the extreme temperatures needed in a fusion reactor.

The Mars reactor will positively impact the world by pushing the boundaries of current nuclear reactor design, allowing the potential for smaller reactors to be deployed in remote locations here on Earth. As the boundaries are pushed and access to electricity continues to grow, those impacted will be able to become more efficient in their daily activities and live a more comfortable lifestyle. The Mars reactor is an important step to ensuring that colonies will be able to thrive in an unconventional environment.

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