

Nuclear electric rocket

A **nuclear electric rocket** (more properly **nuclear electric propulsion**) is a type of [spacecraft](#) propulsion system where [thermal energy](#) from a [nuclear reactor](#) is converted to [electrical energy](#), which is used to drive an [ion thruster](#) or other electrical [spacecraft propulsion](#) technology.^{[1][2][3][4][5][6][7][8]} The nuclear electric rocket terminology is slightly inconsistent, as technically the "[rocket](#)" part of the propulsion system is totally non-nuclear and could also be driven by [solar panels](#). This is in contrast with a [nuclear thermal rocket](#), which directly uses reactor heat to add energy to a [working fluid](#), which is then expelled out of a rocket nozzle.

Concepts[[edit](#)]

Pebble bed reactor combined with gas turbine[[edit](#)]



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A [pebble bed reactor](#) using high mass-flow gaseous [nitrogen](#) coolant near normal atmospheric pressures is a possible heat source. Power generation could be accomplished with [gas turbine](#) technology, which is well developed. [Nuclear fuel](#) would be highly enriched [uranium](#) encapsulated in low-[boron graphite](#) balls probably 5–10 cm in diameter. The graphite would also moderate the [neutrons](#) of the nuclear reaction.^{[[citation needed](#)]}

This style of reactor can be designed to be inherently safe. As it heats, the graphite expands, separating the fuel and reducing the reactor's criticality. This property can simplify the operating controls to a single valve throttling the turbine. When closed, the reactor heats, but produces less power. When open, the reactor cools, but becomes more critical and produces more power.^{[[citation needed](#)]}

The graphite encapsulation simplifies refueling and waste handling. Graphite is mechanically strong, and resists high temperatures. This reduces the risk of an unplanned release of radioactive elements, including [fission products](#). Since this style of reactor produces high power without heavy castings to contain high pressures, it is well suited to power spacecraft.^{[[citation needed](#)]}

Novel electric propulsion concepts[[edit](#)]

A variety of electric propulsion technologies have been proposed for use with high power nuclear electrical generation systems, including [VASIMR](#), [DS4G](#), and [pulsed inductive thruster](#) (PIT). PIT and VASIMR are unique in their ability to trade between power usage, specific impulse (a measure of efficiency, see [specific impulse](#)) and thrust-in-flight. PIT has the additional advantage of not needing conditioned power.^{[[citation needed](#)]}

Electrical generation[[edit](#)]

A number of heat-to-electricity schemes have been proposed. In the near term, [Rankine cycle](#), [Brayton cycle](#), and [Stirling cycle](#) generators go through an intermediate mechanical phase, with attendant energy losses. More exotic technologies have also been proposed: [thermoelectric](#) (including [graphene](#)-based thermal power conversion^{[1][2][3]}), [pyroelectric](#), [thermophotovoltaic](#), [thermionic](#) and [magnetohydrodynamic](#) type [thermoelectric materials](#).

Other types of nuclear power concepts in space[[edit](#)]

Main articles: [Nuclear power in space](#), [Nuclear propulsion](#), and [Nuclear pulse propulsion](#)

[Radioisotope thermoelectric generators](#), [radioisotope heater units](#), [radioisotope piezoelectric generators](#), and the [radioisotope rocket](#) all use the heat from a static radioactive source (usually [Plutonium-238](#)) for a low level of electric or direct propulsion power. Other concepts include the [nuclear thermal rocket](#), the fission fragment rocket, [nuclear pulse propulsion](#), and the possibility of a [fusion rocket](#), assuming that [nuclear fusion](#) technology is developed at some point in the near future.^{[[citation needed](#)]}