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# How a NASA solar system

It'll be safe, engineer

By [Elisha Savers](#) on January



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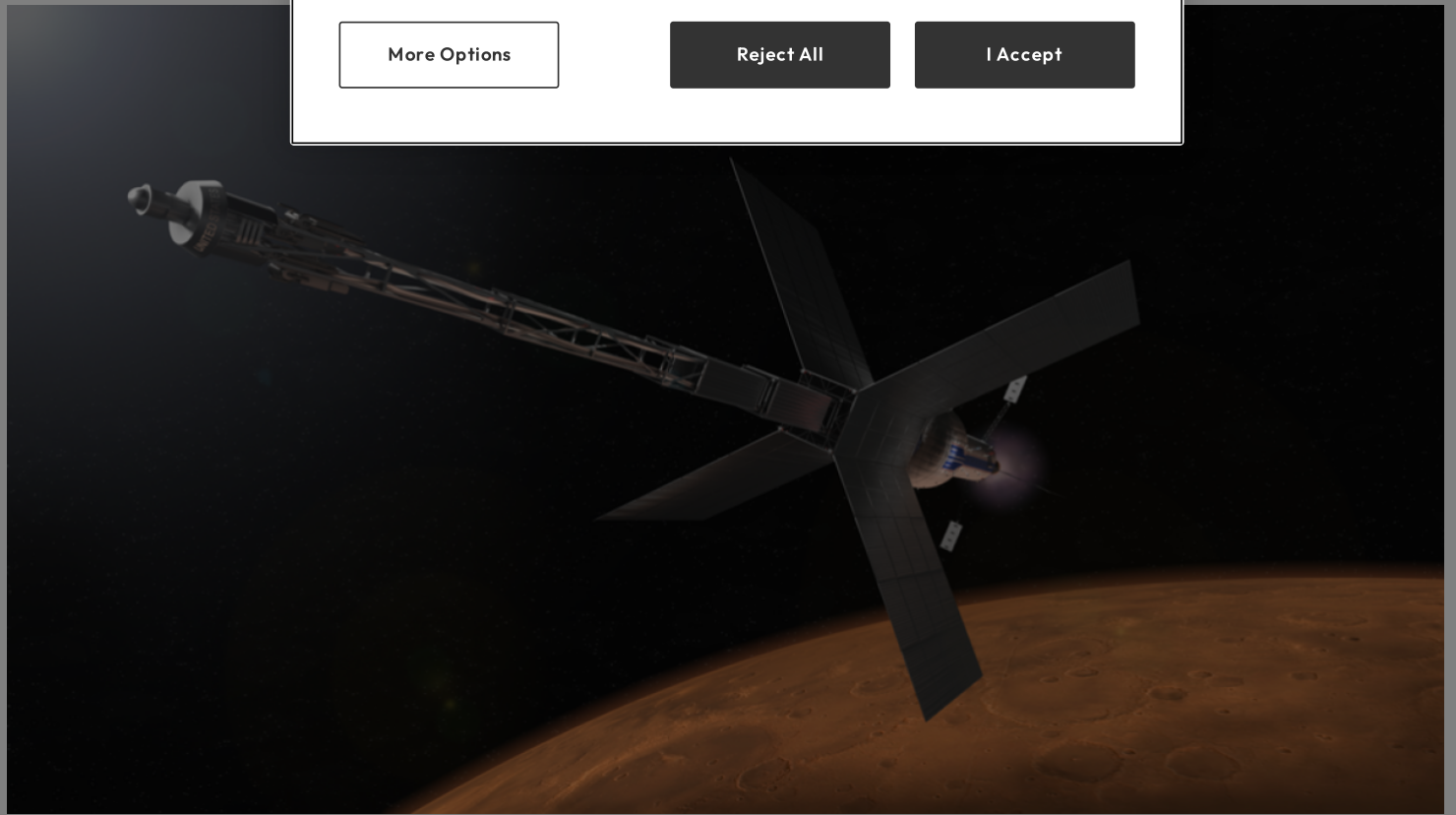
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Engineers say a nuclear thermal rocket could cut astronauts' travel time to Mars from nine months to two. Credit: NASA

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[NASA](#) and the U.S. military plan to test a nuclear-powered rocket engine in [space](#) as early as 2027, potentially revolutionizing how people travel the cosmos in the coming decades.

The two agencies will work on a [nuclear thermal propulsion](#) system, a technology NASA wants to use to send humans to Mars in the late 2030s. But the test mission — known as Demonstration Rocket for Agile Cislunar Operations, or the [DRACO program](#) — would not involve astronauts.



Advocates of nuclear-powered rockets have long-stressed the advantages: allowing spacecraft to travel faster, carry heavier loads of people and cargo, and use fuel more efficiently than the chemical-based rockets of today. Lately, the idea has galvanized, with \$110 million budgeted for the project this year.

It's not clear how concerns about the ground, as well as exposure to harmful

But at the American was announced in conscience when head?"

"We are putting

Stefanie Tompkins, director of the Defense Advanced Research Projects Agency, the research and development arm of the military, which is leading the overall program. "Part of the reason for doing it in space in a lot of ways is it's safer than having to do it on Earth."

will renew people on the have less laboration llective over my

safe," said

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.@NASA is working on an exciting new project with our partners at @DARPA!

Together, we're developing and demonstrating new advanced nuclear thermal propulsion technology, which will play a key role in future crewed missions to Mars 🚀



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## How would nuclear rockets change space travel?

Experts described nuclear-powered rockets to Mashable as being a leap-ahead technology, on the level of horse-and-buggy stage coach to steam locomotive or landline telephone to smartphone. Right now, engineers rely on swinging around planets to get [gravity boosts](#), the extra oomph needed to send space probes deep into the solar system. But nuclear power would free missions of having to wait sometimes years for the correct timing of orbits.

"You're opening up the outer solar system to scientific exploration. You don't have to wait for the planets to align. You'll have launch opportunities every year," said Dale Thomas, deputy director of the University of Alabama in Huntsville's Propulsion Research Center. "And, by the way, since we're talking about direct trajectories, you get there in about half the time."

With nuclear-thermal propulsion, getting to Mars could take as little as two months instead of nine, depending on the path taken, engineers said. And reducing the trip time would have the advantage of limiting the supplies needed for such a journey.



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## Why did the U.S. stop testing nuclear rockets?

The United States' last nuclear thermal rocket engine tests happened more than 50 years ago. During that time, the Los Alamos National Laboratory in New Mexico helped build nuclear rockets for NASA's Project Rover program. The [program ended in 1972](#) when President Richard Nixon made the political decision to cut funding for human missions to Mars and instead focus spending on the Space Shuttle and research in low-Earth orbit.

A nuclear thermal propulsion system would pump liquid hydrogen through a reactor, where uranium atoms would split apart and release heat. This process, [known as fission](#), would convert the hydrogen into a gas and eject it through a nozzle, creating thrust to propel a spaceship.

“**You're opening up the outer solar system to scientific exploration. You don't have to wait for the planets to align. You'll have launch opportunities every year.**”

The "game-changer" in developing the technology today is a new form of uranium, which is not considered a weapons-grade material. That opens the door for commercial space companies to work on spin-offs after the test mission, said Pam Melroy, NASA's deputy administrator.



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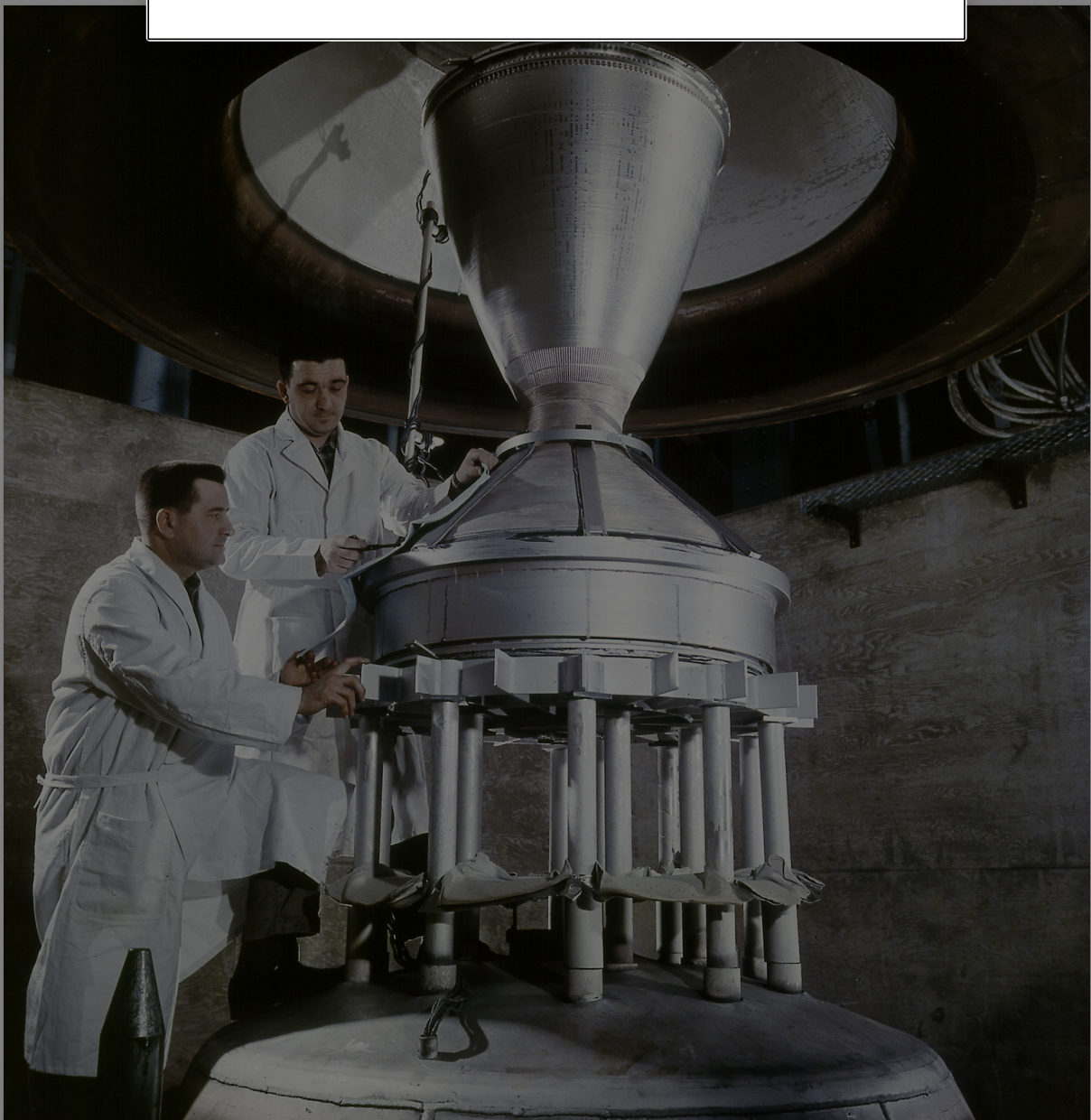
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Technicians prepare a Kiwi nuclear reactor nozzle for testing. Credit: NASA



# Are nuclear-powered rockets safe?

In terms of safety, engineers say the nuclear systems would not be used at the launch pad at all. In fact, that's one of the most common misconceptions about the technology. In sort of a hybrid approach,

chemical rockets  
space between 4  
engines would ta  
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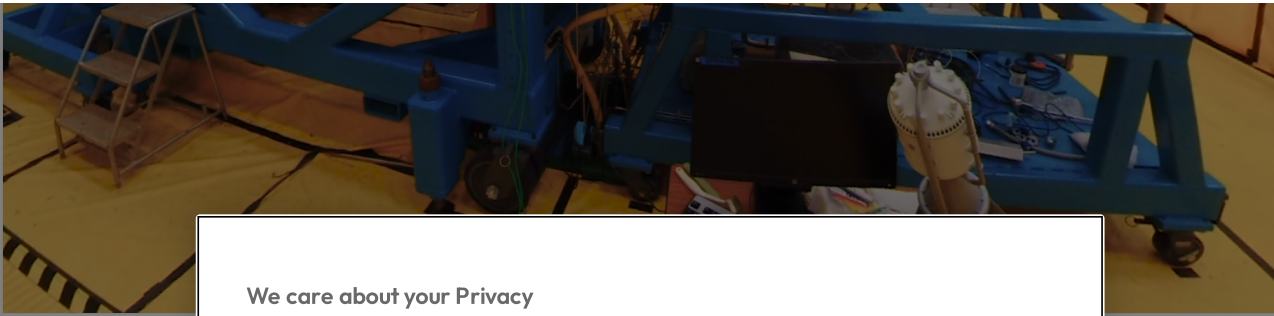
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If for some reason the chemical rocket blows up and the nuclear-powered engine ends up in the ocean, the nuclear hardware still can't "go critical," Thomas said. The in-space rocket system doesn't work until it reaches orbit.

Perhaps the greatest safety risks come into play during ground testing, a crucial step before launch. Engineers will need huge facilities that don't yet exist to capture the exhaust, a recommendation that came out in a [2021 independent report](#) NASA had requested from the National Academies to study nuclear propulsion. New construction or modifications to existing facilities could cost billions of dollars.





A simulator at NASA  
NASA / Mick Speer

Safe testing facility  
earlier versions of  
Academies' studies

types. Credit:

working on  
the National

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"The U.S. government fired nuclear rocket engines in the desert in Nevada in the night, in the late 1960s and early '70s, and they fired them in open air," Myers said. "We're much more careful today."

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## Radiation exposure risks for astronauts

Perhaps surprisingly, experts say future astronauts would not be at greater risk of radiation exposure because of the engine — their bigger concern would still be [deep space radiation](#) from the sun. That comes from the design of the ship, Thomas said. NASA has a research grant to model how a spacecraft could be engineered to work with nuclear-powered rocket engines.

The crew would be at the front and the engine in the back, with a large hydrogen tank between them. Hydrogen happens to be an exceptional neutron absorber. Translation: "It's like your fuel is your shield," Thomas said. "I'd say you're actually in better shape with the nuclear-thermal" rocket than a legacy chemical system.

“

**"It's like your fuel is your shield."**

Another bonus for astronauts is that nuclear-powered rockets afford the crew chances to abort a deep space mission. On chemical engines, once a spacecraft were headed to Mars, there would be no coming back until the planets lined up again.





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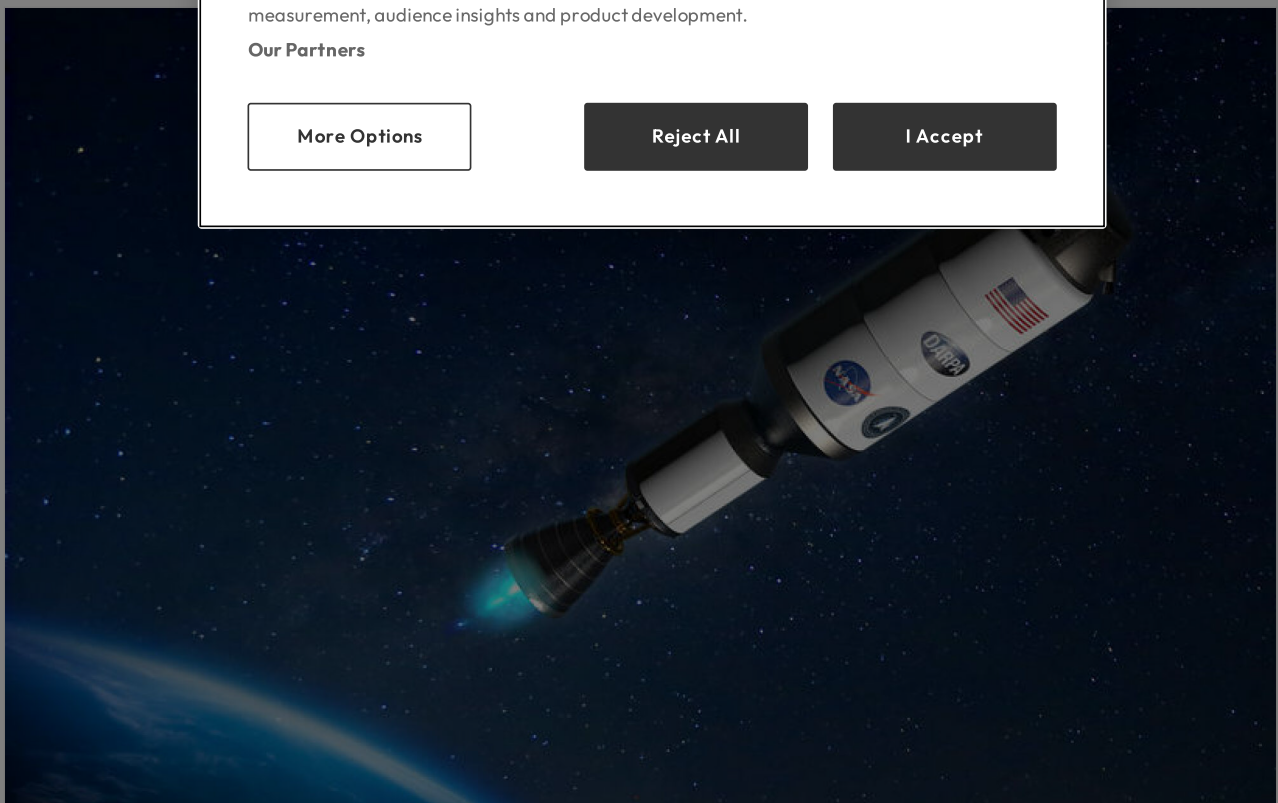
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The DRACO spacecraft will test a nuclear thermal rocket engine. Credit: DARPA Illustration

## Nuclear thermal vs. Nuclear electric rockets

Other [kinds of nuclear propulsion](#) aren't being developed in the collaborative DRACO program, such as nuclear-electric power. A nuclear-electric rocket would use a reactor to create electricity like a small power plant. Myers believes NASA should invest in all of them because they have different advantages for space travel. But joining the Defense Department in this nuclear-thermal test project was wise to combine resources, he said.

There is also something in all this for people whose feet are planted on Earth. If scientists and engineers can develop a fuel and reactor that can take an extremely high temperature, that could lead to safer nuclear power plants on the ground.



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"The reactor fue  
bulletproof," he

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that reactor



## Elisha Sauers

Elisha Sauers is the space and future tech reporter for Mashable, interested in asteroids, astronauts, and astro nuts. In over 15 years of reporting, she's covered a variety of topics, including health, business, and government, with a penchant for FOIA and other public records requests. She previously worked for *The Virginian-Pilot* in Norfolk, Virginia, and *The Capital* in Annapolis, Maryland, now known as *The Capital-Gazette*. She's won numerous state awards for beat reporting and [national recognition](#) for narrative storytelling. Send space tips and story ideas to [elisha.sauers@ziffmedia.com](mailto:elisha.sauers@ziffmedia.com) or text 443-684-2489. Follow her on Twitter at [@elishasauers](#).

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