



To: Al Newhouse, DOE/NE-50

cc: Bob Lange, Ed Mastal, Art Mehner, Bev Cook, Vince Cassella, DOE/NE-53

From: Bob Carpenter *Bob Carpenter*

Subject: Distances Traveled by Our Four Oldest RTG-Powered Spacecraft

Date: May 16, 1994

Reference: DOE Letter, Secretary O'Leary to Admiral Demars,
Subject: "100 Million Mile Milestone on Nuclear Power," 5/4/94

In response to the questions posed on the margins of the referenced letter (copy attached), I have calculated the distances traveled since achieving orbit by our four oldest RTG-powered spacecraft. The first consideration in this calculation is: How far have they traveled in relation to what? Since the Navy milestone distance must have been derived relative to the surface of the Earth, I have also chosen to use the Earth's surface as a reference. I have neglected the rotation of the Earth and its travel around the Sun, as did the Navy.

As of 29 June 1994, our oldest nuclear-powered spacecraft, Transit 4A, will have been in space 33 years (289,272 hours). We do not know how long the SNAP-3 RTG provided power to the satellite because the telemetry signals were lost soon after the launch. The Transit 4A spacecraft was injected into a 890 x 1000 km near-circular orbit, inclined at 67.5° to the equatorial plane, with an orbital period of 104 minutes. During this time, the satellite will have traveled about 4,767 million miles along its orbital path. This amounts to 166,888 times around the Earth and equals 4,151 million miles on the surface (mean radius of the Earth equals 3,959 miles).

The second nuclear-powered spacecraft was Transit 4B, launched on 15 Nov 1961 into a 960 x 1130 km near-circular orbit, inclined at 32.4°, with a period of 106 minutes. The satellite quit operating after about 8 months due to the Starfish nuclear weapon test in space. Transit 4B will have been in space 285,936 hours as of 29 June 1994 and will have circled the Earth 161,851 times. This is a distance of 4,686 million miles along the orbital path or 4,026 million miles on the Earth's surface.

Transit 5BN-1 was the third nuclear-powered spacecraft, and the first fully powered by a SNAP-9A RTG. It was launched on 28 Sep 1963 into a 1090 x 1150 km orbit, at a near-polar inclination of 89.9°, with a period of 107 minutes. As of 29 June 1994, it will have been in space 269,568 hours and circled the Earth 151,160 times. It will have traveled an orbital distance of 4,421 million miles and a distance of 3,760 million miles on the Earth's surface.

The fourth oldest nuclear-powered spacecraft was Transit 5BN-2, also fully powered by a SNAP-9A RTG. It was launched on 5 Dec 1963 into a 1080 x 1110 km, polar orbit (90° inclination), with a period of 107 minutes. As of 29 June 1994, it will have been in orbit 267,912 hours and circled the Earth 150,231 times. By then, it will have traveled 4,379 million miles along the orbital path and 3,737 million miles along the surface of the Earth. We know that the SNAP-9A RTGs performed well for 7 and 8 years, respectively.

In summary, the four oldest nuclear-powered spacecraft have traveled a total of 18,253 million miles (average of 4,563 million miles each) in orbit or 15,674 million miles (average of 3,918 million miles each) relative to the surface of the Earth.

It only takes 4,020 trips around the Earth to be equivalent to traveling 100 million miles on its surface. So it would take about 7,000 hours (less than 10 months) for any one of the above four Transit spacecraft to travel 100 million miles. We know the RTGs lasted far longer than that; but, since we do not know exactly how long (or how well) these early RTGs performed, I do not think we want to create a letter from the President highlighting them.

However, we do know these early units all out-lived their design lifetimes and paved the way for the Pioneer, Voyager, LES 8 and 9, Galileo, and Ulysses RTGs which have demonstrated spectacular lifetimes and traveled billions of miles in outer space. A letter recognizing this outstanding record (maybe on the occasion of Galileo arriving at Jupiter in December 1994) might be very beneficial to the FY 96 budget cycle concerning money for Cassini, Pluto, and new technology development.

Attachment: a/s



The Secretary of Energy
Washington, DC 20585

May 4, 1994

cc: NE-2
NE-10
NE-30
NE-40
NE-50
Kiehl 4p 5/5
NE-1.2
NE-12
NE-13
NE-14
NE-15
Gillis
CC

*Wahlquist
Fange
Carroll
Williams*

MEMORANDUM FOR ADMIRAL BRUCE DEMARS

FROM: HAZEL R. O'LEARY

Hazel R. O'Leary

SUBJECT: 100 MILLION MILE MILESTONE ON NUCLEAR
POWER

It is with great pleasure that I forward to you the attached letter from President Clinton recognizing the Naval Nuclear Propulsion Program having achieved the milestone of its nuclear powered ships steaming 100 million miles.

This accomplishment is particularly significant in that so large a joint enterprise of the Department of Energy and Navy has achieved a safety and environmental protection record unmatched by any other nuclear program. While it was the Navy's ships that accumulated the mileage, the Program's Department of Energy laboratories and prototype reactors are integral to the success of the propulsion plants and the quality of the thousands of operators who have served in these ships.

To all the people in your program, I extend my personal best wishes and my continuing support for the structure and practices that have achieved sustained excellence over the history of this program.

Attachment

cc: All Departmental Elements

I wonder how many million miles our four oldest nuclear power spacecraft have gone?

Carpenter,

How many million miles have our spacecraft gone - could we generate a similar letter?

RGL

THE WHITE HOUSE

WASHINGTON

April 25, 1994

The Honorable Hazel Rollins O'Leary
Secretary of Energy
Washington, D.C. 20585

Dear Hazel:

This month our Navy reaches a historic milestone -- 100 million miles steamed on nuclear power.

From the time the USS NAUTILUS first went to sea nearly 40 years ago, our nuclear-powered fleet has grown to 121 ships, including submarines, cruisers, and aircraft carriers. Nuclear propulsion has enabled these ships to make a vital and continuing contribution to our national interest -- greatly enhancing strategic deterrence, maintaining freedom of the seas, and providing an efficient means to address regional crises.

This milestone is remarkable because it has been reached safely and in a way that has protected the public and the environment, both here and abroad. The Naval Nuclear Propulsion Program, with its high standards and efficiency, exemplifies the level of excellence we are working toward throughout our government.

I commend you and your Department for this great accomplishment. I know that this achievement could not have been possible if it were not for the hard work of thousands of committed people -- military and civilian -- both in industry and in government. They represent a remarkable blend of the best of our nation's talent and resolve, and I ask that you convey to them my personal congratulations for their contribution to this milestone.

Sincerely,

