# Technical Comments

## Comment on "Re-Entry of Radioactive Power Sources"

C. A. WILLIS*
*McDonnell Douglas Astronautics Company, Santa Monica, Calif.*

BRUNNER, Dohner, and Lawit[1] mention the familiar 10-half-lives-decay rule in justifying the need for ablation protection, "Nominally, a re-entry sooner than 10 times the isotope half-life in space may present a radiation hazard to the populace." Although this statement is not essential to this interesting article, it does merit comment because this "criterion" is both popular and unsound.

Although the radiological hazard potential is reduced by radiological decay before re-entry, there is no reason to consider 10 half-lives either necessary or sufficient. Requirements are not the same for different systems and this particular generalization is more often misleading than helpful. For re-entry burnup considerations, the hazard potential is simply proportional to the radioisotope inventory. Thus, if 10 half-lives decay were just sufficient for a 10-kw source it would be inadequate for a 100-kw source and unnecessary for a 1-kw source.

Furthermore, the 10-half-lives rule is an unreliable guide in considering the ground level release case. Although this decay will reduce power density by a factor of 1000 and minimize the probability of melting, it does not necessarily eliminate hazards. For example, consider a 30-kwe, 5% efficient power system fueled with $^{210}$Po; after 10 half-lives (3.8 yr) it would contain some $2 \times 10^4$ Ci. It is easily shown[2] that the release of this amount of $^{210}$Po could produce lethal doses as much as 10-km downwind.

This misleading rule of thumb safety criterion should be eliminated, at least from technical journals.

Received January 20, 1969.

* Group Engineer, Advance Propulsion Department, Research and Development.

### References

[1] Brunner, M. J., Dohner, C. V., and Lawit, R. L., "Re-Entry of Radioactive Power Sources," *Journal of Spacecraft and Rockets*, Vol. 5, No. 4, April 1968, pp 448–453.

[2] Willis, C. A. et al., "Safety Characteristics of Polonium -210," Rept. SC-CR-67-2801, Dec. 1967, U.S. Atomic Energy Commission.

## Reply by Authors to C. A. Willis

M. J. BRUNNER,* C. V. DOHNER,† AND R. L. LAWIT‡
*General Electric Company, Philadelphia, Pa.*

WE concur with the comments of C. A. Willis. Our statement in the Introduction, "...re-entry sooner than 10 times the isotope half-life in space may present a radiation hazard...," was intended to convey a feeling for a time parameter that is not required for other space applications. It was not intended to be used, even as rule of thumb, for general design criteria. As indicated in the article by the differences of $Sr^{90}$ and $Pu^{238}$ the types of emission, chemical activity, and other factors would require specific evaluation of each system to establish the period of "safe" containment.

Received February 13, 1969.

* Consulting Engineer. Associate Fellow AIAA.

† Supervising Engineer.

‡ System Engineer.