Water deorbit device

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Standard approaches

- Revealing and inflated devices
- Electrical rocket engines
- Devices using electricity for surface charging and creation of thrust due to energy of the Solar wind.

An Inflated Shell



General gas generating problems

Possibility of launching before start

Any problems with one satellite can damage all satellites around it

Possibility of not launching at all All electrical devices are subjected to radiation damage

Using Radioactive Decay

- Nothing can impact on radioactive decay
- Kinetics of radioactive decay is simple for calculation and prediction

Special Dense Radioactive Substance

Advantages of T₂O

- Appropriate half-life: 12.3 years
- The weakest beta-decay
- High density: 1.2 g/ml
- Effective gas generator 1.4L per 1ml in 11 years, STP

Reactions



$$4T_2O \xrightarrow[Cat.]{\tau_{1/2} = 12.3 \text{ year}} 4^3\text{He} + O_2$$

Construction

- Titanium tank
- Rupture disc or valve
- Polymer shell





Water mass and time of expansion



Gases pressure vs. time



Easy to scale PV = nRT



Reliability

This system:

- Absolutely safe to use
- Doesn't need any electrical devices
- Based on fundamentality of a radioactive decay
- Will be launched after 11 years in any case

There is only one possible failure – breaching

Impact on satellite

Tritium **radioactivity** has the weakest beta-radiation that can not go through 10mm of even air and so **has no impact** on satellite

Tritium water **volume** and **mass** (upper estimate)

- 43g of tritium water
- 35ml of tritium water
- 50L (1 atm) of He + O_2 after 11 years

The greatest impact has the volume of the shell and it is estimated as $0.25m^3$

Cost

Nowadays, cost of tritium is thousands dollars per gram **but**:

- 1. Tritium water has only **26%** of tritium
- There are many opportunities to decrease water mass (43g is more than sufficient)
- 3. Low demand defines high prices
- 4. Now there is a problem with **tritium utilization**
- 5. For such a reliable construction it is not a big price to pay

Conclusions

Pros

- Reliable
- Effective
- Scalable
- Simple
- Autonomous
- Neglectable

The main concept is to use T_2O as a small effective gas generator. Other components of the deorbiting system may vary. Nevertheless, it is hard to imagine anything that simple.

Cons

- Shell volume
- Expensive

Thank you for your attention

Why did we choose T₂O

PERIODIC TABLE OF THE ELEMENTS







Helium pressure (atm)