SAND2014-2527C

Exceptional service in the national interest

Sandia National Laboratories

Thorium at Sandia

A Briefing for RCTS

March 31, 2014

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

(**SAND2014-2525 C**)

Radiological Properties

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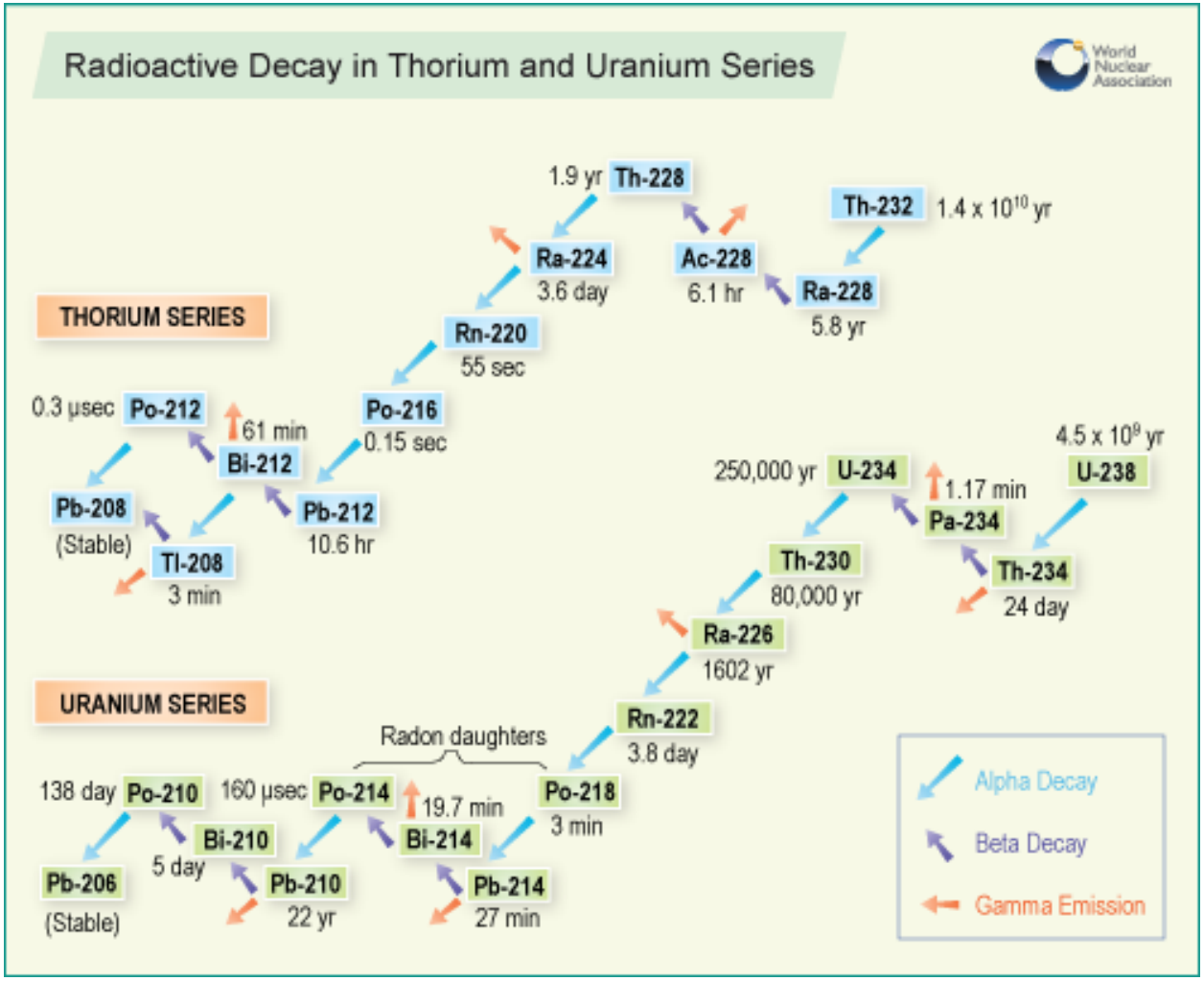
- Half-Life: 14 billion years (longer than the age of the universe)
- Almost 100% Th-232
- Has a long decay chain ending in Pb-208
- Appendix D: 200 removable, 1, 000 total dpm/100 sq. cm

Decay Chain


Radioactive Decay in Thorium and Uranium Series
World Nuclear Association
THORIUM SERIES
Th-232
1.4 x 10^10 yr
Ra-228
5.8 yr
Ac-228
6.1 hr
Th-228
1.9 yr
Ra-224
3.6 day
Rn-220
55 sec
Po-216
0.15 sec
Pb-212
10.6 hr
Bi-212
61 min
Po-212
0.3 µsec
Tl-208
3 min
Pb-208
(Stable)
URANIUM SERIES
U-238
4.5 x 10^9 yr
U-234
250,000 yr
Pa-234
1.17 min
Th-234
24 day
Th-230
80,000 yr
Ra-226
1602 yr
Rn-222
3.8 day
Radon daughters
Po-218
3 min
Bi-214
Pb-214
27 min
Po-214
160 µsec
19.7 min
Pb-210
22 yr
Bi-210
5 day
Po-210
138 day
Pb-206
(Stable)
Alpha Decay
Beta Decay
Gamma Emission

MagThor

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- Aviation metal of the ‘70s & ‘80s
- Used in jet engine castings
- ~1.7% Thorium (less than 4% by weight requires no state or NRC license)
- Production ended due to radiological issues
- Encountered at Sandia in old jet engines, Polaris missile parts and museum displays

Polaris Missile Interstages

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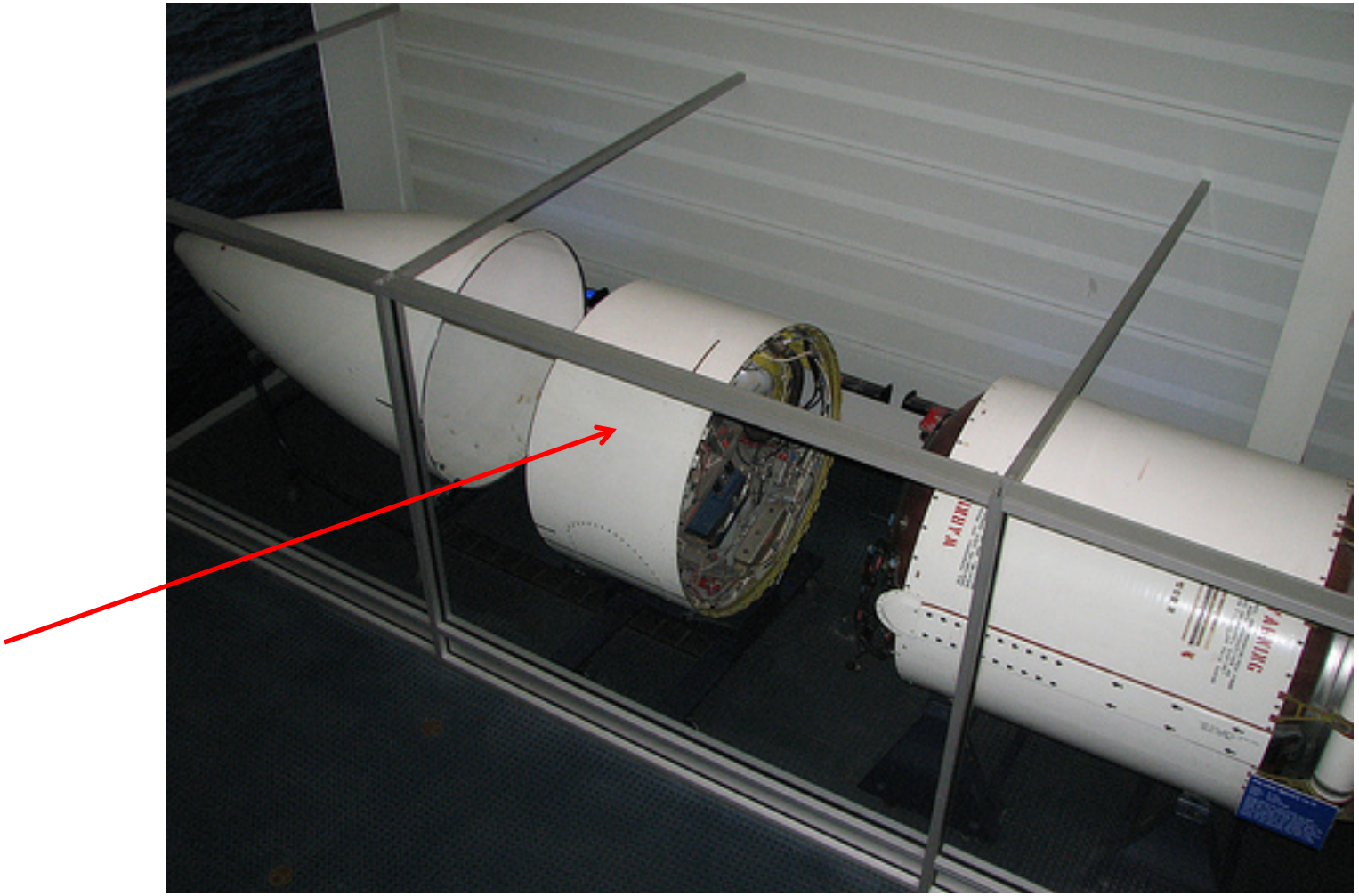

NMARC Museum Boneyard

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Abandoned Jet Engine

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MagThor Castings

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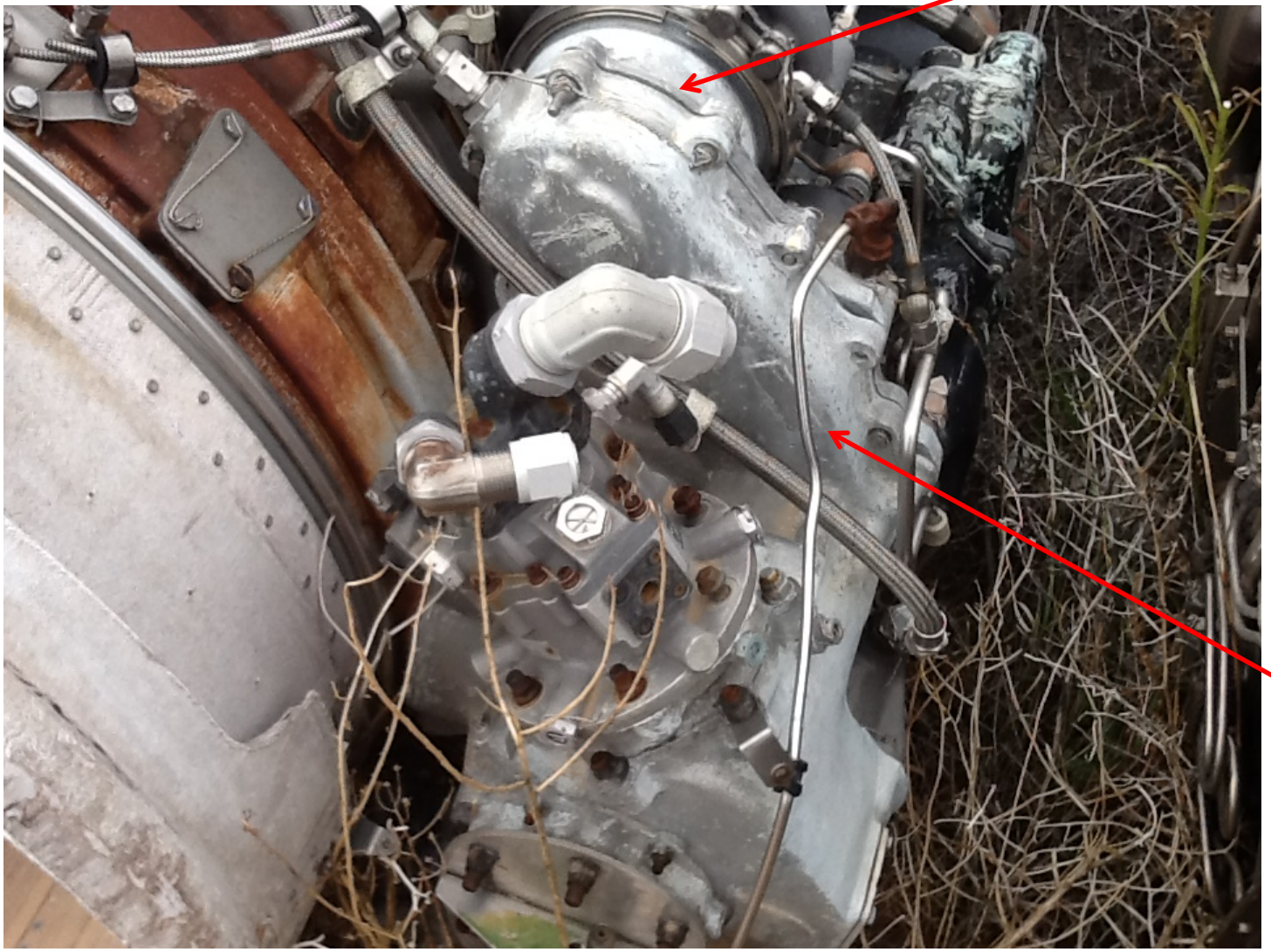

More MagThor

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Bomarc

Thoriated Camera Lenses

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- Produced in ‘40s, ‘50s, ‘60s and ‘70s
- Production ceased due to radiological concerns
- Lenses with <30% thorium oxide by weight are not regulated by the NRC (10CFR40.13)
- Thoriated lenses have a high index of refraction (allowing low weight) and low dispersion (all wavelengths focus in the same plane.)

A Thoriated Lens

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Lens Caught at Reapplication Portal

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Refractory (Fire) Bricks

TIG Welding Rods

Other Sources

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- Grinding Wheels
- Kiln insulation
- High temperature ceramic glazes

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