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## Memorandum

*Nuclear Engineering and Nonproliferation Division  
International Threat Reduction Group NEN-3  
Off-Site Source Recovery Project (OSRP)*

**SUBJECT: Gammatron Model AN-HP Special Form Evaluation for Pu-238 content**

### SCOPE

The purpose of this memo is to characterize Gammatron model AN-HP sealed source containing Pu-238 as US DOT Special Form Radioactive material, with the goal of achieving shipment, consolidation, and interim storage at LANL, TA-54, and final disposition at WIPP.

### Physical Features of the Source

The model AN-HP sealed source is described as a cylindrical double encapsulation made of Armco 17-4 stainless steel and inert gas welded. There are a variety of outside diameters and lengths for these capsules. Construction shall be in accordance with Gammatron drawings: A-2002, A-2004, A-2006, A-2008, A-2012, A-2014, or A-2040. This information is documented by Enclosure A Source Description from the COCA USA/0331/S-96.

### DOCUMENTATION

In April 1976, NSSI and Gammatron registered the model AN-HP sealed source with the US NRC Sealed Source Device Registry (SSDR, see enclosure B). The model AN-HP was a neutron source potentially containing Am-241 or Pu-238 isotopes for use in oil field operations. In this memo we will evaluate the special form character of the model AN-HP sealed source with respect to isotopic content. The original AN-HP Certificate of Competent Authority (COCA) listed Am-241 (20 Ci maximum activity) as the authorized content. Many years later (2012, Rev. 9) the authorized content for the AN-HP capsule is listed as Am-241 and Cf-252 (20 Ci and 0.5 Ci, respectively). The question has arisen about whether a Pu-238 source that was re-encapsulated in 2008 is US DOT Special Form radioactive material.

The Special Form Character of the model AN-HP sealed source was determined by performance testing in accordance with 49CFR173.269. These tests measure the capsule integrity by subjecting the test items (capsule cladding with simulated content) to free drop, impact, bending, thermal, and leach tests as is appropriate. The content is only required to acceptably simulate the behavior of the americium oxide listed as content. This model of radioactive sealed source was issued a US DOT COCA (US/331/S) about 1976.

From a chemical compatibility perspective, oil field operations require durability at high temperatures and pressures (400°C and 25,000 psi external pressure). Am-241 and Pu-238 oxides have a long history of encapsulation in austenitic stainless steels (304, 316, and 17-4 PH) with a high degree of durability and chemical compatibility. For the purposes of determining special form character these questions are

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addressed by referencing the long history of successful TRU material encapsulation in stainless steels by manufacturers like MRC, NUMEC, and Amersham.

From a self-pressurization and aging perspective, the activity in a sealed source pressurizes the interior of the source capsule as alpha particles are emitted by the Am-241, Pu-238, or Cf-252 content of these capsules. The alpha particles eventually lose their kinetic energy and are deionized by material within the source capsule. These deionized particles are helium 4 gas atoms. Since the activity limits are in reality decay event rates, there is no difference in the quantity of alpha particles generated by equal activities of Am-241 and Pu-238 materials within an AN-HP capsule.

### **SUMMARY**

The Gammatron model AN-HP sealed source is very similar to other neutron sources intended for use in oil field operations. The US DOT issued a COCA (USA/0331/S) COCA for international special form shipping of these sources. Pu-238 content in AN-HP capsules was recognized in the original SADR but not in the COCA. Further, from a chemical compatibility and aging source perspective, Pu-238 content of AN-HP capsules is no different than the currently authorized Am-241 content and does not present an unanalyzed safety or regulatory issue for these sources.

### **CONCLUSION**

The Gammatron model AN-HP radioactive sealed source as documented in SADR: TX-333-S-117-U can be self-certified as US DOT special form radioactive material, for domestic shipments only, within the limits and scope of this memo until June 1 2013. After June 1, 2013 all Gammatron model AN-HP radioactive sealed source containing Pu-238 shipped domestically by OSRP need to be re-encapsulated in OSRP Special Form capsules.

**Encl.:** (enclosures not included)

- A. US DOT COCA US/0331/S-96
- B. Gammatron/NSSI AN-HP SADR

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