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## Memorandum

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

**SUBJECT: Gulf Nuclear Model AMC-1 Special Form Evaluation**

### SCOPE

The purpose of this memo is to characterize Gulf Nuclear Inc., model AMC-1 sealed source 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.

### DOCUMENTATION

In April 1975 Gulf Nuclear Inc. registered the model AMC-1 sealed source with the US NRC Sealed Source Device Registry (SSDR). The model AMC-1 was a combination source potentially containing Cs-137 and Am-241 isotopes for use in portable moisture density gauges. In this memo we will evaluate the special form character of the model AMC-1 sealed source by the method of similarity. Using this method we will compare the salient features of five other combination sources to the model AMC-1.

Combination sources were being used by Troxler Electronic Laboratories as evidenced by Troxler drawing A-100281 (enclosure A). This Troxler drawing calls out 4 manufacturers of combination sources and the minimum specifications for these sources to be used by Troxler. In Enclosure B the Troxler specifications and critical dimensions are listed. Additionally the New England Nuclear model NER-560 sealed source is listed, since this combination source was used by other portable moisture density gauge manufacturers and will bound particular critical dimensions used by these source capsules.

The Troxler A-100281 drawing was published in 1970, this time frame marks the establishment of a requirement for high integrity (special form) sealed sources of emitting radiation. Special form was a requirement for activities exceeding an A<sub>2</sub> quantity. The A<sub>2</sub> quantity for Am-241 is 27 mCi. Since the A<sub>2</sub> for Am-241 is lower than the Troxler specification of 50 mCi Am-241, these sources will all need to be classified as DOT special form radioactive material in order to be shipped in a Type A package, which was highly desirable for these commercial products.

### **Troxler Drawing A-100281 Combination Source Specification**

A brief description of the combination source on Troxler drawing no. A-100281 follows: *the source is a double encapsulated right cylinder 0.356 OD x 0.572 inches in length. The source cladding is composed of 304 stainless steel, sealed by heli-arc welding.* The source as used by Troxler will contain 8 mCi of Cs-137 and 50 mCi of Am-241Be. The minimum acceptable wall thickness is 0.025 inches for the inner and outer claddings. Each of the original source manufacturers considered by Troxler are listed on the drawing, along with the particular model of source that was acceptable for this service.

Two additional AmBe/Cs sources are listed in Table 1 of enclosure B. The Gulf Nuclear model AMC-1 whose special form character we are herein trying to document, and the New England Nuclear model NER-560 family of sources. The New England Nuclear source is listed as a combination source used by moisture density gauge manufacturers other than Troxler, with an established special form pedigree.

Examination of the Table in Enclosure B will reveal that all model sources discussed herein have a sealed source and device registration (SSDR). This registration is a summary of the safety analysis report submitted to the AEC (or NRC) prior to approval to manufacture these sources for commercial distribution. These SSDR documents serve as a primary description of the source and also serve as acceptable knowledge (AK) in the EPA mandated disposition process for TRU sealed sources (Peer Review Report).

Another feature in Table 1 of enclosure B is the Certificate of Competent Authority (COCA) column. A COCA is a document issued by the US DOT for international shipment of sealed sources that indicates these sources meet the US DOT requirements for special form radioactive material as codified in 49CFR173.469. Note that of the 6 sources in the Table 1 only 3 source models are documented as having been issued a DOT COCA.

### **Physical Features of the Sources**

The model AMC-1 sealed source was according to the SSDR manufactured for moisture density gauge use. In this function the gauge emits gamma and neutron radiations to allow measurement of density and moisture content on civil engineering sites. The AMC-1 was described as having a maximum activity content of 200 mCi CS-137 and 1,000 mCi of AmBe. The other combination gauge sources were limited to 10 mCi of Cs-137 and 50 mCi of Am-241. The only exception to this is the NEN model NER-560, which as a maximum activity of 200 mCi Cs-137 and 1,000 mCi of Am-241. This information is documented by Enclosure C Source Description from the SSDRs.

Materials of construction used in these 5 combination sources are 304 stainless steel.

The Table in enclosure B shows a comparison of the OD, length, and wall thickness for all five of the sealed sources we are comparing. The minimum wall thickness for these sources is that specified by Troxler A-100281 drawing 0.025"/0.025" (inner/outer cladding). The NEN NER-560 source also meets this minimum specification. The Amersham and Gamma Industries sources exceed this minimum specification for source wall thickness with 0.030"/0.040" for inner and out cladding thickness. The model AMC-1 source exceeds the minimum thickness at 0.030"/0.030" of inner and outer cladding thickness, respectively.

The exterior dimensions of the four sources specified in Troxler drawing A-100281 are 0.356" OD x 0.572" in length. The AMC-1 and NER-560 sources have variable dimensions which encompass these dimensions.

### **Special Form COCA**

Three of these sealed sources had special form Certificates of Competent Authority (COCA) issued by the US Department of Transportation. Enclosure D has the COCA for the Amersham AMN.6002 (X.220), Gamma Industries GI-NB-HP, and the NEN NER-560 sealed sources. Of these sources, the NER-560 meets the minimum capsule wall thickness and the X.220 and NER-560 models exceed the minimum wall thickness. The Gulf Nuclear AMC-1 is intermediate between these two groups of

sources. All three of the sources cited above had COCA issued for sources that were tested to meet the requirements of 49CFR173.469.

## **SUMMARY**

The GNI model AMC-1 sealed source is very similar to other combination type sources intended for use in portable moisture density gauges. Three of the reviewed sources had US DOT COCA issued for international special form shipping. Of the three COCA issued, the critical wall thickness parameter of the three sources ranges from 0.025"/0.025" to 0.30"/0.040" of inner/outer cladding. The AMC-1 source is intermediate in range to this critical parameter (0.030"/0.030"). Models NER-560, X.220, and GI-NB-HP met the requirements for US DOT special form radioactive material, as manufactured, documented by testing and issuance of a DOT COCA .

## **CONCLUSION**

The Gulf Nuclear model AMC-1 radioactive sealed source as documented in SSSDR: TX-333-S-117-U can be self-certified as US DOT special form radioactive material, within the limits and scope of this memo until June 1, 2013. After June 1, 2013 all Gulf Nuclear model AMC-1 radioactive sealed source shipped by OSRP need to be re-encapsulated in OSRP Special Form capsules.

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

- A. Troxler drawing A-100281
- B. Table 1., Comparison of Moisture Density Combination
- C. Sources Sealed Source Device Registry (SSDR)
- D. US DOT COCA for combination sources

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