D: 030-37567
L: 24-32675-02E

Request for Amendment to Exempt Distribution License 24-32675-02E

Ideal Source Quality Assurance

We are requesting an amendment to two administrative portions of License 24-32675-02E, and an exception to the existing rule applying to the electron produced isotope Na-22, which is currently covered by a default limit, applied to all isotopes that are not produced by neutron irradiation, and that are, potentially, the subject of new rulemaking by the NRC. In the absence of the rulemaking, we provide detailed justification for the exception, based on a comparison of the dose rate associated with the Na-22 decay and with that of the frequently encountered neutron produced isotopes, Mn-54, Co-58 and Ta 182.

1) **Change of address**: In order to accommodate a business on the other side of the original office wall for the Ideal Source office (the other business expanded by breaking through), we have moved the Ideal Source Quality Assurance (ISQA) office across the hall. The new address is 409 Vandiver, Building 4, Suite 200 (previously suite 201), Columbia, MO 65202. The security arrangements for the new office are substantially the same as those for the previous office, with the stones and sources locked in a safe within a separate locked room, inside the office. The official mailing address remains unchanged.

2) **Closure of the Office of Ideal Source International**: In the original license application we listed the offices of Ideal Source International as a destination for the cleared stones. The NRC was invited to visit that site to select stones for retesting. This office has now been closed, and the cleared stones are no longer stored in the United States. The testing and clearance for U.S. release continues to be carried out at the office of Ideal Source Quality Assurance, in Columbia MO. The NRC is invited to visit that office, to verify procedures and examine stones that have been tested and cleared for release. The procedure calls for ISQA to retest 5% of the stones cleared for release by the Maria Reactor procedures. These parcels are randomly selected by ISQA from a list provided by email. The NRC is equally invited to choose additional parcels that could be sent directly to the lab of its choice or to ISQA where they would be held sealed, to allow NRC to test, without the explicit knowledge by the Maria personnel that they have been selected for NRC.

3) **Request for exception to NRC rules for Na-22**: It is well known that electron treatment of small topaz stones employs 10MeV electrons, which do no produce any long lived byproducts, and that the only activities encountered are those associated with prior neutron irradiation. In order to avoid end of range effects, leading to breakage, cracking and other damage in large stones, higher energy electrons (typically 20-22 MeV) are employed. Our experience has shown only one additional by-product, Na-22, appearing in these stones. Although the production route for this isotope is not completely clear, we believe that it arises from Bremmstrahlung radiation (arising from the interaction of the high energy

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electrons with heavy metals – from focusing devices and beam stop) which, in turn leads to a alpha + n reaction with Al-27. Efforts will be made to modify the target area to minimize the Bremsstrahlung radiation, but it appears that Na-22 production cannot be eliminated.

We understand that the NRC is engaged in a study to set exempt limits for this (and other potential) electron produced isotope(s). It is not clear how long this process will take. In the interim, we are requesting an exception to the current NRC limit based on the relative dose associated with Na-22 decay, in comparison with the current limits set by the NRC for the commonly encountered radioisotopes in topaz, Mn-54, Co-58 and Ta-182.

Doses have been calculated with the codes in use at the Maria reactor, Gamma_dose and Beta_dose, both of which make use of the nuclear data in the ENDF-VII libraries. Gamma doses were calculated in the point source approximation. The code has been verified (in the past) by comparison with simple table data. The Beta doses were calculated with a more refined algorithm for cylindrical sources. The code has been verified (also in the past) by MCNP calculations for several materials. The calculations are for a 5g (25ct) topaz sample which would be at the lower end of the sizes typically irradiated with high energy electrons, at a distance of 4cm from the measuring point. Because of self shielding effects, the beta dose for larger stones will be decreased. The table below lists the results for the various isotopes. The results are given in nSv/h

Material	**Gamma dose**	**Beta dose**	**Exempt limit (Bq/g)**
Mn-54	0.05	no beta	37
Co-58	0.05	0.2	37
Ta-182	0.07	0.4	14.8
Na-22	0.07	1.2	6 (proposed)

Based on these calculations, Na-22 activity of 5.4 Bq/g would produce the same dose as the exempt limit for Ta-182, whereas the limit could be raised to 7.2 Bq/g to give a dose comparable to that of the Co-58 at its exempt limit.

We request that the NRC allow us to use (on an interim basis, pending final rulemaking) 6Bq/g as the exempt limit for Na-22 in the sum-of-ratios calculations. The current codes used for testing would be modified to include this isotope, but the procedures employed would be otherwise unchanged. It should be noted that this is a conservative limit, inasmuch as topaz is non-ingestible and the major contribution to the dose arises from the beta emission, which is external

and superficial. Under this exception most stones found to contain Na-22 would qualify for release, assuming the other isotopes are present in typical low quantities. However, decay times for all stones irradiated with high energy electrons will be extended to assure that the sum-of-ratios criterion is met.