DCD (SP06)

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Radiological Health
3rd Floor, L & C Annex, 401 Church Street
Nashville, TN 37243-1532
Phone: 615-532-0360, Fax: 615-532-7938

November 16, 1999

Paul Lohaus, Director
Nuclear Regulatory Commission
Office of State Programs (03H20)
One White Flint North
11555 Rockville Pike, 3rd Floor
Rockville, MD 20852

Dear Mr. Lohaus:

Enclosed please find copies of the March 1999 and subsequent amendments and the referenced backup material for Tennessee Radioactive Material Licenses R-01078-L00 and S-01046-L00 issued to Manufacturing Sciences Corporation. The information submitted contains no proprietary material, as you requested.

The amendments to authorize the unrestricted release of decontaminated nickel were issued as part of an ongoing series of licensing actions dating back to about 1990. Throughout the last 9 years MSC has been performing licensed research and development activities on various materials to demonstrate the effectiveness of the decontamination process. During this timeframe the R&D has moved from the lab to the plant floor by way of additional amendments. Much of the process detail is contained in the referenced backup material for those amendments, most if not all of which is proprietary.

Please let us know if we can be of further assistance.

Sincerely,

Lawrence E. Nanney
Acting Director

LEN:jhg

Enclosure

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JCG

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
OFFICE CORRESPONDENCE

DATE: March 24, 1999

TO: JCG, MHM

FROM: JMK

SUBJECT: MSC license request for Unrestricted Release of Decontaminated Nickel

Manufacturing Science Corporation (MSC) has submitted a license request to amend license number R-01078-L00. The request is titled "License Amendment Request for Unrestricted release of Decontaminated Nickel" and is dated December 8,1998, with supporting letters dated January 18, 1999; January 29, 1999 and February 18, 1999. Based on the attached analysis which shows that their proposal is conservative compared to other widely accepted regulations, and the very specific targeted pathways analyses submitted by MSC, I recommend approval of this license request.

Comparison of proposed release of volumetrically contaminated nickel to releases under RegGuide 1.86.

The MSC proposal would release nickel contaminated with a maximum per ingot 162 pCi/g Tc-99 and 16.2 pCi/g of Uranium (including U-234, U-235 and U-238). Thus the maximum contamination for any one ingot would be 178 pCi/g. The average for any single shipment will be half or 89 pCi/g. Material released from this process can reasonably be expected to be melted into another material such as stainless steel.

A release of contaminated nickel under RegGuide 1.86 would allow for an average surface contamination in the amount of 5000 dpm/100cm^2 combined Uranium and Tc-99. There is also a maximum surface contamination limit of 15000 dpm/100 cm^2 for an area of 100 cm^2 or less. Once the nickel is released under RegGuide 1.86 it will likely be melted to be used in another material such as stainless steel.

To be conservative, I will compare the maximum volumetric contamination of a single ingot to the average contamination under RegGuide 1.86.

Given: (the proposal contains references for these numbers)
Density of 304 stainless steel – 8.02 g/cc
Percentage of nickel in 304 stainless steel – 12%

Volumetric calculation:

Starting with an ingot of 178 pCi/g and melting it into 304 stainless steel.

$178 pCi/g \times 0.12 = 21.4 pCi/g$ — Using the density of 304 stainless steel to convert cubic meters to grams.

RegGuide 1.86 calculation:

Starting with a sheet of nickel with surface contamination of 5000 dpm/100 cm^2. To be conservative I will assume that the metal is only contaminated on one side although RegGuide 1.86 would allow the contamination to be on both sides. When this metal is melted to make it part of the stainless steel the contamination which was on the surface spreads into the metal and thus results in steel with volumetric contamination. I will start with a sheet of nickel that is half an inch (1.3 cm) thick, although this is unusually thick compared to the metal we typically see free released using RegGuide 1.86 standards.

$\frac{5000 dpm/cm^2}{1.3 cm} = 3846 dpm/cc$ — Converting surface contamination to equivalent volumetric contamination.

$3846 dpm/cc \times \frac{1 pCi}{2.2 dpm} = 1748 pCi/cc$ — Converting dpm to pCi in nickel

$1748 pCi/cc \times 0.12 = 209.8 pCi/cc$ — 304 stainless steel only contains 12% nickel

$209.8 pCi/cc \div 8.02 g/cc = 26 pCi/g$ — Using the density of 304 stainless steel to convert cubic meters to grams.

The stainless steel produced from nickel released under RegGuide 1.86 with only half the possible allowed surface contamination, on half inch thick nickel plate could have as much as 26pCi/g of contamination. This is again a conservative assumption because in reality the metal could be stainless steel and be released directly under RegGuide 1.86. If this were the case then the contamination in the steel would no longer have the 12% dilution factor. Nickel with the volumetric contamination in this proposal would at most result in stainless steel with 21.4 pCi/g of contamination. And since this is using the maximum for one ingot there could at most be a very limited amount at this concentration. It is more reasonable to assume the average volumetric contamination for a shipment which would be half and therefore stainless steel made from only this nickel would have only slightly more than 10 pCi/g contamination.

In conclusion, the current proposal by MSC for the free release of volumetrically contaminated nickel is much more conservative than releases made under the widely accepted RegGuide 1.86 standards.

November 15, 1999

Our original comparison of the volumetrically contaminated nickel to materials released under Regulatory Guide 1.86 included a number of conservatisms not considered in the approach used by MSC. These calculations are based on more reasonable assumptions although there is still a number of conservative assumptions. This presents a more realistic approach, rather than the overly conservative assumptions used previously.

Metals, including stainless steel, are currently being released with surface contamination limits established by Regulatory Guide 1.86. According to this guidance, material may be released with residual activity levels of 5000 dpm/100 cm^2. It is reasonable to assume a typical thickness for this metal of 0.5 cm (approx. 0.2 inch), with contamination on both sides. Assuming the density of stainless steel to be 8.02 g/cm^3, when melted the resulting volumetric activity would be:

$$\frac{5000dpm + 5000dpm}{100cm^2} \times \frac{1}{0.5cm} = 200dpm/cc$$

$$\frac{200dpm}{cc} \times \frac{cc}{8.02g} = \frac{24.9dpm}{g}$$

$$\frac{24.9dpm}{g} \times \frac{1pCi}{2.2dpm} = 11.3pCi/g$$

It is conservative to assume that all of the nickel in a batch of stainless steel is this processed nickel. Typically only 4% unalloyed nickel is added to the stainless steel. As a conservative assumption it is assumed that 12% of the nickel in the steel is all the processed unalloyed nickel. The nickel, which is being released at 3 Bq/g Tc-99 and 0.3 Bq/g uranium, when alloyed into stainless steel, yields a stainless steel with levels of:

$$3.3Bq/g \times 0.12 = 0.39Bq/g$$

$$0.39Bq/g \times \frac{1pCi}{0.036Bq} = 11pCi/g$$

Manufacturing
Sciences
Corporation

A BNFL Inc. Company *The Metals Recycling Specialists*

December 8, 1998

Attention: Mr. Johnny Graves
Tennessee Division of Radiological Health
3rd Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1532

Gentlemen:

It is requested that License R-01078-L00 be amended to allow MSC to conduct decontamination and unrestricted release operations of DOE volumetric contaminated nickel metal. Unrestricted release of decontaminated nickel metal from MSC will be based on currently accepted *removable* surface contamination release criterion with an additional volumetric contamination release criteria for **^{99}Tc** of *an average of 3 Bq/g (180 dpm beta/g or 81 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 6 Bq/g (360 dpm/g or 162 pCi/g).* The release criteria for **uranium** (inclusive of ^{234}U, ^{235}U, and ^{238}U, all of which are considered in total) will be an average of *0.3 Bq/g (18 dpm/g or 8.1 pCi/g) in a single shipment of nickel not to exceed 20 tons and with no single ingot in the shipment to exceed 0.6 Bq/g (36 dpm alpha/g or 16.2 pCi/g).*

Releaseability with regard to ^{99}Tc will be demonstrated via beta particle assay. With regard to uranium, releaseability will be demonstrated via alpha particle assay.

SNM license quantity limits will require isotopic determinations, but will not have any bearing on unrestricted release. Unrestricted release with regard to uranium is based on alpha activity in total as in *Regulatory Guide 1.86.*

804 Kerr Hollow Road Oak Ridge, TN 37830 Phone (423)481-0455 Fax (423)481-3142

Due to the nature of the nickel contamination and the methods necessary for decontamination, MSC is requesting the above volumetric release criterion be established. This criterion will assure that the risk in using this metal in consumer products is in the range of other "safe" products as demonstrated in the attached risk assessment. This risk assessment demonstrates that under the requested release criteria, the risk of cancer to the most exposed individual is less than $\sim 10^{-6}$. Shipments will not be larger than 20 tons. This volumetric unrestricted release criterion is additional to standard accepted removable surface contamination unrestricted release criteria.

Experiments to date indicate that the MSC procedure is capable of producing an ingot of nickel that contains approximately 3 Bq/g or less of ^{99}Tc and levels uranium at less than 0.3 Bq/g each. There is full expectation that the production units will perform as well as, if not better than, the experimental full-scale units in regard to the decontamination of technetium. Decontamination of the uranium is not expected to present any difficulty at this level. See the attached example of nickel unrestricted release documentation for more detail on unrestricted release information.

The *Sampling and Analysis Plan for Nickel Recycle* attached along with its referenced MSC Instructions and Instruction Guides documents MSC's plan for sampling and analyzing the nickel to ensure that it meets all release criteria. It is presented along with the A&A report, "*Risk Analysis: Nickel Contaminated with ^{99}Tc and Uranium.*" These documents provide the technical information needed to support MSC's request for a state license amendment for unrestricted release of recycled nickel with very low levels of volumetric contamination.

Sincerely,

Bobby A. Adcock, RSO Manufacturing Sciences Corporation

Enclosures:

Sampling and Analysis Plan for Nickel Recycle

MSC Work Instruction: Unrestricted Release Survey of Materials

MSC Work Instruction: Unrestricted Release Calculations

MSC Work Instruction: Laboratory Analysis of Nickel for Technetium-99 and Uranium Utilizing Liquid Scintillation PDA Methods (draft)

MSC Work Instruction: Volumetric Sampling of Refined Nickel (draft)

Risk Analysis: Nickel Contaminated with ^{99}Tc and Uranium