MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

October 6, 1994

TO: Cerium file (CAS# 7440—45—1)

FROM: Gary Butterfield

SUBJECT: ITSL for cerium

Cerium is an element that can occur as a radioactive substance. The radioactive form is used in tracer studies. Because the radioactive forms of cerium (144—Ce and 141—Ce) emit gamma rays and beta particles, they are considered to be highly toxic. Radioactive cerium is normally present in nuclear reactors. Therefore, there has been some concern about the toxicity of radioactive cerium, for nuclear reactor workers and in the case of environmental contamination following a reactor accident. Numerous toxicity studies to evaluate the chronic effects of exposure to radioactive cerium have been published. However, these studies are of little value in attempts to develop a screening level for the non-radioactive form of cerium as the doses are given in terms of radioactivity, as uCi/kg or uCi/m^3, and the toxic endpoint evaluated in most cases is radioactivity produced tumors.

For the purpose of determining a screening level, it will be assumed that the majority of sources of cerium emissions will be emitting non-radioactive cerium. The non-radioactive form of cerium has been poorly studied for its toxic effects. It has been reported that cerium is poorly absorbed from the GI tract following ingestion.

A CAS and NLM on-line literature search were conducted on June 2, 1994. The search found that there is no sub—chronic or chronic studies of the non-radioactive cerium of adequate quality to meet EPA's minimum criteria for calculation of an RfC. In fact, there were no repeated dose studies found that have been conducted with non-radioactive cerium. Some oral LD50 studies are available upon which the screening level may be based. Among the LD50 studies, Bruce et al (1963) reported the rat oral LD50 as 4200 mg/kg for cerium nitrate. Assuming toxicity is due to cerium portion and not the nitrate portion of this compound, LD50 for just the Ce portion could be calculated as 4200x(140/326) or equal to 1800 mg/kg. Using the equation in Rule 232(1)(h) the ITSL can be calculated to be 6 µg Ce/m3, with an annual average.

Per Rule 232 (1) (h),

$$ITSL = \frac{1}{500} x \frac{1}{40} x \frac{1}{100} x \frac{LD50\ \left(\frac{mg}{kg}\right) x\ animal\ weight}{0.167\ x\ daily\ inhalation\ rate}$$

$$ITSL = \frac{1}{500} x \frac{1}{40} x \frac{1}{100} x \frac{1800\left(\frac{mg}{kg}\right) x\ 0.395\ kg}{0.167\ x\ (0.8\ x\ 0.395^{0.8206})\left(\frac{m^3}{day}\right)} = 0.0057\ \frac{mg}{m^3} \approx 6\frac{\mu g}{m^3}$$

Where 0.395 kg is the non-gender default value used for the body weight of a rat and 0.8 x body weight$^{0.8206}$ m^3/day based on the default animal biological values memo and Environmental Protection Agency (EPA) guidance (MDEQ, 1996; EPA, 1998).

References:

Bruce et al. 1963. The acute mammalian toxicity of rare earth nitrates and oxides. Toxicol Appi Pharmacol 5:750—759.

EPA. 1988. Recommendation for and documentation of biological values for use in risk assessment. PB 88-179874.

Michigan Department of Environmental Quality (MDEQ). April 11, 1996. Default animal biological values, revised Jan 27, 1993 memo.