

PNL Report 10065 – Uranium Hexafluoride Public Risk

- Prepared for DOE and published 1994.
- Purpose was to evaluate potential risks to the public from accidental exposures to U in the forms used at GDPs.
- Reviewed scientific knowledge on the toxicity of U by literature surveys.
- Consensus is that chemical toxicity of inhaled and ingested soluble U is greater than its radiotoxicity, up to enrichments of 80%. Chemical toxicity in the kidney is the health hazard of concern.
- U poisoning leads to renal tubular damage. This may lead to acute renal insufficiency and death after high exposures.
- Because of the excess functional capacity of the kidneys, adverse effects on renal function can occur long before nephrotoxicity is evident.
- The toxicity threshold of 3 ug U per g kidney tissue was first proposed in 1953 on the basis of animal studies, and the same level was reaffirmed in another study 1973. An NRC-sponsored study in 1987 found evidence of injury in rats at between 0.7 and 1.4 ug per g kidney weight, and more severe damage at up to 5.6 ug U per g of kidney tissue. Minor damage was repaired within a month.
- Studies at PPNL on workers accidentally exposed to U showed no long-term damage at concentrations that may have reached 2.5 ug U per g of kidney tissue. However, there were indications, such as increased urinary proteins, in the higher exposed workers. This work supports the 3 ug U per g kidney.
- Conclusion: There does not appear to be any new toxicological information that warrants a change in the 3 ug estimate for the threshold for renal damage.
- The ACGIH bases its threshold limit values on a threshold of 3 ug U per g of kidney.
- The occupational limits in most European countries are the same as ACGIH TLV value, with some slightly higher and some much lower.
- Indications are that providing adequate protection to a pregnant woman also provides adequate protection for the embryo/fetus.
- Although children are expected to show greater sensitivity to U toxicity than adults, they inhale less air per unit time, leading to much smaller intakes of U at a given concentration than for adults, and so offsetting the effects of higher sensitivity.
- Animal studies have shown indications of damage at 3 ug U per g of kidney, and the degree of damage increased with concentration above 3 ug. Studies also indicated that the threshold for severe renal damage in humans is higher than

that for dogs but lower than that for rats (10, 70, and 100 ug/kg body weight for dogs, humans, and rats, respectively). For humans, this threshold corresponds to 16.3 ug/g kidney weight.

- The concentration of U in the kidneys is related to inhalation of U by means of lung/GI/biokinetic models. Using the most recent ICRP models, the correspondence is:

3 ug per g kidney (damage threshold) ----- 34 mg U inhalation

16 ug per g kidney (severe damage threshold) ----- 180 mg U inhalation

- Acute intakes may be considered to be intakes that span a period from instantaneous to as much as 5 days. The total intake, whether instantaneous or spread out over the duration, will result in roughly the same peak U concentration in the kidneys.