# Assessing Risk from Low Energy Radionuclide Aerosol Dispersal

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**Abstract**

When considering the potential dispersal of radionuclides into the environment, there are two broad classifications: explosive and non-explosive dispersal. An explosive dispersal relies on a violent and sudden release of energy, which may disrupt or vapourise any source containment. As such, the explosion provides the energy to both convert the source into a dispersable physical form and provides initial kinetic energy to transport the source away from the initiation point. This would be the case for sources of radiation in proximity to a steam or chemical explosion of high energy density. A low energy dispersal, on the other hand, may involve a lower energy initiator event (such as a fire or water spray) that transports particles into the near release zone, to be spread via wind or mechanical fields. For this type of dispersion to take place, the source must be in physical form ready for dispersal. In broad terms, this suggests either an *ab initio* powder form, or soluble/insoluble particulate form in a liquid matrix. This may be the case for radioactive material released from pressurized piping systems, material released through ventilation systems, or deliberate dispersals.

To study aerosol dispersion of radionuclides and risk from low energy density initiators, there are a number of important parameters to consider. For example, particle size distribution, physicochemical form, atmospheric effects, charge effects, coagulation and agglomeration. At the University of Ontario Institute of Technology (UOIT) a unique small scale aerosol test chamber has been developed to study the low energy dispersal properties of a number of radioactive source simulants. Principle emphasis has been given to salts (CsCl and $CoCl_2$) and oxides ($SrTiO_3$, $CeO_2$ and $EuO_2$). A planetary ball mill has been utilized to reduce particle size distributions when required. Particle sizing has been performed using Malvern Spraytec spray particle analyzers, cascade impactors, and hand-held particle counters. Variations in size distribution as a function of spray energy, temperature, atmospheric pressure and charge have been quantified. Both powder and liquid sprays have been considered. Experimental investigations with live agents have also been conducted at Defence R&D Canada and WIS (Germany). In addition to the experimental program, computational fluid dynamics (CFD) modelling has been conducted to support and expand upon the findings.

Results of the particle characterization are presented, along with health physics risk assessments based upon measured parameters and simulations. Current study areas, such as effects of surface roughness on particle lift-off, urban surfaces and consideration of resuspension will be discussed.

***KEYWORDS: Aerosol, Radionuclide, Dispersal, Contamination, Resuspension, Internal dose, Risk***

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