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WIPP ALPHA CAM FAST ALARM SETPOINTS

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ABSTRACT

The Waste Isolation Pilot Plant (WIPP) is a U.S. Department of Energy (DOE) facility planned and built to demonstrate the safe long term storage of plutonium contaminated waste resulting from the nuclear weapons production activities of the United States. While these wastes are all packaged within sealed containers prior to shipment to the WIPP, the danger to human health from plutonium has necessitated extensive safety measures. State-of-the-art monitoring instrumentation has been installed at the WIPP to provide rapid warning of accident situations. The WIPP uses alpha particle CAMs to provide an alarm if significant concentrations of airborne transuranics are present.

The alpha CAM, or Continuous Air Monitor, is an instrument designed to accumulate airborne particles and then continuously measure that accumulated sample for alpha particle emission characteristic of plutonium. The WIPP has two applications for alpha CAMs. One set of alpha CAMs is used for work place monitoring and uses a nominal alarm setpoint of 12 counts per minute. This 12 cpm setpoint has been determined to cause an alarm when the CAM air sampling system has collected the equivalent of 8 DAC (Derived Air Concentrations) of alpha emitting transuranic isotopes. DOE Order 5480.11 states that CAMs should have a detection capability of 8 DAC-hr. The second set of WIPP alpha CAMs is used to monitor the WIPP effluent and uses a nominal setpoint of 40 cpm that has been calculated to ensure that the off-site maximum individual at risk from a WIPP release will not receive a dose greater than 10 mR/yr. Many CAM years of operational experience at the WIPP has established that the 12 cpm setpoints are operationally reliable and result in almost no false alarms.

The WIPP has worked closely with CAM designers and manufacturers to help make available a new generation of alpha CAMs that meet or exceed the requirements set forth in various orders, standards, and guidance documents. The reliability and low false alarm performance of radiation monitoring equipment is just as important as the sensitivity, since the alarm must be believed to be effective. The WIPP workplace CAMs, for instance, reliably provide an alarm to an 8 hour 1-DAC airborne release of transuranic elements. This sensitivity in the presence of varying natural airborne activity, i.e., radon progeny, has introduced some limitations. Statistical variations in the background and target material count rates will produce excessive reporting of high or low variations. We have determined that an algorithm using data from 6 consecutive one minute time intervals to determine an alarm condition accomplishes our goal of high CAM sensitivity with less than one alarm per year resulting from counting statistics.

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This paper documents the logic and approach used to determine a fast alarm setpoint for the airborne alpha radiation CAMs in service at the WIPP. The WIPP alpha CAMs (Eberline Corp. model Alpha-6A) have provisions for two high radiation alarms. These two alarms have been used as a single alarm level by setting them both at the same setpoints.

The WIPP is designed with a "safety in depth" approach to the storage of transuranic wastes. WIPP operational procedures should eliminate any chance of a release, but detailed safety analysis work indicates that if a significant release were ever to occur it would probably be from an accident situation that would produce most of the release in a short duration "puff." While the probability of such a release is small, the fact that it is more probable than other release scenarios has caused us to review the CAM alarm setpoint logic to provide a more timely alarm for a puff release, while not sacrificing the sensitivity already achieved.

The approach presented makes use of the two alarm setpoint feature of the alpha CAM, continues the present use of the one alarm which has been optimized for high sensitivity with low false alarms, and uses the second alarm to provide a fast(er) response to a puff release. The assumption made is that a significant puff release would produce enough airborne alpha emitting material that low counts would not be a (statistical) problem. We can thus develop an alarm setpoint requiring a time short compared with six minutes without excessive false alarms and thereby provide a faster response to an emergency.

An analysis of WIPP alpha CAM minute by minute data indicates that statistical fluctuations seldom produce 60 cpm output readings from workplace CAMs and two consecutive false 60 cpm output readings has never been observed. The WIPP alpha CAM installations are carefully grounded and shielded to prevent external noise from being sensed as alpha particle counts. The presently configured WIPP alpha CAMS have never been observed to report high counts due to noise in two consecutive counting periods. This analysis thus indicates that a fast alarm setpoint of 60 cpm Pu/TRU with a 2-of-2 logic set for one minute counting periods should provide improved CAM alarm performance by reducing the time to alarm from six minutes to two minutes in the case of a significant puff release. A similar analysis for the effluent monitoring CAMs recommends a fast alarm setpoint of 600 cpm with a similar 2-of-2 logic using one minute sampling periods. These fast alarm setpoints ensure a CAM alarm in two minutes when a puff release occurs that is approximately two percent of the allowable yearly dose to the radiation worker or to the off-site maximum individual at risk.

The improved time response of the WIPP alpha CAMs was made possible by the fact that the alpha CAMs have provisions for two alarm settings. The second alarm setting is now defined as a fast alarm, and while it cannot provide the highest sensitivity to airborne transuranics, it does provide the capability to more rapidly respond to a major release. These two CAM alarm setpoints coupled with the WIPP operational procedures and Fixed Air Sampler retrospective air monitoring, yields a radiological monitoring capability that fully complies with the requirements of the DOE Orders and ALARA goals.

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