USE OF A CONTINUOUS AIR MONITORING SYSTEM AT AWE

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ABSTRACT

A new production facility at AWE began active commissioning in 1994 and is now fully operational. Radiation exposure is minimised using engineered controls, monitoring and management systems. The system used to monitor the working environment air consists of a combination of continous air monitors (CAMs) and static air samplers(SASs) linked to a surveillance system.

Operational experience has established that the ambient levels in the facility are < 0.1 DACh. A small number of incidents involving the release of plutonium activity into laboratories during certain operations have provided information as to the effectiveness of the air monitoring system. The results indicate that the air monitoring system is able to detect, and alert personnel to, elevated levels of airborne activity. There is a good correlation between the activity concentrations reported locally in "real time" results and those obtained later by independent sample counting techniques. It's use in conjunction with other established controls demonstrates that the exposure of personnel to airborne activity is adequately monitored and controlled.

INTRODUCTION

A new facility at Aldermaston designed to provide a fully integrated capability for the storage, processing, manufacture, research into and recovery of plutonium components commenced production activities in September 1995 and is now fully operational. The principal fissile material handled in the facility is plutonium and engineering controls, monitoring systems and procedures are in place to provide a safe and controlled environment for the workforce; ensuring that doses received are ALARP and that any abnormal exposure of personnel will be detected and minimised. A system essential to achieve this is the active monitoring of the workplace environment for airborne alpha contamination. This system provides information for the assessment of occupational exposure, and is designed to alert personnel to elevated activity levels. Operational experience concerning the effectiveness of this system to achieve the latter criterion will be reported below.

AIR MONITORING SYSTEM

The workplace air is monitored using a combination of continuous air monitors (CAMs), which indicate the level of alpha contamination at any point in time, and static air samplers (SASs) which provide a cumulative total radioactive contamination over the sampling period for trend analysis. Currently the system consists of 450 CAMs and 80 SASs. Each sampler operates as a stand alone unit, the CAMs having an associated alarm unit, and are connected via a serial data link to a surveillance system (CAMSS). The CAMSS collects data transmitted from each CAM connected on the system via a local data collection unit at one second intervals and provides storage, access, display and hardcopy of this data.

In order to minimise personnel exposure and the magnitude of a potential inhalation, the CAMs have an alarm sensitivity of 4 DACh, which corresponds to an alarm within 9 minutes of a release for a CAM detecting 1 cpm (2 cpm within 18 minutes) over a 30 minute period, for Class W material. The alarm level was chosen to balance the requirement for an early indication of a plutonium release and the associated very low setting, against the need to avoid false alarms due to interference from naturally occurring radon. The CAM continuously analyses for radon background and compensates for it; it will automatically adjust its alert level upwards from the minimum dependent upon the radon background such that the alert level is always just above the radon background value. This ensures that the CAM is measuring to the lowest level at any time. The sensitivity is also dependent on other parameters such as the particle release mechanism/dynamics and air flow patterns.

OPERATIONAL EXPERIENCE

Since the facility has been actively commissioned, the measured air activity levels have established that the ambient levels are < 0.1 DACh. The false alarm rate is minimal and is almost always associated with elevated radon levels due to ventilation shutdowns. There have been only 4 occasions where the CAMs have alarmed to alert personnel to abnormal plutonium in air activity, 3 were associated with a new bagging out/canning operation, and the other a glove change. On all occasions personnel were wearing respiratory protection, the area was restricted to other personnel and no abnormal exposure occurred.

i) Bagging Out/Canning Operation

Table 1 shows the results of air activity levels from just the affected laboratory reported in real time results by CAMs (and the CAMSS), and by independent sample counting, as a result of a bagging out/canning operation.

The time taken for CAM number 1, located 1m from the point of release, to alarm to alert personnel to a potential airborne release and the next CAM 4m away to alarm was approximately 10 minutes. Interrogation of the CAMSS remote from the affected area showed that the levels detected by the CAMs stabilised at around 15 minutes following the initial alarm i.e. no activity additional to that present on the filter card from the initial release was being detected. No surface contamination was detected during this operation. Autoradiograph analysis of the filter papers showed that the average particle size was of the order 1 μm AMAD.

Table 1. CAM results from Bagging Out/ Canning Operation

CAM No.	CAMSS (DACh) (measurements 20 mins after release)	Proportional counting (DACh)
1	17.40	22.2
2	11.74	17.88
3	9.30	12.81
4	8.18	17.59
5	7.50	11.71
6	6.20	9.68
7	5.40	8.87
8	4.70	9.60
9	4.62	7.37
10	4.40	5.84
11	3.48	5.95

ii) Glove Change Incident

Table 2 shows the results of air activity levels from just the affected laboratory reported in real time results by CAMs (and the CAMSS), and those by independent sample counting, as a result a glove change incident. This operation was undertaken following a gloveport rim decontamination task during which a release of approximately 1 MBq plutonium activity occurred, none of which became airborne i.e. no activity above background was detected by the CAMs.

Table 2. CAM results from Glove Change Operation

CAM No.	CAMSS (DACh) (measurements 20 mins after release)	Proportional counting (DACh)
1	37.65	54.0
2	10.21	11.7
3	8.02	10.4
4	7.08	7.4
5	4.65	3.6
6	2.33	4.8
7	1.53	2.0
8	1.05	0.7
9	0.85	1.5
10	0.84	1.0
11	0.28	0.1
12	0.17	0.4
13	0.02	0.1

The time taken for CAM number 1, located 1m from the point of release, to alarm to alert personnel to a potential airborne release and the next CAM 4m away to alarm was approximately 15 minutes. The levels detected by the CAMs stabilised at around 30 minutes following the initial alarm. Surface contamination was detected during the glove change, mainly around the gloveport and the floor area where personnel were located. Autoradiograph analysis of the filter papers showed that the average particle size was of the order 5 µm AMAD.

DISCUSSION

There is a good correlation between the airborne activity concentrations reported locally in "real time" results and those from independent sample counting. This suggests that the magnitude of an airborne release indicated by CAM measurements is sufficiently accurate to determine the hazard to personnel at the time of a release, and hence determine exposure. In the above instances, this information was then used to assess the radiological conditions with regard to a controlled re-entry to the affected area.

The material released from the bagging out operation was a fine, respirable, oxide aerosol which quickly dispersed uniformly throughout the laboratory area and no surface contamination was detected.However the airborne contamination detected from the glove change operation was probably associated with the decontamination of the gloveport and removal of a black residue, visible on the inner gloveport rim surface prior to the decontamination procedure. The CAMs in this instance exhibited a more localised response, detecting larger, heavier particles which were non-uniformly dispersed throughout the laboratory area, mainly within $4m^2$ of the release. Particles were detected as residual surface contamination, especially on the top surface of glove boxes, as a result of heavy particles "settling out".

CONCLUSIONS

The results indicate that the air monitoring system is able to detect, and alert personnel to elevated levels of airborne activity. The results of the events reported above demonstrate that the sensitivity of a CAM **is** highly dependent on the particle release mechanism/dynamics. It's use in conjunction with other established controls demonstrates that the exposure of personnel to airborne activity is adequately monitored and controlled.

REFERENCES

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