REDUCTION OF EXPOSURES ARISING DURING THE MANUFACTURE AND DISTRIBUTION OF RADIOACTIVE PRODUCTS FOR HEALTHCARE, RESEARCH AND INDUSTRY

R W Davies

Amersham International plc
Amersham Place, Little Chalfont
Buckinghamshire, HP7 9NA
England.

ABSTRACT

Radiation dose uptake for workers in a company producing radioactive materials for use in medicine, research and industry is reviewed. The measures that were introduced to optimise protection are detailed and shown to lead to a 90% reduction in the numbers of workers receiving in excess of 15 mSv in the past four years.

INTRODUCTION

Amersham International specialises in the development, manufacture and distribution of radioactive products for use in healthcare, life sciences research, environmental safety and industrial quality assurance. The production and distribution of the radioactive materials give rise to a number of challenges in radiological protection. These include operation and maintenance of cyclotrons for the production of short lived diagnostic products (containing for example Tl-201, Ga-67, In-111) for nuclear medicine; the design and operation of shielded plant for high energy gamma emitting nuclides used in cancer therapy (eg. Co-60, Cs-137); the preparation for transport of more than ½ million radioactive packages annually.

SAFETY POLICY

The company has had a continuing policy of working to reduce radiation exposure to staff and has set company whole body dose limits below those required by legislation as a means of promoting dose reduction. The success of this policy is evidenced by Figure 1. which shows the progressive reduction in the percentage of the UK workforce receiving doses in excess of 15 mSv over the past 15 years to 0.3% in 1990.

Amersham's focus on safety and dose reduction obtained further impetus with the Ionising Radiation Regulations 1985 (IRR) in the UK, and the introduction of formally recorded reviews of working practices and processes for staff who exceeded 15 mSv.

ANALYSIS OF DOSE REDUCTION

Figure 2 shows the collective dose (man-mSv) and number of staff over the period immediately before and after the introduction of the IRRs. Figure 3 shows the numbers of staff receiving more than 15 mSv over the same period. It is evident that the reduction in numbers of staff exceeding 15 mSv was a result of genuine dose reduction since it was accompanied by a reduction in the collective dose. Figure 4 gives a breakdown of the numbers of staff exceeding 15 mSv since 1986 by work activity.

RADIATION SOURCE PRODUCTION

The main reduction achieved in radiation source production areas followed reviews of working practices which developed increased operator awareness. Line management commitment to dose control encouraged the workers to improve techniques; reduce waste arisings, decrease occupancy times and improve general housekeeping. On older plant, use was made of improved local shielding at critical stages of the processes while new plant was designed and built. The majority of the staff receiving greater than 15 mSv in 1990 were working on old plant which is scheduled for replacement in the next 2 years.

CYCLOTRON OPERATIONS

The very nature of cyclotron operations presents unique radiological problems. Cyclotron produced isotopes typically have half lives of the order of 3 days and thus must be produced several days a week, every week to meet the needs of hospitals. Staff outside the heavily shielded machine vaults only receive background levels of radiation. Maintenance of the machine and any other in-vault work, however, give rise to the potential for high doses from highly activated components.

Machine reliability will always have an overriding effect on operator doses so at Amersham, machine components requiring regular, frequent changing, have been designed to facilitate quicker, simpler maintenance. Component failures have been analyzed to attempt to eliminate them. Changes to machine operating schedules, whilst remaining aligned with customer requirements, have maximised the decay of the shorter lived activation of the vault and the machine components. The combined effect of the actions has been to keep all cyclotron staff doses below 15 mSv in 1990.

TRANSPORT

Introduction of new plant to handle and package certain products (eg Technetium generators), along with major refurbishment of the despatch warehouse area has resulted in significant reductions in operator doses. The material flow pattern through the warehouse has been improved and items requiring manipulation or further work in the warehouse are stored in shielded interim storage facilities. The build up of packages on conveyor lines is prevented to reduce ambient dose rates and the conveyor lines themselves are run, where possible, at high level to increase distance between packages and staff. Increased staff awareness coupled with use of gamma integrating dosemeters has had a positive effect on dose reduction.

The numbers of staff exceeding 15 mSv in other work areas also decreased as a result of similar actions to those outlined above.

CONCLUSIONS

Line management commitment with Health Physics support led to a heightened awareness of dose control measures which encouraged individuals to review and improve their own work method.
Investment in personal dosemeters, plant modification and new facilities provided the necessary resource to support the dose reduction initiatives.

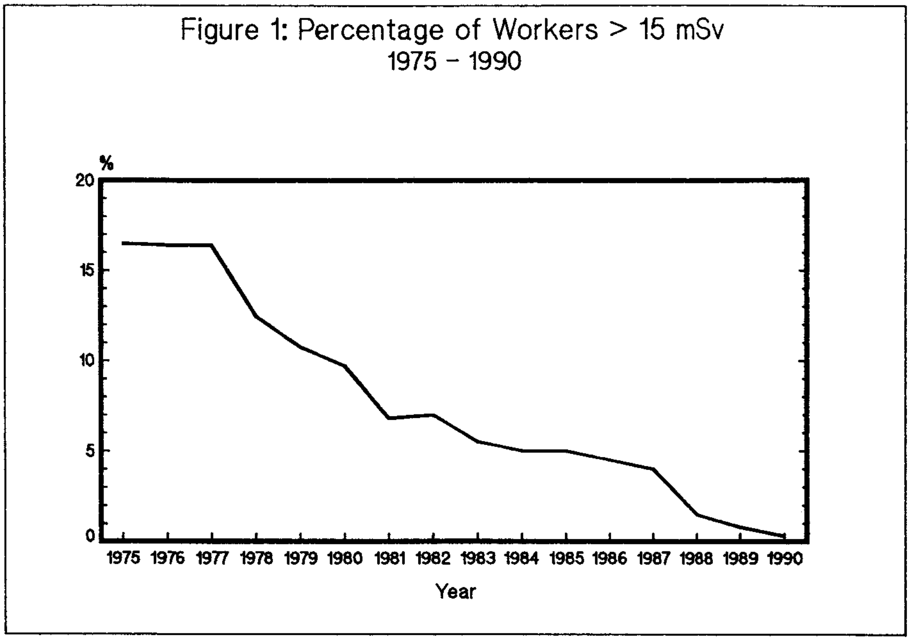
Figure 1: Percentage of Workers > 15 mSv
1975 - 1990
%
20
15
10
5
0
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

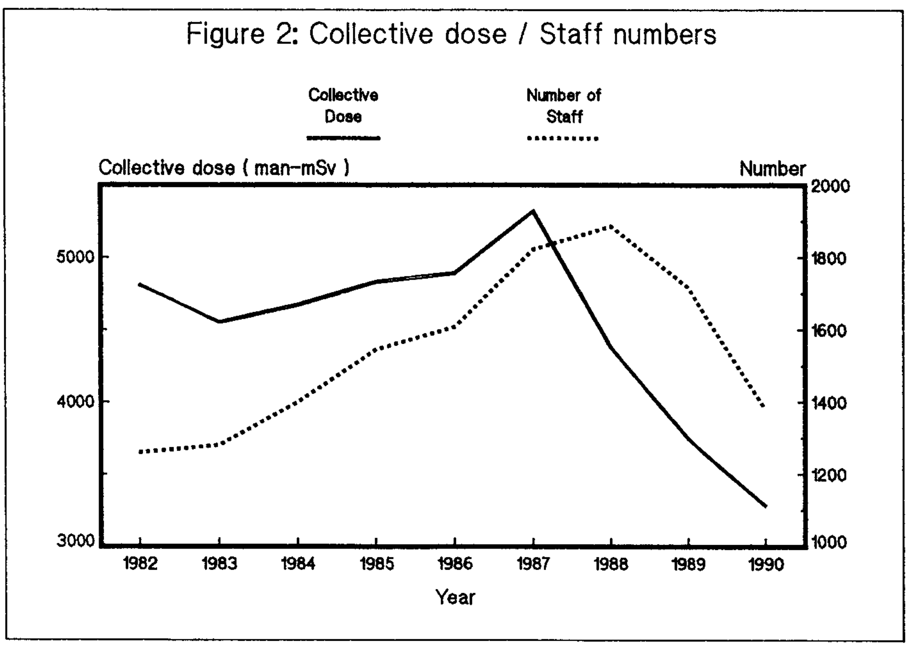
Figure 2: Collective dose / Staff numbers
Collective Dose
Number of Staff
Collective dose (man-mSv)
Number
5000
4000
3000
2000
1800
1600
1400
1200
1000
1982 1983 1984 1985 1986 1987 1988 1989 1990
Year

Figure 3: Numbers of staff > 15 mSv

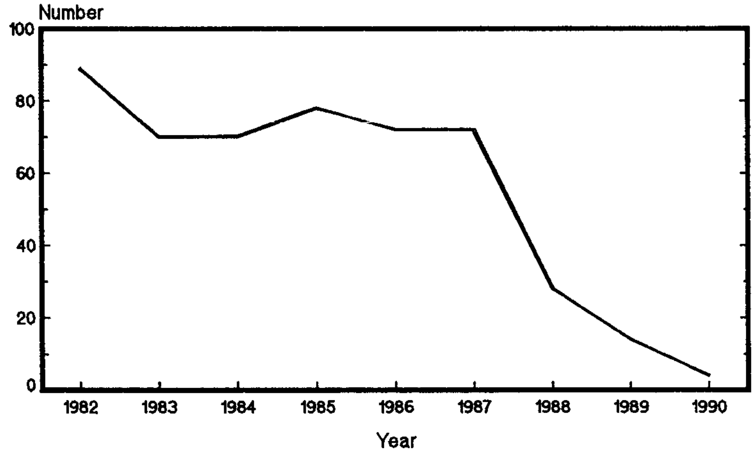

Figure 4: Work activity of staff > 15 mSv