A COMPARISON BETWEEN WORKER DEATHS IN MODERN INDUSTRIES AND IN NUCLEAR ACTIVITIES

L. Failla
Chairman of SC/4 "Radioactive Sources" - UNICEN
c/o CNEN - 125 Viale Regina Margherita - 00198 Rome, Italy

1. INTRODUCTION

Technological progress produces a certain number of human victims through accidents or diseases. The consequences may be fatal, or conditions of illness or disability (temporary or permanent), involving both the present and the future generations. The casualties may be directly connected with production, or linked indirectly to the progress. They may be due substantially to: (1) fortuitous and wholly unforeseeable, and therefore calculable only a posteriori through statistical processes, (2) foreseeable and therefore "preventable" by suitable technical measures and prevention rules, (3) unforeseeable and not previously known, but which become known on occurrence and therefore raise new sets of problems, and (4) foreseeable, calculable and accepted a priori.

With respect to known risks, man can take different attitudes: (a) studying and applying the technical measures required to reduce or eliminate them, regardless of the cost involved, (b) discontiuing the activity or production if the cost exceeds the benefit or if no measures to control them can be found, (c) continuing production while at the same time continuing to seek the necessary measures, and (d) evaluating and accepting the risk up to a certain relation with cost.

This paper is concerned only with fatalities directly connected with production, in both the conventional and nuclear fields. Even with this limitation, however, it is very hard to obtain international statistical data, which we can compare with a fair degree of approximation, because of the great number of variables involved.

After decades of work, the ILO, in the field of conventional industry, has succeeded in furnishing comparable data, but limited to industrial accidents (1). No solution has yet been found, however, for the statistical problem of occupational diseases and of the comparability of the consequences (deaths, permanent and temporary disability) (2) (3).

In the field of nuclear energy, instead, it has proved possible, even though there are still differing opinions, to evaluate with a fair degree of approximation the risk of fatal cancer to the workers in relation to the absorbed doses of ionizing radiations. Based on these evaluations the values of the maximum permissible doses have been set, accepting a risk after having evaluated it. This is, in substance, the case envisaged in point (d) above.

The present difficulty or even impossibility of making a scientifically sound comparison between risks in nuclear industry and in other sectors of production therefore appears evident, even if fatalities alone are considered. It should also be borne in mind that, while in conventional industries the numerical data are recorded among occurred facts (a posteriori), in nuclear industry foreseeable risks are calculated (a priori). It is possible, however, to make certain considerations on the basis of the data available in the literature.

2. CONVENTIONAL INDUSTRY

In the area of conventional industry, it has been possible to work out an Italian figure for the period 1965-71 (4). It is an average value of 0.11% deaths due to occupational diseases per year.

As regards deaths due to accidents, developing the ILO data (1) we obtain, on a world-wide level, in the decade 1965-74, the following average percentage annual values for the various industries: mining 0.11, manufacturing 0.019, construction 0.067, railroads 0.045.Average among the various industries:0.06%.

Extrapolating the above mentioned Italian figure on a world--wide level, we find an annual average of fatal events (by accidents and diseases) of 0.071%.

3. NUCLEAR INDUSTRY

From a recent report by E.E. Pochin of AEN-OECD (1976) (5) and from other sources we can extrapolate, based on the main sources and assuming "linearity", the different values of the risk of the number of fatal cancer cases resulting from the maximum permissible dose (5 rem/yr) per 100 workers and per year: 0.02 (excluding thyroid cancers) (ICRP 8, 1965); 0.06 - 0.07 (UNSCEAR Report, 1972); 0.05 - 0.16 (BEIR Report, 1972); 0.05 - 0.1 (5), (6), i.e. within the range of 0.02% minimum to 0.16% maximum. For the total of 40 working years the values range from 0.8% to 6.4%.

As regards the doses received by workers as a result of nuclear accidents, as no significant statistics are yet available, efforts have been made to obtain some information by an indirect process. In the first place, it should be borne in mind that even in serious nuclear accidents a nuclear risk is not necessarily present. A parameter must then be established to detect the presence of this risk: it could be established by exceeding of the maximum permissible dose (5 rem/yr) (8).

From a NRC Report (7) and a recent paper by Baker (8) it appears that, on a total of 85,097 "monitored" workers, employed in the nuclear sector in the U.S. in 1974, 51,806 received unmeasurable doses and 13,760 got doses of less than 0.10 rem and that as few as 262 got more than 5 rem. These cases of overdose involve a total of 1,808 rem, with a death risk ranging, according to the various sources, from $0.08 \cdot 10^{-3}\%$ and $0.68 \cdot 10^{-3}\%$.

4. CONCLUSIONS

By way of information only, and therefore with all of the appropriate reservations, extrapolating Italian data concerning deaths by occupational diseases in the conventional industry and U.S. data on doses to the workers in the nuclear industry to the world situation, the following can be deduced:

Worker deaths in conventional industry, per year:

$$R = \frac{\text{accident deaths per year}}{\text{deaths per year from occupational diseases}} = 0.5$$

Risk of death to workers in nuclear industry, per year:

$$R = \frac{\text{risk of accident death}}{\text{risk of death from occupational diseases}} = 4 \cdot 10^{-3}$$

The basic difference in trends is obviously due to the fact that in the nuclear field the higher risk is contained in the range of doses regarded as acceptable, given the number of workers who may theoretically be exposed to hem. According to Baker (8) and many others, instead, the doses actually received by workers are much lower than those permissible and therefore these values can definitely be lowered, similarly to what has already been done in West Germany (9) and proposed in the U.S. (10).

For the methods of the evaluations, for the completion of conclusions and for complete references of this paper, those interested may wish to read its full text.

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