UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

July 9, 2002

NRC REGULATORY ISSUE SUMMARY 2002-10
REVISION OF THE SKIN DOSE LIMIT IN 10 CFR PART 20

ADDRESSEES

All U.S. Nuclear Regulatory Commission (NRC) materials licensees.

INTENT

The NRC is issuing this Regulatory Issue Summary (RIS) to inform its licensees of changes in the regulatory dose limit for the skin in 10 CFR Part 20, effective as of June 4, 2002. No specific action nor written response is required.

BACKGROUND

The dose to the skin, referred to in 10 CFR Part 20 as the shallow dose equivalent H_s, was formerly defined as the dose equivalent at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of 1 cm^2 (10 CFR 20.1003). Such a dose may result from exposure to an external radiation field or from contamination on the skin or on protective clothing. The limit specified in Part 20 for H_s is 50 rem (0.5 Sv) [§20.1201(a)(2)(ii)]. In addition to the 50 rem (0.5 Sv) limit, Part 20 also required that the assigned dose equivalent must be for the part of the body receiving the highest exposure [10 CFR 20.1201(c)].

In enforcing this requirement, a distinction was made between exposure of the skin resulting from hot particles and exposures resulting from other sources of radiation. Hot particles are very small, barely visible, particles of radioactive material that are often electrically charged, and tend to cling to the skin or to protective clothing. Some of these particles have a high specific activity, and are capable of delivering shallow dose at a rate that could cause the shallow dose equivalent limit to be exceeded within a few hours or sometimes in less time. Hot particles have been found at both nuclear reactor facilities and at nuclear materials facilities.

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NRC funded research that showed that the doses resulting from these hot particles posed little risk to the exposed person's health, and that exceeding the skin dose limit of 50 rems (0.5 Sv) did not pose a health hazard, nor was it of a safety significance that is normally associated with exceeding the corresponding limits on whole body or organ doses. To alleviate the regulatory burden resulting from this lack of correspondence between the dose limit and the associated risk, NRC implemented a temporary enforcement discretion policy in 1990. According to this policy, exceeding the shallow dose equivalent limit of 50 rem (0.5 Sv) was still to be considered a violation of a regulatory limit. However, the enforcement actions that would normally be taken when a regulatory limit is exceeded were not implemented until the exposure from the hot particle exceeded 75 µCi-hr, which corresponds to a shallow dose equivalent of about 300 - 500 rem (3 - 5 Sv), the exact value being dependent on the energy of the beta radiation emitted by the hot particle. Exposures from sources other than hot particles were not subject to this enforcement discretion policy. Licensees were still required, under this discretion policy, to report any dose above 50 rem (0.5 Sv) shallow dose equivalent, to the NRC, as an exposure above the regulatory limit.

Because workers who exceeded any NRC regulatory limit are required to stop working in any activity that might result in additional occupation radiation exposure, there have been cases in which radiation workers had to stop their radiation work after a hot particle exposure that resulted in exceeding the 50 rem (0.5 Sv) limit. This meant that these workers had to be re-assigned to non-radiological duties for the remainder of the calendar year, if such re-assignment were possible within the worker's organization. Similar situations occurred in medical settings, where a drop of very high-specific-activity radiopharmaceutical could have the same effect as a high-activity hot particle. Again, interruption of a radiation worker's duties was viewed as being an action that was not commensurate with the risk resulting from the exposure, but the rules were written in such a manner that there was no alternative course of action other than exemption of the licensed activity from the rule.

SUMMARY OF ISSUES

The revision to the shallow dose equivalent limit was accomplished by making two changes to Part 20: (1) The averaging area of 1 cm^2 was removed from the definition of shallow dose equivalent in 10 CFR 20.1003. The shallow dose equivalent is now defined only as the dose equivalent at a depth of 0.007 cm (7 mg/cm^2); (2) the averaging area was increased from 1 cm^2 to 10 cm^2, and was inserted together with the requirement to assign the shallow dose equivalent to the part of the body receiving the highest exposure in 10 CFR 20.1201(c). This section now requires that the assigned shallow dose equivalent be the dose averaged over the contiguous 10-cm^2 area of skin receiving the highest exposure.

The effect of these changes is to gradually increase the shallow dose equivalent limit for the exposed skin area from 50 rem (0.5 Sv) for exposed skin areas larger than 10 cm^2, to higher values as the area of exposed skin decreases below 10 cm^2. For a hot-particle exposure, the revised limit, in effect, permits a dose that under the old rule would be equivalent to 500 rem (0.5 Sv) averaged over an area of 1 cm^2. Under the new rule, this dose would be averaged over the contiguous 10 cm^2 of skin containing the hot particle, yielding a dose of 50 rem (0.5 Sv) averaged over 10 cm^2. This latter quantity is considered to be commensurate with the health risk resulting from such a shallow dose equivalent to small areas of skin.

It should be noted that, because the doses from small hot particles are very localized, and could be quite high in the immediate vicinity of the particle, exposures to a hot particle close to the new limit could result in a small skin lesion. The probability of such an occurrence is small, and the lesion, if it does occur, would be barely perceptible, and would quickly heal, leaving no lasting health effects. Several benefits are gained by radiation workers as a result of this rule change. One is that less time should be spent in attempts to identify hot particles on workers by frequent exits from work areas for contamination surveys. Such a change should reduce whole body exposures and also increase industrial safety by reducing stay times in radiation areas, and by reducing the number of times workers have to traverse various areas of the plant on their way to and from the survey locations. Also, workers will not be required, as often, to stop their radiation work when the 50 rem(0.5 Sv) limit is exceeded because of contamination by hot particles or by high- specific-activity radiopharmaceuticals. These changes represent a net gain in safety and job security for the radiation worker, and the rule is now more risk-informed than had been the case previously.

The Commission believes that the less restrictive limit on dose to small areas of skin might permit more observable, transient, deterministic effects, but nonetheless represents a substantial increase in worker protection because reduced use of protective clothing will result in a less hazardous workplace and less frequent monitoring for hot particle contamination will result in reduced whole-body occupational dose. This represents a shift in emphasis toward a risk-informed approach that would possibly permit more frequent deterministic effects in order to avoid the physical stress and whole-body doses associated with monitoring workers and the use of protective measures.

The revised rule does not change the basic methods used to assess shallow dose equivalent resulting from exposure to external radiation fields, general skin contamination, or hot-particle skin exposures. The same methods of measurement or calculation that have been used in the past are still applicable, with the only change being the use of a skin averaging area of 10 cm^2 instead of 1 cm^2 when assessing shallow dose equivalent. It should be noted, however, that dose averaging must include the dose to all exposed skin within the 10-cm^2 averaging area. For example, assessing dose based on only the highest exposed 1-cm^2 area of skin and then dividing by 10 may seriously underestimate the dose if the skin surrounding this 1-cm^2 area also received a dose. It should also be noted that licensees must still comply with the limit on the total effective dose equivalent (TEDE). In the case of exposure of the skin of the whole body, the relevant component of the TEDE is the deep dose equivalent, which is subject to a limit of 5 rem per year (0.05 Sv/yr). Because of the higher skin dose limit, skin exposures caused by

radiation fields that contain a significant component of penetrating radiation may, in some situations, cause the DDE limit to be exceeded before the skin dose limit is reached.

This RIS requires no specific action nor written response. If you have any questions about the information in this summary, please contact the technical contact listed below or the appropriate regional office.

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