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RECORD #102

TITLE: Meaning of the Expression "Dose Equivalent Xe-133" in the
Technical Specifications

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MEMORANDUM FOR: Daniel M. Montgomery, Chief
Independent Measurements and
Environmental Protection Section, Region I

FROM: Charles A. Willis, Leader
Effluent Treatment Systems Section
Meteorology and Effluent Treatment Branch
Division of Systems Integration, NRR

SUBJECT: MEANING OF THE EXPRESSION "DOSE EQUIVALENT Xe-133" IN
THE TECHNICAL SPECIFICATIONS

This is in response to your recent request for clarification.

Generally the technical specification limit of the content of a waste gas decay tank is expressed in terms of "dose equivalent Xe-133". This means equivalent in ability to deliver gamma dose rate. For these purposes, either .018 Ci Kr-89 or 18 Ci Kr-85 is equivalent to one Ci of Xe-133. This is discussed further in the enclosure.

Charles A. Willis

Charles A. Willis, Leader
Effluent Treatment Systems Section
Meteorology & Effluent Treatment Branch
Division of Systems Integration
Office of Nuclear Reactor Regulation

Enclosure:
Table 1

cc: D. Muller
F. Congel
J. Partlow
R. Bellamy (Region I)
C. Paperiello (Region III)
B. Murray (Region IV)
F. Wenslawski (Region V)
R. Perch

DOSE EQUIVALENT XENON-133

Historically, the activity inventory limits for waste gas storage tanks have been expressed in curies (Ci) of dose equivalent Xe-133; specifically: "curies noble gas (considered as Xe-133)". In the RETS implementation program it was suggested that this be clarified by adding a definition to the RETS. This suggestion was rejected on the grounds that the intent was manifest from the "bases" statement. The "bases" statement says that this limit is to ensure the release of a tank's contents will not cause a whole body dose to any individual at the exclusion area boundary of more than 0.5 rem. Recently, questions have indicated that further clarification may be needed. This paper is intended to provide that clarification.

The intent of the LCO is to ensure that the inadvertent release of the content of a waste gas storage tank does not cause a dose of over 0.5 rems off site. The LCO whole body was given in terms of Xe-133 equivalent curies to facilitate implementation. That is, the licensee need never determine the actual radioactivity content of a tank; instead he may simply determine the gamma dose rate and convert to equivalent curies of Xe-133 based on a calibration with Xe-133.

This approach seems more accurate than the alternative. The alternative is to determine the quantity present of each nuclide and calculate the potential dose using the various dose conversion factors.

The problem is more difficult if the detector responds to beta radiation. The beta dose rate is not the quantity of interest and so cannot be used directly. It is necessary to determine the nuclide composition of the gas and relate this to the total activity. The quantities of the various nuclides can be converted to Ci Xe-133 equivalent using the dose conversion factors (DFB₁) of Reg. Guide 1.109; the values for gamma radiation of DOE/TIC-11026; the gamma energy values of the "Table of isotopes" (7th Ed.); or other convenient reference.* Where this approach is used the dose equivalent Xe-133 concept offers no practical advantages; it is simply another way of saying "potential for delivering gamma dose".

If the inventory is determined by sampling and isotopic measurement by gamma spectrometry, the problem is much the same as with beta measurements; the weighting by dose conversion factors is needed.

*The slight difference in results obtained with the different references is unimportant.