Distribution of Lake-Bottom Radionuclides Measured with an Underwater HPGe Detector (U)

by

W. G. Winn
Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808
D. L. Dunn
P. J. Bresnahan


DOE Contract No. DE-AC09-89SR18035

This paper was prepared in connection with work done under the above contract number with the U. S. Department of Energy. By acceptance of this paper, the publisher and/or recipient acknowledges the U. S. Government's right to retain a nonexclusive, royalty-free license in and to any copyright covering this paper, along with the right to reproduce and to authorize others to reproduce all or part of the copyrighted paper.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401.

Available to the public from the National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
Distribution of Lake-Bottom Radionuclides Measured with an Underwater HPGe Detector

W.G. Winn, D.L. Dunn, P.J. Bresnahan

Westinghouse Savannah River Company
Savannah River Technology Center
Aiken, SC 29808

INTRODUCTION

This study at the Savannah River Site\(^1\) was conducted to assist decisions concerning the future alternatives of L Lake, an artificial reservoir developed in 1983-1985 to provide additional cooling for L Reactor discharges. EG&G overflight NaI mappings of the lake area prior to filling in 1985 indicated that the bulk of the man-made radionuclides were concentrated in the earlier stream beds that would lie beneath the lake,\(^2\) consistent with earlier historical releases. Only \(^{60}\)Co and \(^{137}\)Cs were observed, where \(^{137}\)Cs was dominant. Giving the existence of these activities, it was deemed necessary in 1995 to re-establish their distributions prior to any future remediation decisions that would involve draining the lake.

Prior SRS experience in mapping radiation levels of pond bottoms\(^3\) was used to check the radiation distribution on the bottom of L Lake. Subsequently, measurements with an underwater HPGe were then utilized to rapidly scope the present (1995) radiation levels of the man-made radionuclides.
EQUIPMENT

The overall equipment has been described in detail elsewhere. Briefly, the operations platform was a pontoon boat from which the underwater detector (standard 30%-efficient HPGe) was lowered to the lake bottom. All electronic equipment was battery operated, although backed up with a 5 KVA gasoline generator. The detector electronics and multichannel analyzer were comprised of a EG&G NOMAD™ and a COMPAQ Lite/253 notebook computer. Measurement location coordinates were determined with a Motorola TRACKER™ GPS unit.

MEASUREMENTS

Underwater HPGe measurements were conducted at 96 locations given in Figure 1, which cluster in transects 1-7 for mapping the lake in general and transects 8-12 for examining specific areas where excavation work may have relocated some of the radionuclides. The dominant $^{137}$Cs contours in the figure are given in count/min, which upon multiplication by 3 μSv/cpm (0.3 mrem/cpm) convert to the annual dose that would be at the surface of the drained lake, as demonstrated earlier. Accordingly, the maximum measured $^{137}$Cs of 380 cpm corresponded to 1100 μSv/yr.

Using the underwater detector measurements as a guide, 20 sediment grab samples were retrieved and counted on 90%- and 166%-efficient HPGe detectors in the SRS underground counting facility, indicating that the only other significant man-made radionuclide was $^{60}$Co, which was distributed similarly as the
$^{137}$Cs but had intensity about two orders of magnitude weaker. The grab sample concentration maxima were 24 Bq/kg $^{60}$Co and 1270 Bq/kg $^{137}$Cs, corresponding to a sample retrieved from the creek bed. The minimum concentrations were more than two orders of magnitude lower for samples outside the stream bed. The grab samples are representative of the top few cm of the bottom sediment.

DISCUSSION

The present results are in reasonable agreement with the earlier EG&G overflight NaI mappings of the prefilled lake in 1985, showing little if any evidence for redistribution of the radionuclides, which are primarily concentrated within the underlying bed of Steel Creek, from which the artificial lake was formed. All discrepancies between the measurements are consistent with differences in the measurement techniques. For example, the overflight contours were somewhat broader than those of the underwater detector, due to spatial resolution differences for the two measurements. Also, the underwater detector revealed activity in the creek bed near the dam, which was shielded by water during the earlier overflight measurements.

The results are being used to guide decisions concerning the future of L Lake. In particular there is interest in draining the lake to eliminate the pumping/maintenance costs and also to reclaim the land for other uses. Accordingly, there are plans for extending these initial scoping measurements to provide better
detail for final contour mappings and their computer-based analyses. Also segmented bottom corings will be sought, so that the surface radiation levels may be supplemented with information about the radioisotope distributions beneath the surface. Such information is important with regard to legal restraints on how the land may be used.

REFERENCES


Figure 1. L Lake $^{137}$Cs Contours Counted with Underwater HPGe Detector