



SOFTWARE ERROR NOTIFICATION

Use continuation pages as necessary

ERROR IDENTIFICATION

Error Notice Identification Number: 19 Page 1 of 2

Software Name: RADTRAD

Version(s) Affected: 3.03 and Serco-RADTRAD 3.10 Rev 0-4

Associated CAR Number(s): CAR 2025-01

DESCRIPTION OF PROGRAM ERROR

RADTRAD source code contains a typo in the FORTRAN subroutine BIXLER1.FOR which calculates the removal coefficient for elemental iodine in a pipe assuming negligible revaporization. The BIXLER1.FOR subroutine was written in 1995 citing a document prepared by J.E. Cline & Associates dated March 28, 1991, titled "MSIV Leakage Iodine Transport Analysis," commonly referred to as the "Cline Paper". In section 2.2 of the Cline Paper titled *Coefficient Evaluation and Selection*, equations are given for deposition velocities of elemental iodine, HOI and organic iodine. The equation given for elemental iodine is as follows:

$$d_{SI} = e^{(2809/T - 12.80(\pm 0.33))}$$

However, in early photo copies of the Cline Paper used by code developers, the exponent was not legible and the value of 12.80 was mistakenly read as 12.50. This number (12.50) was used in the source code of the original version of RADTRAD software dating back to 1995 while under development by the NRC through Sandia National Laboratory. In 2000, the Cline Paper was added to the NRC ADAMS database. The copy of the paper available via accession number ML003683728 is a legible document.

The misread value of 12.50 is within the 0.33 uncertainty range reported in the equation, however, use of the misread exponent (12.50) has the effect of increasing the vapor deposition velocity of elemental iodine by a factor of 1.35 times higher than the intended rate at all values of gas temperature. Increased vapor deposition velocity has the effect of exaggerating the deposition of elemental iodine in pipes, which may increase control room dose but decrease elemental iodine inventory available for environmental release, thereby underestimating external doses. It should be noted that the data used to define the exponent value of 12.80 ± 0.33 vary widely and could be scrutinized to justify continued use of the misread value 12.50.

PROGRAM USER NOTIFICATION

Software Users Notified by:

Signature

Jamie L. Gerard

Date 10/17/2025



SOFTWARE ERROR NOTIFICATION

Use continuation pages as necessary

RECOMMENDATIONS TO PROGRAM USERS

Each plant should individually investigate their RADTRAD analysis and determine (1) IF they used the Bixler correlation for iodine deposition, and (2) the effect this error has on control room, EAB and LPZ doses.

However, if it is preferred to match the published fit exactly, there may be an option. One possible work around would require artificially increasing the gas velocity and thereby reducing residence time by a factor of 1.35 to achieve the intended deposition in each pipe. The user has access to basic pipe geometry and volumetric flow rate needed to control residence time. The gas velocity = V_{rate}/A_{pipe} , for example, where V_{rate} is the volumetric flow rate and A_{pipe} is the cross sectional pipe area.

This work around would only work if 1) vapor deposition is the only depletion phenomenon affecting elemental iodine, i.e., there is only one rate constant in the differential equations; and 2) temporary parameters introduced for pipe cross sectional area, volumetric flow rate, etc. do not arbitrarily affect some other aspect of the calculation. These caveats suggest that element iodine would need to be run as a separate nuclide and then the results added to obtain total dose

Assuming elemental iodine can be isolated as described, the effect of artificially accelerating gas velocity would cause the entire release scenario to 'run faster,' so timing actions would need to be shifted, and final dose histories obtained for the elemental iodine component would need to be back to a common timeline before adding to other dose contribution histories. Mathematically, artificial acceleration of gas velocities can be described as a linear change of time variable from t to $t' = t/1.35$, and there is no effect on the numerical solution process.

COMPLETION/APPROVAL/CLOSE-OUT

Project Manager: Jamie Gerard
Printed/Typed Name

Jamie L. Gerard
Signature

10/17/2025
Date

Software POC: Jamie Gerard
Printed/Typed Name

Jamie L. Gerard
Signature

10/17/2025
Date

QA Manager: Andy Roudenko
Printed/Typed Name

AR Roudenko
Signature

17-OCT-2025
Date